MINERALS INDUSTRY SAFETY HANDBOOK

Edition 1

July 2002

ACKNOWLEDGMENTS

We wish to thank the State Government regulators of Australia's mining industry and State Mineral Councils for their most welcome cooperation in support of this national publication and their contributions.

DISCLAIMER

Each State's legislative requirements may over-ride the information provided in this publication. Check the specific legal requirements in your state.

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PURPOSE AND SCOPE

The mining industry must reach the highest levels of safety and occupational health practice. Minerals Industry Safety Handbook is a resource that will help all mine sites to reach these levels.

Everyone on a mine site has a 'duty of care' around safety and health. This includes mine owners, employees, employee representatives, site managers, corporate and technical staff, contractors, consultants and government officers. The mining and extractive industries' duty of care also extends to the community in many ways.

The information in Minerals Industry Safety Handbook is key when a mine develops or reviews its operating practices. As part of this, the Handbook can help to identify competency and training needs. A competent and trained workforce means that managers, supervisors and employees are better able to work safely and to fulfil their duty of care.

Mines can use the Handbook when assessing risks, developing risk controls and putting in place or reviewing workplace practices and procedures. When developing safety management systems, users can refer to the extra information listed at the end of each topic, particularly Australian Standards. As well, a complete list of relevant standards is given in Part 7.4.1.

The information in this has come from publications available from Government agencies and Minerals Councils in several States. The aim of all governments is to promote standards in best practice in Occupational health and safety. At the same time, when developing safety management systems, the reader should be aware that each State has specific requirements which must be met.

As these are provided in loose-leaf format, the topics are easy for site personnel to access, and easily amended to allow updates and to insert extra references.

Where possible, the structure for each major section first considers the importance of each topic, then looks at how to deal with identified hazards. This is followed by ways to control hazards, monitoring and analysis of results and making improvements.

The Handbook contain valuable information on hazards and safe working practices to protect miners from injury. They are a companion to the "Safety Management Plan – Workbook", which contains information on implementing safety management plans. This Handbook replaces the earlier "draft" Guidelines for Safe Mining, which were produced at the same time as the Workbook was released.

Many topics are yet to be developed or which require additional information. These constitute "work in progress". Some of this work is already under way and will be ongoing to keep abreast of changes in mining technology or improved standards.

We encourage your contribution to the ongoing development of this Handbook. Should you have ideas, information or comment on how to improve the Handbook, please fill in and return the feedback sheet in the Handbook to help the mining industry develop "best practice" methods of work.

DEFINITIONS

Specific terms are defined in a glossary in Part 7.

REFERENCES

In addition to references at the end of each respective topic, a more comprehensive schedule has been included in Part 7.

CROSS - REFERENCES WITH SAFETY MANAGEMENT PLAN – WORKBOOK

The following information provides a cross-reference between material provided in the Safety Management Plan – Workbook and this publication. This is to help people apply the information in this Handbook when developing their Safety Management Plans for the operation.

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LIST OF ABBREVIATIONS

°C	degrees Celsius
A	amps
AC	alternating current
ADR	Australian Design Rule
AGPS	Australian Government Publishing Service
AS/NZS	Joint Australian/New Zealand Standard
AS	Australian Standard
cm-1	per centimetre
CO	carbon monoxide
CO^2	carbon dioxide
CSA	cross sectional area
cu m, m^3	cubic metre(s)
DB	dry bulb temperature (in °C)
DC	direct current
ECG	electrocardiogram
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
FEL	front-end loader
FTIR	Fourier transform infra-red (spectrophotometry)
GT	globe thermometer temperature (in °C)
hp	horsepower
H^2S	hydrogen sulphide
Hz	hertz
ICS	International Classification for Standards
IEC	International Electrotechnical Commission
ISO	International Standard Organisation
kV	kilovolts
kVA	kilovolt amperes
kW	kilowatts
L (may be l)	litre(s)
LHD	load-haul-dump
LPG	liquefied petroleum gas
m/s	metres per second (velocity)
m/s^2	metres per second per second (acceleration)
MERD	Mine Emergency Response Development (Program)

mg/m^3	milligram(s) per cubic metre
mL (may be ml)	millilitre(s)
m	metres
mm	millimetres
MSDS	Material Safety Data Sheet(s)
MW	megawatt (million watts)
NEEITCC	National Electrical and Electronic Industry Training Committee
NFPA	National Fire Protection Authority, USA
NHMRC	National Health & Medical Research Council
NO	nitrogen (or nitrous) oxide
NO^2	nitrogen dioxide
NOHSC	National Occupational Health and Safety Council
NOx	nitrogen oxide(s)
OH&S	cccupational health and safety
RCD	residual current device
RMS	root mean square
RPM (or rpm)	revolutions per minute
SAA	Standards Association of Australia
SDE	sulphide dust explosion
SO^2	sulphur dioxide
SES	State Emergency Service
SWL	safe working load
t	tonnes
TLV	threshold limiting value
um	micron
V	volts
VA	volts amperes
VWF	vibration white finger
W	watt
W/m^2	watts per square metre
WB	wet bulb temperature (in $^{\circ}C$)
WBGT	wet bulb globe temperature
WBV	whole-body vibration
XRD	X-ray diffraction (or diffractometry)

PART 1

ADMINISTRATION–MANAGEMENT, RESPONSIBILITIES, DOCUMENTATION AND SAFETY SYSTEMS

UPDATED 16 JAN 2004

PART 1: ADMINISTRATION–MANAGEMENT, RESPONSIBILITIES, DOCUMENTATION AND SAFETY SYSTEMS

1.1 KEEPING RECORDS

You can keep a good watch on health and safety in the workplace if you keep good records. These records can help you find the risks and control them, and so stop accidents, injuries or illnesses. If you have taken steps to control risks, you must keep a check on them to make sure that they work. If you change the way the work is done, you may need to watch the changes carefully and make notes to see that there are no new risks. You must keep notes of what is done in your workplace to make it easier to control health and safety.

1.2 CONTROLLING RECORDS

The Mine Safety Management System (MSMS) contains the special rules for each type of work, the way the work is done, and the skills and training needed by the workers. They are the work safety rules.

You should make special notes (also called documents [see Safety Management Plan Workbook]) on the way the work is done, and you must keep these notes up to date. The company also must have special notes for each type of work and the place where this is done, so that the work can be done safely.

The work safety notes help workers to know what the company wants them to do to have a safe and healthy workplace. The company can then watch to see if the work is being done safely, and make changes if they are needed.

Big companies will have many workers and many different types of work. This means that it must be very careful to keep good notes on each type of work, and must make sure that everyone knows that the workplace must be safe and healthy.

The safety rules are for workers in every place, including the mine and the company's offices. All the company's notes for the different jobs must also have notes on safety (what we call the Occupational Health and Safety (OH&S) documentation), so that everyone knows that health and safety comes first).

The company should make a special document, called a "summary document", which:

- says what it thinks a safe workplace should be;
- says how it will make and keep the workplace safe, and how it will improve it when necessary;
- says who is in charge of work safety, what they must do, and how they must do it;
- says how the work safety notes should be made, and makes sure that everyone in the company knows about the safety notes; and
- shows what the company has done and is doing to make the workplace safe.

Because OH&S documents say what should be done to make the workplace safe, they should be kept up to date, and be made by someone whose special job is to make the documents and who is also someone that the workers will trust.

The company must make sure that:

- each document is clearly marked with:
  - a version number;
  - a date;
  - the name of the company;
  - the name of the workplace and what is done there; and
  - the name of the person in charge;
- each document is kept up to date, and is given an OK before it is given to workers;
- copies of all up-to-date documents are available for workers to read; and
- at least one copy of each old document is kept in a special place, called an "archive", and is marked so that it will not be confused with up-to-date documents. These old documents are kept because they may be needed by a lawyer or by an historian. Throw away any copies of old documents.

Documents must be handy to anyone who wants to read them, and must be useful and easy to understand. The documents can be on paper, or kept on a computer.

1.2.1 RECORDS NEEDED

Special rules are needed for health and safety in each workplace Documents or notes that must be made are also special for that workplace, and must show that the workers there follow the rules. The following records are typical examples of what is needed.

- A statement about what the workplace health and safety plan wants, how it will be done, and what to look for to know that it is working. (Site OH&S objectives, plans and performance indicators).
- Finding what the risks are in the workplace. (Job safety analysis).
- Special rules for each workplace. (Site-specific safe working procedures).
- Permits to work, eg hot work, confined space entry. (Only people with a permit can work there).
- A medical check-up before working in special workplace. (Pre-placement health evaluation).
- Special training for new workers. (Induction training for new and transferred workers and contractors).
- Ongoing OH&S training. (Safety and health training update).
- Safety and health rules for contract workers. (Procedures for managing contractor safety).
- Safety and health rules for visitors. (Visitor control).
- Notes kept of safety committee meetings. (OH&S committee minutes).
- Site safety inspections.
- Checking to see what risks are in the workplace. (Risk assessments).
- Hazardous substances inventory, register, and material safety data sheets (MSDSs):
  - a list of dangerous materials that are kept in your workplace;
  - a special book to make notes when you use these dangerous materials; and
  - special lists that come with all new materials that are delivered to your workplace. These lists tell you what the materials are, and they must be placed in the register.
- A plan to remove risk from the workplace. (Hazard rectification program).
- Making sure that you clean yourself after handling materials in the workplace. (Occupational hygiene monitoring).
- Regular medical check-up. (Health surveillance).
- Making notes on checking, adjusting and fixing equipment and vehicles. (Inspection, calibration and maintenance records for plant equipment and vehicles).
- Operational reviews and external audits. (A regular check-up of how things are done in your workplace, and allowing someone outside your site to check that you are keeping your notes up to date).
- Emergency procedures and practice drills. (A plan to make sure you know what to do if there is an emergency – for example,

an accident, a gas leak, a spillage, or a fire – and regular test runs to see that all workers know what to do when these things happen).

- Accident and incident investigation. (Finding out what happened to cause an accident or incident).

To make sure that the way you get information for notes, what you learn from your notes, and how you tell others what you have learnt really works well for you, you must:

- check that the forms you use to make your notes are designed so people know what to write and they help you get all the information you need;
- test if you have collected enough information to say what has caused an accident or an incident;
- make sure that you do not make too many notes, or not enough; and
- make sure that everyone who might use your notes will get the information they need.

Well-designed inspection and monitoring reports will:

- show if the way work is done has changed, or if there is a greater risk of an accident, or of something else happening;
- show developing patterns, for example, if people are being careless, maybe taking dangerous short-cuts in the way they do their work;
- showing any potential problems, for example, workers doing too much overtime so that they are tired on the job;
- show what has been done to stop the risks that you know about;
- make sure that someone checks that something is being done to lessen risks;
- check if the people whose job it is to check on safety are doing their job; and
- show what is causing dangerous incidents, accidents and illness.

If there is one type of injury that happens often, it may be caused by a hazard you can control. One way you can find out about this if you check the records kept in the first aid room, to see if there is a connection between different incidents.

How can you use the notes and decisions made at health and safety committee meetings?

They can be used to:

- show what health and safety problems are talked about, and if these things keep cropping up;
- see that the health and safety committee decisions are carried out;
- show if there are some problems you can't easily guess that may be causing hazards;
- keep a watch on what is being done to control risks;
- show if there needs to be special training;
- show if there need to be new rules on how a job is done; and
- show what these accidents and incidents are costing the company.

What can incident or dangerous occurrence investigation reports show us?

They can show us where and when these things happen, and the type of job being done, and can help us:

- know what the hazards are, work out the risk of an accident happening, and start doing things to remove the risk;
- know what is unsafe in the way work is done, or in that workplace;
- know what needs to be done to improve training; or
- suggest new or changed ways of doing work.

To know which records you should keep, ask yourself these questions:

- Are the company and you obeying the workplace law?
- Are you keeping a proper record of accidents (register)?
- Do you know (and keep proper records of) how many times an accident has happened, or how many workers have an illness?
- Do you check the record of incidents and the incident investigation reports from time to time to show whether or not the number of injuries and illnesses are increasing or staying the same?

- What records do you have on first aid given in the workplace?
- What happens to workplace monitoring (eg dust, noise, fumes) reports?
- What ways (systems) do you have for storing and recording workplace inspection information (data)?
- How do you record product and equipment details (specifications and standards)?
- What types of materials do you store and use in the workplace?
- Have you made health and safety checklists using the information you have collected on hazards?
- Do you use the minutes of health and safety committee meetings to follow up on issues that are raised?
- Do you keep records of the health and safety training for each worker has done?
- When you inspect and maintain equipment, do you keep records?
- When was your last fire drill?

1.2.2 INFORMATION MANAGEMENT

The company keeps records to show it is managing the mine safely (MSMS), and these records should cover:

- external (eg legal) and internal (ie OH&S performance) needs;
- permits to work;
- dangerous materials and situations, and working out the chance of an accident happening (hazard identification and risk assessment);
- teaching people about occupational health and safety (OH&S training);
- checking equipment, making adjustments to it, and making repairs and replacement of worn or broken parts (inspection, calibration and maintenance activity);
- checking that records are being made and kept up to date;
- details of incidents, accidents and complaints, and what is done about them;
- knowing what materials and equipment are used in the workplace, their brand names and what they're made of;
- names and details of suppliers and contractors; and
- check-ups that people are following occupational health and safety rules and are keeping proper records, and seeing if changes should be made to the way things are done.

The amount of information can be very large and detailed, and must be well managed if the OH&S system is to work.

1.2.2.1 STORING RECORDS

Choose a good place to store the records so that you can easily file them and get to them when needed.

1.2.2.2 RESPONSIBILITY (WHO'S IN CHARGE OF THE RECORDS)

Put someone in charge of the records. This could be the Safety Officer or the local OH&S people at the worksite.

1.2.2.3 MAIN POINTS

Main points of good OH&S information management include:

- someone clearly labels the records with their subjects, dates and people involved;
- make notes on when the records are to be collected and where they should be kept;
- anyone who needs to look at the records can do so easily; and
- someone checks the records from time to time, and makes a decision to keep them, destroy them or put them in a special place for old records in case they are needed. Someone may need them if looking into workers' health, the special ways they keep themselves protected from dangerous dust and materials while working, and wash-up at the end of their shift, or what has been done to remove the risk of accidents.

REFERENCE DOCUMENTS

AS/NZ5 4804:1997, Occupational Health and Safety Management Systems, General Guidelines on Principles, Systems and Supporting Techniques.

"Boral OH&S Manual", Boral.

"Information and Recording Systems", Victorian WorkCover Authority.

1.3 RESPONSIBILITIES AND ACCOUNTABILITIES

1.3.1 GOVERNMENT COMMITMENT (WHAT GOVERNMENT SAYS IT WILL DO)

1.3.1.1 WHAT THE GOVERNMENT DOES

The Government looks after the mineral resources of the State for the benefit of the whole community and it makes laws (or "legislation") so that mines can be operated safely, with little risk to the health and safety of the people who work in them or to the community. The Government want the laws to show that it is serious about these things.

As well as making new laws, the Government wants to:

- make sure that the owners, employers and workers, and contractors, agree to improving safety and health at mines;
- encourage education, training and awareness on safety and health at mines;
- make ways of checking up on the safety and health performance of mines;
- say what it thinks about safety and health in mines and what should be done about it, and to see that there are people whose job is to check that the Government's laws are followed; and
- investigate an accident or dangerous occurrence if this would help improve mine safety.

1.3.1.2 INSPECTORATES

The Government has a team of inspectors (called an Inspectorate) whose job is to monitor, check, promote where necessary, and enforce the law on mine health and safety.

The main aim of the Inspectorate is to:

- promote the best in safety and health performance;
- make sure that mine operators make it easy to inspect and examine all records on safety and health matters;
- ask mine operators to quickly fix any defect or problem that has been found at the mine;
- investigate the cause and events around every fatal and serious accident and every dangerous occurrence; and
- provide help through information and education so that mine operations follow the law.

The Inspectorate not only makes sure that the law is followed. It also carries out regular checks on how the safety systems are run; and it educates, trains and gives advice to encourage the best safety performance.

1.3.1.3 LEGISLATIVE FRAMEWORK (THE LAW)

All States and Territories have laws for health and safety that follow guidelines for reforms made by a British Committee of Inquiry in Safety and Health at Work known as the Robens Committee.

As well, most States have laws just for mining. Each of these laws says what duties owners, employers, supervisors and workers must do (responsibilities), and that these people may be asked if, or how, they have done these duties (accountability).

Duty of care

Duty of care is a legal responsibility of employers, workers, suppliers, designers and manufacturers. Duty of care means everything "reasonably practicable" must be done to protect the health and safety of people at the workplace. However, there are different responsibilities for each group. The employer has the greatest responsibility.

The word "practicable" is important because it shares how far employers must go to make the workplace safe. Here, "practicable" means "reasonably practicable". It covers:

- how badly any injury or harm to health may be, the chance it will happen, and if it can be seen coming;
- if people working in the industry know that there is a chance a bad injury could happen;

- the chance of the injury happening and the way the risk can be removed or lessened; and
- if the way of removing or reducing the risk of injury is available and suitable, and what it may cost.

This means that employers must know what is being done in the industry now to control mine site hazards and make sure that what is done to remove or reduce these hazards is kept up to date. There are a number of "codes of practice" (such as Australian Standards) – that is, rules on how things should be done – that say what authorities expect an employer can do. These codes can be used if there is not a special law to follow. A wise employer should know which of these rules might be used in his/her workplace and make sure that they are followed as far as possible.

There are two types of duty of care – common law duty of care and statutory duty of care.

Common law duty of care (what the courts say)

The judges in the Courts have pointed to four separate ways where employers must show care for workers:

- all staff and fellow-workers must be capable of doing their work (called competency);
- to provide a safe place of work, that is, premises, appliances in use are safe and properly maintained;
- to provide proper plant and equipment, that is, any equipment used by workers must be right for the job; and
- to provide a safe system of work. Part of the duty of making the job safe is looking at everything that is done on the job and always asking the question: "Is this job being done in the safest way possible?" If there are ways of doing things to make the job safe for workers or if they need safety equipment, they must ask the question: "Are my supervisors doing what they can to make sure that workers are following the safety rules?"

Common law differs from workers' compensation as it is based on the idea that the employer must not be careless or negligent.

Statutory duty of care (what legislation says)

- Statutory law is written law made by Parliament. These laws say how people must behave and, if they don't obey, they can be punished by the criminal courts. Most States have made laws to control working conditions and provide for the health, safety and welfare of people in the workplace.
- Under common law, employers have a duty to obey these laws (called "statutory duty").

Due diligence

Due diligence at work means:

- working with care and showing that you care enough about your workplace and colleagues and take all sensible steps to carry them out;
- following what the law says should be done, and following the standards made by industry, professional and other rules, and what the courts say should be done;
- looking for hazards at work and the special ways you do your work or the conditions of your work;
- once hazards are found, you must protect workers from them. That is, do something to make certain that an accident won't happen; and
- telling others about the hazards found.

The idea of "due diligence" is important because it can be used to defend companies, supervisors and workers who the law might find responsible for things that have happened.

Offences under legislation are what is termed "strict liability offences". In such cases, the prosecution must only prove that the offence occurred and not that the defendant meant to commit the offence.

The most common defence to such a charge is to show that the accused took all "reasonable" steps to prevent the offence from happening. This is called the defence of "due diligence".

- If there is an accident it will not be good enough to just show that a workplace had a health and safety system. You will need to show that the people who worked there took every step possible to prevent an accident from happening.
- The safety system must be able to protect workers from the worst things that can happen.
- The duties of the corporation, its manager, supervisors and workers are tied together.

REFERENCE DOCUMENTS

Brown, C. October 1982, "Common Law Damages Claims – Their Implications on Mining Management", Underground Operators' Conference.

"Due Diligence in Occupational Health and Safety", Canadian Centre for Occupational Health and Safety.

Krstic, F. May 1998, "Understanding and Demonstrating Duty of Care", Extractive Industries Safety Seminar Workshop.

Safety and Health at Work; Report of the Committee (Great Britain committee on Safety and Health at Work) 1920 – 1972 (Circa 220 pages) Chairman Lord Robens.

Thompson, S. 7 September 1994, "Duty of Care".

Penney Pengilley, "Occupational Health and Safety in Mining: Contractor Safety and Law".

1.3.2 INDUSTRY COMMITMENT (WHAT INDUSTRY SAYS IT WILL DO)

1.3.2.1 LEADERSHIP (SHOWING THE WAY)

Management provides leadership in the workplace by saying what it wants and how it will happen. It gives important information and help with rules on how things are to be done to make things better for the safety, health and welfare of its workers, and for the safety of equipment and facilities.

Company leadership is about:

- making worker health and safety policies that will improve the way things are done, and telling this to workers and their supervisors;
- deciding how to do things, and giving workers what they need to work safely and to have a safe workplace;
- keeping a check on, encouraging and rewarding good ideas to improve worker safety; and
- giving advice to workers and teaching them about rules and how they are applied, as well as letting them know the best ways of doing things in their industry, both in Australia and in other countries (called "best practice").

Leadership from the company means that management places a high value on having a safe and healthy workplace, and covers:

- letting people know about, support and recognise worker health and safety (OH&S) polices, goals and performance;
- letting people know about what is being done for safety and health in every part of the company, so that they can use this for the way they work;
- giving workers the power to take control and improve their work and workplace;
- giving encouragement to workers and rewarding them for what they have done to make the workplace healthy and safe; and
- setting a high standard or reference point for performance called "benchmarking". For example, what people agree is the best way of doing things, used to compare performance and letting other people know how well the system is working.

1.3.2.2 MEASURING PERFORMANCE OF WORKER HEALTH AND SAFETY SYSTEMS

There have been problems in measuring how well worker health and safety systems have worked in the past, and these problems are now more important because the types of risks are changing. People concerned with worker health and safety now want to know what the signs are that something will happen as well as looking at things after they happen. Companies want to know what a poor worker safety system costs, as well as if they will save money with their worker health and safety system.

1.3.2.3 MINE OPERATORS

Mine operators include the owner, operator, individual or "body corporate" having ownership or financial control of a mining operation.

A mine operator should:

- say that the mine will be managed and the work done in the way the law wants;
- make sure that the way work is done is, as far as possible, safe and does not injure the health of those working at the mine;
- have enough qualified people to make the mining operations as safe as possible, and to lessen the risks to the health of the workers;
- say that they will obey the State laws and regulations which say how the mine must be managed; and
- point out the different risks, and take steps to prevent injuries and dangerous incidents.

1.3.2.4 WORKER AND INDUSTRY ASSOCIATIONS

Worker and industry associations, including unions and professional associations, should talk to relevant Governments or Government bodies, and help in the review of law and information on safety and health matters.

1.3.2.5 DESIGNERS, MANUFACTURERS AND SUPPLIERS

A designer, manufacturer, or supplier of any machinery or material for use at a mine should:

- provide a manual of operation and maintenance, or storage instructions, written in plain language, so that, as far as possible, machinery or materials used on the job can be used safely or kept in good repair, and will not cause a risk to health when properly used;
- carry out research, testing and examination so as to find and remove, or lessen, any risks to safety or health, and doing this with the help of people working at the mine site; and
- give information to workers who are using the machinery and materials, including:
  - what the machinery is designed to do, and how to use and maintain it and maintain safely and without risk to health; or
  - the results of any relevant tests or incidents, or any conditions needed to ensure the safety and health of workers when properly used.

Standards Australia (the Standards Association of Australia) has a number of display posters giving information on chemicals in common use, and what to do if there is an accident using these chemicals.

1.3.3 SITE ACCOUNTABILITIES (WHAT EMPLOYEES MUST DO)

In the mining industry, the general "duty of care" parts of the law mean there are some things all workers must do while on the job.

Each worker has both a right and a duty to work safely. If an unsafe situation happens or is noticed in the workplace, everyone there will have to make sure that the danger does not spread or that others are kept away from it, and that the supervisor or someone of authority is told about it.

Everyone must work together to make the workplace safe. Everyone has a right to information and training and to have a say in how the work is done. An important example is having on hand what are known as the "material safety data sheets" (MSDS) when handling hazardous materials.

1.3.3.1 GENERAL MANAGEMENT

The community expects management to behave responsibly, and works in accordance with the laws. This also means that if management does not do some things, it can be asked why it did not do them, and it can be punished for not doing them. These laws may include special terms or concepts, such as "international best practice", "risk management" and "due diligence and care".

The general duty of care concept means that management must make sure that both themselves and all workers have training and education in skills and knowledge. This will help everyone to know when there are risks in the workplace and put in place ways (controls) for dealing with a risk to safety or health.

Because of this, training for management should include:

- a "risk management" approach to health and safety (that is, knowing what the risks are, and knowing what to do to remove or minimise risk);
- management saying that they want the workplace to be safe ("commitment");
- the company is organised to support safety and make people answer for what they are doing or not doing for safety ("accountability"); and
- knowing what the workplace law is, and having hands-on experience with it (knowing how it works in a practical way).

1.3.3.2 SUPERVISION

Everyone working at a mining site must support safety and health if they are to have it.

The word "supervisor" has as one of its meanings the person who passes information between the managers and the workers.

A supervisor is one of the important people who make sure that the worker health and safety rules are followed in the workplace. Because supervisors deal with safety in the workplace from day to day, they should have a good knowledge of how the work is done, and what training and ability the workers under their care need.

To the workers, the supervisor stands for the management. The supervisor gives the management a way of keeping in touch with the workers and letting them know what it thinks and wants. Supervisors can tell the workers about the safety rules, and can prevent or settle differences or misunderstandings between management and workers.

For someone to be a supervisor, they need more than a good working knowledge of the job. They must also answer what for happens in the workplace, especially with worker safety, they need special help from management. This help is with training in management and knowledge of the law, which the law says they must have.

The employer must have enough supervisors to visit each workplace at regular times and spend enough time there to make sure that the operations are safe. The number of people under each supervisor will depend on:

- what is done at the workplace;
- how complex the work is and the area covered by it; and
- the amount of guidance needed between the supervisor and each worker.

When managers appoint supervisors, they are chosen because they have the right attitude towards safety, enough relevant experience on the job, and are able to work out what is needed by each workplace.

Training for a supervisor

A supervisor should normally have a good variety of practical experience in the mining industry and will have had experience in all the work they will be supervising.

Generally, the supervisor should have received:

- first aid training (which remains current);
- mine safety training; and

- preferably have had operator training relevant to the type of mining to be supervised.

Training of supervisors may also include:

- the mine's safety and health program;
- mine rescue;
- safe work procedures;
- managing contractor;
- planning for a safe mine;
- worker induction (showing new workers what is done); and
- governing regulations (knowing the regulations that control the workplace).

Role of the supervisor (what they do)

The supervisor sees to it that:

- those under them understand their duties; and
- that the workplace law is fully obeyed.

In more detail, supervision involves:

- making sure that workers have the skills needed for the task(s) they are doing;
- making sure that the work methods and workplace(s) are safe;
- making sure that hazards in the workplace(s) under their control are found, and that any risks are controlled;
- making sure that changes in the way the work is done that may affect the safety or health of workers are made known to all;
- making sure that other supervisors in control of other workers, and supervisors on connecting shifts, are told about the state of the workplace, what was done and equipment used;
- making a report at the end of the shift about the work done, and ensuring that this report deals with the state of the workplace, what was done and equipment used. This report should be given to the supervisor starting the next shift;
- helping to make sure healthy and safe rules are adopted;
- attending to accidents and incidents;
- helping to train new workers, and giving ongoing training for other workers;
- doing something about problems raised by health and safety representatives of the workers;
- giving the company statistics (for example, numbers of injuries) and reports on health and safety performance;
- making sure that the company buys the things needed;
- making sure that safety equipment (special clothing, gloves, helmets and so on) is given out, used and stored properly, and kept in good repair; and
- helping to make sure that emergency plans for first aid, fire and evacuation are known by workers in their workplace.

1.3.3.3 WORKER REPRESENTATIVES

Workers may appoint suitable people at the mine to do inspections and put their point of view about matters of safety in their workplace.

1.3.3.4 WORKERS

Employees and contractors should:

- take whatever care is needed for the safety and health of themselves and of other people who may be affected by what they do or don't do at work;
- work with their employer or any other person to do anything that their handbooks or the law says should be done;
- following instructions on what to do for the safety and health of themselves and others;
- know about lifting aids and other forms of helping physical effort, and use them correctly;
- use safety devices and equipment correctly and not make them unusable;
- keep their workplaces tidy and clear of obstructions;
- take steps to fix any unsafe situation that directly relates to them, report as soon as possible to their supervisor any situation

which they think could be hazardous. For unsafe situations that do not directly relate to them, the person should do whatever they can to make the situation if possible safe before reporting the matter;

- report any accident or injury that happens while working or while doing anything else to do with work; and
- report the state of their workplace, equipment or work method to the supervisor, and coworkers on the next shift.

1.3.3.5 SHOTFIRERS

Shotfirers include those people who are trained in and responsible for the planning, manufacture, storage, transport and use of explosives at a mine.

A shotfirer is an authorised person in charge of handling and firing explosives. To be authorised as a shotfirer, a person must be able to show that they know about and have experience in the use of explosives at a mine, and has to pass an exam to prove that they understand the hazards related to explosives.

The shotfirer should be capable of showing:

- the ability to design, prepare and set off a blast;
- the ability to prepare and put in place safety procedures on site for training people in completing a blast;
- procedures for controlling noise, overpressure (air blast), dust and fly rock from a blast;
- that a minimum number of blasts has been done for training purposes; and
- the safe use of allowable ways of setting off explosives.

A shotfirer must know about and follow a mine's explosives management plan related to the risks in drilling and blasting.

1.4 POLICIES AND MANAGEMENT PLANS

An Occupational Health and Safety policy says what a company wants for worker health and safety, and gives its guidelines for bringing it about.

Senior management must make sure that the policy is carried out with no exceptions. The health and safety policy should have the same importance as the other policies of the organisation.

An operation's OH&S Policy forms part of or is the basis of a Mine Safety Management System (MSMS) set up to reduce accidents, disease and incidents at work. It should clearly say what is wanted, and make sure that things are done to improve safety. The site OH&S policy should agree with a Corporate Policy. In smaller operations, the Corporate Policy could be the site policy.

The reasons why a workplace should have a written health and safety policy are:

- to show that the employer wants and will support an Occupational Health and Safety program that works;
- to help the company to prevent accidents. The policy will make it clear that the employer wants to remove or prevent the causes of injuries and illness;
- to show that everyone in the company will know and care about making sure that the workplace is kept safe and healthy; and
- to make sure that Occupational Health and Safety happens by having enough people and money to do what should be done to make the workplace safe and healthy.

The policy says what the employer wants done to make the workplace healthy and safe for the workers. Some important points to consider when writing the policy are:

- that the workers must have their say;
- making sure that everyone knows that the health and safety of workers is most important;
- to make sure that workers are protected from risks (hazards); and
- doing what the law says should be done.

Your policy statements could include some of the following things:

- that the employer will give workers a healthy and safe workplace, and that health and safety will be tied in with everyday work activities;
- that the employer will be careful to do everything that can be done to prevent illness and injury to an worker, for example:
  - seeing that workers learn how to do their work in a healthy and safe way;
  - putting special people in the workplace whose job is to see that the work is done safely;
- that the employer says it (he or she) will work with all people in the company to make sure that what the Occupational Health and Safety policy says will be done;
- to check and update the policy at least once every year, so that it follows changes in the workplace and the law; and
- all workers must take care to see that the workplace is healthy and safe, and if not they must explain why.

The policy should be:

- up to one page long;
- stated clearly;
- signed by the Chief Executive Officer, General Manager and workers' representative;
- kept up to date;
- told to each worker;
- obeyed where all work is done; and
- put up where everyone can see it in the workplace.

Everyone must be able to have their say to make sure that the policy works for your company.

To make the policy work, you must make sure that:

- everyone in the workplace knows about the policy;
- everyone knows what should be done and who should do it;
- everyone knows who they should report to, and what happens if they fail to do this;

- there are enough people and money; and
- there is a way to set up the health and safety programs, and a way of checking how they are working and if they need to be changed.

1.4.1 REVIEW AND EVALUATION

To make sure that the OH&S management system is always getting better (continuous improvement), that it is the right system and that it is working, the company's management must do a regular check-up (or review) of the system. The check-up does not have to look at everything at the one time, but can do this over a period of time, for example every six months.

The check-up of the Mine Safety Management System (MSMS or mine safety system) should look at all the activities, products or services of the company to see what they have to say about worker health and safety, as well as what this means to the company's profits.

A review of the mine safety system should include:

- if the worker health and safety policy is the best one;
- a look at what the worker health and safety policy sets out to do, and what to look for to know that it is working;
- what mine safety check-ups (MSMS audits) have found out; and
- a check-up to see how well the mine safety system is working, and if it needs to be changed because of:
  - changes to the law;
  - changes in what people want from the company;
  - changes in the products or activities of the company;
  - changes to the set-up of the company;
  - changes in science and technology, including epidemiology (that is, what people have learnt about illnesses and diseases in your industry);
  - lessons learned from worker health and safety incidents;– changes in what the market wants – if it wants the company's products, which products, and how much;
  - changes to the way reports are made, when and to whom they are made, and the ways people are told about things (communication); and
  - what people, especially workers, have to say about the mine safety system (feedback).

Some companies make mine safety part of their regular management meetings, while others have meetings of both management and worker representatives for the review.

Other companies have special management meetings just for checking mine safety.

When the workers' representatives take part in the check-up, they must also include the ideas of all the workers and others who are concerned about worker health and safety.

As well, everyone should be told about what changes and improvements to be made after the check-ups have been done.

The MSMS includes the idea that health and safety will always get better. This is done by always checking how the system is working against worker health and safety policies (OH&S), so as to point to improvements.

The continual improvement process should:

- show areas where improvements can be made to the mine safety and health system;
- show what problems are causing the safety and health system not to work, or not to work properly;
- make and put into action plans to fix these problems;
- show that these action plans are working;
- make a written record of changes made in the way work is done after making the improvements; and
- make comparisons between what is wanted and what is achieved.

1.4.2 BENCHMARKING

Benchmarking is a tool that shows how your company is going with its health and safety when compared with what people think is the world's best. It includes an examination of the methods, processes, procedures, products and service performance of your company against companies in the same area. If done correctly, benchmarking will increase your knowledge of the improvements you need to make to become world-class. Benchmarking is a guide on the road to best practice.

Benchmarking and continuous improvement

Continuous improvement is a way of getting your company to change, through constant, small improvements. Those who do the work are given the power to find and make changes to improve the way things are done.

Benchmarking gives practical information by encouraging a close look at your own company and other companies, looking at their methods, processes, procedures and performance. Benchmarking is a process, not an outcome. It should be used to look at special problems and can be used to get continuous improvement within your own company.

REFERENCE DOCUMENTS

"A Basic Occupational Health and Safety Program", Canadian Centre for Occupational Health and Safety.

"A How to Guide for an Occupational Health and Safety Policy and Program", Department of Labour, Occupational Health and Safety Division, Nova Scotia.

ISO 9001 Quality Systems – Model for Quality Assurance in Design, Development Production, Installation and Servicing.

"Benchmarking Occupational Health and Safety", National Occupational Health and Safety Commission.

AS/NZS 4801 (2001), Occupational Health and Safety Management Systems, Specifications with Guidance for Use.

AS/NZS 4804: 1997, Occupational Health and Safety Management Systems, General Guidelines on Principles, Systems and Supporting Techniques.

EXAMPLES OF OCCUPATIONAL HEALTH AND SAFETY POLICIES

Example No. 1

Occupational Health and Safety Policy

The Occupational Health and Safety of all people employed by this Company and those visiting any of its sites is considered to be of the utmost importance. Management has every desire to provide a safe working environment for its workers.

To accomplish this, resources commensurate with the importance attached to comply with all relevant Acts and Regulations and to ensure the health, safety and welfare of all workers.

The Company will address Accident Prevention and Control, Hazard Control and Rehabilitation as priorities. Occupational Health and Safety is both an individual and shared responsibility of all parties. This Company places Occupational Health and Safety on a priority equal to productivity.

Signed CEO: ____________________

General Manager: ____________________

Worker Representative: ____________________

Date: ____________________

[The company thinks that the Occupational Health and Safety of all people working for it and those who are visiting any of its sites is very important. The management wants to make sure there is a safe working environment for its employees.

To do this, the company will give resources in line with the importance it thinks is needed so that the workplace law can be obeyed and all workers can be given proper health, safety and welfare.

The company will give special attention to Accident Prevention and Control, Hazard Control and Rehabilitation. Occupational Health and Safety must be looked after by each person and with all other people in the company. This company believes that Occupational Health and Safety is as important as productivity.]

Example No. 2

Occupational Health & Safety Policy

It is our aim to provide a safe working environment for workers of this company by:

- giving the resources needed so that work can be carried out safely and effectively;
- making sure that all workers know how to work safely;
- regularly looking at how work is done to remove unacceptable risks; and
- management and workers working closely together to share their thoughts and suggestions to get the best results.

Signed CEO: ______________________________

General Manager: ______________________________

Worker Representative: ______________________________

Date: ______________________________

Example No. 3

Occupational Health & Safety Policy

The XYZ Company wants the best in health and safety in all workplaces.

It can do this by working closely with workers and contractors in the company's health and safety programs.

The company wants Occupational Health and Safety Committees to be set up, and agrees that such committees can bring about Hazard Recognition and Accident Prevention.

The company will use a responsible and effective accident Prevention and Rehabilitation and Program to look after the welfare of workers

Signed CEO: ______________________________

General Manager: ______________________________

Worker Representative: ______________________________

Date: ______________________________

Example No. 4

Occupational Health and Safety Policy Statement

ABC is committed to providing a healthy and safe workplace for all workers, subcontractors and visitors.

Resources will be made available to comply with the current legislation and standards to protect the Health, Safety and Welfare of all workers and subcontractors.

ABC will continue to address hazard control, accident prevention and training as priorities. The company considers Health, Safety and Welfare an integral part of production.

Health, Safety and Welfare is both an individual and shared responsibility of all workers.

Acceptance of the following responsibilities is essential to the success of the policy.

All ABC management shall:

- plan, develop, implement and monitor comprehensive Health, Safety and Welfare Programs;
- promote communication about Health, Safety and Welfare as a normal component of all aspects of work; and
- take effective action to provide and maintain a healthy and safe workplace.

Workers and subcontractors shall share the responsibility to:

- work in a healthy and safe manner;
- encourage others to work in a healthy and safe manner;
- cooperate with management in the support of promotion of Health, Safety and Welfare in the workplace; and
- promptly report accidents, unsafe practices or conditions that become apparent and work with others to promote a safe workplace.

Signed CEO: ____________________

General Manager: ____________________

Worker Representative: ____________________

Date: ____________________

Example No. 5

Occupational Health and Safety Policy

EFG accepts that the safety of its workers is very important and is a major part of the Company's operation.

The Company's Safety Policy is to reduce as far as possible the risk of accident or injury to any person happening because of the Company's activities.

The company will carry out this policy by developing and maintaining a workable and ongoing Accident Prevention Program to protect workers and other people from accidents.

Responsibilities

- The Management is responsible for accident prevention throughout the company.
- Each Supervisor is responsible for accident prevention within his area.
- Each Worker is responsible to him/herself and to his/her workmates for accident prevention.

Accident Prevention Requirements

- Always following the existing safety rules.
- Developing safe working practices and procedures.
- Training in these practices and procedures.

Signed CEO: ______________________________

General Manager: ______________________________

Worker Representative: ______________________________

Date: ______________________________

1.5 RISK MANAGEMENT

Risk is a part of life, and every day, each and every one of our decisions is concerned with risk and its management. We say that risk is being exposed to things that can or do cause injury.

Controlling those risks depends on the type of work being done.

For most companies, the risks that come with work are the most important and costly ones, which is why companies have an Occupational Health and Safety policy or plan.

Risk Management is: "The systematic application of management policies, procedures and practices to the task of analysing, evaluating and controlling risk." That is, looking closely at the risks, deciding what the consequences are, and doing something to remove or lessen the risks.

Risk has various properties. For instance, risk, before it happens, is part of what the future is made of. A risk that happens no longer has a chance of happening, because it is now certain; it has moved itself from the future to the past.

Hence, each risk has a chance of happening. This chance may be in qualitative or quantitative form, depending on what we know about that particular risk. That is, we can see from what we know about the way work is done that there is a risk (qualitative), or know it from the number of times that a type of accident has happened (quantitative). This chance, in quantitative or qualitative form, is called **risk likelihood**.

Another way of knowing about risk is what it does. We say **risk impact** is what we think will happen because of the risk. Impact can be measured. Qualitative and quantitative ways of measuring may be used. Again, how much you know about risk will tell you how to measure its impact.

The most important thing about Risk Management is using risk assessment to show how the risks line up, from least important to most important. In this way, you are saying that you know where to start and put in the most effort, to stop the worst type of accidents happening, even if you can't stop other types from happening. Sooner or later, if you think only of stopping one type of accident, it can take your mind off reducing another incident from happening.

Safety is the result of knowing about and doing something to control risk. It doesn't mean there are no risks. But it does mean that the risks are so low that everyone thinks the work can be done safely.

There are three basic steps to Risk Management:

- **Identifying the hazards:** involves recognising things that may cause injury or harm to the health of a person, for instance flammable material, ignition sources or unguarded machinery.
- **Assessing the risk:** involves looking at the chance of injury or harm happening to a person if exposed to a hazard.
- **Controlling the risk:** by introducing ways of doing things (measures) that will remove or reduce the risk of a person being exposed to a hazard to a level where everyone thinks the work can be done safely.

It is important to regularly go over the steps, especially if there are changes in the work environment, new technology is introduced, or standards are changed.

Employers should talk with the workers when they are going over these steps.

The element of a risk management process is shown in figure 1.1, which has been reproduced from AS/NZS 4360 – 1999 Risk Management.

1.5.1 IDENTIFYING HAZARDS (OR RISKS)

There are a number of ways of pointing out the likely sources of injury or disease. Picking the right way will depend on the type of work done and the hazards it has.

Ways may range from a simple checklist for a special piece of equipment or substance to looking at a number of related work processes. A combination of methods may give the best results.

Methods of finding workplace risks include:

- making up a risk checklist;
- looking around the workplace (walk-through surveys);

- looking over information from designers or manufacturers;
- looking at unsafe incidents, accident and injury data;
- looking at work processes;
- talking with workers;
- closely looking at and thinking about material safety data sheets (MSDSs) and product labels; and
- asking for help from people who have special knowledge (specialist practitioners, consultants and representatives).

Hazard Types

A hazard means anything that may result in injury or harm to the health of a person,

Some hazards come with the type of work done, such as mechanical hazards, noise, or the toxic properties of substances. Other hazards come from equipment and machine breakdowns, or by machines being misused, or by control or power system breakdowns, chemical spills, and structural failures (for example, cracks in wooden beams, rust in steel supports), and can be expected when looking for hazards.

It is useful to prepare a list when considering these hazard types and looking for work-related hazards to make sure that you think about all the hazards there are. The table below lists some types of hazards, with some examples.

Types of hazards and specific examples include the following:

- Gravity: falling objects, falls of people.
- Kinetic energy: projectiles, penetrating objects.
- Hazardous substances: skin contact, inhalation.
- Thermal energy: spills and splashes of hot matter.
- Extremes of temperature: effects of heat or cold.
- Radiation: ultraviolet, arc flashes, microwaves, lasers.
- Noise: hearing damage.
- Electrical: shock, burns.
- Vibration: to hands and body.
- Biological: micro-organisms.
- Stress: unrealistic workload and expectations.

1.5.2 HAZARD REPORTING

Hazard reporting encourages workers to take a proactive approach to safety. It is mainly to get workers to ask about their jobs “What are the hazards?” or “What can go wrong?” before an accident happens, and then find the likely hazards and bring them to the attention of their supervisor or the manager.

Usually, hazards will be found during day-to-day work and can be fixed on the spot. However, sometimes a hazard cannot be fixed straight away.

Reasons why this may happen include:

- disagreement over whether there is a hazard, or how bad it is;
- no one can think of or knows a way of controlling the hazard;
- disagreement over the best way to control the hazard;
- there is no time to fully control the hazard because workers are too busy, and because of this they do something to control the hazard only for a short time; or
- the people in the workplace agree that no one will come in contact with the hazard and it can be fixed later.

For any of these situations, you must make a report.

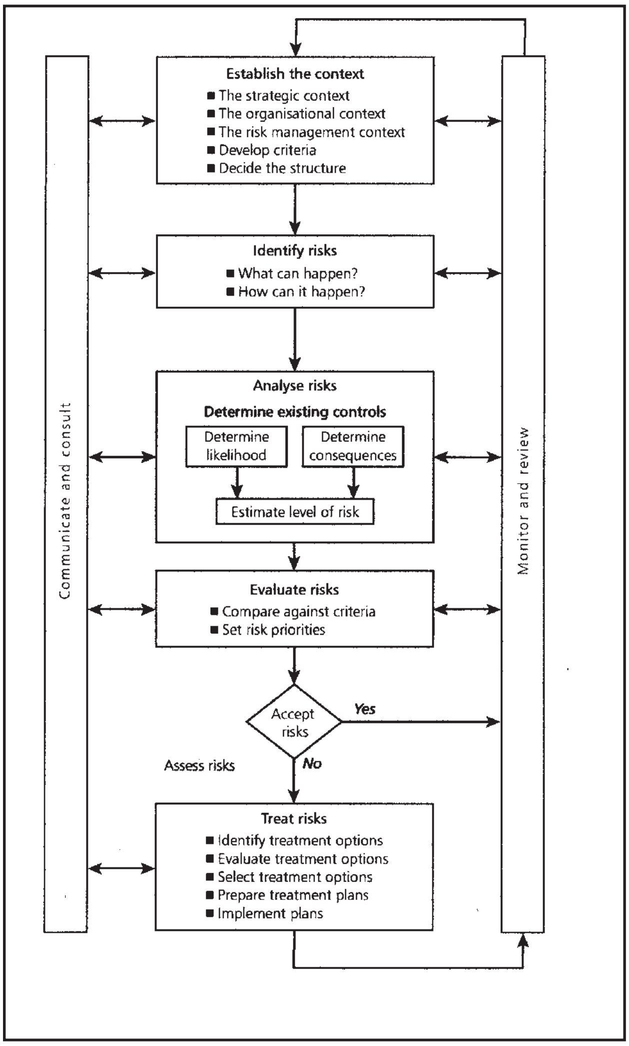
1.5.2.1 WHAT IS A HAZARD?

A hazard is anything likely to cause damage to people, the environment, property, machinery or equipment.

Hazards may be related to:

- the work environment (for example, slippery floors, poor lighting);
- the way the work is organised (for example, having to carry heavy loads a long distance);

Figure 1.1 Risk Management Process



- the plant, equipment, tools or substances used (for example, toxic chemicals, unguarded machines);
- lack of information, training and supervision; and
- poor or ill-fitting personal protective equipment (PPE).

Why report hazards

Reporting hazards is important for several reasons:

- For every serious injury/accident or death in the workplace, there is usually a history of "warning signs" or "near misses" that were ignored because conditions in the workplace change daily.
- Changes in working conditions can bring new hazards.
- The next injury/accident might be serious.

These "warning signs" or hazards should be fixed before the accident happens.

Reporting Hazards

Be alert at work! Workers should look out for likely hazards and work out what the problem is, then report it to the supervisor of the work area.

Everyone should report hazards to the person in charge of the work area. There are a number of ways to report a hazard. How dangerous the risk is will tell you how soon you should report it and the best way to do this.

Report right away if a hazard might cause death or serious injury or illness, or might cause harm to a number of people.

If it is less urgent, you should:

- use a hazard report book; and
- report hazards at meetings with your Supervisor.

1.5.3 ANALYSING AND ASSESSING THE RISKS (WORKING OUT WHAT THE RISKS ARE)

In working out the risks from the hazards you have found (risk assessment), you can draw up a list of what injuries or harm can happen, and if these might happen. These should be set out from the most serious to the least serious, for example, from death by crushing to a small scrape or cut in the skin. For each hazard that you find, you should work out if there is a risk of someone being killed.

In working out risks, you should find out what is known about how many people have had an injury or a disease because of a hazard (frequency of injury), how long they were exposed to a hazard that caused the injury or disease (duration of exposure), and how bad the injury or disease was (outcome).

You can be helped in working out the risks by knowing about other mines and work that are like yours. You should look at several aspects.

- **Frequency of injury**: How often is the hazard likely to result in an injury or disease?
- **Duration of exposure**: How long is the worker exposed to the hazard?
- **Outcome**: What are the consequences or potential severity of injury? (For example, will the injured worker get better? Will the injuries take a long time to heal?)

In looking at these three things, you can work out the likelihood of workers being injured or harmed. It also shows how bad the injury can be (**severity**). To work out the risks, you should consider all the facts, and know about the likely risks in the type of work you are looking at.

If you have worked out the risk, it will help you know what can happen (**consequences**) and help you find ways of reducing the risk.

Risk assessment should include:

- working out how good is the training or knowledge needed to work safely;
- looking at the way the jobs are done;
- looking at the way work is organised (who does what and how);
- working out the size and layout of the workplace;
- working out the number and movement of all people in the workplace;
- working out the type of work to be done;
- looking at the plans for an emergency evacuation (for example, what has to be done to get people away from danger when there is an accident or a fire, and how to rescue people);
- looking at the way all materials and substances are stored and handled; and
- looking at workplace factors such as temperature, lighting and dust.

Sometimes you will have to look at each part of the work being done to work out its risk.

This way, you can find out which tasks have a higher risk of injury or disease, how often, and how bad.

1.5.4 ASSESSING THE RISK

Talk to the supervisor of the work area to work out how dangerous the hazard is and what can be done to solve the problem.

If you can fix a hazard easily, go ahead! If not, risk assessment can help you find answers.

To work out the level of risk, consider the:

- Severity of the consequences of an accident:
  - How bad would the injury or illness be?
  - How many people are at risk?
- Likelihood of the accident happening:
  - Has it happened before?
  - How often might it happen?
  - When is it most likely to happen?

A proactive approach considers what might be done to decrease the likelihood of an accident happening.

1.5.5 REDUCING THE RISK

1.5.5.1 FINDING WAYS TO CONTROL RISK

The last step in controlling risk is to decide which ways to do this. Sometimes, you may need more than one way. The ways of reducing risks can be to:

- remove or reduce the risks of a hazardous work process;
- minimise the effects of injury or disease; and
- reduce the risk of exposure to hazardous substances, machinery (plant), noise and ultraviolet (UV) radiation.

1.5.5.2 FIXING THE HAZARD

When you do something to remove or lessen the risk from a hazard, you might need help from the supervisor. You should think about which is the best way to fix a hazard. This is sometimes called a "hierarchy of controls", that is, they start with the best way, and go on to the next best way, and so on (see Section 1.5 on Risk Management).

1.5.5.3 MINE HAZARD CONTROL

Hierarchy, or preferred order of control

Control of Risk – General

Elimination (or removal) is a lasting answer and should be tried first of all. The hazard is eliminated altogether, for example, the elimination (removal) of a hazardous work process or substance.

Substitution is replacing the hazard by one that has a lower risk. This could be replacing a toxic substance with a less toxic substance.

Engineering controls are ones that change how you move about in the workplace or handle the machinery being used by putting a barrier or block between yourself and the hazard. This may include:

- machine guards (for example, that stop your hands, your clothing or your hair getting caught in a machine);
- isolation or enclosure of hazards;
- the use of extraction ventilation; and
- manual handling devices such as gloves or tongs for dangerous substances, or pulleys for heavy loads.

Administrative (procedural) controls reduce or eliminate exposure to a hazard by making workers stick to the right way of doing things. Written instructions should provide all the steps to be taken and the controls to be used in doing a task safely. These controls only work if workers do what they've been told to do. Examples are:

- rules to follow so that you can do the job safely; and
- permits to work, which means that the company gives you permission to do the work because it knows you are able to do the work.

Personal protective equipment is special clothing worn by people to protect them from a hazard. This control will work if you have the right protective clothing, and if it is fitted correctly and worn at all times when needed.

You should try first to pick a control that removes the hazard. It is best to choose these controls when the project is being planned. However, you may have to use a number of different controls to remove or lessen the risk.

1.5.5.4 PREFERRED CONTROLS

Controls are ways of doing things that reduce the hazard and risk to the health or safety of people working there.

The control of worker injury and disease should best be dealt with by:

- design;
- substitution;
- redesign;
- separation; or
- administration.

These controls are better than personal protective clothing at removing, reducing or making the risk small.

Where the law says there are special ways of controlling the risk, these ways must be followed.

Information or ideas on control measures can come from:

- codes of practice;
- guidance notes;
- workers;
- industry or employer associations;
- unions;
- government bodies;
- specialist practitioners and consultants;
- Australian Standards;
- other relevant standards and guidelines;
- other publications and reference databases;
- Material Safety Data Sheets (MSDSs);
- manufacturers and suppliers; and
- designers and architects.

1.5.5.5 CONTROL USING PROTECTIVE EQUIPMENT

Protective clothing should only be used when other methods of control can't be used. When to wear protective clothing will depend on:

- the type of work or the work process done;
- what you know about an injury or disease that can be caused by doing the work or process;
- what the company knows about ways of stopping injury or disease from any special hazard or risk; and
- having good ways to prevent, remove or lessen injuries or diseases caused by a hazard or risk.

There are some situations where protective clothing should be used just for a short time. These include:

- where it is not possible to control of the hazard in other ways. When this happens, the hazard should first be reduced as far as possible using other ways before using protective clothing to make it safe enough to work;
- where the known risks allow protective clothing to be used for a short time until there is better control of risks using other methods, for example, where urgent action is needed because of plant failure;
- during routine maintenance work. Although exposure to hazards often happens during such work, it is only for a short time and there are only a small number of people doing the maintenance, and other ways of controlling risk cannot be done;
- the type of work or the work process done;
- how bad the likely injury or disease is;
- what you know about an injury or disease that can be caused by doing the work or process;
- what the company knows about ways of stopping injury or disease from any special hazard or risk;
- having good ways to prevent, remove or lessen injuries or diseases caused by a hazard or risk; and
- if the cost of doing anything else to prevent, remove or lessen an injury or disease is too much to make the job worth doing at all.

1.5.5.6 HIGH-RISK PERMITS

High-risk permits are needed for work done in places that are always dangerous and need extra precautions to make them safe. Permits are good only for a short time and are only given out when the person in charge has checked that the workplace is safe to carry out the work. The person in charge of handing out permits must sign all permits.

Workers should know about the type of work or the places where permits are needed, and must have special training for that type of work.

The permits and the type of work they cover should be checked from time to time. Changes should be made to the permits where workers have experienced extra risks or the supervisor has seen other risks when working on a high-risk job.

There are a number of jobs on mine sites that need high-risk permits. Some examples of these are:

- hot work;
- storing gas cylinders;
- isolating energy sources;
- working alone in a hazardous area;
- working in confined spaces;
- working in high-voltage areas;
- working at heights; and
- access to the workplace and the use of machinery.

1.5.5.7 SAFETY SIGNS

Workplace signs should be put where everyone can see them, and they should be looked after, be clean, well-lit and easy to read.

All signs should relate to the hazard. When the hazard is removed, the sign should be removed also.

All workers must understand what the signs say. The meanings of the signs and how they are used must be explained to all workers, as well as changes to the words on the signs or where they are put. Management should be aware of workers

who have English as a second language or where reading could be a problem.

All people working in the mine must obey all signs.

Safety signs provide information about situations affecting health and safety and are not a solution for accident prevention.

The function and meaning of signs should be included in employee induction training programmes.

Employees need to be told about any new sign or changes to an existing sign, before it is displayed.

Classification (types) of signs

AS 1614 - The design and use of reflectorized signs for mines and tunnels, lists nine classes of signs. These are:

Class A-Danger signs

Class B-Caution signs

Class C-Emergency-related safety instruction signs and rescue markers

Class D-Fire services signs

Class E-Direction signs

Class F-Traffic signs

Class G-Information signs

Class H-Mandatory (obligation) signs

Class J -Prohibition signs.

Some examples are:

Hazard Signs

These signs advise of hazards and are subdivide into:

- Danger signs: (usually shown with a red oval shape with white writing on a black background) These signs warn of a hazard or hazardous condition that is likely to be life threatening, for example "Danger High Voltage", "This machine starts automatically at any time".

Figure 1.2 Danger Signs

* Warning (Caution) Signs (usually shown as a black triangle with yellow background) These signs warn of a hazard or hazardous condition that is not likely to be life threatening, for example "opening door hazard", "slippery surface".

Figure 1.3 Warning (Caution) Signs

Emergency Signs

(Usually shown as green background with white writing or symbol) These signs indicate the location of, or direction to, emergency related facilities, for example "first aid", "emergency assembly area"

Figure 1.4 Emergency Signs

Fire Services signs: -

(Usually shown as red background with white writing or symbol) These signs advise the location of fire alarms, fire fighting facilities, emergency stops, for example "Fire Extinguisher", "Emergency Stop"

Figure 1.5 Fire Services Signs

Direction and Traffic signs: -

Limitation or Restriction signs: (usually shown as a red circle with number inside) place a limitation on an activity or use of a facility, for example speed limit signs.

The colour scheme, shape and size of the sign is appropriate to the particular service. Refer to AS 1614 for the preferred type of sign.

Information Signs: -

(Usually shown as blue background with white writing or symbol) These signs provide general information, for example "parking areas", "toilets", "storerooms", "offices".

Mandatory Signs: -

(Usually shown as blue background with white writing or symbol) These signs

advise an order for action that "must" be obeyed, for example "hearing protection must be worn", "hard hat area"

Figure 1.6 Mandatory Signs

Prohibition signs: -

(Usually shown as a red circle with a line though it) forbidding an action for example "no entry", no smoking". If you do not obey these signs you may be committing an offence against the law or breaching safety procedures.

Figure 1.7 Prohibition Signs

Dangerous Goods Signs

Dangerous goods are classified by the United Nations, based upon the hazard a substance or material may cause.

There are nine classes of dangerous goods:

Class 1 Explosives

Explosives
(example TNT, ANFO, primers)

Class 2 Gases

Class 2.1 Flammable gases which will burn (example acetylene, hydrogen, LPG)

Class 2.2 Non-flammable non-toxic gases (example air, carbon dioxide, nitrogen)

Class 2.3 Poisonous or toxic gas (example chlorine, nitric oxide)

lass Flammable Liquids

Liquids which will burn (example petrol, diesel, kerosene)

able solids

Class 4.1 Flammable solids and self-reactive substances and which are easily ignited and readily combustible. (example desensitised explosives, sulphur, phosphorous, picric acid)

Class 4.2 Spontaneously combustible materials that may ignite if exposed to air (example non-activated charcoal)

Class 4.3 Dangerous when wet means that moisture may cause a fire (example calcium carbide)

ing Substances

Class 5.1 Oxidising agents (example chlorine, sodium peroxide)

ious and Infectious Substances

Class 5.2 Organic peroxides (liquid or solid) similar to class 5.1 but can explode under certain conditions

Class 6.1a Poisons which cause death or serious injury if inhaled, swallowed or adsorbed (example cyanides, lead, arsenic)

Class 6.1b Harmful materials that must be stored away from foodstuffs but are not classified as poisonous (example pesticides, heavy metals)

Class 6.2 Infectious Substances, which contain viable micro-organisms that may cause disease in humans and animals (example live vaccines)

Class 7 Radio Active Substances

Materials, which spontaneously emit ionising radiation (example uranium, radio isotopes, plutonium)

sives

Chemicals, which will eat away at a wide range of materials (example hydrochloric acid, sodium hydroxide)

ellaneous Goods

Label

Substances and articles, which have potentially dangerous properties (example aerosols, polyester beads)

Used whenever more than one class of Dangerous Goods is being carried in the one load

1.5.5.8 REVIEW OF CONTROL MEASURES (CHECK-UP OF WAYS OF CONTROLLING RISKS)

Doing a check-up of ways of controlling risks is important so that they are always up-to-date and can stop or control exposure to hazards or hazardous work practices.

Engineering controls should be regularly tested to make sure that they work. Performance testing and evaluation standards should be set up.

Repair and maintenance programs should say:

- where servicing is needed;
- how much servicing is needed;
- what type of servicing is needed;
- how often the servicing should be done;
- who looks after the repair and maintenance programs; and
- how problems will be fixed.

To keep good records, you need a way of making records or reports.

The employer is only required to take actions that are "reasonably practicable" to make sure there are no risks to the health and safety of employees and others.

This means the employer must decide how big the risk is – if it will happen and how bad it will be if it happens – and if the employer can remove it and how much it will cost.

If the risk is greater than the difficulties and costs of removing it, then the employer must remove the hazard. If the risk is very small, but hard and costly to remove, the employer may be able to say that it doesn't have a duty of care to use that method to remove the hazard.

The test is "objective". This means that the employer only has to look at what any other employer thinks they can do when dealing with the same sort of problem.

The employer must be "reasonable". If it costs too much to control a risk or is too hard to do, these are good reasons not to do it. Also, if it is not too hard to do, or too costly, these are good reasons to do something about the risk.

You can ask the question: "Should the employer already know about a hazard, if it can happen, how bad it is and if it can be removed?" Because of questions like this, employers must keep up with what people are learning about hazards and how to remove them. To do this, the employer may need help from work health and safety experts.

Thinking about if hazards can happen, the employer must know that they can be caused by workers not paying proper attention, or by being careless, or even by disobeying rules or instructions.

The employer cannot ignore his duty just because:

- the hazard has been looked at before;
- there has not yet been an injury from a hazardous way of doing work; or
- the employer has bought the plant or equipment with problems that make it hazardous to use.

If you can find that there is a way of controlling a hazard that people use everywhere, this does not mean that an employer is wrong when he or she says they could not use some other and safer method (that is, that it was not "reasonably practicable" to do).

When you have questions about safety and if something can be done to remove a risk, it is important to remember that:

- your common sense, and not special knowledge, can tell you what needs to be done to remove the risk; and
- if the employer does not do this, he or she are not doing their duty to care for your safety.

Check that the hazard is fixed for good.

After the changes are made, the supervisor and staff should check that the risk of injury or illness is as low as they can make it.

The law says that workers must inspect and take action to make their workplace safe.

The law may ask a person or a worker to carefully examine the workplace and any machinery or system used there so that they can be sure that it is safe.

REFERENCE DOCUMENTS

"A Short Guide to the Employer's Duty of Care" under the Occupational Health and Safety (Commonwealth Employment) Act 1991.

1995, "Risk Analysis of Technological Systems – Application Guide", AS/NZS 3931 (Int).

AS/NZS 4360, 1999, "Risk Management".

"Guidance Note – General Duty of Care in Western Australian Mines", ISBN 1 875 449 310.

"Risk Management Handbook of the Mining Industry – MDG 1010", NSW Department of Mineral Resources.

"Safety Signage", Combustion and Chemical Engineering P/L.

AS 1319 – 1994, Safety Signs for the Occupational Environment.

AS 1614 – 1985, The design and use of reflectorised signs for mines and tunnels.

1.6 CONTRACTOR MANAGEMENT

1.6.1 MINE OPERATOR'S RESPONSIBILITY

The mine operator is responsible for the control and safety of any person at the mine, not just directly employed people, but all people working on the mine site, either for a long time or for only a short visit. Picking the right contractors for the job is the best step management can take to ensure the safety of personnel and plant and equipment. The mine operator must be satisfied that the contractor is able to do the work and has the right ways of working safely before giving him or her the job.

Many contractors do higher-risk jobs, like construction, repair or other work not done by other workers that is more hazardous than normal operations.

The size of the contract (cost and time) will say how much time and resources will be spent on managing the safety of the contract. Major (cost) and medium to long-term contracts normally use special written agreements on the systems and procedures used for the work. Processes in larger contracts have more details and deal with more things than small contracts and casual contracts. However, the amount of effort to be spent on the contract should be in proportion to the risks to be managed – that is, it doesn't matter if it is a large or a small contract – it must give enough attention to the risks for them to be controlled.

1.6.2 SPECIFIC WORK HEALTH AND SAFETY (OH&S) SYSTEMS REQUIREMENTS

- Does the contractor have the right work health and safety (OH&S) systems (for example, policies, consultative processes) that at least follow what the law wants?
- Are the systems the contractor says he or she uses being used now, or ready to go?
- Do the contractor's management care enough about work health and safety (OH&S)?
- Are the contractor's safety systems able to deal with risks of the proposed job? (The higher the risk, the better the systems must be).
- Does what the contractor thinks about work health and safety (OH&S) agree with what the company thinks about work health and safety?

1.6.3 THE CONTRACT

The written contract should contain details of the safety needs of the job. All parties (that is, the people who sign the contract) should agree to these details before the contract is given, and they should have a plan of how the safety system is to be run. The safety clauses in the contract are to:

- make clear who must care for safety;
- make sure that the law is obeyed;
- minimise accidents and injuries;
- make sure that new workers know what they will be doing;
- make sure accidents and hazards are properly investigated; and
- make sure that plant and equipment is kept in good condition.

1.6.4 CONTRACTOR'S SAFETY MANAGEMENT SYSTEM

For high-risk contracts, the contractor should make a work health and safety (OH&S) Management System. All large contractors should have a ready – made (or general) system for all types of work that can be changed for individual contracts. The general system could contain:

- health and safety policy statement;
- organisational chart showing the key people working for the company;
- a list of safety duties of workers, their authority to do these duties, and their training;
- list of workers who already have skills;

- who is an employee and who is a subcontractor for the purpose of selection, placement and training methods or programs;
- details of health and safety training given to workers before starting the job (including special training and induction);
- accident investigation (procedure, documentation);
- injury/illness reporting (procedure, documentation);
- workplace inspections and auditing (procedure and documentation);
- hazard reporting (procedure, documentation);
- worker communication/consultation/ participation – for example, tool box talks, health and safety committee;
- scope of works;
- safe work procedures/job hazard analysis process (to be developed/modified as project proceeds);
- static plant (Certification Reports);
- mobile plant safety certification (about inspection before coming on site and how to keep it in good repair);
- hazardous substances control (listing and MSDS register);
- personal protective equipment and clothing (policy and register);
- health and safety and environment controls (for example, noise, vibration);
- rehabilitation (process and documentation);
- emergency response and evacuation (procedures, documentation), that is, plans for an emergency, like a fire or an explosion, and how to get workers away from where the explosion or fire happens; and
- disciplinary action (policy and procedures), that is, how workers or employers are punished if an accident happens, either because of something they have done or something they have not done.

REFERENCE DOCUMENTS

1998, "Boral OH & S Manual".

"Guidelines for Managing Health and Safety in the Labour Hire Industry", WorkCover – South Australia.

"Occupational Health and Safety Manual", Pioneer Concrete NSW P/L.

"PLDC Health and Safety Management Procedures" – Penrith Lakes Development Corporation.

"QuarrySAfe – Occupational Health and Safety Resource Manual", QuarrySAfe Group Health and Safety – South Australia.

"Guidelines for Contractor Occupational Health and Safety Management for New South Wales Mines" – MDG 5003, Dept Mineral Resources.

1.7 HAZARD AND WORK INJURY REPORTING SYSTEM

1.7.1 SITE REPORTING

1.7.1.1 HAZARD REPORTING PROCESS

A hazard report may be made for many reasons, including:

- to remind the supervisor to take proper action to control the hazard;
- to record the fact that the hazard was found;
- to record a hazard that has not been properly fixed or controlled by management;
- to ensure that the hazard report is sent to other management people or the Health and Safety Committee; or
- to record an action done by a person that has increased the risk to themselves or others.

For hazard reporting to work, it must be:

- easy to get to;
- easy to use; and
- followed up by corrective action.

1.7.1.2 EASY TO USE

Keep it simple. The aim of a hazard report form is to help workers to spot and record hazards. A report form should be no longer than a page.

Some workplaces have made good use of report forms in pocket-size, carbon-copied books.

1.7.1.3 CORRECTIVE ACTION (ACTION TO FIX HAZARDS)

For hazard reporting to work well, you must have a way of recording and following up the actions to fix hazards. One such way is to use a Hazard Control register.

A hazard-control register or other way of keeping track on what is done to fix hazards will help you to work out how hazards are controlled in your workplace. Health and safety committees use the Hazard Control register to help find out about:

- substandard conditions and practices that have not been fixed;
- the need for training and information; and
- areas that still need action to fix hazards.

1.7.1.4 INJURY/ILLNESS REPORTING AND RECORDS

For an accident-prevention program to work well, it must have:

- ways for reporting all incidents and injuries;
- full investigation of all accidents, injuries and illnesses; and
- detailed ways of recording.

The purpose is:

- to keep full records of personal injuries, illnesses, property damage and other incidents and near-misses. This information can be used to find problem areas that need action to fix hazards;
- make people in the workplace more aware of the hazards there by getting them to look into accidents and incidents and go over the information collected about accidents and incidents;
- so that the way the incident happened can be looked at toolbox meetings and used for case studies in training sessions; and
- to give a way for senior management to keep tabs on how well the control actions work following incidents/injuries and other losses.

Ways of reporting must be made for use by the company and for use by other people not working for the company who must know about its Occupational Health and Safety. All details recorded should agree with AS 1885.1. Measurement of occupational health and safety performance. (rules on how to record incidents and injuries).

REFERENCE DOCUMENTS

"QuarrySAfe – Occupational Health and Safety Resource Manual", QuarrySAfe Group Health and Safety, South Australia.

Getting Started with OH&S", Regular Hazard Spotting Inspections, National Occupational

Health and Safety Commission.

“Finding and Fixing Hazards, University of Technology, Sydney.

“Occupational Health and Safety Manual”, New England Antimony Mines.

1.7.2 EXTERNAL REPORTING

Some types of incidents and those where there is lost time must be reported to the relevant state authorities. Employers should know about legislation (laws) in their State.

1.7.3 COMPILATION OF REPORTS

1.7.3.1 LOCAL REPORTING

The local branch of a company needs to make reports to see how its own safety performance compares to the goals it has set itself and to report the results the its head office.

1.7.3.2 DIVISION AND GROUP REPORTING

Senior management need to keep tabs on the safety performance of their workplaces so that the information can be used in reports for the Board of Directors, and to give performance feedback to individual business units and employers.

1.7.3.3 BOARD OF DIRECTORS

Company directors have a duty to keep tabs on everything that the company does, including for health and safety. In Australia and some overseas countries, directors can be made responsible for breaking the health and safety law, and can be punished. Accurate and regular reports to the board give information needed by the directors to know if the company is obeying the law.

1.7.3.4 ANNUAL REPORT

The company gives information on safety performance to its shareholders through the Annual Report. This document is given both to shareholders and to other people who have an interest in the company, and is used to show how well the company is doing. The report shows if the company is following its own standards and those made by the law, and also gives information on accidents.

Reporting on work health and safety (OH&S) performance has in the past looked only at injury numbers, that is, negative (reactive) results. Companies should also look at positive (proactive) ways to look at performance.

Someone who wants to know how a work health and safety system is working can learn more if it makes reports on what has happened by controlling workplace risks as well as looking at injury numbers. To help people to want good safety management, health and safety reports should be talked about at all management meetings in the company.

1.7.4 COMMUNICATION OF REPORTING (LETTING OTHERS KNOW)

1.7.4.1 ACCESSIBILITY (EASY TO GET TO)

Workers need an easy way of getting to a report form or another way of reporting hazards. Before making a form that can be used for a report, you should think about:

- all the different workplaces that can use the form. For example, workers who are moving about, or work off-site and can’t get to photocopiers and so on; and
- getting the workers to have their say in making the form, and saying if they think the form is good or not, or if it needs to be changed.

1.8 WORKERS' COMPENSATION AND INJURY MANAGEMENT

1.8.1 INJURY MANAGEMENT

Occupational rehabilitation is getting injured workers back to their fullest physical, psychological, social, vocational and economic usefulness, as near as it can to what they were before the injury. Rehabilitation aims at keeping injured or ill workers in, or returning them to, suitable employment, and to give these workers the help they need.

The rehabilitation program that has been worked out by the company and the workers together says what they want rehabilitation to be and how they will make it happen.

1.8.2 REHABILITATION POLICY

By writing down what it thinks rehabilitation should be and how it will help (the rehabilitation "policy and procedures document"), the company shows to everyone that it supports the idea of rehabilitation. The document says what services injured workers can get and how to get them.

The policy should be made for what each workplace needs, and should include:

- what the policy wants to happen (objective);
- everyone saying that they want workplace-based rehabilitation commitment;
- who can get rehabilitation and how they will be helped;
- names of the people who are running the rehabilitation and what they do;
- ways of settling arguments about rehabilitation; and
- that all people running the rehabilitation can show, or answer for, what they are doing and if they are getting the results they want (accountability).

Workplace-based rehabilitation programs should aim to get the best services for looking after injured workers or returning them to the right sort of work.

Sample Rehabilitation Policy

ABC Company will help workers keep their jobs if they are injured or become ill because of their work.

Specifically, the return-to-work policy is that:

- everything done to help the worker will start as soon as possible, but must follow doctor's advice;
- injured and ill workers will be returned to work as soon as possible only if it is safe and can be done; and
- the worker will be given other work that won't make them ill.

The company wants all workers to help make its policy work.

Our commitment to this policy means:

- Return to work will start as soon as possible after illness or injury and return to work plan will be set up for any worker who is unable to work for 20 or more days. This plan will be set up as soon as the company knows an ill or injured worker will be off work for 20 or more days.
- For the worker to keep his or her job, if they can still do it, the illness or accident and its treatment must be reported just after it happens.
- The company always tries to return injured workers to work when it is safe to do it.
- As part of the return to work program, workers will at first not be given work that could make them ill again.
- The injured workers will have a say in their return to work.
- The privacy of the workers will be protected.
- The company will not hold it against a worker if he or she is in a return-to-work program.
- There will be a weekly check-up of the return-to-work activities, with the worker having his or her say, to make sure the worker is getting better.

1.8.3 WORKPLACE-BASED REHABILITATION

Studies have shown that the sooner a person gets back to work after an injury the less likely is the injury to become worse and the better is the chance of recovery.

It may not at first be possible for the injured worker to continue at work or return to his/her original job and the rehabilitation providers and coordinator would work together to develop a plan to bring about a return to work. Normally, the plan would be gradually upgraded until the worker was able to return to his or her pre-injury duties.

Rehabilitation should begin as soon as the injury or illness has been notified and in line with medical advice.

Everyone should agree to the type of rehabilitation for the injured worker (that is, the worker, his/her union, the employer, health care professionals, insurer).

Workplace absences through an injury or illness incur costs for the worker and employer. For example, for the worker, the costs would include pain and loss of physical, social, and psychological wellbeing that may result in depression, frustration and low self-esteem. For the employer, the costs could include lower production and payments for overtime to maintain production.

Rehabilitation providers are an important part in the health and productivity of the workforce. Rehabilitation could include help with physical and social problems due to the injury. Each team will include a professional who is skilled at advising on what injured workers can and cannot do at work during their recovery. The rehabilitation provider can help to plan how they can continue to work or to help them return to work at the earliest possible time.

1.8.4 MINE OPERATOR’S RESPONSIBILITIES

The mine operator’s responsibilities are to:

- set up the company’s rehabilitation program and procedures;
- show the company’s rehabilitation program at all workplaces;
- make sure that workplace management of the rehabilitation program is done and the worker chosen as the rehabilitation coordinator is given right training;
- make sure that an injured worker gets the right treatment. A worker should be able to choose his or her doctor;
- assist an injured or ill worker to return to the pre-injury job through a personal rehabilitation program, which may include other duties;
- consult workers either directly or through the OH&S committees to talk about the program and let workers know about it;
- check to make sure the rehabilitation program is working; and
- set up a procedure to handle any disputes over occupational rehabilitation.

1.8.5 REHABILITATION COORDINATOR□S RESPONSIBILITIES

Good coordination of rehabilitation is important. Employers should appoint someone from their organisation, who can talk with senior management, workers and their representatives, line management, rehabilitation providers, medical practitioners and insurers to help injured workers return to work.

A coordinator must:

- get the support of management, workers and unions;
- help the employer to set up rehabilitation programs in line with State/Federal legislation, coordinate and check the workplace rehabilitation program and individual rehabilitation plans;
- help injured workers to return to work as soon as possible;
- set up and maintain contact with the injured workers doctor; and
- make sure that workers who need rehabilitation services are set to the right rehabilitation providers.

1.8.6 WORKER□S RESPONSIBILITIES

The worker's responsibilities are to:

- cooperate with the rehabilitation program;
- cooperate with a program by attending all medical check-ups; and
- not worsen the injury by doing things that might lead to more damage.

1.8.7 SUITABLE ALTERNATIVE/ MODIFIED DUTIES

It is important for injured workers to return to work as quickly as possible because they can get a sense of identity and purpose at work. This complex psychological and social environment can give support when difficulties are experienced.

The trauma of injury that separates the worker from workmates and the activities of work can give feelings of inadequacy and hopelessness. The supportive relationships the injured worker experiences when returning to work can help the worker to cope with the injury and rehabilitation.

Suitable duties are not merely something for injured workers to do while they are recovering from the injury. While it is important to return to work as quickly and safely as possible after an injury, it is equally important that what they do on their return helps in their rehabilitation.

The employers, with the doctor, the rehabilitation provider and the injured worker should set up the range of activities the injured worker is able to do.

There should be an attempt to provide suitable duties that include the abilities, interests and expertise of the injured worker. For example, an electrician, who is injured at work and unable to do his/her job for some time, may be able to use his/her experience and knowledge as an estimator.

Such a plan helps to keep the injured worker's self-esteem and assist in rehabilitation. It is also helps the company to make the best use of the worker's abilities.

When suitable duties for an injured worker are not an option

In some cases, because of the nature of the worker's injuries or the types of jobs available in the workplace, it may not be possible to set up a rehabilitation program with suitable duties.

Two options are:

- a schedule of rehabilitation at a gymnasium or swimming pool may help the injured worker to recover and get back to his/her job; and
- even with good rehabilitation, the injured worker may not be able to get back to work. In this case, retraining should be talked about with the injured worker and the rehabilitation provider. The rehabilitation provider will be able to help the injured worker with retraining and will know about the assistance WorkCover can give in meeting the cost of this retraining.

1.8.8 TRAINING AND EDUCATION OF WORKERS

- Workers must know of their responsibilities about rehabilitation. For rehabilitation programs to work, they depend on the cooperation of every worker within the company.
- Induction training of new workers should include a part on occupational health, safety and rehabilitation where worker responsibilities are explained.
- Management should be given help in meeting their roles and responsibilities.
- Workers should be given help in meeting their roles and responsibilities.
- Rehabilitation coordinators should be given the right training to help them to meet their responsibilities.

1.8.9 ACCREDITED REHABILITATION PROVIDERS

Most cases should only need discussion between the worker, treating doctor, supervisor and workplace coordinator to return an injured worker to work. The type of injury should decide the type of rehabilitation needed and the time he/she will be away from work.

Should a company wish to appoint a rehabilitation provider, a number of things need to be considered:

- use of a provider in all cases, or if recommended by the coordinator or case team;
- how to choose providers;
- the number and type of providers needed;
- the worker's role in choosing a provider;
- if the providers can meet the employer's rehabilitation needs; and
- letting providers know what they need to tell the company about the injured worker.

Generally, rehabilitation providers can provide different services. Employers should take care in choosing the right provider.

1.8.10 RECORDING AND MONITORING

- Records should be kept of an injured worker's progress.
- A rehabilitation plan should be prepared with the worker and his/her doctor.
- Medical information about a rehabilitation case should be confidential.
- Management and the workplace OH&S Committee should review the rehabilitation programs of injured workers to make sure they are getting better.

REFERENCE DOCUMENTS

"Guidance Note for the Best Practice Rehabilitation Management of Occupational Injuries and Diseases", NOH&SC: 3021, 1995.

"WorkCover Small Business Standard Rehabilitation Program for Employers of no more than 20 Workers".

"Boral OH&S Manual", 1998, Boral.

"Safety Manual", New England Antimony Mines NL.

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PART 2

PROCEDURES AND

PROCESSES

UPDATED 8 NOV 2002

PART 2: PROCEDURES AND PROCESSES

2.1 COMMUNICATION AND CONSULTATION

Ask any football coach why his team won the day before and he will say: "Every one of my players was motivated to win. They gave it 100%". Before a football game, the coach leads the practices and motivates the team, the players train and discuss strategy, the support staff makes sure all the equipment is in order. All members of the team must play their part, and whether they win or lose comes down to their performance on the field.

It is the same when a company is successful. Whether we are talking about productivity or occupational health and safety, success depends on the commitment of all members of the team.

The "football team" principle is participatory management with all personnel–employers and employees-participating in problem-solving and decision-making. When employees are involved in making a decision, no matter what it may be, they are more inclined to accept the consequences and put that decision into practice.

Using this approach to the OH&S program will decrease the chance of having an accident. Management commitment and worker involvement is central to any occupational safety and health program.

2.1.1 OCCUPATIONAL HEALTH AND SAFETY COMMITTEES

The Occupational Health and Safety Committee (OHSC) is the way management can formally approach accident reduction. It can:

- discuss health and safety issues;
- provide health and safety information;
- discuss health and safety performance;
- review workplace OHS systems and procedures; and
- solve workplace health and safety issues.

2.1.1.1 MEMBERSHIP

The Committee is formed from employer, contractor and worker representatives:

- there should be a similar number of representatives from each group;
- the term of office of a OHSC member should be no longer than three years;
- a chairperson should be elected from within the members each year;
- a secretary should be elected from within the members each year;
- if an employee representative resigns, the replacement should be from the same work group; and
- all management representatives should be filled by a person chosen by management.

2.1.1.2 MEETINGS

The OHSC should meet on a regular basis with no more than three months between meetings.

2.1.1.3 AIMS AND OBJECTIVES

In general the OHSC:

- may consider everything relevant to safety, health, welfare and rehabilitation;
- check if the company is meeting the requirements of appropriate Acts, Regulations and Legislation;
- gather, review and communicate Occupational Health, Safety and Welfare Policies, Plans and Procedures;
- consider any changes to Occupational Health, Safety and Welfare Policies, Plans and Procedures that may affect the workers;
- develop a team work approach within the workgroup and ask workers to stick to policy;
- ask workers help plan and put in place Occupational Health, Safety and Rehabilitation Policies;
- decide on the way workers talk to each other within the workgroup;
- tell management of any problems with Occupational Health and Safety Procedures; and
- recommend any training of employees in health and safety.

2.1.1.4 OTHER ACTIVITIES

The OHSC may:

- call special meetings to consider important matters;
- appoint sub-committees, working groups, delegates and other groups or persons to help OHSC activities; and
- ask for help from persons who have skills and abilities, which may help meet the aims of the OHSC or subcommittees. These persons would generally have no voting rights.

2.1.1.5 DUTIES OF OFFICERS

The chairperson

- Should be at all meetings of the OHSC and keep order. When minutes are agreed, the chairperson should sign the minutes at the meeting.
- Should make sure the decisions made in the meeting can be carried out under the “terms of reference” for the committee.
- If there is an emergency, the chairperson should make decisions with the Occupational Health and Safety Representative and Management. Any actions are to be reported to the next OHSC meeting.
- If not at a meeting, another chairperson should take over for that meeting.

The secretary

- Attend all meetings of the OHSC.
- Take notes during the meeting and keep a copy.
- Take notes on what was said in the meeting and any actions to be taken. Make sure everyone on the committee gets a copy.
- Prepare and send out an agenda for each meeting at least five days before the date of that meeting.
- Keep up to date the information on the Health and Safety Acts and Regulations, Codes of Practice and other important material.
- Send reports on accidents/incidents, rehabilitation and current activities.
- Provide advice on changes in standards and legislation.
- Check that agreed processes are working as planned.

Quorum

A quorum is the number of members that must be at the meeting for it to be held. It should consist of not less than half of the employee and/or contractor representatives and half of the management representatives. At OHSC meetings, there should be the same numbers of employee representatives or more than that of management.

The chairperson/secretary may be counted as a member in a quorum.

Requirements of OHSC members

- Must behave at all times.
- Items discussed in confidence within the OHSC will not be mentioned out of meetings.

Replacement of OHSC members

The office of OHSC members may become vacant if a member is:

- no longer employed by the company;
- permanently unable to work because of ill health;
- absent without apology for a number of meetings; and
- no longer the elected representative of one of the management or employee/contractor groups.

Observers

- Observers may include:
  - interested employees; and
  - health and safety consultants.
- Have no right to debate or vote on any committee matter.
- If observers wish to attend a meeting, they should tell the chairperson before the start of the meeting.

- The chairperson should be told prior to the meeting if an observer needs to address the meeting on an item. The chairperson should put this request to the OHSC.

Guests

- Guests with relevant expertise may be invited to attend specific meetings.
- Guests have no right to debate or vote on any OHSC matters.

2.1.1.6 DISTRIBUTION OF MINUTES

Minutes should be sent within one week after the meeting. Should a meeting be stopped and restarted, then minutes should be sent one week after the final meeting.

The secretary or other appointed person should send the minutes to:

- HSC members;
- responsible officers;
- managers/supervisors;
- health and safety representatives (HSRs); and
- notice boards.

2.1.1.7 MEETING AGENDA

Agendas include what will be discussed at the meeting and should be prepared by the secretary and sent at least one week before the meeting date.

A typical agenda could include:

- apologies for non-attendance;
- minutes of the previous meeting;
- business arising from the minutes;
- documentation review;
- correspondence and training;
- safety reports on hazards and problems, outstanding safety item reports etc;
- accident/unusual incident report/ rehabilitation;
- human resources/maintenance reports; and
- any other business.

2.1.2 TOOL BOX MEETINGS

Tool box meetings are group talks between management and workers. They give the workforce the chance to raise important issues about them and the operation.

Organisation of meetings

Tool box meetings should be held on a regular basis but should be informal. They can be held as the need arises, for example, to discuss an accident or "near hit".

Meetings may be held by managers, supervisors, safety officers, members of an OH&S Committee or at the request of an employee who has an important issue to talk about.

Meetings can be held anywhere so long as people will not be interrupted. Formal meeting rooms are not needed.

Tool box meetings are not meant to be long training sessions but as a time when ideas on a topic can be talked about.

Formal agendas are not usually needed, but the person calling the meeting should have prepared some topics and be able to direct the discussion and bring it to an agreed end.

Records of topics and names of attendees should be kept at all tool box meetings.

Discussion topics include the following:

- recent workplace incidents, injuries, near hits and possible preventative measures;
- raising people's awareness of their responsibilities for working safely, for example attention to housekeeping, wearing of personal protective equipment;
- inviting people to raise safety issues which are a concern;
- workplace modifications, new plant or equipment;
- people not turning up to work;
- how to lower injuries;
- employee input into lowering manual handling problems or modifying jobs to reduce potential risks;

- workplace safety topics such as hazardous substances, permits to work, warm-up exercises, sun exposure; and
- incident reports from outside sources.

Involving workers in matters about their jobs and their workplace goes a long way towards building a committed and productive team. Input from the workforce is of great benefit to management in planning and problem-solving. The workers are the people doing the job, so they are in the best position to come up with right answers.

2.1.3 OTHER CONSULTATIONS

Areas of management/employee consultation should include:

- preparing Occupational Health and Safety policies and procedures;
- occupational health and safety training;
- accident and incident investigation;
- workplace/hazard inspections;
- preparing written safe work practices;
- change which may greatly affect health and safety at work, for example in procedures, equipment or ways of working;
- employer's arrangements for getting competent people to help satisfy health and safety laws;
- information that employees must be given on the likely risks and dangers in their work, measures to reduce or get rid of these risks and what they should do if they have to deal with a risk or danger;
- planning of health and safety training; and
- health and safety issues of new technology.

2.1.4 COMMUNICATION SYSTEMS

Two-way communication is an important part of an Occupational Health and Safety Management System. Good communication is the key to understanding OH&S issues that affect employees, managers and the community.

What kind of information?

The huge amount of information available can result in "information overload", so it is important to be selective. There is a need to determine the type of information that is useful, and the way it is presented. A highly technical report could be full of important information, but if the words are too technical, only a few people might understand it.

Where will the information come from and how?

Commonly used types of communication are:

- newsletters;
- bulletins;
- critical incident reports;
- signs;
- notice boards;
- manuals;
- safe work procedures;
- meetings;
- videos;
- reports; and
- safety committee minutes.

It is important to have a communication system, otherwise people who should get the information may miss out. Making sure people understand the information is also important. Reading difficulties and language problems may have to be overcome by having the information read out or translated. This can be important when employees have to follow safety or emergency procedures.

Occupational health and safety information is also available on the Internet, e-mail and other computer systems such as Infosearch, Chemsearch and CC Info.

Day-to-day communication

Mine personnel need to understand what has been said or written. One way to do this is to check with the other person by asking questions or repeating the information. If listening is difficult in noisy or busy areas, move to an area where people can really listen.

Management's role

Managers must set up a culture for safety in their areas of responsibility by making a point of talking about safety topics during site visits and by having safety as an item on the agenda at management meetings. When employees keep hearing the safety message from their managers, they know it is important and part of the way things are done.

2.1.5 COMMUNICATION OUTSIDE THE ORGANISATION

Standards and guidelines that affect OH&S are available for the public to read before they are finished.

Comments are also asked on proposed legislation and codes of practice. Industry associations, trade unions, local OH&S authority journals and newspapers are good ways to find out about these documents.

Communication

Communication is not just about sending memos and reports, it is about talking-giving and getting messages which are understood. This is important to provide a safe and healthy place to work.

REFERENCE DOCUMENTS

"Occupational Health and Safety Resource Manual", QuarrySAfe Group Health and Safety, South Australia.

"Occupational Safety and Health – Information, Education and Training", Article 24.5, North American Occupational Safety and Health Week.

"Occupational Safety and Health – Manager and Employee Commitment", Article 24.3, North American Occupational Safety and Health Week, Canadian Center for Occupational Health and Safety.

"A Basic Occupational Health and Safety Program", Canadian Center for Occupational Health and Safety.

"Boral OH&S Manual", Boral.

"Consulting Employees on Health and Safety – A Guide to the Law", Health Safety Excentive, United Kingdom.

2.2 SAFE OPERATING PROCEDURES

For good health and safety, there needs to be a process set up for identifying and assessing risks, and then developing measures to control these risks. One of the most important controls is to prepare work tasks, work instructions and technical rules. These help to make sure that planning is done and that there are written instructions on how to do the job because a lack of control could cause safety problems.

2.2.1 PROCESS CONTROL

Safe work procedures should be set up for the operation of all machinery and tasks that could cause safety problems.

Mines should look at potential hazards and assess the risks of work processes. Written procedures and work instructions are then developed to manage work processes, plant, equipment and materials in a safe way. Employees who do the tasks should help develop the procedures.

The written procedure should contain clear and easy-to-understand instructions. Workers will not always follow written rules. This is because the rules may not be sensible. Procedures must be correct, completed and able to be used.

A method of setting up standard operating procedures for a job is to do a Job Safety Analysis (breaking down every job into small tasks). From this process safe, work procedures can be developed.

2.2.2 JOB SAFETY ANALYSIS

Job Safety Analysis (JSA) is an important part of a safety program for stopping work accidents and illnesses. It is about looking at each job to identify and assess hazards and set up safe work practices.

The JSA technique is good way of getting employees to take part in assessing safety and reducing accidents. Through JSA, workers can make play an important part in setting up and maintaining safe work procedures. It is also a part of "consultation" which may be in legislation.

2.2.2.1 DESCRIPTION

A "job" is a number of steps done in a set order to do the task.

JSA breaks a job down into steps and lists any hazards or risks which might be found in each step. This is done so that the hazard can be found and controlled.

The four basic steps to completing a JSA are as follows.

- Choose the job to be assessed.

  In choosing which jobs should be looked at, it is useful to begin with those jobs that have a high accident rate or where a high risk is present. "New jobs" should also be looked at because they will have no accident history. The potential for accidents or work-related illness may not be found unless a JSA is done before the new job is started.

- Work out the job steps or stages involved.

  In working out the job steps, it is useful to "work through the job", list each step and make notes of what is done. Use a Job Safety Analysis form to do this.

- Look at a person while they are doing the job.

  The stages of the job can then be looked at step-by-step to identify any hazards. Write down any hazards that you find.

- Find hazard controls.

  For each hazard found, write down the controls that need to be put in place to stop the hazard from causing an accident.

2.2.2.2 PURPOSE

When the JSA has been done, it can be used tell the worker how to do the job, and is ideal for training, since it shows an worker how to do the job in the best and safest way. It also sets the standard for the job so that everyone learns to do the job in the same safe way.

The JSA can help managers and supervisors learn about the jobs to be supervised, even if they have not actually done all the jobs themselves.

The finished JSA is a record showing that the company has completed hazard identification, assessment and control.

The JSA should be used as a checklist when doing safety inspections or audits, as it tells the auditor what should be happening on any job.

The JSA provides a "measure" during any incident investigation, as it sets out how the job should be done.

Workers will take more interest in a job if they are asked to help with the JSA. Workers might have good ideas on how to do the job safely and better ways to do the job safely, for example:

- some part of the workplace may need to be changed (materials, lighting, work area layout, ventilation, safety gear);
- the number of times the job is done may need to be reduced; and
- a complete change of the way the job is done might be needed.

2.2.2.3 RECORDS

A copy of the JSA should be kept on the job so it is handy for reference. Another copy should be filed in the office.

Because a JSA produces permanent instructions, it should be a continuing activity. JSAs have to be kept up to date or the benefits will be lost over time. Misinformation or an out-of-date JSA can be dangerous.

Changes may not needed very often, but when they do occur, everyone concerned with the job should be told of the changes and instructed in the new procedures.

The JSA for a particular task should be repeated if:

- an accident occurs on a job covered by a JSA;
- a job method is changed;
- a job process is changed; or
- a safety inspection shows that the job is not being performed according to the JSA.

2.2.2.4 PITFALLS

There are three main problems in doing JSAs that could prevent them being useful. These are:

- not listing all the hazards;
- listing the hazards, but taking no action; and
- making unclear instructions.

2.2.3 SAFE WORK PROCEDURES

It is the employer's job to provide the employee with safe work procedures, and with education, training and supervision.

A manual handling job should have its own safe procedure. Some safe procedure steps include:

- the task should be planned before work begins;
- employees should be trained in the skills needed;
- employees should be told about hazards;
- the area should be cleared to avoid bumping into or tripping over things; and
- suitable safety clothing should be given to workers and worn by them.

Safe work procedures should reduce lifting, carrying, pushing, pulling, lowering, throwing, holding, or tasks using force. They should:

- remove unnecessary tasks;
- prevent double handling;
- prevent heavy carrying;
- provide rest breaks during heavy or repetitive work;
- provide shelf storage for heavier objects at waist level, smaller objects on high or low shelves; and
- provide such mechanical aids as trolleys, hoists, levers, adjustable height workbenches and seating, hooks and jacks, tools and equipment kept within easy reach.

Specific tasks may be:

- lighten loads (break loads into smaller amounts);
- reduce bending, twisting, reaching movements;
- use two people to carry bigger loads; and
- prevent muscle strain and fatigue. This includes warming up before working, allowing time for rest breaks and time to gradually get used to a new job.

Statistics show that most people who get back strains are below the age of 20 or above the age of 60. For workers below the age of 20, the cause is generally inexperience and lack of supervision and training, while for workers over 60, the build-up of minor damage and lower physical ability can be the problem. As a rule of thumb, persons should think of other ways of lifting weights more than about 20kg. Reference should be made to the Manual Handling Code of Practice – Worksafe Australia.

2.2.3.1 WRITING SAFE OPERATING PROCEDURES IN PLAIN LANGUAGE

"Plain English" is getting a clear message across to your audience in an appropriate way. This means being clear about what you want to say, who you're saying it to and how you're going to say it.

Plain English means:

- considering the reader;
- communicating a clear message to the reader;
- using clear and simple language; and
- rethinking how information is provided to get the reader's attention;

Plain English does not mean:

- writing in simple English;
- using the minimum amount of words;
- getting rid of technical language;
- talking down to the reader; or
- losing meaning;

Plain English has many benefits:

- workers are more likely to read and act on written texts;
- readers are less frustrated and view documents in a positive way;
- there is less interruption to work from queries and misunderstandings;
- documents take less time to produce;
- safety and quality can be improved; and
- training is easier and more timely.

Audience:

Keep in mind the people who are going to read the material, and consider these questions:

- How well do they read? (educational background).
- Are they from a non-English-speaking background?

Seven ways to write effectively:

There are seven ways to write work-method statements in plain English so they are easier to write and understand.

1. write out the job procedure step by step;
2. use an active voice;
3. sequence ideas logically;
4. keep sentences short and clear;
5. choose words carefully;
6. use verbs not nouns; and
7. consider layout and formatting.

1. Write out the job procedure step by step

- start each step with an action word; and
- set it out as shown in the procedure section of the Suggested Pro forma.

Example 1:

1. Deliver all nails to the site
2. Store in areas set aside by the builder
3. Clear work area of all obstacles
4. Join timber on the floor in lengths less than nine metres.

Example 2:

1. Locate centre of each hole
2. Check that each hole would only enter the slab thickness
3. Drill an 8 to 10 mm pilot hole
4. Insert a small wire or rod through each hole.

Example 3:

1. Erect and brace columns
2. Erect and brace beams
3. Tie beams and bracing
4. Bridge purlins
5. Tension bolts.

2. Use active voice

- It is more personal and direct and says who must do the action.

Examples:

✖ Materials must be removed in manageable lots.

✔ Remove materials in small lots.

✖ Protective gloves are to be worn.

✔ Wear protective gloves.

✖ Fork lifts must not be driven faster than walking speed.

✔ Never drive forklifts faster than walking speed.

✖ Leads are to be kept above floor level.

✔ Keep leads above floor level.

✖ All equipment to be checked and tested.

- Check and test all equipment.

3. Sequence ideas logically

- Put the main idea first.

Examples:

✖ When you are working in a dusty and windy area, wear safety glasses.

✔ Wear safety glasses when you are working in a dusty and windy area.

✖ From the information on the plan, establish the required width of the formwork.

✔ Set up the required width of the formwork from the instructions on the plan.

- Put the time phrase, if important, as a subheading and then the instructions in point form underneath.

Example:

- When cutting, drilling or shaping glasswool insulation:
  1. wear protective clothing;
  2. use a suitable dust mask; and
  3. avoid contact with your eyes.
- Try to put information in point form for clear and easy reading.

Example:

✖ When compressed air jackhammers are to be employed for the purpose of excavation, it is advisable to make certain that the air compressor is placed within as close a proximity as practicable to the worksite and all equipment is to be fitted with suitable apparatus for noise abatement. Hearing protection is to be worn by all employees at all times and air hoses are to be fitted with snap-on safety couplings which are to be fixed to the hose by the use of safety locking pins.

✔ When using jackhammers for excavation work:

1. place the compressor as close to the work as possible;
2. make sure that the equipment is fitted with noise controls;
3. wear hearing protection;
4. use snap-on safety couplings on all hoses; and
5. fix safety couplings with safety locking pins.

- Separate extra information that may be needed to make the instruction clear. Do this by putting the extra information in a highlighted box or by using italics.

Example:

Block off fixed-type laser beams by using a beam stop.

Safety Note:

- Effective beam stops have a matt finish to stop reflection. Earth, wood plywood, brick, mortar, concrete or plasterboard surfaces are suitable.

- Roughen the surface of metal beam stops.

Use parallel structures-that is, use the same grammatical structure to express similar ideas or two or more ideas in the same sentence.

Example:

✖ To prevent falls:

- fix solid one metre high guard rail
- workers must use a safety harness
- workers wearing safety footwear
- securely covering all floor penetrations

✔ To prevent falls:

- fix solid one-metre-high guard rail
- use safety harness
- wear safety footwear
- cover all floor penetrations securely.

4. Keep sentences short and clear

Remember:

- Long and/or complex sentences are more difficult to understand. They take longer to read and can hide information.
- A sentence should contain only one or two ideas. Separate ideas with lists, dot points and punctuation (commas, semi-colons, colons).
- If you must have a long sentence (more than 18 words), follow it with a short one.

Example:

✖ The trainer will ensure that each crane driver/chaser is fully skilled in lifting procedures and, most importantly, will confirm that each crane driver/chaser fully understands what his duties are.

✔ Trainers must make sure that crane drivers/chasers:

(a) know correct lifting procedures

(b) understand their duties.

5. *Choose words carefully*

- don't use too many formal words or long-winded phrases.

  Examples:

✖ ensure

✔ make sure

✖ accordingly

✔ so

✖ without further delay

✔ immediately

✖ at this point in time

✔ now.

- Avoid unnecessary repetition or redundancies.

  Examples:

  ✖ Power to the construction site is available on an around the clock basis.

  ✔ Power to the construction site is available 24 hours a day.

- Do not use too many nouns together. They can make the document difficult to understand because the reader must take in a lot of information.

Examples:

✖ safety regulation handbook

✔ handbook of safety rules

✖ estimated monthly attendance performance bonus

✔ monthly attendance bonus.

- Avoid jargon, slang, idioms, sexist or racist terms and foreign expressions.

  Examples:

  1 chippie, sparky, gofer

  2 I'm broke

  3 as slow as a snail

  4 foreman

  5 deja vu.

- Do not use contractions (short forms). They are not as strong as the words written in full.

  Example:

  ✖ Don’t

  ✔ Do not

- Beware of acronyms (words made from initials). You must explain what they mean the first time you use them.

  Example:

  Construction, Forestry, Mining and Energy Union (CFMEU).

  – Spell out abbreviations to avoid confusion whenever possible. If you must abbreviate:

    > do so only when necessary, and

    > make sure that the abbreviations are understood.

  Examples:

  ✖ e.g.

  ✔ for example

  ✖ i.e.

  ✔ that is:

- Spell out one, two, three, four, five, six, seven, eight, nine and ten. Over ten, use numbers – 11, 12, 13.
- Use spelling from the Macquarie Dictionary. It is the most suitable for Australia.

6. Use verbs, not nouns

Be careful of turning verbs into nouns (nominalisation). This makes the document “heavy” or “academic” and hard to read.

Examples:

✖ Utilisation of backhoes on construction site must only be done in consultation with supervisor.

✔ Consult supervisors before using backhoes on construction sites.

✖ Failure to comply with these directives will result in expulsion from this facility and/or notification of the construction company.

✔ We will expel you from this site and notify the construction company if you do not comply with these directives.

7. Consider layout and formatting

- Keep your layout open. Use plenty of white space. This makes the procedure more readable.
- Use no more than two separate font styles: one bold and the other Italic. If you use more, the finished product will not present well.
- Avoid using CAPITALS to write full words – THEY ARE MORE DIFFICULT TO READ.
- Do not use underlining. Make important headings larger.
- Justify (line up) the text to the left as this helps you to read the document more easily.
- Take care with the length of lines. 50 to 70 characters is the ideal number of characters per line.
- Use subheadings to help break up large blocks of text and guide the reader to the information.
- Use colour sparingly. It is harder to read than black and white.
- Make sure graphics are easy to understand.
- Keep layout consistent in the document.
- If you need to include a glossary of technical terms, make sure that you follow the agreed layout.
- Finally, get somebody who does not know the job to read it. You have achieved a satisfactory result if they understand it.

2.2.3.2 ALTERNATIVES TO WRITING

It is very important to consider alternatives to writing if you have employees who have reading problems. They may not be able to read words but they may be able to follow a picture, a diagram or spoken instructions.

Use alternatives to writing to make the meaning clearer:

- flow charts for writing work instructions and procedures, explaining processes, defining production goals;
- diagrams, illustrations, graphics, line drawings for technical terms and procedures;
- tables, charts, graphs (pie, vertical, line etc.) for statistics, production data figures; and
- maps for emergency procedures, locations and layout of areas.

Or

Read the information to workers and check that they have understood it. Make sure that they then sign it.

REFERENCE DOCUMENTS

"Create Effective Operating and Maintenance Procedures", William G Bridges, Thomas R Williams. JBF Associates Inc.

"Guidelines for Writing Work Method Statements in Plain English", NSW WorkCover, August 1998.

"QuarrySAfe" Occupational Health and Safety Manual, QuarrySAfe Group Health and Safety South Australia.

Job Hazard Analysis, U.S. Department of Labor, OSHA 3071 – 1998.

2.3 WORKPLACE INSPECTION

Inspection is one of the best tools to find problems and assess risks before accidents occur. A well – managed inspection program can do the following:

- Identify potential problems. Standards overlooked during design, and hazards not discovered during job/task analysis, become apparent when inspecting the workplace and workers.
- Identify defects in equipment. The causes of these problems are normal wear and tear, and abuse or misuse. Inspections help managers find out if equipment is getting worn or is inadequate or has been not been used properly.
- Identify poor work practices. Since inspections cover both conditions and practices, they help managers spot poor work practices.
- Identify effects of changes. Processes can change from the original design. As different materials become available, or as original materials are hard to get, changes are made. Changes can occur gradually and their effects may go unnoticed. Inspections give managers the chance to check on materials used and current problems.
- Identify inadequacies in actions taken to fix a problem. Actions are usually taken to fix a specific problem. If the actions are not properly done, they can cause other problems. Also, the original problem may not be fixed. Inspections should be done to follow up on how well the actions are working.
- Check that the standards are being followed. The inspection is an excellent opportunity for measuring performance. It provides a way of checking that things are being managed, for example:
  - the equipment is in good condition or parts are about to break down;
  - efficient layout or poor use of space;
  - tools in order, or scattered about and must be searched for when needed;
  - materials are ready for use or buried under things;
  - a safe work area or one with hazards; and
  - a clean work area or one that will require a clean-up.
- Show commitment through involvement. Every manager should check the workplace regularly to see that people have the things they need to get the job done.

Inspection activities are a good way of showing employees that their safety and health are important. When management makes regular safety tours, and when the supervisor does informal and formal inspections, workers know that they care. Workers can play a part by being involved in the safety program.

Two broad categories are “informal” inspections and “planned” inspections. Both are important. They are discussed below, with major emphasis on planned inspections.

2.3.1 INFORMAL INSPECTIONS

Informal inspections are simply workers being aware of others as they go about their day-to-day activities. They can spot potential problems as changes occur and work progresses.

Informal inspections have limitations. They are not systematic. They miss things that take extra effort to find. Managers constantly have things on their minds. Preoccupied, they don’t realise what they are seeing. They may notice some things, but not the total picture. They may forget to follow up. To overcome this problem, some managers carry a pocket notebook to make notes on things to check and actions to take.

Some companies have formalised the informal inspection by setting up a hazard reporting system.

2.3.2 PLANNED INSPECTIONS

Informal inspections may not be enough. They do not meet all needs for inspection. There are also critical needs for planned inspections, such as critical parts/items inspections, housekeeping evaluations and general inspections.

2.3.2.1 CRITICAL PARTS/ITEMS INSPECTIONS

Critical parts or items can be defined as parts of machinery, equipment, materials, structures or other components that result in a major problem or loss when worn, damaged, misused or improperly applied. If in use, it is a critical part. If in storage, it is a critical item. For instance, a grinding wheel is a critical part when on the grinder, but it is a critical item when in storage because it requires special care.

Look out for things that could cause the biggest problems. Supervisors should be able to tell you the parts and items that are most likely to fail and what might happen if they fail. Effective inspection programs make sure that all parts/items are checked and kept in good condition.

No supervisor or manager should leave these inspections to chance. This involves doing a stocktake or inventory, setting up inspection schedules and auditing the inspections.

2.3.2.2 MAKING AN INVENTORY

This involves listing all critical parts and items in areas, structures, machines, equipment, materials and substances used by the company. Many of these issues will come to mind by giving them some thought. An employee who is familiar with the history of the parts and items, including maintenance experience, should do the inventory.

Incident reports, maintenance records, manufacturer's guidebooks, servicing instructions and interviews with employees can help track down the critical parts. Examples might be safety devices, guards, controls, work or wear point components, electrical and mechanical components and fire hazards. Consider those parts and/or exposure that are most likely to develop into unsafe conditions due to stress, wear, impact, vibration, heat, corrosion, chemical reaction and misuse.

2.3.2.3 PRE-USE EQUIPMENT CHECKS

A type of critical parts/items inspection is pre-use checks. Many types of equipment have systems such as controls, emergency controls, lights and brakes that are needed for safe operation. These systems can be damaged between normal maintenance schedules.

Motor vehicles and materials handling equipment such as mobile equipment and cranes are common examples of items that should be checked before use. These checks are usually made at the start of a work shift to ensure safe operation during the shift. The operator usually makes the pre-use check and gives the form to the supervisor who reads it to ensure that the equipment is "fit for purpose" (is working properly). A pre-use check is an important part of the operator's training.

2.3.2.4 GENERAL INSPECTIONS

A general inspection is a planned walk-through of the whole area, looking for any hazard and noting unsafe work practices. Some of the benefits of these inspections are that:

- inspectors give full attention to the inspection. It should be done as something which is part of operational work;
- checklists should be used to make sure that a thorough inspection has been made;
- inspectors should look into closed rooms, small area and at equipment not in use. They look around, behind, beneath and above the work area; and
- reports of findings and recommendations increase hazard awareness, put in place corrective actions and procedures to improve job safety.

General inspections are often made monthly to quarterly, sometimes more often depending on the types of hazards, and the rate at which things change in the workplace. Changes in people, equipment, materials and environmental factors can create unknown situations. The general inspection should be done often enough to keep up with changes. Time between inspections should allow for action to be taken to fix a problem.

Team inspections may involve management, workers and union representatives. Inspection teams often are used for special problems to ensure all the issues are dealt with. Teams may include specialists in quality control, personnel, safety, hazard control, environmental health, fire, security, maintenance and so on.

Conducting the inspection

Here are some key points that will help make inspections more effective:

- Refer to the map and checklist. Be thorough. Follow the planned route so you give each area the full attention and look at the all items. Without checklists, people may become interested in the process and fail to see the problems.
- Note the positive. Make brief notes or list what you have looked at and found satisfactory.
- Look for off-the-floor and out-of-the-way items. Without getting into danger, make sure you get a complete picture of the whole area. Look in closed rooms and cabinets. Ask operators to start up machines not in use (but in workable condition). It is usually items outside normal operations that cause problems.
- Take immediate temporary actions. When any serious risk or danger is found, do something right away. See that the proper supervisor shuts down operations if the dangers are out of control. Put up barriers to isolate hazards. The action should be appropriate to the risk, but should always lower the risk or correct the problem.
- Describe and locate each item clearly. Write down a concise simple description of the problem. Give an exact location. Use correct names and markings to pinpoint locations. Photograph to aid the written descriptions, but always write a full description on the spot. Don't rely on memory or abbreviated notes. Remember, other people may need to locate the item in your absence.
- Prioritise the hazards. This enables managers to give priority in the budgeting of personnel and material resources to the major problems.
- Report items that seem unnecessary. Putting materials where they are needed or exchanging them for resources that are needed helps control costs. Freeing valuable floor or storage space where the items were removed becomes an extra bonus. Removing congestion and possibly interference makes work more efficient and safer.
- Determine the basic causes of substandard actions and conditions. The work is only started when the problems are found. The same things will occur over and over again unless the basic causes of the problems are uncovered. Answer the question, "Why?" Why does the substandard condition exist? Why did the person perform in a substandard manner? Find out the basic causes (personal factors and job factors). Never accept an action to correct the problem without answering the question, "Does it address the basic causes?"

2.3.2.5 INSPECTION REPORTS

Writing a report is an important part of an inspection. The report should communicate information on the hazards found in the workplace.

- The supervisor's inspection report gives feedback on safety problems. It helps workers make better decisions on equipment, materials and people needed to do a job. It also helps make decisions on purchasing, training, safety equipment and changes needed in the workplace.
- Sharing information in the reports can help identify similar problems in other areas.
- The written report is a formal way of letting employees know what needs to be done. The written report prompts people to remember what they have to do, and how to do it.
- The report prompts follow-up actions between inspections.

REFERENCE DOCUMENT

"Introduction to Modern Safety Management (MSM) and International Safety Rating System (ISRS)", DNV Loss Control Management, Australia.

2.4 ACCIDENT INVESTIGATION

While investigation of accidents is generally seen as a reactive process, a precise accident investigation can be an effective proactive way to prevent work-related injury or illness. Accidents are rarely caused by one single factor. Use a formal process to find the facts: interview witnesses, review systems of work and procedures, inspect the workplace and check equipment.

When action is taken to address each of the factors in an investigation, the chances of a similar accident/incident is reduced. It may also be important in preventing accidents/incidents that are different but where similar factors may have played a part. It is important to put time and effort into the accident/incident investigation.

2.4.1 RESPONSE

A company should respond to an accident straight away and make sure the injured worker(s) is (are) taken care of, no other worker is in danger and the area is secure to allow an investigation to start. A company's response to an accident requires a planned procedural approach that:

- considers immediate actions required at the accident scene; and
- sets up a formal process for the investigation.

The company will need to develop its own specific responses beyond these basics. The basics are:

- remove, where possible, any further danger(s);
- provide first aid care or medical treatment for injured/affected personnel; and
- contact emergency services for assistance:
  - ambulance;
  - police;
  - fire authority; and
  - emergency services;
- identify all personnel or third parties directly involved;
- contact essential services if required;
  - power;
  - water; and
  - gas;
- block off, separate and secure the area to restrict access to assist the investigation;
- take immediate action to stop the accident happening again;
- report the accident as required to:
  - the relevant regulatory authority(ies);
  - line and executive management;
  - health and safety manager/coordinator;
  - health and safety representative(s);
  - chief executive officer/general manager;
  - board of management/directors; and
  - unions;
- identify who else needs to be told about the accident;
- visit the injured person(s);
- visit and contact involved person(s) family(ies) or next of kin;
- complete and file the required documentation such as:
  - first aid report;
  - treatment report;
  - compensation document;
  - insurance report documentation;
  - accident report (injury/damage/ environment); and
  - statements and investigation reports;
- identify what resources are needed to manage the situation;
- decide who will be involved in the investigation;
- start the documented investigation (ensure all information is referenced so it can be found;
- advise employees of the investigation;
- with discretion, take photographs and/or a video of the accident and area;
- measure and note features of the accident and the surrounding area;

- identify witness(es) name and contact details;
- list witness(es) details by name and contact location;
- organise interviews with each witness;
- start an assessment independent of the investigation to identify:
  - a breach of any legal responsibilities under legislation;
  - a breach of the company's own policies or procedures;
  - potential litigation/prosecution;
  - operational disruptions (short and long-term effects);
- keep all employees informed of what is happening;
- respond to the media if required; and
- organise trauma counselling (if required) for:
  - other people involved;
  - witness(es); and
  - family(ies) or family members.

The factors that cause an incident are often unique to the incident, and if any employee is involved, the following should be done from the treatment/accident report:

- a rehabilitation program in line with policy procedures;
- a company should also consider:
  - what information it should tell its customers;
  - competitor comments;
  - negative media attention; and
  - effects on the company's other operations;
- Before restarting operations, consider the following:
  - obtain an OHS authority clearance to continue production;
  - advise other sites if affected by the accident;
  - start any off-site isolation of plant until checked;
  - discontinue the job until the risk(s) are removed;
  - correct immediately if possible (ensure compliance);
  - defer the activity indefinitely and await further instructions;
  - consider temporary repair and ensure compliance;
  - assess work alternatives with the work group;
  - assess if the injury-causing task can be completed;
  - assess engineering repair and modification;
  - assess the total system of work for its safety;
  - initiate an immediate preventative maintenance program or upgrade the existing maintenance program; and
  - conduct a total hazard assessment on the specific operation.

2.4.2 WHO SHOULD INVESTIGATE

Which supervisors or other managers should make investigations? Selecting the investigator or investigating team is a critical first step. As with any type of problem-solving, the person with the most interest in the problem is the first choice. There is also another important consideration in the choice of the investigator. The person must be able to work through the investigation without coming to an early conclusion. The findings have to be relevant and consider only the facts or the problem isn't really solved.

Possible choices are: the supervisors, other managers and specialists.

2.4.2.1 LINE SUPERVISORS

Supervisors should be involved in investigations because most of their time is spent solving problems. Other reasons may be:

- They have a personal interest. Supervisors are responsible for specific work and work areas. Supervisors must deal with incidents because they affect the work output, quality, cost and every other part of the workplace.
- They know the people and conditions. Supervisors plan the use of resources

daily. They make decisions that affect who does what, what training is needed, what standards need to be met and how long the job will take. They know what things influenced other decisions and already know much of the information that an investigator wants.

- They know how and where to get the information. Supervisors know their people, know "who knows what" and what records are kept and where they are. They can get accurate information about an incident quickly.
- They will start or take the action. They can decide what will work and what won't, and why. They will take better action if they are involved in decisions on how to fix problems.
- They benefit from investigating. There are several benefits.
  - It shows concern. Supervisors who carefully investigate accidents and incidents show their concern for people. Failure to be involved can create serious morale problems.
  - It increases productivity. Work is interrupted first by incidents and then by investigations, emergency actions and actions to remove hazards. If these actions are carried out properly by the supervisors, there is less interruption and less chance of the incident happening again.
  - It reduces operating costs. Injuries cost time and money through people being away from work, production loss, material being wasted and many other issues. Proper investigation will prevent accidents that lower operating costs. Everybody will benefit.
  - It shows that supervisors have control. People go to the managers who have control with their problems and ideas. They follow the instructions of those who are really in charge. Studies of leading companies show that people who work for supervisors who are "in control" take greater pride in their work.

2.4.2.2 MIDDLE MANAGERS

Sometimes investigations involve middle or higher-level managers. Typical situations are when:

- there is a major loss or a high potential incident. It would be unfair to ask supervisors to solve problems beyond their level of knowledge and authority;
- the accident involves other supervisors' areas. The lowest-level manager should investigate accidents, as a rule; and
- the actions to fix the problem are broad and high in cost. At times, a supervisor will start an investigation only to discover other areas could be affected. The responsibility should then be passed to a higher level of authority that can work out the best way to fix the problem.

In all of these situations, the line supervisors can still give good help. They can be included as members of investigation teams to make the most of their knowledge and skill.

2.4.2.3 SPECIALISTS

Occasionally, special knowledge is needed. This could be because of a new process, equipment failure, use of hazardous materials, or a complicated situation. Parts of the information may need to be obtained or looked at by a technical expert. The experts then become advisers to the investigators.

2.4.3 INVESTIGATION PROCESS

When starting your investigation, you should consider:

- whether you know what records to keep for legal reasons and how long these records should be kept;
- the purpose of your accident investigations;
- whether the purpose been developed and written up suits your business;
- whether to use a standard form for investigation;

- whether all reported accidents should get the same investigation or whether there should be different levels of investigation for:
  - first aid treatment accidents;
  - injury/illness accidents;
  - damage incidents; and
  - near-miss/no visible loss accidents.
- who is/should be responsible overall for the investigation;
- how long should the investigation take from the date of the accident;
- who looks at the investigation to see if the true causes and system failures have been identified;
- how long after the investigation are the workers told, and who gets them;
- who should get the completed investigations;
- where do the completed investigation notes go;
- who is responsible for checking the action from the investigation;
- who is responsible for providing resources for the action;
- what time frame will be allowed for corrective action;
- how you will measure the results of the action taken;
- when should the results be measured (every six months is a minimum);
- whether your investigations find the causes or failures that allowed the accident to happen;
- what information, training and instructions do investigators need so they can:
  - conduct investigations to find the causes, or systems failures; and
  - develop action plans to get rid of the causes or failures;
- how often will the investigation procedure be reviewed; and
- how will any legislative changes be put in place?

2.4.3.1 INVESTIGATING AN ACCIDENT

An investigation is about finding out why an accident happened and how to stop the accident happening again. Investigations must follow a standard procedure to get all of the information.

They will not succeed unless everybody involved believes the investigation is fair and not a threat to themselves.

An investigation must be given enough time to make sure all the information is gathered.

The investigator must tell everybody why the investigation is happening and what it is hoped it will find.

The right questions must be asked to get the right answers.

When asking questions, think about:

- the words in the question;
- why you're asking it;
- at what stage you ask it;
- how you ask it;
- where you ask it; and
- who do you ask.

2.4.3.2 QUESTION TYPE AND EXAMPLE

Overhead question, to open discussion
Where shall we start?

Direct question, to gain information
Were you trained to operate?

Relaxing question, to gain opinion
Would you like to comment?

Reverse question, to encourage thought
Tell me your experiences?

Factual question, to get the facts
Who? What? When? Why? Where? How?

Broadening question, to broaden discussion
What other factors were involved?

Justifying question, to gauge a further perspective
Is that important?

Hypothetical question, to change discussion
Did we ever consider?

Alternative question, to decide an alternative
What is the best solution?

2.4.3.3 STEPS IN INVESTIGATION

- Respond to the emergency quickly. On seeing or being told of an incident, the supervisor should go to the scene straight away. Take charge and give instructions. Keep those who aren't needed out of the area. Decide if emergency care is needed. Decide if people should be removed from the workplace or put back to work. Decide who else should be told about the incident.
- Collect information about the incident. Ask yourself some questions: What appears to have happened? Who should be interviewed? What equipment, tools, materials, or people are missing that should be there? What things might have failed or not operated properly? What do you need to know about training, repair, maintenance and other things that are in records?
- Look at all significant causes. Find out about injury and damage. Then list the actions and conditions that allowed the incident to happen. Finally, trace the job and personal factors for each action and condition. Clearly identify what you know (facts), what you need to find out (gaps) and what you can assume (links).
- Take corrective actions. Systems may need to be shut off or locked out to keep another incident from happening . Barriers may need to be put up. Work orders may need to be written. Recommendations may need to be made for engineering changes, purchase requisitions or a program to stop the incident happening again. Some of these may need approval for funding, hiring or personnel transfer.
- Review findings and recommendations. Every investigation should be reviewed at the next higher level of management. One reason is to check that the problem has been defined and solved. Another is to decide who else should know about it. A third is to find why the safety program has not stopped the hazard.
- Check that the actions were effective. This is to see that the actions don't have unexpected, undesired results. Things are often forgotten as other problems arise. Checking actions can prevent the incident happening again.

2.4.4 INVESTIGATION OUTCOMES

The investigation should identify and correct accident causes and systems failures. It should look at any areas that require development or change. For example:

- employee induction;
- employee training (job-specific);
- training for supervision;
- standard operating procedure (SOP);
- policy; or
- awareness session for employees/work groups:
  - work layout;
  - material assessment;
  - plant/equipment assessment;
  - safety clothing or equipment;
  - worker selection and placement criteria;
  - job roles and responsibilities; and
  - purchasing standards.

The investigation should also look at:

- records required;
- procedures required;
- maintenance records/schedules;
- fault-reporting systems;
- awareness training;
- job/task training;
- job responsibility/knowledge and competency/skills; and
- checklists and audits in place or required.

2.4.5 CORRECTIVE ACTION MONITORING

After the investigation, a formal system must be put in place to make sure controls put in place to stop the accident happening again are being used. This system could include:

- regular scheduled inspections;
- specific testing;
- specific monitoring;
- specific calibration requirements;
- technical or scientific assessment;
- specific job/task audits/assessments with pre-set criteria;
- survey monitoring;
- regular checklist inspections;
- safe work practice/procedure competency review;
- operator observation/assessment;
- regular operator reporting;
- job compliance and performance assessment; and
- team work/group responsibility.

REFERENCE DOCUMENTS

"Investigating and Managing Accidents", Gavin Johnson, Safety News, September 1998, National Safety Council of Australia.

"Procedures for Accident and Incident Reporting and Investigation", University of South Australia.

"Introduction to Modern Safety Management System and International Safety Rating System", DNV Loss Control Management Australia.

2.5 EMERGENCY PLANNING AND RESPONSE

2.5.1 EMERGENCY SITUATIONS

An emergency can be described as an abnormal, dangerous or life-threatening situation requiring urgent action to protect people, property and the work area.

Workers must be trained in what to do in an emergency and they must be given the right tools to do the job.

Emergencies could be things that have happened or that might be about to happen, such as:

- serious injury to any person at the mine;
- a fire which is not readily controlled;
- spillage, loss or exposure to hazardous materials;
- a failure of the workings of the mine;
- any person trapped;
- an accidental explosion or ignition of dust;
- shaft and shaft equipment damage or failure;
- out-of-control machinery;
- failure of a dam or tailings storage;
- an inrush of water;
- natural disasters; and
- sabotage.

2.5.1.1 NATURAL DISASTERS

Natural disasters could include:

- earthquake;
- flood;
- storm-rain, wind, lightning strike; and
- bushfire.

2.5.2 RESPONSIBILITIES OF MINE OPERATORS

The mine operator should plan for emergencies and put procedures in place to lower risk to persons.

The mine operator's responsibilities include:

- identify emergency situations, and plan to reduce the chance of an emergency;
- develop and put in place procedures to stop emergencies happening;
- provide measures that will control an emergency;
- provide warning of an emergency;
- provide resources and training for workers to control emergencies;
- clearing the mine or part of the mine in the event of an emergency;
- investigate any emergency and provide a debriefing (including the counselling of persons traumatised); and
- provide a report of every emergency to the appropriate authority.

2.5.3 PLANNING FOR EMERGENCIES

A plan to deal with major emergencies is a part of OH&S programs. The lack of an emergency plan could lead to fatalities, injuries, losses and possibly the financial collapse of the company.

A plan may:

- uncover hazard conditions that could make an emergency worse;
- show other problems such as lack of training, tools and supplies needed to respond to an emergency; and
- show the company is serious about the safety of its workers.

A plan can prevent an emergency being turned into a disaster by:

- panic;
- the need for quick decisions;
- shortage of time;
- poor judgment under pressure;
- lack of resources;
- insufficient training; and
- breakdown of normal channels of authority and communication.

2.5.4 RISK ASSESSMENT

Development of the plan begins with a risk assessment. The assessment will show:

- what sort of emergency could happen;
- how likely it is;
- what can be done to prevent it; and
- what is needed to handle the emergency.

The risk assessment may result in a list, which includes:

- fire;
- collapse of face;
- mobile equipment accident;
- damage, injury, fatality;
- explosion;
- flood;
- chemical spill; and
- lightning strike.

Any of the above could happen alone or be connected. For example, a dump truck hit by lightning might run out of control, fall over an embankment and catch fire, explode and leak hazardous substances.

Emergency plans can be made when the risk is understood. Catastrophic events should be included in a risk assessment. These are events of high consequence and low probability.

Identifying impacts, actions and resources

Before starting an emergency plan, you should think about who should be involved in the planning. This will include those who are to be involved directly in an emergency, plus others who may assist. The list may start with one work team. Then, other groups may be added, such as the mine's OHS committee, the engineering department, electrical employees and so on. You may need to go outside the mine and ask other groups to join the planning process. These could include police, ambulance and fire brigade. The list can include anyone you think might be involved in helping with an emergency.

Having found the hazards, the possible major impacts of each should be listed, such as:

- fatalities;
- injuries;
- sequential events (for example, fire after explosion);
- evacuation;
- damage to plant and buildings;
- loss of vital records/documents;
- damage to equipment; and
- disruption of work.

Based on these events, consider the following:

- declare an emergency;
- sound the alert;
- evacuate the danger zone;
- close main shutoffs;
- call for outside aid;
- start rescue operations;
- attend to casualties; and
- fight fire.

The following list should be considered:

- medical supplies;
- auxiliary communication equipment;• power generators;
- respirators;
- chemical and radiation detection equipment;
- mobile equipment;
- emergency protective clothing;
- firefighting equipment;
- ambulance;
- rescue equipment; and
- trained personnel.

2.5.5 EMERGENCY PROCEDURES

These might include any or all of the following for underground mines only, and some for all mines.

- The evacuation order for alerting workers. One type of signal should be understood and used to clear the mine:

  - sirens or fire bells might be used in open-cut mines and quarries. The all-clear signal is less important, since time is not an urgent concern.
  - a stench alarm system in the air intake, flashing lights, through-the-earth communications, or a leaky-feeder radio system could be used as a means of evacuating underground mines.
- Emergency escape routes are needed in underground mines and, the direction of the exit clearly marked.
- Workers must be trained to know the escape routes and what to do in an emergency. Escape routes must not be obstructed.
- Safe locations must be named and marked where the workers will gather to be counted to make sure everybody has left the danger area. People must be given the job of helping injured employees in an emergency.
- Injured people must be treated as soon as they can, and efforts made to contain the emergency and search for missing people.
- Alternative sources of medical aid must be planned, in case the normal aid cannot be reached.
- The safety of employees and any other people must come before the protection of property and equipment.
- There should be a plan for the safe shutdown and clearance of the workplace. All employees must be told about the plan, and the details must be displayed where they will be seen. Personnel should be available at the mine to provide first aid treatment to any person suffering accident or illness while at the mine.

  When reviewing the mine's preparation for an emergency, think about:
  - decision-makers not understanding mines rescue;
  - difficulty in keeping experienced mines rescue members;
  - mines not being designed to handle fire controls;
  - inadequate fire protection systems in mines;
  - industry slow to introduce new technology;
  - age and poor physical fitness of team members; and
  - outdated regulations and plans.
- Possible solutions may include:
  - redefining corporate priorities; and
  - more involvement of managers through consultation with experienced rescue and emergency team members.

2.5.6 WHAT SHOULD BE IN AN EMERGENCY RESPONSE PLAN

The emergency response plan should have specific duties, responsibilities, authorities and resources. Responsibilities that should be assigned are:

- reporting the emergency;
- activating the emergency plan, the mines rescue team;
- taking overall command;• ensuring effective communication;
- alerting staff;
- ordering evacuation;
- alerting external agencies;
- confirming evacuation;
- alerting others out of the mine of possible risk;
- requesting external aid;
- coordinating activities of various groups;
- advising relatives of casualties;
- providing medical aid;
- controlling media and visitors; and
- sounding the all-clear.

External organisations that may be available to assist could include:

- fire brigades;
- mobile rescue squads;
- ambulance services;

- police;
- telephone company;
- hospitals;
- other mine sites;
- government agencies; and
- local businesses.

These organisations should be contacted in the planning stage to discuss each of their roles during an emergency.

For a good emergency response, the employer should:

- develop an evacuation plan and procedure;
- develop specific procedures for an emergency response for specific risks in the workplace (for example: hazardous substances spill);
- put in place and maintain all necessary firefighting and emergency equipment;
- maintain all necessary rescue equipment;
- train all personnel as required;
- provide a large-scale plan of the workplace, including exits, safe evacuation paths, location of fire and emergency equipment and assembly areas; and
- list the local emergency services (fire, ambulance, police, volunteer emergency organisations) and show their direct contact phone numbers around the mine.

2.5.7 TRAINING, TESTING AND REVISION

The mine operator should develop strategies for emergency situations. All workers must be trained and have practised their role in the event of an emergency.

There should be regular training of all employees for all potential emergencies. Training drills make sure workers know what to do; how to raise the alarm, who to contact, know the location and use of firefighting equipment and the location of the emergency assembly area.

Records should be kept of the names of people attending the training, and the date and details of training.

The plan should be reviewed at least annually or when there are changes in plant, processes, materials used and key personnel.

2.5.8 FACILITIES

The standard of facilities for emergency response and the number and level of training of personnel for emergencies, should take into account:

- the number of people, including contractors, who work at the mine;
- the availability of outside help;
- the remoteness of the operation and need for outside services and support;
- particular hazards of the operation; and
- the effect of a site emergency on the locality or region.

Emergency refuges should be placed in underground mines. The refuge should be:

- clearly marked;
- able to be sealed; and
- provided with items such as:
  - water supply;
  - first aid kit;
  - emergency rescue equipment;
  - air supply from the compressed air lines;
  - copy of mine emergency plans;
  - several self-contained self-rescue units; and
  - means of communicating with the surface.

For large above and underground mines, special fire-fighting and rescue crews should be set up and regularly trained. A person with sufficient experience in fire-control, or a person trained in an approved fire control course, should be put in charge of inspecting and ensuring maintenance of all fire and rescue equipment.

Everybody should know where the room is that is used for the safe storage of emergency fire-fighting and rescue equipment. Sufficient equipment should be kept available to meet any emergency.

Sufficient numbers of self-contained breathing apparatus should be kept and maintained ready for use. In underground mines, self-contained self-rescuers should be located in fresh air bases and other locations as thought necessary.

2.5.8.1 OTHER CONSIDERATIONS

Mine operators or local organisations should, where practicable, provide and maintain adequate central rescue stations, fully equipped for rescue work and for the training of rescue personnel.

During a major emergency, consider the following communication issues:

- keeping the media away from sensitive or dangerous areas;
- setting up a fully equipped media room;
- giving the media ID tags;
- issuing frequent press releases at set times;
- providing a trained spokesperson;
- only giving facts; and
- explaining technologies so the media can get the story right.

For family members who are awaiting news, communication and counselling issues should be addressed:

- have a comfortable waiting area;
- provide food, drink and telephones;
- provide an official to stay with them;
- isolate them from the media;
- issue them with ID tags;
- provide trained counsellors;
- give them truthful updates;
- make sure the spokesperson has a “high profile” in the mine;
- answer all questions;
- provide access to medical facilities; and
- control contact with workforce.

For provision of counselling, ensure that:

- it is immediate;
- trained professionals are used;
- there is follow-up;
- there is management support;
- all mines rescue teams used are briefed and debriefed;
- every one is aware that stress causes behaviour changes; and
- critical stress syndrome is included in all emergency plans.

2.5.8.2 RESCUE EQUIPMENT

The following are examples of rescue equipment that may be required for emergencies.

The type of mine rescue breathing apparatus available are:

- closed-circuit oxygen units for underground mines;
- liquid oxygen units;
- compressed air units; and
- self-contained self-rescuer (for emergency only).

Other rescue equipment could include:

- heights rescue; and
- confined space rescue.

2.5.9 FIRE

2.5.9.1 RESPONSIBILITY OF THE MINE OPERATOR

The general manager should:

- provide for the control of fires; and
- develop procedures to ensure the safety of all people in the mine in the event of an emergency.

2.5.9.2 BASIC FIREFIGHTING PRINCIPLES

For combustion to start three basic elements are required:

- oxygen;
- fuel; and
- heat.

The removal of any one of these elements would generally result in the fire going out.

2.5.9.3 CLASSES OF FIRE

Fires are divided into five classes:

- Class A – Fires in which the fuel source is generally carbon compounds which are organic in nature, such as wood, paper and plastics.
- Class B – Fires that involve flammable or combustible liquids or liquefiable solids, such as petrol, kerosene, cooking oils and waxes.
- Class C – Fires involving flammable gases or liquefied gases, such as liquefied petroleum gas (LPG), propane and butane.
- Class E – Fires involving energised electrical equipment, such as circuit boards and electrical appliances.
- Class F – Fires that involve cooking oils and fats.

Fire extinguishers are the first line of defence in a fire, and quick use of the correct fire extinguisher can prevent serious injury or damage. There is no single type of fire extinguisher that can be used for all fires. Refer to Figure 2.1 “Portable Fire Extinguisher Selection Chart” for the type(s) of extinguisher(s) that may be used for each class of fire.

Note: Electrical arcs are not to be considered as a fire. However, they may act as the ignition source for any class of fire.

As an example, explosives would fall into the Class A category and therefore most fire-extinguishing mediums would prove effective.

2.5.9.4 FIRE PREVENTION

Fire prevention measures might include:

- no source of heat or naked flame should be left unprotected close to flammable materials;
- cutting, heating or welding of materials should only be done as specified in AS 1674 Safety in Welding and Allied Processes, or when special precautions are needed;
- explosives should not be fired near flammable materials;
- flammable waste material should not be allowed to gather, but be collected and regularly removed from the mine;
- store flammable and combustible substances in a safe place, such as fire proof cabinets and compounds;
- warning signs which comply with AS 1319 – 1994 “Safety Signs for the Occupational Environment” should be put up to show materials that burn with speed or could cause an explosion;
- provide fire hoses, alarm systems and sprinklers for local building regulations, OH&S legislation, and codes of practice;
- recording of regular checks and maintenance of all fire extinguishers, hoses sprinklers, and alarm systems;
- spills of flammable liquids should be absorbed, or adsorbed and removed from the mine, or drained to a sump for removal; and
- petrol or flammable fluids that may ignite (flash point less than 61.5^{o}C) should not be used for cleaning equipment. If it is essential that a particular fluid be used, then ensure:
  - fire extinguishers are provided;
  - good ventilation is provided to ensure vapours are removed;
  - signs are posted warning of the danger of fire, and
  - work is done away from ignition sources.

All firefighting and rescue equipment should be maintained in good condition.

Programs of routine or specific monitoring to assess any fire outbreaks should be put in place.

2.5.9.5 FIRE CONTROL

Fire control planning and procedures might include the points noted below.

- Plans of the mine showing:
  - the location of fire-fighting equipment;
  - the ventilation directions in the mine; and
  - the location of fresh air bases, emergency refuges, telephones and escape routes in the mine.

- All workers should know of the plans, and a copy should be displayed at the surface brace of a shaft and control room, as well as all emergency refuges. The plans should be used in the training of safety and rescue personnel.
- Fire escape routes and fire service points are kept free from obstruction at all times.
- All company vehicles should be fitted with fire extinguishers.
- Fire wardens should be appointed and trained.

2.5.9.6 FIREFIGHTING EQUIPMENT AND FACILITIES

Basic requirements are:

- for underground operations, a water supply should be available in the headframe, shaft and on each level for emergency firefighting. A reserve of water should always be available;
- fire hydrants should be located at each underground level plat, fresh air bases, and put throughout the mine where flammable materials occur;
- fire hydrants and hoses should comply with AS 2419 Fire Hydrant Installations and AS 2792 Fire Hose – Delivery Layflat;
- fire hose reels should be installed as per AS 2441 – Installation of Fire Hose Reels;
- portable fire extinguishers and blankets should be provided, mounted and signed to comply with AS 2444 – Types of Fire Extinguishers;
- all firefighting equipment must be regularly checked, as required by AS 1851 Maintenance of Fire Protection Equipment, or as required by legislation;
- portable fire extinguishers of various sizes and types should be placed throughout the mine where hazards are identified. Appropriate fire extinguishers should be placed on all mobile equipment; and
- safety clothing required to fight fires should be worn.

2.5.9.7 TYPES OF PORTABLE EXTINGUISHERS

The following types of extinguishers may be available at the workplace:

- Water extinguisher – Colour Code Red

  Only for use on fires involving wood, paper, plastic, and other solid combustible material. Stream should be directed at the base of the fire. Do not use on electrical or solvent fires.
- Foam extinguisher – Colour Code Blue

  Used on flammable liquid fuel type fires (that is petrol, oils, thinners and solvents). Do not use on electrical fires.
- Dry chemical powder (DCP) – Colour Code Red with a Horizontal White Band

  Can be used on all fires, but mainly for flammable liquid fires, and fires involving live electrical equipment. Use with a sweeping motion across the flames. This is a non-conductive extinguishing agent.
- Carbon dioxide (CO2) - Colour Code Red with a Horizontal Black Band.
- Can be used on electrical fires such as on a computer or other electrical instruments.

(For further information, also refer to AS 2444).

2.5.9.8 FIRE WARDENS

Personnel must be trained in the use of firefighting equipment. The number of persons trained will depend upon:

- the nature of the hazards within the mine; and
- the size, location and type of work being performed; and
- the number and mobility of employees.

Fire training should include both training in evacuation procedures and in the use of fire extinguishers, and must be adequate to allow that person to perform their job competently.

Where multi-storey office accommodation exists:

- one fire warden should be appointed per floor (Floor Warden); and

PORTABLE FIRE EXTINGUISHER SELECTION CHART

INDICATOR	CLASS OF FIRE		A	B	C	(E)	F	SPECIAL NOTES
PRE 1995 (FIRE EXTINGUISHER)	Type of Fire		Ordinary combustibles: • wood, • paper, • plastics etc)	Flammable and combustible liquids	Flammable gases	Fire involving energised electrical equipment	Fire involving cooking oils and fats	
	IDENTIFYING COLOURS	TYPE OF EXTINGUISHERS	EXTINGUISHER SUITABILITY					
PRE 1995		**Water**	✓	✗	✗	✗	✗	Dangerous if used on electrical fires
		Wet Chemical *Vapours can cause respiratory distress*	✓	✗	✗	✗	✓	Dangerous if used on electrical fires
		Foam	✓	✓	✗	✗	✗	
		AB(E) Dry Chemical Powder	✓	✓	✓	✓	✗	
		B(E) Dry Chemical Powder	✗ #	✓	✓	✓	✓	# May be used on small surface fires
		Carbon Dioxide (CO_2)	✗ #	✓	✗	✓	✓	# May be used on small surface fires
		Vapourising Liquid *(fumes may be dangerous in confined spaces)*	✓ ##	✓ 5kg only	✗	✓	✗	## Vapourising liquid extinguishers are not suitable for smouldering deep seated A class fires
NOTE	Yellow	Halon	As from 31st December, 1995 halon extinguishers will cease to be a legal extinguisher					
			Class 'D' fires (involving metals eg magnesium) - use special purpose extinguishers only					

Figure 2.1 "Portable Fire Extinguisher Selection Chart"

- one head warden should be appointed (Head Warden).

All fire wardens should be trained in the use of the fire protection equipment, including:

- fire extinguishers;
- fire hoses;
- fire sprinkler systems and fire alarm systems; and
- evacuation procedures.

Notices should be posted identifying the fire wardens by name and location. Fire wardens may be provided with coloured or labelled hard hats for easy identification in an emergency.

Everyone about the mine should receive instructions and training in what to do in the event of a fire or emergency. Training should be held at regular intervals to ensure the information provided is up-to-date.

The manager should ensure an emergency procedures policy is provided and all employees know the policy exists.

Properly trained personnel should only undertake emergency rescue.

2.5.9.9 SPECIAL CONSIDERATIONS

Special consideration must be given to particular fire hazard risks.

- LPG and other gas storage areas must be cleared of rubbish, vegetation or other material that may cause a fire to start.
- Vehicles which are driven in areas where there is long grass or weeds should have heat shielding on their exhaust systems.
- Flammable substance stores and conveyors should be protected from the sparks generated by welding/cutting or other maintenance procedures.

Also consider:

- how far away is the nearest assistance;
- even if it is relatively close, how much water is going to be available to fight a fire;
- how well trained do the workers need to be;
- what firefighting equipment is available on the site, is more needed. and does it need replacing; and
- is the mine at risk from bushfire.

REFERENCE DOCUMENTS

AS 1674 Safety in Welding and Allied Processes.

AS 1851 Maintenance of Fire Protection Equipment.

AS 2419 Fire Hydrant Installations.

AS 2444 – 2001 Portable Fire Extinguishers and Fire Blankets – Selection and Location.

AS 2792 – 1992 Fire Hose – Delivery Layflat.

AS 3745 – 2002 Emergency Control Organisation and Procedures for Buildings.

“Emergency Planning”, Canadian Centre for Occupational Health and Safety.

“QuarrySAfe – Occupational Health and Safety Resource Manual”, QuarrySAfe Group Health and Safety, South Australia.

“Boral OH&S Manual”, Boral.

2.6 PURCHASING

Well managed purchasing procedures can avoid many potential safety and health problems. People responsible for selecting goods and services should know that purchasing decisions take safety and health issues into consideration. Preferred suppliers should be considered as a means of knowing the quality of the product.

The best way of making sure safety requirements are part of a formal purchasing or procurement policy is to include the Mine Safety Management System. At very least, the requirements should be written down, sent to all purchasing personnel, and regularly checked to see that the policy is working.

2.6.1.1 POLICY AND PROCEDURES

All related OH&S issues must be identified and addressed before any plant or materials are purchased. This should be written in a policy statement for the operation.

Example of purchasing policy

The company aims to ensure, so far as is reasonably practicable, that all plant and substances used in operational activities are safe for use, handling, processing, storage, transportation and disposal.

It is company policy that, prior to making a decision to purchase, lease or hire significant items of plant, equipment or substances, a review will be made of the health, safety and welfare impacts of the purchase.

This policy also applies to the purchase, lease or hire of items of plant, equipment and substances which could have an affect on the environment as part of company operations.

In addition, plant and substances are to have been tested or examined, comply with prescribed standards, regulations and approved codes of Practice. Material Safety Data Sheets (MSDS) are to be available on site for all hazardous substances.

All purchasing contracts, where used, will have all legislative requirements.

Procedures should include all the usual operational and purchasing requirements. Operational managers, supervisors and employees who are experienced with equipment, materials or processes should be spoken to. This consultation should look at OH&S problems under normal conditions of use, and under dangerous situations that may be present in the particular workplace.

Information will be gathered about the products available. Requests for information should include OH&S information. (Material safety data sheets must always be requested for chemical substances, and these must be reviewed prior to making a purchasing decision.)

A specification should be written on all occasions. This will vary from several lines on a purchase order for straightforward items to a comprehensive document for major or complex items. The specification should include:

- compliance with the general and specific requirements of legislation (always quote specific sections where applicable);
- compliance with the appropriate government or industry standards and codes (be specific);
- evidence that designs are registered where this is required;
- documentation for the safe delivery, installation, use, operation and maintenance of equipment and materials;
- the availability of training for users and written material to support training; and
- documentation of designer, manufacturer and supplier risk assessments.

A risk assessment based on the available information about the product and the way it will be used in the workplace should be performed.

The assessment of alternative designs, tenders and quotes should consider productivity and price implications regarding the control of health and safety risk. The costs and solutions for risk control after purchase (in-service) will almost always be less favourable than engineering-out hazards prior to purchase.

The product must be inspected prior to the acceptance for delivery, to check its compliance with the specification.

An audit trail must be written down to ensure that all the necessary steps in the procedure are taken.

Where substances are to be purchased for vehicles, maintenance or operational use, the substances should be designated as hazardous or non-hazardous.

Where hazardous substances are purchased, managers/supervisors should ensure that:

- a risk assessment is undertaken that includes finding out if a less hazardous substance can be used;
- controls are in place to reduce exposure;
- all workers are informed and trained;
- upon approval, a Material Safety Data Sheet (MSDS) is obtained before delivery of the substance; and
- the MSDS is provided where the substance is to be used and discussed with employees who will be exposed to the substance.

Once a product, substance or item of plant or equipment has been approved, it should be entered onto either:

- approved “Plant and Equipment Register”; or
- “Hazardous Substances Register”.

The item can then be purchased freely by company personnel, but only for its approved use. If it is to be used for another activity or process, it should be checked for that purpose.

When a register of approved plant and substances is kept, there should be no need to evaluate items for the same use again.

REFERENCE DOCUMENTS

“Boral OH&S Manual”, Boral.

“QuarrySAfe Resource Manual”, Occupational Health and Safety Resource Manual, QuarrySAfe Group Health and Safety, South Australia.

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PART 3

PEOPLE

UPDATED 12 NOV 2002

PART 3: PEOPLE

3.1 ACCESS TO THE MINE

3.1.1 SITE SECURITY

When developing a suitable security system and procedures for an operation, the mine operator should consider the following factors:

- the nature and size of the operation;
- the location of the operation with respect to the nature of the surrounding community and environment;
- the likelihood of mischief or sabotage; and
- the integrity and reliability of proposed hardware and design.

3.1.1.1 EXTERNAL SECURITY

The normal operation could require:

- only one permit of entry;
- a lockable gate at the point of entry;
- appropriate fencing around the perimeter of the site; and
- "danger" signs attached to the perimeter fence.

3.1.1.2 INTERNAL SECURITY

Checklist for buildings and offices

- Are all doors or gates to enclosed hazardous areas kept locked, for example, chemical stores, electrical switchboards, explosives magazines?
- Is there adequate night lighting to allow safe building access?
- Are all site buildings lockable, including windows?
- Where access to buildings is required outside normal hours, are procedures in place to ensure personnel do not work alone?
- Is the movement of portable equipment recorded?
- Are there product dispatch security and gate pass procedures in place?
- Are alarm systems in place? If so, are all personnel aware of procedure?
- Are critical business documents secured?
- Is petty cash secured?
- Are measures in place to prevent theft of company property?
- Are data security notices placed on terminals?

Checklist for yard areas

- Is perimeter lighting operative and adequate?
- Are barriers, lights and other protective devices in place around excavations, manholes, ditches, settling ponds, interceptor pits or other openings into which a person can fall?
- Are signs erected to warn of potential hazards, for example, "danger, deep water"?
- Is regular surveillance provided?
- Are security officers licensed?
- Are lock-up/unlocking procedures adequate?
- Are yard areas clean and tidy, and free of trip/fall hazards?

Checklist for mobile equipment

- Are vehicles able to be garaged under lock and key?
- Are ignition keys secured when not in use?
- Are procedures in place to prevent "hot wiring"?
- Are warning signs in place?

Checklist for computers

- Is there a security system and back-up of records and documentation?

3.1.2 VISITOR CONTROL

- Ensure there is only one point of entry to your business for people other than your employees.
- Erect warning signage at the entrance to the site, indicating that quarrying activity is in progress and that all visitors must report to the site office.

- Erect appropriate traffic-movement signage, indicating the destination of the road, for example, site office, crushing plant, workshop) and direction of travel if one way.
- If large and heavy vehicles (haul trucks etc) are operating, erect signage indicating that these vehicles have right of way and that light vehicles should take care.
- Erect signage indicating where visitors should park their vehicles so that, for example, they do not park near pit faces or in areas where heavy plant is operating.
- Identify the site office or reception area where visitors are to report on arrival. This is to prevent them walking around the site and possibly into high-risk areas, for example, blasting areas, over pit faces etc.
- If the office is often unattended, install a bell or similar device that the visitor can ring and that can be heard from the usual work areas.
- All visitors should be accompanied by a supervisor, requested to sign the visitors, book, and be inducted.
- Visitors could wear some form of identification colour.

3.1.2.1 VISITOR INDUCTION PROCEDURE

Visitors should be inducted to ensure they understand the site safety procedures, site emergency procedures and environmental guidelines.

Visitors should comply with these procedures, which may include:

- wearing some form of identification colour;
- site-specific roles and responsibilities;
- job/work instructions;
- hot work permits;
- manual handling procedures;
- control of hazardous/dangerous materials;
- personal protective equipment;
- lockout/danger tag procedures;
- machine-guarding procedures; and
- confined space entry permits.

3.1.2.2 PERSONAL PROTECTIVE EQUIPMENT

All visitors should wear appropriate personal protective clothing (complying with Australian Standards) when it is a requirement of that workplace.

3.1.2.3 SUPERVISION

Visitors should not enter any other site-designated work areas, other than those required to carry out their current business unless otherwise authorised by the person in charge.

Visitors should be escorted or supervised by a company employee at all times while on site to ensure they do not enter unauthorised areas.

3.1.2.4 VEHICLE SAFETY

Visitors should not operate company plant, equipment or vehicles unless accredited and authorised to do so.

They should comply with all traffic signs and rules appropriate to that workplace.

3.1.2.5 CHILDREN AND PETS

Under no circumstances should visitors bring children or pets into any work location.

3.1.3 WITHDRAWING PEOPLE IN DANGER

A manager should anticipate, plan for and withdraw all persons from a mine or part of a mine found to be dangerous; organise an appropriate investigation of the danger; and undertake necessary remedial action. In such a situation it is important that a report be prepared and be made available to all people employed in the mine

3.1.4 CONTRACTORS

3.1.4.1 CONTRACT RISK ASSESSMENT

Below is an example of how contract control measures may be gradually increased to ensure greater reliability in the contractors OH&S Management System.

- *Very low risk*–Loss or damage to personnel highly unlikely to occur.

  Minimum level of management:

  – restricted access to work area;

  – induction to the work area/emergency procedures; and

  – arrival and departure from the work area monitored.

- *Low risk*–Loss or damage to personnel not likely to occur.

  Minimum level of management:

  – induction to work area or site/emergency procedures;

  – conformance with site's safe working standards for contractors; and

  – arrival and departure from work area monitored.

- *Medium risk*–Loss or damage to personnel is known to occur. Specific risks that require special precautions may be identified.

  Minimum level of management:

  – contractor supervisor appointed;

  – full induction to work area and/or site for all employees;

  – contractor selection process applied;

  – hazards formally identified and risks control measures developed;

  – JSAs conducted as appropriate;

  – conformance to all site safe working procedures;

  – regular inspections/audits by principal; and

  – arrival and departure monitored.

- *High risk*–Loss or damage to personnel commonly occurs with this type of work.

  Minimum level of management:

  – a contractor supervisor plus a systems safety OH&S adviser appointed;

  – full induction to work area and/or site for all employees, based on job specific risks;

  – contractor selection process applied rigorously;

  – hazards formally identified and risks control measures developed;

  – JSAs conducted for almost all tasks;

  – full participation by principal in risk assessments;

  – regular scheduled inspections and audits by principal; and

  – arrival and departure monitored.

3.1.4.2 CONTRACTOR SELECTION

Regardless of the level of risk, there are some general requirements which apply to all categories of contractors:

- the contractor safety record and technical and commercial ability is of high standard;
- relevant insurances, licences, registrations and certificates are held by the contractor and their employees;
- pre-job safety discussion/site induction where specific safety requirements are outlined, relevant hazards indicated and emergency procedures explained, including first aid provision and fire protection;
- supervision of the contractor should be arranged so that a responsible person ensures compliance with site procedures;
- the contractor:

  – is responsible for their own property while on site;

  – should possesse suitable and good quality plant and equipment;

- should employ workers who are competent, trained and properly qualified to perform their designated task;
- employs workers who understand the procedures and work methods of the company;
- employs drivers and plant operators over 18 who are authorised and licensed to drive or operate plant equipment;
- employs workers who wear required personal protective equipment at all times;
- provides any suitable induction training; and
- ensures workers comply with any relevant principal procedures when working with the principal employees;

The principal's intent in the selection process should be to:

- satisfy itself that the contractor is capable of performing the job to be undertaken in a safe and healthy manner (ie to the standards set by the principal);
- brief the contractor on the job sufficiently to enable him/her to effectively devise (and cost) a work method and safety management;
- plan to complete the specific job safely and without risk to health;
- evaluate tenders to select the most appropriate contractor, having assessed risks inherent in the job, the contractor's method of work, OH&S capability and safety management plan;
- assess the degree and nature of the principal's proposed involvement in the site operations activity to ensure its duty of care is fulfilled;
- satisfy itself that responsibilities and responsibilities for specific tasks are clearly set down (nobody should be left in doubt about who should do what and who can make decisions on issues, and especially actual and potential problems.

3.1.4.3 CONTRACTOR CONTROL

The principal should have a system in place to monitor the contractor's work performance and adherence to health and safety requirements. The system should provide for a competent person to supervise the contract.

Their duties could include:

- jointly investigating injuries and accidents;
- undertaking site audits;
- undertaking site inspections;
- analysing results of monthly reports;
- recommending improvements to the health and safety program; and
- providing a written report on the health and safety performance at the completion of the contract.

REFERENCE DOCUMENTS

"Getting Started With OH&S Visitors, Contractors and Other Persons", National Occupational Health and Safety Commission.

"Boral OH&S Manual", Boral.

"QuarrySAfe–Occupational Health and Safety Resources Manual", QuarrySAfe Group Health and Safety.

"Guidelines for Contractor Occupational Health and Safety Management for New South Wales Mines" – MDG 5003, Dept Mineral Resources.

3.2 PEOPLE WORKING ALONE

Working alone/out of hours is work carried out in a area where normal means of contact (eg verbal, sight) with other staff are not generally available, so that the potential risk of any existing hazard(s) is increased to an extent where extra precautions need to be taken.

The manager is responsible for evaluating the risks associated with any person working alone, and must instigate measures designed to minimise those risks. Where a person working alone becomes injured at his or her workplace, the manager should have in place such measures to minimise the time that an injured person may be unattended. These measures may include, but not be restricted to, any or all of the following points.

- Supervisors, or other designated people, should visit the person's workplace more frequently than is normally the case, as it is deemed necessary.
- The person working alone should make contact with another person at frequent pre-arranged intervals. If the person working alone fails to make contact at the arranged times, the other person must then try to make the contact.
- The manager should promote and maintain a system or culture within the workforce whereby employees check on one another at regular intervals. Checking may be carried out by face-to-face contact, sighting from a distance or calling up on a two-way radio or telephone.
- Where applicable, the manager should provide a personal alarm system for persons working alone.

All tasks to be carried out whilst working alone/out of hours should be assessed for hazards and potential risks. These aspects should be considered together with the health, experience and training of the individuals concerned. Additional training and instruction may be required before working alone/out of hours is allowed.

Staff working alone/out of hours should ensure that:

- they are aware of high-risk hazards in their work area and are familiar with the appropriate safety equipment that may be required;
- all practical measures are taken to minimise risk during execution of their work;
- the agreed communications with their supervisor's approved nominee are adhered to; and
- if performing shift work for extended hours, take appropriate rest periods (break after working for eight-hour period).

3.3 LABOUR HIRE

Labour hire agencies should do all things reasonably practicable to ensure their contract employees are not put at risk of injury or disease whilst working for a client.

The employment relationship between agencies and their contract employees is different from a normal employer/employee relationship. The difference stems from the fact that agencies do not employ persons to carry out work for them, but for a client. The agency does not supervise the tasks the contract employee will be performing, or control the workplace where they are required to perform the work. Consequently, some agencies may believe that obligations of employers do not apply to them or cannot be practicaly carried out.

Nevertheless, this type of employment relationship does not diminish the responsibilities of agencies to do all things reasonably practicable to ensure their contract employees are not put at risk of injury or disease whilst working for a client.

Clients of the agency become the "host employer" once they employ contract labour. Whilst it is the legal responsibility of the agency to ensure the health and safety of their contract employees, the host employer has an equal responsibility to these contract employees while they are working for them.

REFERENCE DOCUMENTS

1998, "Boral OH & S Manual".

"Guidelines for Managing Health and Safety in the Labour Hire Industry", Work Cover South Australia.

"Occupational Health And Safety Manual", Pioneer Concrete NSW P/L.

"PLDC Health and Safety Management Procedures" – Penrith Lakes Development Corporation.

"QuarrySAfe Occupational Health and Safety Resource Manual", QuarrySAfe Group Health and Safety South Australia.

3.4 EMPLOYEE MANAGEMENT

3.4.1 EMPLOYEE SELECTION

An organisation is only as good as its employees and hiring is a key process. High turnover, absenteeism and inefficiency because of a poor match between people and job requirements increase the cost of doing business. Through selection of the right person for the job, these factors can be moderated.

The selection process should:

- determine if the employee can carry out the tasks required of a job without undue harm to themselves or others;
- establish base-line information on an employee's health status;
- determine whether reasonable accommodation is required to enable an employee to carry out the function of the job; and
- comply with equal employment opportunity considerations.

3.4.1.1 DEVELOPING SELECTION CRITERIA

- Carry out Job Safety Analysis (JSA) to determine accurate details of the physical and mental demands of the tasks required, including strength and flexibility requirements.
- Ensure job specification is up to date and consistent with requirements of the job.
- Formulate selection criteria that is consistent with the job specifications, that is, only includes skills and experiences that are required (on a regular basis) to carry out the duties of the position.
- Distinguish between essential criteria, those that the person must satisfy to be able to do the job, and desirable criteria, those that will help to do the job.
- Assess whether formal qualifications (academic, trade etc) are essential to the performance of the job.
- Ensure length of experience, age required etc are essential, and justifiable, for performance of the job, and not set arbitrarily or based on stereotypes.
- Ensure there are no unnecessarily restrictive English language qualifications on jobs that do not require them.
- Be specific. (For example, does "communications skills" refer to talking on the phone to customers, writing reports for management, instructing technical operators, inter-cultural skills or teamwork?)
- Determine how criteria will be assessed: interview, referees report, work record and testing.

Language

People employed in a mine (whether as managers, supervisors, employees or contractors) should be able to communicate readily in the event of danger, receive instructions and provide safety and health information, to enable compliance with relevant safety systems in place.

3.4.1.2 APPLICATION FORMS

- Ensure language and length is relevant to the performance of the job.
- Do not include any invasive or irrelevant questions.
- Predetermine to what use the information collected will be put and ensure no discrimination.
- Ensure strict confidentiality.

3.4.1.3 ADVERTISING

- Consider benefits to the organisation of a multi-skilled workforce by advertising all positions internally (as well as externally).
- Determine the best method for reaching the widest pool of applicants possible. For example, use of ethnic, media, informal networks, community groups, and organisations, industry groups, trade and journals.

- Ensure the information in the advertisement matches the selection criteria.
- Do not use stereotyped or discriminatory language or discriminatory requirements. For example, "front end loader operator, age 30-45 years".
- Include name of a contact person in the advertisement and ensure they have information (presented in a clear and consistent way) prepared about the position.

3.4.1.4 REVIEWING APPLICATIONS AND SHORT-LISTING

- Cull (short list) on essential qualifications first, then on desirable, prioritising criteria and determining method first.
- Don't make assumptions about qualifications/ experience, how people could handle particular situations or how others may react.
- Seek more information if necessary. The aim is to find the best person for the job.
- Be consistent. Document decisions made and reasons for them.

3.4.1.5 INTERVIEWING

- Aim to allow applicants to demonstrate what they can offer the organisation, not to simply confirm expectations or to see how applicants perform under pressure.
- Check need for any specific arrangements, for example, physical access and interpreters).
- Have questions prepared in advance.
- Ensure consistency and fairness in questioning.
- Focus on the real needs of the job. Don't make assumptions or stereotype individuals.
- The selection committee is entitled to ask applicants whether they can fulfil the requirements of the job (travel, work overtime, perform the physical functions); but such questions must be asked of all applicants.
- It is appropriate to ask people with disabilities whether they require any adjustments to perform the job.
- Allow interviewee time to make his/her point. Allow silence. Rephrase or clarify if necessary.
- Do not make assumptions about a person's ability to do the job based on physical characteristics.
- Do not ask invasive and irrelevant questions, for example: Do you intend to have a family?).
- If necessary, rephrase to gain the essential information you require and ask of all applicants, for example: Can you commit yourself to the organisation for 2 years?.
- Keep records of questions and answers.

3.4.1.6 REFERENCE REPORTS

- Applicant offers referees, or is able to comment on choice of referees, for example, supervisor's report.
- Be consistent in use of referees. Ideally, use a standard referee reporting form that matches the selection criteria.

3.4.1.7 ASSESSMENT

- Assessment should match the requirements of the job.
- Check that assessments are up to date and relevant.
- Check for any bias or indirect discrimination, for example, an assessment for potential trades apprentices which examines prior knowledge of the trade rather than aptitude.

3.4.1.8 MAKING THE DECISION

- Focus on the selection criteria.
- Rank applicants according to performance against essential and desirable qualifications.
- Assess all information: application form, interview, referees reports and tests.
- Record decisions made and reason for them.

- Avoid value judgments and ensure report and process is kept confidential.
- If requested, provide constructive feedback to unsuccessful applicants on their performance against the selection criteria.

3.4.1.9 MEDICAL EXAMINATION

- It is appropriate to have employees medically examined if potential health risks could be high for employees with particular health problems, for example, jobs which involve heavy lifting for people with spinal injury or disease.
- The medical examiner should have the job specification so any recommendation made relates specifically to the job.
- Ensure only information relevant to the position is sought, and avoid invasions of privacy irrelevant to the job requirements.
- Selection committee and examiner to be aware of technical equipment and other reasonable adjustment provisions for people with disabilities.
- Where there is concern about ability to perform a job, examiners to seek expert advice and assessment from vocational specialists in disability organisations.
- Ensure strict confidentiality.
- Applicants to be advised of results.

3.4.1.10 EMPLOYEE APPOINTMENT

Some of the key items that should be addressed at the appointment and induction of all new employees are as follows:

- familiarisation with workplace;
- introduction to co-workers and management;
- relocation assistance;
- position description and responsibilities;
- establishment of records;
- career path;
- development and competency needs;
- performance review;
- resignation; and
- exit interview.

REFERENCE DOCUMENTS

"Best Practice: Recruitment and Selection", Human Rights and Equal Opportunity Commission.

"Boral OH&S Manual", Boral.

3.5 TRAINING AND DEVELOPMENT

The minerals industry should use a formalised approach for examining mine operating needs so that operators may then select effective means (including training) for improving performances. Training schemes should incorporate safety and health training with both skills and task training, in order to establish a workforce that will be efficient and safety-conscious. Employees should have a record of their training, that could be accepted by managers at mines to which they transfer.

3.5.1 MINE OPERATORS RESPONSIBILITIES

Mine operators should implement a training scheme which will:

- identify what skills, knowledge or competencies are to be acquired before an employee starts the job, and analyse the training needed for that job;
- set objectives to develop, maintain or improve employment-related skills, knowledge or competencies of employees;
- let trainers determine the pre-existing skills and knowledge of trainees;
- design the training for the skills to be acquired and how to impart them;
- show how the training will be conducted; and
- let trainers evaluate the training.

3.5.2 TRAINING PROGRAM REQUIREMENTS

- A formalised training scheme should include a range of tasks and outcomes, and should:
  - provide induction training for new entrants to the industry;
  - give additional training for persons moved to new work;
  - train and employ persons on the surface before they proceed to work underground;
  - train under close personal supervision when starting work, especially underground, or when undertaking new tasks;
  - give skills maintenance training to each person employed at a mine; and
  - require that records of the training of each person be kept.
- Training should focus on a job and task performances rather than on an occupation.
- Diagnostic maintenance skills for employees involved with equipment and changing work site conditions. Training should include techniques for identifying potential malfunctions, hazardous conditions and unsafe work situations.
- Refresher training should be included in mine training programs, and should include briefing techniques for updating individuals, miners, supervisors, production managers and general managers on changes in work practices, new equipment operating procedures, and changes in the working environment generally.
- Mine instruction and training schemes should be reviewed regularly.

3.5.3 TRAINING NEEDS ANALYSIS

Conducting training needs analysis will help to ensure that the people in your organisation get the type of training they need.

It will enable you to ensure that the training is relevant to the job and the changing needs of the workplace.

A training needs analysis involves analysing all aspects of work, including the work environment, the actual jobs people do and the skills and knowledge of each person at work. Once this information is collected, then you can start to plan what training your organisation needs.

There are a number of stages to a training needs analysis:

Analyse the workplace

This includes analysing:

- the work environment; and
- the activities that people are expected to perform at work.

Assess the current approach to job organisation

This includes assessing:

- selection and recruitment procedures;
- the way jobs are designed;
- the way equipment and tools are selected; and
- the way work procedures are designed and managed.

Analyse jobs

- Study a job and identify all the tasks, equipment, materials, work processes and the associated hazards.

Forecast job changes

- Make predictions about the way jobs may change and how changes may affect the health and safety of staff:
- Identify the skills, knowledge and attitudes needed to prevent health and safety problems.

Assess the current approach to health and safety at work

- Identify the actual health and safety competencies that people in the organisation already have.
- Compare these existing competencies to those needed to prevent health and safety problems.
- Work out deficiencies that health and safety training would reduce or eliminate.

Management training needs

These training needs include:

- occupational health and safety legislation;
- health and safety principles and practice;
- management systems;
- assignment of health and safety roles and functions;
- workplace hazard identification;
- risk assessment and control;
- keeping health and safety records;
- communication; and
- dealing with hazardous events.

Supervisors training needs

Supervisors need to be able to carry out any health and safety roles and functions which have been assigned to them. They may need training to:

- recognise hazards in the workplace and conduct health and safety inspections;
- select and apply appropriate risk-control measures;
- investigate incidents or dangerous occurrences;
- produce clear and accurate investigation reports;
- communicate effectively;
- consult effectively;
- conduct effective on-the-job training;
- ensure employees understand and follow workplace procedures;
- assist the employer to comply with provisions of the legislation;
- deal with hazardous events; and
- maintain health and safety records.

A shared approach to training, where managers, supervisors and health and safety representatives attend training together, can produce good results. Most health and safety issues need managers and employees to work together to successfully resolve those issues, and so it makes sense to have a joint approach to training. Joint training can supplement specific training that relates to the respective health and safety roles and functions within the organisation.

3.5.4 TYPES OF TRAINING

The type of training that each person in the organisation needs depends on:

- each person's role and responsibilities at work;
- each person's occupation (for example: plant and machine operators and people who handle hazardous substances need specific training);
- the hazards identified during an inspection of your workplace; and
- the type and occurrence of injury and disease at work.

3.5.4.1 INFORMAL TRAINING

An important provider of training may be a supervisor or experienced worker who has skills and knowledge in health and safety. Such a person can provide information and training to others at work.

For this informal training to be effective, the supervisor or experienced worker needs to undertake trainer-training to develop the skills to train others in the workplace.

TAFE colleges and private training providers may offer trainer-training courses, which generally run for three to five days.

3.5.4.2 FORMAL TRAINING

There are basically four types of safety training courses available:

Licence or certificate courses

Certain jobs require an operator to hold an officially recognised certificate or licence to do a task like operating a winder. The mine operator may be required in some instances to determine the competencies of loader drivers, truck drivers and others. The mine operator may take the opportunity to have operators attend the appropriate course and be assessed by a qualified assessor. Advice on such courses can be obtained from the National Mining Industry Training Advisory Board or branch office in your State.

Accredited and approved courses

Courses like introductory training courses for health and safety representatives are classified as accredited under legislation. Some States and Territories use the term "approved" for these courses. Courses for managers and supervisors may also be classified as accredited in some States and Territories. Accredited and approved courses have to meet certain criteria determined by the relevant Commonwealth, State or Territory health and safety authorities.

Short courses

Short courses are usually designed for a specific group of people such as operators of equipment, employees, supervisors and managers.

The most common types of short courses are:

- general introductory courses on topics such as hazard management;
- management and supervisory training courses on legal obligations and managing health and safety in the workplace;
- courses on specific issues, such as hazardous substances, manual handling, confined spaces and workplace ergonomics; and
- courses for employees with non-English-speaking backgrounds, giving a general introduction to basic health and safety principles.

Vocational and professional courses

Traineeship and apprenticeship courses normally include health and safety modules as part of the course. There are also two-to-four-year health and safety courses for training health and safety professionals and managers. These courses usually involve part-time study at a college or university over two to four years and result in a qualification in health and safety.

Most training can be provided by:

- employer organisations;
- unions;
- health and safety organisations;
- TAFE college and universities; and
- private occupational health and safety consultants/trainers.

Many employers send their supervisors to these organisations for training. Training can also be provided in-house by these organisations.

3.5.5 SPECIFIC TRAINING REQUIREMENTS

3.5.5.1 INDUCTION TRAINING

Health and safety education should start with employee induction when an employee joins the organisation or is transferred to a new job. It has been found that inexperienced workers, in general, are involved in accidents at a higher rate than others. While experience can only be gained through time, both health and safety education and job skills training can be used to improve this record. Induction sessions normally cover such items as explanation of the function of the work unit, organisational relationships, administrative arrangements, and miscellaneous policies and rules.

Induction training program

New or transferred employees need training that enables them to:

- understand the hazards of their work;
- notify their supervisors of identified hazards;
- understand workplace consultative arrangements, including the role and functions of health and safety representatives and health and safety committees;
- understand and follow health and safety procedures applying to their workplace;
- understand their responsibilities under the legislation;
- understand general safety rules and policies such as:
  - hazard communication and chemical safety procedures;
  - hearing conservation;
  - electrical safety and lockout/tagout;
  - emergency plans: routes and assembly locations;
  - procedures for safety violations, accidents, near-miss;
  - proper lifting and ergonomic techniques; and
  - equipment safety;
- Induction training for new employees could include:
  - a tour of the work area;
  - an explanation of local amenities;
  - introductions to fellow employees;
  - introduction to health and safety representatives;
  - description of general workplace hazards and risk control measures;
  - an explanation of the location and use of firefighting equipment;
  - details of emergency exits; and
  - issue of personal protective clothing and equipment (if required).

Follow-up on induction

No one can learn everything about a job in one day or one week. There must be regular follow-up of a new or transferred employee to ensure that the job is understood and safe working practices are being adhered to. Feedback from fellow employees and immediate supervisors should also be considered. Initial follow-up should be at least daily until the person in charge is satisfied that the employee has grasped all the features of the job. After the first week or two, follow-up may have to continue on a weekly basis for up to three months, depending on the nature of the job and the workplace.

On the job training

It is important to be confident that all employees understand their roles, and that management's expectations of how particular tasks will be carried out can be satisfied. It is worth building the following steps into induction arrangements:

- describe the job or task in detail;
- check previous experience of the employee;
- demonstrate key aspects of the job;
- identify possible hazards and risk-control measures;
- demonstrate safe operating procedures;
- watch the employee perform the job and suggest corrections as required;
- ask the employee to describe potential hazards; and
- repeat these steps unless it is clear the employee understands the health and safety implications of the job/task.

Assessment of understanding

Questions should be asked to test whether an employee has grasped the essential features of the job and workplace. This can also highlight aspects of the induction program that need further attention. Questions should be asked in such a way that employees have to respond with information rather than just a yes or no. Where appropriate, a written questionnaire could be used.

3.5.5.2 HEALTH AND SAFETY TRAINING

In all organisations, no matter how large or small, everyone needs some training in health and safety matters:

- the employer;
- the supervisor;
- all employees–casual, part-time and full-time;
- students on work experience;
- new employees;
- contractors who work on your site;
- the health and safety committee representative;
- members of the health and safety committee; and
- visitors.

The need for health and safety training at work is continuous. As circumstances at work change, there will always be the need to ask the questions:

- How does this change affect health and safety?
- What health and safety instruction and training do I need to provide now?

Typical times when you need to ask these questions are:

- whenever you take on someone new at work–health and safety is an important part of induction training;
- whenever you buy new machinery or equipment or new substances such as chemicals;
- whenever people's jobs change;
- whenever you change the layout of your work environment;
- whenever there are new health and safety regulations, standards or laws that affect your industry; and
- if there has been an accident, injury or health and safety incident at work.

There is a need to make some decisions, such as:

- How much money you are going to invest in training over the next 6 to 12 months.
- How much time you will devote to training.
- What the most cost-efficient way is for you to make this investment.
- Whether to send one employee to the health and safety course and a train-the-trainer course and then schedule time for him/her to train others at work.
- Whether to send a group of people to the training course.

- Whether to arrange for a trainer to come to the work site and deliver training to a group of workers.

Planning for safety and health training

Training programs are best planned if everyone at work:

- has basic information about the relevant laws and regulations;
- has the opportunity to talk about health and safety concerns;
- uses the health and safety skills and knowledge they have;
- takes part in a workplace inspection and identifies hazards at work; and
- takes part in a training needs analysis to find out what training each person needs.

3.5.5.3 FIRST AID TRAINING

As far as practicable, every new employee should be instructed in first aid facilities and practices at the mine. The mine operator should have enough employees trained in first aid to assist in an emergency, with refresher courses held regularly to keep such people up to date. Holders of First Aid Certificates should be re-examined at least every three years.

People employed in a first aid centre should receive instruction and training in artificial resuscitation techniques, as well as in first aid at a level commensurate with the availability of external first aid assistance and the likelihood of serious injuries.

3.5.5.4 METAL FABRICATORS' AND WELDERS' TRAINING

Personnel on a mine site performing arc welding, oxygen/acetylene/LPG cutting/welding for the fabrication/repair of structures/equipment must be properly trained in that work. That work must be performed so as not to endanger the health and wellbeing of the employee and fellow employees.

For any work that will change the structural integrity of a structure, original plans must be re-examined and the engineering design calculations amended or the complete structure redesigned.

REFERENCE DOCUMENTS

"Getting Started", Health and Safety Training, Victorian WorkCover Authority.

"Organising Health and Safety Training for Your Workplace", National Occupational Health and Safety Commission.

"A Basic Occupational Health and Safety Program", Canadian Centre for Occupational Health and Safety.

"Boral OH&S Manual", Boral.

3.6 HEALTH AND FACILITIES

3.6.1 HEALTH SURVEILLANCE

Mining operations encompass the disturbance, removal, washing, sifting, crushing, leaching, roasting, evaporation, smelting, refining, palletising of any rock structure, stone, fluid or mineral-bearing substance.

Workers in the mining industry may be exposed in varying degrees to mineral dusts, process fumes, diesel exhaust emissions, and a wide range of hazardous chemicals, either used during mineral processing or in the maintenance and repair of plant and equipment.

Inhalation of mineral dusts such as silica or asbestos remains a concern in the mining industry and thus a health surveillance program is focused primarily on monitoring respiratory symptoms. Audiometric testing is also undertaken as mine workers are typically exposed to very high noise levels and may be at risk of acquiring noise-induced hearing loss.

The objectives of the health surveillance program for mine employees are:

- to assess the health status of employees on a regular basis by progressively collecting relevant health information;
- to analyse collected data to detect adverse health effects at the earliest opportunity; and
- to enable appropriate and timely corrective action to be taken in order to safeguard the health and wellbeing of employees.

It is the employer's responsibility to protect employees against health hazards in the workplace. Therefore, where employees may be exposed to airborne contaminants, or any other health risks, all possible preventative measures, such as engineering, work method, administrative or combination risk controls, should be implemented.

The following health risks could be present in your operation.

3.6.1.1 QUARTZ SILICA

Prolonged or repeated exposure to fine airborne crystalline silica dust may cause severe scarring of the lungs, a disease called silicosis. The risk of developing and the severity of silicosis depends on the airborne concentration of respirable size silica dust to which an employee is exposed and duration of exposure. Silicosis usually develops gradually over 20 years or more of exposure. Particles with diameters less than 1 micrometre and freshly cleaved particles (for example, those produced by sandblasting) are considered most hazardous. Several reliable studies have found silicosis in employees with exposure to considerably less than 1 mg/m3 respirable quartz.

The early symptoms of silicosis (cough, mucous production and shortness of breath upon exertion) are non-specific, so the development of silicosis may not be detected until advanced stages of the disease. Silicosis may continue to develop even after exposure to crystalline silica has stopped. Evidence of silicosis can normally be seen on
an X-ray.

Silicosis can vary in severity from minimal to severe. In cases of mild silicosis, there is typically no significant respiratory impairment, although there is X-ray evidence of lung injury. In severe cases, significant and increasingly severe respiratory impairment develops. There is no proven effective treatment for the disease. Life expectancy may be reduced, depending on the severity of the case. Death is not usually a direct result of silicosis, but cardiac failure (or pulmonale) may occur as the heart has increasing difficulty pumping blood through the scar tissue in the lungs. Silicosis may be complicated by the development of bacterial infections, including tuberculosis.

“Accelerated” silicosis results from exposure to high concentrations of crystalline silica over a period of five to 10 years. The disease continues to develop even after exposure stops and is often associated with auto-immune diseases, for example, scleroderma (a skin disease involving thickening of the skin).

“Acute” silicosis (also referred to as “silicotic alveolar proteinosis”) is rare in humans, but can develop if very high concentrations of crystalline silica dust are inhaled over a relatively short period (1–2 years) and has occurred in occupations such as sandblasting or tunnelling where exposure controls were minimal. Acute silicosis may result in death within a few years, often with tuberculosis as a complication.

Inhalation of quartz has also been associated with a number of other, less well characterised, harmful effects including effects on the kidney (glomerulonephritis), the liver, the spleen and immune system disorders (progressive systemic sclerosis, scleroderma or rheumatoid arthritis).

The International Agency for Research on Cancer (IARC) has concluded that crystalline silica in the form of quartz or cristobalite from occupational sources should be classified as carcinogenic to humans (Group 1), known to cause human cancer. This conclusion was drawn on the basis of a relatively large number of human population studies that together provide sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica. In many (although not all) of these studies, lung cancer risks were elevated and could not be explained by other factors. Recent reviews have tended to conclude that if exposures are controlled to prevent silicosis, they will probably prevent cancer. The risk of developing silicosis depends on the airborne concentration of crystalline silica, the particle size and the duration of exposure.

3.6.1.2 NOISE

It is essential that all individuals be convinced that noise does produce a hearing loss and that it can be prevented by active cooperation between employer and employee.

The consequences of noise exposure are not as obvious as those from accidents. For example, the consequences when a piece of metal enters an eye are immediately obvious, whereas the results of noise exposure are not obvious until it is too late. Therefore, education becomes exceedingly important to convince the individual about what can happen to his/her ears if they are not protected.

- Hearing loss is a gradual process, and the individual may incur considerable hearing loss without realising it. At the outset, hearing loss takes place without any external signs; therefore, continual reminders help employees to develop the habit of hearing protection.
- Proactive steps taken by the employer and union representatives, such as posters, discussions and films, reinforce the understanding of how damaging it can be to become lax about protecting one's ears.

3.6.1.3 ASBESTOS

Asbestos fibres can have serious effects on your health if inhaled. There is no known safe exposure to asbestos. The greater the exposure, the greater the risk of developing an asbestos-related disease.

The amount of time between exposure to asbestos and the first signs of disease can be as much as 30 years. It is known that smokers exposed to asbestos have a much greater chance of developing lung cancer than just from smoking alone.

Asbestos can cause asbestosis, a scarring of the lungs that leads to breathing problems and heart failure. Workers who manufacture or use asbestos products and have high exposures to asbestos are often affected with asbestosis.

Inhalation of asbestos can also cause lung cancer and mesothelioma, a rare cancer of the lining of the chest and abdomen lining. It may be linked to cancer of the stomach, intestines and rectum as well.

As noted earlier, the symptoms of asbestos-related diseases may not become apparent for many decades after exposure.

Symptoms are:

- shortness of breath;
- a cough or a change in cough pattern;
- blood in the sputum (fluid) coughed up from the lungs;
- pain in the chest or abdomen;
- difficulty in swallowing or prolonged hoarseness; and/or
- significant weight loss.

3.6.1.4 ISOCYANATES AND POLYURETHANE

In recent years in Sweden, new hazards have been found to be associated with certain chemical products and with plastic/rubber materials that are manufactured with isocyanates and which contain PUR (polyurethane). These risks were discovered by measuring with a new and improved method. This may also occur with binding agents in mineral wool or in some types of the plastic Bakelite. When PUR is heated, toxic compounds are produced–isocyanates–which can harm the respiratory system. When heating plastics and resins made from urea and phenol or formaldehyde (which does not contain PUR) an isocyanate (methyl isocyanate) can be formed. The levels may be high, so high that they cause asthma. Measurements made in the past with old methods have almost always shown low levels of isocyanates. New measuring methods show that the levels can be very high. The reason is that the old methods do not detect all the different isocyanates that can be generated when materials containing PUR are heated.

High levels of isocyanates can cause asthma. There are suspicions, moreover, that the respiratory system can be affected by very short-term exposures to high concentrations. In the worst-case scenario, few breaths of smoke from something containing PUR can be sufficient to harm the airways.

When materials containing PUR are heated, for example, in heat treatment, weld, torch-cutting, sawing, cross-cutting, grinding or soldering, or when heating material in some other way, a large number of different compounds are formed. These include isocyanates. It is sufficient for the temperature to become high at a single point for isocyanates to be formed. It is estimated that breakdown can begin at about 150–2000oC and sometimes at higher temperatures. Isocyanates are odourless, but sometimes other substances are formed which do have an odour. If polyurethane plastic is heated to the point of discolouration, isocyanates are formed–but the plastic may also be emitting isocyanates even before discolouration occurs.

Isocyanates can give rise to a range of symptoms. The most usual ones consist of respiratory problems, for example, nasal congestion, runny nose, dry cough or nose bleeding. Diffuse symptoms such as eye irritation, headaches or feeling heavy-headed also occur. Lung function may be impaired, which is most noticeable in the form of heavy breathing in conjunction with physical exertion or loss of stamina. It may sometimes be difficult to identify impaired lung function oneself, but a doctor can measure it. The symptoms may arise at work, but they may also only be noticeable several hours after work. They usually disappear after a few days away from work.

Severe cases may involve asthma, which is lifelong. Every time one is exposed to isocyanates, one can suffer an asthma attack. Asthma may also mean that the airways become more sensitive to dust and odours. This means that an asthma attack can be triggered by such things as perfume, exhaust emissions or solvents.

Isocyanates can also cause contact dermatitis.

3.6.1.5 LEAD

Exposure to lead fumes, lead dust or dust of lead compounds may result in the absorption of some lead into the body. Indications of exposure may present as tiredness and difficulty concentrating. Lead poisoning may present with muscular weakness, change in sleeping habits, irritability and abdominal discomfort with colicky pain.

Health evaluation with a blood test and sometimes a urine test as well should be performed every 3–12 months, depending on exposure and the results of previous tests.

Individuals with elevated blood lead levels may have to be transferred to other jobs where there is no exposure to lead until their blood lead levels fall.

3.6.1.6 MEDICAL PROCEDURE

Valid techniques for use in health surveillance are those of acceptably high sensitivity and specificity which can detect adverse effects related to the nature and degree of exposure to hazardous agents and substances in a mine. Health surveillance procedures should be safe, easy to perform, non-invasive and acceptable to employees. Depending upon the potentially hazardous agents and substances present, some or all of the following procedures may be required:

- work history;
- respiratory questionnaire;
- lung function test;

- audiometric test; and
- chest X-ray.

Note: the health assessments conducted for the purpose of the Health Surveillance Program are not designed to determine whether or not an employee is medically fit for work. Prospective employers are required to use their own guidelines and make their own decisions on the suitability of employees for a particular job.

3.6.1.7 DRIVERS

Drivers of heavy goods vehicles and vehicles carrying dangerous goods require examinations.

The purpose of these examinations is to:

- ensure drivers remain fit to perform the tasks required of them;
- detect the early onset of medical conditions and refer for treatment before an employee's ability to drive is impaired;
- ensure drivers do not suffer from a condition that could affect their level of consciousness and thus endanger themselves and other users of the road; and
- provide an opportunity to counsel drivers on health maintenance.

The health evaluation should include a comprehensive medical history and physical examination. Eyesight, hearing, urine and lung function tests will be included, and, depending on risk factors, an electrocardiogram and/or exercise stress test will be done.

3.6.1.8 RECORD-KEEPING

Comprehensive records should be kept of all medical examinations, and results should be strictly confidential.

REFERENCE DOCUMENTS

"Health Effects of Quartz Silica", Canadian Centre for Occupational Health and Safety.

"Questions and Answers About Asbestosis Exposure", National Cancer Institute.

"Asbestosis", American Lung Association.

"Do You Work With Isocyanates and Polyurethane?", Joint Industrial Safety Council, April 1999, ISBN91 – 7522 – 638 – 3.

"What Kind of Industrial Noise ws Harmful?", Hearing Health, House Ear Institute, www.hei.org

"Boral OH&S Manual", Boral.

"Approved Procedures for Health Surveillance of Mine Employers", WA Department of Minerals and Energy.

3.6.2 FITNESS FOR WORK

3.6.2.1 DRUGS AND ALCOHOL

Where employees or other persons working on or visiting a mine site are under the influence of alcohol or drugs and are compromising the safety of themselves or other employees, the mine operator has the right, and legal obligation, to take action to ensure a safe and healthy workplace is maintained.

Policy

Dealing with drug and alcohol problems requires the formulation of a policy. It should apply to all employees and be developed by management and employees.

The aim of any workplace policy and procedures should be prevention, education, counselling and rehabilitation, and it should be a part of an organisation's overall occupational health and safety strategy.

The policy should be well publicised within the workplace, and provide for a suitable training and education program for all staff.

Details of the policy in induction and ongoing training should be included. Post the policy on notice boards and include it on electronic networks for all staff to refer to.

Training should cover

- what constitutes harmful drug and alcohol use;
- dealing with the long-term user and those intoxicated in one-off situations;
- the effects of alcohol and drug use on health, safety and work performance;
- general statistics on workplace drug

and alcohol use and related injuries and incidents;

- the consequences for employees who fail to comply with company drug and alcohol guidelines;
- personal stress reduction methods;
- ways of dealing with harmful alcohol and drug use;
- who to approach in the workplace for assistance with a drug or alcohol problem;
- skills for managers, supervisors, health and safety representatives and OHS committee members in identifying drug and alcohol use and in how to manage the issue in their workplace;
- the legal position (rights and penalties) of staff and management in relation to drug and alcohol use and drug testing; and
- the counselling, treatment and rehabilitation services available in the workplace and externally. Post contacts with phone numbers on notice boards.

Approaching a worker under the influence

The approach taken when dealing with an employee whose work performance appears to be affected by alcohol or other drugs depends on:

- the workplace culture and structure;
- the rapport between the authorised person and employee;
- the communication skills of the authorised person;
- the position of the employee;
- the personality of the employee; and
- whether it is a case of long-term harmful use, or a "one-off" situation.

Options for approaching the employee include:

- by their supervisor or more senior manager;
- by a person designated in the workplace policy; and/or
- by a fellow employee or peer.

The policy should state the chain of responsibility for making approaches if initial contact produces a negative or hostile response.

When approaching an intoxicated employee, it can be more effective and less confronting to talk in terms of their approach to safety and general work performance rather than their apparent alcohol or drug use.

The policy could contain a statement from the organisation including:

- its commitment to providing a safe and healthy workplace;
- the consultation process;
- the aims and objectives and expected outcomes for the policy; and
- detailed procedures.

Procedures

When developing procedures, management should recognise that drug or alcohol dependency is an illness that can be controlled and treated.

Employees who have such a problem may be provided the same opportunities to obtain help and assistance as would a sick or injured employee.

If any person needs to take prescription medicine for an illness, and this may affect their performance at work, they should report it to their supervisor so that an appropriate task can be allocated.

The following procedure could apply:

- lost time should be deducted from their annual sick leave entitlement;
- the employee should be required to be interviewed by the manager to determine the extent of the problem;
- where the manager deems it appropriate, the employee should attend an appointment with a professional organisation where further assistance can be provided; and
- at all times, the confidentiality of the employee should be maintained.

Where there is an ongoing disregard for the operations policy on this matter, the Code of Discipline should be invoked.

REFERENCE DOCUMENTS

“Guidelines for Drugs, Alcohol and the Workplace”, WorkCover, South Australia.

“Occupational Health and Safety Resource Manual”, QuarrySAafe Group Health and Safety Services, South Australia.

3.6.3 FIRST AID AND MEDICAL TREATMENT

Workers should be informed about first aid facilities and services. Information should be complete, easy to understand and accessible. Language factors and the literacy levels of target groups should be taken into account when workers are informed about the provisions at the workplace. Where appropriate, verbal methods (explanations, demonstrations), visual methods (videos, posters) and plain English or other appropriate languages should be used. All workers should know what to do, where to go, and from whom to seek first aid.

Information about first aid should include an accident plan. This plan should:

- specify the “response” procedures to be followed in an accident situation; for example, notify supervisor, telephone for medical assistance);
- allocate specific tasks involved in such procedures to individuals; for example, supervisor to telephone the ambulance;
- include emergency transportation arrangements; for example, who has a driver’s license, location of available vehicle for use;
- detail the location of first aid facilities at the workplace, including details of personnel responsible for these facilities; and
- specify the role of the first aid provider. In specifying the role of the first aid provider, it is important to remember that this person should not administer assistance beyond that for which they are qualified and have maintained competency.
  In particular:
- the first aid providers should be instructed not to exceed their training and expertise in first aid; and
- other staff, such as supervisors, should be instructed not to direct first aid providers to exceed their first aid training and expertise.

For example, if the first aid provider is not certified to perform CPR, the plan should not require this person to perform CPR.

Information about first aid facilities and services and the accident plan should be provided to workers on commencement of employment. Current information about specific risks in the workplace and changes affecting the provision and use of first aid facilities and services, and procedures detailed in the accident plan should be available to all workers.

Information may be provided through:

- induction programs;
- information and awareness seminars;
- training courses;
- newsletters;
- notice board announcements;
- policy and procedure manuals; and
- company memoranda.

Workers should be advised of other matters including:

- the availability of first aid facilities and services; and
- infection-control procedures.

Up-to-date lists of the telephone numbers of emergency personnel and organisations should be clearly displayed near central telephone or radio communication systems. Key emergency personnel and organisations to be included on such a list are:

- the nearest ambulance service;
- the nearest doctor with whom arrangements have been made for emergency care;
- the nearest hospital with an accident and emergency department;
- the Poisons Information Centre; and
- emergency services.

3.6.3.1 FIRST AID FACILITIES

The choice of first aid facilities and services should be based on the risk-assessment process. In making this decision, consideration should be given to:

- nature of the work;
- size and layout of the workplace;
- location of the workplace; and
- number and distribution of workers.

A first aid room should be of sufficient size to treat more than one person at the same time, with entrances at least 1.2 m wide, to allow stretcher access. Signpost first aid rooms in accordance with AS 1319–1994 Safety Signs for Occupational Environments, and display the name of the first aid room attendant.

Rooms should be well-lit and ventilated, have at least two power points, a sink and a wash basin with hot and cold running water. Access to toilet and shower facilities is also important.

A work bench or trolley, first aid supply cupboards, lined containers for soiled dressings, an armchair, two upright chairs, a folding stretcher and folding chair, a desk and telephone should be provided. Keep emergency and resuscitation equipment, which attendants must be able to operate and maintain, in first aid rooms.

3.6.3.2 NATURE OF THE WORK

Certain work environments have greater risks of injury and illness, due to the nature of the work being performed. This is an important criterion for deciding first aid requirements, as different first aid facilities may be required for different activities. For example, factories may require different first aid facilities to mines.

Where highly toxic or corrosive chemicals are stored or used, additional first aid facilities should be provided particularly if specified in the relevant Material Safety Data Sheet (MSDS). Facilities may need to include emergency showers and eyewash stations. Additional first aid training in the treatment of injuries specific to a workplace may also need to be provided.

Additional items may need to be added to a basic first aid kit and first aid room for treating specific injuries and illnesses such as burns, eye injuries and poisoning. The suggested contents of a basic first aid kit are listed further on.

3.6.3.3 SIZE AND LAYOUT OF THE WORKPLACE

In relation to the size and layout of a workplace, consideration should be given to:

- the nature of work being performed at different work areas;
- the distance an injured or ill person has to be transported to first aid facilities;
- the ease with which this can be undertaken; and
- the level of first aid available throughout the workplace.

The first aid facilities and services should be located at points convenient to the workforce and where there is a significant risk of an injury occurring.

A workplace with a large physical area may require first aid to be available in more than one location, for example, when:

- small numbers of workers are dispersed over a wide area;
- access to first aid facilities is difficult; and
- a workplace is on more than one floor.

3.6.3.4 LOCATION OF THE WORKPLACE

The distance of the workplace from ambulance, hospital and medical centres should be considered.

If it takes more than half an hour to get medical aid to an injured or ill person, access to a person trained in more advanced first aid may be necessary. The final decision depends on a combination of factors such as worker numbers, first aid personnel and the type of work.

The time taken for medical aid to reach the injured or ill person is more significant than distance. For workplaces in remote areas, additional first aid facilities and services should be provided. In these areas, consideration may need to be given to the following when planning first aid facilities:

- road quality and access;

- potential for flooding; and
- evacuation facilities.

Efficient communication systems should be available for ensuring optimum response times.

3.6.3.5 NUMBER AND DISTRIBUTION OF WORKERS

The risk of injury or work-caused illness can be influenced by the number of workers.

Where there are separate work areas, it may be appropriate to locate first aid facilities centrally and provide portable first aid kits in each work area.

Where workers work away from their workplace, other factors will need to be considered, including:

- whether workers work alone or in groups;
- workers' access to communications, such as telephone or emergency radio; and
- the nature of the work being performed.

In these situations, consideration should be given to providing small and more portable first aid kits to workers. Workers should be informed about the contents of these kits, their location and access arrangements.

Consideration should be given to circumstances in which the workplace is not a building, for example work vehicles. In such situations, the choice and extent of first aid facility provided should depend on the risk-assessment process.

Where work occurs on more than one shift, first aid facilities should be available whenever there are workers at work. The number of workers working overtime is often less than a regular shift, but additional hours of work heightens fatigue. This may increase the risk of accidents and injuries. When overtime or shift work is being performed, appropriate first aid facilities and services should be available for the number of workers working each shift.

In determining appropriate first aid facilities and services, decisions will also need to be made about the following:

- first aid personnel;
- first aid kits;
- first aid rooms; and
- infection control in the workplace.

The next stop in the risk-management approach is the implementation of chosen first aid facilities and services.

3.6.3.6 FIRST AID KITS

A person with a senior first aid qualification, at least, should be responsible for first aid kits including:

- recommending actions about use, contents, modifications and maintenance;
- ensuring a first aid kit is accessible whenever workers are at work;
- checking and replenishing contents; and
- ensuring equipment and contents are within the "use by" dates.

The contents of first aid kits should be appropriate for the types of injuries and work caused illnesses likely to occur at the workplace. The contents of a first aid kit listed further on are appropriate for work environments where the risk of serious injury or illness and the demand for first aid is low.

In work environments where specific injuries and illnesses such as burns, eye injuries and poisoning may occur, additional first aid kit contents should be provided and appropriately trained personnel should be appointed. Where burns have been identified as potential injuries, supply of water and additional dressings should be considered. Eyewash stations should be considered where potential eye injuries have been identified. Provision of emergency showers should be considered for workplaces where chemical splashes may occur.

First aid kits should be provided for workers working:

- in remote areas from which access to accident and emergency facilities may be difficult or delayed; and
- away from their employer/person in control of the workplace's establishment.

At least one first aid kit should be provided for each workplace. A first aid kit may be of any size, shape or type. It should be large enough to house all of the contents, including any additional items.

CONTENT OF FIRST AID KITS	KIT A	KIT B	KIT C
Adhesive plastic dressing strips, sterile, packets of 50	2	1	1
Adhesive dressing tape (2.5 cm x 5 cm)	1	1	–
Bags, plastic, for amputated parts:			
Small	2	1	1
Medium	2	1	1
Large	2	1	–
Dressing, non-adherent, sterile (7.5 cm x 7.5 cm)	5	2	–
Eye pads, sterile	5	2	–
Gauze bandages:			
5 cm	3	1	1
10 cm	3	1	–
Gloves, disposable, single	10	4	2
Rescue blanket, silver space	1	1	–
Safety pins, packets	1	1	–
Scissors, blunt/short nosed, minimum length 12.5 cm	1	1	–
Splinter forceps, stainless steel	1	1	–
Sterile eyewash solution, 10 ml single-use ampoules or sachets	12	6	–
Swabs, prepacked, antiseptic, packs of 10	1	1	–
Triangular bandages, minimum 90 cm	8	4	1
Wound dressings, sterile, non-medicated, large	10	3	1
First aid pamphlet (either St John, Red Cross or other approved)	1	1	1
Resuscitation face mask (Laerdal)	1	1	1
Burns card (AIP)	1	1	1

Location of first aid boxes

- No employee should be more than 100 metres from a first aid box, and no more than one floor above or below a first aid box.
- All boxes should be in close proximity to running water.
- All boxes should be marked according to AS 1319–1994 Safety Signs for the Occupational Environments sign 471–white cross on green background.
- All vehicles should carry a first aid kit.
- All boxes should be marked with the name of the first aider in charge of the box and the usual work location.
- A list should be maintained of all boxes and their location at each box site.

Content of first aid kits

There are three types of first aid kits (A, B and C). In any workplace, the total number of workers at any time determines the content of the required kit.

Kit A more than 100 employed

Kit B less than 100, but more than 10

Kit C less than 10 and company vehicles

3.6.3.7 REPORTING OF FIRST AID TREATMENT

Where first aid treatment is provided to any person, the person's particulars and other relevant details should be recorded in a first aid register, the quarry diary or a first aid treatment notebook.

Reporting first aid treatment is especially important for minor injuries where a doctor's visit is not required, as it provides the evidence that a person was injured at work and will protect their rights to compensation should a claim be lodged in the future.

REFERENCE DOCUMENT

"Advisory Standard for First Aid", Queensland Department of Employment, Training and Industrial Relations.

3.7 MANUAL HANDLING

3.7.1 INTRODUCTION

Manual handling is not just about lifting heavy objects; it includes any activity requiring the use of force exerted by a person to lower, push, pull, hold or restrain a person, animal or thing.

Placing boxes and other items on shelves, painting, gardening, cleaning, writing and typing are some examples of manual handling tasks.

Manual handling injuries include:

- strains and sprains;
- neck and back injury;
- slips, falls and crush incidents;
- cuts, bruises and broken bones;
- hernia;
- strained heart muscles; and
- occupational overuse syndrome (OOS), once known as Repetitive Strain Injury (RSI).

The employee should be informed and trained in:

- safe manual handling methods;
- specific manual handling hazards;
- safe work procedures;
- using manual handling aids; and
- the right to ask for help.

Most manual handling injuries can be prevented by instruction, training and supervision. Safe work procedures should be prepared by employers with the help of employees, to care for the special needs of young and inexperienced workers.

Most manual handling injuries are strains and sprains, and the most frequently injured part of the body is the back. Some manual handling back and neck injuries can cause workers long months of pain and rehabilitation. Serious strain injuries may require surgery and occasionally may cause life-long disability and loss of career.

3.7.2 WAYS TO REDUCE THE RISK

Most manual handling injuries can be prevented by education, training, and supervision. Safe work procedures should be prepared by employers with the help of employees to care for the special needs of young and inexperienced workers.

It is the employer's responsibility, as far as possible, to provide a safe working environment, which includes:

- safe plant and equipment;
- safe protective equipment;
- manual handling aids if necessary; and
- rest or exercise breaks during tiring or repetitive tasks.

Reducing hazards should be part of the safe work procedure for each task in the workplace.

3.7.3 SAFE WORK PROCEDURES

It is the employer's responsibility to provide the employee with safe work procedures, and with education, training and supervision for manual handling tasks.

Each manual handling job or task should have its own safe procedure. Some safe procedure steps include:

- the task should be planned before work begins;
- employees should be trained in the skills required;
- employees should be told about potential hazards;
- the way should be cleared to avoid bumping into or tripping over things; and
- suitable protective clothing should be provided and worn.

Safe work procedures should reduce lifting, carrying, pushing, pulling, lowering, throwing, holding, or tasks requiring the use of force. They should:

- remove unnecessary tasks;
- prevent double handling;
- prevent heavy carrying;
- provide rest breaks during heavy or repetitive work;
- provide shelf storage for heavier objects at waist level, smaller objects on high or low shelves; and

- provide such mechanical aids as trolleys, hoists, levers, adjustable height workbenches and seating, hooks and jacks, tools and equipment kept within easy reach.

Specific tasks may be to:

- lighten loads (break loads into smaller quantities);
- reduce bending, twisting, reaching movements;
- use two people to carry bigger loads; and
- prevent muscle strain and fatigue. This includes warming up before working, allocating time for rest breaks, and allowing time to gradually get used to a new job.

Statistics show that most of the victims of back strains are below the age of 20 or above the age of 60. This points to inexperience and lack of supervision and training in the former group, and to an accumulation of minor damage and decreasing physical resilience in the latter. As a rough rule of thumb, persons should not lift unassisted, weights greater than about 20kg. Reference should be made to the Manual Handling Code of Practice–Worksafe Australia. Observation of the few golden rules of lifting listed below could dramatically reduce the injury rate.

Dos and Don'ts

Dos

- Bend the knees, but not beyond a right angle.
- Keep the back straight, but not vertical.
- Lift using the strong thigh and calf muscles.
- Keep the centre of gravity of load and body in line with the feet.
- While carrying, clasp the load close to the body.

Don'ts

- Do not turn the body or head while lifting. Lift, then pivot on feet.
- Do not jerk or snatch. Slowly accelerate the load.
- Do not use the weak back muscles to lift.

REFERENCE DOCUMENTS

1991, Code of Practice for Manual Handling, NSW WorkCover Authority.

Manual Handling, CSIRO Minerals.

Manual Handling in the Meat Industry, WorkSafe Western Australia

1998, Boral OH&S Manual.

3.8 PERSONAL PROTECTION

Personal protective clothing and equipment (PPE) is often treated as if it were the only control measure needed to prevent occupational injury and disease. There are, however, other far more effective steps which should be taken first to control hazards at work.

Using PPE does not remove or even control a hazard. It just limits exposure. The hazard still exists. This means that the workplace is not intrinsically safe.

Properly used, PPE limits the exposure to a particular hazard, and although protective equipment is often calibrated, tested and certified to a certain level of effectiveness, it is still difficult to measure what level of protection is actually being achieved by the wearer. For example, if a noisy machine is replaced by a quieter machine, the new sound level can be measured. You can find out what level of noise employees are exposed to and determine whether this is safe. On the other hand, if earmuffs are issued to employees instead, the amount of noise getting through the earmuffs into employees' ears cannot be measured. All that can be measured is the damage done by the noise. Clearly, it's much more effective to control the hazard so that the PPE is not needed.

All employees who may be required to wear personal protective equipment should be instructed and trained to ensure that they understand when it should be used, how it should be maintained and its limitations.

3.8.1 USE OF PROTECTIVE CLOTHING AND EQUIPMENT

All employees who may be required to wear personal protective equipment should be instructed and trained to ensure that they understand when it should be used, how it should be maintained and its limitations. Other factors include the following.

- Selecting and using PPE can be an effective part of the health and safety program in the workplace, but it will only work if it is:
  - selected carefully;
  - used and maintained properly; and
  - monitored carefully.
- Employers and contractors must provide all equipment.
- Personal protection devices must be worn in all designated hazardous areas.
- Adequate protection for the entire body should be available.
- Sampling or testing should be carried out at each work site to gauge the level of exposure of staff to hazards and to determine if exposure is safe.
- Equipment and machinery should be built and installed in line with Australian engineering practices.
- It is better to install reliable engineering equipment than to rely on personal protection equipment.
- Australian Standards set out technical standards which all items of PPE should meet, and the Australian Standards sign appears on all items of PPE which are manufactured according to the relevant standard. There is an item of PPE on the market for just about every part of the body. These include the following:
  - *Headwear*: to protect the head from chemicals, the sun, or blows from falling objects–safety helmets, hats, balaclavas or hoods.
  - *Eye protection*: to protect the eyes from chemicals, the sun, flying objects–safety glasses, sun glasses or chemical goggles.
  - *Ear protection*: to limit exposure to damaging levels of noise–earmuffs, earplugs.
  - *Hand protection*: to protect hands from cuts and abrasions, and chemicals–gloves.
  - *Feet protection*: to protect the feet from chemicals, and blows from falling objects–rubber boots or steel-capped boots.
  - *Body protection*: to protect the body from bad weather, chemicals, the sun, falls and flames–bluey jackets, aprons, overalls, shirts, trousers, safety belts and harnesses.

- *Respiratory protection*: to prevent breathing in too much of a poisonous substance-air-purifying respirators which reduce the amount of poisonous substances in the air being breathed, and supplied air respirators which provide clean air.

On its own, PPE will not be effective in reducing workplace injury and disease. Its use must be part of the overall health and safety strategy in the workplace. The effectiveness of most types of PPE is drastically reduced if they are not used constantly.

3.8.2 SELECTION OF PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

The most important consideration in the selection of PPE is the nature of the hazard. For example, in order to select appropriate hearing protectors, the precise characteristics of the noise in the workplace needs to be identified. The correct types of hearing protectors can then be identified for the main frequencies of noise in the workplace.

In the case of respiratory protection, the range of airborne chemicals must be identified and their concentrations measured. Different types of respirators and different types of filters protect against exposure to different chemicals. For example, an acid gas filter is not appropriate when there are dangerous levels of ammonia in the air.

As well as the detailed hazard evaluation, you must consider the following:

- Relevant Australian Standards, Codes of Practice and Regulations. A number of Australian standards provide guidance on the selection of appropriate PPE (for example, AS 1270 1983 Hearing Protection Devices; AS 1715 1982 Selection, Use and the Maintenance of Respiratory Protective Devices).
- The range of PPE required for a specific workplace environment to protect against more than one hazardous element. If several different items of PPE are needed, the constraints on wearing them all at once must be taken into account. For example, if a respirator and safety glasses are needed, a full-face respirator may be the best option. Safety glasses may not sit properly and may also prevent proper sealing with a half-face respirator. Likewise, if a safety helmet and hearing protection are both required, special types of equipment may be your best option. Some safety helmets come with earmuffs already attached to the helmet. If the noise reduction characteristics of these models are appropriate, these helmet and earmuffs combination can be more comfortable and effective than helmets and earplugs.
- The use of PPE must be carefully monitored.

Common problems with PPE may include the following:

- *Lack of protection as claimed on equipment*: If equipment is not manufactured to strict standards and is not carefully maintained, it will not perform the job it is supposed to do. Make sure that all PPE used in your workplace is marked with the Australian Standards symbol, and is maintained according to the manufacturer's specifications. It is an employer's responsibility to ensure that this is carried out.
- *Discomfort and difficulty working*: PPE is often uncomfortable, making it difficult to work effectively. This may cause stress, increase the time spent working in dangerous environments, and make it less likely that PPE will be used to the full extent it should be. By using PPE only as a last resort for protection, it is possible to reduce the amount of PPE needed, and the length of time it has been worn.
- *Inability to see or hear properly*: Some equipment or clothing may limit employees' field of vision or hearing range. As well as making it difficult to work effectively, if employees can't see or hear properly, then they may be unable to see or hear warnings. There may, therefore, be more risks from the other types of accidents on the job.
- *False sense of security*: Wearing PPE may give a false sense of security, so that not all of the other, far more important, necessary precautions are taken. For example, safety gloves will not be much protection if a

chemical is dripping down an employee's arm. It is essential that all other control measures are followed, even if PPE is worn.

- *Diverts attention*: Use of PPE may divert attention from more effective control measures, such as redesign of processes and substitution of materials. It is essential that other control measures continue to be tried even when PPE is in use. (For example, earmuffs might continue to be used by operators of a very noisy machine, even when a cheaper, quieter machine is available simply because PPE has become the approach to occupational health and safety.)
- *Infection*: Infection may result unless PPE is personally issued and fitted; cleaned regularly and thoroughly; maintained properly; and employees are trained in its use. (For example, sharing respirators is certainly one way to spread colds and flu, and wearing dirty earplugs can cause ear infections.)

Remember: The use of personal protective clothing and equipment does not remove the hazard. All it does is to reduce the risk of injury or disease as long as it is selected carefully, used and maintained properly and employees are trained in its use.

3.8.3 HEAD PROTECTION

3.8.3.1 SAFETY HELMETS

Any persons likely to bump their heads or to be hit by falling objects must wear protective helmets. These are compulsory for all employees, contractors and visitors in designated Safety Helmet Areas.

Types of helmets needed at different sites are set out in AS 1800 1981 The Selection, Care and Use of Industrial Safety Helmets and AS 1801 1981 Industrial Safety Helmets (incorporating amendment 1). Managers should determine conditions and sites where head protection is not required.

Attachments such as earmuffs, visors, lamp brackets and cable clips can be fitted to safety helmets.

Bump/laceration hats must not be substituted for safety helmets where these are required.

Wide-brimmed hats will be required for employees working outdoors for the protection from heat stress.

Hoods may be required on their own or in conjunction with respiratory protection for certain hazards, for example, heat stress environments, abrasive blazing.

3.8.3.2 HAIR NETS

Staff with long hair or beards that could be caught in machines should tie hair back or wear protective hair nets.

3.8.3.3 EYE PROTECTION

Safety spectacles with side shields should be used in all areas where there is the possibility of eye damage from flying particles.

Goggles should be used when extra eye protection is required, for example, grinding.

Face shields provide additional protection for high temperatures, high density/impact particles or against chemical splashes, for example, washing concrete trucks with diluted hydrochloric acid.

Eye-protection equipment should comply with:

- AS 1336: Recommended Practices for Eye Protection in the Industrial Environment;
- AS/NZS 1337: Eye Protectors for Industrial Applications; and
- AS/NZS 1338: Filters for Eye Protectors;

Mine operators may choose:

- conditions under which eye protection aids are worn in mines; or
- sites in which eye protection aids are worn in mines, or both.

However, employees may request provision of eye protection in any location with high air velocities, or for specified tasks.

3.8.3.4 HEARING PROTECTION

Hearing protection must comply with Australian Standards:

- AS 1269–Occupational Noise Management; and
- AS 1270–Acoustics–Hearing Protectors.

Earmuffs are the hearing protection choice in most workplaces. They are available in light, medium and high-performance models, depending on the degree of sound attenuation required. Selection is also on basis of attenuation of the different frequency components of the offending noise. Replacement cushions are available, as are absorbent liners, to minimise irritation from sweat. Earmuffs suitable for wearing under welding helmets are available.

Earplugs should be available as an alternative for people who experience difficulty with earmuffs, as long as they provide sufficient sound attenuation for the work situation. The types that can be inserted into the ear using a small tag attached to the external part of the plug are preferable to the types that have to be rolled between the fingers.

Earplugs will give the stated protection ONLY if they are correctly inserted into the ear canal.

3.8.3.5 RESPIRATORY PROTECTION

Respiratory protection must comply with Australian Standards:

- AS/NZS 1716–Respiratory Protective Devices; and
- AS/NZS 1715–Selection, Use and Maintenance or Respiratory Protective Devices.

Careful assessment of the respiratory hazard must be made to ensure the correct degree of protection is given to employees.

Disposable Respirators are available in different thicknesses, and must be discarded when resistance to breathing increases or when breakthrough of vapours is suspected (for example, increase in smell of filtered air).

Caution: Single-strap disposable respirators are not to be used in the workplace unless they conform with AS/NZS 1716. Verify this by the markings on the mask or by contacting your supplier of the masks.

Half and Full-Face Respirators are to be used in conjunction with the appropriate filter for the hazard in question. Use only filters (or cartridges) with the same brand name as the respirator mask. Powered Air Purifying Respirators (PAPR) provide a purified positive pressure air stream by drawing air through filters using a battery-operated pump worn on the person.

Air Line Respirators provide a pure air supply from a remote air source. Use these where the oxygen content of the atmosphere is deficient or uncertain.

Self Contained Breathing Apparatus (SCBA) are to be used when maximum respiratory protection is required and there is space for the employee to carry out the task required while wearing air tanks. Time of use will be limited by tank capacity.

Self-rescuer masks

Managers should gauge the risk level at all sites and then determine when, where and what type of breathing protection to provide. Managers also should stipulate:

- conditions and mine areas in which self-rescuer masks (protective mouth and nose pieces made of chemical gauze to filter air) should be used, carried, or worn;
- distribution point(s) and availability of self-rescuer masks;
- purposes for which self-rescuer masks are to be used; and
- testing and maintenance requirements for self-rescuer masks.

Respirators

Particle size ranges are important when considering respiratory protection. Large particles usually are unable to enter lungs, while very small particles are inhaled and exhaled without being retained in the lungs. Other particles in the respirable range (see figure 1) can be dangerous if they enter and remain in the lungs.

Filter-type respirators are not suitable for sites with depleted oxygen levels. A comprehensive guide to selection, use and maintenance of respiratory protective devices is in AS/NZS 1715: 1994 Selection, Use and Maintenance of Respiratory Protective Devices and AS/NZS 1716: 1994 Respiratory Protective Devices.

TABLE 3.1 GAS AND VAPOUR FILTERS

TYPE	APPLICATION
A	Vapours of organic solvents (boiling point >65°C)
B	Acid gases (chlorine, hydrogen sulphide, hydrogen cyanide)
E	Sulphur dioxide
G	Agriculture low vapour pressure pesticides
K	Ammonia
Hg	Mercury
NO	Oxides of nitrogen
AX	Organic vapours (boiling point <65°C)

TABLE 3.2 GENERAL CLASSIFICATION FOR FILTERS

TYPE	CLASS	FILTER PERFORMANCE	
Gas & capacity vapour	1. (Disposable & Cartridge)	Low (L)	absorption
	2.	Medium (M)	capacity
	3. (Canister)	High (H)	capacity
Particulates	P1	(L) –	used for mechanically generated particulates
	P2	(M) –	used for mechanically & thermally generated particulates
	P3	(H) –	for all particulates, including highly toxic materials

The three main categories of air-purifying respirators include:

- gas filter respirators;
- particulate filter respirators; and
- combined gas and particulate filter respirators.

Filter respirators are available in various configurations with many combinations of face pieces and filters. Some recognised suppliers are listed towards the end of this section.

Caution: Gas filters will not provide protection against dust, and dust filters will not provide protection against gas.

In the context of respiratory protection, the term "particulate" refers to any solid or liquid particle suspended in air, including dusts, mists, smokes and fumes. The term "fumes" refers to particles resulting from the heating of a solid to such an extent that it vaporises and then condenses into small particles in the surrounding air.

Fumes are not gases and vapours. ("Nitrous fumes" is commonly used in mining terminology to describe oxides of nitrogen gases.)

Classification of filter respirators

Table 3.1 shows types and applications of gas and vapour filters.

Table 3.2 shows the general classification for vapour and gas as well as particulate type filters. There are combination gas and particulate filters (example: 1-P2 filter) which have low absorption capacity for gases and are suitable for mechanically and thermally generated particles.

Particulates can be generated from mechanical activities including grinding, blasting, mixing powders, spraying and sanding. Mechanical particulates include:

- silica dust;
- coal dust;
- lead dust;
- mists; and
- asbestos fibres.

Welding, brazing and smelting create thermal particulates. These include:

- lead fumes;
- zinc oxide;
- welding fumes; and
- chromium fumes.

Respirator selection

Respirator selection is determined by:

- contaminant – nature/type (gas or particulate), toxicity, exposure standards, concentration;
- task – frequency and length of time for completion, location, maintenance; and
- facial size, an operator's acceptance and comfort.

It is important to ensure concentration of contaminants that the wearer breathes in are below the accepted level (usually the threshold limiting value [TLV]).

Selection is done after evaluating the likely range of contaminant concentration.

Do not use filters of one brand in the facepiece of another.

Respirators must fit the face to ensure maximum protection.

Contaminants may be inhaled, bypassing the canister or filter in facepieces that do not fit. Facial hair may prevent and effective fit and seal.

Fit respirators and test them before issuing.

One method to test how well respirators fit is to gauge the wearer's ability to taste a saccharine aerosol. Put 0.83% sodium saccharine solution in water in a nebuliser. Kits are commercially available. Before fit-testing, establish that the wearer is able to detect the aerosol taste. Alternative testing methods are available and may be more suitable for different applications.

Replace gas and particulate filters when:

- masks become difficult to breathe through or if they are damaged and no longer sealed (particulate filters collect dust that inhibits the flow of air); and
- an odour is detected in the inhaled air. Gas filters use sorbents and have a limited life. Half-facepiece gas and vapour respirators are only suitable for contaminants that can be detected by taste, smell or irritation before threshold limit values are reached, or after a predetermined period of time where they are in continuous use. Caution should be exercised if the contaminant is hard to sense.

Maintenance

Generally, all maintenance programs should follow manufacturers' instructions and include:

- cleaning and disinfecting equipment;
- storage;
- repair;
- inspection for defects; and
- an inspection record.

A used gas filter should be marked unusable and disposed of.

Inspect disposable respirators to determine if:

- the filter has holes;
- the straps are strong; and
- the metal nose clips need tightening.

Discard defective respirators.

Inspect reusable air-purifying respirators (half and full-face pieces) to ensure:

- they are clean and have no cracks, tears, holes, scratches or loose lenses, and are not distorted;
- head straps still have elasticity, and are not

torn or broken, and buckles are not serrated or worn;

- no valves are missing, all valves are free of dust and dirt, and valve covers are sealed; and
- correct types of filters are being used, gaskets and threads are not missing or worn, storage is secure, and the service date has not expired.

Half-face piece respirator suppliers list

Generally, use half-facepiece respirators for protection in conditions up to 10 x TLV (1 000 ppm). Greater protection requires the use of a full-facepiece. Do not use P1 filters for protection against highly toxic dusts such as salts of hexavalent chromium and cyanide, beryllium and arsenic.

Most suppliers of half-facepiece respirators can also give details on other types of face protection.

The following suppliers can assist operators in preliminary inquiries.

Disposable Respirators

- Particulate Filters P1 (low capacity)
  MSA Australia Pty Ltd
  Norton Pty Ltd
  3M Australia Pty Ltd
- Particulate Filters P2 (medium capacity)
  3M Australia Pty Ltd
- Gas and Vapour Respirators Class 1 (low capacity)
  3M Australia Pty Ltd

Replaceable Filter Respirators

- Particulate Filters P2 (medium capacity)
  MSA Australia Pty Ltd
  Protector Safety Pty Ltd
  Sundstrom Australia Pty Ltd
- Gas or Vapour Respirators, Class 1 (full-facepieces with these filters are Class 2)
  MSA. Australia Pty Ltd
  North Safety Industries Inc.
  Protector Safety Pty Ltd
  Sundstrom Aust Pty Ltd.
- Gas and Particulate Respirators
  MSA. Australia Pty Ltd

Other suppliers include: Draeger Australia Pty Ltd, Fire Fighting Enterprises (Australia) Ltd, James North Australia Pty Ltd, Siebe Gorman Australia Pty Ltd, and Safety Equipment (Australia) Pty Ltd.

This list is not comprehensive and is a guide for operators.

3.8.4 HAND PROTECTION

Hand protection must comply with AS/NZS 2161 1-9 Occupational Protective Gloves.

Gloves are available in many different materials, depending on the protection required (for example: cotton, rubber, PVC, viton, stainless steel mesh, kevlar, leather. Selection must be based on the protection required for the particular hazards involved. They may be of wrist or elbow length).

Barrier Creams should be available at all work locations where materials are handled that are likely to cause skin irritation (for example, solvents, oils, grease).

Industrial hand cleaners care must be taken to use cleaners that will not damage the skin, which may occur if the cleaner is unduly abrasive, has a high pH, or contains solvents.

3.8.5 FOOT PROTECTION

Foot protection must comply with a joint Australian & New Zealand Standards AS/NZS 2210.1 to 9 2000/01 Occupational Protective Footwear.

Safety footwear such as steel-capped boots, shoes or waterproof boots should be compulsory, except where there is absolutely no risk of foot injury (for example: offices, cafeterias or plant control rooms. A wide variety of styles and fittings are available).

Leather spats are available for wearing over shoes/boots to prevent welding sparks from dropping into the footwear.

Staff working on broken ground should wear footwear that gives ankle support and metatarsal protection. AS 2210 does not give complete guidance, and general managers should also refer to Canadian Standard CSA Z195 – M92 Protective Footwear.

3.8.6 BODY PROTECTION

Staff working close to machinery must wear close-fitting and close-fastened garments that cannot get tangled in machinery. Do not wear jewellry or personal ornaments near machinery.

Advice on suitable clothing is in AS 3765.1 1990 Clothing for Protection Against Hazardous Chemicals: Protection Against General or Specific Chemicals and in AS 3765.2 1990 Clothing for Protection Against Hazardous Chemicals: Limited Protection Against Specific Chemicals.

Polyester/cotton blend uniforms should be avoided whenever employees have to perform welding or flame cutting tasks where there is a potential risk of fire (for example: handling LPG, or where heat stress or hot ambient conditions prevail).

Cotton uniforms should be provided in the above situations, and, if necessary, flame-retardant material should be used.

Overalls are required to protect people when engaged in dirty tasks, and may be cotton or disposable.

Aprons may be made from rubber, PVC, or leather, and may be heavy or lightweight. They are required when extra body protection is needed (for examplel, welding, handling chemicals).

Jackets are required for protection in cold weather, may be “parka”, “Bomber” or “Bluey” style, and are made from wool or water-resistant material.

Sleeves, knee pads and elbow pads are all available for extra protection when required.

3.8.7 FALL-ARREST DEVICES

Fall arrest devices must comply with Australian Standards:

- AS/N25 1891 – 1983 Industrial Fall-Arrests Systems and Devices.

Fall-arrest equipment should be designed and used to reduce the possibility of injury if a worker falls.

Safety belts and harnesses, lanyards, safety lines, descent-control units, fall arresters and safety attachments for ladder work are available. Advice may be needed to determine the most suitable equipment for a particular job. Thorough training in the use of these devices is essential as serious injury can result if they are incorrectly used.

3.8.8 WELDING PROTECTION

The hazards associated with welding require special protection for employees, including:

- welding helmets incorporating a shade filter cover lens;
- leather aprons;
- spats, leggings;
- gloves; and
- respiratory protection when necessary.

REFERENCE DOCUMENTS

Occupational First Aid Manual, St John Ambulance, Australia.

Australian First Aid Manual (Vol 1 and 2), St John Ambulance, Australia.

AS 1270 – 1988 Acoustics Hearing Protectors.

AS 1319 – 1994 Safety Signs for the Occupational Environment.

AS/NZ 1336 – 1997 Recommended Practices for Occupational Eye Protection.

AS/NZS 1337 – 1992 Eye Protectors for Industrial Applications.

AS/NZS 1338 Filters for Eye Protectors.

AS/NZS 1715 – 1994 Selection, Use and Maintenance of Respiratory Protective Devices.

AS/NZS 1716 – 1994 Respiratory Protective Devices.

AS 1800 The Selection, Care and Use of Industrial Safety Helmets.

AS 1801 – 1997 Industrial Safety Helmets (incorporating amendment 1).

AS/NZS 1891 – 1995/2001 Industrial Fall Arrest Systems and Devices.

AS/NZS 2161 – 2002 Occupational Protective Gloves.

AS/NZS 2210 Occupational Protective Footwear.

AS 2430 Classification of Hazardous Areas.

AS 3765 1990 Clothing for Protection Against Hazardous Chemicals.

SAA HB 13 1992 Electrical Equipment for Hazardous Areas.

"Personal Protective Equipment" Section B4, Princeton University Health and Safety Guide.

"Boral OH&S Manual", Boral.

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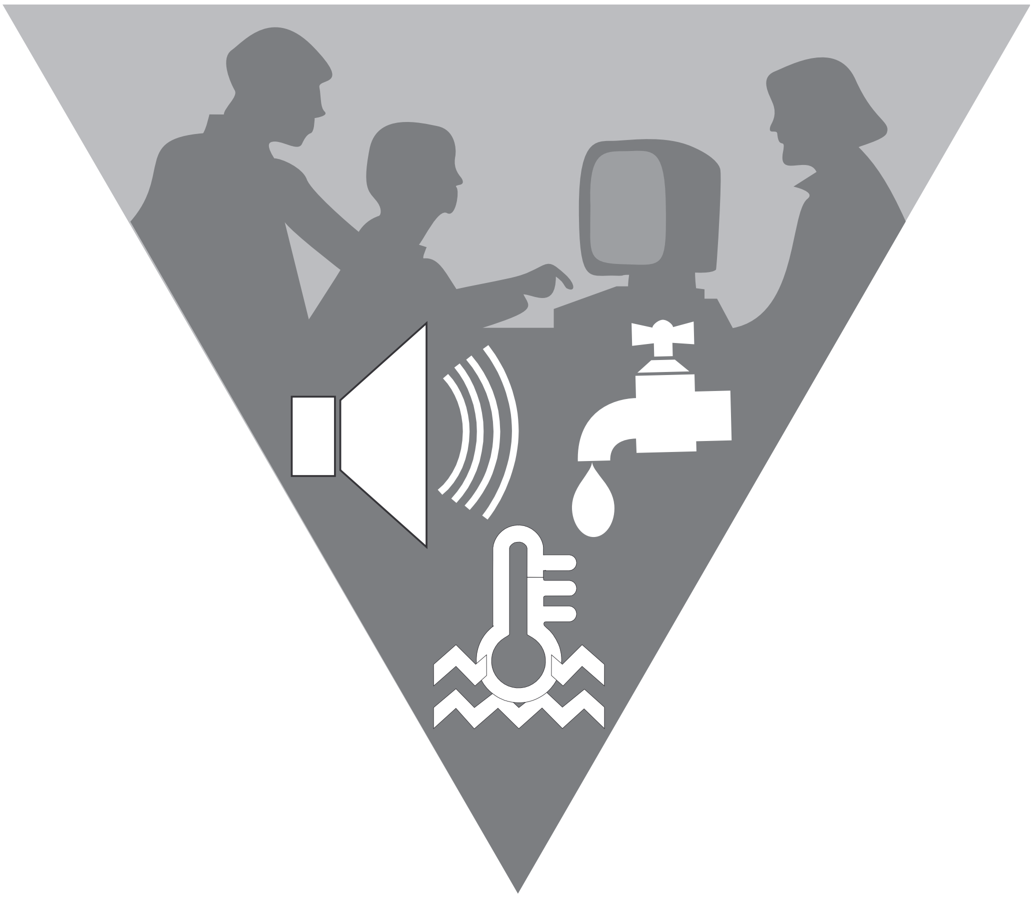
PART 4

WORKING ENVIRONMENT



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PART 4: WORKING ENVIRONMENT

4.1 FEASIBILITY, DESIGN AND PLANNING

Safety and health should be an integral part of planning and design in all phases of a project such as exploration, construction development, commissioning, operation, maintenance, modification, decommissioning and rehabilitation. Design and planning should be integrated with all other management systems and include proper risk assessment with the primary aim of eliminating hazards through good design.

A procedure should be developed which enables:

- consultation with potential operating personnel in the development stage;
- the use of appropriate standards;
- a risk management approach;
- control over modification;
- a systematic recording procedure for designs and plans;
- a systematic recording procedure on decisions; and
- appropriate stages of review, verification and validation.

4.1.1 IDENTIFY CORE RISKS

It is essential that core risks be identified when new mining operations or methods are considered. These core risks should be identified at the beginning of a feasibility study. This will help to review different mining methods or options to assist in removing or controlling core risks.

When the mine design is proposed, strategies to deal with core risks need to be planned as a part of the design. This planning should aim to eliminate or control core risks to acceptable levels during the life of the mine.

4.1.2 REVIEW CORE RISKS

During the feasibility or design stage, the project should be reviewed by an independent audit team, which is external to the project design team. The audit process should look at the safety, financial and technical parts of the project and assess whether the core risks have been identified and are being controlled.

A review of core risks should be repeated at regular stages of the project - during the planning through to the operational stages. The review should consider any changes that have been made during planning and design. This is to ensure that any critical safety-related decisions and strategies are still appropriate. These reviews do not need to be done by external teams.

The person(s) responsible for carrying out the reviews, and for any actions arising from them, should be clearly defined and managed according to the Mine Safety Management System and its procedures and processes as outlined in Parts 1 and 2 of this Handbook.

4.2 EXPLORATION

4.2.1 GENERAL

Most exploration activities involve the use of uncommon or heavy equipment. Activities may vary from track and gridline cutting to earthworks by bulldozers, or deep diamond drilling with large drill rigs, or aerial surveys with small aircraft, and are normally carried out by specialist contractors. It is therefore often necessary for exploration companies to engage contractors at an early stage in any program and it is important that the contractor/principal relationship is properly established at this time. The mine operator must establish the suitability of the contractors safety systems and safe work procedures at the time of tendering for the work. The selected contractor must also accept delegation of any appropriate statutory responsibilities.

Surface prospecting and soil and rock sampling often involves one or a small number of persons travelling on foot or in light vehicles in remote and hostile locations. This work will require careful planning and preparation to ensure communications, equipment and supplies are adequate for the task and duration. Training in bush sense and survival in hostile environments is a requirement for all personnel. Additional training may include using a four-wheel drive vehicle and being aware of potential hazards before work is undertaken. Developing a document that outlines emergency procedures as well as field survival procedures is suggested. This document should be always available and can then be referred to if required.

4.2.2 INDUCTIONS AND TRAINING

(Reference: Queensland Minerals Exploration Safety Guidelines)

Everyone involved in exploration, including employees, consultants, contractors and visitors should undergo formal basic induction training on all relevant aspects of safe working practice before starting employment.

Induction should be carried out by suitably qualified persons and on completion this should be recorded and acknowledged by the participant in writing.

Inductions should be considered in two parts, a general induction covering common requirements for all exploration activities and a specific induction for the particular site and type of exploration being undertaken. Refresher inductions should be conducted as required and appropriate. A shorter induction may be appropriate for visitors.

All involved in exploration work should be trained so that they can carry out their work in a safe and competent manner.

Topics for inclusion in General Inductions and Refresher Inductions, depending on the work to be carried out and the location, could be as follows.

4.2.2.1 GENERAL

Occupational health and safety

- relevant company health and safety policy and safety management systems;
- relevant standard operating procedures;
- assessment of hazards in the field;
- use of all types of personal protective equipment including sun protection, sun and safety glasses, safety footwear etc;
- safe use of hand and power tools;
- safe practices around drill rigs and heavy equipment;
- house keeping and basic hygiene whilst camping;
- need to carry or have access to potable water;
- ensuring work plans and destinations are known by others;
- advising companions of allergies and afflictions;
- correct practices for manual handling of equipment;
- hazards associated with petrol, diesel fuel, LPG, other flammables and chemicals;
- fire prevention, fire fighting and bush fires;

- company policy on drug and alcohol usage;
- general communications with companions;
- reporting safety incidents; and
- emergency procedures.

First aid

- explanation of principles of Danger, Response, Airways, Breathing, Circulation (DRABC);
- treatment of sunburn and other burns;
- treatment of snake, spider and scorpion bites;
- stemming bleeding and treating broken bones;
- dehydration and heat exhaustion;
- exposure and hypothermia;
- treatment of shock; and
- contents of various first aid kits, their use and their locations.

Radios and communication

- need for regular communication between field parties and base;
- company Standard Operating Procedures;
- search and rescue procedures;
- thorough instruction in and demonstration of use of transceivers, installation of aerials, use of frequencies, selcall, radio telephone, Royal Flying Doctor Service (RFDS) network; and
- maintenance of equipment.

Vehicle/driver awareness and driving techniques

- attitudes to road safety, road rules, traffic laws and responsibility towards passengers and other road users;
- driving practices for prevailing conditions;
- driver fatigue, safe driving periods and rest intervals;
- basic vehicle spares;
- understanding four wheel drive vehicles and practising relevant driving and recovery techniques;
- vehicle daily checks, maintenance and road worthiness; and
- vehicle loading, carrying capacity and towing procedures.

Bush sense and survival skills

- correct use of maps, compasses and GPS units;
- planning daily work schedules and notifying others of the schedules;
- vehicle breakdowns, staying with vehicle, parking in clear area;
- knowledge of contents of first aid and survival kits;
- basic survival skills and preparation of a survival plan; and
- awareness of weather reports.

4.2.2.2 SITE-SPECIFIC

In addition to the General Induction it is essential that each person is fully aware of relevant health and safety policies and of the work and hazards at specific exploration sites or for each exploration program. These should be discussed at initial site meetings and reviewed periodically.

Topics for site-specific inductions include:

- special emergency procedures for the area being explored including specific emergency contact numbers and names, airstrip locations and dimensions;
- safety aspects of the particular geographical area such as climatic conditions, vegetation, plant species, isolation, access, tides, river flows, dangerous animals and insects;
- safety aspects of particular exploration methods;
- equipment to be used such as earthmoving equipment, drill rigs, helicopters and boats;
- land use hazards and practices including electric fences, herbicides/pesticides;
- potential hazards such as ground water, gas and liquids under pressure in drill holes, surface and underground excavations, toxins

such as cyanide or arsenic around abandoned sites and radioactive ores; and

- local community contact.

4.2.3 FIELD WORK

An important aim should be to develop and improve the systems employed in managing safety and not simply fix one issue.

An attempt should be made to identify all potential hazards prior to any field work being undertaken. The risks associated with those hazards should then be assessed and control measures should be determined to eliminate or minimise those risks.

4.2.3.1 PROSPECTING, MAPPING AND SOIL/ROCK SAMPLING

Traversing remote areas should be carried out at least in pairs wherever possible.

Working alone is a common exploration hazard. No one should ever work alone in a high risk situation. This would include using motor-driven equipment. When identifying potential hazards for persons working alone the following could be taken into account in addition to specific hazards for the particular work to be undertaken:

- topography;
- climate;
- preparation time available;
- level of training;
- experience;
- communication and check in procedures;
- availability of maps and Global Positioning System (GPS) equipment;
- accessibility of area; and
- availability of support or assistance in emergencies.

Issues for system and procedures development for work in the bush include the following.

- Induction and Training – to include basic issues relating to first aid, communications, driving techniques, bush sense, navigation and survival.
- Personal Care and Hygiene – to include special training for remote locations relating to cleanliness of body and clothing and prevention of minor ailments and injuries.
- Camp Management – to include issues of comfort, cleanliness and waste management.
- First Aid – the level of training and equipment to be appropriate for the work and the degree of isolation.
- Communications and Emergency Procedures – the level of system development to be appropriate for the type of work and the degree of isolation. Assistance in times of emergency must be assured within a reasonable period of time.
- Vehicles and Travelling – to include an appropriate choice of properly equipped vehicle for the distances and landforms to be traversed. Training in advanced driving techniques and vehicle maintenance will reduce the chances of being stranded or an incident arising. Consideration of the most appropriate times to travel should be made to minimize the risk of colliding with kangaroos and other animals.
- Sampling Procedures – to include correct methods of taking samples so as not to cause bias in selection, and method for recording sample locations. Adequate allowance must be made for transport of samples, in both volume and weight, back to assay laboratories. Allowance to be made for personal protective equipment, particularly eye protection during rock chip sampling.

4.2.3.2 TRACKS AND GRIDLINES

The route of vehicle tracks should be chosen carefully, especially in rough or hilly terrain and should preferably be traversed on foot initially. Steep gradients and slopes may need survey control.

All handtools and chainsaws should be properly maintained and only used by trained operators.

Large trees should be felled only by experienced persons and only in accordance with environmental licence conditions.

Earthmoving equipment should be operated only by properly trained and approved operators.

4.2.3.3 SURFACE EXCAVATIONS

Trenches, costeans and pits present hazards to those working at the bottom or sampling the sides of the excavation.

Standard work procedures for excavating and working in trenches, costeans and pits must be developed.

- Equipment should only be driven by trained and competent operators.
- Keep clear of large equipment while it is working.
- When approaching a machine, establish visual contact, signal operator, and approach from the front in view of operator.
- Batter the sides of an excavation or shore up with suitable supports.
- Avoid deep, narrow trenches.
- Check sides and surroundings for faults and planes of weakness that may collapse, particularly in wet conditions.
- People should not work alone in excavations.
- Highlight edges of an excavation with flagging and protect them from entry by persons or machinery.
- Leave excavations in a safe and stable condition at the end of the work.

4.2.3.4 ABANDONED MINES

Exploration activities often occur adjacent to old mine workings as extensions to known orebodies are investigated. Inspection and sampling of old workings can provide valuable information on the structure and direction of orebody extensions.

Entry into old mine workings, however, presents unusual and severe hazards which must be thoroughly assessed before attempting to go underground. People unfamiliar with underground workings will be placed at very high risk levels. Advice and support from experienced and competent persons in this area of work is suggested. Never enter high risk underground workings alone. Some of the physical dangers can include:

- unsupported and weathered ground that may collapse at any time;
- deteriorating ground support which appears sound but which may give a false sense of security;
- rotten timbers in shafts which may break under any load;
- rotten timber supports which may allow rockfalls if disturbed;
- corroded steel supports and rungs of ladders;
- open passes in drives not safely covered;
- hung up ore passes or shrink stopes;
- deep water and flooded workings;
- wildlife, such as snakes and spiders, which tend to congregate in old mine workings;
- diseases from bats, bat droppings and mould;
- oxygen deficient atmospheres;
- high carbon dioxide levels; and
- toxic or flammable gases.

Before entering old mines preparation and planning is needed which may include:

- discussions with previous owners or employees to determine the extent and condition of workings;
- studying old mine plans and reports that may be held by the government;
- seeking advice from experts;
- careful study of the surface for evidence of old shafts, stopes and underground collapses; and
- employing competent and experienced miners to carry out inspections and refurbishment of shafts and accesses to return the workings or part thereof to a safe condition.

4.2.4 AVIATION

When selecting contractors and types of aircraft to be used, consider:

- what will the aircraft be used for eg. ferrying staff to and from site, transporting equipment and aeromagnetic surveys;
- seating capacity, average and maximum loads to be carried, range required;

- contractor and pilot experience, reliability and record;
- liaison between contractor and exploration company so that each other's needs are fully understood;
- maintenance and servicing and fuelling arrangement;
- aircraft landing requirements; and
- adequacy of public liability insurance.

Companies should conduct their own review/audit covering safety procedures, training, pilot experience, maintenance, public liability insurance of charter operators. This review/audit should be carried out by independent external consultants who are recognised within the industry.

The pilot is in command of operations affecting the aircraft but total cooperation is needed from all those using it. Important issues to be remembered include:

- the pilot is the sole arbiter of safety. There should be no harassment, coercion or encouragement to act against the pilot's judgment;
- compliance with pilot briefings of passengers concerning in flight procedures, including emergencies, embarking/disembarking and general safety;
- the pilot is responsible for the loading of any cargo to the aircraft, including overall weight, position of items (balance), and the correct loading and packaging of both general and hazardous cargoes;
- the pilot's decision is final, but should conform with the Civil Aviation Safety Authority (CASA) regulations;
- the pilot should be briefed concerning passenger numbers, loads to be moved and destination;
- appointment by the company of a competent experienced person to be in charge of ground operations on remote airstrips;
- the weighting of articles is required when large loads are being considered; and
- it is mandatory to notify the pilot of the carriage of any Dangerous Goods (hazardous cargo) – refer CASA document CAA23/CAR262.

4.2.4.1 AIRBORNE SURVEYS AND LOGISTIC SUPPORT

All aviation operations in Australia are controlled by the Civil Aviation Safety Authority under the Commonwealth Civil Aviation Act and Regulations (CAA).

Selection of fixed wing or helicopter aerial surveying or logistics support contractors will need to consider the following.

- Suitability of the Aircraft – for transporting personnel and/or equipment to and from remote sites or solely for aerial surveys. No aircraft should be chartered unless the proposed charter company has been audited by aircraft consultants. A second hand verbal report is not sufficient. Aircraft should never be overloaded. Safety and survival equipment should be carried on all aircraft.
- Contractor and Pilot Experience – pilot and aircraft are often subcontracted and evidence of past reliability and performance should be obtained. It should be noted that most charted aircraft crashes are the result of pilot error. Pilots should have the training, experience and expertise for the conditions to be encountered. Pilots are limited by law on the number of hours they can fly in a given period.
- Navigation and Communication Facilities – these are important for remote sites, particularly when persons are being dropped off at isolated or unscheduled locations.
- Aircraft Support – maintenance, servicing, fuelling and landing requirements should be identified.
- Public Liability Insurance – adequate coverage should be sought for the type of operation planned.

Training is essential in regards to particular hazards around aircraft. These may include moving propellers and and rotor blades and being distracted when walking nearby, being aware of sloping ground around the aircraft which may bring a person closer to rotating blades, safe embarking and disembarking, obeying the pilot's directions, no smoking, use of emergency radio beacons, and location and use of other survival equipment.

Operations affecting the aircraft are always under the command of the pilot and total cooperation is needed from all those using it.

A competent and experienced person is to be appointed to be in charge of ground and airstrip or helipad operations.

4.2.4.2 FIXED-WING AIRCRAFT

(Reference: Queensland Minerals Exploration Safety Guidelines)

Airstrips

Airstrips should conform to CASA's Civil Aviation Advisory Publication No 92 – 1(I) Guidelines for Aeroplane Landing Areas.

General requirements for airstrips include:

- construction so that they are closed by only the heaviest rains;
- inspection daily before any aircraft movements;
- periodic maintenance inspection of regularly used airstrips by external consultants during safety audits;
- audit should consider:
  - layout, design and fencing;
  - maintenance, usage levels and wet season access; and
  - radio frequencies, survey diagrams and incident reports;
- inspection of infrequently used strips by vehicle or on foot before use;
- low-level flyover of unattended strips to check obstructions and startle animals into movement; and
- formal surveys with a summary location diagram to CAA standards kept at:
  - exploration company head office and appropriate campsites;
  - air charter operators' offices and in aircraft used regularly; and
  - Royal Flying Doctor Service (RFDS) operations base.

Night-time operations

In general, night flying operations should not be made in remote areas. The significant exception is the case of an emergency medivac by RFDS personnel.

Night-time operations by RFDS are only possible on airstrips registered with the RFDS as having suitable facilities. The pilot and aircraft should have suitable rating and instrumentation.

Boarding procedures

Light aircraft should be boarded some distance from the main passenger terminal, and always from ground level because of the danger of the propeller blades. A fixed wing aircraft which has its engines running, should not be approached until the blades stop turning. The pilot will direct passengers to the parts of the aircraft that they are allowed to approach.

Pre-flight briefing and operations plan

Before each flight, there should be a two-way briefing between the charter operator (usually the pilot) and the company person responsible for organising the flight. This meeting clarifies the roles and procedures of each person on the flight, the flight plan (destination and distance), confirmation of aircraft and fuel status, search and rescue frequency and location, and the communications frequencies to be used. Anyone with a potentially active role in procedures should be present at the meeting.

Flight plan and passenger list

The pilot should fill in a passenger manifest and leave this with the contract company or company base. For non-routine flights and flights exceeding one hour, way points will be agreed and acknowledged by the company spokesperson.

All company charter flights should use GPS navigation aids.

The flight plan for ferry operations can be simply stated. However, the size and location of the area in which aircraft will be operating during reconnaissance operations should be stated concisely. This may be by centre point in Australian Map Grid (AMG) or latitudes and longitudes and radius, or by specifying corner coordinates of the block to be covered.

The flight plan and a record of the passenger list should be left with the base ground party, on the day board. Estimated time of arrival (ETA) should be communicated to the flight destination.

A company radio base with a telephone can provide a backup to the Search and Rescue (SAR) watch facility in situations where communications with CASA may be unreliable (due to poor or doubtful radio reception). The company radio frequency to be used should be communicated and a full-time radio operator should be available.

Every flight should complete this notification and be acknowledged by the relevant authority/ company base, or else the mission should be abandoned.

The agreed company flight plan should not be changed unless the written records are amended and SAR notified before the flight plan is changed, even if it means an unscheduled return. To do so greatly increases the safety risk. Lodging larger than necessary location areas to gain increased perceived freedom of action should not be done.

Flight debriefing

On completion of a flight there should be a debriefing between the pilot, passengers and company representative at which any safety issues or concerns that may have arisen during the flight are discussed. If any concerns raised indicate any aspect of the flight was at risk then a formal incidents report should be made.

Aircraft operations record book

A durable fast bound book giving details of incoming flight times, passengers and nature of any freight should be kept at each remote site. Details of statistics and incidents collected as part of the formal safety management system should be cross-checked from site sources into an overall operations record book kept in the company office. Charter operators should also keep a record book of departures and ETAs as a backup.

4.2.4.3 HELICOPTERS

(Reference: Queensland Minerals Exploration Safety Guidelines)

Helicopters introduce new hazards into exploration that are not encountered in general aircraft operations. Their versatility introduces unusual hazards and risks. which must be controlled by careful selection of contractors and equipment, competency-based training for employees and strict compliance with rules and operating procedures. Margins for error are small. All operations must be conducted in accordance with the relevant CASA requirements.

Whilst the helicopter pilot is the key person in the safety chain, and must remain in total charge of the aircraft, all those involved in helicopter operations have important roles to play.

Helipad design

Appoint competent experienced person to be in charge of ground and helipad operations

Helipad requirements vary according to types of helicopter, frequency of landing, terrain, vegetation and type of work to be carried out. Helipad safety must be under the control of a competent experienced person who must have full authority on the ground.

Points to be considered include:

- size of pad must be fully discussed with contractor and pilot taking into account the helicopter type and size and the need for slinging loads;
- good all-round clearance is required for manoeuvring of helicopter and loads;
- vegetation must be sufficiently cleared to allow room for tail rotors and for approach and departure. A fully loaded helicopter may not be able to take off vertically. Dense low vegetation may absorb the downdraft and affect lifting ability;
- touchdown area must be clearly marked and any markers securely fastened down so they do not blow into rotors;

- pad design must suit local prevailing winds;
- wind speed and direction indicators should be erected at base camp helipads;
- fuel storage should be at a safe distance from pad;
- helipad should be kept clear of unauthorised persons, equipment and loose or light objects;
- only authorised person should give signals to pilot except in emergency;
- keep clear of tail rotor at all times and do not approach helicopter when main rotor blades are in motion unless authorised; and
- excessive rotor flopping can occur in gusty wind conditions.

Embarking and disembarking

Embarking and disembarking procedures vary according to the landing site. General rules include:

- wait until the pilot gives permission before approaching or leaving helicopter;
- always approach and leave from the front and remain in pilot's line of vision and in the 10 to 2 o'clock position;
- never walk behind or under the tail even when rotors are stopped;
- approach and leave in crouched position holding on to loose clothing and equipment;
- always secure doors and harnesses when leaving, do not jump on or off the helicopter; and if the aircraft is hovering, transfer weight gradually to avoid suddenly upsetting the balance of the machine;
- hats or safety helmets should be firmly fastened or carried in the hand;
- on sloping ground, approach and leave from the downhill side to avoid main rotor; and
- provide survival kits and communications systems at drop-off points in case the helicopter cannot return.

Loading and unloading

General rules for loading and unloading include:

- keep landing site clear of loose articles;
- carry tools at waist height, do not carry anything on shoulders, and do not throw articles in or out of the aircraft;
- use two people to carry long items and carry them horizontally;
- accurate assessment of load weight includes allowance for reduced lifting capacity at high altitude;
- check goods to be loaded with the pilot, especially batteries, fuel and LPG;
- hazardous cargo must be identified and packaging requirements adhered to;
- slinging loads beneath the helicopter is a specialised operation subject to Air Navigation Orders issued by the Civil Aviation Safety Authority. Sling loading may only be carried out if:
  - the helicopter has an approved supplementary flight manual detailing how the operations will be carried out;
  - slinging is in accordance with the manual;
  - the pilot has been trained and certified and has an endorsed licence;
  - passengers other than flight crew or those essential to slinging are not carried;
  - all personnel are suitably briefed by the pilot before hand;
  - only those authorised by the pilot attach/detach slings;
  - all precautions are taken by the pilot to ensure the safety of persons on the ground; and
  - unusual items are properly prepared for slinging, especially long items.

Signals and communications

Universally accepted hand signals exist for communication between ground and helicopter pilots. These include signals for helicopter movements, landing, slinging, winching loads and clear to start engines. Signals should only be given by trained and authorised persons, except in an emergency but it is essential that all of the exploration crew are familiar with them.

Do not rely on the helicopter radios as the sole means of communication.

Emergencies

Passengers should not be dropped off at isolated points or unscheduled locations unless they have a survival kit and a means of communicating with a base or emergency service, preferably by radio.

Points to be considered before starting exploration work include:

- copies of work area maps should be kept on the helicopter and at the base camp;
- all persons landed at a remote site must have food, water and a radio communications system landed at the site with them;
- ensure that you know where you are before the helicopter leaves; and
- if walking from the landing site, fly route to be traversed beforehand and carry emergency rations, signalling equipment etc at all times.

Emergencies can involve incidents with the helicopter itself or using the helicopter for evacuation of injured people.

Points to be considered for helicopter emergencies include:

- provision of survival kits on the helicopter containing water, food, tents and life jackets;
- first aid kit, compass, maps, signalling equipment, distress flares;
- Emergency Locator Beacon with both impact and manual switches;
- firefighting equipment on helicopter and at the helipad; and
- provision of survival kits and emergency communication to all persons dropped off at isolated or unscheduled locations.

Factors to be considered before transporting injured or sick people and which may adversely affect the patient include:

- atmospheric pressure changes which may cause severe pain to ears and sinuses;
- turbulence and vibration causing further pain or injury to those with fractured bones or internal injuries; and
- noise causing distress to those with head injuries.

4.2.5 VEHICLES AND TRAVELLING

(Reference: Queensland Minerals Exploration Safety Guidelines)

Many exploration fatalities occur in motor vehicle accidents and vehicle travel produces numerous other injuries. The most severe and obvious vehicle accidents are roll overs and head-on collisions, which often occur because of some combination of poor training, driver inattention, poor visibility, excessive speed, rough roads and poor maintenance. Severe injuries also occur due to vibration or poor seating causing long term back injuries, particularly when driving extensively over rough roads or striking holes or rocks. Other and often less severe injuries involve stationary vehicles, and arise during jacking, winching or loading operations, with some injuries arising from trailer hitching or unloading.

Each company should establish its own guidelines for safe operation of vehicles. All employees should be properly trained to drive the vehicles that they are expected to drive and in the driving conditions that they are likely to encounter. This applies to standard, off-highway and heavy vehicles. A maintenance routine at least equivalent to manufacturer's standards should be developed for each vehicle.

Suggested points for inclusion in safety guidelines are:

- vehicles should be driven only by those with a valid licence for that type of vehicle;
- all employees should pass a standard training program before being permitted to drive 4WD vehicles either on or off-highway. Periodic refresher courses should be held as required and for driver rehabilitation;
- vehicles should always be driven sensibly, with consideration for the comfort and safety of others;
- drivers must obey all traffic regulations and specific company rules;
- importance of not using alcohol or drugs when driving;

- properly fastened seat belts must be worn by all occupants whilst a vehicle is moving. Passengers must be properly seated within the cabin of the vehicle. No riding on the back of a ute;
- attention must be paid to safe loading of vehicles. Overloading must be prohibited;
- use of Walkman type tape players or hand-held mobile phones or radios whilst driving should not be permitted;
- tyres should be inspected for stakes and other weaknesses, which may cause a blowout at high speed, after each episode of off-road driving. Special and lower than standard speed limits may apply to vehicles fitted with off-road tyres;
- the mechanical condition of each vehicle should be checked by a responsible person daily and weekly in accordance with a specific check list and faults recorded; and
- all employees should be instructed in, and practice, tasks such as jacking, puncture repairs (particularly with split rim wheels) and winching in accordance with standard work procedures.

Some standard precautions which should be taken by all drivers and included in the training program are:

- drive at a speed to suit prevailing conditions and which will allow the vehicle to be stopped safely. The poor visibility/high speed/rough road combination of hazards must be avoided;
- proceed slowly through dust clouds, and be ready to avoid cattle or any other animals and vehicles which may 'suddenly' appear;
- do not attempt to pass a vehicle in a cloud of dust. A vehicle is easier to see in areas of poor visibility (dust, smoke, fog, rain, twilight) if headlights are on;
- plan long distance travel by road carefully and try to avoid travel at night. Rest frequently on a long trip to avoid travel fatigue and include a driver reviver stop at least every two hours; and
- get out of the vehicle and inspect any gully, creek crossing or rocky area that looks dangerous or difficult to cross.

4.2.5.1 VEHICLE ACCIDENTS

The following procedures are recommended for any person involved in a motor vehicle accident, or any person who wishes to help at an accident:

- make the scene of the accident safe so that no more injuries occur;
- see who is injured and assist them as best as you can;
- call for help on your mobile radio or phone, or if that is not possible, send for help;
- advise the police of any accident in which a person is injured; and
- collect information such as names and addresses of injured persons and witnesses, time, date and location, description of accident.

4.2.5.2 VEHICLE BREAKDOWNS

Mechanical problems can be minimised by sensible driving habits, frequent inspections and regular maintenance. A breakdown whilst on a field trip can lead to safety being compromised. Thorough checks of steering and braking systems are recommended after each field trip, with the vehicle on a hoist or ramp. Any faults should be recorded and repaired, preferably by a qualified mechanic, as soon as they are recognised. Recommended practice includes to establish daily and weekly mechanical and equipment check lists, which must be carried out by the person in charge of the vehicle.

Items in the daily checklist should include:

- tyres for pressure and condition;
- radiator, engine oil, steering, brake and clutch fluid levels;
- checks for leaks of any fluids;
- lights, batteries and electrical connections;
- two-way radio and emergency equipment;
- air cleaners, radiator fins; and
- underbody.

Items in the weekly checklist should include:

- tyres, wheels, wheel nuts etc including spares, all tools, breakdown and emergency equipment brakes, clutch, steering, fan/alternator belts etc;

- ensure that all necessary spare parts are available when travelling off-road or long distances such as extra spare wheel, fuses, globes, hoses, oil, coolant, belts;
- change mechanical and electrical systems only if qualified to do so; and
- check the underside of the vehicle during and at the end of each period of bush driving and when the vehicle arrives at the first stretch of graded road to remove any sticks, grass or items stuck in tyres or wheels and to check for damage.

4.2.5.3 VEHICLE EQUIPMENT

It is important that the vehicle is equipped to cope with emergencies, particularly when travelling long distances or off-highway. Emergencies could arise from accidents, breakdowns, being trapped by floods, fires, or by conditions preventing the vehicle from moving such as being bogged in mud or sand. In extreme conditions these emergencies could be life-threatening. A list should be made and fitted to each field vehicle showing the entire standard safety and emergency equipment to be carried by the vehicle.

Recommended equipment, depending upon the intended trip, includes:

- essential vehicle spare parts;
- jacks, chocks, fire extinguisher, tools to suit the vehicle;
- two-way radios with agreed radio schedules;
- dual batteries, long range fuel tanks or spare fuel suitably stored;
- jumper leads of adequate capacity;
- winches, shovels, picks, axes, ropes and other recovery equipment;
- emergency signalling equipment, survival kits, first aid kits;
- adequate supplies of food, water and fuel;
- current edition maps or air photos; and
- spare ignition keys.

4.2.6 EXPLOSIVES AND DANGEROUS GOODS IN EXPLORATION

Regulations on the use, handling, transport and storage of explosives and dangerous goods together with the appropriate Australian Standards AS 2187 for Explosives, AS/NZS 1596 the Storage and Handling of LP Gas, AS 1940 SAA Flammable and Combustible Liquids should be known and followed.

4.2.7 EXPLORATION DRILLING

4.2.7.1 PLANNING DRILL SITES

Poor site layout can contribute to accidents at drill sites.

Points that should be considered when planning and preparing a drill site include:

- provision of clear access for support trucks and service vehicles, particularly if the rig will operate at night;
- identification and assessment of existing potential hazards such as power lines, flood paths, ground instability and fire before earthworks begin;
- clearance of dangerous trees and branches;
- planning of the layout of auxiliary equipment for safe access;
- provision for shelter, rubbish disposal and sanitary facilities;
- provision for separate storage area for fuels and chemicals away from drill rigs;
- drainage of rainwater and placing material or matting on the ground to minimize any slippery surface for persons to work on;
- containment of process water in a manner so that people cannot slip into any deep water;
- provision away from the immediate drill area for parking;

- arranging for noisy equipment, such as generators, to be as far away as possible from regular work areas; and
- provision of clear escape routes in case of emergency. Seek to identify more than one escape route to the nearest additional support and communication sources.

4.2.7.2 SELECTING DRILL RIGS

The size and capacity of drill rigs will vary, depending on the depth of hole to be drilled. Additional support vehicles may be required to carry the rod string and pump equipment in deeper holes also.

The use of contractors is normal practice in this phase of an exploration program. Issues affecting the safety of all persons must be made clear to all parties. The management process to deal with those issues should be stated within a contract document and details documented within a jointly agreed safety management plan.

General principles involving the selection of drill rigs are:

- select drill rigs that reduce hazards by their design, such as hydraulically operated clamps and hydraulic rod handling which reduces the need for manual handling;
- select the right drill rig for the work to be carried out. Consider the safety issues involved, such as any additional forces that could be generated if a breakthrough into underground workings could take place;
- determine if the rig owner has carried out any modifications to the drill rig, such as the mast which may compromise its structural integrity; and
- determine if rig owners have a documented safety system in place, which includes training of employees, regular inspections and maintenance of important components, such as wire ropes which are replaced on a predetermined basis.

Some general principles when moving rigs and vehicles around drill sites:

- only authorised and competent persons to drive or control a vehicle or drill rig;
- procedures are to be established and then extreme caution used around powerlines, bridges, tree branches, steep terrain, soft shoulders and in wet slippery conditions;
- persons should stand on the uphill side when moving equipment in steep, slippery or confined areas;
- bystanders must remain well clear when equipment is being moved;
- drill masts must be lowered when being moved;
- vehicles are not to be left idling on slopes or loose ground; and
- all loads are to be secured when being transported within moving machinery.

4.2.7.3 DRILLING OPERATIONS

Rigging up

Prior to rigging up, identify all hazards associated with each activity to be carried out, especially any that are specific to each site. Assess the level of risk involved with each hazard to prioritize the control of them. Determine what measures are necessary to eliminate or control each risk to its lowest possible risk level.

Some hazard-control measures could include:

- ensuring the site will take the weight of the rig and equipment before moving onto the site;
- stability of the rig and the measures required to ensure rigs are made level and stable at each drill site;
- drill rig jacks are placed on sound foundations;
- loose rocks, debris and tree stumps are cleared;
- location of powerlines, underground cables and services pipelines are checked;
- controls, gauges and emergency controls on rigs are all clearly labeled;
- rig controls are easily accessible to the operator;
- condition of winches, ropes, hoisting plugs and clamps are checked;
- guards are in place over rotating rods, or moving pulleys, belts, gears and shafts, and to control whipping rods;

- handrails and ladders are adequate and other items, such as hoses do not affect access on them;
- a lanyard is in place along the mast's ladderway so that a safety harness can be attached when the ladderway is used;
- all electrical items are maintained and tagged as being safe to use;
- essential electrical protection is in place, such as circuit breakers and earth-leakage protection devices;
- electrical plugs and power cords are kept off the ground when in use;
- hoses, especially high pressure hoses, couplings and connections are in good working condition;
- high pressure hoses have chains or whip checks;
- cyclones are in good order;
- dust control measures are satisfactory;
- first aid kits are available and maintained;
- sufficient fire extinguishers are available and maintained;
- fire restrictions are known for the area;
- adequate communications are available;
- sufficient personal protective equipment (PPE) is made available for crews and visitors;
- specialised PPE is available and maintained such as harnesses when working at heights;
- special work platforms are used in steep terrain;
- safety barriers may be needed where there is a danger of persons falling from platforms, down steep slopes or into old excavations;
- racks and trestles may be needed for ease in handling core trays and proper stacking of drillrods and tools;
- fuels, muds and lubricants are stored away from rigs;
- firefighting and emergency equipment is available, maintained and is easily accessed;
- barricades may be needed to prevent access by the public;
- signs are in place, to warn or restrict access or highlight what PPE are required within specified areas;
- weather protection and drinking water are provided;
- long-term duties, such as core logging is done well away from an operating rig and preferably within a shaded area; and
- a checklist is provided for the supervisor to carry out a safety audit of the site and equipment before work commences.

Work procedures

Factors to be considered may include:

- a person should be appointed to take charge of the day-to-day operations;
- site induction and general work procedures have been determined and documented;
- a copy of the work procedures is kept on site, especially for high risk activities such as when safety harnesses are to be used;
- emergency procedures are developed for each drill site, so that contact details and procedures are clear and can be accessed by everyone working on site;
- sufficient numbers of trained first aiders are on site at all times;
- persons are trained as competent to operate all equipment;
- particular attention is paid during training on difficult or specialized activities around rigs, such as:
  - raising or lowering rods;
  - casing of drill pipe;
  - correctly screwing in hoist plug or rotation head sub before taking the weight;
  - ensuring clamps are firmly set when breaking joints in the rod string;
  - ensuring that no part of the body is placed in a position where it may be struck by rotating tools when operating retaining tools, rod spanners, stilsons, tongs or breakout spanners;

  - not using compressed air to pump core from a barrel;
  - never carrying tools by hand when climbing a mast, using a bag instead;
  - ensuring no person is on a mast when the rig is operating;
  - having drill rod guards in place when rig is operating; and
  - not carrying out maintenance while the rig is operating;
- training includes the use of personal protective equipment, such as hard hats; eye, hearing, dust and UV protection; and wearing steel-toed boots;
- loose-fitting clothing is not to be worn;
- housekeeping of work areas is more important than many realize in preventing trips and falls. Training should reinforce the need for housekeeping; and
- fitness for work issues, such as hours of work, drug and alcohol policies, are understood and adhered to.

4.2.7.4 COMPRESSORS, PUMPS AND HIGH-PRESSURE EQUIPMENT

Factors that may be considered include:

- ensuring all high-pressure pipes and fittings are suitably restrained in case of breakage;
- fitting restraints on air hose connections to prevent whipping in case of failure;
- constructing and maintaining air receivers and pressure vessels in accordance with the Australian Standards;
- fitting high-pressure water pumps and air compressors with pressure-relief valves;
- protecting hydraulic hoses and pipes from spraying oil onto engines or hot components in the event of a failure; and
- regularly examining all components of pressure systems to check for suitability and condition.

REFERENCE DOCUMENTS

Exploration Safety Guidelines, Queensland Department of Mines and Energy, 1998.

Drillers Guide, New South Wales Department of Mineral Resources, 1992.

Hydraulic Safety CMSAC, 1993.

Australian Standards AS 2187 Explosives – Storage, Transport and Use.

AS/NZS 1596 Storage and Handling – LP Gas.

AS 1940 SAA Flammable and Combustible Liquids Code.

4.3 CONSTRUCTION, BUILDINGS AND STRUCTURES

4.3.1 CONSTRUCTION WORK

The mine operator should design, construct, modify and maintain buildings and structures in accordance with best practice and relevant standards.

Mine construction work is often non-routine and generally not directly associated with ongoing production. It often involves personnel from outside the mining industry and frequently brings together people who have not worked together previously.

Mine operators are responsible for all people working at a mine, including construction workers, but they may not have construction experience. Mine construction work varies, making control of that work difficult.

Experience has shown that mineworkers, supervisors, managers and mine operators need to continually upgrade their skills in construction work as applications change. Construction workers need to be more aware of the hazards and systems used in mines. All workers need to plan their work in accordance with the mine operator's requirements.

4.3.1.1 MANAGEMENT CONTROL

Mine operators are deemed responsible for all construction work on their mine. A person placed in charge of mine construction work may have delegated to him/her the mine operator's responsibilities in respect of that work.

When supervisors are selected for such work they should ensure that:

- the mine construction workers being supervised are appropriately trained;
- the work methods and workplace are safe, and procedures are standardised and are being observed;
- hazards are eliminated from workplaces through judicial planning and implementation;
- changes in employment, production, equipment, and procedures are communicated to all mineworkers;
- other mine or construction supervisors are informed during the shift and on change of shift of the state of workings, employment and deployment of equipment; and
- a written shift report is prepared and read before start of the next shift.

Safety strategy

A safety strategy should be prepared which includes procedures for checking the safety experiences and records that come from other major construction sites.

The chief hazard to be considered is the exposure of people to risk of falls. Special effort should consequently be directed to compulsory use of harness and restraints, for both workers and their equipment.

Special attention should be directed to:

- the responsibility of the mine operator;
- enforcement of regulations;
- prompt reporting of any accident to relevant authorities; and
- use of guards, rails, harnesses, safety belts, etc.

Commitment to safe working

A comprehensive safety program is costly but such costs need to be included in any total project allocation.

A qualified professional safety adviser could be appointed specifically to the project. The major contractor should also provide a safety adviser/ inspector.

The commitment to agreed safe-working practices is also necessary.

A major factor contributing to positive safety is consistent enforcement of safety regulations. This process is enhanced by using a set of rules for any necessary disciplinary action.

4.3.1.2 INDUCTION AND TRAINING

All persons working on a construction site should pass through an induction process relevant to the project being undertaken.

The induction course should be suitably designed for the tasks in hand.

No worker should enter the site without proper induction and this should be consistently enforced.

Any visitor to the site should be briefed in site hazards and safety procedures; and should only be allowed entry at the mine operator's discretion and approval, and at all times under close direction.

To maintain a high level of safety and security as the number of workers fluctuate and new people are introduced to the site constantly, it is important to install a sense of pride in safe working, as well as to ensure that everyone is adequately informed and instructed on site-specific safe working procedures.

Multiskilling

Multiskilling should be formalised by determining requirements and examining specific mine operating needs so that operators may then select the most effective means for improving overall performance.

Contractors should participate in such procedures and get recognition for their skills. A portable record of their training could be accepted by mine operators at other mines to which they transfer.

The formalised approach would allow upgrading worker's performances and would achieve industry-wide uniformity.

4.3.1.3 PLANNING

The mine operator needs to design an efficient utilisation plan for developing a multiskilled workforce. He/she should include maintenance training and refresher training as part of this plan.

The same procedures apply to safeguard the safety and health of the contractor's employees. The managing contractor must consider safety and health issues as an important part of the job. Some of those issues are as follows:

- establish a schedule with clear objectives for achieving safety goals by detailing the responsibilities of those charged with carrying out the plan (including any involvement by mine employees or staff);
- ensure that those given responsibilities are also given the necessary authority to meet those responsibilities;
- ensure that those with responsibilities are accountable;
- communicate with all mine employees and contractor's employees, and ensure that they are participating in the plan; and
- provide appropriate training.

Hazard awareness

It is important to:

- identify operating hazards;
- assess the importance of different risk factors; and
- control risks through redesign, use of mechanical aids and training.

Combating the risks

During construction risks can be minimised by using the appropriate equipment and procedures. Some examples relevant to above-ground operations have been reviewed in this section. Application of such techniques and procedures could also apply to underground mine construction.

Safety harnesses

- Safety belts or harnesses should be used for work above any floor or landing, if there is no fixed perimeter edging.
- A static line may need to be positioned on the pre-assembled steelwork before this unit is lifted and fixed to the structure. People should be able to attach their lanyards, and walk along and work in safety for the entire length of the static line.

- According to the safety policy for working at heights, riggers should wear safety belts or harnesses connected to the safety line at all times, if they are working outside the fixed perimeter edging. Use of the girder pin has proved effective for attaching a lanyard to the top of a steel column when no higher section of steelwork has been positioned.
- Riggers should fix Sala Block inertia reels to the pre-assembled steelwork while such sections are still on the ground. After this, steel sections can be lifted into place and the reel is immediately available for workers to attach their safety harnesses.
- Steelwork should always be brought upright, ready to be lifted into position on the structure. Sala Blocks, walkways and handrails should have already been installed.

  Extensive pre-planning should be undertaken prior to fitting steelwork into any confined space and to allow for other activities to continue on the site. Pre-assembled steel sections should be placed in a remote laydown area and then delivered to the site as required, ensuring assistance of wide load escorts and road closures as necessary.
- A Manualink is a girder grip device for attaching lanyards. It opens like a set of jaws when gripped, and will release with half a turn.This device (also known as a rigger's grip) is very useful, especially on scaffolding where a worker must constantly undo and re-attach a personal safety line. They are also used to attach static lines. A karabiner can connect an inertia reel to the Manualink.
- People working on a nearby roof of a building can use the new structure to provide attachment points for the inertia reels to their safety harnesses. Even at 40 metres above ground, the roof of cyclones can provide attachment points for inertia reels. This can be useful when persons are fixing walkways which cannot be positioned before an assembly is installed.
- The provisions of AS 2865 Safe Working in a Confined Space for confined space entry should be strictly followed on any project. Any operation conducted more than 2.4 metres above the ground, should use a harness and follow strict procedures.
- Debris nets must be suspended below active work areas to protect people from injury by any falling objects. Commercially manufactured debris nets are available and have proved to be both suitable and effective.
- Pedestrian walkways confine workers to defined pedestrian passages where overhead protection and meshed barrier panels can be installed to best effect. In particular, ground level barriers can be installed to ensure pedestrian traffic is correctly directed. Mesh sides also prevent haphazard entry to working areas.
- Walkways should be constructed on the lowest level with fixed perimeter edging and handrails attached. No more than two floors should be added at a time if the edging is not permanently fixed in place.

  All pre-assembled steelwork sections should be raised to a vertical position in preparation for lifting to its place on any structure.
- Flags can be used to signal the positioning of the topmost section of any structure or building.
- By thorough planning and pre-construction of each steel unit, a great deal of the climbing and rigging work can be eliminated. This lowers exposure of workers to the risk of falling, and of people below to the possible injury from falling equipment or materials.
- Barricades can be used to protect excavations, trenches and direct people to safe walkways. They are effective in blocking roads and allocating storage areas.

  Bins or skips left at several positions throughout the construction site allow for ease of collection and promote good housekeeping. The skips should be lifted down and emptied daily.

  When appropriate, travel on stairways should be denied by erecting barricades and danger signs. These prevent unauthorised people from entering restricted areas without the proper authority.

  At entry points to particular areas, such as the gate restricting access to the top floor of a structure, entry should only be allowed for those required to work there. The access key for the gate should be issued by the control room to authorised personnel only. This procedure gives the officer in charge the opportunity to check that appropriate safety procedures are being followed.

- In constricted areas, work could prevent scaffolding being fitted around large pre-assembled units like hoppers. A temporary platform called the crows nest (individual platform with guard rails) should be used to enable the tops of the supporting columns where the base of the equipment is to be installed The crows nest can be used again and again in different locations.

  Crows nests should be firmly fixed to the top of columns. People can be lifted in a lift box (or dog box sully), so that additional sections can be positioned and ready to be fixed immediately into the assembly.

  When crows nests are used on girders the clamping arrangement can also be modified so that it could be used on a flanged column.

- Workers operating on the external face of the building should be required to wear a wrist restraint for tools. This restraint consists of a small spliced lanyard with a safety clip for fitting to the tools, and secured to the wrist by a Velcro fastener.

  Canvas ground sheets should also be positioned over open mesh flooring when work is under way in the area.

  A canvas tool bag should be provided for maintenance people who are required to work at heights.

  Tools can also be secured by lanyard constraints, for example the scaffolder's key. This has a hole drilled in the end so that the lanyard could be attached. The other end of the lanyard can be clipped to the person's belt. The lanyard length should be sufficient to allow a tool to be used effectively.

  Tool loops should be provided on the worker's belt, so that hand tools can be kept with the individual worker, rather than scattered about the workplace. This lessens the possibility of falling tools.

  Riggers who have fitted bolts to their splice joints are able to attach their lanyards to the completed handrails. An extended inertia reel can also be made available, ready for riggers who want to tighten bolts.

  Brackets should be designed and located to provide easy access to fire extinguisher units. These should include a safety bar and clip which allow the carrier to be moved along the rails and the extinguishers to be readily lifted out for use. This bracket should end the problem of concealed, moved, bumped, or rolling extinguishers.

- The status of scaffolding should be indicated by a tag system. Any scaffold tag, attached after inspection and approval of the completed work, should identify the permit number and the scaffolder's number.

  Scaffolding should be constructed only by qualified people, who are granted permission to start only after their work schedule is approved.

- Weekly toolbox talks for all crews can be held throughout the period of construction activity. At these talks, people should be kept informed of the progress of various parts of the project, and any incidents which have occurred. Safe methods of working should always be stressed. Special addresses can be given, for example, on avoiding eye injury. At such meetings, any updates of rules should be advised and all safety concerns discussed.

Other supportive aspects include:

- adequate finance for the program;
- consistent management support for adherence to the agreed safe working practices;
- a safety incentive scheme; and
- a company newsletter; stories and photographs could highlight, or feature: construction progress; details of numerous aspects of the project; tender status; safety matters; social snippets; worker profiles; and progress reports.

4.3.2 TRENCHES

4.3.2.1 INTRODUCTION

Sufficient measures must be taken to control edge breakaway when excavating trenches, particularly when the depth exceeds 1.6 metres.

Consequently, consideration must be given to creating batters which reflect the angle of repose of the trench material. Alternatively, a recognised method of shoring must be used to secure the sides of the trench.

Particular care needs to be exercised when excavating close to previously disturbed or unconsolidated ground, especially if this is very wet or very dry.

Supervisors in charge of excavating any trench should consider such factors as weight of equipment working in the vicinity of the trench, and/or spoil stacked near the trench. The spoil heap should be placed at a safe distance from the edge of the trench.

Supervisors should ensure that ground supports, when used, should be installed as quickly as possible after the trench has advanced sufficiently to allow their installation. All timbering or other ground support system must be inspected regularly by a competent person, particularly after heavy rains or flooding. Ground supports should only be removed under the supervision of a competent person appointed by the general manager.

The workmen installing the support should, as far as practicable, work from within the supported structure of the trench. Special timbering tongs can be utilised for installing toms (horizontal struts) from the surface.

Collapsible aluminium soldier sets can be installed and removed from the surface and are useful in providing temporary support before erecting permanent timber soldier sets. Screw-jacks may be used instead of timber members as struts in a support system but must at all times be placed squarely against the vertical member of the support system. An adequate bearing surface must be provided between the end of the strut and the vertical support member.

Site investigation

Before commencement of work, contractors or mine personnel should get as much information as possible as to the ground conditions at the working site.

4.3.2.2 GROUND SUPPORT

The layout in the accompanying diagrams show timber sizes and positioning of supports which should be installed to provide the minimum protection in unstable ground. By far the most common method of support in trench excavations is the simple soldier set layout illustrated in Figure 4.1.

This system of trench support is very extensively utilised in stiff clays and other unconsolidated or highly weathered sediments and sedimentary rocks. The bottom tom should also be installed as low as possible, bearing in mind the use of the trench and in the case of a pipeline, the diameter of the pipe that has to be installed. As to the installation of the soldier sets, the removal of the sets should be done as far as possible from the surface or from the supported section of the

Figure 4.1 Typical use of soldier sets in a trench

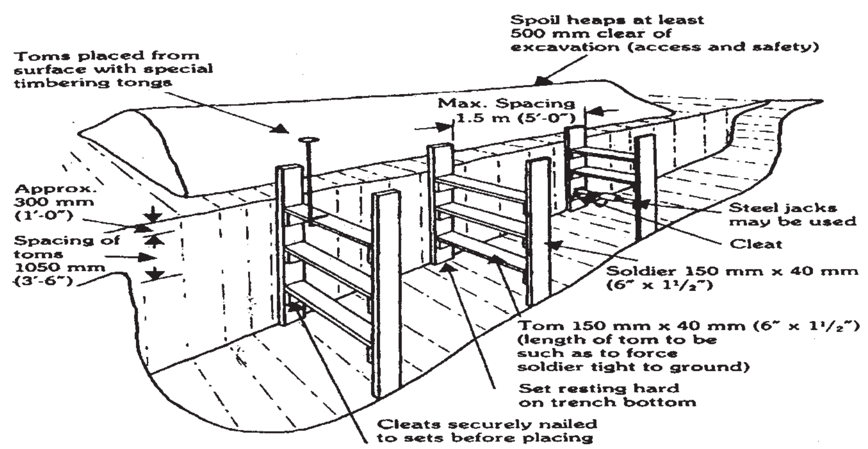
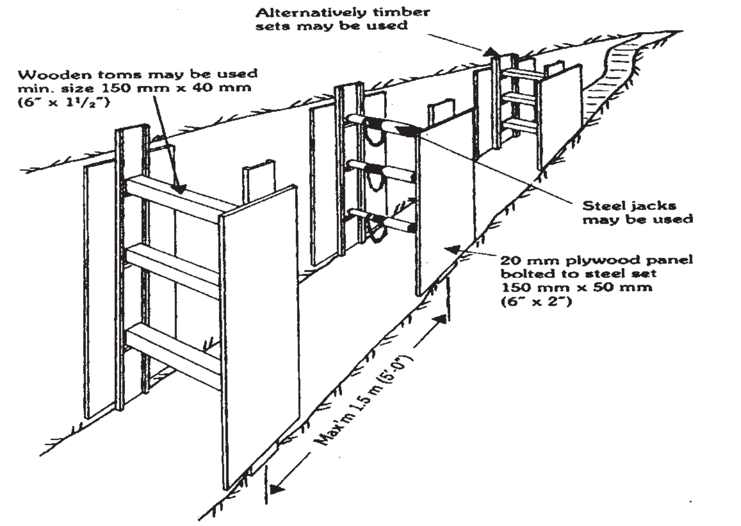


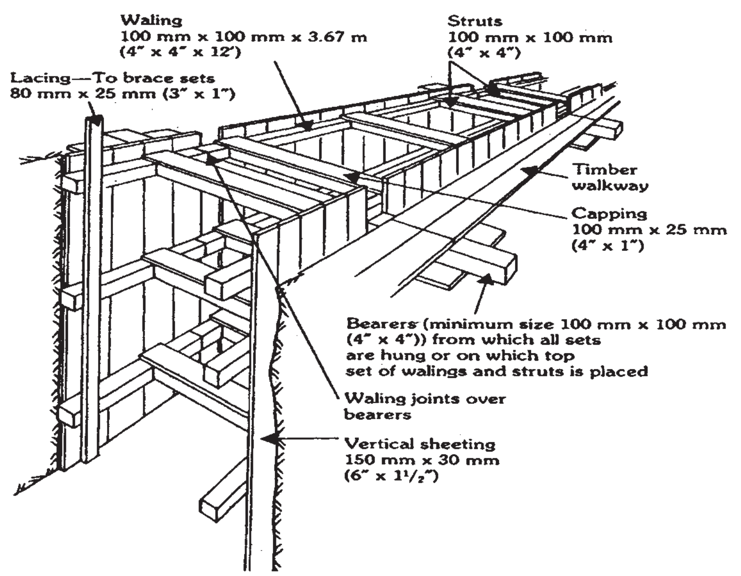
Figure 4.2 Acrow steel supports for use in variable ground conditions. Spacing may be varied as required



trench. At increased depths, in similar types of ground, it is advisable to resort to the use of horizontal members known as walers. This is particularly important where increases in side pressure on the walls of the trench are likely to result and/or where longitudinal pressures along the axis of the trench occur.

Another very useful extension of this system is illustrated in Figure 4.2 where steel channel sets are used with TEG plyboard bearer sheets bolted to the sets. This system can be utilised using either wooden tom struts or Acrow props. An expansion of this support system can be used where unstable ground conditions like wet sand and greasyback clays exist and there is danger of the ground running. In this method the vertical closed sheeting is inserted immediately after excavation has taken place or can be driven ahead of the ground being excavated. Walers and struts are installed as soon as possible after the excavation has progressed sufficiently to permit their installation (Figure 4.3). The capping over the horizontal struts must extend for the full width of the trench.

Figure 4.3 Closed vertical timber trench supports for a maximum depth of 3.6 metres for use in unstable ground



Note the use of 150 mm x 150 mm (6” x 6”) bearers on the surface on which the first sets of struts and walers are placed. Where unstable ground conditions such as wet sand and greasyback clays occur and the excavation depth exceeds 4 metres, it may be necessary to excavate the trench in two stages, as shown in Figure 4.4, advancing the vertical sheeting ahead of the excavation. However, it should be stressed that where trench excavations need the design of support systems of this nature, it should be undertaken by persons familiar with engineering principles.

A similar system of ground support is the use of steel trench sheeting as outlined in Figure 4.5. This method is particularly adaptable to use in wet saturated running ground. This sheeting is normally driven ahead of the excavation with the walers timbers being hung from hanging

Figure 4.4 Double vertical sheeting timbered trench supports for trenches of depth in excess of 3.6 metres for use in unstable ground

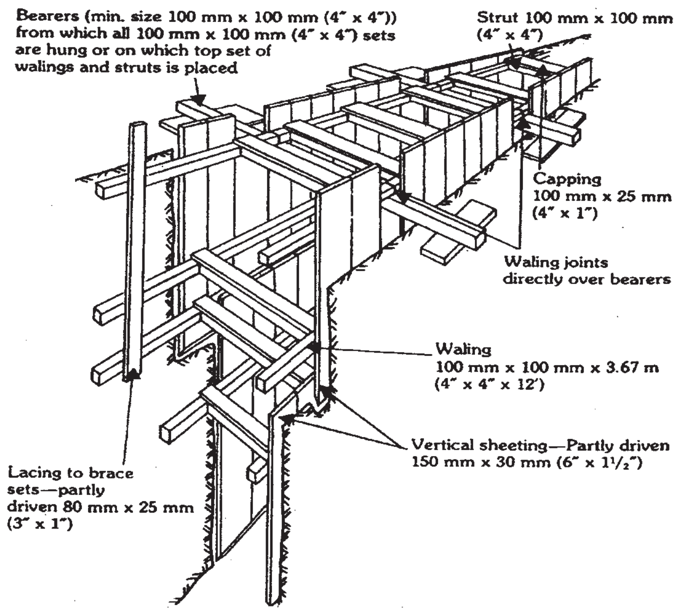
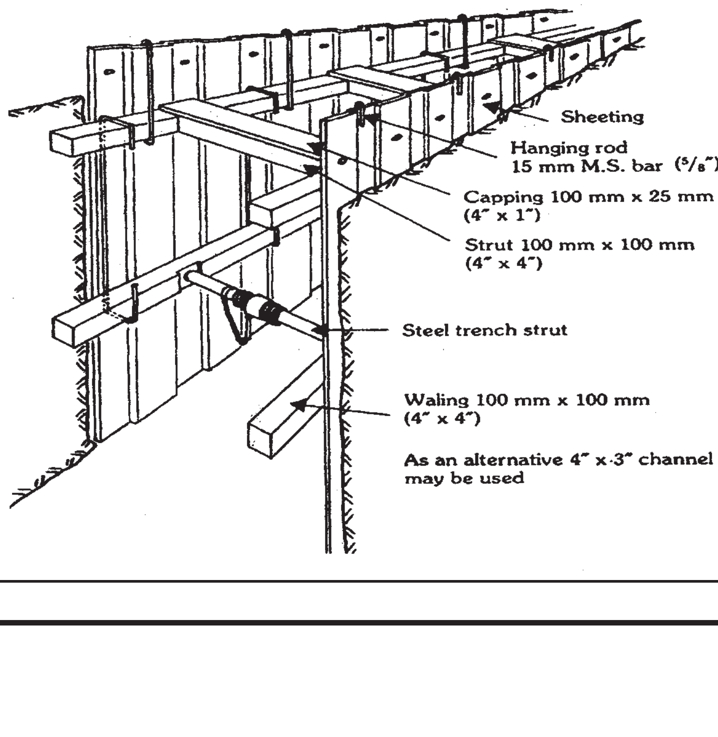


Figure 4.5 Sheet piling technique for use in wet unstable ground



rods as shown. Another method of using this system where heavy loads on the sheeting can be anticipated is to suspend the walers from bearer sets situated on the surface. Note the use of the steel trench strut (across prop) in this method in place of the 100 mm x 100 mm (4" x 4") timber. These steel struts can also be used in the other systems of support.

Use of shields

Shields are being used more and more frequently in trenching especially in deeper excavations. Figure 4.6 shows a typical illustration of a steel shield. Shields are more frequently used in wider excavations for the installation of larger diameter pipes where greater disturbance of ground occurs. While they do not provide support to the trench walls, they are a very effective means of preventing falls of ground on people within an excavation.

The design and construction of steel shields should be undertaken by experienced engineering personnel using the relevant Australian Standards code for the design of steel structures. The installation and removal of shield components must be undertaken by experienced crane-operators and crane-chasers. While the shield system effectively protects workmen from collapses from the trench walls, it is essential to ensure there is no danger of ground spilling over the top of shield sides.

Shields can be used very effectively in jointing pits and also in traversing previously disturbed and unstable ground.

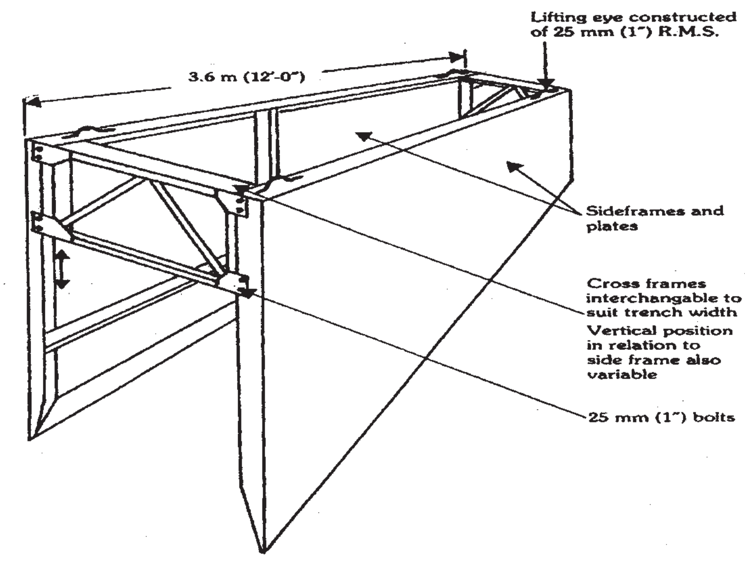
Installation and removal of trench support systems

It is essential that supports are installed as soon as possible after the trench excavation has progressed sufficiently to permit their installation.

As far as possible, the installation of timber supports should be undertaken from the surface of the trench or the supported section of the trench. Where the excavation of the trench does not require the use of explosives, it is often possible to construct the set entirely on the surface and then install it from the surface. The use of timber tongs for the installation of toms in the soldier set support layout has already been mentioned. The removal of trench supports should be undertaken in a pre-determined manner from the surface of the trench or the supported section of the trench. The danger of standing or working in an unsupported section of the excavation cannot be overstressed.

The installation of temporary collapsible false sets in order to permit the removal of the permanent

Figure 4.6 Portable steel shield for use in unstable ground conditions



ones is an extremely useful and safe manner of removing supports. Another very safe method of removing timber supports is to remove the horizontal toms and walers as the backfilling of the trench reaches the level of each set of toms and walers. The vertical sheeting can then be removed when backfilling is completed.

REFERENCE DOCUMENTS

AS 1657 – 1992. Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation.

AS/NZS 2865 – 2001 Safe Working in a Confined Space.

AS 4368 – 1996 Preparation and Symbols – Mine Plans.

4.3.3 SCAFFOLDING

4.3.3.1 INTRODUCTION

A scaffolder's ticket may be required, but persons performing this work should be appropriately trained to an equivalent standard, bearing in mind the work involved. State and Territory legislation normally requires such training.

Important questions to ask are attached for guidance. These questions may not be relevant in every situation.

4.3.3.2 USE OF SCAFFOLDS

- Does company policy require that work performed from ladders is kept to a minimum and that scaffolds or other platforms are used wherever possible?
- Has management established adverse weather condition limits for various work activities beyond which work cannot progress? (Examples are high wind velocity and temperature extremes.) How does management insist that these limits are adhered to?
- Are all workers in the vicinity warned to keep clear of scaffolds? (There are dangers both from falling objects and due to mobile machinery knocking the scaffold.)
- Are both operators and supervisors aware of the book A Guide for Scaffolders (AS/NZS 4576–1995) and Stands for Portable Ladders (AS/NZS 1892).

4.3.3.3 SAFE ACCESS AND PROVISION OF LADDERS

- Do employees know:
  - the high and serious incidence of accidents from ladders set in temporary positions and work platforms without safe access?
  - that ladders often slide sideways or slip away at the base?
  - that scaffolding members are not suitable ladderways and that scaffolding may be overturned by misuse?
  - that, when access to formwork is required, ladder access should be provided within the framework so that the scaffold remains stable?
  - the best ladder design for different applications? Examples include cantilevered ladders; ladder access tower; (and extension, single and portable Batten) ladders.
  - safe ladder angles and placement of lighting for underground vision or night use?
- Do unauthorised personnel know not to interfere with guardrails, toeboards, ladder lashings etc. without contacting the scaffolding supervisor?
- Do operators know the hazards of using metal or wire-reinforced ladders in the vicinity of electrical conductors?
- Do operators know how to check for defective or broken ladders? (Broken or defective ladders should be removed or tagged as dangerous.)

4.3.3.4 SUPERVISION

- Are supervisors:
  - trained in the hazards associated with the use of scaffolds?
  - able to check the use of scaffolds readily and regularly?
  - able to have rectified any apparent defect reported to them?
  - able to restrict work near the scaffolding? and
  - trained for emergencies that might arise?
- Is an erection and dismantling procedure established and followed?
- Are employees directed in the use of ramps, stairs and ladders for access and egress (exit) from work platforms?
- Is jumping from elevated platforms, scaffolding or ladders should be prohibited?
- Are supervisors aware of their responsibility while scaffolders are undergoing training on the job?
- Are guidelines clear about when different scaffolding types are to be used with which the scaffolder may be unfamiliar?

4.3.3.5 PERSONNEL

- Are personnel adequately trained? Do they have any training record?
- Are personnel assessed for their level of skill? The scaffolder should have a thorough knowledge of:
  - bends and hitches for cordage and light wire ropes;
  - safe working loads of fibre;
  - safe working loads of flexible steel wire (FSW) ropes, and safety measures when used as suspension ropes, winch ropes, and lashings on scaffolds;
  - safe working loads, which can be supported by timber beams, and cantilevers (or needles);
  - the correct way to use an RSJ beam clamp;
  - the correct way to use “S” type scaffold hooks;
  - the various masses of scaffold planks and timbers in ordinary use;
  - the manner of attaching counterweights and securing same;
  - safe working loads on mild steel (MS) bolts in tension, for securing cantilevered scaffolds etc;
  - the manner in which the mass of the counterweights required on various types of scaffolding is determined;
  - how to detect defects in structural timbers, both hardwood and softwood;
  - how to examine fibre ropes for defects;
  - how to examine wire ropes for defects;
  - the correct way to use bulldog grips; and
  - the correct usage of ladders, stepladders, and access platforms.
- Are outside personnel given induction training at the mine sufficient to cover any area in which they may be required to work?
- Are certificated personnel given induction and familiarisation training at the mine?
- Is there a recognition that some people cannot work safely and efficiently at heights?
- Do all operators inspect the scaffold before use and report defects to their supervisor?
- Do all operators see that the area below them is clearly marked with signs and barricades if necessary? Have they checked with their supervisor that all workers in the vicinity have been warned to keep clear?
- Are fork lift and Load-Haul-Dump (LHD) and Front-End Loader (FEL) operators who place material on scaffolds required to have a physical examination including assessment of visual acuity, depth perception and hearing loss?
- Are operators able to clearly understand the English language and the use of hand or other signals?

4.3.3.6 CONSTRUCTION AND MAINTENANCE

- Are scaffolds built to comply with applicable codes, including material selection and scaffold design?
- Is there one person who is responsible for erection and dismantling, and who is aware of code requirements?
- Is maximum load considered in the scaffold design and construction so that there is a correct factor of safety? Is overloading of scaffold prohibited?
- Are footings under scaffolds stable and able to bear the load safely?
- Are supports plumb and bracing adequate and checked after mine firings?
- Are scaffold planks cleated on the bottom to prevent slipping or sliding?
- Are scaffolds secure to the structure? Are outriggers used according to manufacturers recommendations?
- Are railings and toeboards installed on all scaffolding? Are scaffold ends closed?
- Is a safe and unobstructed access, such as a walkway, stairs or ladder, provided on all scaffold platforms?
- Do ladders comply with the ladder code?
- Is good housekeeping maintained on scaffolds and their approaches?
- Is each scaffold walkway kept free of ice, oil, spillage and other slippery or loose substances?
- Is particular care taken for the stability of platforms where heavy parts are to be shifted about or heavy strains to be taken?
- Are swing stages or suspended scaffolds erected and used according to applicable standards?
- Is the use of safety belts and separate life lines required when work is done from a suspended scaffold, and are these maintained and tested regularly?
- Are written exemptions from use of safety belts received when working conditions or experience of operator negate the use of same – for example, experienced riggers on steelwork?

4.3.3.7 MOBILE PLATFORMS

- Are mobile platforms used only for light work?
- Are they kept to a height not exceeding three times the smallest base dimension?
- Is help provided when rolling the platform to a new position?
- Are all persons off the platform when it is moved?
- Are the operators trained so that they will not overextend the levelling jacks?
- Are wheel locks provided to prevent movement when in use?
- Can the platform be located to avoid over-reaching?
- Are guard rails installed at 1 metre above the platform?
- Are toeboards greater than 100 mm in height used and secure?

4.3.3.8 TRESTLE SCAFFOLDS

- Is the platform surface wide enough for comfortable work?
- Do the planks forming its surface project (say, more than 230 mm) beyond the end of the scaffold supports and, if so, what precautions are there to prevent tipping?
- Are adjoining planks cleated to prevent sagging more than the adjacent one(s) to it?
- Is attention paid to the soundness of the planks and trestles, as well as to the foundations?
- Is the use of extension ladders for ladder jack scaffolds prohibited?

4.3.3.9 FALLS FROM SCAFFOLDS

- Are openings barricaded?
- Are safety belts and lifelines used when employees are working on unguarded surfaces? Are safety nets used whenever necessary?
- Is all reinforcing steel bent or covered to eliminate impalement if an employee were to fall?
- Are qualified riggers used when there is a danger from falling and safety hats or lifelines are not used?

4.3.3.10 FALLING OBJECTS

- Is work planned so that workers are not working below one another?
- Are workers instructed in safe material handling to prevent objects from falling? Are safety lines used on tools where needed?
- Are nets or shelters used where necessary as protection from falling objects? Are forklift trucks or similar mobile plant equipped with overhead protection?
- Is the wearing of head protection enforced?
- Is work planned to avoid handling material over workers? If a suspended load is moved over a work area, are warning signals sounded so workers will keep out from under loads?
- Is all lifting and hoisting equipment regularly inspected and maintained in accordance with manufacturer's recommendations and applicable standards?
- Is a rope used to haul tool boxes and equipment to the platform? If fibre ropes are used, are they checked for damage from sparks, heat, acid or other chemicals?
- Are special precautions taken when drilling or welding to ensure that swarf, sparks, and molten slag do not drop on people below? Can a fire blanket be used below the platform to prevent falling of sparks and metal?
- Are oxyacetylene bottles, fuel, and explosives placed so that hot or flammable objects cannot land on them?
- Are employees instructed to secure a piece of timber or metal before it is cut? If pipes are being cut, is there a potential for the securing slings or ties to slip and for the pipes to fall out of control?

4.3.3.11 EMERGENCY CARE

- Are supervisors and other selected employees trained in critical emergency care techniques that might be necessary in the event of a serious injury?
- Are rescue procedures for persons who may be electrified or suffering electric shock understood?
- Are first aid supplies readily available and their location known?
- Do supervisors and other staff know how to contact the nearest ambulance or emergency service. In case of a serious injury, is that contact facility readily available?

REFERENCE DOCUMENTS

AS 2243 – 1990 to 2002 Safety in Laboratories. [Note: There are 10 parts to this Standard.]

AS2865 – 1995 Safe Working in a Confined Space.

AS2987 – 1987 General Conditions of Contract for the Supply of Equipment with or without Installation.

ASNZS 4576 – 1995 Guidelines for Scaffolding.

AS1892 – Portable Ladders.

AS1657 Fixed Platform, Walkways, Stairways and Ladders.

4.3.4 BUILDINGS AND STRUCTURES

4.3.4.1 INTRODUCTION

When providing necessary and relevant hygiene and health facilities at mines, managers should consider:

- sanitation and hygiene needs, including:
  - an adequate supply of potable water (both above and below ground and cooled where necessary);
  - provision to maintain cleanliness and sanitation (including eradication of vermin);
  - clean and sufficient toilet and washing facilities at surface and underground (where necessary, male and female employees should have separate facilities);
  - sufficient hand basins;
  - regular checks to stop pollution of work sites and misuse or fouling of toilets;
  - sufficient crib rooms or dining areas (both above and below ground as appropriate at every mine);
  - sufficient change houses, depending on the size, scale and nature of the mine;
  - drainage of stagnant water (note: noxious gases may be produced when draining water);
  - checks for waste timber and decaying wood in underground sites;
  - regular disposal of debris, refuse and other waste; and
  - sheltered reception areas for people entering or leaving the mine;
- mine lighting;
- first aid precautions; and
- medical matters.

4.3.4.2 SUPPLY OF POTABLE WATER

Water should meet standards set out in Australian Drinking Water Guidelines (1996) by NHMRC and ARMCANZ.

Water should be:

- accessible to employees;
- clean;
- dispensed at clean and hygienic locations marked by signs; and
- below 24°C.

Water used for industrial processes which is unfit for drinking should be marked "unfit". Staff working away from main water supplies should have access to water in clean containers.

4.3.4.3 TOILET AND WASHING FACILITIES

Above ground facilities should be conveniently located with:

- adequate toilets and urinals (as a guide, one toilet and urinal for every twenty-five male staff and one toilet for every nine female staff);
- hand towels or hand dryers; and
- adequate heat, light and ventilation.

Toilets on the surface of a mine should have:

- flushing water;
- individual compartments with locking doors
- walls and floors made of easy-to-clean materials;
- seats and toilet paper;
- clothes hook and lighting; and
- be kept clean and hygienic and with all waste products removed regularly.

Toilets at underground mines should be at many locations and accessible on foot unless:

- workings are close to the surface; or
- a conveyance is available to take staff to underground toilets or to the surface.

Toilets in underground mines should be well ventilated and near the main work site to serve the largest number of staff. They should have:

- floors of concrete or other impervious material;
- screens for privacy;
- regular maintenance, cleaning and waste removal;
- toilet paper; and
- sinks or hand basins.

4.3.4.4 CRIB ROOMS

All mines should have clean, well-lit and ventilated crib rooms and eating areas. Crib rooms should have refuse bins, a sink, tables, chairs and appliances to store food, heat food and boil water. They should also have supplies of hot and cold drinking water, insect repellents or traps, and be close to toilet and washing facilities.

Management should encourage staff to put rubbish, waste food and paper in bins that should have well-fitted covers. Empty bins in underground crib rooms regularly and take rubbish to the surface daily. Clean the refuse area in crib rooms daily.

4.3.4.5 CHANGE HOUSES

The design of change rooms should consider the following:

- lighting, heating and ventilation;
- floors that will not rot and are easy to clean;
- proper drainage;
- tiled walls to keep out moisture;
- passageways at least 1 m wide;
- be near mine entrances;
- have facilities to protect people from the weather when travelling from the mine entrance to the change house;
- have lockers for each underground employee; and
- have benches.

Change rooms should be designed to include:

- adequate floor space per person using the change house during a shift;
- an ample supply of clean hot and cold water, hand basins and showers;
- ventilation, lighting, facilities to dry and store clothes;
- separate areas for clean and working clothes;
- heaters and/or air conditioners; and
- separate facilities for males and females.

Mine operators should set out guidelines and rosters for cleaning change houses.

4.3.5 CONFINED SPACES

The AS/NZS 2865 – 2001 Safe Working in a Confined Space provides comprehensive information to use in confined spaces.

A more comprehensive discussion of this topic is provided in Part 5 Equipment and Machinery, Section 5.1.5.

4.3.5.1 CHECKLIST

Below is a checklist of considerations before entry to confined spaces takes place:

- Are confined spaces thoroughly emptied of any corrosive or hazardous substances, such as acids or caustics, before entry?
- Are all lines to a confined space, containing inert, toxic, flammable, or corrosive materials valved off and blanked or disconnected and separated before entry?
- Are all impellers, agitators, or other moving parts and equipment inside confined spaces locked–out if they present a hazard?
- Is either natural or mechanical ventilation provided prior to confined space entry?
- Are appropriate atmospheric test performed to check for oxygen deficiency, toxic substances and explosive concentrations in the confined space before entry?
- Is adequate illumination provided for the work to be performed in the confined space?
- Is the atmosphere inside the confined space frequently tested or continuously monitored during conduct of work?
- Is there an assigned safety standby employee outside of the confined space, when required whose sole responsibility is to watch the work in progress, sound an alarm if necessary and render assistance?
- Is the standby employee appropriately trained and equipped to handle an emergency?
- Is the standby employee or other employees prohibited from entering the confined space without lifelines and respiratory equipment if there is any question as to the cause of an emergency?

- Is approved respiratory equipment required if the atmosphere inside the confined space cannot be made acceptable?
- Is all portable electrical equipment used inside confined spaces either grounded and insulated, or equipped with ground fault protection?
- Before gas welding or burning is started in a confined space, are hoses checked for leaks, compressed gas bottles forbidden inside of the confined space, torches lightly only outside of the confined area and the confined area tested for an explosive atmosphere each time before a lighted torch is to be taken into the confined space?
- If employees will be using oxygen–consuming equipment, such as salamanders, torches and furnaces, in a confined space, is sufficient air provided to assure combustion without reducing the oxygen concentration of the atmosphere below 19.5% by volume?
- Whenever combustion-type equipment is used in a confined space, are provisions made to ensure the exhaust gases are vented outside of the enclosure?
- Is each confined space checked for decaying vegetation or animal matter which may produce methane?
- Is the confined space checked for possible industrial waste which could contain toxic properties?
- If the confined space is below the ground and near areas where motor vehicles will be operating, is it possible for vehicle exhaust or carbon monoxide to enter the space?

WARNING: Many people have died when they have entered a confined space to rescue a person who has collapsed. Avoid this by ensuring that harnesses and lifelines are used. No person should be allowed to enter any confined space without means of life support and without rescuers standing by.

REFERENCE DOCUMENTS

Boral OH&S Manual, Boral.

AS/NZS 2865 – 2001 Safe Working in a Confined Space.

Occupational Health and Safety Manual, Pioneer Concrete NSW P/L.

OSHA's Self – Inspection Checklists, Confined Spaces Safety Information Com, OSHA.

4.3.6 WORKING AT HEIGHTS

Employers have an obligation to ensure workplace health and safety where there is a risk of a person falling from any height.

4.3.6.1 RISK MANAGEMENT

Risk management is the process of finding out what can cause an injury such as falls from heights deciding what could happen as a result (injury to persons at or near a workplace), and doing something about it.

The steps of risk management are:

- identify the hazards to workplace health and safety arising from construction activities;
- assess the risks;
- determine and implement control measures to eliminate or reduce the risks; and
- monitor and review the effectiveness of the control measures.

Hazard identification

Prior to commencing work, all hazards related to falls from heights should be identified. There are a number of ways to identify potential sources of injury. The selection of the appropriate procedure will depend on the type of work processes and hazards involved. Methods of identifying hazards include:

- consultation with workers is one of the easiest and most effective means of identifying hazards. Workers are usually aware of what can go wrong and why, based on their experience with a job; and
- specialist practitioners and representatives of industry associations, unions and government bodies may be of assistance in gathering health and safety information relevant to falls from heights.

Factors which can cause a person to fall include:

- sudden acceleration or deceleration;
- moving from one surface to another;
- inadequate capability of the surface supporting a load;
- openings or holes that are not identified or protected;
- open edges are not protected;
- change of levels;
- loss of hand grip;
- slippery surfaces (surfaces are wet, polished or oily);
- unsuitable footwear;
- equipment, tools, rubbish obstructing work areas;
- incorrect use of ladders;
- catching of clothing;
- moving surfaces;
- unsatisfactory lighting;
- bad weather conditions (for example, heavy rain or wind);
- struck by moving or falling object; and
- fall-arrest systems and devices are not provided or are used incorrectly.

Risk assessment

Risk assessment allows appropriate control measures to be developed. Once hazards have been identified, they should be assessed in terms of their potential to do harm. To assess risk, consideration should be given to:

- the likelihood that harm will occur; and
- the severity of the harm should it occur.

Various techniques can be used to carry out a risk assessment. The risk assessment calculator is an example of one technique which can be used to assess risk.

Factors to consider when assessing the likelihood and severity of risk include:

- potential sources of injury and illness;
- number of people who may be exposed;
- location of the work area;
- location of access routes;
- type of work to be carried out;
- work practices in use;
- scheduling of work;
- type of plant, machinery and equipment to be used; and
- training and experience of persons carrying out the work.

Risk control

Risk control is the process of eliminating or reducing the risk factors. Control measures should be chosen and implemented to eliminate or reduce the risks as far as possible. When deciding on the most appropriate measures to use, practicability and acceptance of the control measures should be considered.

The following control measures are listed in order of the most effective way of managing the risk of injury from falls from heights at a workplace.

- Eliminate the hazard.
- Minimise the risk:
  - substitute the material or process with a less hazardous one;
  - modify the system of work or equipment; and
  - isolate the hazard.
- Provide backup controls:
  - adopt administrative controls so the time or conditions of exposure to the risk is reduced; and
  - use personal protective equipment.

4.3.6.2 CONTROL MEASURES

The control measures to protect a person from the risk of falling from a height should be in place before any work at the height starts. For example ensuring working platforms are in place before formwork is erected.

Several control measures are available to protect persons from the risk of falling from a height when carrying out work at that height. In some circumstances, more than one control measure may be necessary. The three levels of control measures, in order of preference, are:

- erecting a physical barrier;
- providing personal fall protection; and
- measures to catch a person after they have fallen.

Physical barriers

The aim should be to prevent a person from falling from a height. This is achieved by implementing control measures which provide a physical barrier.

Preventing a person from falling from a height is the preferred control option, as other measures will not always prevent the person from being injured. For example:

- fall arrest systems may prevent a person from falling to another working surface. However, the person using the system may suffer an injury as a result of the load placed on the person's body by the fall arrest harness when the fall is arrested; and
- a person may lose their balance and fall from a working platform and be caught by a catch net. However, because the fall was unexpected the person may suffer an injury through landing in the catch net awkwardly.

Some of the control measures to prevent persons from falling are:

- edge protection systems;
- fall protection covers; and
- working platforms.

Edge protection systems

An edge protection system is a barrier which is erected around the edge of a building or structure of penetration.

Guardrailing

Guardrailing is a protective barrier attached directly to a building or structure by posts. Guardrails should be used on the edge of a working platform, walkway, stairway, ramp or landing and be able to withstand the impact of a person falling against it. The guardrail should run parallel to the working surface and be not further than 100 mm outside the edge of the working surface. Guardrails used for working platforms, walkways, stairways, ramps or landings should be between 900 mm and 1100 mm above the working surface.

Guardrailing should not be used without a midrail. A midrail is a structural member which should be secured midway between the guardrail and the working surface and be able to withstand the impact of a person falling against it. The midrail should also run parallel to the working surface and be not further then 100 mm outside the edge of the working surface.

A toeboard should be used in conjunction with guardrails and midrails to prevent a person from falling under the guardrailing. Toeboards may be fully sheeted with timber or metal or made from mesh. They should be secured adjacent to the work surface and extend a minimum of 150 mm above the work surface.

4.3.6.3 FALL PROTECTION COVERS

All holes and openings, other than lift shafts and stairwells, should be protected to prevent persons falling through the holes or openings. A fall protection cover is a protective structure placed over holes and openings to prevent persons from falling through the holes or openings. A cover should be capable of supporting the impact of a person falling onto it. Fall protection covers are usually sheeted with:

- solid sheeting (timber, plywood or metal); and
- mesh.

Any holes or openings covered with wire mesh should not be used as a working platform. All covers should be securely fixed around the hole. Signs should also be attached to the cover to warn person that there is a hole underneath.

4.3.6.4 WORKING PLATFORMS

A working platform provides a permanent or temporary surface for persons to carry out work. The platform should be secured against uplift or displacement to a structure and be installed with edge protection systems. The area of the working platform should be of a size and strength to safely support tools, materials and persons who may be working on it.

When using a working platform:

- persons should not use platforms supported by a crane or hoist which is designed for the carrying of materials only;
- a person's body should not protrude from the confines of the working platform while it is moving;
- working platforms should not be used in wind conditions which may result in the working platform becoming unstable; for example, a boatswain's chair;
- working platforms should not be less than 450 mm in width or length;
- plant used to support working platforms should be used in accordance with the designer and/or manufacturer's instructions; for example, an elevated working platform;

Different types of working platforms that can be used include:

- Working Platforms on Scaffold: consist of planks or prefabricated platforms secured against uplift or displacement; and
- Elevating Work Platform; consist of platform surrounded by an edge protection system. The elevating work platform is used to position person at work areas. Different types of elevating work platforms include telescopic, scissor, boom, articulated platforms or any combination of these.

4.3.6.5 PERSONAL FALL PROTECTION

Personal fall-protection systems of work, including equipment, which secure a person to a building or structure. These systems should only be used where:

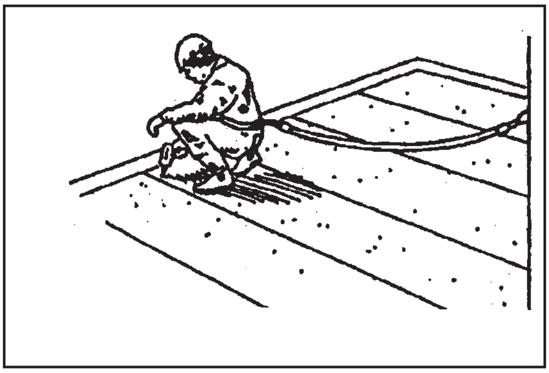
- it is not possible to work within the confines of a working platform or to provide other forms of fall protection such as guardrailing; or
- it is used in conjunction with other measures.

The use of these systems requires the active involvement of all person to ensure the equipment is worn, attached and used in the correct way.

Where no other forms of fall protection can be used, personal fall protection systems should be used to:

- minimise the risk of a person from falling from a height (travel restriction devices); and
- minimise the risk of injury to a person after a person has fallen from a height (fall arrest systems).

Figure 4.7 Fall-protection prevention system



Travel restriction devices

Personal fall-protection systems which do not allow a person to get into a falling situation are preferred over those which arrest a person once the person has fallen. These are travel restriction devices where a person is tethered to an eyebolt or another suitable anchorage point to restrain a person from reaching an unprotected edge. The anchorage points should be capable of taking the load. Personal fall-protection devices which restrict travel include:

- industrial rope access systems; and
- fall-prevention systems.

An industrial rope access system is a twin rope system used to provide access to a work area. A work positioning harness or seat is attached to one rope and a fall arrest harness is attached to the other rope. The system should be used in accordance with the designer's and/or the manufacturer's instructions.

A fall-prevention system is a restraint belt or work positioning harness connected to a restraint line and attached to a fall-prevention static line or an anchorage point which prevent a person getting into a situation where they could fall. The following points describe the components of a fall-prevention system:

- a restraint belt, or work positioning harness is worn by a person connected to a restraint line to restrict the horizontal distance of the wearer; and

- a fall-prevention static line is a horizontal line connected to a fixed anchorage point, to which a restraint line is attached. An anchorage point of a fall-prevention system should be positioned to ensure that the restraint line does not allow the person wearing the system to free-fall.

4.3.6.6 METHODS OF FALL ARREST

The function of a fall-arrest system is to arrest a person's fall to minimise injury if a fall occurs.

Fall-arrest systems may be used in conjunction with higher levels of control measures, such as perimeter guardrails or scaffolding. Where it is not practicable to provide higher levels of control, fall-arrest systems may be used.

When fall-arrest systems are used in a system of work, they should be evaluated to ensure that they are effective and safe, and that no new hazards are created (such as trip hazards or persons movements being restricted).

Fall-arrest systems

Industrial fall-arrest systems and devices are designated to arrest an accidental fall, and consist of some or all of the following:

- anchorage points;
- energy absorber;
- fall-arrest device;
- fall-arrest harness (safety harness);
- inertia reel;
- lanyard;
- lanyard assembly; and
- static line.

Fall-arrest devices such as harnesses and lanyard can be used as travel restriction systems to prevent workers moving from safe to unsafe areas on the roof. Industrial fall-arrest systems and devices should be used in accordance with the manufacturer's instructions.

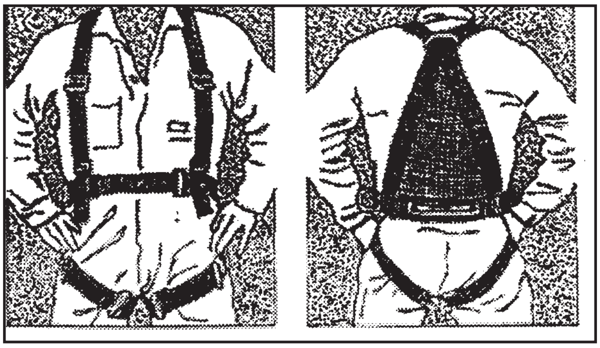
The various parts of fall-arrest systems and harnesses should be compatible. It is therefore essential for the user to check that all components are compatible and fit safely together.

Components of fall-arrest systems and harnesses from different manufacturers should not be mixed as they may be unsafe when used together and can lead to failure of the fall-arrest system.

Harnesses and lanyards

Fall-arrest systems should be designed so that the safety line is as short as possible. The shorter the free-fall distance, the less chance a person has of falling into objects or being injured.

Figure 4.8 Harness



Full-body harnesses parachute type, complying with AS/NZS 1891 Industrial Fall Arrest Systems and Devices should be used. The harness should be connected to the lanyard or line at the top dorsal position. If a line and rope grab device is used on steeply sloping roofs, the user needs the device in front in order to manually operate the mechanism. In this case, the user should consider a harness with a front D-ring connection.

Note: Waist-type belts must not be used for work at heights, or where any free-fall may be involved.

Lanyards used should have a minimum of slack in the lanyard or safety line between the person and attachment to the anchorage.

Lanyards used should have minimum tensile strength of 15 kN (approx 1500 kg) and should comply with AS/NZS 1891 Fall – Arrest Systems and Devices.

Energy absorbers should be used as part of the lanyard assembly to reduce shock to the body and anchorage point by absorbing some of the fall energy.

The use of lanyards in conjunction with inertia reels should be avoided as they could reduce the effectiveness of the inertia reel. Where the use of a short lanyard is necessary for ease of connection to the rear harness connection point of an inertia reel, it should be no greater than 450 mm in length.

Persons using a fall-arrest system must be attached to the system at all times where there is a risk of a fall. If transferring from one anchorage or secure point to another, a second lanyard attached to the safety harness may be used. Connect the second lanyard to the anchorage or secure point before disconnecting the first.

Do not connect snaphooks to each other. Persons wearing fall-arrest systems should not work alone. It is vital that before the commencement of working at heights that all persons working in the area understand the emergency rescue procedures in the event of a fall. A risk assessment associated with the rescue method should also be conducted.

Inertia reel systems

Inertia reel systems can be used to prevent falls where persons are required to carry out their work near an unprotected edge (see diagram). They should comply with AS/NZS 1891 Fall – Arrest Systems and Devices.

Inertia reels are not designed for continuous support but become effective in the event of a fall. They should not be used as working supports by locking the system and allowing it to support the user during normal work. Inertia reels may be less effective for certain applications such as stopping a person falling down the inclined surface of a pitched roof.

Static lines

The installation of safety line systems should be carried out in accordance with the manufacturer's or designer's specifications by a competent person.

The static line to be used should be located as high as practicable. It is dangerous to work above the static line as the person could fall more than 2.4 metres.

Static lines should have a minimum tensile strength of 22 kN (approx 2.2 tonne) and their anchorages should have a design capacity of 22 kN (approx 2.2 tonne). Intermediate supports for static lines should not exceed 6.0 metre spacing unless specifically designed to do so.

Pendulum effect

The pendulum effect is a potential hazard associated with the use of fall-arrest systems. It can occur during swing down and swing back. The pendulum effect may also occur within the interior of the roof if the positioning of the inertia reel allows for a significant length of unsupported line connected to the user.

Figure 4.9 Inertia reel system

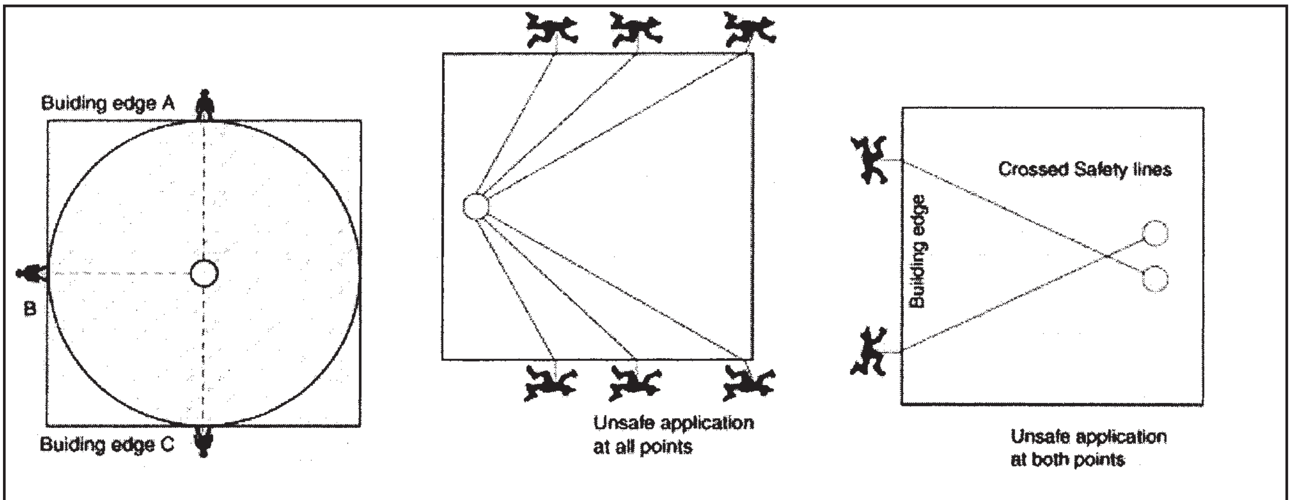
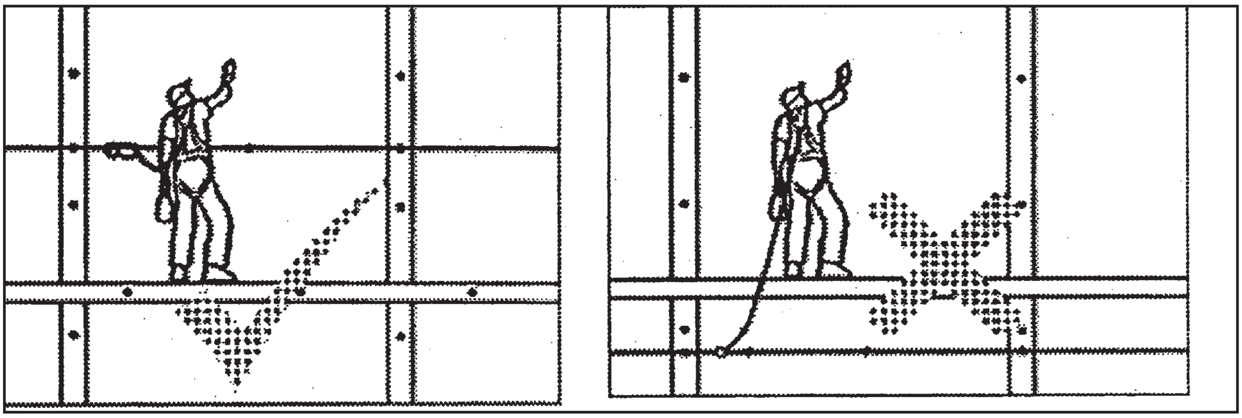


Figure 4.10 Static lines



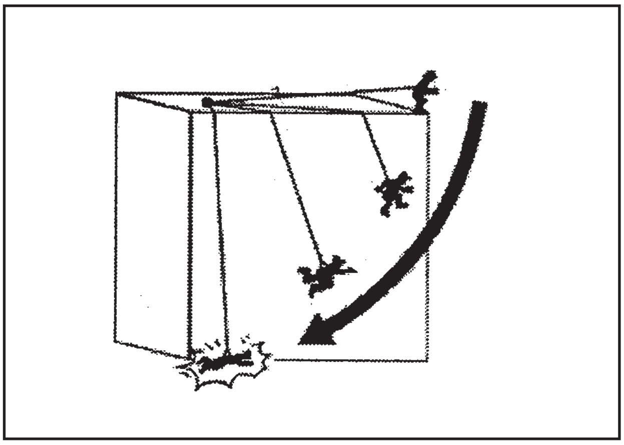
Swing down can occur if an inertia reel is extended out diagonally so that the line makes an extreme angle with the roofs perimeter edge. In this situation, the forces generated in an arrested fall over the edge will cause the line to rotate back along the roof perimeter until it reaches a position directly in line with the anchorage point of the inertia reel and at right angles with the roof edge.

As the line moves back in this way, its unsupported section lengthens, thus dropping the attached worker further than the original (arrested) fall distance. If the length of the unsupported line equals the height of the building, then the worker will hit the ground.

To eliminate the pendulum effect:

- a secondary anchorage point and lanyard or line should be used (see figures);
- place the inertia reel anchorage point more or less perpendicular to the position of the line at the perimeter edge. A mobile anchorage helps here; and
- a perimeter guardrail should be used to prevent any falls over the perimeter.

Figure 4.11 Swing back



Swing back – in an arrested outward fall, particularly from a perimeter edge, a person will swing back into the building structure and collide with any obstructions in the path of the swing. If this situation could arise, the use of fall-arrest system should be reassessed.

4.3.6.7 CONTROL AFTER A PERSON HAS FALLEN

The use of control measures to catch a person after they have fallen should only be used where it is not possible to provide any other more reliable means of fall protection, such as the erection of physical barriers and personal protection systems. The control measures which may be used to catch a person after the person has fallen are:

- catch platforms; and
- safety nets.

4.3.6.8 LADDERS

Ladders used should be:

- designed in accordance with:
  - AS 1892.1 – 1996 Portable Ladders Metal;
  - AS 1892.2 – 1992 Portable Ladders Timber; and

  - AS 1657 – 1992 Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation
- designed and constructed to have a load rating of not less than 120 kg; and
- marked industrial use only.

Portable step ladders

Portable step ladders should:

- not be used on working platforms to gain height above the protected edge, for example next to floors with penetrations, edges of floors;
- be used only in the fully opened position; and
- be of a length that ensures a person's feet are not positioned any higher than the third-highest tread.

Portable single and extension ladders

Single and extension portable ladders should be pitched at a slope of not less than an angle of 1 horizontal to 4 or of not less than an angle of 1 horizontal to 6. The ladder should extend 900 mm above the surface where a person can gain access. If a series of ladders are used to gain access to a surface, landing platforms should be provided at every 6 metre interval. The ladder should be secured against movement and supported from a firm, level, non-slip surface. Fall-arrest systems should be used by person using a ladder as a working surface.

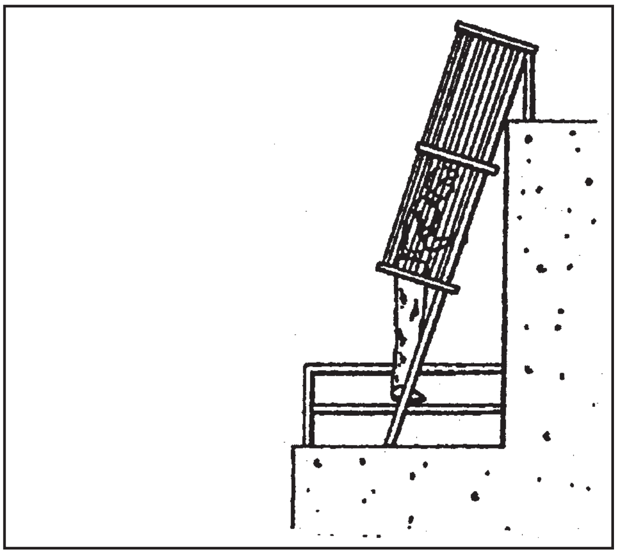
Portable single and extension ladders should not be used:

- in access areas or within the arc of swinging doors;
- on working platforms to gain height above the protected edge; and
- to support a working platform.

Portable trestle ladders

Portable trestle ladders should be used only by a person painting. The trestle ladder should only be used in the fully opened or closed position, Trestle ladders should not be used where a person can fall 4 m or more.

Figure 4.12 Fixed ladder



Fixed ladders

Fixed ladders are vertical or near-vertical ladders fixed to a structure. The ladders should have ladder cages or the person using the ladder should use fall- arrest systems. If a series of ladders are used to gain access to a surface, landing platforms should be provided at every 6 metre interval.

4.3.6.9 OTHER ISSUES

Stairs

Stairs should serve each floor of a building or structure being constructed or demolished so that stairs provide access to the third uppermost working floor.

Lighting

Lighting provided at the workplace should be not less than:

- 200 lux for a working area; and
- 50 lux for stairs or other areas giving access to a working area.

Housekeeping

Materials, tools and equipment on working platforms should be stored so as to leave a clear access way of at least 450 mm.

Access

Consideration of exposure to the weather should be given when establishing the area for an access way. For example, rain may make surfaces slippery or strong winds may cause loss of balance.

Warning signs

Warning signs should be erected to warn persons of the risk of falling from a height. The signs should be positioned where they will be clearly visible to persons working in the area.

REFERENCE DOCUMENTS

Construction II – Frequently Asked Questions About Construction Matter, Queensland Government, Workplace Health and Safety.

Workplace Health and Safety (Falls From Heights) Advisory Standard 1996, Version 3, May 1998.

ISBN 0724276793, Queensland Government, Workplace Health and Safety.

Pioneer Employee Handbook, Pioneer.

Safety Standard for Fall Protection in the Construction Industry, Occupational Safety and Health Administration, US Department of Labor.

Code of Practice for Working at Heights, Workplace Standards, Tasmania.

Australian Standards

AS 1657 – 1992 Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation

AS/NZS 1891 – Industrial Fall – Arrest Systems and Devices

AS/NZS 1892 – Portable ladders

Part 1 – Metal

Part 2 – Timber

4.4 MINE WORKINGS

4.4.1 GENERAL

The mine operator should take reasonable measures to ensure the safe operation of a mine or exploration site by:

- designing and implementing a safe mine layout;
- maintaining current and accurate plans;
- developing and implementing safe operating procedures to best practice; and
- investigating, documenting and reporting dangerous occurrences/conditions.

The working areas and access to any mine should be designed, constructed, worked, maintained and protected so as to minimise risks to the safety and health of all personnel who work in or enter into the mine.

The mine operator should take measures so that operations in the mine are carried on to minimise risk from falls of ground.

The mine operator should have the workings, if unsafe for any reason, adequately sealed off or barricaded to stop access by any person other than authorised persons entering the area for the purposes of assessing the safety of the working or for the purpose of making the workings safe.

The mine operator should provide for the stability of the mine workings to prevent any subsidence or effect outside the mine boundaries, so far as reasonably practical.

4.4.2 SURVEYS AND PLANS

4.4.2.1 PLANS

The mine operator should keep in the office at the mine site accurate plans that:

- are updated at regular intervals; and
- are prepared on a scale that accords with good engineering practice.

Accurate plans should show:

- the surface area of the property showing a permanent mark connected to a boundary of the appropriate lease;
- the surface workings; and
- the underground workings (where appropriate) should be maintained on a mine.

Surface plans should include all offices, buildings, concentrators, workshops and any other permanent structures.

In order to facilitate emergency responses and to prevent damage to these services during work or excavation in their vicinity, mine operators should also maintain reasonably accurate plans and drawings of:

- the high voltage electrical reticulation system;
- the ventilation system underground;
- the geological structure;
- major mains for compressed air and water supply systems and other essential services on the surface and in underground workings of a mine; and
- all buried services and services in bore holes in underground mines.

4.4.2.2 MINE SURVEYS

A datum station should be established in the general vicinity of the mine, to which a coordinate system is related for plan reference. The datum station should be related to the Australian Map Grid.

Conventional signs to be used on mine plans should:

- in the case of surface plans, be consistent with symbols used by the Division of National Mapping, Canberra; and
- in the case of geological plans, comply with "Standard Geological Symbols" issued by Geoscience Australia, Canberra.

4.4.3 HOUSEKEEPING

Good housekeeping includes the day to day cleanliness, tidiness and good order throughout the workplace. It has a direct bearing on the exposure to personal injury and property damage or loss.

Effective safety management and accident prevention programs must have good housekeeping as a basic requirement.

Good housekeeping cannot be left to the unplanned activities of the persons employed, but incorporated into each task rather than an extra to it, and time allocated accordingly.

The standards of housekeeping can be a measure of the level of safety sophistication which exists at an operation.

4.4.3.1 DUST AND DIRT REMOVAL

In some jobs, enclosures and exhaust ventilation systems may fail to collect dust, dirt and chips adequately. Vacuum cleaners are suitable for removing light dust and dirt. Industrial models have special fittings for cleaning walls, ceilings, ledges, machinery and other hard-to-reach places where dust and dirt may accumulate.

Dampening floors or using sweeping compounds before sweeping reduces the amount of airborne dust. The dust and grime that collect in places like shelves, piping, conduits, light fixtures, reflectors, windows, cupboards and lockers may require manual cleaning. Special-purpose vacuums are useful for removing hazardous substances. For example, vacuum cleaners fitted with HEPA (high efficiency particulate air) filters may be used to capture fine particles of asbestos or fibreglass.

Compressed air should not be used for removing dust, dirt or chips from equipment or work surfaces, including laboratories and vehicle cabs.

4.4.3.2 EMPLOYEE FACILITIES

Employee facilities need to be adequate, clean and well maintained. Lockers are necessary for storing employees' personal belongings. Washroom facilities require cleaning once or more each shift. They also need to have a good supply of soap, towels plus disinfectants, if needed.

If workers are using hazardous materials, employees' facilities should provide special precautions such as showers, washing facilities and change rooms. Some facilities may require two locker rooms with showers between. Using double locker rooms allows workers to shower off workplace contaminants and prevents them from contaminating their "street clothes" by keeping their work clothes separated from the clothing that they wear home.

Smoking, eating or drinking in the work area should be prohibited where toxic materials are handled. The eating area should be separate from the work area and should be cleaned properly each shift.

4.4.3.3 SURFACES

Floors:

Poor floor conditions are a leading cause of accidents, so cleaning up spilled oil and other liquids at once is important. Allowing chips and dust to accumulate can also cause accidents. Trapping chips, shavings and dust before they reach the floor or cleaning them up regularly can prevent their accumulation. Areas that cannot be cleaned continuously, such as entrance ways, should have anti-slip flooring. Keeping floors in good order means replacing worn, ripped, or damaged flooring that poses a tripping hazard.

Walls:

Light-coloured walls reflect light while dirty or dark-coloured walls absorb light. Contrasting colours warn of physical hazards and mark obstructions such as pillars. Paint can highlight railings, guards and other safety equipment, but should never be used as a substitute for guarding. The program should outline the regulations and standards for colours.

4.4.3.4 MAINTAIN LIGHT FIXTURES

Dirty light fixtures reduce essential light levels. Clean light fixtures can improve lighting efficiency significantly.

4.4.3.5 AISLES AND STAIRWAYS

Aisles should be wide enough to accommodate people and vehicles comfortably and safely. Aisle space allows for the movement of people, products and materials. Warning signs and mirrors can improve sight-lines in blind corners. Arranging aisles properly encourages people to use them so that they do not take shortcuts through hazardous areas.

Keeping aisles and stairways clear is important. They should not be used for temporary "overflow" or "bottleneck" storage. Stairways and aisles also require adequate lighting.

4.4.3.6 SPILL CONTROL

The best way to control spills is to stop them before they happen. Regularly cleaning and maintaining machines and equipment is one way. Another is to use drip pans and guards where possible spills might occur. When spills do occur, it is important to clean them up immediately. Absorbent materials are useful for wiping up greasy, oily or other liquid spills. Used absorbents must be disposed of properly and safely.

4.4.3.7 TOOLS AND EQUIPMENT

Tool housekeeping is very important, whether in the tool room, on the rack, in the yard, or on the bench. Tools require suitable fixtures with marked locations to provide orderly arrangement, both in the tool room and near the work bench. Returning them promptly after use reduces the chance of being misplaced or lost. Employees should regularly inspect, clean and repair all tools and take any damaged or worn tools out of service.

4.4.3.8 MAINTENANCE

The maintenance of buildings and equipment may be the most important element of good housekeeping. Maintenance involves keeping buildings, equipment and machinery in a safe, efficient working order and in good repair. This includes maintaining sanitary facilities and regularly painting and cleaning walls. Broken windows, damaged doors, defective plumbing and broken floor surfaces can make a workplace look neglected; these conditions can cause accidents and affect work practices.

It is important to replace or fix broken or damaged items as quickly as possible. A good maintenance program provides for the inspection, maintenance, upkeep and repair of tools, equipment, machines and processes.

4.4.3.9 WASTE DISPOSAL

The regular collection, grading and sorting of scrap contribute to good housekeeping practices. It also makes it possible to separate materials that can be recycled from those going to waste disposal facilities.

Allowing material to build up on the floor wastes time and energy since additional time is required for cleaning it up. Placing scrap containers near where the waste is produced encourages orderly waste disposal and makes collection easier. All waste receptacles should be clearly labelled (eg recyclable glass, plastic, scrap metal etc).

4.4.3.10 STORAGE

Good organisation of stored materials is essential for overcoming material storage problems whether on a temporary or permanent basis. There will also be fewer strain injuries if the amount of handling is reduced, especially if less manual materials handling is required. The location of the stockpiles should not interfere with work but they should still be readily available when required. Stored materials should allow at least one metre of clear space under sprinkler heads.

Stacking cartons and drums on firm foundation and cross tying them, where necessary, reduces the chance of their movement. Stored materials should not obstruct aisles, stairs, exits, fire equipment, emergency eyewash fountains, emergency showers, or first aid stations. All storage areas should be clearly marked.

Flammable, combustible, toxic and other hazardous materials should be stored in approved containers in designated areas that are appropriate for the different hazards that they pose. Storage of materials should meet all requirements specified in the fire codes and the regulations of environmental and occupational health and safety agencies.

REFERENCE DOCUMENTS

"Boral OH&S Manual", Boral

"Workplace Housekeeping – Basic Guide", Canadian Center for Occupational Health and Safety.

4.4.4 MATERIALS HANDLING

Each person should be able to carry out their task safely, using any necessary equipment, without the task being onerous or causing undue physical strain to either the person or the equipment being used. Refer to the Australian National Standard for Manual Handling (NOHSC 1990) for advice, but also take account of the frequent need to handle awkward loads on poor surfaces and in confined spaces where conventional mechanical aids cannot be used.

4.4.4.1 HUNG BINS, CHUTES, PASSES

Hung passes, chutes and/or bins pose a sufficient danger that established procedures are advisable.

The person, if any, whose duty it is to attend to the free running of the contents of the bin, pass or chute should when the contents of the bin, pass or chute becomes firmly jammed (hung) as to require some special effort to set them free:

- at once notify their immediate supervisor;
- ensure the feed into and from the pass, bin or chute has been effectively stopped; and
- isolate and tag out the extraction system.

A risk assessment should be conducted to determine the safest method for freeing hung passes, chutes or bins.

The method of freeing hung stope drawpoints should take account of the hazards of falling ground and airblast when large amounts of ground fall.

4.4.5 SURFACE EXCAVATIONS

An assessment of the height of faces, the face angle and the proximity of the excavation to the mine boundary are relevant to the precautions for preventing instability at the boundary, unexpected slope failures and dangers associated with mucking out high rock piles.

4.4.5.1 OPENCUT OVER UNDERGROUND WORKINGS

There may be a danger that an opencut worked in the vicinity of underground workings might collapse. This should not, however, preclude the sinking of passes from the floor of an opencut for the purpose of filling underground stopes.

When work is being carried on in any opencut, underground stoping should not be carried out within a distance of the bottom of the pit in any direction which would render the underground working unsafe.

4.4.5.2 HAUL ROADS

Active haulage and access roads should at all times be clearly defined. They should be kept watered against dust, and speed limit signs should be placed in strategic positions where vehicles may converge.

Haul roads used for two-way vehicular access should be wide enough to allow two vehicles to pass in safety, unless the traffic is one-way and no vehicle will pass another, or unless traffic flow is controlled and passing bays are provided.

Exposed haul road edges require a bund. A minimum height of half a haul truck wheel height is recommended.

4.4.5.3 METHODS OF WORKING OPENCUTS

In open cuts where the vertical height of the face exceeds three metres and where explosives are used, bench drilling should be carried out from the top of the bench, but this should not preclude the drilling and firing of toe holes.

A face should not be drilled in a manner which will create an overhang of the face, and where unconsolidated rock is mined; the face and sides should be battered (that is, be at an appropriate angle) to prevent a collapse.

A face should not be undercut by the excavation of a slot at the toe of the face, but this does not preclude a tunnel or adit being driven into the face.

Where a person on foot is required to work at the toe of a quarry face or on the face itself, the face should be scaled of any loose rock which could fall on that person.

In an area close to centres of population, the manager may need to fence against inadvertent access to the faces.

No one should walk or climb onto any active surge stockpile of broken rock to which broken rock is fed from above and from which the rock is withdrawn from a chute below unless:

- that person has been authorised to do so by the general manager;

- the feed to and from the stockpile has been stopped;
- it has been established that the chute below is not hung up;
- that person is wearing appropriate fall arrest equipment securely fixed to an anchorage above him or her; and
- that person is assisted by another person stationed at a safe vantage point above. Unless the mine operator or the mine operator's representative is satisfied that it is safe to do so, earthmoving equipment should not be used on a surge stockpile.

4.4.5.4 SAND PIT

Sand pit means a quarry from which free running sand is excavated by machinery other than a dredge.

The owner or manager of an area proposed to be used as a sand pit within or adjacent to a centre of population should fence it so as to prevent access to it by the public.

Any unfenced sand pit in close proximity to a populated area should be inspected by the mine operator, or a person nominated by the mine operator, at the end of each day's work to determine whether that working face has been sloped to prevent a slump of sand.

A fence erected around the sand pit will need to be maintained.

Unless the face of a sand pit stands at an angle that closely approximates the natural angle of repose for sand, the maximum height of a working face should not exceed the vertical reach of the excavating equipment working at that face or a lesser height depending on the circumstances. Where the total depth of a sand pit exceeds that height it should be worked by a series of benches.

Each bench of a sand pit should have separate loading arrangements and be of sufficient length and breadth to provide safe working conditions for the vehicles and equipment used on it.

A working face should be worked back and forth in as straight a line and over as great a length as practicable and at the end of each day's work sloped to prevent a slump of sand.

4.4.5.5 CLAY PIT FACE

For slope stability reasons, it is a general rule of thumb that clay pits should be worked so that the width of an active berm is more than twice the vertical height of the face.

4.4.6 TAILINGS

A number of sections within this topic consist of extracts from guidelines available through the Western Australia Department of Mineral and Petroleum Resources.

4.4.6.1 GENERAL

The manager should ensure the safe design, construction, operation and rehabilitation of tailings storages. While various designs and construction techniques exist, the manager should ensure that factors involved with the storage's size, location, construction, operation, extention, maintenance, and rehabilitation are selected to suit local conditions.

Any tailings dam which presents a risk to any person who may venture onto its surface should be securely fenced and have signs posted prohibiting unauthorised entry.

Managers should seek the assistance of geotechnical services when tailings storage involves the construction of dams.

Where ores require concentration, most of the material mined will be waste, requiring permanent storage. The tonnages of material planned to be mined, its mineral recovery rates and its bulking factor can be used to calculate the tailings containment volume required. The storage's area will be determined by how high the containment barrier can be safely constructed.

4.4.6.2 LOCATION

Factors which the manager should ensure are considered in locating a tailings storage facility include:

- tailings toxicity and properties;
- method of tailings generation (wet or dry);

- area requirements (tailings, mine and infrastructure);
- flooding prevention (topography and climate);
- structural failure and leakage prevention (local geology);
- geotechnical investigations; and
- seismic activity.

4.4.6.3 BELOW-GROUND STORAGE

Tailings storage in underground voids or derelict open pits, although possible, requires the manager to ensure that this method of storage should only be developed when:

- the tailings are non-toxic;
- contamination of groundwater will not occur;
- a long-term public safety hazard is not created; and
- mining below the tailings storage is not contemplated.

Water should not be allowed to accumulate in filled stopes, particularly those filled with uncemented sand fill. The accumulation of water in sand filled stopes can potentially result in the following:

- liquefaction of the fill by dynamic loading;
- hydraulic pressure on fill bulkheads or barricades; and
- hydraulic pressure on lined ore passes or ventilation rises in the fill.

The dynamic loading of a saturated sand fill mass, by seismic events and/or nearby blasting, may cause liquefaction of the fill mass with potentially catastrophic consequences. Excess hydraulic pressure may result in the sudden unexpected collapse of one or more fill bulkheads or lined passes which may result in the flooding of large areas of the mine resulting in a major hazard to the workforce.

The removal of crown pillars below filled stopes containing significant volumes of water should be treated with extreme caution and suitable measures to drain the water should be undertaken before the pillar is removed.

4.4.6.4 IN-PIT STORAGE

The following brief notes are intended to provide guidance on the issues that need to be addressed when considering in-pit method of tailings storage. The final rehabilitation of a tailings storage facility must always be kept in mind when considering which tailings storage method is the most cost-effective. Short-term economic advantages of storing tailings in a mined-out open pit may be offset by very considerable monitoring and remediation works before rehabilitation can be done. Substantial rehabilitation costs may then be incurred once the pit is filled with material with, for example, a high liquid content and/or very low strength characteristics. In-pit tailings storage presents a number of difficulties not normally associated with the more conventional methods of tailings storage.

Groundwater table

There are basically two types of open pits that need to be considered, those:

- wholly above the groundwater table; or
- in contact with the groundwater table.

Both have their own unique challenges that must be considered before any decision is made to commit to in-pit tailings storage. Many open pits are considerably deeper than the depth to the groundwater table; hence the tailings will be in contact with groundwater.

Tailings storage above the groundwater table is generally considered to present fewer difficulties than storage below the groundwater table.

The quality, quantity and potential use of groundwater resources need to be considered when assessing future adverse impacts on the groundwater resources. The presence of significant quantities of potable groundwater, in close hydraulic proximity to a proposed in-pit tailings storage, would require detailed hydrogeological investigation.

It is strongly recommended that groundwater monitoring bores be installed around the open pit and regularly monitored prior to and during tailings deposition. This will facilitate long-term monitoring of the potential for groundwater contamination.

Appropriate capping and marking of the monitoring bores is required for their long-term use.

In-pit dewatering

Successful in-pit storage of tailings must be able to achieve an on-going and high level of dewatering during the process of tailings deposition in the open pit. Failure to give sufficient consideration to the dewatering requirements may result in a delayed and unnecessarily difficult and/or very costly rehabilitation phase.

The design phase of in-pit storage, above or below the groundwater table, requires careful consideration of the dewatering procedures to be adopted. Limited open pit access, via the haul ramp, to service and maintain pontoon-mounted pumping equipment will mean that the decant pond must be kept in close proximity to the end of the haul ramp.

Progressive filling of the open pit will require the decant pond to be moved to follow the end of the haul ramp as it traverses its way up the wall or walls of the open pit. This is different to from conventional storage where the decant pond remains in an essentially fixed horizontal position around the decant tower.

Multi-point tailings discharge procedures are required to ensure that the decant pond is easily accessible at all times. Having to reach the dewatering pumps by travelling over saturated or partially saturated tailings is not considered a desirable operating procedure.

In-pit storage above the groundwater table

Some open pits are excavated entirely above the natural groundwater level. If tailings are stored in these pits, the tailings water seeps into the ground and may come into contact with the natural groundwater. This may result in contamination of groundwater supplies, particularly if potable groundwater is present. However, consolidation of deposited tailings may be relatively faster when compared to the tailings storage below the natural groundwater table.

In-pit storage near groundwater table

Often open pits are excavated well below the natural groundwater table. If tailings are stored in open pits deeper than the groundwater table the position of the final tailings surface relative to the groundwater table needs to be recognised in advanced. If the final surface of the tailings is at or near the level of the groundwater table the saturation of the tailings surface may become an important rehabilitation issue. Other tailings storage options should be seriously considered before adopting this approach. If tailings are deposited to a level well above the groundwater table the effects of groundwater on rehabilitation may be less significant.

Subaqueous tailings storage

The success of subaqueous storage of tailings requires the continuous presence of a sufficient depth of water above the tailings surface at all times. There should be a minimum water depth of five metres above the surface of the tailings once the deposition of tailings is complete. This is required to ensure as far as practical that no person may be injured by striking, or becoming trapped in, the tailings material.

The ability to maintain a sufficient depth of water will depend on a number of factors, including:

- the net difference between rainfall and evaporation at the site; and
- the amount of groundwater inflow to the open pit.

With a bund wall around the open pit the amount of surface water runoff into the open pit should be minimal. Each of these hydrogeological and hydrological issues needs to be addressed to fully understand the water balance required to maintain a minimum depth of 5 metres of water above the tailings material.

4.4.6.5 ABOVE-GROUND STORAGE

Tailings storage above ground can be created as needed through predetermined stages of construction over a period of years. There is generally little or no opportunity for their removal at the conclusion of mining and they must therefore be structurally competent.

Tailings are mostly wet or contained in water. Stored material can consist of loose, unconsolidated, relatively impermeable solids and water containing contaminants of varying toxicity. Liquefaction of saturated tailings can result from severe shock, causing hydraulic pressure loading to the storage embankment significantly greater than prior static loading. If the embankment was constructed by hydraulic deposition, it may also be at risk of failure through liquefaction and loss of strength under the same shock conditions.

As mining proceeds so does the need for tailings storage. This can be satisfied by progressive construction in stages, with the embankment being raised when required over a period of years to accommodate ongoing tailings production. While such an approach allows a degree of flexibility unknown in the construction of conventional water storage dams, it decreases the degree of control that can be achieved in the case of conventional construction. However, tailings deposits are continually rising as the embankment is raised. The embankment may therefore develop significant structural support from the tailings being stored.

4.4.6.6 TAILINGS STORAGE STRUCTURE

Consideration should be given to the following.

- *Plan and section*: A detailed contour plan and section of the proposed storage should be provided.
- *Construction method*: A description of the site preparation and construction procedures including details of any supervision to be provided, test procedures.
- *Area*: The total area of the structure and the functional area for tailings disposal at start-up, full production and at close of operations.
- *Height/depth*: Ultimate design height of tailings storage facility and number of lifts envisaged.
- *Capacity*: The volume of storage available for tailings and expected dry tonnes capacity, that is, allowance for non-recovered water content must be made.
- *Wall angles*: Final outer wall angle (recommend a maximum of 20° from horizontal for any outer slope, but this depends on materials to be exposed, and their erodibility).
- *Decant/underdrainage system*: Provide details of design and expected performance of any decant or underdrainage (objectives are to achieve maximum tailings density and water recovery for process plant recycling). Designs without a decant or underdrainage must be justified, and have sufficient surface area to achieve acceptable tailings density by evaporation between placement cycles. Designs which incorporate upstream wall lifts using tailings may not be permitted unless some form of central decant is employed.
- *Liners*: Details of the liners (if used). Decant or return water sumps must be lined preferably using synthetic liners.

4.4.6.7 HAZARD RATING OF TAILINGS STORAGE

A tailings dam which presents a risk to persons venturing onto its surface should have warning signs posted and be secured with fencing to prevent unauthorised access.

The manager should ensure that tailings storage under his control undergo regular hazard review to determine the potential impact on any life, property, or mine infrastructure and the environment as a result of uncontrolled leakage or failure of the embankment.

Hazard reviews should be undertaken in accordance with nationally accepted standards and should result in each tailings storage facility receiving an individual hazard rating.

A hazard rating assesses the potential impact of controlled or uncontrolled escape of material or seepage, or the failure of the embankment, and is not an assessment of the risk of failure. A well designed and constructed storage facility may have a low risk of failure but may be given a significant or high hazard rating since the impact of the worst possible combination of failures determines the hazard rating.

The purpose of this process is to ensure that appropriate design, construction, operation, maintenance and rehabilitation safety standards are applied. The process should undergo regular review, supported by constant monitoring particularly in cases of significant or high hazard ratings. In such cases, the use of instrumentation and monitoring should be incorporated into the design, construction and operation, and rehabilitation phases. If structural changes in mining occur, which may be impacted upon by the tailings storage system, a reassessment of the hazard rating should be undertaken.

4.4.6.8 MONITORING

The aims of monitoring are to provide a measure of actual performance against expected performance for the project. In addition to conventional environmental monitoring for dust, gases and water, it is recommended that monitoring of such aspects as achieved tailings densities and properties, available storage volumes and deposition time remaining, should be performed on a regular basis to assist with management planning. The results of environmental trials for final rehabilitation, in addition to the performance of the facility during significant seasonal events, should also be considered as part of the facility monitoring to aid rehabilitation planning.

A description of all monitoring procedures is required. Details of the sampling locations, frequency and parameters should be provided. The detailed design for tailings storage should address the measures to be taken to limit the extent and amount of contamination, and the monitoring program should provide the means to assess the effectiveness of the measures taken.

All fauna deaths and any technical malfunction resulting in tailings or water escaping from the containment system should be recorded and reported. All tailings pipelines not equipped with automatic cut-outs in the event of pipe failure are to be buried, or located in a suitably bunded easement capable of containing any spill for a period equal to the time between routine inspections.

Decant or return water ponds are to be fitted with a warning system that will alert plant operators to any possible overflow.

4.4.6.9 EMERGENCY PLANNING

An emergency plan should be developed if required which identifies:

- risks to life, property, mine infrastructure and the environment; and
- details of flood warnings and emergency procedures.

4.4.6.10 DECOMMISSIONING AND REHABILITATION

Decommissioning

Decommissioned tailings storage facilities should be:

- safe;
- stable; and
- aesthetically acceptable.Decommissioned facilities should be left in a manner, which does not allow them to breach any of the embankments necessary for containing the tailings. Decant systems, if used, will be fully decommissioned and made safe so that when normal weather forces act on the decant systems they will not be a cause of undermining the embankment. The embankment walls should be left in such a condition that they would not be heavily eroded by surface run-off from the structure. In particular, considerable attention should be paid to the probability of gullies developing on the wall and any capping of the wall to armour it against erosion should be specifically designed to minimise gully development.

The outer walls or embankments should also be protected against the erosion effects of any surface run-off from around and upstream of the structure that could undercut the structure and cause it to collapse. Measures to provide long term surface stabilisation; consideration should be given to covering the top surface with a minimum of 500 mm of suitable waste where saline process water has been used, followed by spreading of topsoil and seeding. Those facilities which use potable quality water during ore processing may not require the top surface to be covered with waste, but should be ripped, seeded, and fertilised to encourage revegetation to reduce the erosion and dusting hazards.

All structures should be left with an effective drainage management system that takes into account the long-term stability and erosion impacts of rainfall, the consolidation of the structure and wind erosion. It is anticipated that the surface will have an erosion resistance similar to that of the surrounding areas.

Measures should be taken to minimise the possibility of uncontrolled release and erosion during flood periods, and endangerment to life. Decant and underdrainage systems should be decommissioned, sumps refilled and a drainage control system developed to shed rainfall runoff from all external surfaces so as to minimise the possibility of erosion.

Considerable care should be exercised when capping is used as it must be sufficiently well-engineered to resist the development of gullies in peak rainfall events and avoid the long-term problems that may be caused by the materials used in such capping breaking down during weathering. While recognising that aesthetics are a largely subjective matter, the tailings storage facility should blend into the landscape and the visible portions of the structure should be covered by suitable self-sustaining vegetation.

Rehabilitation

The tailings storage rehabilitation options available to a mine will largely be determined by the conditions in the top several metres of material. It is preferred that all tailings storage is revegetated with natural plant species endemic to the general mine site location.

The following general geotechnical issues must be considered when determining what rehabilitation is required:

- profile of the tailings surface;
- amount of surface settlement that is acceptable with time; and
- moisture content of the tailings surface.

There will be a range of chemical and biological issues that may also need to be addressed to ensure viable lasting rehabilitation of the site.

Measures to be taken to establish a self-regenerating cover compatible with the surroundings; to achieve this, topsoil or a growth medium could be spread on all external surfaces and, where necessary, additional seed and fertiliser applied.

It is emphasised that slopes of 20° may not be suitable for fine grained, or highly erodible materials, without adequate armouring; where such fine grained or erodible materials exist at the surface, slopes of less than 20° may be required to minimise gully erosion.

REFERENCE DOCUMENTS

Guidelines on the Safe Design and Operating Standards for Tailings Storage, Western Australia Department of Minerals and Energy, May 1999.

Geotechnical Considerations in Underground Mining Western Australia Department of Minerals and Energy, December 1997, Guideline Document No.: ZME723QT

4.4.7 UNDERGROUND EXCAVATIONS

4.4.7.1 VERTICAL OPENINGS

Special attention needs to be given to falling objects and to the risk of persons falling into openings.

4.4.7.2 HEIGHT OF BACKS

When miners are working beneath freshly broken ground they need to be able to examine the backs, check the condition of the ground, and scale and secure this ground. Adequate lighting, and appropriate equipment for access and protection are necessary for this purpose. The method and equipment used should be appropriate for the size, geometry and ground conditions.

4.4.7.3 WINZES

Tools should not be raised or lowered in any winze or other confined place in which persons are working, except in a bucket or proper receptacle; and any projecting tool should be secured so as to prevent it falling out of the bucket or receptacle.

Every winze should be sunk clear of the travelling way, to minimise the risk of person or objects falling into the winze.

Communication by voice alone should not be made up or down any winze exceeding a depth of about six metres when hoisting appliances are utilised. Radio communications, a knocker line, or other suitable device should be provided in every such winze to enable signals to be communicated to the driver from every part of the winze.

4.4.7.4 RISES

Whenever a rise is intended to be more than eight metres in length above the recognised back, and the inclination exceeds 45^{o}, a method designed to protect persons travelling in the rise should be used.

4.4.7.5 SHRINK (OR SHRINKAGE) STOPES

Where stopes are worked on the shrinkage system, ore should not be drawn off until the persons working in the stope or likely to enter the stope have been notified to that effect. This should include written instructions from the supervisor.

4.4.7.6 ALLUVIAL MINES, ESCAPE DRIVES

Appropriate escape systems and refuges to ensure the safety of personnel working underground should be established in any alluvial mine which is liable to any inundation or inburst of water.

4.4.7.7 WORKINGS APPROACHING WATER OR GAS

In a mine which is liable to an inundation or inburst of water or gas, the general manager should at all times be aware of the locations of faces being advanced, and have identified relevant precautions. The mine operator and other personnel should be ready to take all necessary steps in the event of an inundation or inburst.

Suitably directed boreholes should be drilled from the workings, and be sufficient in number and length, to give ample warning of the presence of water or gas. These holes should be drilled through collars incorporating shut-off valves.

The geometry and length of water and gas cover drill holes should be determined according to the geology (particularly stratigraphy) and any earlier experience in the area.

Influx of toxic noxious gases

Precautions to prevent ignition of the gas and to protect persons from harm to health arising from toxic or noxious gases might include any or all of the following.

The prohibition of any lamp, light, matches or other means of ignition other than a locked safety lamp or an electrical cap lamp adapted for use in explosive atmospheres.

A competent person, appointed by the mine operator, should inspect:

- immediately before the commencement of every shift; and
- during the course of every shift every part of the mine and associated working in which persons work or travel.

Appropriate self-rescue apparatus should be available, and adequate instruction given in their use.

4.4.7.8 WORKINGS APPROACHING EACH OTHER

When any tunnel is being developed towards another working and approaches within about 10 metres of that working or the surface, whether work is being carried out or not at such place, the general manager needs to consider whether:

- one end only is advanced;
- the stopped end is cleaned out and checked for misfires and all butts in the stopped end cleaned out with water at sufficient pressure; and
- the stopped end is effectively barricaded off at a safe distance.

4.4.7.9 LADDERS

Ladderways in shafts which exceed 10 metres in depth should be cased off from haulage compartments, kept in a safe condition and regularly inspected.

No one should ascend or descend any portion of a shaft by ladderways while the haulage portion is in use, unless the haulage portion is cased or securely fenced off from the ladder compartment.

Suitable ladders or footways should be provided to connect floors of sets in stopes, and other places requiring access in a mine.

A proper ladder or footway should be provided in every shaft, winze or rise being sunk or risen for persons ascending or descending, unless other suitable and reliable means of travel are provided.

For shafts greater than 30 metres in depth, a ladder permanently used for the ascent or descent of persons in a mine should meet AS 1657 Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation, and:

- be securely fixed but not in an overhanging position, and it should be inclined at the most convenient angle which the space in which the ladder is fixed allows;
- have substantial platforms at intervals of not more than 10 metres;
- unless the ladder extends above the top of the opening or platforms, suitable fixtures for the hand grip should be placed above such ladder for the use of persons ascending or descending the ladder; and
- ladders must be so placed that there is not less than about 130 millimetres of foothold between rungs and the wall against which they are placed, and the distance between centres of rungs must not be more than about 300 millimetres.

4.4.7.10 ACCESS TO AND FROM MINE WORKINGS BEING DEVELOPED

Where a new mine or a new section of a mine is being developed, an alternative exit independent of and separate from the principal access should be planned and put in place as soon as reasonably practicable.

A proper ladder or footway should be provided in every shaft being sunk unless other suitable and reliable arrangements for travel are made.

A stage winder with a separate kibble winder, both of which may be operated from mains and auxiliary power (or electricity) supplies, may be appropriate for deeper shafts.

During sinking operations a chain ladder may be used from the stage to the bottom of the excavation, and it is recommended the length of travel on such chain ladder is not longer than 6 metres.

4.4.7.11 RAIL-MOUNTED EQUIPMENT NEAR SHAFTS

Railway sidings, plats and braces should be designed and constructed so as to allow the safe storage of rail trucks, locomotives and other equipment, machinery and stores or other materials, and for the effective holding of rolling stock to prevent its accidental movement towards main lines or shaft openings.

4.4.7.12 EXIT FROM MINES

In addition to any mechanical means of entry and exit, there should be at least one proper ladder or footway connecting from the surface to the workings. However, instead of a ladderway in a shaft, it may be sufficient to have at least two winding plants available for use, and for power (or electricity) to be available from two independent sources (ie a plant or source ready to be returned to service or which is in service). These travelling ways must be clearly and adequately marked so that persons can readily leave the mine in an emergency. The mine operator must prepare a suitable scheme of the action to be taken to secure the safety of people when an accident, dangerous occurrence or breakdown of apparatus or equipment leaves only one exit available for use ("exit" means a mechanical or physical means of leaving an area, section or the entire mine).

4.4.7.13 COMBUSTIBLE DUSTS

In an underground mine where the sulphur content of the ore is high (more than 20%) or a sulphide dust explosion may be expected to occur, the general manager should prepare and implement a scheme for minimising the danger from such an explosion.

Further advice is given in Section 4.12 Dust.

4.4.7.14 SHAFTS AND EXCAVATIONS TO BE PROTECTED

Every abandoned or disused shaft or dangerous excavation should be fenced or securely covered and its position indicated on the surface by a post with a notice.

4.4.8 MANAGING HAZARDS

Risk management is an important part of good management practice. AS/NZS 4360 - Risk Management, provides information and examples on the basic requirements and process to plan and implement a risk management program.

Hazard management provides a number of advantages, including

- eaurly detection and reporting of an increase in risk;
- well-planned responses with adequate resources;
- cost-effective controls, and
- a formalised approach that provides consistency if there is any change of management.

The common approach to managing hazards is to assess and rank the risk for each activity with respect to the consequence and likelihood of a hazard resulting in a fatality. Hazards having a potentially very high risk should be tackled first by either eliminating the risk or putting controls in place to minimise the risk.

Activities should be reviewed to determine what hazards need to be monitored to detect changing conditions that may lead to a greater risk. The monitoring system should warn that a very high risk is developing for a particular hazard.

“Trigger-levels” based on measurable information should alarm management that conditions are changing and prompt a planned response. The response may lead to more regular monitoring or put additional controls in place to minimise the risk. In addition, benchmarking hazards against other similar mining operations with the assistance of specialist advice should be considered when establishing trigger-levels and controls.

A table can be used to summarise the management of risk relating to each Major Hazard and can consider:

- what form of monitoring would be appropriate for changed conditions,
- how regular the monitoring would be carried out,
- identifying staged trigger values or levels from this monitoring that indicate conditions have changed and require a response,
- a planned and well considered action or response if this trigger value is reached,
- additional reporting to management and government agencies in response to a trigger level reached, and
- identifying persons responsible for taking action and reporting.

Some have called this table a Triggered Action Response Plan (TARP).

Managing Major Hazards in this way can have the following advantages:

- it provides for early detection of an increase in the risk levels of Major Hazards,
- trigger levels set off “alarm bells” for management
- management are obliged to respond to those triggers or “alarm bells”,
- the trigger values are staged so that an early response is made before a hazardous situation escalates beyond control, thereby countering any advance towards a serious incident,
- management’s response to such trigger values is a well planned response,

- unacceptable levels of risk is continuously prevented from occurring,
- these planned responses or actions have been determined well before an event has occurred. It is also based on research using tangible or scientific reasoning and not just from an opinion, thereby being a more effective response than otherwise might have been the case,
- early detection and reporting of changes occurring could ensure resources will be provided that otherwise may not have been available to deal with an escalating situation,
- a simple table (see below) can provide for easy viewing of the controls of Major Hazards, thereby assisting in reviewing its overall effectiveness, and
- corporate memory is maintained by this simple, effective and well-established system. Corporate memory is particularly important, as managing of Major Hazards would be the most important safety management area for any mine.

Example of a Triggered Action Response Plan (TARP)

Major Hazard	Form of Review or Monitoring	Review or Monitoring frequency	Trigger Level	Planned Response	Reporting Requirements	Comments

4.5 GROUND STABILITY

4.5.1 INTRODUCTION

Sections within this topic consist of extracts from guidelines available through the Western Australia Department of Mineral and Petroleum Resources.

Mine management should recognise that a well managed ground control plan is a necessary component of any successful mining operation or project and be able to demonstrate that it has adopted “sound practice” in the field of geotechnical engineering as applied to ground stability. A ground control management plan would include pre-mining investigations of ground conditions, development of a mine plan and design according to the assessed ground conditions and required rates of production. Once mining is underway, a system of ground performance monitoring and re-assessment of ground control management systems should be undertaken such that the safety and health of all mine personnel can be maintained for the duration of mining.

4.5.2 GEOLOGICAL STRUCTURE

In geotechnical engineering the term geological structure refers to all the natural planes of weakness in the rock mass that pre-date any mining activity and includes: joints, faults, shears, bedding planes, foliation and schistosity. Planes of weakness divide the rock mass up to a collection of potential blocks the size, shape and orientation of which strongly influence rock stability conditions in mines.

The combination of wide excavation spans and the presence of flat dipping continuous planes of weakness is particularly adverse for rock stability.

The important role that geological structures have in ground control cannot be over-emphasised. Thorough investigation and analysis of geological structure is vital to a good understanding of the major influence that geological structure exert in determining the ground conditions in underground mining.

4.5.2.1 DRILL CORE LOGGING

Once the potential for economic mining has been identified there appears to be a strong case for the geotechnical logging of a high proportion of all diamond-cored bore holes as soon as the core becomes available.

Regardless of the actual number of holes geotechnically logged, what is of fundamental importance is that those holes that are geotechnically logged constitute a representative sample of the ground conditions found in the ore zone(s) and the wall rocks of a potentially mineable deposit.

4.5.2.2 GEOLOGICAL MAPPING

An ongoing mapping assessment is required because of the relative paucity of data that is usually available when the mine design (and ground control management plan) is first formulated. An example of the ongoing review of geotechnical databases is mapping of geological/geotechnical features (such as. the orientation, spacing and length of planes of weakness) as mine faces/walls are exposed.

4.5.3 HAZARD AWARENESS

Recognition and assessment of hazards forms a critical part of a ground control management plan. The installation of a particular level of ground support and reinforcement may not be adequate when that same development is in a highly stressed abutment of a large stope. The following factors should be recognised and acted upon when identifying hazardous conditions.

4.5.3.1 ROCK CONDITIONS

The main factors that may combine to produce a given set of hazardous ground conditions include:

- geological structure;
- rock stress;
- rock strength;
- groundwater;

- blast damage; and
- size, number, shape, type and orientation of openings and their interaction with the five factors listed above.

4.5.3.2 ROCK STRESS

Rock stress has both magnitude and orientation and can be considered to consist of two parts:

- pre-mining stress field; and
- disturbance effects due to excavation.

Rock stress around an excavation = Pre-mining stress field + Disturbance effects

The reliable determination of the rock mass stress magnitude and orientation is not something to be undertaken lightly or in haste. Considerable experience, technical skill and the appropriate equipment plus technical backup are required for success.

4.5.3.3 ROCK STRENGTH

The strength of the rock mass is controlled by the complex interaction of a number of factors including:

- intact rock substance compressive strength;
- geological structure (planes of weakness) – particularly orientation, persistence, spacing and shear strength parameters;
- groundwater; and
- alteration of minerals on exposure to air and/or water with time.

Rock mass strength is probably the least well-defined aspect of geotechnical engineering. The limitations that exist in this area of geotechnical engineering need to be recognised, particularly with regard to the use of numerical stress analysis techniques.

Soft rock may be identified as those where the intact rock has a uniaxial compressive strength that can range from approximately 0.5 to 25 MPa, while in hard rock mining conditions the strength of the intact rock is usually considerably greater than 25 MPa.

4.5.3.4 GROUNDWATER

The combination of groundwater and exposure to air may have an adverse influence on the rock mass strength, particularly in soft rock ground conditions. The potential for corrosion of the ground support and reinforcement by groundwater, in association with air and the particular minerals present, also needs to be recognised, investigated and if necessary remedied. Corrosion is an important factor that needs to be considered in the design and selection of the rock support and reinforcement. The influence of corrosion will mean that virtually none of the conventional forms of rock support and reinforcement can be considered to last indefinitely.

4.5.3.5 BLASTING

The technique of drilling and blasting is a very large field that is constantly evolving and hence cannot be summarised in a few lines. Those interested in pursuing this matter further are referred to their suppliers of drilling equipment and explosives who are able to advise on drilling and blasting concerns.

Substantial and unwarranted damage can be caused to rock at the perimeter of an excavation through the use of inappropriate drilling and blasting practices. There is a need to have standardised drilling and blasting patterns that have been determined using well-founded and recognised blast design procedures.

Mine managements need to ensure that the workforce is provided with ongoing training in the safe and efficient handling and use of explosives and initiation devices. This should include the need to have soundly-based development and production drilling and blasting practices that assist in minimising blast damage to the rock remaining at the perimeter of the excavation. The design of the blasting patterns should be optimised for the particular combination of ground conditions, initiation system, explosive product, initiation sequence, hole diameter, length of round and geometry of the opening. A critical review of drilling and blasting procedures is recommended on a regular basis to ensure that the minimum practical blast damage is occurring to the rock remaining at the perimeter of the excavation.

While consultation of the workforce on such matters is recommended, it is not appropriate that fundamental decisions on important aspects of blast design and practice be left in the hands of individual miners on the job, without any blast engineering support.

4.5.3.6 SEISMIC ACTIVITY

The progressive removal of rock from a stope causes the stress originally carried by that rock to be transferred to nearby abutments and/or pillars. The induced rock stress can eventually reach a sufficiently high level to cause one of the following things to happen:

- sudden movement or slip occurs on pre-existing planes of weakness in the rock mass; and/or
- failure through the intact rock mass creating a new plane or planes of weakness on which movement can occur.

Movements of the rock mass can result in a wide variety of consequences including:

- rock noise;
- small rock falls;
- rock ejected into excavations at high velocity;
- large-scale collapse or crushing of excavations; and
- bursting of pillars or faces in development headings or stopes.

There is always potential for the workforce to be exposed to hazards associated with seismically-active ground conditions where high rock stress levels exist. The use of appropriate mining practices when seismic rock conditions are encountered is an important issue that management should recognise and address.

4.5.3.7 TIMING

The timing of the installation of ground support and reinforcement should be considered as an integral part of the design to limit the potential for ravelling of the rock. In those areas requiring reinforcement, the delay in the installation of the ground support should be minimised as far as is reasonably practicable.

It is recognised that several days or longer extended delays in the installation of ground support, in the order of weeks to months, may jeopardise the effectiveness of the ground control because of the rock mass loosening and consequent reduction in the shear strength that may occur.

When the ground conditions are sufficiently poor, the available time that the excavation will remain open and stable (the stand-up time) may be considerably less. In these situations special measures may be required to promptly install ground support and reinforcement prior to the removal of broken rock from the face. Shotcrete applied to the exposed backs and walls, before the heading is cleaned out, is one approach that may be necessary or effective. Rapid placement of the ground support as soon as practicable after blasting, minimising the time that the ground has to stand unsupported, is likely to be important for successful mining in these ground conditions.

If the ground conditions are considered to be sufficiently poor, or the potential for failure of a block is judged to be high, then a hole by hole installation technique should be used. The drilling of a large number of holes, prior to the installation of the ground support, is not considered to be an appropriate system of work.

4.5.4 HAZARD CONTROL

The size, shape and orientation of openings relative to the geological structure needs to be recognised as a major factor controlling the number, size and shape of potentially unstable blocks that may form. It is strongly advised that the design and selection of ground support and reinforcement takes due consideration of the size, shape and orientation of the openings in relation to the geological structure in the workplace.

Successful ground control is an integral part of any well-managed underground mining operation and is primarily concerned with rock stability and instability issues that result from mine development and the economic extraction of ore.

4.5.4.1 GROUND SUPPORT AND REINFORCEMENT

Ground support is applied to the perimeter of the excavation to limit movement of the rock mass, for example: mesh, straps, steel sets, concrete lining, timber props and shotcrete. These methods typically require the rock mass to move on to the support to generate loads in the support.

Ground reinforcement is applied to the interior of the rock mass to limit movement of the rock mass, for example: rock bolts, grouted dowels, cable bolts and friction rock stabilizers.

Selection of the appropriate method(s) of ground support and reinforcement is vital to successful ground control. To achieve this the ground support and reinforcement should be matched to the ground conditions.

The important issue about any rock support and reinforcement design method is that it should be based on sound geotechnical engineering practice.

The universal application of any one particular type of rock support or reinforcement, regardless of the ground conditions and the excavation geometry, is simply unacceptable.

Ground support and reinforcement includes all the various methods and techniques that may be used to improve the stability of the ground. Obviously, depth, shape and orientation of the excavations and the ground conditions would need to be considered when selecting the most appropriate ground support and reinforcement system.

It is imperative that the mine management develop a quality control procedure that ensures that the standard of installation and reinforcement elements used actually meets that required by the design criteria for all ground conditions in the mine.

The end user of the rock support and reinforcement should be able to demonstrate that they are following the manufacturer's instructions for the correct installation of the equipment. Where this is not practicable, appropriate work procedures should be developed and implemented to minimize the hazards to the workforce when installing rock support and reinforcement elements including mesh, straps or other surface fittings. It is recommended that the following issues be acted upon:

- ground conditions in the area where the rock support and reinforcement elements are to be installed are understood;
- timing of the reinforcement installation should take account of the potential for early deterioration of the ground conditions and the ability of the reinforcement to contain this;
- progressive scaling of the workplace should be conducted prior to and during the installation work;
- reach and capacity of the equipment should be matched to the opening dimensions;
- placement of the support and reinforcement element(s), including mesh, on the equipment prior to installation should be carried out from a secure position;
- correct alignment of the support or reinforcing element relative to the orientation of the previously drilled hole;
- appropriate operation of the insertion device, eg if a drifter is being used, the mode of drifter operation should be "percussion off" or "no percussion" while travelling up the slide;
- preferable to use rotation only (no percussion) when tensioning threaded reinforcement elements;
- required torque that needs to be applied to the rock bolt or dowel nut can be achieved without damage to the individual components; and
- movement of people in close proximity to the installation equipment should be controlled.

4.5.4.2 ROCKBOLTS

It is recommended that the following controls be acted upon:

- storage and handling of the rock support and reinforcement elements on the surface, while in transit and underground should be such as to minimise damage and deterioration to the elements;
- intact rock strength should be adequate to develop the full capacity of expansion

shell rock bolts – expansion shell bolts are generally ineffective in soft rock conditions;

- recommended hole diameter range for the particular type of support or reinforcement is being achieved consistently in all the rock conditions likely to be encountered;
- correct hole length is drilled and holes are flushed clean of all drilling sludge;
- orientation of the hole is appropriate for the excavation geometry and expected block movement – axial tensile loading of the steel elements installed in the rock is generally preferred; shear loading should be avoided;
- hole should be drilled nearly perpendicular to the rock surface – use of hemispherical ball and domed plates may be required where this cannot be achieved;
- load capacity of the anchorage method, bar or tendon and surface restraint fittings should be appropriately matched to prevent the premature failure of any one component;
- all steel and other components designed to be encapsulated in resin or cement grout should be clean of all oil, grease, fill, loose or flaking rust and any other materials deleterious to the grout;
- where full grout encapsulation of the steel elements is required, the method of grouting should show a grout return at the collar of the hole; other methods that can demonstrate complete hole filling may also be appropriate;
- correct tensioning or loading procedures should be used for the various rock support and reinforcement systems;
- plates and/or straps against the rock surface should have the required thickness to prevent nuts or barrel and wedge anchors being pulled through the plate and/or strap at the ultimate tensile strength of the tendon when loaded against the rock surrounding the bore hole;
- corrosion issues are recognised and remedied;
- blast vibrations may loosen threaded reinforcement systems; and
- load tests are regularly carried out on point anchored rock bolts and friction anchored rock bolts.

4.5.4.3 GROUTING AND SHOTCRETE

It is recommended that the following controls be acted upon:

- fully grouted reinforcement systems should be checked on a regular basis to ensure that the grout strength and encapsulated length of the bar or tendon is adequate;
- implement an action plan when it is found that the load capacity of the installed support or reinforcement system, grout strength and/or encapsulated length does not meet specifications;
- storage of resin grouts should be at the temperature range recommended by manufacturer;
- resin grouts are consumed before their “use by” date, or within a specified period of time;
- mixing of resin grouts should be for the recommended time and at the recommended speed – these should not be exceeded;
- cement grout is mixed at the recommended water: cement ratio, at the recommended angular speed in the specified equipment for the required time;
- water used for cement grout mixing is of the required quality or the cement used should be able to develop the required uniaxial compressive strength with the run of mine water supply;
- any additives (eg retarders, accelerators, fluidisers, etc) to the cement grout mix are added in the recommended amounts and at the specified time in the mixing and pumping process;
- all grout mixing and pumping equipment to be cleaned and maintained on a regular basis;
- any pumping equipment used to pressurise rock support and reinforcement should be regularly maintained and operate at the recommended pressure;
- shotcrete mix specification should state the slump of the mix, the uniaxial compressive strength and a measure of the toughness of the product at specified time intervals prior to or following mine application, as appropriate;

- samples of the mine shotcrete mix should be collected at specified intervals, under normal mine operating conditions, and tested in a NATA–registered concrete testing laboratory for compliance with the shotcrete design specifications; and
- shotcrete thickness should be tested regularly during placement to ensure that the specified thickness has been applied – a means of permanently marking the shotcrete surface with a depth gauge probe may be appropriate.

4.5.5 CONSULTATION AND TRAINING

Mine geologists, mining engineers, supervisors and the underground workforce should all recognise that geological structure, on a scale from less than a metre to some tens of metres, is a major factor in most, if not all, rock falls.

A well-managed ground control plan should include regular discussions of all local-scale ground control issues with the workforce both during visits to individual workplaces and in more formal ongoing training sessions. In particular, changes in the geological structure encountered during the development of a heading or a stope need to be recognised early and appropriate steps need to be taken to review ground support and reinforcement practices and to modify these if necessary. The large-scale ground control issues should also be regularly and routinely discussed with the workforce, with the need for modifications to the ground support regime or other aspects of mining practice being dealt with on an ad hoc basis as frequently as necessary.

It is strongly recommended that a formal mine planning and design system be established early in the life of a mine. Such a system might involve the regular informed discussion, as often as required, of a range of planning and design issues in the current operational areas and the new areas of the mine. The "mine planning and design meeting" should be an interdisciplinary meeting requiring the involvement, as necessary, of a range of expertise including: survey, geology, mining engineering, ventilation, drilling and blasting, geotechnical engineering, mechanical engineering, electrical engineering, supervision and management (principal and contractor).

Suppliers of rock support and reinforcement elements are also encouraged to provide an appropriately detailed set of instructions for the correct installation and testing for each element type. Training courses and materials should be readily available to ensure that the workforce is fully conversant with the type(s) of ground support and reinforcement in use.

4.5.6 GROUND CONTROL MANAGEMENT PLAN

It is suggested that a ground control management plan be produced for a mine using a combination of in-house and outside expertise in the field of geotechnical engineering. The ground control management plan should be critically reviewed at least annually, or more frequently if necessary, to correct areas of deficiency exposed by experience in the previous 12 months or by active investigation, analysis, planning and design of new mining areas that will be developed in the near future.

An integral part of any ground control management plan should be a competent grasp of the current geotechnical literature. The recognition of potential ground control challenges at an early stage in the mine design is considered to be central to having a balanced ground control management plan.

The size, scope and type of a potential or existing mining operation will obviously be major factors in determining the amount of effort and the resources that are required to develop and implement the ground control management plan. It will be necessary to apply considerable mining experience and professional judgement when establishing the ground control management plan at a mine for the first time. With experience, it will be possible to successively refine the plan over time to address the ground control issues identified as important to the maintenance of an acceptable standard of working conditions.

The mining issues that should be considered when developing the ground control management plan include:

- depth of mining;
- geotechnical considerations;

- expected ground conditions in the orebody and wall rocks;
- size of the mining operation;
- number, size, shape, orientation and proximity of orebodies being mined;
- entry or non-entry method(s) of mining;
- production rate;
- size, shape and orientation of the excavations; and
- level of mechanization.

Approval of the plan(s) should require the signature a number of people including those responsible for: survey, geology, ventilation, drilling and blasting, geotechnical, planning and design aspects plus the senior management, as appropriate.

Development of the ground control management plan may be facilitated by the use of qualitative risk assessment techniques. These techniques can assist in identifying the high-risk aspects of a mine and develop a range of appropriate controls to effectively manage the risks. A range of geotechnical and risk assessment expertise is available in a variety of organisations such as mining companies, geotechnical consulting companies, risk assessment companies, research organisations and universities.

The ground control management plan should recognise the importance of developing an underground mining culture in the workforce that understands the vital importance of the rock mass, as well as the people and equipment, to a viable mine. It will be necessary to have a team approach, involving the whole underground workforce, if the ground control challenges facing underground mining are to be overcome in a safe and cost-effective manner.

4.5.6.1 QUALITY CONTROL

The importance of quality control to the successful design and installation of an adequate ground support and reinforcement system needs to be clearly recognised and proper quality control procedures should be put in place. The supplier of the rock support and reinforcement system elements should provide information on storage and controls that determine the quality of the installation.

4.5.7 GROUND STABILITY IN UNDERGROUND MINES

The potentially hazardous nature of underground mining requires the application of sound geotechnical engineering practice to determine the ground conditions, the ground support and reinforcement requirements, as well as the size, shape and orientation of all the openings that can be safely and economically excavated in a particular rock mass.

Management at each underground mining operation should recognise, identify and address the geotechnical issues that are unique to a particular mine.

The regular use of permanent openings, such as the main decline, by the workforce over a long period of time results in a high level of employee exposure to the ground conditions in these openings. The potential risk of injury to the workforce is higher because more people use these openings, particularly main declines and access ways, and are exposed to the ground conditions in these openings. Hence, a higher standard of ground support and reinforcement may be required in permanent openings to manage the increased risk.

4.5.7.1 BACKFILL

The role and design of mine fill needs to be recognised as an integral part of the stope planning and design process. There needs to be a recognition that the stoping process is not complete until the stope void has been filled as completely as is practicable with a suitable material. The creation of large volumes of unfilled stope void can result in a mine structure where large-scale displacement (collapse or caving) may occur in an uncontrolled manner with little prior warning.

4.5.7.2 MONITORING

Instruments used to measure and monitor rock stress include the following:

Stress Measurement:

- CSIRO hollow inclusion cell (3D);
- Borehole slotter stressmeter (2D);

- USBM borehole deformation gauge (2D);
- Hydraulic fracturing method (2D);
- CSIR “doorstopper” (2D); or
- Flat or cylindrical pressure cell (1D).

Stress Monitoring:

- CSIRO yoke gauge (2D);
- CSIRO hollow inclusion cell (3D);
- Vibrating wire stressmeter (1D);
- Seismic monitoring of a rock volume; or
- Flat or cylindrical pressure cell (1D).

It is not suggested that every mine should necessarily undertake a comprehensive programme of rock stress measurement. However, it is reasonable to expect that mine management does recognise that rock stress is an issue that cannot be ignored.

Records of visual observations of ground behaviour, made during regular underground inspections with adequate lighting, play a very important part in building up a history of ground behaviour. Considerable judgement, experience and technical support are required for the selection, location, operation and maintenance of advanced monitoring equipment. Simple, robust monitoring equipment combined with regular recorded visual observations, preferably made while on foot, is considered to be a good starting point for most mines. The early collection and analysis of monitoring data is essential to develop an understanding of the ground conditions and to refine the mine design process.

The detonation of explosives in the rock mass, particularly large stope blasts, can trigger seismic activity or audible rock noise. The occurrence of this should be recorded, noting for example the location, time, subjective description, number of events and any rock falls. It may be possible to determine a reasonable explanation for these events. However, if the rock noise continues for some time, or occurs at unexpected times, then further investigation of the situation may be advisable, as this could be a precursor of more serious seismic activity in the future.

The occurrence of rock noise does not necessarily mean that a seismic monitoring system should be installed immediately. However, if damage is occurring to the rock mass at the surface of openings and/or if the ground support and reinforcement is being damaged or broken, then further investigation of the seismic activity should be undertaken.

In order to gather relevant information on rock failure events in underground mines it is proposed to introduce an underground rock failure report form. The purpose of the form is to improve the understanding of rock failure modes which should assist in the development of remedial measures by modifying support and reinforcement design.

4.5.7.3 UNDERGROUND VOIDS

All underground mines that have large unsupported voids should have a hazard management system as outlined in Section 1.5. The hazard management system should be consistent with legislation and include:

- establishing a risk assessment approach for hazard identification;
- determining the level of risk associated with the stability of the mine as well as any ground movement or destressing;
- identifying hazards associated with air-blast;
- establishing a process of ongoing risk assessment and review;
- developing appropriate response procedures which are initiated by predetermined triggers should mining conditions change;
- developing monitoring procedures to regularly check any changes to the size and shape of the void;
- recording of consultation procedures adopted by key staff and specialists in keeping with the overall mine safety management plan.

Monitoring of hazards associated with a void is an essential part of the hazard management system. The monitoring should take into account any potential changes that would trigger appropriate responses and identifying any new risks.

Actions as part of a response should eliminate or continually reduce the level of risk to people within the mine.

4.5.8 GROUND STABILITY IN SURFACE MINES

The issues that would need to be considered include:

- depth and operating life of mining projects;
- potential for changes in expected ground in the wall rock mass (for example, rock strength, earthquake events, rock stress and rock type);
- production rate;
- size, shape and orientation of the excavations;
- the location of major working benches and transportation routes;
- potential for surface water and groundwater problems;
- the equipment to be used, excavation methods, and handling of ore and waste;
- the presence of nearby surface features (for example public roads, railways, pipelines, natural drainage channels or public buildings);
- the potential for the general public to inadvertently gain access to the mine void during and after mining; and
- time-dependent characteristics of the rock mass (particularly after abandonment).

It follows that early identification of relevant geotechnical issues at a site will greatly assist with the development of a well-balanced ground control management plan.

Further, it is not uncommon throughout the operating life of an open pit, that alterations will be made to the general mine plan (such as blast design optimisation to minimise blast damage and wall cut-backs); therefore, when designing mines, a certain amount of flexibility is required.

If ground support and reinforcement are required to stabilise a pit wall, each component must be matched to the ground conditions and expected displacements.

4.5.8.1 PIT DESIGN

It must be recognised that steeper and higher batters will generate greater driving forces and thereby increase the potential for rock failure and represent a higher risk to the operations. It should also be acknowledged that batters excavated within rock masses that contain persistent geological structure have greater potential to develop large wall-scale failures than those excavated within rock masses that contain defects with shorter trace lengths. The ramifications of small-scale failures are not as important as those for large-scale failures – particularly if the small-scale failures are being contained by catch berms. One common method for control of small batter-scale failures is to install local ground support and/or reinforcement. Control of large wall-scale failures, on the other hand, is generally more important and also more difficult. Potential large-scale failures are usually controlled by excavating slopes/walls to a shallower angle, depressurisation of groundwater in the wall rock mass, or installing more costly ground support and/or reinforcement than that used for stabilising small-scale rock mass instability.

4.5.8.2 GROUNDWATER

The influence of groundwater or incident rainfall is often not given the level of importance it warrants when designing a mine. The importance of hydrogeological considerations for pit wall design and management is well documented, such as Hoek and Bray 1981. Some of the more significant effects water can have on the general integrity of pit walls include:

- increase in pore pressure within the rock mass (which reduces shear strength);
- softening of infill or rock material (particularly clays);
- slaking of soft rock due to wetting and drying cycles;
- erosion of weaker bands of rock by water seepage or run-off;

- reduced blasting efficiency, and
- corrosion of ground support and reinforcement.

In order to understand the hydrogeological conditions at a mine site, it is necessary to undertake adequate investigation of the range of geological conditions, and characteristics of water flow throughout the site. It is recommended that this investigation be carried out in conjunction with exploration drilling. The major characteristics of aquifers within the rock mass should be established prior to the commencement of mining.

Furthermore, as open pit wall failures often occur after rain, it may be necessary to develop an understanding of the time-lag and mechanisms of infiltration of surface water into the rock.

Water drainage paths through and around the mine must be designed such that rainwater run-off or groundwater seepage does not pond at the crest or toe of critical slopes within pit walls.

4.5.8.3 BLASTING

Inappropriate drilling and blasting practices can result in substantial damage to the rock mass within the operating and final pit walls. There is a need to have standardised drilling and blasting patterns that have been determined using well-founded and recognised blast design procedures, and that are appropriate to the ground conditions at the mine site.

The factors that control the level of wall damage caused by drilling and blasting include:

- rock mass properties such as orientation, persistence and spacing of geological structure, presence of groundwater;
- the degree of “confinement” and amount of burden shifted by the proposed blast;
- inadequate removal of rock debris from earlier blasts from the toe of batter slopes;
- the degree of rock fragmentation required;
- selection of the appropriate hole diameter;
- control of individual hole collar position, hole bearing, inclination and length;
- the type and amount of stemming used;
- placement of holes in a suitable pattern to achieve the required excavation geometry;
- the use of specific perimeter holes such as stab holes, or smooth blasting techniques (for example, pre-splitting, post-splitting, or cushion blasting);
- selection of appropriate initiation system(s) and initiation sequence of the blast or blasts;
- specific types or combinations of explosives. Explosives must be selected according to the given ground mass conditions, for example, groundwater or reactive shales can affect the result of a blast. Explosives must also be selected to achieve required energy levels, maintain compatibility with the initiation systems, the explosives’ expected product life in blast holes;
- control of explosive energy levels in the near-wall holes and preferably using decoupled explosive charges, with a cartridge diameter less than the blast hole to minimise blast damage at the excavation perimeter;
- the required mining bench height and the depth of subgrade drilling (subdrill); and
- availability of well maintained drilling, explosives handling and charging equipment of appropriate capacity.

It is considered good practice to qualitatively and quantitatively monitor the extent of blast damage and evaluate the success of blasting methods as the open pit expands and deepens. Blast monitoring tools include: visual observations, vibration records, noise records, video footage, displacement markers, and complaint records. Blast monitoring results should then be used as part of an ongoing critical review of drilling and blasting to ensure that the blast design is performing to the standards required and is producing the required results.

While consultation of the workforce on such matters is recommended, it is not appropriate that fundamental decisions on important aspects of blast design and practice be left in the hands of individual miners on the job, without any blast engineering support. Nonetheless, mine management needs to ensure that the workforce is provided with ongoing training in the safe and efficient handling and use of explosives and initiation devices.

4.5.8.4 ROCK WEATHERING

Weathering is the process by which rocks are broken down and decomposed by the action of external agencies such as air, water, and changes in temperature. The two main types of weathering are mechanical (for example, shrinkage and expansion due to temperature changes, and chemical (for example, certain minerals being leached from the rock or other compound elements being formed by interaction with water).

It follows that the engineering properties of rock will be significantly affected by the degree and nature of weathering. Weathering is the main agency by which soft rock conditions are developed and is a very important geotechnical issue when considering the stability of open pit walls.

4.5.8.5 MONITORING

The specific nature of monitoring programs required for a given open pit will be dependent on the site-specific conditions of the mine.

Slope failures do not occur spontaneously. There is scientific reasoning for each failure, and failures do not occur without warning if the failed area is being well monitored.

It is clear, therefore, that each site must have its own monitoring strategy, matched to local ground conditions. Pit slope monitoring programs should start off simple, and become more refined or complex as conditions demand.

Visual signs that may indicate potential failure of pit walls include:

- formation and widening of tensile cracks;
- displacements along rock defects in the batter face;
- bulging of the slope face or toe;
- ravelling of rock within the slope;
- increased water seepage;
- bending of reinforcement or rock support elements, and
- rock noise and ejection.

Records of visual observations made during regular inspections of pit walls, play a very important part in building up a history of ground behaviour for assessment of pit wall conditions.

Some of the more commonly used include:

- survey techniques (such as Electronic Distance Measurement (EDM) and GPS levelling or photogrammetric surveys);
- displacement monitoring pins and tape extensometers fixed across cracks or major rock;
- defects;
- borehole inclinometers; and
- extensometers anchored within the rock mass via boreholes drilled into pit slopes.

In critical areas, it is recommended that monitoring systems be installed with warning devices attached (for example, a horn, or flashing light). The preferred method for setting off alarms is to use a monitoring system that is compatible with a data logger with computational capability so that solenoid switches can be activated electronically once a specified rate of movement has been recorded.

It is strongly recommended that mines adopt a systematic approach to the collection, analysis and interpretation of geotechnical monitoring data as it applies to mine design.

In order to gather relevant information on rock failure events in open pit mines a rock mass failure report form should be used. The information gained from these reports should statistically analyse falls of ground. Factors including failure location, failure dimensions, typical effects of failures on mines, failure mode, geotechnical features, rock mass quality, excavation details, ground support and reinforcement details, and monitoring information should be assessed from this data.

4.5.8.6 MINING THROUGH UNDERGROUND WORKINGS

Mining through underground workings presents a number of potential hazards that must be accounted for in the mine design. A range of mine planning related geotechnical issues must be investigated, including the following.

- Definition of the extent and status of the underground excavations (such as, use of probe drilling and/or remote sensing applications to locate the mine voids, determine whether underground mine voids are filled or partially collapsed, and/or whether the underground voids encountered in the base of the open pit equate to those shown in the mine plans of the underground workings). Accurate survey plans should be kept that record the location, spacing, depth, direction, angle, and number of drill holes, along with records of interpreted ground during drilling. It is also important to denote locations where voids have been removed or filled during the mining process.
- Establishing a set of operating procedures for mining near and through underground voids that match with production requirements. Issues to be covered include personnel and equipment access, blasting strategies, infill/backfill and barricading procedures, and general reporting procedures (particularly in the case of new unstable ground being detected).
- Definition of the minimum pit floor pillar thickness such that mining equipment and personnel can safely traverse during normal mining operations.
- Determination of the likely stability of ground at the edges of underground voids and derive the positioning of safety barricades to minimise the risk to personnel or equipment working near mine voids – particularly near unfilled stopes.
- Determination of the safe thickness of "rib" pillars left between open pit walls and underground workings to ensure continued stability of the pit walls.

It is the responsibility of mine management to ensure that safe working procedures, that address each of these issues, are appropriate for the risks at each mine site, and are implemented rigorously. The implementation of these procedures should be incorporated as part of the overall ground control management plan.

REFERENCE DOCUMENTS

Geotechnical Considerations in Open Pit Mines, Version 1.0, Guideline August 1999, Western Australian Department of Minerals and Energy.

Geotechnical Considerations in Underground Mines Version 1.0, Document No. ZME723QT Guideline December 1997, Western Australian Department of Minerals and Energy.

Hoek E and Bray J, Rock Slope Engineering 3rd ed. Institute of Mining and Metallurgy 1981.

4.6 TREATMENT AND PROCESSING PLANTS

Treatment plants means any treatment or processing works on a mine or quarry where mine products are crushed, screened, concentrated, beneficiated, treated chemically or by other means, pelletised, smelted or refined.

The national Safe Mining handbook contains additional information.

Sufficient room and safe footing should be provided where people are normally employed.

Floors should be:

- of sound construction suitable for the process carried on in that part of the plant;
- maintained in a good and serviceable condition;
- properly drained to speed the removal of any water or liquid falling on them; and
- free from any obstruction likely to cause a person to fall, trip, slip or stumble.

An opening in a wall or floor, or a break in the floor level in a treatment plant, should be properly guarded if it could constitute a hazard.

4.6.1 ANTIDOTES AND WASHES

Where poisonous or dangerous compounds, solutions or gases are used or produced, a sufficient supply of satisfactory antidotes, washes and showers for treating people affected by accidental contact with them should be readily available and properly labelled with instructions for their use.

Showers should be easily accessed and capable of simple actuation to provide instant full water flow.

Appropriate special protective equipment or clothing should be readily available.

4.6.2 LIGHTING

Lighting must be maintained to standards appropriate for the task or location.

Where the failure of artificial lighting could cause a hazard in a treatment plant, emergency lighting might be needed.

4.6.3 VENTILATION

Treatment plants should be suitably ventilated and maintained at a reasonable temperature and with sufficient air movement to provide suitable air quality.

Steam, fumes or products of combustion may need to be removed from the plant by a flue or duct.

Hot or heating equipment may need special consideration.

4.6.4 PRECAUTIONS BEFORE ENTERING A TANK

Before anyone enters a tank in a treatment plant:

- the atmosphere in the tank should be checked to determine that it is safe to breathe;
- the requirements for a suitable respiratory apparatus should be determined; and
- closed vessel entry procedures should be checked.

REFERENCE DOCUMENTS

Australian Standards

AS/NZS 2865 – 2001 Safe Working in a Confined Space

4.6.5 REFINERIES AND SMELTERS

4.6.5.1 MOLTEN METAL

When handling molten materials in a treatment plant, care must be taken to minimise the possibility of spillage or explosion which could be hazardous to anyone in the vicinity.

Every effort must be made to prevent molten material from coming into accidental contact with cold, damp or rusty surfaces where the contact could cause an explosion.

Adequate precautions are required for all ash pits, ash heaps and other places where there are hot or molten materials so that no one is endangered by these materials.

4.7 ESSENTIAL SERVICES

4.7.1 SERVICE DESIGN AND LAYOUT

4.7.1.1 AMENITIES

When providing necessary and relevant hygiene and health facilities at mines, managers should consider:

- sanitation and hygiene needs, including:
  - an adequate supply of potable water (both above and below ground and cooled where necessary);
  - provision to maintain cleanliness and sanitation (including eradication of vermin);
  - clean and sufficient toilet and washing facilities at surface and underground (where necessary, male and female employees should have separate facilities);
  - sufficient hand basins;
  - regular checks to stop pollution of work sites and misuse or fouling of toilets;
  - sufficient crib rooms or dining areas (both above and below ground as appropriate at every mine);
  - sufficient change houses, depending on the size, scale and nature of the mine;
  - drainage of stagnant water (note: noxious gases may be produced when draining water);
  - checks for waste timber and decaying wood in underground sites; and
  - regular disposal of debris, refuse and other waste;
- sheltered reception areas for people entering or leaving the mine;
- mine lighting;
- first aid precautions, and
- medical matters.

4.7.1.2 POTABLE WATER

Water should meet standards set out in Australian Drinking Water Guidelines (1996) by NHMRC and ARMCANZ.

Water should be:

- accessible to employees;
- clean;
- dispensed at clean and hygienic locations marked by signs; and
- below 24°C.

Water used for industrial processes which is unfit for drinking should be marked unfit. Staff working away from main water supplies should have access to water in clean containers.

4.7.1.3 TOILET AND WASHING FACILITIES

Above-ground facilities should be conveniently located with:

- adequate toilets and urinals (as a guide, one toilet and urinal for every 25 male staff and one toilet for every nine female staff);
- hand towels or hand dryers; and
- adequate heat, light and ventilation.

Toilets on the surface of a mine should have:

- flushing water;
- individual compartments with locking doors;
- walls and floors made of easy-to-clean materials;
- seats and toilet paper;
- clothes hook and lighting; and
- be kept clean and hygienic and with all waste products removed regularly.

Toilets at underground mines should be at many locations and accessible on foot unless:

- workings are close to the surface, or
- a conveyance is available to take staff to underground toilets or to the surface.

Toilets in underground mines should be well ventilated and near the main work site to serve the largest number of staff. They should have:

- floors of concrete or other impervious material;
- screens for privacy;
- regular maintenance, cleaning and waste removal;
- toilet paper; and
- sinks or hand basins.

4.7.1.4 CRIB ROOMS

All mines should have clean, well-lit and ventilated crib rooms and eating areas. Crib rooms should have refuse bins, a sink, tables, chairs and appliances to store food, heat food and boil water. They should also have supplies of hot and cold drinking water, insect repellents or traps, and be close to toilet and washing facilities.

Management should encourage staff to put rubbish, waste food and paper in bins that should have well-fitted covers. Empty bins in underground crib rooms regularly and take rubbish to the surface daily. Clean the refuse area in crib rooms daily.

4.7.1.5 CHANGE HOUSE

Change rooms should have:

- lighting, heating and ventilation;
- floors that will not rot and are easy to clean;
- proper drainage;
- tiled walls to keep out moisture; and
- passageways at least 1 m wide.

Change rooms should be designed to include:

- at least 1 m^2/0.6 m^2 of floor space per person using the change house during a shift (do not include area covered by passageways, heating pipes and drying racks);
- an ample supply of clean hot and cold water, hand basins and a minimum of eight showers;
- screened shower recesses at least 1.2 m apart;
- drains;
- ventilation, lighting, facilities to dry and store clothes;
- separate areas for clean and working clothes;
- heaters and/or air conditioners; and
- separate facilities for males and females.

Change houses for staff at underground mines should:

- be near mine entrances;
- have facilities to protect staff from the weather when travelling from the mine entrance to the change house;
- have lockers for each underground employee;
- have lockers that can be heated to dry wet work clothes; and
- have chairs.

Mine operators should set out guidelines and rosters for cleaning change houses.

4.7.2 TANK CONSTRUCTION AND INSTALLATION ABOVE GROUND

Introduction

Storage of diesel and oil has special safety factors related to above–ground and underground tanks. Similarly, above-ground and underground transfer of diesel and oil should be conducted safely.

4.7.2.1 TANK CONSTRUCTION AND INSTALLATION

The construction and installation of storage tanks should comply with the Dangerous Goods Legislation, AS 1940 The Storage and Handling of Flammable and Combustible Liquids, and AS 1692 Tanks for Flammable and Combustible Liquids are two important standards.

Acceptable categories of dangerous goods:

- Class 3.3 Dieselene, Distillate, Diesoleum, Diesel Fuel; and
- Class 3.4 Lubricating Oil, Hydraulic Oil.

Design and construction

- The compound should be isolated from other activities on the mine site and sufficiently impervious to retain any liquid which leaks from the storage tank.
- A bund wall should be designed to withstand the hydrostatic head when full.
- The location of a bund relative to the closest tank should be such that no portion of the tank lies outside a line drawn from the top inside edge of the bund at an angle of 1 in 2 from the horizontal.
- The clearance between a bund and a tank should not be less than 1 metre.

Foundations

The foundations of a tank should be adequate for the direct load imposed by the tank, including contents when full. The tank should be anchored so the empty tank will not overturn, when subjected to wind loading.

Marking

Each tank should be marked to show its content and maximum allowable capacity.

Gap between horizontal tanks

The distance between horizontal tanks should not be less than 600 millimetres.

Bunds and compound

A separate compound should be provided for any above ground tank where the total capacity exceeds 1,200 litres.

The capacity of the compound should be not less than 25% of the volume of the tank if dieselene, or 12% if only hydraulic oil.

Compound drainage

A compound that is wholly or partly exposed to rainfall should be drained in accordance with the following:

- the floor of the compound should be sloped to a sump and the sump emptied by either a manual activity pump or gravity; and
- the valve fitted to the gravity drain pipe should be of a type in which it is easy to determine the open and shut position and can be locked.

4.7.2.2 LOCATION

A storage tank should be located to avoid damage during operations on a mine site; and exposure to excessive heat (to minimise fuel losses through evaporation).

Gap between horizontal tanks and office blocks, workshops, lunch room or warehouse

For a small dieselene tank the minimum distance is 3.0 metres.

For tanks having a capacity of between 2,500 litres and 100,000 litres the distance is increased from 3.0 metres for the smaller volume tank to 7.5 metres for any larger one.

For lubricating oil: in the case of a tank holding lubricating oil there should be at least 2.0 metres for access around the tank.

4.7.2.3 ACCESS

A storage tank should be enclosed by a wall, fence or equivalent barrier to prevent public access. The barrier may enclose either the entire site or the tank storage.

Note: Most mine sites can be classed as enclosed.

An enclosure is not required if:

- only lubricating oil is stored;
- there is less than 5,000 litres of diesel in store; or
- the tanks are temporary or used as mobile storage by contractors or on a construction site.

4.7.3 STORAGE AND USE OF FUEL UNDERGROUND

4.7.3.1 DIESEL FUEL

Oil for fuelling diesel engines used underground should have a flashpoint of not less than 61.5^{0}C as determined by the Pensky-Martens closed cup method as specified in AS 2106 Methods for the

Determination of the Flashpoint of Flammable Liquids (Closed Cup). It should also contain not more than 0.25% sulphur by weight.

4.7.3.2 CONVEYANCE OF FUEL OIL AND OIL UNDERGROUND

The method of conveying fuel oil and hydraulic oil underground should be such that spillage does not occur and it is protected from accidental damage.

4.7.3.3 FUELLING STATION AND FUEL STORAGE DEPOT

Design criteria for fuel storage and for fuelling underground include:

- fuelling stations and fuel storage depots should be constructed of non-flammable material;
- fuelling stations and fuel storage depots should be located as near as possible to exhaust airways so that in the event of a fire contaminated air does not enter the workings of the mine;
- the floor should be constructed of concrete and so sloped that any spillage can be washed into a sump;
- adequate space should be provided around storage tanks in the fuel storage depot for inspection and maintenance purposes;
- the fuel storage room should be fully enclosed, with small openings for ventilation; those openings being arranged so that they close automatically in the event of a fire;
- precautions should be taken to avoid spillage, but any losses should be collected and placed into a waste tanker for transfer to the surface;
- the backs and walls should be rock bolted and meshed or shotcreted;
- a fuelling station should be not closer than 10 metres from a fuel oil and oil storage room, unless sufficient barriers or precautions are in place to prevent the spread of fire;
- hoses, hose reels and nozzles should be robust and rated for the delivery of fuel oil and oil, and should be maintained in good condition at all times, and nozzles should be the automatic shut-off variety; and
- the design and location of piping should provide for maximum safety, with the pipe constructed of steel and located to reduce the risk of impact damage, and with all joints in the pipe being leak proof, and the pipeline be hydrostatically pressure tested prior to use.

4.7.3.4 FIRE CONTROL AT UNDERGROUND FUELLING STATIONS AND FUEL DEPOTS

Appropriate fire control measures should be in place at all fuelling stations and fuel depots.

This should include at least two fire extinguishers of suitable size and a foam generator unit. The firefighting equipment should be accessible to fight the potential source of fire, securely supported and close to the entrance of the fuelling bays.

All fuelling stations and depots should be kept clear of all superfluous flammable material.

No new fuelling should commence until the engine has been turned off and the unit parked correctly.

There should be no smoking at a fuelling station or fuel depot.

No oxygen-acetylene, electric arc equipment, friction-cutting, naked lights, or plant capable of generating a spark should be allowed in or about a fuelling station or fuel depot unless full precautions are taken. Isolation signs will need to be displayed at fuelling stations and fuel depots to indicate repair work is taking place and the area is temporarily off limits.

A person must be present at all times during the refuelling of vehicles.

4.7.4 MINE LIGHTING

Above ground

AS 1680.1 – 1990 Interior Lighting: General Principles and Recommendations gives guidance on type and amount of light fittings for surface work sites. It also sets out procedures to measure the adequacy of light in surface workplaces.

Below ground

Fence and light all shafts, holes and ground openings. Also light paths and walkways.

Personal lighting for underground use

Staff should only take fully charged batteries underground.

Lamps should be maintained regularly.

Cap lamps globes should be checked for correct operation before proceeding underground.

Locked safety lamps for underground use should:

- be checked above ground by trained staff to ensure they work and are securely locked;
- not be taken into mines unless they are fully functional and secure; and
- not be unlocked underground.

Electric lamps being used near explosives must be checked outside the mine to ensure they are sealed and will not ignite gas in the air.

Lighting should have protective equipment and shields must conform to an Australian Standard. Classify all explosive areas in accordance with Explosive Gas Atmospheres; AS 2430.2 – 1986 Combustible Dusts and AS 2430.3 – 1991 Specific Occupancies.

Staff should be familiar with regulations in the Australian Standards handbook and SAA HB13 – 1992 Electrical Equipment for Hazardous Areas.

REFERENCE DOCUMENTS

Boral OH&S Manual, Boral.

AS 2430 Classification of Hazardous Areas, including AS2340.1 – 1987.

4.8 ENERGY SOURCES

The control of energy sources and the barriers between energy sources and people are very important safety measures.

The identification of the various energy sources in the mining process is essential. It is too late to identify the energy source after an accident has happened.

Energy sources are listed below.

- *Gravitational*: Gravitational energy might be represented as a raised section of equipment falling; columns of fluids falling; falling down shaft and off equipment.
- *Mechanical*: Mechanical energy can be compressed gas, liquids, and solids; moving machinery parts; or material subjected to tension.
- *Electrical*: Contact with power (electricity) cables, switches and instruments; welding; or using electric power tools can represent an energy source.
- *Chemical*: Chemical energy could be use of toxic chemicals in metallurgy processes; fuels for combustion engines; gases and particulate matter that are emitted from diesel engines, and welding; or combustion products.
- *Thermal*: Thermal energy could include fire; welding; hot water (eg from sand pumps); and hot metal.
- *Radiation*: Radiation energy might be present in the use of probes in milling operations.
- *Radiant*: Radiant energy could arise from heat or light from welding.

4.8.1 ISOLATION

4.8.1.1 INTRODUCTION

Isolation can be defined as:

- to place in a detached position;
- to place apart or alone;
- to insulate;
- to separate or segregate; and/or
- to disconnect.

Traditionally, isolation has been thought of as to turn off an item of equipment, such as a conveyor, and put a tag or a lock on the switch.

However, isolation covers a much broader range of protection. Gloves, insulation of extremely hot and cold components and a roof to protect from falling objects are means of isolation.

Before considering isolation it must be understood what is being isolated.

Basically, energy flow is isolated. Energy is the driving mechanism for all activity on a mine site. Provided that the energy flow is confined and controlled, it is safe to use. However, when not confined and out of control it can injure and kill. So the object in any form of isolation is to put a barrier between personnel and the unwanted energy flow.

To be able to control and confine any unwanted energy flows, all potential unwanted energy flows in any given system or process must first be identified. Once identified, the unwanted energy flows can be isolated by selection of a means of isolation to protect from injury.

It is extremely difficult to change human nature. Instead of trying to persuade people not to make mistakes, accept people as they are and try to remove opportunities for error by:

- elimination of possible unwanted energy flows;
- use of a lower or different type of energy source;
- control and containment of possible unwanted energy flow by permanent isolation;
- neutralisation of possible unwanted energy flows by temporary isolation; and
- training and education of personnel in the control of unwanted energy release.

4.8.1.2 ENERGY CONTROL

Elimination of possible unwanted energy flows

Slips or lapses of attention are similar to those of everyday life and cannot be prevented by exhortation, punishment or further training. Hence either an occasional error must be accepted, or the opportunity for error should be removed by a change in the work situation, that is, by changing the design or method of working.

It is impossible to eliminate all unwanted energy flows on the mine site.

However, any system should be looked at closely to determine how the potential unwanted energy can be eliminated.

Use of a lower or different type of energy source

The energy that is to be used should be determined, then evaluate the potential of that energy to injure. If the risks involved in the use of that energy are too great then the possibility of reducing the energy should be examined.

As an example, an electrically-powered, low-voltage hydraulic solenoid at 240 volts is replaced by one at extra low-voltage such as 24 volts.

Control and containment of possible unwanted energy flow by permanent isolation

By identifying a possible source of unwanted energy flow it is possible, if it can not be eliminated, to put in place permanent structures that isolate person(s) from possible injury. Such structures include pressure relief valves, handrails, guards, high and low level cutout devices, overhead protection, fences, insulation of hot and cold components and insulation of electrical cables.

Control or containment can also refer to the use of appropriate engineering standards when equipment is designed, manufactured and maintained, such as design of pressure pipe that is the correct thickness for the pressure to be used in the system.

Environmental isolation should also be considered, such as noise isolation, dust isolation and radiation isolation.

4.8.1.3 PERSONAL ISOLATION

Personal isolation is the use of protective clothing and equipment to prevent injury – for example:

- wearing apron, gloves and shield when welding to prevent injury from radiant energy;
- wearing hard hat to prevent injury from gravitational energy;
- wearing earmuffs to prevent injury from mechanical energy; or
- wearing rubber gloves to prevent injury from chemical energy.

Provision of correct equipment

Provision of the correct equipment can reduce or prevent injury.

For example, use of correct scaffolding can prevent injury from gravitational energy.

Procedures and rules

General requirements of isolation procedures: An isolation system identifies the equipment to be isolated and provides security against accidental operation. Isolation makes equipment and machinery safe to work on by neutralising the energy source.

4.8.2 TYPES OF PROCEDURES

4.8.2.1 ISOLATION PROCEDURE

This procedure is a systematic way of identifying the sources of energy that, if uncontrolled, could cause injury; and controlling the activation of that energy source by other people. A lockout device or danger tag system can be used.

Two basic types of isolation procedures that can be used, depending on the circumstances, are:

- general procedure; or
- permit procedure.

4.8.2.2 GENERAL ISOLATION PROCEDURES

Note: Each person working on the equipment must individually ensure that it is isolated.

Step 1 – Identify all equipment to be isolated

Confirm that the switches, valves, chains, locking pins and other devices to be used to isolate the system are the correct ones.

Associated equipment that could create a hazard shall also be isolated.

Step 2 – Determine the correct point of isolation

Positive isolation can only be achieved by isolating the sources of energy from the equipment to be worked on. Use main switches, circuit breakers, decontactors, valves, locking devices for isolation.

Do not use auxiliary devices for isolation, such as push buttons, conveyor lanyard switches, control circuit devices.

It is also necessary to communicate to other parties that isolation is going to occur. For example, it would be dangerous to isolate power to the first aid room whilst someone was being attended to.

Step 3 – Carry out the isolation

The level of isolation or hazardous energy treatment will depend on the work to be performed. There are a number of locking devices available for ensuring isolation or hazardous energy treatment is not inadvertently defeated and a risk assessment should consider the use of locking devices or hardware appropriate for the type of isolation or hazardous energy treatment. Locking devices that require the use of a key or special tool to achieve its removal can be used in conjunction with identification tags. Push buttons, stop switches, interlocks and emergency stops should not be considered as a sole means of isolation or hazardous energy treatment.

If necessary additional barriers shall be used to define the boundary of the isolated or hazardous energy area or provide a warning of additional hazards Part of the isolation or hazardous energy treatment process may require structures or flagging, bunting or tape, as appropriate, to secure the access and egress to an isolation or hazardous energy treatment area.

For example, before working on a conveyor chute, isolate conveyors by turning off the electrical starter main isolator, isolate both conveyor loop take ups by turning off the main isolator at the loop take up motor.

Isolate the primary energy sources from the equipment to be worked on by switching the main isolators, operating the valves, removing the plugs, etc.

Isolate or secure all secondary sources, such as conveyor take-up, springs, accumulators, elevated equipment, pressure vessels and tanks and monitoring circuits.

Ensure all associated equipment creating a hazard is also isolated.

Step 4 – Test the effectiveness of the isolation

Test that the equipment has been isolated to ensure that the equipment cannot operate while personnel are working on it.

Typical tests are as follows:

- attempt to start the equipment;
- have someone else, perhaps a supervisor, check the method of securing and isolation;
- check the indicator on the main isolator to ensure it has fully opened; and/or
- any other check considered necessary to ensure the equipment will not operate.

Note: When working on electrical equipment, special instruments and devices are available to check for the presence of voltage – these should only be used by competent electricians, electrical technicians and electrical engineers

Step 5 – Place safety lock/tag(s) on isolating device(s)

Print clearly the following information on the Personal Danger Tag if a tagging system is used:

- the name of the person who performed the isolation (your name);
- the date;
- the plant or equipment number; and
- any necessary remarks on the remarks side of the tag.

Attach safety lock/tags securely and in an obvious manner on the isolating switch or isolation point.

Step 6 – Re-energising

There have been instances where the injury has occurred when restoring energy sources after the work has been completed. The basic steps for restoring energy sources are as follows.

- Check it is safe to restore the energy source.
- Communicate to all affected parties that work has been completed and that the energy source is to be restored and that the equipment is now considered "live".
- Remove any blocks, chocks, earths.
- Remove tags and locks.
- Restore energy sources.
- Communicate to affected parties that energy sources have been restored.
- Check the plant or equipment operates satisfactorily.
- Report.

4.8.2.3 REMOVAL OF LOCK/DANGER TAG

A lock or danger tag may only be removed by the person who placed it (them) there, except as indicated below.

Removal of lock/danger tag when the person has left the site

When a person leaves the site without removing a personal lock/danger tag the following procedure should be observed:

- the supervisor shall endeavor to contact the person and, if practical, have them return to the work site to remove the lock/tag; or
- if the person does not return, a supervisor and another person will carry out an inspection of the affected area to determine that:
  - no person is in a position of potential danger; and
  - the equipment is safe to operate.

Then, and only then, can the lock/tag be removed to restore the equipment to operational status. It may be prudent to have removed danger tags attached to shift reports for audit and review purposes.

It is important that the supervisor and the other person are competent to make the decision. For example a processing plant supervisor and a process plant operator will generally not be competent to make such a decision relating to electrical equipment.

4.8.2.4 PERMIT OF ISOLATION

Requirement

A Permit of Isolation is required:

- when the task involves several personnel, or is of a complex nature;
- personnel are unable to affect their own isolation; and/or
- where radio communication is being used to control distant functions.

Definitions

A PERMIT HOLDER is an Authorised Person who has the knowledge of the work area and the interaction of equipment in the work area. This person assumes the responsibility for those persons exposed to danger and acts on their behalf.

An ISOLATOR is an Authorised Person who has the knowledge to carry out isolation procedures. This person identifies the points of isolation for the PERMIT HOLDER and can carry out isolation and proof testing of the isolation.

Step 1 – Identify equipment to be isolated

Prior to personnel commencing work on any item of equipment, the PERMIT HOLDER will:

- identify all items of equipment which need to be isolated to safely carry out the work required in that area;
- record the items of equipment on the Permit; and
- fill out a separate Danger Tag for each isolation point.

Step 2 – Determine isolation points

The PERMIT HOLDER obtains the services of an ISOLATOR and together they identify the point of isolation for each piece of equipment.

Step 3 – Carry out isolation

The ISOLATOR, in the presence of the PERMIT HOLDER, isolates all the equipment nominated on the Permit.

Step 4 – Test for dead

The ISOLATOR then proves the equipment dead.

Step 5 – Place tags on isolating devices

The PERMIT HOLDER and ISOLATOR check that:

- the item(s) of equipment listed on the permit corresponds with that on the Permit of Isolation Danger Tag(s) and the isolation point; and
- the number written on the Permit of Isolation Danger Tag(s) corresponds to the number printed on the Permit.

The PERMIT HOLDER then attaches the Permit of Isolation Danger Tag to the point of isolation and ensures that all other tags are securely attached.

The PERMIT HOLDER then records the number of Permit of Isolation Danger Tags attached.

Step 6 – Acknowledgment of isolation

The ISOLATOR completes the isolation section of the Permit.

The PERMIT HOLDER then completes the acknowledgment section of the Permit.

Step 7 – Signing on the permit

Once a Permit of Isolation has been raised, the Permit must be taken to the work site by the PERMIT HOLDER so that each person may sign on. The Permit must remain at the work site for the duration of the job or until all personnel have signed off the Permit.

Prior to commencing work in the area, each person shall sign on to the Permit of Isolation.

Prior to signing on each person shall satisfy themselves that the Permit is correctly completed and relates to the item of equipment to be worked on.

Step 8 – Signing off the permit

Each person who has signed on a Permit shall, at the completion of his/her work under that Permit, sign off the Permit on the same line he/she originally signed on.

The PERMIT HOLDER shall ensure that all persons who have signed on the Permit have also signed off.

If the work is performed over several shifts each person must sign on and off as they start or finish work.

The PERMIT HOLDER checks the equipment involved to ensure that it is safe and ready for service (relative to this Permit). If it is not ready for service, attach a Caution tag at the point of isolation.

Step 9 – Removing the danger tags

The PERMIT HOLDER then obtains the services of an ISOLATOR and returns to the point of isolation.

The PERMIT HOLDER completes the section of the Permit to allow the removal of the Permit of Isolation tags.

The ISOLATOR checks the Permit of Isolation to ensure that all persons have signed off

The ISOLATOR then identifies the tag(s) bearing the number of the Permit being cancelled and the PERMIT HOLDER checks to ensure that the numbers on the Permit and tag(s) are the same.

Once the correct tag has been identified, the PERMIT HOLDER removes only the tag whose number corresponds to the number on the permit and destroys the tag(s). The PERMIT HOLDER checks that all remaining tags are secure.

The ISOLATOR completes the section of the Permit certifying that only the correct tag(s) has/have been removed and records the number of Danger Tags removed.

The PERMIT HOLDER is appointed by the manager. Any PERMIT HOLDER can remove a danger tag identified with a Permit number subject to observing the requirement of this section.

Step 10 – Persons who have left

When a person leaves the site without removing a personal danger tag or signing off a personal danger tag or signing off a Permit of Isolation the following procedure must be observed.

- The supervisor must endeavor to contact the person and if practical have them return to the work site to remove the tag or sign off the Permit:
- If the attempt to contact the person is unsuccessful or the person is unable to return to the work site, the supervisor and others who may be present must be satisfied that:
  - no person is in a position of potential danger; and
  - no equipment has been left in an unsafe condition.

In such cases, the supervisor shall forward the tag together with a formal written report to the plant manager.

Step 11 – Cancellation of the Permit

The PERMIT HOLDER then completes the cancellation section of the Permit by acknowledging that the correct tag(s) has/have been removed.

Where no further tags remain on the isolation point, the ISOLATOR energises the equipment.

Points to Remember

Sign on and sign off personally.

Do not rely on the fact that other people around you have signed on the Permit.

Do not sign on or off the Permit for anyone else.

In cases where repeated isolation and energising of any drive occurs, a new Permit of Isolation must be raised for each isolation.

The old Permit and tag must not be re-used.

Persons who have signed on to a Permit of Isolation shall not leave the site until they have personally signed off.

Where a Permit becomes full and no spaces remain to allow persons to sign on, a new Permit must be raised.

Equipment shall not be energised until all Permit of Isolation tags have been removed.

Instructions on Caution tags are to be observed. Tags no longer required shall be removed.

A breach of the Isolation and Tagging Procedures should be a disciplinary offence.

4.8.2.5 OUT OF SERVICE

Introduction

The Out of Service tag indicates that repairs to equipment or machinery are required, or incomplete, and that damage or injury may result if the equipment or machinery is used or operated.

An Out of Service procedure should provide a systematic way of indicating to personnel that a particular item of equipment or machinery should not be operated because it needs to be repaired or is being repaired and an Out of Service tag should be used.

Requirements

No person shall commence work on equipment until they have satisfied one of the following requirements:

- raised a general isolation; or
- raised or signed on to a Permit of Isolation; or
- been instructed in a Safe Working Procedure where a normal isolation cannot be effected.

If it is not possible to isolate the plant or equipment, then energy source must be isolated from the person through Safe Working Procedures that include appropriate PPE and hard barriers which are established prior to, and maintained throughout, the complete job, include the following examples.

- Bearing vibration analysis and running maintenance (such as greasing) where the person is isolated from the mechanical energy source by appropriate guarding.
- Testing electrical circuits is a specialised area requiring PPE (gloves – insulating

and burn protection, general clothing, face masks, goggles, flash hoods, flash jackets etc), knowledge of the electrical system being tested (fault levels, curable burn distances, voltage, correct creepage and clearance distances) and fit for purpose instruments (fault rating, voltage classification, general class of instrument).

Any other equipment that will create a hazard to personnel shall also be isolated (eg equipment feeding onto the isolated equipment).

For new equipment/installations, isolation and tagging procedures must apply from the time the equipment is connected to their power source. Isolation and tagging procedures need to be considered at the design phase of plant and equipment and throughout the life cycle.

Benefits

- Identification of hazards prior to work commencing.
- Protection of personnel from injury.
- Protection of equipment and machinery from damage.

4.8.2.6 TRAINING AND EDUCATION OF PERSONNEL

Training/education

Giving people an understanding of the technology and of their duties and teaching them skills such as the ability to diagnose faults and work out the action required.

Instructions

Informing people what they should and should not do.

It is the level of competence achieved from training, knowledge, experience, qualifications and ability that determines the level of judgement and discretion that can be applied in the performance of a task.

It is imperative that personnel working on an energy system understand the system so that they can operate and maintain it in a safe manner. Training and instruction is therefore of critical importance.

An isolation procedure must include a training program for employees to explain the system, with refresher courses at regular intervals. There must also be regular surveys or checks on the awareness of isolation needs and procedures and revision of the procedures to see if they fit the needs of the current work environment.

Placement of tags

An Out of Service tag must be attached to equipment when:

- repairs are left incomplete; and/or
- operation or use could lead to equipment damage or to injury.

On each Out of Service tag must be printed:

- the operator's name (or the name of the person specifying the machinery is out of service);
- date;
- time;
- equipment being tagged; and
- reason for being out of service.

Ensure that the tag is fastened securely so that it will not become detached.

The placement of Out of Service tags can be on any plant and equipment, including:

- valves for the isolation of pipelines, air and hydraulic equipment;
- mobile plant and vehicles;
- faulty electrical equipment; and/or
- manholes and other openings which are secured open or closed.

When an Out of Service tag has been attached, the foreman should be advised of the placement and reason for it.

Whenever a Personal Danger tag is attached to equipment there should also be an Out of Service tag attached.

Except for testing by an authorised person, equipment must not be operated when an Out of Service tag is in place.

Removal of tags

An Out of Service tag can only be removed by:

- the employee who attached the tag; or
- personnel authorised by the company to repair or check the fault shown on the tag.

Before removing an Out of Service tag the employee or authorised person will check that the equipment is in proper working order and that the operation will not cause injury to personnel or damage to plant.

The tag may be destroyed after use and properly disposed of or it may be prudent to attach all removed out of service tags to shift reports for audit and review purposes.

Note: An Out of Service tag does not provide personal protection as it may be removed and the equipment operated without a person being aware of it.

Under no circumstances are Out of Service tags to be used in place of Personal Danger tags.

4.8.3 ELECTRICITY

4.8.3.1 PREAMBLE

There are a number of Australian Standards numbers quoted in this document. Further details can be obtained from the Australian Standards catalogue or website.

4.8.3.2 INTRODUCTION

Electrical installations must comply with the provisions of the relevant mining acts and regulations. Legislation generally requires that electrical installations and equipment are fit for purpose and that persons working on the equipment and installations have adequate competence. For example a person who designs an electrical installation for a processing plant must be competent in the design of electrical installations; a person maintaining electrical installations must be competent in that particular aspect of maintenance.

Legislation also generally details the dangers associated with electricity which have to be dealt with; together with the requirement to inspect and test to identify and then deal with deficiencies associated with these dangers.

The main Australian Standards for electrical installations and equipment at mines are:

- AS/NZS 3000: 2000 Wiring Rules;
- AS3007.1: 1987 Electrical Installations – Surface Mines and Associated Processing plant – Scope and Definitions;
- AS 3007.2: 1987 Electrical Installations – Surface Mines and Associated Processing Plant – General Protection Requirements;
- AS 3007.3: 1987 Electrical Installations – Surface Mines and Associated Processing Plant – General Requirements for Equipment and ancillaries;
- AS 3007.4: 1987 Electrical Installations – Surface Mines and Associated Processing Plant – Additional Requirements for Specific Applications; and
- AS 3007.5: 1987 Electrical Installations – Surface Mines and Associated Processing Plant – Operating Requirements.

Electricity used at a mine may be supplied by a local supply authority (LSA) or generated on site and it will often include the use of energy storage devices such as capacitors and batteries.

4.8.3.3 ELECTRICAL ENGINEERING SAFETY

The purpose of this guideline is to enhance safety in mines through good and safe electrical engineering practice. This practice can be described as electrical engineering safety.

Electrical engineering safety encompasses:

- prevention of electric shock and burns;
- prevention of electrocution;
- prevention of injury or death from electric shock;
- prevention of electrical burns, including electrically-induced radiation burns;
- prevention of electrical arcing and surface temperatures that have sufficient energy to ignite gas and/or dust;
- prevention of fires caused by the malfunction of electrical equipment; and
- prevention of injury and death from unintended operation or failure to operate, of electrically powered and electrically controlled equipment.

Where any form of electrical energy is used the responsible person at the mine should design, install, commission, operate, maintain (including servicing and repairs) and dispose of electrical equipment in a manner that achieves electrical engineering safety. To achieve electrical engineering safety:

- the equipment must be fit for purpose;
- the people installing, commissioning, operating, maintaining and disposing of electrically powered equipment and electrical reticulation systems must be competent to do the work;
- safe working procedures must be provided;
- appropriate competent supervision must be provided;
- the work environment must be managed; and
- installing, commissioning, operating, maintaining and disposing of electrically powered equipment must be done within a management system framework.

Electrical engineering safety – risk controls

To achieve electrical engineering safety there are a number of fundamental risk controls that should be in place and maintained for the life cycle of the mine. These risk controls are:

- electrical technology management systems incorporating incident investigation;
- competent people engaged in electrical equipment and systems throughout the life cycle;
- fit for purpose electrical equipment;
- fit for purpose electrical protection;
- fit for purpose earthing systems;
- fit for purpose lightning protection;
- isolation and electrical testing procedures;
- removal/restoration of power procedures;
- fit for purpose machinery control circuits and systems;
- classification of hazardous areas;
- fit for purpose electrical equipment in hazardous areas;
- maintenance of electrical powered or controlled equipment and systems; and
- correct first aid treatment for persons who receive an electric shock.

Electrical engineering safety – standards and guidelines

The requirements and guidance for electrical equipment and installations can be obtained from Australian Standards, International Electrotechnical Commission Standards, Energy Authority guidelines, industry-specific guidelines and technical literature. Where published standards or guidelines are not complied with in part or in total, then the reason for this must be demonstrated by a risk management process. Information on standards and guidelines can be obtained from the relevant organisation.

The base Australian Standards for electrical installations at mines are AS 3000 and AS 3007. Although the scope of AS 3007 does not encompass underground mines, it is applicable for the surface installations of underground mines and the touch voltage/clearance time curves of AS 3007.2 are applicable for electrical installations in the workings of an underground mine. This Guidance Note gives complementary and additional information to that contained in AS 3000 and AS 3007.

4.8.3.4 ELECTRICAL ENGINEERING SAFETY–ESSENTIAL RISK CONTROLS

Electrical technology management systems

Guidance on developing management systems can be obtained from the Australian Standards relating to Quality Management Systems (AS ISO 9000) and Occupational Health and Safety Management Systems (AS 4801, AS 4804).

Guidance on risk management can be obtained from AS 4360 – 1999.

4.8.3.5 ELECTRICAL WORK–COMPETENCY

National competency requirements have been developed for both the mining industry and the national utilities industry. Many of the competency standards relate to working on or with electrical equipment. Persons working on or with electrical equipment should be competent to a level consistent with the electrical competencies specified by the Mining Industry Training Advisory Board and the National Utilities Industry Electrical Training Advisory Board.

AS 3007 refers to three types of persons and these are discussed below.

Skilled persons

Skilled persons are defined as persons with technical knowledge or sufficient experience to enable them to avoid dangers which electricity may create.

Conventionally, a skilled person in a particular field is an electrical engineer whose education and experience would entitle him/her to corporate membership of the Institution of Engineers Australia.

However, persons who do not satisfy the above may be regarded as skilled persons for specific tasks. For example, a power station or systems controller may be regarded as skilled for the purpose of determining switching procedures for isolation.

Instructed persons

Instructed persons are defined as persons adequately advised or supervised by skilled persons to enable them to avoid dangers which electricity may create.

Electrical tradesmen, other electrical workers such as linesmen or cable joiners and electrical engineers who are not eligible for corporate membership of the Institution of Engineers Australia are regarded as instructed persons.

Ordinary persons

Ordinary persons are defined as persons having inadequate training or experiences to enable them to avoid the dangers which electricity may create.

Generally, persons other than skilled and instructed persons are regarded as ordinary persons.

4.8.3.6 FIT FOR PURPOSE – ELECTRICAL EQUIPMENT

Electrical equipment should be adequately rated with regard to:

- voltage;
- frequency;
- temperature;
- normal operating current;
- overload current;
- ability to make and break the maximum prospective fault current;
- ability to withstand the maximum prospective through fault current; and
- working environment.

Other considerations should include electromagnetic compatibility and the ability to withstand electromagnetic radiation interference

When selecting equipment and cables, consider over voltages and over currents to which the equipment and cables may be subjected at the points of connection to the supply system.

Electrical equipment and their connecting cables should be selected so that they adequately perform their intended duty without resulting in electric shock and burns, explosions, fires or unintended movement of machinery and equipment.

Basically, equipment and cables should be selected so that they do not overheat or have insulation failures when subjected to their intended duty. They should be selected taking into account the intended purpose, together with climatic and environmental conditions (pollution) they may experience within their intended work environment.

Isolation equipment

Adequate means and measures to control and isolate the power/electricity supply should be provided at a mine as a means of removing danger to any person. Isolation should be provided at the incoming supply point or at the generator, as the case may be. The electrical reticulation system should be sectionalised so that specific parts of the system can be isolated without affecting other parts.

The isolation points should be readily accessible and clearly labelled.

The isolation equipment (switch or circuit breaker) should be able to be operated without endangering the operator.

Signs advising which circuits are supplied from the isolation points should be legible and durable.

Communication

Means of communication between all major supply points and between surface and underground supply points should be provided as a means of communicating danger or faults with the power/electricity supply.

Items of electrical equipment

Most individual items of equipment on sale are manufactured to Australian Standards so that it is necessary to ensure that although the item might comply with a particular Standard it is also suitable for its allotted task. Standards dealing with safety equipment, such as circuit breakers and fuses, require purchasers to supply with their order details relating to application of these items. If supplied correctly, these details should ensure that equipment is suitable for its allotted task.

Many Australian Standards apply to individual items of equipment which make up an electric circuit. To list them in this document would make a very long list. Therefore refer to Standard AS 2006 dealing with high voltage circuit breakers as an illustration of details which are required to be supplied with an order.

Assemblies of electrical equipment

There are a number of Australian Standards relating to assemblies of switchgear and control gear. Desirably, equipment assemblies should comply with these Standards.

Assemblies not made to the above Standards should comply with the provisions of AS 3000 and AS 3007.

Signage warning of the presence of electricity and advising on what to do in the event of a fire or electric shock should be located near electrical equipment.

Portable equipment

Because electrical faults or mechanical damage which may cause portable equipment or the cable to become live are likely to occur when the equipment is being handled, the supply to the equipment and cables should be in accordance with AS 3000 and AS 3007.

Also, because the equipment and cables are required to be carried, cables in particular need to be light in weight and will usually be unscreened cables. Damage to cables can therefore result in live parts being able to be contacted.

Circuits supplying a single piece of portable equipment should be either:

- from an extra low voltage supply whose source is isolated from other systems, eg separate generator supply or a safety isolating transformer complying with AS 3108 Approval and Test Specification – Particular Requirements for Isolating Transformers and Safety Isolating Transformers; or
- from a TN (earthed) or TT (earthed) supply where the phase voltage is not greater than 250 volts and protection is provided with a residual current device with residual current operating values no greater than 30 mA and constructed to AS 3190; or
- from an IT (unearthed) supply whose line voltage is no greater than 250 volts and is supplied from a system which is isolated from other systems, eg a separate generator complying with AS 3010.1 or a safety operating transformer complying with AS 3108.

Mobile equipment

Mobile equipment must comply with AS 3007. Further guidance on mobile equipment can be obtained in the references and other sections of this Handbook.

Where the mobile equipment is fed by trailing or reeling cables, electrical protection should be provided to ensure that if the earth connection between mobile equipment and the point of supply is ineffective then the supply of electricity is cut off to the mobile equipment.

Reeling and trailing cables should comply with AS 1802 or AS 2802 as appropriate.

Automotive wiring on mobile equipment should comply with AS 4242.

Movable (transportable) equipment

The type of cabling and protection used for movable equipment will depend on the intended operation of the equipment.

If the installation is made with the intention to disconnect and reconnect cables on each move, then cables and protection used on fixed installations should be adequate.

If on each move, the means of disconnection is by means of plug and socket connections or bolted connections, then the type of cables and protection specified for mobile equipment should be used.

Welding

Electrical welding equipment should be constructed in accordance with Australian Standards.

Electrical welding equipment should be used in accordance with AS 1674.

Voltage reducing devices (VRDs) are readily available to reduce the voltage at welding electrodes, to a safe level, when the welder is not welding, but still energised. These should be installed on welding systems.

Cables

Electric cables should be selected considering the provisions of AS 3007, AS 3000 and other Australian Standards on the selection of cables.

Cables in underground mines should be placed and protected so that damage from mobile equipment, their loads or any fallen material is unlikely.

Cables in shafts should also be placed and protected so that damage from falling material is unlikely.

Cables should be adequately supported throughout their length or be of a type which is specially constructed for a specific purpose – such as single point suspension vertical cables for use in shafts, and boreholes and cottage loaf cables for use horizontally.

Cables for use in underground situations such as roadways and haulageways should be armoured.

Cables used for portable or mobile equipment are handled in use and should be constructed and/or protected to minimise the possibility of dangerous electric shocks during handling and be designed for flexing, coiling etc.

Trailing and reeling cables should comply with AS 1802 or AS 2802 as appropriate.

Because of the likelihood of digging occurring near buried cables associated with mining and ore treatment operations, the following additional procedures should take place in addition to the requirements of AS 3000:

- marker tape should be installed above the cable installation irrespective of the requirements for marker tape specified in AS 3000;
- the route of the cable(s) should be surveyed and marked on site plans; and
- markers on the surface should indicate the cable route directions and changes of direction.

Overhead Lines

Overhead electricity lines (also known as powerlines) and their associated equipment should be placed so that normal mining operations can be carried out without affecting the security of the line. It is good mining practice to route overhead lines around the mining area to minimise the crossing of roads where dump/tipper trucks travel.

Basic requirements

- Overhead electricity lines should be designed, installed and maintained according to the requirements of the ESAA Guidelines for Design and Maintenance of Overhead Distribution and Transmission.
- Clearances may need to be increased above published values where operations associated with mining and treatment take place near the overhead electricity line.

- Consideration of sag due to hot weather and electrical faults needs to be considered.
- Consideration of adverse and damp weather needs to be considered.
- Signs should be installed at appropriate places to warn of the presence of overhead lines. The signs should state the voltage and the maximum height of any vehicle that can travel under the overhead lines.
- Overhead lines should be accessible for inspection purposes – in particular access needs to be available at night and in poor weather.

Clearance to mobile equipment

It should be noted that rear dump trucks and other vehicles that can raise parts above their normal level commonly contact overhead lines and overhead cables with rear dump trays, even when warning devices of the tray raised are often fitted. Consideration should be given to routing overhead lines away from traffic routes, haul roads etc or raising the overhead lines to a height where safety clearances can not be encroached upon.

Where overhead lines pass over work areas, roads, maintenance areas or parking areas and where mobile drilling, excavating, loading, hauling or lifting equipment is used in normal mining operations, conductors should be placed so that the clearances specified in AS 3007 are always maintained between the conductors and the mobile equipment, any of its extensions, people on the equipment or items with which they may be in contact.

When determining this clearance, take account of conditions which give the least clearance between the overhead line and mobile equipment. The condition which gives the least ground clearance, ie maximum sag condition, should be considered. To non-horizontal surfaces, swinging conditions from wind should also be considered.

For mobile equipment, consider the condition which gives the maximum distance above the ground of the equipment. For example, in the case of a dump truck, this would be when the body is fully raised and springs and tyres are at maximum extension (after a bump); and in the case of a drilling rig, its mast in the vertical position.

For vehicles which have a long overhang (such as the jib of a mobile crane) the ground clearance considered may need to be when the vehicle (with jib down) is passing over the crest of a hill causing the overhanging part to have a greater clearance to the ground than if the ground was level.

Where dump/tipper trucks regularly pass underneath overhead lines, consideration should be given to erecting warning signs and devices (goal posts).

Where floating plant is used the maximum possible pond level should also be considered. Such level may be due to raising of water table, pump failures, etc.

Note: Ground clearance is the perpendicular distance between the ground and the conductor. That distance is the smallest arc which can be drawn from the conductor, the ground being tangent to it.

Maximum distance above the ground is also the perpendicular distance to the ground.

Provided overhead lines (electricity or powers) are installed and maintained with clearances to mobile equipment as specified in this guide, the equipment to which these clearances relate may be used without restrictions.

Where this equipment is used in areas where these clearances may not apply, or equipment which was not considered in determining these clearances is used on the site, considerations for the use of this mobile equipment should be made. These considerations should be made within the framework of risk management and consider the following as a minimum.

Basic consideration

Before mobile equipment, which is not regularly used, is used on the site, determine the likelihood of the clearance between the mobile equipment and the overhead line being reduced below that specified. The results of this determination will determine the necessary remedial action.

Initial determination

Initially a determination of likely clearances should be made by comparing the known minimum ground clearances of overhead lines on the site with the maximum height above the ground of the mobile equipment, its load, any item of the equipment extended to its full height, or persons on the equipment.

If this comparison shows that the specified clearances can always be maintained, the equipment may be used without restrictions, provided the road surface is not increased in height due to ballast, grading etc.

Site inspection

Should the initial determination show that the clearances specified cannot always be maintained, a thorough inspection of the route to be taken and the work to be carried out on the site should be made. That inspection should determine clearances between the mobile equipment and the overhead line. This should be determined by physically checking the height of the vehicle and the ground clearance of the line with suitable measuring devices; for example, a high voltage operating stick of appropriate voltage rating for determining conductor heights.

Isolation requirements

Should the site inspection show that the clearances specified may not be maintained the overhead line should be isolated, short circuited and earthed as detailed

Removal requirements

Should the site inspection show that movement of the mobile equipment could cause damage to the overhead line the overhead line should be disconnected and removed from the site as detailed in AS 3007.

Clearances to hand-held objects

Where overhead electricity lines pass over areas where long conducting objects may be handled as part of the normal mining operations, eg metal survey staffs, pipes for pumping system, etc, the cable conductors should be placed so that the clearances specified AS 3007 should be maintained.

All factors should be taken into account to determine the least clearance between the hand-held object and the overhead line.

The maximum sag condition should be considered for assessing the overhead line the condition which gives least ground clearance.

The maximum distance above the ground should be considered for the hand-held object. In the case of a survey staff this would be the staff fully extended and held perpendicular to the ground surface at a height of 2.4 m above the ground.

Clearance to excavations

Overhead lines should be placed at such a distance from excavations that the stability of supports of the line should not be affected by excavation or slump.

Clearance to blasting operations

- Fly Rock Considerations: Overhead lines should be placed so that fly rock from blasting operations will not damage any part of the overhead line.
- Electric Blasting Lead Considerations: Refer to AS 3007.
- Induced Effects in Electric Blasting Circuits: Refer to AS 3007.

Clearance to stockpile and tailing areas

Overhead lines should be kept well clear of stockpiles and tailing areas. The clearance should be such that stockpiles and tailings can not encroach on the overhead lines in such a manner that safety clearances will be compromised.

Clearance to store areas

Overhead lines should be kept well clear of storage areas. The clearance should be such that stored equipment and mechanical lifting devices used for storing equipment can not encroach on the overhead lines in such a manner that safety clearances will be compromised.

Areas where spontaneous combustion is a risk.

Power poles of wooden construction should not be used in areas where spontaneous combustion may occur.

4.8.3.7 ELECTRICAL PROTECTION

Electrical protection is closely associated with equipment rating. Electrical protection should be provided for applications or conditions which may occur outside the intended duty.

Electrical short circuit faults can cause fires and explosions within the electrical equipment or within the working environment.

Personnel can receive electric shocks from electrical enclosures if earth faults are not quickly disconnected.

Overloading of electrical equipment can lead to electrical equipment overheating which can cause fires and explosions.

In particular electrical protection should be capable of detecting and initiating circuit breaking in the event of a short circuit between active conductors, a short circuit between active conductors and earth, excessive overload currents flowing and in the event of excessive earth leakage currents flowing.

Electrical protection should be provided so that electrical distribution systems can be sectionalised and only the faulted circuit is turned off, this requires a systematic analysis of the electrical system and electrical protection to be graded. The electrical protection should be able to detect and clear any fault anywhere on the electrical system.

Electrical faults

Electrical circuits can fail in a number of ways, the most common failures are due to earth faults and short circuits. It is possible under short circuit conditions for currents of thousands of amperes to flow. If protection devices do not detect these fault conditions cables can catch fire along their entire length and electrical enclosures can explode or melt, the consequences of this happening anywhere on a mine site, but particularly underground, are obvious.

There are also less obvious hazards. Under earth faults or certain types of short circuits, high currents can flow in the ground at locations well away from the faulted points, these high currents can cause voltages differences across the ground. Also when an earth fault occurs the outside of metal electrical equipment and other metallic objects can become live, it has been known that metallic pipes and fencing have become live over many kilometres. If electrical protection does not detect and disconnect these faults there is a high risk of people receiving electric shocks that may be fatal.

System over-voltages can cause flashover at insulators and the immediate failure of other insulation systems, they can also cause deterioration of insulation over a period of time. This in turn can cause earth faults and short circuits.

Mining situations often have additional hazards associated with equipment that is fed by flexible trailing cables. Generally it is essential that there is a good earth connection between the electrical equipment and the point of electrical supply. If this earth connection is not good and an earth fault occurs on the electrical equipment there is a possibility that a person touching the electrical equipment will receive an electric shock.

Types of electrical protection

To adequately manage the risks presented by electricity, mines need to have electrical protection on all circuits. The electrical protection should detect and disconnect:

- short circuits between active conductors;
- short circuits between active conductors and earth;
- earth leakage faults; and
- earth leakage faults on hand held tools (earth leakage should operate at 30 milliamperes).

Where electrical equipment is fed by flexible trailing cables additional special protection should be provided that ensures the electrical equipment is effectively connected to earth – that is earth continuity protection.

Where electrical equipment is fed by flexible trailing cables underground and in a hazardous zone, additional special protection should be provided that prevents the power being turned onto a cable that has a fault on it – that is earth fault lockout protection.

Another form of electrical protection is overload protection, this is not used to detect faulted electrical circuits, it is used to protect electrical circuits from overheating due to too much load, such as a conveyor with too much material on it. When an overload occurs it is important that the power is tuned off the circuit. If the power is not turned off electric cables, motors and transformers can overheat to such an extent that they become permanently damaged.

Common types of electrical protection

- Instantaneous short circuit.
- Overcurrent.
- Earth fault.
- Earth leakage.
- Earth leakage – personnel protection.
- Earth continuity.
- Earth fault lockout.

Design of electrical protection

Design of electrical protection is not a simple matter. A thorough mathematical analysis of the electrical system needs to be done. This should be done by a competent electrical engineer. In general the electrical protection should operate in a reliable manner and disconnect only the faulted circuit. Where electrical protection disconnects non-faulted circuits considerable disruption can occur to production and it can have adverse effects on safety (for example, all the lights in a processing plant going out).

In general, electrical protection should be designed to:

- clear the fault as quickly as possible;
- see and clear the first fault;
- disconnect the faulted circuit only;
- clear the fault before electrical equipment deteriorates due to electrical heating or arcing;
- disconnect overloaded circuits before electrical equipment deteriorates due to overheating;
- comply with legislation; and
- comply with relevant Australian Standards.

4.8.3.8 EARTHING

Earthing of electrical installations has two basic requirements:

- to provide a sufficiently secure low impedance path to allow circuit protection to operate when required to clear faults resulting from an insulation failure to earth; and
- to limit touch voltages, transfer potentials and step voltages to a level that is not dangerous.

AS 3007 defines the touch voltages that are permitted and conductor sizes that are required for both protective conductors and earthing conductors. Earthing system design and installation is, however, not dealt with in AS 3007.

Details and methods of installation earthing with reference to touch and step voltages is given in:

- Substation Earthing Guide – 1995, Electricity Supply Association Australia;
- Electricity Council of New South Wales publication EC5 Guide to Protective Earthing; and
- Institute of Electrical and Electronic Engineers (USA) Standard 80 Guide to Safety in Substation Grounding.

Many electrical engineering consultants provide an earthing design and testing service and are a useful resource in designing new earthing systems and testing existing earthing systems to ensure dangerous touch, step and transfer potentials are not possible.

4.8.3.9 LIGHTNING PROTECTION

AS 1768 Lightning Protection deals with protection of structures generally, as well as critical structures such as fuel storage and explosives magazines, electrical and communications circuits – together with requirements for protection of surface and underground operations. AS 1768 should be used to determine adequate protection.

Additional provisions to AS 1768 may be required for underground mines such as separation of mine electrical earths from lightning earths, earthing of metallic structures that are partly on the surface and partly underground (eg conveyors, compressed air pipes). Lightning protection and earthing for the purpose of discharging lightning safely to earth should be arranged to prevent the effects of lightning from being transferred into underground workings.

4.8.3.10 ISOLATION PROCEDURES

Definitions of electrical isolation terms

"Effectively isolated" means either:

- operating a switch which has a visible break;
- operating a switch or circuit breaker which is then withdrawn from the connected position;
- disconnecting a plug and socket connection; or
- any other means of isolation which shows a visible break.

This switch or device should then be kept in the open position with equivalent security to that of a padlock so that the visible break of the switch or other means remains open or the withdrawable circuit breaker or plug cannot be reconnected with the lock in place.

"Proved dead" means testing the part with a device which is suitable for the voltage of the circuit of the part if the part were alive. The device having been checked to prove its correct operation immediately before and after it is used to prove the part dead.

"Short circuited and earthed" means connection of parts together which when live would be at a voltage difference and also connected to a part of the installation which is effectively earthed. If there is no part which is effectively earthed (eg overhead line), a metal stake (minimum diameter of 12 mm) should be driven in the ground (minimum depth of 1 m). Connections between live parts and between live parts and earth should be capable of carrying the maximum prospective fault currents for the time they may be present at the point at which they are short circuited and earthed.

"Sources of supply" also includes supplies in addition to the normal electricity supply which may introduce voltages above extra low voltage(eg AC voltages by capacitive induction from parallel circuits, DC voltages from insulation testing meggers and stored energy from capacitors) on the part which is to be approached. These additional sources of supply may be control circuits, overhead lines running parallel to the circuit being worked on, uninteruptable power supplies, battery back up supplies, and capacitors.

Further details of isolation procedures, equipment for performing work, determining safety clearances, erecting barriers, are requirements for requiring access permits are given in AS 3007, AS 2467 and other Australian Standards.

Safe electrical work

No work should be carried out on electrical conductors energised at a voltage above extra low voltage.

This does not prohibit the attachment of test instruments, provided the following conditions apply.

- A risk management exercise has been conducted in accordance with relevant guidelines and standards.
- The instrument is adequately rated for the duty (note some multi-metres are protected by fuses rated at only 6 ka, if the fault level exceeds this, the instrument is not adequately rated).
- The instrument has been inspected to a specified standard and is in good condition and is fit for purpose.
- The instrument probes can be attached without encroaching on creepage and clearance distances.
- The environment (humidity, dust) does not reduce creepage and clearance distances.
- The instrument and task are the subject of a documented safety procedure authorised by an electrical supervisor.
- No part of any worker encroaches on the curable burn distance associated with the electrical equipment, unless appropriate personal protective equipment is used.

- Workers wear safety goggles or face-masks and suitable clothing with minimum bare skin exposed, whilst operating the instrument.
- A contingency plan for mitigating the effects of a mishap including the provision of a safety observer to implement the contingency plan.

Effective isolation of electrical equipment is the best method of preventing accidents whilst working on or in close proximity to electrical equipment. Where electrical test instruments are to be used to measure voltage, current, frequency etc. It may be possible to first isolate the electrical supply attach the instrument and then restore power.

Basic isolation procedures

The following steps are essential for safe isolation:

- Identify the equipment to be worked on.
- Identify the sources of electricity.
- Identify the isolation points.
- Communicate the intention to isolate to affected persons.
- Check the interment for presence of voltage is functional.
- Effectively isolate at the points of isolation.
- Check for a visible break (if possible).
- Lock out the point of isolation.
- Attach personal warning notices.
- Prove dead (ensure isolation is effective).
- Recheck the interment for presence of voltage is functional.
- Earth (if required).
- Communicate that isolation has been done and work is to commence.

Basic procedure for restoring power after isolation

- Check it is safe to restore power.
- Communicate that the work has been completed and that power is to be restored, and that all personnel should consider the circuit is live.
- Remove earth (if required).
- Remove warning notices and locks.
- Restore power.
- Communicate that the power has been restored.
- Check equipment operates satisfactorily.
- Report.

4.8.3.11 RESTORATION OF POWER AFTER AN ELECTRICAL FAULT TRIP

Before power is restored after a fault trip an investigation as to the cause of the trip should be undertaken by a person competent to do so. Power should not be restored unless the faulty part of the circuit has been isolated and/or repaired. It is bad practice to reclose onto faults to try and find a fault.

Automatic reclosing after a fault should not be done.

Before reclosure after a fault, it should be determined that it is safe to reclose and in particular no personnel or external parts of machinery are in contact with electrical conductors.

4.8.3.12 FIT FOR PURPOSE MACHINERY CONTROL CIRCUITS AND SYSTEMS

Many control circuits for fixed equipment such as processing plants, conveyors, stackers, reclaimers and the like are powered from sources of electricity that are greater than extra low voltage. Many of these circuits are located in wet and hazardous environments, it is essential that devices and cable connections have the correct IP rating and that IP rating is maintained. To minimise the risk of electric shock from these types of circuits, a number of alternative risk controls can be used.

- Replace the circuits with extra low voltage circuits.
- Fit sensitive earth leakage protection to detect earth faults and automatically switch off the supply of electricity before operators

receive an electric shock from the devices in the circuit.

- Implement a rigorous maintenance program that ensures the circuit and device IP ratings are maintained and that moisture and/or dirt can not ingress the devices and cables.

Many types of machines are very complex and are controlled by plc's and computers. These control systems should be designed in accordance with AS/NZS 61508 and AS 4024.

Remote control

Remote control machinery should be designed and operated in accordance with AS/NZS 4240.

4.8.3.13 CLASSIFICATION OF HAZARDOUS AREAS

Hazardous areas can occur where flammable gases/vapours are present and where flammable dusts are present in clouds or in layers. Hazardous areas should be identified and classified in accordance AS/NZS 2430.

4.8.3.14 FIT FOR PURPOSE ELECTRICAL EQUIPMENT IN HAZARDOUS AREAS

Electrical equipment located in hazardous areas should be explosion protected and certified as such. AS/NZS 2380, AS/NZS 60079 and AS/NZS 2381 for the construction of electrical explosion protected equipment and the selection, installation and maintenance of electrical explosion protected equipment should be applied to hazardous area equipment.

4.8.3.15 MAINTENANCE OF ELECTRICAL EQUIPMENT AND SYSTEMS

Maintenance should be conducted within the framework of a maintenance management system. Electrical installations should be maintained in order to locate deficiencies in the installation and so prevent electric shock and burns, explosions, fire and unintended operation of machinery and equipment.

Inspection and testing requirements

Inspections and testing of electrical installations should be carried out so that the following matters are dealt with.

- The possibility of electric shock from direct contact is prevented. This can be done by ensuring that exposed electrical conductors are maintained out of reach on structures or enclosed.
- The possibility of electric shock from exposed conductive parts, or extraneous conductive parts due to insulation failure between them and live parts, should be minimised by ensuring that both circuit protection and the protective (earthing) circuits are functionally adequate.
- The possibility of explosion or fire should be minimised by ensuring that any observed overheating is eradicated and that provisions made in the form of protection and/or construction for containment of arcing faults and/or fires are adequate.
- The possibility of spread of fire should be minimised by ensuring that the provisions made for containment and fighting of fires are adequate.
- The possibility of malfunction of protection and control equipment, used for control of critical machinery, should be minimised by ensuring their correct function.
- Establish the possibility that any alterations or additions to the installation might have altered any of the original design parameters (fault level, enclosures etc) and hence need attention.
- Electrical protection settings of circuit breakers, fuses, relays etc are correct and functioning. The main areas of concern are ensuring that electrical protection devices: are set correctly. operate to specification and operate only when there is a fault. Generally the settings of electrical protection should only be determined by a competent electrical engineer, the setting/adjustment of the electrical protection should be checked regularly by a competent electrical tradesperson or engineer. Electrical protection devices should be periodically tested to ensure they operate within their specification. This is normally done by specialist electrical testing

engineers, using what is commonly termed as injection test methods.

Inspection and testing frequency

Inspection and testing of equipment and their connecting cables should be carried out at the time of installation and then at regular intervals thereafter. The length of the time interval between inspections and tests should be determined on the basis of deficiencies found, work environment and mode of operation.

The use of condition monitoring can be used for determining maintenance actions.

Inspection and testing

Inspection testing and any corrective maintenance of equipment should be carried out considering requirements of AS 3007 and AS/NZS 3000; the particular equipment standard; and with consideration of the equipment manufacturer's recommendations.

Further guidance regarding inspection and testing of switchgear and ancillary items can be obtained from AS 2467 and AS 1883.

Guidance for inspection and testing of earthing installations may be obtained from:

- Substation Earthing Guide – 1995, Electricity Supply Association Australia;
- Electricity Council of New South Wales publication EC5 Guide to Protective Earthing;
- Institute of Electrical and Electronic Engineers (American) Standard 80 Guide to Safety in Substation Grounding; and
- AS 1768, – 1991 Lightning Protection

Details of inspection and testing of smaller installations can be obtained from:

- AS/NZS 3017, – 2001 Electrical Installations; and
- AS/NZS 3760, – 2001 Inspection and Testing of Electrical Equipment.

Further information with particular reference to inspection and testing of overhead line distribution systems can be obtained from the following Electricity Council of New South Wales publications:

- EC1 Guide for Maintenance of Protection Devices for Sub-transmission and Distribution Overhead Lines;
- EC3 Guide for Tree Planting and Maintaining Safety Clearances near Power Lines;
- EC4 Guide to the Inspection of Overhead Lines;
- EC8 Guide to the Inspection Assessment and Preservation of Wood Poles; and
- EC10 Procedures for the Aerial Inspection and Patrol of Overhead Lines.

4.8.3.16 MANAGEMENT OF ELECTRIC SHOCK

Effects of electricity on the human body

It is generally known that the human body depends for its survival on oxygen being brought to the brain. The oxygen, inhaled into the lungs by breathing, is extracted from the air, passes into the bloodstream and is pumped, by the heart, throughout the body, including the body's nerve centre, the brain. Should the brain be starved of oxygen for any length of time (generally in excess of two minutes), then rapid irreversible deterioration of its functions will occur and death will set in very shortly afterwards.

Life is therefore sustained by two important body functions:

- breathing (expiration); and
- heartbeat (blood circulation).

Should there be a failure of any one of them, life will be in danger.

There are various degrees of electric shock which range according to their effect, from a mild sensation (tingle) to severe shock, resulting in death. Electricity needs to be treated with respect at all times.

In case of electric shock electricity affects the human body (not counting the actual burning of the tissues in some cases of severe shock) by interfering with the minute electrical impulses which travel through the body's nervous system and control the muscles, ensuring breathing and heartbeat.

The degree of interference with a muscular function by an electric shock depends on the amount of current passing through the nerves affecting it. This means that electric shocks where the current flows through the head (affecting the brain), or through the chest (affecting heartbeat and breathing) are more dangerous than when the same magnitude of current would flow only through some extremity of the body, say between fingers of the same hand or foot to another.

While breathing can cease after an electric shock due to a block in the central nervous system, the heart will go into the so-called state of "ventricular fibrillation". This is the condition where the electrical impulses controlling the regular heartbeat have been thrown into confusion and the individual heart-muscle fibres contract out of step with each other instead of making a concerted effort (regular heartbeat). The heart, instead of contracting at regular intervals to pump blood, simply quivers (flutters) and any pumping activity ceases.

There have been several well reported cases where arrhythmias have developed many hours (8–12) after a significant shock. Other delayed effects have been well reported in the medical literature over the past 25 years or so; these include:

- muscle tissue coagulation and necrosis (death of the muscle cells);
- blood vessel changes;
- nerve damage;
- liver enzyme changes, and
- kidney damage.

These complications are rare, but very serious, and can lead to death if not treated promptly.

Degrees of electric shock

The current will normally take the shortest path within the body from the point of entry to the point of exit. It will take the path of least electrical resistance. This resistance, which is made up of the contact resistance between the skin and the "live" conductor and the body resistance, varies between very wide limits. It could be as low as 1,000 ohms (wet sweaty skin conditions), but could be as high as a few hundred thousand ohms. The current obeys Ohm's Law which means that current flow is directly proportional to the voltage; the higher the voltage, the higher the current. While it is not possible to state any "safe" voltage, electricity codes and rules generally consider that only a negligible hazard exists at extra – voltages.

The magnitude and the effect of an electric shock depends on the current passing through the body. It is generally accepted, on the basis of a large number of investigations, that electric currents of the following magnitudes will generally cause the effects shown below. The currents are expressed in milli-amperes (mA) or 1/1,000th of one ampere.

1–2 mA	Limit of perception, the smallest current it is normally possible to detect.
2–8 mA	The sensation becomes more painful.
8–12 mA	Painful muscle spasm sets in.
12–15 mA	This is the limit of being able to "let go" – muscles will no longer obey voluntary commands. For example, it will not be possible to release the grip around a live conductor, the muscles being "frozen" stiff.
20–50 mA	Such current, if passing through the chest, will interfere with, and possibly stop, breathing.
50–100 mA	If passing in the vicinity of the heart, such current will cause ventricular fibrillation.
100–200 mA	Such current will stop the heart.
Above 200mA	Severe burns.

It must be pointed out that duration of the shock is of some significance: the longer the exposure to shock, the smaller is the victim's chance of recovery.

More information on delayed effects of shock can be found in :

Jensen, P (1987): "Electrical Injury Causing Ventricular Arrhythmias", British Heart Journal Vol 57, No3, pp 279 – 283 and AS 3859.

Electric shock protocols

Electric shocks are potential life-threatening events. When a person receives an electric shock from a source above extra-low voltage professional medical attention should be sought immediately.

The potential harm from electric shock depends on the characteristics of the shock scenario and the characteristics of the victim. It would be inappropriate to expect non-trained employees or first aiders to make any judgement. For this reason, it is recommended that any employee who has sustained an electric shock should be escorted to hospital for medical assessment.

First aid management plans should include procedures to be followed in the event of an electric shock. The following issues should be addressed:

- procedures for freeing the victim from contact with live apparatus;
- securing the site to prevent injury to any other person;
- procedures for resuscitation, which should be incorporated into signs located at electrical distribution boards and switchrooms; and
- procedures for onsite first aid assessment of the victim, including base line monitoring, attention to burns or electrical penetration injuries etc.

Even where the victim appears to be recovered from the effects of the shock, there is still the risk of delayed onset cardiac arrhythmia.

First aid procedures should include making arrangements for immediate hospital assessment of the victim, including ECG and blood enzyme level tests. Electric shock victims should not be allowed to drive themselves home or to the hospital.

4.8.3.17 AN EXAMPLE – PREVENTING ELECTRIC SHOCKS

Mines, quarries and processing plants use electricity in large quantities, and often in difficult environments. Managers, engineers and maintenance personnel need to be able to recognise the barriers to electric shock so that they can review their effectiveness throughout the life cycle of the installation (design, commissioning, installation, operation, maintenance and decommissioning.)

How electric shock occurs

There are two main ways in which electric shocks are received.

- Direct Contact Occurs when a person makes contact with a live conductor.
- Indirect Contact Occurs when a person makes contact with the outer metal casing of electrical equipment, or some other metal structure, which has become live because of a fault condition in the equipment.

Other types of electric deserve consideration, (for example effects of lightning, static electricity, automotive ignition systems etc). However they tend not to be directly related to wiring systems.

Barriers to direct contact

There are various well-established barriers to direct contact documented.

- Insulation: The outer covering of cords or cables.
- Enclosures or barriers: Placing conductive parts inside enclosures.
- Obstacles: Fences around switchyards.
- Placing out of reach: Overhead aerial conductors
- Special Designs: For wet situations such as hose down areas.

The effectiveness of these barriers depends on a high degree of integrity, obtained through good design principles and proper maintenance practices. Effectiveness is supported by:

- The extensive use of warning signs and other awareness devices.
- Isolation procedures incorporating lockout/tagout measures.
- Establishment of operating areas, ie defined areas or enclosures that are accessible only to skilled persons, where access is managed through the use of locks.
- The proper use of test instruments.

These barriers are all prevention barriers. There are no measures designed to protect persons after direct contact has occurred. A residual current device (a sensitive earth leakage relay) is not a barrier to direct contact, but it may reduce the risk of electrocution.

Barriers to indirect contact

The philosophy for prevention of indirect contact begins with ensuring that all exposed metal parts are effectively connected to the general mass of earth. This means that when a faulty situation occurs, most of the current will be directed into the earth, significantly reducing harmful voltage. Fault currents are readily detectable by the disconnecting device, which is intended to remove power before a person can make contact with the faulty equipment. Ideally this device should be an earth leakage unit, which disconnects power in faulty circuits before high current flow. On some circuits, fuses and overcurrent circuit breakers can be used, however these may allow higher leakage currents to flow with an increased risk of fire and shock.

In the case of portable apparatus, (hand tools and the like) there is a high risk that the fault will occur while a person is actually handling the equipment, so the standards require a very sensitive and fast-acting disconnecting device to be employed. This is required to be a 30 milliamp residual current device (RCD). RCDs are required to be fitted to all circuits supplying sockets outlets (power points).

The identified barriers to indirect contact can be listed as follows.

- Earthing – All exposed metal parts connected to earth.
- Disconnecting device – A fuse, circuit breaker, earth leakage breaker or RCD.
- Double Insulated Equipment – Equipment designed so that it cannot become live.
- RCD – Sensitive fast–acting device for socket outlets.
- Circuit Design – Conductor sizes and lengths selected to ensure harmful voltages can't appear on earthed metal parts, and that earth faults are detected and switched off.

Special situations

Certain situations increase the risk of electric shock and also increase the severity. These are generally associated with the presence of water and frequently occur in mining and mining support operations.

Electrical equipment is readily available for these situations through the use of Ingress Protection rating (IP rating). Electrical equipment in hose down areas, for example, must have a rating of at least IPX5, which means it is capable of withstanding jets of water directed at it at all angles without failure.

Ensuring electrical installations are safe

Design, installation and commissioning to Australian Standards

This ensures the barriers are in place. Any new installation, addition or modification should be designed, installed and commissioned in accordance with the current Australian Standards. The project specification should nominate the relevant Australian Standards, and the means by which the provider will demonstrate that Standards compliance has been delivered.

Maintenance/testing

This ensures that the barriers remain in place and are effective. Each of the barriers to electric shock should be inspected, maintained and tested to ensure they are effective. Maintenance personnel need to be familiar with the requirements of the current Australian Standards, to the extent that any compromise in a barrier is noticed, prompting reporting and programming of rectification work.

The barriers to direct contact (insulation, enclosures, obstacles and out of reach) can fail gradually, and loss of protection may not be noticed by the casual observer.

Insulation can be degraded over time by the effects of sunlight, metal enclosures can rust, fences gradually deteriorate, and clearance under power lines can be altered by build-up of ground level, sagging lines etc. Accurate reporting of the condition of electrical plant can allow maintenance managers to budget for rectification in a timely manner.

The barriers for indirect contact (earthing, disconnecting devices, RCDs) can be confirmed by implementing a rigorous testing regime. Circuit designs need to be checked at the time of installation, and reconfirmed after every modification. Routine independent auditing will not only bring fresh eyes to an operation, but help to keep maintenance managers abreast of changing standards.

Competence

When engaging people to carry out electrically oriented tasks, whether it be system design or plant maintenance, make sure that only people possessing the necessary competencies are considered.

A 10 point check-up on your electrical safety health

1. Are regular risk assessments conducted for the purposes of preventing electric shock?
2. Has your site been audited recently to the latest electrical standards?
3. Are your maintenance personnel well-acquainted with the requirements of the latest standards?
4. Have your maintenance activities been reviewed recently to see if you are inspecting for compliance with Australian Standards?
5. When electrical systems are modified, are they assessed for Australian Standards compliance?
6. Before modified electrical systems are put into service, do they undergo the commissioning as described in AS 3000: 2000?
7. Is there a thirty milliamp RCD protecting EVERY socket outlet?
8. Does all electrical apparatus in general hosing down zones and other damp areas have at least an IPX5 rating?
9. Are all enclosures with exposed live parts locked to non-skilled persons, and fitted with appropriate warning signs and labels?
10. Do your safe work procedures demand the use of a non-contact tester before working on conductors EVERY TIME? Do your supervisors rigidly enforce this?

4.8.4 COMPRESSED AIR AND COMPRESSED AIR EQUIPMENT

4.8.4.1 AIR COMPRESSORS USED UNDERGROUND

Any compressor which compresses air, used underground in a mine, should be designed, constructed, operated, regularly tested and maintained so that:

- air entering the compressor is not contaminated by pollutants and is as dry, clean and cool as practicable;
- only high-quality mineral oil or suitable synthetic oil, having a flashpoint as specified by the statutory authority, should be used for lubricating the compressor;
- services should be supported from properly secured fastenings, which should not be used for any other purpose, and the number of fastenings should be adequate;
- services hung in haulage and travelways (including ladderways) should be installed in such a manner to provide for adequate clearance for persons and equipment;
- pipelines should be connected by approved couplings; and
- no repairs should be carried out while any service is under pressure.

4.8.5 RADIATION

4.8.5.1 GENERAL

A range of sources including rocks, soil, water and fossil fuels give off low levels of ionising radiation. However, in mines, radiation should be monitored and exposure kept in recommended levels where people are:

- exploring, mining and milling radioactive ores;

- rehabilitating mine sites and tailings associated with radioactive ores; or
- working near fixed radiation gauges.

Ultraviolet radiation from the sun or welding arcs is another type of radiation which must be controlled, particularly for employees of above ground mines.

4.8.5.2 RADIATION GAUGES

Radioactive gauges measure radiation levels by monitoring density of slurries or thickness of materials.

Gauges should include a radiation source housed in a container, controls and a source detector. They should be securely fastened to rigid supports and focussed in a specific direction and locked into position.

4.8.5.3 INSTALLATION

Only those licensed are permitted to sell, install or service fixed radioactive gauges.

Only those as Radiation Assessors (Fixed Radiation Gauges) are permitted to assess fixed radioactive gauges for compliance with legislation and suitability for registration.

Radioactive gauges must conform with standard quality assurance programs.

Gauges must be maintained and checked regularly.

General managers installing fixed radioactive gauges should consult all documents listed in the reference list at the end of this chapter. The two most important documents governing installation are:

- Code of Practice for the Safe Use of Radiation Gauges (1982), National Health and Medical Research Council; and
- Guideline – Recommendations for Minimum Standards and Safety Requirements for Fixed Radiation Gauges (Sealed Radioactive Sources) March 1995, EPA.

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4.8.5.4 ULTRAVIOLET RADIATION

Description

Ultraviolet (UV) radiation is a form of electromagnetic radiation, like radio waves, X-rays and light. It is also sometimes called ultraviolet light. On the electromagnetic spectrum, UV radiation comes between visible light and X-rays. That is, its wavelengths are shorter than the wavelengths of the light and longer than those of X-rays. It is divided according to its effects on living tissue into three wavelengths bands: UV-A, UV-B and UV-C.

Sources of UV radiation in the workplace include various kinds of welding arcs and UV lamps. The sun is the main source of UV radiation out of doors.

Exposure to Solar Radiation

Although exposure to small amount of UV radiation can have beneficial effects, such as vitamin D synthesis in the skin, overexposure can cause serious acute (short-term) and chronic (long-term) health effects.

Short-term exposure to the sun

Effects on the skin

The effects of sunburn include reddening of the skin, blistering, swelling and, later, peeling of the skin. Untanned skin, exposed to the summer sun between 10.00 am and 2.00 pm EST will show:

- mild sunburn within 12 minutes;
- appreciable discomfort within 30 minutes;
- peeling and blistering in 60 minutes; and
- permanent damage after 120 minutes.Effects on the eye

Prolonged exposure to solar UV radiation can cause short term effects such as photoconjunctivitis and photokeratitis. Photoconjunctivitis is an inflammation of the conjunctiva (the mucous membrane covering the anterior portion of the eye). Photokeratitis is an inflammation of the cornea.

Symptoms of these complaints include a painful sensation in the eyes, excessive blinking and tears, the sensation of a foreign body in the eyes, difficulty in looking at strong lights, and swelling of the eyes. The effects are apparent within a few hours and usually disappear within two days. Permanent damage is rare.

Some industrial chemicals can cause photosensitisation of the eyes, for example, exposure to some coal tar derivatives can damage the outer surface of the eye.

Long-term exposure to the sun

Effects on the skin

In the longer term, repeated exposure to the sun can result in keratoses, skin cancers, premature skin ageing and injuries to the eye.

Keratoses

- Keratoses, sometimes called sunspots, are dry, rough, firm spots on the skin. Like premature aging, they are indicators or prolonged exposure to solar UV radiation. Keratoses very occasionally develop into cancers.

Skin cancers

There are three main types of skin cancers in Australia:

- Basal cell carcinoma (BCC) – This is the most common, but least dangerous type of skin cancer. They are usually found on the face and neck. BCCs first appear as small, round or flattened lumps which are red, pale or pearly in colour and may have blood vessels over the surface. If untreated, they will continue to spread into surrounding tissue, eventually breaking down to form ulcers.
- Squamous cell carcinoma (SCC) – This skin cancer is less common, but more dangerous than BCC. Caused by sunlight, this cancer can occur on the lips, particularly the lower lip. SCCs are characterised by scaling and red areas that may bleed easily and become ulcerated. Very occasionally, SCCs may spread to the lymph nodes.
- Melanoma – This is the least common, but most dangerous skin cancer. This cancer usually starts as a new spot, freckle or mole on the skin that changes in colour, thickness or shape over months. Melanomas occasionally occur in parts of the body other than the skin, such as the eye and mouth. Melanomas can be dark brown to black, red or blue/black or a combination of colours with an irregular outline or shape. Melanomas can also develop in preexisting moles, particularly those which have irregular borders and variable shades of black and other colours. People who have many moles of this type, as well as individuals with Dysplastic Naevi Syndrome (a rare familial condition, presenting as numerous brown moles over the body), seem to have a higher risk of developing melanoma. Melanomas can spread to internal organs and cause death if not detected and removed promptly.

Effects on the eye

- Long-term effects of prolonged exposure to solar UV radiation include damage to the cornea, formation of cataracts and pterygia. Cataracts are opacities of the lens of the eye. Pterygia are wing/shaped growths of the tissue on the outside of the eye. They can grow over the cornea of the eye and cause symptoms of mild conjunctivitis.

Control methods for solar radiation

Consideration may be given to simple reorganisation of outdoor work programs, and to the opportunity to undertake alternative tasks when the sun is most intense. The provision of canopies and shade covers should be considered..

The use of personal protection is an important component in the solar UV radiation control strategy.

It is also important to ensure that the use of personal protection itself does not create a secondary hazard to the worker. For example, loose clothing worn near outdoor machinery, such as a post hole digger/auger, may constitute a secondary hazard. Heat stress may also be a secondary hazard when wearing some types of protective clothing and performing heavy manual labour.

Over-reliance on only one form of personal protection should not be encouraged, for example, the use of a hat and a sunscreen together is preferable to the use of a sunscreen alone.

Clothing

- Most clothing provides personal protection for screening out solar UV radiation. The selection of appropriate clothing must take into account both the need to screen out solar UV radiation and the need for coolness in hot conditions. The key features to look for when selecting clothing are:
  - tightness of weave or knit;
  - permeability of the material to assist the evaporation of sweat; and
  - design.
- Loose-fitting clothing allows air to circulate. Cuffs, ankles and waist bands should be loose. Long-sleeved shirts with collars worn with long trousers are preferred, if comfortable to wear. Shirts are best worn outside trousers to increase ventilation, providing care is taken to ensure that this does not place the worker at greater risk of injury.
- The tighter the fabric weave or knit, the less solar UV radiation reaches the skin. However, tightly woven fabrics provide more protection at the cost of being warmer. Impermeable materials, such as some disposable overalls with plastic linings, do not allow sweat to evaporate and will increase the risk of heat stress in certain circumstances. Cotton fabrics, which tend to be tightly woven, usually offer better protection than synthetics. In addition, cotton, because it assists sweat evaporation, is more comfortable to wear than fully synthetic fabrics. Light-coloured fabrics are cooler to wear because they reflect the heat.

Hats

- Hats provide shade and the bigger the brim, the greater the amount of shade that is provided. For adequate head and face protection, hats with brims of at least 8 centimeters should be worn. Foreign Legion-style caps, with loose flaps to protect the neck and ears, are also effective.
- Where practicable, hard hats and other protective hats should be fitted with broad brims. Attachable brims and neck flaps are available for this purpose. Due to their size, the wearing of wide brimmed hats may cause difficulties in some circumstances. In such cases, the safety function of the hat should take precedence over protection from the sun. Sunscreens and other protective measures should be used instead
- Hats with wide brims will not protect against solar UV radiation reflecting from shiny surfaces.

Sunscreens

- Sunscreens should be selected in accordance with the skin type and working conditions of the user. Broad-spectrum sunscreens provide protection against UV-B rays and some UV-A rays. A water-resistant sunscreen may be suitable for some types of work. Sun protection factors (SPFs) are based on AS/NZS 2604, – 1998 Sunscreen Products – Evaluation and Classification. The higher the SPF, up to a value of 15+, the greater the protection. However, the SPF value only relates to the reddening of the skin caused by one part of the UV spectrum (UV-B). Therefore, it is a wise precaution to use a high SPF broad-spectrum sunscreen that will block a greater range of the UV spectrum, not just the part that causes this effect.
- No sunscreen provides a complete protection. For example, a SPF of 15+ filters out 94 per cent of solar UV radiation. Therefore, hats, clothing and other protective measures should always be used in addition to a sunscreen.
- Sunscreens are best applied to dry skin at least 15 minutes before the start of any outdoor work. Sunscreens are more effective if they are wiped on, rather then being rubbed into the skin. Reapply sunscreens every two hours. In hot conditions, when sweating is profuse, reapply the sunscreen more frequently as the sweat will wash off the previous application. The effectiveness of any sunscreen depends on its correct use. Too much sunscreen can reduce sweating and cause heat stress, and too little may not provide protection. Always read the instruction on the label to ensure correct use.
- Sunscreen selection should take into account whether the user is working in dusty conditions. Use of an oil-based sunscreen will increase the risk of dust adhering to

the skin, thereby giving rise to a secondary hazard if the dust is of hazardous nature. In such situations, a sunscreen with an alcohol or vanishing cream base can be used. Manufactured dusts, such as cement powders, may present problems on skin contact. Consult the Material Safety Data Sheet for the relevant dust to see if there is a health risk.

- The possibility of hypersensitivity and allergies to sunscreens cannot be excluded, and any history of individual reaction or preference for a particular type of sunscreen should be taken into account. Rather than not wearing a sunscreen under such circumstances, another sunscreen type should be used.
- Adequate supplies of sunscreen should be maintained at any outdoor work location. Bracket-mounted pump-packs of sunscreen are available from some suppliers, and can be mounted in change rooms, near time clocks or in vehicles. Simple preparations, such as zinc cream (SPF 15+), will provide economical protection to essential areas such as the nose, lips and top of the ears. Zinc cream must be applied thickly but cannot be used on large areas of the body because it prevents sweat evaporation in hot conditions. This can be used as a base for any coloured cosmetic lipstick they may use. Opaque, coloured lipsticks may provide some lip protection. In the case of men, a moustache can add to the protection that a sunscreen provides. Shading from broad-brimmed hats will also contribute to lip protection.
- Lip protection is very important as lips do not contain melanin which provides natural protection. Lip cancer from prolonged exposure to sunlight is common in outdoor workers. To avoid damage by solar UV radiation, lips should be protected with an SPF 15+ sunscreen or a lipstick which has an SPF 15+ rating.

Eye protection

- Eye protection from solar UV radiation is recommended, particularly in highly reflective environments. Where eye protection is required, two issues should be considered – safety and health.
- Where safety is the over-riding concern, glasses which comply with Australian Standards AS 1337 Eye Protectors for Industrial Applications are recommended. This standard includes tinted and untinted protectors which afford UV protection.
- Where health (for example, protection from cataract formation) is the over-riding concern, sunglasses designated as specific purpose type (b) in Australian Standard AS 1067.1 Sunglasses and Fashion Spectacles – Part 1: Safety Requirements may be worn.

4.8.5.5 EXPOSURE TO WELDING ARCS

Welders flash, also known as arc-eye and snow-blindness (medical name: photokeratoconjunctivi tis).

This is a painful irritation of the cornea and the conjunctiva (the membrane connecting the eyeball with the inner eyelid).

There is a feeling of sand in the eye and sensitivity to light. UV-B is most effective in causing this sunburn of the eye. The eye is more sensitive than the skin to UV radiation because it lacks the skin's horny outer layer and protective pigment.

Symptoms appear from six to 24 hours after exposure and usually disappear within the following 48 hours. No permanent damage to the eye results unless a severe exposure has occurred.

4.8.6 GASES AND STEAM

4.8.6.1 COMPRESSED GASES

Installations generating and using steam should be installed, designed, repaired and used to safeguard persons from danger or burning as a result of loss of outburst of steam or heated water.

4.8.6.2 LIQUID PETROLEUM GAS

The supply, storage and use of LPG or natural gas on the surface of a mine should be in accordance with relevant Dangerous Goods Legislation.

This material is widely used throughout the mining industry. Hazards arise as a consequence of the potential for fire or explosion, rather than health effect risks.

LP gas (also known as LPG) should not be used below ground, except for special short-duration applications. In such applications, procedures are required to minimise the risk of leakage.

LP gas cylinders should not be refilled below ground given the problems associating with leakage.

REFERENCE DOCUMENTS

Environment Protection (Nuclear Codes) Act 1978 (Commonwealth).

Code of Practice for the Safe Use of Radiation Gauges (1982) National Health and Medical Research Council.

Code of Practice for the Near – Surface Disposal of Radioactive Waste in Australia (1992) National Health and Medical Research Council.

National Standard for Limiting Occupational Exposure to Ionising Radiation, National Health and Medical Research Council.

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Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores 1987 (Commonwealth).

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AS/NZS 3000: 2000 Wiring Rules.

AS 3007: 1987 Electrical Installations – Surface Mines and Associated Processing Plant.

AS/NZS 4836: 2001 Safe Working on Low – Voltage Electrical Installations.

IEEE Std 902 – 1998, IEEE Guide for Maintenance, Operation, and Safety of Industrial and Commercial Power Systems, Institute of Electrical and Electronic Engineers, 1998.

4.9 VIBRATION

4.9.1 INTRODUCTION

Workers who drive tractors, trucks, buses or earth-moving equipment are exposed to whole body vibration. Piles, heart disease and backache can result from rough rides in poorly-suspended vehicle cabins and seats.

Workers operating hand-held machinery may suffer, particularly in cold climates, from the vibration syndrome, typified by aches in arms and shoulders, loss of nerve conduction and vibration white finger. This condition, also known as dead finger, can lead to gangrene in hands and fingers. Similarly, workers using pneumatic chipping hammers, rivet machines, pneumatic rock drills and chainsaws, may experience vibration white finger and vibration syndrome.

The rapid motion of an object such as a pneumatic drill, chainsaw, tractor seat, or the seat of mining or earth-moving equipment causes vibration.

Vibration can cause permanent damage to health including:

- bone damage, rubbing of bones and joints causing inflammation, especially along the backbone;
- stomach and digestive problems from shaking of organs and the abdominal cavity;
- heart problems, varicose veins, varicocele and piles due to constant variation in blood pressure; and
- disruption of the nervous system resulting in weakness, fatigue, loss of appetite, irritability, headache, insomnia and impotence.

The extent of damage vibration causes to the human body depends on:

- the length of time a worker is exposed;
- the frequency rate at which the surface or implement vibrates, measured in vibrations per second or Hertz (Hz); and
- the amplitude of vibration which is measured in terms of displacement – metres (m); velocity – metres per second (m/s); and acceleration – metres per second per second (m/s^2).

4.9.2 TYPES OF VIBRATION AND EFFECTS

Different types of vibration affect different parts of the body:

Whole-body vibration (WBV) occurs when a worker is shaken up and down (vertically), side to side (transversely) or back to forth (linearly). Employees in driving cabins or standing near machinery can experience this type of vibration.

Very low-frequency whole-body vibration (less than 1 Hz) can cause motion sickness for drivers.

Low-frequency whole-body vibration (1 Hz to 80 Hz) can cause nausea, blurred vision and giddiness.

Hand-arm vibration (also known as vibration white finger [VWF] or dead finger) occurs in hands and arms, when using tools such as chainsaws, chipping hammers or pneumatic drills.

- The first signs of vibration white finger are tingling or numbness in the fingers after work. As exposure increases, fingertips nearest the source of vibration turn white and stay like that for an hour or more. A “pins-and-needles” pain develops as circulation returns. Attacks can occur outside working hours and can be triggered by touching cold objects.
- After prolonged exposure, the whiteness can spread to the whole hand and fingers may become permanently damaged or gangrenous and require amputation.
- There is no cure for vibration white finger.

4.9.3 CONTROLLING VIBRATION EXPOSURE

4.9.3.1 GENERAL

Mine operators should:

- conduct surveys to identify vibration in work sites;
- develop strategies to control vibration;
- use survey findings to establish vibration limits for:
  - whole-body vibration transmitted through supporting surfaces; and

  - vibration white finger affecting hand and arms as a result of using portable tools;
- review vibration limits regularly and in the light of new strategies for prevention, scientific knowledge and technical progress.

4.9.3.2 TARGETS FOR VIBRATION LIMITS

In the absence of vibration limits:

- reduce vibration to the lowest level technically feasible;
- where whole-body vibration (WBV) occurs, ensure employees are not exposed to an acceleration of amplitude greater than $0.63 m/s^2$ over an eight-hour period;
- where very low-frequency vibration (motion sickness) occurs, ensure employees are not exposed to an acceleration of amplitude greater than $0.25 m/s^2$ over an eight-hour period; and
- where vibration white finger and hand – arm vibration occur, ensure employees are not exposed to an acceleration of amplitude greater than $1.0\ m/s^2$ over a four-hour period.

4.9.3.3 VIBRATION MEASURING EQUIPMENT

Vibration measuring equipment includes:

- a transducer or pick-up;
- an amplifying device (electrical, mechanical or optical); and
- an amplitude or level indicator or recorder.

Networks may be added to electric instruments to:

- limit frequency range of equipment; and
- apply recommended frequency range to input signals.

A root mean square (RMS) device is a rectifying device that directly reads or records vibration values.

4.9.3.4 CONTROLLING VIBRATION HAZARDS

Whole-body vibration can be controlled or reduced with vibration damping in vehicles and by ensuring vehicles are properly constructed by supervising vehicle design.

- Heavy earth-moving equipment should be designed to include:
  - isolated cabs;
  - pilot–operated controls;
  - power steering;
  - suspension systems or cushion hitch; and
  - suspension seats.
- Suspension seating should include:
  - seats that can be adjusted from left to right;
  - adjustable seat arm rests and back supports;
  - spring-mounted suspension including shock absorbers; and
  - seats that can be adjusted according to weight.

Vibration white finger and associated illnesses that occur when using portable tools or established machines should be minimised.

- Reduce vibration from pneumatic tools with:
  - differential pistons to alleviate arm pressure on tool operators;
  - recoil damping and air cushioning to soften vibration; and
  - padded handles to reduce transmission.
- Reduce vibration from chainsaws with:
  - anti-vibration chainsaws;
  - fitted spring grips; and
  - rubber shock absorbers.

- Reduce vibration from established machines (grinders, lathes, presses), with:
  - heavy base mounting;
  - insulated mountings; and
  - sinking machines into insulated pits.

4.9.3.5 VIBRATION CONTROL STRATEGY FOR MANAGEMENT AND EMPLOYEES

Management and employees should:

- develop a joint statement of aims to eliminate vibration-induced disease;
- set a target for maximum vibration levels;
- consult before introducing new equipment;
- conduct vibration surveys at all work sites;
- consider implementing engineering solutions to problems pinpointed in surveys;
- establish "vibration danger areas" and "vibration danger tools" where job rotation and regular work breaks can be practised;
- label or designate all vibration hazard processes and equipment and develop safe working practices;
- carry out and record regular vibration monitoring;
- keep medical monitoring records;
- provide information on vibration occurrence and its hazards in the work site; and
- teach new staff how to avoid vibration and update long-time employees.

REFERENCE DOCUMENTS

AS 2670, Evaluation of Human Exposure to Whole Body Vibration.

AS 2763 – 1988, Vibration and Shock – Hand–transmitted Vibration – Guidelines for Measurement and Assessment of Human Exposure (ISO 5349).

AS 2973 – 1987, Vibration and Shock – Human Response Vibration-measuring Instrumentation.

AS 2993.1 – 1987, Vibration and Shock – Dynamic Characteristics of the Human Body: Driving Point Impedance of the Human Body. (ISO 5982).

AS 3658 – 1989, Vibration and Shock – Mechanical Vibration and Shock Affecting Humans – Vocabulary (ISO 5805).

ISO/DIS 8662 – 1995, Hand – Held Portable Power Tools – Measurement of Vibrations at the Handle. (Parts 7, 10 and 13).

ISO/DIS 9996 – 1995, Mechanical Vibration and Shock – Disturbances of Human Activity and Performance: Taxonomy.

ISO/DIS 10819 – 1995, Mechanical Vibration and Shock – Hand and Arm Vibration: Measurement and Evaluation of the Vibration Transmissibility of Gloves.

ISO/DIS 10227-1 – 1995, Human/Human Surrogate Impact (Single-shock) Testing and Evaluation.

4.10 NOISE

4.10.1 INTRODUCTION

Sound is what we hear. Noise is unwanted sound. The difference between sound and noise depends upon the listener and the circumstances. Rock music can be a pleasurable sound to one person and an annoying noise to another. In either case, it can be hazardous to a person's hearing if the sound is loud and if he or she is exposed long and often enough.

4.10.2 MEASURING NOISE LEVELS

Measuring noise levels and workers' noise exposures is the most important part of a workplace hearing conservation and noise control program. It helps identify work locations where there are noise problems, employees who may be affected and where additional noise measurements need to be made.

4.10.2.1 NOISE SURVEYS

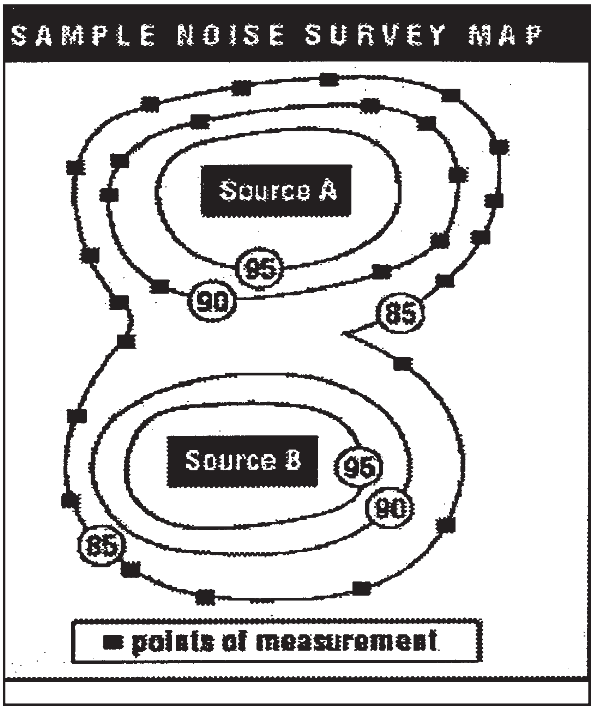
Noise surveys are conducted in areas where noise exposure is likely to be hazardous.

A noise survey involves measuring noise levels at selected locations throughout an entire plant or in workplaces underground to identify noisy areas. This is usually done with a sound level meter (SLM). Noise level measurements are taken at a suitable number of positions around the area and are marked on a sketch. The more measurements taken, the more accurate the survey. A noise map can be produced by drawing lines on the sketch between points of equal sound level. Noise survey maps, provide very useful information by clearly identifying the limits of areas where there are noise hazards.

Noise surveys permit the identification of:

- areas where employees are likely to be exposed to harmful levels of noise and personal dosimetry may be needed;
- machines and equipment which generate harmful levels of noise;
- employees who might be exposed to unacceptable noise levels; and
- noise control options to reduce noise exposure.

Figure 4.13 Sample noise survey map



Where noise levels are above 85 dB(A) a full investigation of the cause should be undertaken. The aim of the investigation in order of priority should be to:

- reduce the noise level to below 85 dB(A);
- designate high noise areas as "protective zones"; and
- provide appropriate hearing protective equipment as per AS/NZS 1269, – 1998 Occupational Noise Management. No person should be subjected to a noise level greater than 115 dB(A).

4.10.2.2 NOISE MEASURING INSTRUMENTS

Sound Level Meter (SLM)

The SLM consists of a microphone, electronic circuits and a readout display. The microphone detects the small air pressure variations associated with sound and changes them into electrical signals. These signals are then processed by the electronic circuitry of the instrument. The readout displays the sound level in decibels. The SLM takes the sound pressure level at one instant in a particular location.

To take measurements, the SLM is held at arm's length at the ear height for those exposed to the noise. With most SLMs it does not matter exactly how the microphone is pointed at the noise source. The instrumentís instruction manual explains how to hold the microphone. The SLM must be calibrated before and after each use. The manual also gives the calibration procedure.

With most SLMs, the readings can be taken on either slow or fast response, The response rate is the time period over which the instrument averages the sound level before displaying it on the readout. Workplace noise level measurements should be taken on slow response.

A standard SLM takes only instantaneous noise measurements. This is sufficient in workplaces with continuous noise levels. But in workplaces with impulse, intermittent or variable noise levels, the SLM makes it difficult to determine a personís average exposure to noise over work shift. One solution in such workplaces is a noise dosimeter.

Sound level meters (SLM) have four principal grades of precision as shown in the table below.

Table 4.1 Precision of sound level meters

TYPE/DESCRIPTION	TOLERANCE
0 – Laboratory reference meter	+ 0.4 dB
1 – Precision	+ 0.7 dB
2 – General purpose	+ 1.0 dB
3 – Survey	+ 1.5 dB

Noise assessments should be performed with Type 2 general purpose meters, or better. Type 3 survey meters are usually inexpensive but may have wide precision tolerances and some models cannot be calibrated. Type 3 survey meters are only suitable for preliminary noise checks to find out whether more accurate assessments are needed.

Integrated sound level meter (ISLM)

The integrating sound level meter (ISLM) is similar to the dosimeter. It determines equivalent sound levels over a measurement period. The major difference is that an ISLM does not provide personal exposures because it is hand-held like the SLM, and not worn.

The ISLM determines equivalent sound levels at a particular location. It yields a single reading of a given noise, even if the actual sound level of the noise changes continually. It uses a pre-programmed exchange rate, with a time constant that is equivalent to the slow setting on the SLM.

Noise dosimeter

Noise dosimeters can be worn by employees for a given period, for example, a working day. The dosimeters records the personal noise exposure of the employee. Some dosimeters are capable of recording a time-history of an employee's noise exposure for the measurement period. A typical time-history report will provide a histogram of minute-by-minute noise exposure levels. This is a great advantage in identifying major contributors to the average daily noise exposure which can then be further investigated with a hand-held meter.

The following points should be considered when using a dosimeter.

- Reflection of sound from the clothes and body can cause an increase of about 1–3 dB.
- The microphone should be attached as close as possible to the ear. Other inappropriate positioning of the microphone may give higher or lower results. For example, if the microphone is attached to the lower part of the collar or pocket, it may be much closer to a noise source than the ear and an unduly high result will be recorded. Also, the body may shield a noise source.
- The assessment of exposure over just one day may not give a representative sample. If possible, it is best to take measurements over a few days.

- It is advisable to check the dosimeter results with a hand-held sound level meter.
- Some dosimeters do not measure impulse sound adequately.
- Dosimeters should comply with Australian Standard AS 2399 (except that the crest factor should exceed 10 if used for impulse sound).
- All SLMs and ISLMs should comply with the specifications laid down AS 1259, – 1990 Acoustics Sound Level Makers.
- A full calibration of measuring systems should be performed at regular intervals not exceeding two years by a laboratory approved for the purpose.
- Meters should be checked with an acoustic calibrator immediately before and after the measurements.

A-weighted decibels

The sensitivity of the human ear to sound depends on the frequency or pitch of the sound. People hear some frequencies better than others. If a person hear two sounds of the same sound pressure but different frequencies, one sound may appear louder than the other. This occurs because people hear high frequency noise much better than low frequency noise.

Noise measurement readings can be adjusted to correspond to this peculiarity of human bearing. An A-weighting filter which is built into the instrument de-emphasises low frequencies or pitches. Decibels measured using this filter are A-weighted and are called dB(A). Legislation on workplace noise normally gives exposure limits in dB(A).

Noise levels in decibels for some commonly heard sounds are given in Table 4.2.

A-weighting serves two important purposes:

- gives a single number measure of noise level by integrating sound levels at all frequencies; and
- gives a scale for noise level as experienced or perceived by the human ear.

The decibel [dB, and also dB(A)] is dimensionless and is derived for intensity readings using a logarithmic scale. For mathematical calculations using dB units, we must use logarithmic mathematics where:

Intensity in decibels (dB)
= 10 log 10 (intensity 1/intensity 2)

Table 4. 2 Typical noise levels

NOISE	SOUND LEVELS (DBA)
May break a plate glass window	160
Threshold of pain	120
Pneumatic drill	100-120
Shovel (diesel)	107
Timber saw	100
Screens	95-100
Compressor	90-100
Cursher	90-100
bulldozer	85-106
FEL/dump truck	80- 95
City traffic	65- 75
Quiet office	50
Threshold of hearing	0

Table 4.3 Decibel (dB) basics

CHANGE IN DB	CHANGE IN SOUND ENERGY
3 dB increase	Sound energy doubled
3 dB decrease	Sound energy halved
10 dB increase	Sound energy increased by factor of 10
10 dB decrease	Sound energy decreased by factor of 10
20 dB increase	Sound energy increased by factor of 100
20 dB decrease	Sound energy decreased by factor of 100

However, in our day-to-day work we do not need such calculations.

The use of dB unit makes it easy to deal with the workplace noise level data provided we use a set of simple rules (Table 4.3).

Noise over time

Currently 85 dBA is set as the upper limit 8 hour dosage.

Noise dosage doubles with every 3 dBA increase in the sound level.

Therefore the time exposure to noise must be halved for every 3dBA increase, that is, if 85 dBA for 8 hours is OK then:

- at 88 dBA, exposure should only be 4 hours;
- at 91 dBA, exposure should only be 2 hours;
- at 94 dBA, exposure should only be 1 hour;
- at 97 dBA, exposure should only be 30 minutes; and
- at 100 dBA, exposure should only be 15 minutes.

(Every 10 dBA increase is equivalent to 10 times the noise level.)

Noise over distance

Sound pressure waves expand spherically and follow an inverse square law. If the distance is doubled the sound level is / of what it previously was. That is:

dB = 10 log 10 (4/1) = 10 x (0.602)

Consequently the reading drops 6 dB.

For example:

> A machine measured 97 dB(A) at 2 metres, so what is safe distance to stand from a machine without wearing earmuffs?

97 dBA was measured at two metres distance from the machine.

Hence:

91 dBA at 4 metres

85 dBA at 8 metres

79 dBA at 16 metres

73 dBA at 32 metres

Hence a recommended distance from the machine over an 8-hour period is 8 metres without wearing earmuffs.

Adding noise levels

Sound pressure levels in decibels (dB) or A-weighted decibels [dB(A)] are based on a logarithmic scale. They cannot be added or subtracted in the usual arithmetical way. If one machine emits a sound level of 90 dB, and a second identical machine is placed beside the first, the combined sound level is 93 dB, not 180 dB (Table 4.4).

Step 1:

Determine the difference between the two levels and find the corresponding row in the left hand column.

Table 4.4 Addition of decibels

NUMERICAL DIFFERENCE BETWEEN TWO NOISE LEVELS [DB(A)]	AMOUNT TO BE ADDED TO THE HIGHER OF THE TWO NOISE LEVELS [DB OR DB(A)]
0	3.0
0.1 – 0.9	2.5
1.0 – 2.4	2.0
2.4 – 4.0	1.5
4.1 – 6.0	1.0
6.1 – 10	0.5
>10 (ignore second sound source)	0.0

Step 2:

Find the number [dB or dB(A)] corresponding to this difference in the right hand column of the table.

Step 3:

Add this number to the higher of the two decibel levels.

4.10.3 CONTROLLING NOISE EXPOSURE

4.10.3.1 GENERAL

Noise-related illnesses are the most common health risks for miners.

General managers should determine conditions and sites in which hearing devices must be worn in mines.

A hearing protection device should conform with AS 1270 Acoustics – Hearing Protectors.

Mine owners should:

- supply staff with hearing protection devices; and
- ensure employees, contractors and visitors maintain hearing protection devices.

4.10.3.2 ENGINEERING NOISE CONTROL

The best form of protection is the reduction of noise to an acceptable level at the working place.

Noise control is an engineering problem and it requires the services of experts to reduce the noise output from a machine by redesigning it or installing acoustic covers and barriers.

4.10.3.3 USE OF EAR PROTECTION

Personal hearing protection should be used only where technical or economic considerations prevent the reduction of noise to below the levels prescribed. The function of the hearing protection device is to reduce the amount of noise reaching the inner ear of the wearer by covering the ear, covering the entrance to the ear, or blocking the ear canal with an ear plug.

The devices used by individuals must suit them personally and be appropriate to the working environment. There are many forms of ear protection available, but most fall into the following categories.

4.10.3.4 REDUCTION OF EXPOSURE TIME

In some cases it is possible to have employees in sound-proof enclosures to perform certain tasks in order to shield them from a particular noise by means of barriers or baffles. However, in many situations this cannot be done; where the noise approached the set limit, an arrangement of tasks should be made for individuals so that they are not exposed to the noise for too long a period at any one time.

Part of a well-designed hearing conservation program should involve education about the adverse effects of noise exposure away from the working place. Exposure to noises such as using a lawnmower, power tools, or listening to loud music can contribute significantly to a person's overall daily noise dose.

4.10.3.5 NOISE CONTROL STRATEGY

Mine operators should ensure that a strategy for noise control includes:

- reducing noise at work sites to the lowest practical level. Determine exposure to noise in accordance with AS/NZS 1269, Occupational Noise Management;
- monitoring employees' exposure to noise at work sites. Use survey findings to determine necessary precautions and the need for a noise control program;
- keeping written records of noise monitoring surveys for at least three years after an employee ceases to work at the mine; and
- making results (records and surveys) available to an Inspector of Mines and eventually forwarding to the appropriate authority for archiving.

To establish a comprehensive noise control program, general managers should:

- Ensure noise levels are regularly measured and recorded. Noise levels should be recorded on an "A Scale" in decibels (dB), and dB levels should be known at all work sites signposted "noisy". If noise levels vary, averages should be recorded (Leq) so noise dose can be determined.
- Ensure appropriate engineering controls to reduce noise levels are used where practical.

  Examine all forms of noise and reduce "easy-to-control" noise including rattling guards and high pressure air leaks.

  Investigate effectiveness of other methods of noise control and consult noise specialists.
- Identify and signpost high noise areas and designate them as "protective" zones.

  Areas where noise exceeds statutory action levels should be clearly designated. Hearing protectors (muffs or plugs) should be worn at all times in any "protective" zone or where noise could damage hearing. Before selecting hearing protectors, refer to AS 1269 Acoustics – Hearing Conservation.
- Provide adequate training.

  All personnel should understand the importance of hearing protectors and should be trained to use and maintain protectors. noise management and control.

  Management and supervisors must take all steps to reduce noise-induced hearing loss.
- Prepare necessary noise control and reduction procedures.

  Include noise procedures in company health and safety policy statements, work system documents, conditions of employment, purchase specifications and orders for new machinery.

  Noise problems should be removed at the start of projects and on installation of new equipment.

  Review methods of noise reduction before during, and after installation of new equipment.

  Accepted average noise levels for a work site may change and may not be practical after new machinery and equipment is installed and in use.
- Investigate benefits of audiometry.

  Audiometric hearing tests gauge an individual's hearing level and can aid in early detection of hearing disorders.

  Only trained staff in fully equipped laboratories should conduct audiometric hearing tests.
- Monitor and periodically review noise levels to ensure the best noise reduction methods are used.

REFERENCE DOCUMENTS

AS/NZS 1269, – 1998 Occupational Noise Management.

AS 1270 – 1988 Acoustics – Hearing Protectors.
"Workplace Noise" – Basic Information, Canadian Centre for Occupational Health and Safety.

"Code of Practice for Noise Management and Protection of Hearing at Work" – NSW WorkCover on Disk, Codes of Practice.

"Handbook on Quarrying" – Department of Mines and Energy, South Australia.

"Measurement of Workplace Noise", Canadian Centre for Occupational Health and Safety.

4.11 WORKPLACE TEMPERATURES

4.11.1 GENERAL

This chapter discusses the management of heat and gives advice on how to protect workers from heat illnesses. This chapter also provides information on environmental conditions, which may lead to “cold” illnesses and the measures to be taken to protect persons working in cold conditions.

4.11.2 RESPONSIBILITIES

4.11.2.1 MINE OPERATORS

Mine operators should ensure that measures and precautions to protect employees from heat and cold illnesses are developed at mine sites. Qualified occupational hygienists or physicians should be consulted before establishing programs to monitor health and work environments.

Mine operators should:

- only permit trained personnel to enter areas that meet the “hot” determination;
- appoint trained staff to measure the appropriate heat stress index and monitor employees for heat illness;
- establish cool rest areas that have cold drinking water and are close to “hot” work sites;
- provide suitable canopies, cabins or clothing to protect staff from direct sunlight in above-ground mines; and
- provide suitable canopies, cabins or clothing to protect staff from cold atmospheric conditions and cold or high velocity wind in above ground mines or intake airways in underground mines.

Persons who travel through or work in “hot” work sites:

- should be trained in prevention and treatment of heat-related illness; and
- should be allowed to rest at agreed times to prevent heat-related disorders.

4.11.2.2 MANAGERS AND SUPERVISORS

The accountability for the management of working in heat should be assigned to those who have the responsibility and resources to correct problems associated with working in heat.

Managers and supervisors should ensure that the safety and occupational health needs of people working at the mine are appropriately monitored and workplace temperature hazards are detected and controlled and comply with the requirements of the legislation.

Operational changes that may affect the safety or health of person working at the mine need to be communicated

4.11.2.3 EMPLOYEES

Employees have responsibilities to:

- work in accordance with the workplace temperature procedures;
- self-pace by adjusting work-effort with self identification of heat symptoms;
- examine the working place, machinery and ventilation system to make sure it is adequate and safe; and
- identify hazards and fix, if competent to do so, or report hazards to a supervisor.

4.11.3 SYSTEMS AND PROCEDURES

Mine safety systems and procedures should be developed, communicated, implemented and reviewed to ensure that health and safety of employees working in hot and cold environments are effectively managed.

The following systems and procedures should be considered.

Engineering controls of the environment

- Aspects include design, function, maintenance and monitoring.

Job design

This should take into consideration:

- work-load;
- acclimatisation of employees and contractors;
- shift arrangements and rest periods;
- job rotation;
- work rates; and
- flexibility to reduce work rate and physical demands to accommodate changes in temperature, air flow and humidity.

Work arrangements

This should include:

- job pacing where employees self-pace the rate of work to match individual tolerances;
- supervision to monitor and action changes in the workplace where the adverse effects of heat or cold are identified; and
- environmental monitoring.

Emergency and rescue

- Emergency, rescue and first aid procedures have been tested.

Job safety analysis

- Work tasks that are identified as having a risk should be analysed step-by-step to pinpoint the hazards and to identify controls for implementation before the work is commenced. This information can then be written into the work procedure.

4.11.3.1 WORK PROCEDURES AND PERMIT TO WORK SYSTEMS

The inclusion of special arrangements should be incorporated into general procedures where exposures have been identified.

It may include triggers or actions where decisions are made to cease the work and/or withdraw or replace employees from a work area.

These triggers should be:

- measurable or observable (temperature, air flow;
- in line with statutory and company requirements;
- identified by risk assessment, unless statutory;
- set recognising the normal or background conditions;
- relevant to the risk being considered;
- reflect the level of risk and degree of response required;
- set after the results of any similar testing;
- set to a level that recognises the time taken to initiate effective response (ie developing a staged response to triggers which will depend on the severity of the risk); and
- developed by agreement with all stakeholders.

Depending on the degree of urgency of the trigger, actions could be (but not be limited to);

- the collection of additional data to determine a course of action;
- withdrawal of employees from an area;
- substitution of unacclimatised employees for acclimatised employees; or
- initiation of emergency response plans.

Note: A sample “standard” for working in heat is provided in Appendix 4.1 at the end of Section 4.11.

4.11.3.2 TRAINING AND EDUCATION

Training on the effects of heat should be conducted periodically for employees and others who work in heat environments. Work in heat or cold procedures, and where applicable testing arrangements, should be included in induction training for employees and contractors.

Training and education topics should be appropriate to the work environment, and could include:

- systems and procedures on site;
- acclimatisation;
- workplace monitoring;
- fitness for work;
- emergency and first aid; and
- PPE, hazards of exposure.

4.11.3.3 DOCUMENTATION AND DOCUMENT CONTROL

There should be mine safety systems in place to control the documentation at the workplace. The following types of documentation to consider may include:

- work environment monitoring data and reports;
- procedures;
- policies;
- mine safety systems;
- training records;
- health records;
- permits to work; and
- induction records.

These records should be stored and maintained for ease of reference. Health and medical records should be stored in a confidential file with restricted access.

A sample "permit" for working in heat is provided in Appendix 4.2 at the end of Section 4.11.s

4.11.3.4 MEASUREMENT AND MONITORING

Incident reporting systems should include any incidents related to heat effects. These should be recorded and analysed to detect trends, which may require corrective actions.

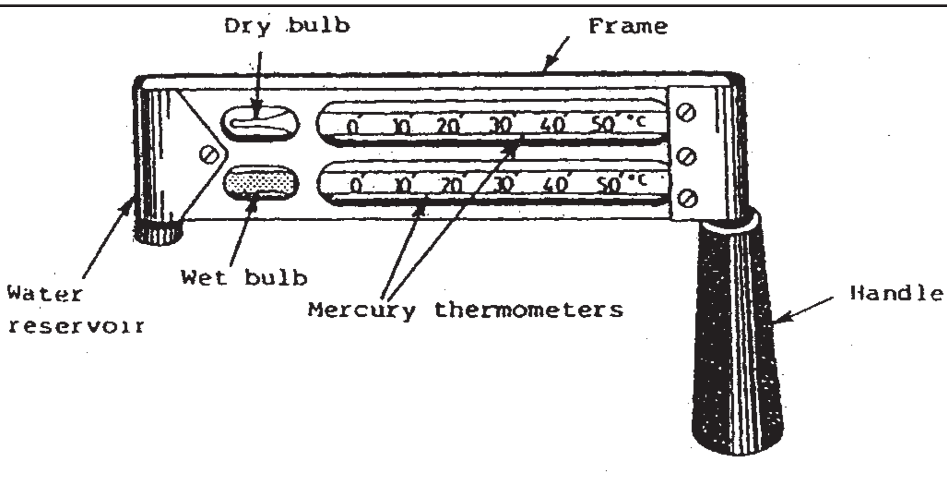
The systems and procedures for managing exposures should be periodically reviewed through auditing processes, which, may be as part of a safety management system, audit, or as a discrete audited unit. Internal and/or external audits should be considered.

The outcomes of any measures or monitoring should be fed back into the management review process.

Management review

Management should review the systems and procedures for managing hot and cold environments to ensure that the systems are effective and updated to keep pace with technology and research, and that they remain appropriate to the work site.

Figure 4.14 Sling psychrometer



4.11.4 HEAT

When the body is unable to cool itself through sweating, serious heat illnesses may occur. The most severe heat-induced illnesses are heat exhaustion and heat stroke. If actions are not taken to treat heat exhaustion, the illness could progress to heat stroke and possible death.

4.11.4.1 IDENTIFICATION OF HEAT HAZARDS

The identification of hazards is the first step in the process of risk management. The identification of hazards should include the following:

- consultation, with people working at the mine;
- analysis of incidents;
- analysis of health monitoring;
- analysis of workplace monitoring; and
- identification of heat sources where new equipment is being purchased, or where changes to processes or the workplace environment are planned.

As a guide the following may assist in the process of identifying areas where heat sources could occur:

- high level of radiant heat emitted from machinery, rock or naturally occurring high ambient temperatures;
- areas where ventilation is poor or where airflow is minimal; and/or
- areas where physical exertion is greatest; and/or
- areas with no protection from solar heat; and/or
- unscheduled physical activity where the above conditions may be present.

4.11.4.2 ASSESSMENT OF HEAT HAZARDS

Assessment of heat hazards should, as a minimum, take into account, the:

- heat factors associated with work environment;
- tasks to be performed and duration of the work;
- fitness, hydration levels and acclimatisation of the people performing the work;
- personal protective equipment used and its effect on the body's ability to cool through perspiration; and
- availability of fluid replacements.

Workers are at increased risk when:

- they are dehydrated;
- they take certain medication (check with your doctor, nurse or pharmacy and ask if any medicines that a person is taking are likely to give an adverse effect when working in hot environments);
- they have had a heat-induced illness in the past; and
- they wear personal protective equipment such as respirators or suits.

4.11.4.3 DETERMINING HEAT CONDITIONS

The main heat indices are as follows:

Wet bulb globe temperature

The "wet bulb globe temperature" (WBGT) is a weighted average of temperatures indicated by wet bulb (WB), dry bulb (DB) and globe (GT) thermometers. The method of measurement is as follows.

- Suspend the three types of thermometers from stands in conditions as close as possible to those of the work site. Air should flow freely around the three thermometers. Shield dry bulb thermometers from sun and radiant heat. Do not shield wet or globe bulb thermometers. Keep wicks of wet bulb thermometers clean and wet with distilled water.
- Read dry and globe bulb temperatures using conventional methods. Wet bulb thermometers do not need artificial ventilation and should be read after they are deliberately exposed to radiation. Temperatures measured in this way are known as "natural wet bulb" temperatures.
- Glass thermometers with mercury are recommended for all three measurements. However, other types of temperature sensors

may be used if they have been calibrated and give readings identical to those of mercury thermometers. Glass thermometers should be at least 300 mm long. They should range from -5°C to +100°C and should be graduated to at least 0.5°C.

- Globe thermometers consist of hollow copper spheres (150 mm in diameter). They should be coated with black matt paint and sealed around the stem of a mercury-in-glass thermometer (or other temperature sensor) with its bulb at the centre of the sphere. Spheres smaller than 150 mm are highly sensitive to air movement and will give incorrect values of WBGT. Globe thermometer stems should be long enough to ensure scale markings as low as 10°C are visible outside spheres. Globe thermometers have slow response times and should be exposed for at least 10 minutes before reading.

Cooling power index

The cooling power index gauges heat transferred to or from a body in thermal environments by

CONTROL METHOD	EXAMPLE
Elimination	Remove manual labour through mechanised tasks. Design and plan to eliminate manual tasks. Select and purchase equipment with lowest heat emission rating.
Substitution	Replace a hot process with a cold process. Acclimatised personnel to replace unacclimatised personnel.
Isolation	Provide a cooled work environment separated from the heat source, eg : – operator cabins; – isolate the heat source from the work environment; and – maintain insulation.
Mitigation	Maintain equipment so that it operates without overheating: – insulate pipe–work, and conduits which carry heated product; and – provide shade for outdoor work.
Administration	Training in the effects of heat on the body: – job rotation; – hydration testing; – fitness assessments; and – procedures for working in heat.
PPE	Use of cooling vests: – clothing issue – avoid synthetic materials, “breathability”; and – UV and light colours for outdoor work. Sunscreen, glasses and hats for outdoor work.

APPENDIX 4.1 SAMPLE MINE WORKING IN HEAT STANDARD

Compliance with this standard is mandatory

STEPS	SPECIAL POINTS
Ventilation Standards 1. Ensure vent duct is not more than 20 m from the actual work place 2. Check vent line for tears and repair if necessary 3. Check vent doors and other local controls (e.g. fans) are correctly set 4. Install a pump if casual water is present 5. Ensure adequate drinking water is on the job – 1 to 2 litres per hour per person 6. If conditions are oppressive, request supervisor to check the MHB	1. Air movers are not to be instead of sufficient primary ventilation 2. Primary ventilation must be at least 4 m3/s per 100 kW of rated diesel engine p 3. ower in the air intake to the job 4. Supervisor must make every attempt to get to the job site within 2 hours of request. 5. If supervisor does not arrive within 2 hours, relocate to cooler area
Measurement and Recording 1. Measure WB, DB and wind speed as close as practicable to working position of employee□s upper body using whirling hygrometer and vane anemometer 2. Determine WIH zone using charts 3. Record zone on shift report for each location tested	1. Show zone to employee 2. Avoid placing heat sources (hand or cap lamp) near thermometers 3. Between October and March inclusive, MHB must be measured in every workplace at least once per shift for any employee working in manual labour
Metabolic Heat Balance (MHB) 1. Unrestricted zone MHB > 220 a. No restrictions apply 2. Acclimatisation zone 140< MHB < 220 a. Unacclimatised workers must not work alone 3. Buffer zone 115< MHB < 140 a. Unacclimatised workers must not work at all b. No lone or isolated workers c. If airflow is less than 0.5 m/s, it must be increased to at least 0.5 m/s d. Ventilation to be fixed if defective e. Employee to be redeployed if practical f. If work continues, supervisor must complete Corrective Action Request g. Employee must have Dehydration test 4. Withdrawal zone MHB < 115 or WB > 32 or DB > 44 a. Work can only occur in safety emergency or to fix the ventilation b. Permit to Work in Heat must be authorised in advance by the Manager	1. Unacclimatised person is one who has been off-work for any reason for more than 14 days 2. Unacclimatised person must have dehydration test at end of shift for first week back at work 3. All cases of heat illness must be reported and treated 4. No person suffering heat illness is to be left alone or allowed to travel by himself 5. Supervisor must measure and report MHB at all locations where heat illness symptoms are first reported, or where an accident/incident occurs 6. Completed Corrective Action Requests and Permits to Work in Heat must be sent to Manager and Ventilation Officer within 48 hours of incident

APPENDIX 4.2 PERMIT TO WORK IN HHEAT

1. Circle at least one item from each box

Must be completed BEFORE working in conditions where	Reason for permit to be issued:
• MHB is less than 115, OR • WB is greater than 320, OR • DB is greater than 440	fixing ventilation safety
Brief description of activity	Date
Supervisor (print)	Location

2. Fill in the following table, ticking any circle that applies, employees sign

Employee Name	Employer	Required to work alone	Unacclimatised	Woman of child-bearing capacity	Consent of employee (refer below)
		O	O	O	
		O	O	O	
		O	O	O	
		O	O	O	

Employee consents to conducting the work on the basis that the following has been discussed

- the nature of the job,
- the need to maintain fluid levels by drinking every 15 minutes
- the maximum work period is 20 minutes, followed by 40 minutes of rest

If any circle in the table is ticked, **that person must not work** under this permit

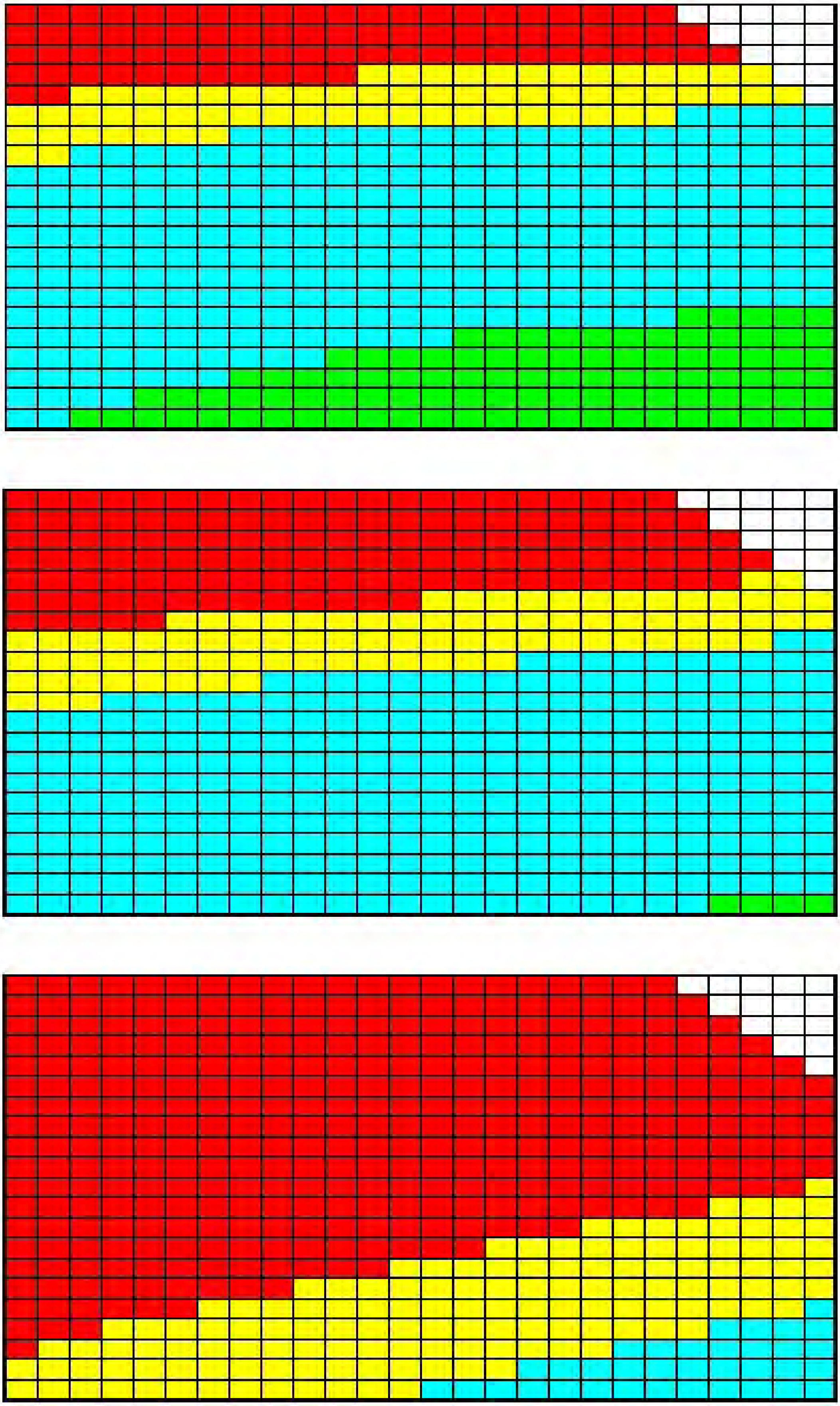
3. Fill in the following table

Name of responsible person on job at all times (print)			
Type of emergency communication		Check emergency communication OK (time)	
Start time	Expected duration	Finish time	
Managers approval granted (time)		Adequate water on job (min 1 litre/person/hour)	

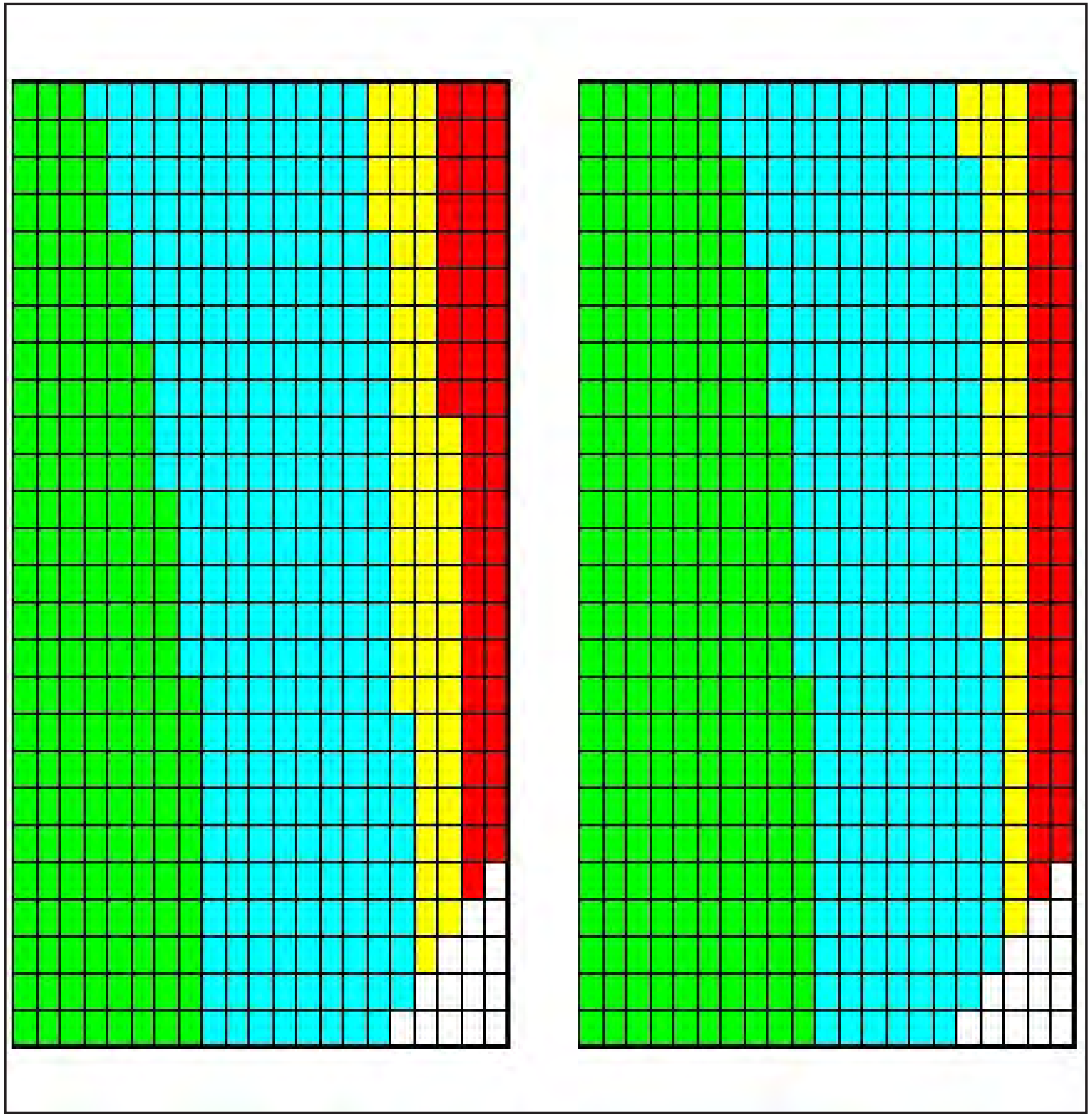
4. Supervisor signs form.

5. Return form to Manager within 48 hours.

APPENDIX 4.3 CHART 1 FOR AIR VELOCITY LESS THAN 0.5 M/S



APPENDIX 4.3 CHART 2 FOR AIR VELOCITY GREATER THAN 0.5 M/S



REFER to Procedure "Working In Heat"

WITHDRAWAL region (red)
MHB less than 115 or WB>32 or DB>44)
No work allowed except in safety emergency or to fix ventilation.
Permit to Work in Heat required.
Compulsory dehydration test at end of shift

BUFFER region (yellow)
MHB between 115 and 140)
Fix vent or redeploy person if possible.
No person to work alone
No unacclimatised person to work.
If work continues, Corrective Action Request must be completed and signed by manager within 48 hrs.
Compulsory dehydration test at end of shift

ACCLIMATISED region (blue)
MHB between 140 and 220)
Unacclimatised persons may work but not alone.

UNRESTRICTED region (green)
MHB more than 220)
No restrictions apply.

NOTE: If MHB < 140, wind speed must be increased to at least 0.5 m/sec by improving vent or installing airmover.

How to measure MHB before Heat Stress Meters Arrive

1. Ensure the glass is full of water and the wick is wet and clean.
2. Swing the glass for 30 seconds and read the wet bulb immediately.
3. Re-swing the the glass for a further 30 seconds and read the wet bulb immediately. Use the higher of the two readings.
4. Read the dry bulb.
5. Keep your cap lamp away from the thermometers.
6. Measure the wind speed in meters per second using the anemometer.
7. Select the correct chart according to wind speed.
8. Find the cell in the chart that corresponds to the wet and dry bulb
9. Take the appropriate action (see above plus the Procedure depending on what region of the chart the workplace falls into.

NOTE: temperatures and airflow are to be measured in the working area at the location of the employee's upper body.

radiation, convection and evaporation, and is measured in Watts per square metre W/m2). The method of measurement is as follows.

- To obtain the cooling power index, measure wet and dry bulb air temperatures with a whirling hygrometer in an environment representative of the work site and refer these to the appropriate charts for different air velocities.
- Mercury in glass thermometers are recommended. However, other temperature sensors may be used if they are calibrated and give identical readings to mercury thermometers. Mercury in glass thermometers should range from -5°C to +50°C and should be graduated at 0.5°C intervals. Keep wet bulb thermometer wicks clean and damp with distilled water.
- Read wet and dry bulb temperatures in hot work sites during every working shift. Read air velocity at least once a month or when there are changes to air flow rates. If air velocity at a work site is unknown, it should be taken to be less than 0.2 m/s.

To determine indices for “hot” environments:

- measure ambient air temperatures in degrees Celsius from wet bulbs, dry bulbs and globes;
- use thermometers that comply with the British Standard 2842; and
- use calibrated vane anemometers to measure air velocities in metres per second.

4.11.4.4 CONTROL OF RISK

The hierarchy of controls approach can be utilised when addressing heat hazards. This involves considering the most effective way of controlling a risk.

- Elimination – Is it possible to remove the problem by engineering methods, or design changes, or by getting rid of the problem all together.
- Substitution – Is it possible to replace the problem with something less hazardous?
- Isolation – Can a barrier be put between the person and the hazard? For example – by distance, a control room.
- Mitigation – Can the hazard be lessened, by reducing the exposure of people, or by reducing the form of the hazard?
- Administration – For example, job rotation, training, work procedures, permit to work systems.
- Personal protective equipment – PPE is considered the last resort, as it is the least effective method of managing risk.

Some examples of controlling the risk of heat stress using this method are listed in the table below:

4.11.4.5 CONTROLLING EXPOSURE TO PERSONS

Training and education topics should be appropriate to the work environment, and could include:

- understanding the ventilation system in workplaces in underground mines;
- measure atmospheric temperatures in places where people are working;
- learning the signs and symptoms of heat-induced illnesses and what to do to help an affected person;
- in above ground mines perform the heaviest work in the coolest part of the day;
- slowly build up tolerance to the heat and the work activity (usually takes up to 2 weeks);
- use the buddy system (work in pairs);
- drink plenty of cool water;
- wear light, loose-fitting, breathable clothing;
- take frequent short breaks in cool areas;
- avoid eating large meals before working in hot environments; and
- avoid caffeine and alcoholic beverages (these beverages make the body lose water and increase the risk for heat illnesses).

Note: *Paced work* is work where the worker is unable to regulate his own work rate. In practice, this means situations where the worker is unable to reduce his work rate or unable to take rest pauses as he deems necessary for his own health and safety.

Self-paced work is work where the worker is able to reduce his work rate and take rest pauses as he deems necessary for his own health and safety.

4.11.4.6 TRAINING OF EMPLOYEES AND VISITORS

Identify the education and training needs to address each specific hazard. All persons whose work may impact upon that hazard should receive appropriate training.

Establish and maintain procedures to make its employees at each relevant function and level aware of:

- the importance of conformance with procedures and with the requirements of managing heat;
- the significant safety impacts, actual or potential of their work activities and the safety benefits of improved personal performance;
- their roles and responsibilities in achieving conformance with procedures and with the requirements of management systems, including emergency preparedness and response requirements; and
- the potential hazards and consequences of departure from established procedures.

Provide for employees to complete the general training modules as part of the induction training for the mine and receive refresher training at schedule / regular intervals.

Ensure visitors and non-permanent employees receive suitable induction with regards to heat they may encounter.

Ensure mine rescue and other emergency workers receive suitable training with regard to management of heat stress. In many cases, this will require a separate hazard management plan for heat stress for these workers. This plan would need to take into account the emergency nature of their work, and the fact that they are usually working under self-contained breathing apparatus.

For persons with defined responsibilities and authority with respect to managing heat, the required competency standards for each position should be determined. Training modules, aimed at developing competencies of selected personnel should be incorporated as an internal standard for the mine, eg. recognition of heat illness symptoms. Employees should have to demonstrate that they have attained the required competency.

The education and training program should include components on hydration, pacing and the working in heat protocols. The working in heat protocols should include but not be limited to:

- the correct actions before, during and after work shifts;
- first aid, both for themselves and for any affected workmates;
- basic understanding of heat illness, particularly the symptoms and a general awareness of the relative severity of symptoms, and the need to report all symptoms immediately; and
- lifestyle and personal responsibility, particularly the individual factors outside of work hours that could impact on the ability of the worker to work safely and healthily in the heat.

4.11.4.7 REVIEW OF CONTROLS

A review of the controls which, have been implemented, should be conducted using the risk management process to ensure that the controls have produced the desired effect and that no new hazards have been introduced. Employees should be consulted and involved in this review.

4.11.4.8 WORKPLACE ENVIRONMENT MONITORING METHODS

Monitoring of the work environment to determine temperature, humidity and airflow should be conducted where a heat exposure risk has been identified through the risk management process.

Above ground mines and quarries would need to take into account the ventilation in areas where people work, and where heat has been identified as a risk. Where possible air-conditioned control rooms and cabins should be provided for mobile plant, mobile equipment and fixed control rooms. The aim being to provide a work environment, which is temperature and dust-controlled. Other work areas where ventilation and heat issues may exist include:

- confined spaces such as, crushers, silos, and tunnels;
- screen houses and screen decks;
- conveyor attendant workstations; and
- enclosed work areas.

Monitoring measurements may vary depending on the work environment.

Underground mines would require the measurement of:

- ambient temperature;
- wet bulb and dry bulb readings; and
- wind speed/air flow.

Above ground mines would require as a minimum:

- ambient temperature and humidity.

Other measurements, which may be desirable, depending on the environment could include:

- wet and dry bulb readings; and
- wind speed/air flow.

The monitoring should be conducted in the areas where people work and are exposed to heat. The frequency and timing should be determined based on the operating hours of the mine, frequency and duration of exposure of employees and the readings obtained.

The results of the work environment monitoring should be included in subsequent risk assessments.

4.11.4.9 DETERMINING HEAT STRESS CONDITIONS

Charts are attached in Appendix 4.3. Where sites determine other controls the following may be a guide.

Above ground

The WBGT is determined as set out in section 4.11.4.3.

When the WBGT above ground is:

- greater than or equal to 32°C – then procedures to reduce the risk should be implemented; or
- greater than 28°C – then appropriate risks should be assessed and controls implemented.

If the WBGT is found to approach or exceed 28°C more than occasionally, a trained occupational hygienist or physician should be consulted to help design a suitable work/rest regime taking account of the workload, duration, clothing and other factors.

Below ground

The WBGT and "cooling power index" are determined as set out in section 4.11.4.3 above. Controls might include:

Stop work might include:

- dry bulb temperature is greater than or equal to 45°C;
- wet bulb temperature is greater than or equal to 32°C;
- cooling power index is less than or equal to 115 W/m^2 (refer to notes accompanying charts); or
- wet bulb temperature exceeds 27°C and air velocity is less than or equal to 0.2 m/s.

Refer to notes for charts in Appendix 4.1

4.11.4.10 HEAT STRESS INDEX

The adoption of a heat stress index which is a scientifically based and recognised index can provide guidance where work is conducted in hot environments such as would be found in some underground mines. The use of such an index may also be useful for above ground mines where climatic/work conditions warrant.

There are many modern heat stress indices available in the referenced literature, some of which are more suited to Australian mining conditions than others. The index selected needs to be easily understood and be able to have environmental parameters such as air velocity and wet and dry bulb temperatures measured quickly easily and reliably.

4.11.5 HEALTH MONITORING

Where working in heat has been recognised as a risk, consideration should be given to appropriate health monitoring measures. This must be in conjunction with the recommendations for control of heat sources and workplace environment monitoring.

Health monitoring measures could include:

- period health checks; and
- hydration testing.

Other health measures related to working in hot environments are:

- acclimatisation of employees; and
- emergency procedures for the treatment of employees affected by heat.

4.11.5.1 SYMPTOMS AND TREATMENT

Heat exhaustion

The symptoms of heat exhaustion are headaches, dizziness, light headedness, weakness, mood changes, (that is, feeling irritable or confused), vomiting, decreased and dark coloured urine, fainting and pale clammy skin.

If heat exhaustion is not treated, the illness may advance to a heat stroke.

Heat stroke

The symptoms of heat stroke are dry pale skin (no sweating), hot red skin (looks like a sunburn), mood changes, (that is, feeling irritable or confused), seizures, fits, collapse and unconsciousness.

Treatment

All cases of heat illness must be taken seriously as there is a high risk of death resulting from lack of treatment. Medical attention must be sought as soon as possible. All cases of heat stroke must be treated as an emergency and the patient taken to hospital.

4.11.6 COLD

When the body is unable to warm itself, serious cold-related illnesses and injuries may occur and permanent tissue damage and death may result. Hypothermia can occur when land temperatures are above freezing or water temperatures are below 37°C. Cold related illnesses can slowly overcome a person who has been chilled by low temperatures, brisk winds, or wet clothing.

4.11.6.1 IDENTIFICATION AND ASSESSMENT OF HAZARDS

Frostbite

Freezing in deep layers of skin and tissue; pale, waxy-white skin colour; skin becomes hard and numb; usually affects the fingers, hands, toes, feet, ears and nose.

Hypothermia

Normal body temperature (37°C) drops to or below 35°C; fatigue or drowsiness; uncontrolled shivering; cool bluish skin; slurred speech; clumsy movements; irritable, irrational or confused behaviour.

4.11.6.2 TREATMENT

All cases of cold illness must be taken seriously and medical attention must be sought as soon as possible. All cases of frostbite must be treated as an emergency and the patient taken to hospital.

4.11.6.3 CONTROLLING EXPOSURE

Identify the environmental and workplace conditions that have the potential to lead to cold-induced illnesses and injuries.

Train the workforce about cold-induced illnesses. Employees should learn the signs and symptoms of cold-induced illnesses and what to do to help an affected person.

- Select proper clothing for cold, wet and windy conditions. Layer clothing to adjust to changing environmental temperatures. Wear a hat and gloves, in addition to underwear that will keep water away from the skin (polypropylene).

- Take frequent short breaks in warm dry shelters to allow the body to warm up.
- In above ground mines perform work during the warmest part of the day.
- Avoid exhaustion or fatigue because energy is needed to keep muscles warm.
- Use the buddy system (work in pairs).
- Drink warm, sweet beverages (sugar water, sports-type drinks). Avoid drinks with caffeine (coffee, tea or hot chocolate) or alcohol.
- Eat warm, high-calorie foods like hot pasta dishes.

4.11.6.4 WORKERS AT RISK

These include:

- those with predisposing health conditions such as cardiovascular disease, diabetes and hypertension;
- those taking certain medication (check with your doctor, nurse or pharmacy and ask if any medicines being taken could affect workers while working in cold environments); and
- those who are in poor physical condition, have a poor diet, or are older.

REFERENCE DOCUMENTS

AS 1674 Safety in Welding and Allied Processes.

AS 1006 – 1995 Solid Stem General Purpose Thermometers.

MJ McPherson, Sub-surface Ventilation and Environmental Engineering, 1993.

Brake R., Donoghue, Dr. M., Bates, G., A New Generation of Health and Safety Protocols for Working in Heat, in Proceedings, Qld Mining Industry Health and Safety Conference, 1998

Department of Mineral & Energy WA. 1997 Guidelines. Management and Prevention of Heat Stress. ISBN 0 7309 8558 X,

Department of Natural Resources and Mines Qld 2001. Guidance Note: Management of Heat

Worksafe Australia, Working Environment Series No 14, Thermal Comfort at Work, 1981.

Electrical Sub-surface Ventilation and Environmental Engineering by MJ McPherson, 1993.

“Heat Stress Card”, US Department of Labor, Occupational Safety and Health Administration.

“Cold Stress Card”, US Department of Labor, Occupational Safety and Health Administration.

4.12 DUST

4.12.1 DUST CONTROL STRATEGY

4.12.1.1 INTRODUCTION

All respirated dusts must be considered harmful in some degree. Even where there may be only slight danger to the lungs, there is very likely some adverse effect on the respiratory system, particularly to asthmatics or sufferers from hayfever.

Dust particles of size ranging from 0.001 to 0.1 mm (1 to 100 microns) pose a threat to health when they become airborne, reducing visibility, creating an uncomfortable environment (irritation of eyes, ears, nose, throat and skin) and possibly resulting in damage to the tissues of the lungs. Included among potentially harmful dusts are silica, asbestos, sugar cane fibre, carborundum, diatomite, talc and cotton dust – each of which can produce its own form of lung damage when dust control is inadequate.

The most common harmful dust in mines is that which contains silica, and it would appear that the harmfulness increases with the increase in the percentage of silica in the dust. Also, the most harmful dust is that which is less than 5 microns in size, that is, particles smaller than 0.005 mm. As this dust is not visible to the naked eye, it does not follow that because dust cannot be seen there is no danger.

4.12.1.2 PHYSIOLOGICAL EFFECTS

When dust-laden air is inhaled, most of the dust particles greater than 5 microns are caught in the mucus which coats the nose, sinuses, trachea and bronchi. They are moved up with the mucus towards the throat and either expectorated or swallowed.

Dust particles less than 5 microns can pass into the lungs. Some pass out again with the exhaled air but other particles are caught up in the lung tissue and may eventually result in fibrosis of the lungs. Individual susceptibility seems to play an important part in determining the degree of fibrosis produced. Other factors of importance are the age of the person when first exposed to the dust, the concentration of dust and the years of exposure.

Silicosis is lung damage caused by breathing dust containing extremely fine particles of crystalline silica. Crystalline silica is found in materials such as concrete, masonry and rock. When these materials are made into a fine dust and suspended in the air, breathing in these fine particles can produce lung damage. Silicosis can lead to heart failure and increase the risk of other diseases such as tuberculosis.

Serious features of silicosis are that it predisposes a person to tuberculous infection, and that the silicosis may advance even after exposure to harmful dust concentrations has ceased.

4.12.1.3 CONTROL METHODS

This information is a guide to factors that may be required in a dust control strategy and methods that can be used to sample and analyse dust results. Advice on sampling of respirable and inspirable dust is also given in AS 2985 and AS 3640, respectively.

Generally, a dust control strategy needs:

- establishment of a dust control program;
- monitoring and analyses of airborne dust;
- implementation of corrective action to control generation of dust and limit employee exposure to dust, where required; and
- results, particularly personal exposure records.

Dust monitoring programs are part of dust control strategies and should be designed to determine and assess concentration of airborne dust for all activities and workplaces. Dust sampling results should be reasonable representations of each person's exposure to dust.

The methods by which dust in working places is suppressed or controlled are universal.

They include the following:

- wet drilling, water mist drilling and drilling with an exhaust system to remove and collect dust;
- proper ventilation of working places, particularly dead ends (for example, by supplying dust-free air to the face);
- wetting muckpiles when moving broken rock, loading trucks or dumping into bins or stockpiles;

- providing wheels or cutting compound of silicon carbide or aluminium oxide instead of sandstone (to reduce the amount of silica in the dust) and water sprays when using grinding wheels, sawing dimension stone or core cutting;
- use of wetting agents with water in selected processes;
- use of clear water for sprays and mists; and
- use of total wet processes in crushing and screening plants.

Good plant layout practices include:

- separating dusty from non-dusty operations;
- enclosing dusty machines and transfer points and extracting dust through an exhaust system;
- reducing the amount of fall of materials at transfer and discharge points with the discharge chute for fine material being sloped rather than perpendicular;
- using collapsible wind socks (elephant trunks) at the discharge point of stockpile conveyors
- preventing chutes becoming empty;
- providing a dust-free operator's room under positive air pressure;
- employing good housekeeping methods by cleaning up spillage, paving the environs of the plant or keeping them oiled or damp;
- reducing the speed of all vehicles near the plant; and
- covering dumps with vegetation as soon as practicable, but in the early stages spraying with chemicals to provide a protective coating.

Pay attention to roads throughout the minesite area by:

- providing paved surfaces where practicable;
- watering roads and tracks whether sealed or not;
- restricting vehicles to defined roads or tracks;
- restricting speed of vehicles; and
- watering down loads before leaving the loading site.

Also ensure that any dust produced by blasting in open cut mines and quarries is blown away from neighbouring houses. Remember that too strong an explosive for the rock to be blasted will create excessive dust.

While the above considerations are mainly directed towards the elimination of health hazards to employees, it will be apparent that a dust suppression program for surface operations, based on some of the above good practices as are appropriate, will also have the effect of reducing complaints from the community.

4.12.1.4 DUST MONITORING AND RECORDING

The maximum concentration of dust types including respirable dust, quartz bearing dust and asbestos dust can be obtained from the NOHSC 1003 Worksafe National Exposure Standards.

Dust can be generated during different stages of mining operations and therefore mines may need to determine personal exposure and what precautions may be required to safeguard employees' health, and whether a dust control strategy is necessary. Sources of airborne dust include wind action, earth moving, vehicles and moving equipment, drilling, blasting, loading, dumping, feeding, crushing, screening, chutes, conveyors, transfer and discharge points, bins, stockpiles, dumps, loading points and road transport.

Dust monitoring programs should ensure a reasonable representation of the dust exposure for given activities and the mine site. Programs should be reviewed every two years and appropriate changes made if programs are inadequate for intended purposes.

For simplicity and statistical purposes all activities sampled for airborne dust should be categorised under the following headings. Every effort should be made to ensure each activity is categorised correctly.

Extraction

Examples: drill operator, rockbolt rig operator, loader driver, scraper operator, driller, bulldozer driver, quarry operator.

Transport

Examples: truck driver, LHD operator, loco driver, grader driver, trucker.

Treatment

Examples: crusher operator, crusher attendant, screen house attendant, feeder attendant, general hand, conveyor attendant.

Service/maintenance/supervision

Examples: shift boss, fitter, electrician, ventilation officer, forklift operator, leading hand, supervisor, weighbridge attendant, dispatcher, cleaner and miscellaneous office staff.

4.12.1.5 DUST SAMPLING

Airborne dust samples may be either static or personal. Dust limits are based on personal exposure for a standard shift of eight consecutive hours and calculated as a time-weighted average. The preferred approach is personal dust sampling.

Personal dust sampling should:

- identify and quantify airborne dust concentrations a person has been exposed to whilst performing a work activity; and
- if concentration cannot be determined from dust sampling, assume dust originates from the rock being extracted or processed.

Static sampling should:

- only be performed to verify personal airborne dust results for a particular work area or for engineering purposes;
- be used to determine air quality by comparison with prescribed limits (such comparisons should be clearly identified in reporting of results); and
- be more useful than other methods, in areas visited infrequently but where airborne dust poses concern, or impacts on populated work areas.

An adequate number of samples should be taken for all activities to ensure levels of exposure are clearly identified and quantified.

Frequent sampling ensures dust exposure levels for an activity are within prescribed limits and exposure trends are adequately identified.

Additional sampling is required:

- when flow or quality of air through a work area has changed;
- when processes or activities are modified or new technology introduced; or
- after corrective action has been implemented.

Sampling frequency can be modified:

- based on trend demonstrated by past results (mines with insufficient historical data to delineate trends of airborne dust levels should conduct at least two annual surveys every six months, excluding any follow-up testing after recording unsatisfactory results); and
- to a higher frequency where ore or mineral contains substances that can generate dust with a high health risk.

Standard limits for different dusts in mines are shown in Table 4.5. Allowable limits indicate there are possible health risks associated with specific types of airborne dust. For example, an operation which has < 4% quartz in the ore would be expected to undertake two surveys a year, whereas an asbestos operation might be expected to undertake four surveys per year. Frequency needs to be determined considering the above factors.

Areas and activities should be selected for dust sampling based on:

- type and composition of dust;
- previous monitoring results;
- consultation with workplace committees, ask inspectors and concerned people;
- a random number system for selecting people for personal monitoring; and
- personal or static sampling which may be used to obtain a representative result of various activities.

The company should carry out personal dust sampling in any area of the site which is known to generate dust. The sampling should take place on a 12 monthly basis in accordance with AS 3580 Methods for Sampling and Analysis of Ambient Air – Determination of Particulates.

If the sampling results exceed exposure standards a full investigation of the cause should be undertaken. The aim of the investigation in order of priority should be to:

- eliminate the source;
- put in engineered controls; or
- as a last resort, provide proved appropriate respiratory protective equipment as per AS/NZS 1715 (Selection, Use and Maintenance of Respiratory Protective Devices):

A responsible person should be nominated for this activity.

Concentration of a type of dust

Airborne dust in a mine should not exceed the maximum concentration for the type of dust as specified in the following table.Information on maximum concentration of dust other than that shown above is contained in Exposure Standards for the Atmospheric Contaminants in the Occupational Environment issued by Worksafe Australia.

Recording dust sampling results

Everyone participating in a dust monitoring program or whose activity was included in a dust monitoring program should be notified of results.

Methods to determine concentration fo dusts

The following standards should be used for information on dust sampling procedures and determining concentration levels.

- “Asbestos Code of Practice and Guidance Notes” cat. no. 8928451, AGPS, August 1988.
- Quartz standard A 9950 (Aust 1) obtainable from Worksafe Australia.

REFERENCE DOCUMENTS

AS/NZS 2430 Classification of Hazardous Areas.

AS 2985 – 1987, Workplace Atmospheres – Method for Sampling and Gravimetric Determination of Respirable Dust.

AS 2986 – 1987, Workplace Atmospheres – Organic Vapours: Sampling by Solid Adsorption Techniques.

AS 3640 – 1989, Workplace Atmospheres – Method for Sampling and Gravimetric Determination of Inspirable Dust.

NOHSC 1003 – 1990, Worksafe National Exposure Standards.

SAA HB13 – 1992, Electrical Equipment for Hazardous Areas (NEEITCC 181–1:1991).

WAP 90/012 – 1990, Exposure Standards for Atmospheric Contaminants.

WSO 13 – 1994, For the Assessment of Health Risks Arising from the Use of Hazardous Substances in the Workplace.

WSO 16 – 1991, Exposure Standards for Atmospheric Contaminants in the Occupational Environment: Guidance Notes and National Exposure Standards.

Worksafe Australia, Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Dust, Worksafe Australia Publication.

Asbestos: Code of Practice and Guidance Notes, Cat. no 8928451, AGPS, August 1988.

‘Handbook on Quarrying’, Department of Mines and Energy – South Australia.

Silicosis Fact Sheet for Construction for Construction Workers – Canadian Centre for Occupational Safety and Health.

4.13 VENTILATION

4.13.1 VENTILATION RESPONSIBILITIES

Mine operators should appoint competent persons to measure and record:

- air quality and temperature;
- air distribution in work sites;
- atmospheric composition and compliance with air quantities;
- air maintenance plans; and,
- advice given to managers on all potential problems with air quality.

In underground mines competent persons should:

- regularly inspect, test and record atmospheric conditions;
- analyse atmospheric contaminants and air quantities and determine if they comply with appropriate Australian Standards;
- inspect, test and record wet and dry bulb temperatures at sites where temperatures are identified to have an adverse effect on the safety and health of staff;
- calibrate and maintain all metering and monitoring devices;
- select and position primary and auxiliary fans and record air levels at the parameters once every three months;
- record air volume and pressure in the mine at regular intervals;
- update ventilation plans as required to ensure current information is available in cases of emergency;
- identify and deal with equipment defects or deficiencies in air volume or contaminants; and
- provide technical advice.

With crushing or screening plants:

- regularly inspect and test workplaces to determine and maintain atmospheric contaminants at levels as low as are reasonably possible;
- ensure dust suppression and collection systems are effective;
- operate, calibrate and maintain all metering devices; and
- identify and deal with equipment defects or air contaminant levels exceeding appropriate standards.

4.13.2 HAZARDS

4.13.2.1 MINE AIR QUALITY

Air is a mixture of gases in the natural atmosphere. The main constituents of air are:

- nitrogen 78%
- oxygen 21%
- carbon dioxide 0.03%
- other gases 0.9%.

Of these, the gases of greatest interest are oxygen and carbon dioxide.

Oxygen (O_2)

Oxygen is an odourless, tasteless and colourless gas essential for humans, plants and animals.

An oxygen level of less than 17% is hazardous. Dilution from other gases, or by sulphide ores and carbonaceous shales which oxidise slowly, can also deplete oxygen volume.

Timber decay and rust on iron deplete oxygen content and can also produce carbon monoxide or carbon dioxide which may contaminate mine air.

Carbon Dioxide (CO_2)

CO_2 is a colourless gas with a pungent smell in high concentrations, non-explosive in air, denser than normal air and can be found at floor level.

At concentrations greater than 10%, CO_2 causes loss of consciousness. The rate of breathing doubles at a concentration of 3%. Mine fires and slow combustion of timber, blasting, breathing, burning of flame lamps, breakdown of carbonate ores and burning diesel fuel increase carbon dioxide levels in the air.

Surveys at Lightning Ridge Opal Fields in 1992 found significant concentrations of carbon dioxide on some fields, particularly, in blind shafts and newly drilled bore holes. For more information, see recommendations in the clause on abandoned workings in this section before entering newly drilled or blind Caldwell holes.

4.13.2.2 ATMOSPHERIC CONTANIMANTS

The main contanimants in air are:

Dust

Airborne dust affects health and safety of underground staff and is dangerous in excessive amounts if staff breathe it in over a sufficient length of time.

Take precautions to minimise potential for dust to become airborne, particularly when using machinery and shot-firing underground.

When dust is airborne, velocity of ventilating air currents should be strong enough to dilute and remove dust and any fumes.

Dust includes:

- *pulmonary dust* (harmful to respiratory system):
  - silica (quartz, chert);
  - silicates (asbestos, talc, mica and sillimanite);
  - metal fumes (nearly all);
- *toxic dust* (poisonous to body organs, tissue, etc):
  - ores of arsenic, lead, mercury, tungsten, nickel, silver (principally the oxides and carbonates);
- *explosive dust* (combustible when airborne):
  - metallic dust (magnesium, aluminium, zinc, tin and iron); and
  - inert dust (harmful effect).

Gases

Carbon Monoxide (CO)

CO is a colourless, tasteless and odourless gas, lighter than air, easily absorbed into the blood stream and very toxic at low concentrations.

It is explosive in air between concentrations of 12.5% and 74%. and can be detected with gas detector tubes.

The main sources of CO are diesel emissions, blasting operations, and any incomplete combustion. Petrol engines create carbon monoxide and are prohibited for use underground or located adjacent to intake airways.

Sulphur Dioxide (SO_2)

Sulphur dioxide is a non-combustible, non-flammable toxic, colourless gas with a strong sulphurous suffocating odour.

It is very poisonous and can irritate eyes and respiratory passages. SO_2 in high concentrations is dangerous to breathe over a long time.

Principal sources of SO_2 are fires in sulphide ore bodies, diesel engines, blasting and burning rubber. The gas may be detected by smell at concentrations of 0.003% or by gas detector tubes and gas instruments.

Nitrous Fumes or Oxides of Nitrogen (NOx)

The term nitrous fumes includes all nitrogen oxides and in particular nitrogen dioxide, nitric oxide and nitrogen peroxide. All are toxic, having a pungent smell and an irritating effect on the air passage. Any air with sufficient nitrous fumes to cause appreciable irritation of the air passage should be regarded as dangerous.

Main sources are diesel exhausts and partial detonation of explosives. Detection is by odour and should be taken as a warning not to proceed. Gas detector tubes are also available.

Other gases

Other gases which may be present in mines include methane, aldehydes and hydrogen sulphide.

4.13.2.3 DIESEL EXHAUST FUMES

Before diesel engines are used underground, carry out the following checks to ensure compliance with National Occupational Health Safety Commission (NOHSC 1003).

Atmospheric contaminants to be considered include:

- carbon dioxide;
- carbon monoxide;
- nitrogen dioxide;
- nitric oxide;
- hydrogen sulphide;
- sulphur dioxide;
- aldehydes (as formaldehyde); and
- respirable combustible dust.

Undiluted exhaust gases from a diesel engine should be measured for CO and oxides of nitrogen or NO (new engines should be able to achieve about one third of the CO limit).

Diesel engines should be fitted with an appropriate conditioner or scrubber.

Airflows in which diesel engines operate underground should have been determined by the dilution required to achieve the atmospheric limits specified in by the NOHSC 1003 Standard. This requires knowledge of the swept exhaust volume of the engine and the maximum raw exhaust gas concentrations for the duty cycle).

Sufficient quantity of air for ventilation should be available when engines in one specific area of a mine are operating.

Contaminant levels are not being exceeded and appropriate monitoring methods, such as detector tubes, are in place.

4.13.2.4 EXPLOSIVE ATMOSPHERES

In addition to methane, carbon monoxide and hydrogen sulphide, other materials can create explosive atmospheres in mines. These include:

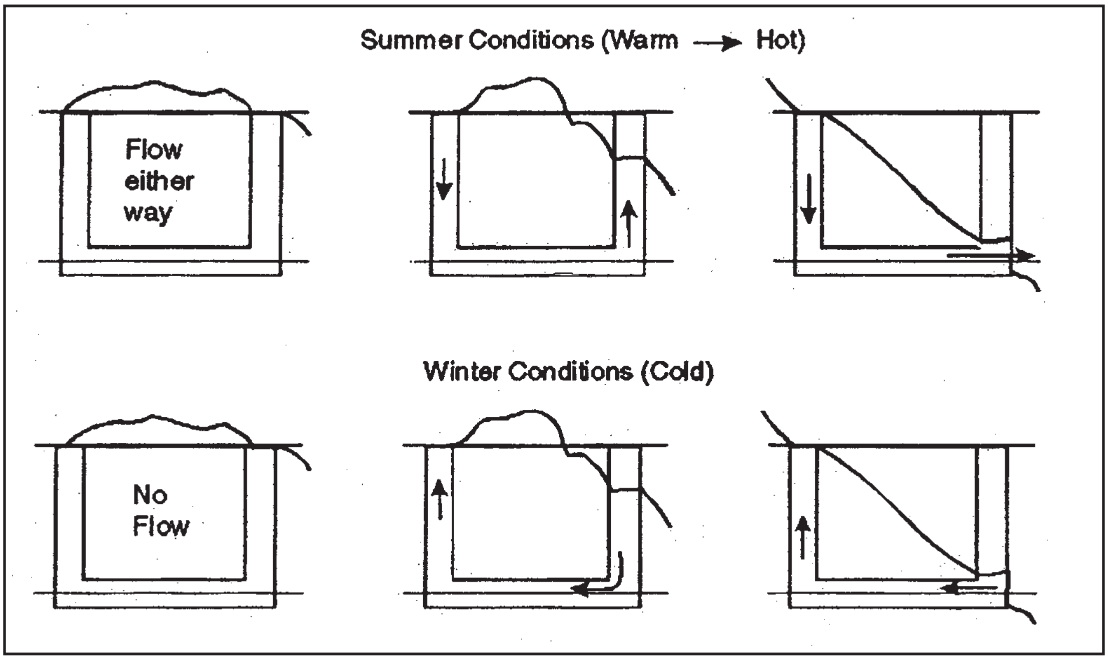
- acetylene, a colourless gas usually stored in bottles for oxy-acetylene cutting, which is

  explosive in air mixtures ranging from 3% to 82%;
- oxygen, stored in bottles, which can easily rupture and should be stored away from grease and electrical equipment;
- fuel vapours, which are easily ignited by flame if not properly flushed by a current of air; and
- vapours from fast-drying agents and paints which should be stored in well-ventilated areas in mines – if possible away from air that workers breathe and not in dead ends.

4.13.2.5 HEAT AND HUMIDITY

Controlling exposure to high temperatures and humidity is essential to reduce possible health hazards.

Figure 4.15 Directional airflow in natural ventilation as a result of surface temperature



Workers experience undesirable physiological effects when body heat, produced after physical exertion, cannot be transferred to surrounding air because of ambient temperature and humidity. To protect persons from adverse effects of working in high humidity, work site temperature should ideally be less than 27°C wet bulb.

Humidity and temperature must regularly be monitored using instruments such as a sling (whirling) psychrometer, shown in Figure 4.14 when above the trigger temperatures.

4.13.3 VENTILATION CONTROLS

4.13.3.1 ATMOSPHERIC STANDARDS

Air in mines should be high quality and fit to breathe without respiratory protection.

Mine air should:

- not contain more atmospheric contaminants than those specified in NOHSC 1003 Worksafe National Exposure Standards;
- not contain more than 0.2mg/m^3 of diesel particulate matter (soot) being the level that has been found that effects of irritation are minimal – refer NSW Minerals Council October 1999;
- be reasonably free of visible dust.

4.13.3.2 AIR-CONDITIONING AND REFRIGERATION

Cooling towers, evaporative condensers, warm water systems or other devices that may be breeding grounds for micro-organisms must meet regulations set out in AS/NZS 3666 – 2002 Air-Handling and Water Systems of Buildings.

Gases from cooling systems are dangerous if breathed in or combined with diesel fuel and must not leak into underground mines.

4.13.3.3 SUPPRESSION OF DUST

Clean dust–free water must be available on and below the mine surface to spray on dusty surfaces.

Use deflection devices and dust collectors on drilling and boring machines to suppress and catch dust.

Use water sprays or jets to settle floor dust.

Eliminate dust at source where possible.

Use circulating fluids in drilling equipment underground to stop machines overheating and creating dust.

4.13.3.4 CRUSHING OR SCREENING PLANTS

Action to reduce air borne dust must be taken when:

- air is offensive or uncomfortable to breathe; or
- dust seriously impairs visibility or is likely to make employees ill;
- monitoring indicates exposure standards for contaniments or respirable dust, is exceeded.

4.13.4 VENTILATION METHODS

Mine ventilation ensures air that mine workers breathe will not damage their health, contains an acceptable level of oxygen and is free of contaminants.

An adequate air flow through work sites is needed to remove excess heat generated from machinery. To ensure adequate and continuous flows of clean air, work sites must connect to intake and exhaust shafts.

4.13.4.1 NATURAL VENTILATION

Natural ventilation is airflow through a mine resulting from air pressure differences in intake and exhaust air in shafts. Airflow depends on air temperature differences inside and outside mines and on the depth of a mine.

Natural ventilation, flow, direction and volume of natural air in underground mines is affected when:

- surface temperature changes (see Figure 4.15). Air temperature in underground mines remains fairly constant during the year due to consistency in rock temperatures. However, surface temperatures vary during the day and throughout the year;
- outside air is hot during summer and too light to balance cool air in mine shafts.

Consequently, hot wind is drawn down mine shafts and then out of the mine through existing openings (adit or shaft);

- air in mines is warmer than outside air during winter and blows up shafts in the opposite direction to summer airflow;
- temperatures above and below ground are similar, there is no wind or airflow resulting from natural ventilation. (When there is no airflow, as seen on the left-hand side of Figure 4.15, fans or other machines must be used to create an air flow. Mechanical ventilation gives better control over air flow direction and required quantities); and
- the length and size of mine openings varies.

Natural airflow in a mine can be enhanced by:

- installing black, large diameter pipes at the collars of ventilation shafts or boreholes. Black pipes heat up in the sun and increase air temperature in pipes forcing air to rise. This allows cooler air to enter mines;
- removing obstructions in shafts and air passages to increase the quantity of air moving inside the mine. Large pipes and mine openings increase the quantity of air; and
- placing industrial exhaust ventilators (powered by wind) on top of a large diameter pipe fitted to a borehole. As wind rotates ventilators, air is exhausted from mines. These energy saving devices provide greater flow of air regardless of surface temperatures.

4.13.4.2 MECHANICAL VENTILATION

Mechanical ventilation includes exhaust ventilation systems and two main types of fans (axial flow and centrifugal/radial).

Fans are commonly mounted over an upcast shaft and can be installed:

- to supply air to the entire mine or, when used as auxiliary ventilation, to part of the mine;
- as either an intake (blowing) or exhaust ventilation system, preferably working with the direction of the natural ventilation;
- either by fixing on the surface as a major ventilator, or used underground as an auxiliary fan; and
- to vary the quantity of air flow and put stagnant air in motion. Fans designed for use in mines are similar to simple axial, desk or ceiling fans with rotating blades.

Exhaust ventilation extracts air from inside the mine and creates a flow of clean, outside air being drawn along adits and down shafts.

4.13.4.3 AUXILIARY VENTILATION

Auxiliary ventilation supplements natural and mechanical ventilation systems inside mines.

Use auxiliary ventilation:

- when main air currents are inadequate or do not reach all work sites;
- to supply air to dead ends, blind corners, drives, rises, shafts, winzes or work sites where air is not replenished by currents from main ventilation systems; (this is the most frequent and important application of auxiliary ventilation);
- to supply uncontaminated air to work sites where air is contaminated (auxiliary ventilation must be maintained until contaminated air is entirely replaced with “clean” air); and
- to supply cooler air to hot working places.

There are two types of auxiliary ventilation layout – exhaust and force, and force only. Before deciding which ventilation system to install, ventilation officers must:

- determine the required size of fans and tubing for an effective system (Figure 4.16 shows an exhaust and forcing system);
- assess how far fans should be from workers’ faces (Figure 4.17 shows a force system that delivers air to workers’ faces at a greater velocity than in Figure 4.16. Distances in diagrams are only as guides);
- ensure the proposed auxiliary ventilation system has sufficient air velocity and power to discharge contaminated air. Auxiliary ventilation systems must not recirculate “contaminated” air inside mines (see Figure 4.18).

There are two common auxiliary ventilation methods – compressed air/injectors and fan and ventilation tubing.

- Compressed air and injectors need limited maintenance, are easy to install, and operate under adverse conditions. Exhaust from compressed air equipment helps cool hot and/or dusty work places. Use ventilation from compressed air lines to purge rises and winzes and to clear smoke and fumes from the face after blasting. (This type of ventilation is expensive and seldom warranted.) Do not use compressed air exhausts as substitutes for ventilation as most of these machines run for only part of a shift and air quantity is insufficient to remove airborne contaminants. Injectors are limited to a small area of influence and require constant supply of compressed air. Direct ventilation from an air line is expensive.
- Fan and ventilation tubing is suited to ventilating larger areas and work sites over longer distances than compressed air injectors. Tubing is suspended from hangers on walls and attached to auxiliary fans. Vent tubing is easily damaged and vulnerable to decreases in air velocity inside the tubing.

4.13.5 VENTILATION MONITORING

4.13.5.1 AIRFLOW DETECTION AND MEASUREMENT

Air velocity or movement is measured using a variety of instruments, including smoke tubes, vane anemometers, pitot tubes or hot wire anemometers.

The simplest way to detect air direction and flow is from a visible trail created from a puff of smoke, talcum powder or chalk dust.

Calculating air velocity

- Paint two lines one metre apart on a wall at the work site.
- Create a puff of smoke or chalk dust trail at the upwind side.
- Use a watch to time the period it takes for the visible trail to travel one metre.

Sample calculation

If the dust trail takes 10 seconds to travel one metre through a drive having a cross-sectional area of 1.5 m x 2 m, the velocity can be calculated as follows:

Air velocity (V) = Distance/time
= 1/10 = 0.1 m/s

Quantity of air moving past that point can be calculated as follows:

Air quantity (Q)= Velocity x Area of Drive
= 0.1 m/sec x 1.5 m x 2.0 m
= 0.3 m^3/s

The volume and velocity reflect the ability of the ventilating current or flow of air to remove dust particles, sustain life, and dilute gases and other contaminants present in the mine air.

4.13.5.2 SAMPLING OF DUST AND VAPOURS

Monitor employees exposure to dust and atmospheric contaminants and determine whether a control program is necessary and what precautions to take. Advice on sampling of inorganic vapours, respirable and inspirable dust is in AS 2985, AS 3640 and AS 2986.

Employee exposure records should be kept for at least three years after an employee ceases to work at a mine and then should be forwarded to the appropriate authority for archiving.

Respirators must be available always and employees should be trained to use and fit the correct apparatus.

4.13.6 PROBLEMS WITH OLD ABANDONED WORKINGS

Before entering old or check:

- mine atmosphere and assess ground conditions;
- for hazards such as noxious gases that may not be obvious or readily detected from outside;

- for natural ventilation;
- noxious gases are not present in exhaust airways; and
- a system of forced ventilation has been installed and operating for a sufficient period of time before entry to mines where atmosphere contains insufficient oxygen and/or high concentrations of dangerous gases. Use a small compressor, compressor air hoses, small compressed air fans or flexible ventilation tubing and ensure equipment reaches work sites.

  An experienced underground miner or other qualified person should accompany the party. Never enter abandoned workings alone. Always have another person in a safe place, in communicating range, to help if required.

  Do not enter vertical openings such as shafts, rises or winzes unless accompanied by an adequately equipped party.

  Adits and other horizontal developments may be entered after atmosphere and ground tests are completed.

REFERENCE DOCUMENTS

Australian Design Rule 30/00 (Federal Department of Transport) Diesel Engine Exhaust Smoke Emissions.

AS/NZS 2430 Classification of Hazardous Areas.

NOHSC 1003 Worksafe National Exposure Standards.

WAP90/010 – 1990 Workplace Hazardous Substances.

WSO 13 – 1994 For the Assessment of Health Risks Arising from the Use of Hazardous Substances in the Workplace.

WSO 16 – 1995 Exposure Standards for

Atmospheric Contaminants in the Occupational Environment: Guidance Notes and National Exposure Standards.

NSW Minerals Council October 1999 – Diesel Emissions in Underground Mines – Management and Control.

Figure 4.16 Auxiliary ventilation – exhaust and force systems

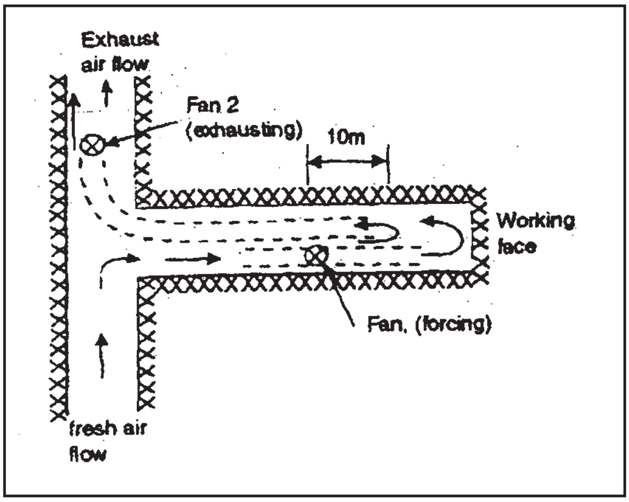


Figure 4.17 Auxiliary ventilation – forcing only systems

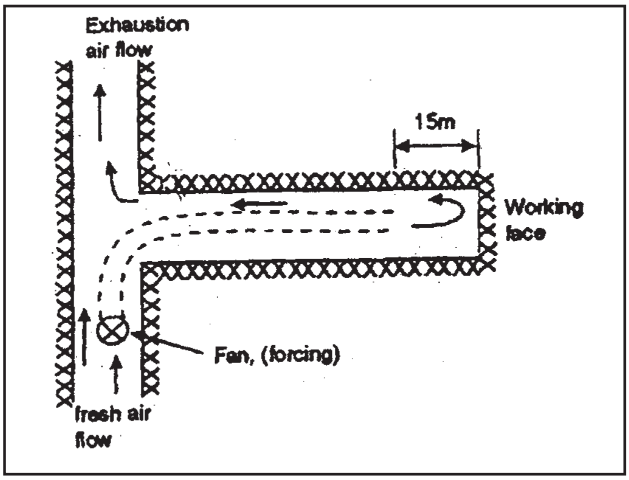
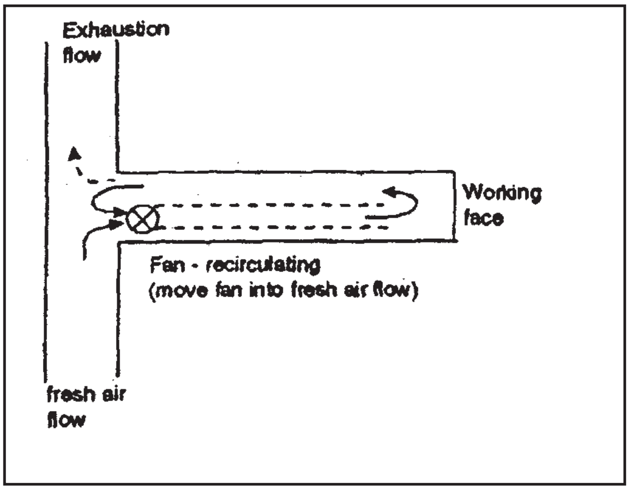


Figure 4.18 Auxiliary ventilation – forcing fan recirculating exhaust air



4.14 HAZARDOUS SUBSTANCES

4.14.1 INTRODUCTION

The National Occupational Health and Safety Commission (NOHSC) has declared a package of standards and codes of practice that, in conjunction with guidance materials, comprises the National Hazardous Substances Regulatory Package. All jurisdictions have given legislative effect to it.

Many hazardous substances are also defined as dangerous goods under the Dangerous Goods Legislation. Dangerous goods are divided into nine classes according to their dangerous properties – see attached sheets at end of this Section.

It is necessary to obtain a licence to keep dangerous goods, however there maybe some exceptions depending on the quantity.

4.14.1.1 DEFINITIONS

A “hazardous substance” is:

- any mixture, element or chemical; or
- any solid, liquid or gaseous substance that has the potential, through being used at work, to harm the health or safety of persons in the workplace.

Under the National Model Regulations for the Control of Workplace Hazardous Substances (NOHSC:1005 (1994)1, a hazardous substance means a substance which:

- is listed on the List of Designated Hazardous Substances (NOHSC: 10005 (1999); or
- has been classified as a hazardous substance by the manufacturer or importer in accordance with the Approved Criteria for Classifying Hazardous Substances (NOHSC: 1088 (1999).

The list should be checked as the initial reference source to establish whether the substance or, if it is a mixture, any ingredients, are listed.

Where a substance or, in the case of mixtures, an ingredient, is not included on the list, it will be necessary assess information about its health effects against the Approved Criteria in order to determine whether it is hazardous or not.

From such an assessment, the nature of the hazard (if any) presented by the substance can be identified and classified with the most appropriate risk phrases selected for each hazardous substance. Classification of substances is important in producing labels in MSDS as required by Commonwealth, State and Terriroty government regulations.

4.14.1.2 INFORMATION AND TRAINING

No matter which control method is used, education and training for employees is essential to:

- monitor the workplace situation as necessary;
- provide appropriate regular medical examinations as necessary; and
- keep records to show what action has been taken to control hazardous substances.

4.14.1.3 MATERIAL SAFETY DATA SHEETS (MSDSs)

National Model Regulations for the Control of Workplace Hazaardous Substances (NOHSC: 1005 (1994) applies to all workplaces in which hazardous substances are used or produced, and to all persons with potential exposure to hazardous substances in those workplaces.

The two principal components of the national model regulations are:

- *Information provisions* – which address the deliver of specific information, such as labels and Material Safety Data Sheets (MSDS), that the supplier has to provide;
- *Assessment and control provisions* – which require employers to identify hazardous substances in the workplace, make an assessment of those hazards and then take appropriate control action.

Manufacturers and importers of hazardous substances used in workplaces must prepare and make available an MSDS for each substance. Employers and contractors must obtain and make readily available an MSDs for any hazardous substance used in the workplace, and consult with employees who use the hazardous substance and may be exposed to it. Employers need to keep a register of hazardous substances used in the workplace.

Employees should always request MSDSs for all hazardous substances they use.

MSDSs allow employees to use hazardous substances correctly and safely, and understand why the safety measures are recommended. Employees will know what will happen if they are harmed by the substance, and what first aid and emergency procedures they must take.

The MSDS should contain complete information on the product, including:

- *product name* – trade name, chemical name, UN number, Hazchem code and poisons schedule number;
- *description and properties* – appearance, boiling point/melting point, vapour pressure, specific gravity, flashpoint, flammability limits and solubility in water;
- *uses* – all major uses and methods of application;
- *composition* – chemical ingredients listed under chemical name, CAS number and proportion;
- *health hazards* – short term and long term health effects, route of exposure, description of symptoms, toxicity data;
- *first aid* – initial care following exposure, first aid facilities required, advice to doctor;
- *precautions for use* – controls and protection necessary for safe use; and
- *safe handling* – storage and transport, spills and disposal, fire and explosion hazards.

4.14.1.4 EMPLOYER DUTIES

- Obtain Material Safety Data Sheets (MSDS) from suppliers for all hazardous substances used in the workplace.
- Compile a Hazardous Substance Register.
- Ensure all hazardous substances are clearly labelled according to Dangerous Goods Class Labels and Haz Chem Codes.

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- Ensure all employees exposed to a hazardous substance receive appropriate training and instruction.
- Decide whether any improvements should be made to machinery or procedures;
- Decide whether any environmental monitoring should be done; and
- Check that emergency equipment and procedures are adequate.
- Carry out a basic risk assessment by:
  - identifying the hazardous substance by examining the label looking for words such as caution, poison, hazardous and dangerous goods labels;
  - review information from MSDS regarding the toxicity and the precautions to reduce risk;
  - examine the workplace and work practices asking:
    - how often are employees exposed to the substance? and
    - are there fumes, dust or other airborne contaminants exposed to employees?
- take steps to prevent or adequately control exposure to hazardous substances.

4.14.1.5 HEALTH EFFECTS OF HAZARDOUS SUBSTANCES

There are a wide range of health effects that can be caused by exposure to hazardous substances. Harm to health may occur suddenly, such as dizziness, itchy skin, burns, nausea; or it may occur gradually over years, such as cancer. Some people can be more susceptible than others.

Some of the most common health effects of exposure to a hazardous substance include skin irritation or dermatitis, occupational asthma, eye irritation and headaches.

Other health effects include chemical burns from corrosives, damage to the central nervous system, effect on the reproductive system which can effect the developing child, and cancer.

The risks to health posed by hazardous substances depends on the amount of exposure, the way it enters the body and other factors, such as whether a person is exposed to other hazardous substances and the person's own sensitivity to the substance's effect.

The main way that a hazardous substance enters the body is by breathing the substance and then by skin contact. Ingestion is uncommon as a route of entry in the workplace, but is much more common with children.

4.14.1.6 IDENTIFICATION OF HAZARDOUS SUBSTANCES

Employers and contractors should identify all the hazardous substances that are used in the workplace, and obtain information about each hazardous substance by:

- checking the supplier's labels eg: words like warning, poison, hazardous and risk phrases that indicate the type of hazard;
- checking if there is an MSDS from the supplier;
- checking the WorkSafe Australia's List of Designated Hazardous Substances for substances produced at the workplace; and
- where appropriate, getting expert advice.

4.14.1.7 LABELS

Labels are convenient since they are attached to the container but may have limited information, particularly on small containers.

The supplier of any hazardous substance must ensure the container is labelled according the National Code of Practice for the Labelling of Workplace Substances (NOHSC: 2012 (1994)). The chemical names of ingredients must be listed on the label.

Employers must make sure that all containers of hazardous substances used in the workplace are labeled according to the National Code of Practice for the Labeling of Workplace Substances. Substances must be kept in their original container and not kept in a wrongly marked or unmarked container.

Labels should contain:

- signal words (warning/poison/dangerous poison) and dangerous goods class or schedule;
- product name, chemical name, UN number, ingredients and formulation details;
- risk phrases – example flammable, irritating to skin or harmful if swallowed;
- directions for use;
- safety information – for example; avoid contact with skin or do not breathe dust;
- first aid procedures;
- emergency procedures – control of leaks, spills or fires;
- details of manufacturer/supplier;
- expiry date;
- reference to MSDS;
- the identification of the hazardous substance;
- a review of the information on the MSDS and container label;
- an assessment of the risk created by the hazardous substance, the working environment, and work processes;
- a decision whether workers may be exposed to the hazardous substance; and
- a decision on the control measures (including health surveillance and monitoring) needed in relation to the hazardous substance.

Control of measures can be achieved through the application of a hierarchy of measures. Whilst the particular circumstances will influence the control of measures adopted, it is generally agreed that controls should be implemented in the following order of preference:

- elimination from the workplace;
- substitution by a less hazardous substance;
- isolation of the process to control emission of the substance;
- engineering controls (ventilation, containment, etc);
- adoption of safe work practices; and

- where other effective measures of controlling the hazards are not practicable, use of suitable, approved personal protective equipment.

It is essential that all engineering controls, safe work practices and personal protective equipment are effectively maintained. Those using personal protective equipment must be adequately instructed in the fitting, use and care of the equipment.

This will be sufficient at most workplaces. However, if the substances used are particularly hazardous or they are used in unusual circumstances you may need to undertake a more professional assessment.

4.14.1.8 AFTER RISK ASSESSMENT

As soon as practicable after doing an assessment, you must record the following information:

- the date of the assessment;
- the product name or other identification of the hazardous substance;
- whether the degree of risk is assessed to be significant;
- the control measures for use of the substance; and
- the type of monitoring and/or health surveillance, if any, and the intervals at which it must be carried out.

You must then try to prevent exposure (the cause of the risk). If this is not possible, you must reduce the exposure to as low a level as is reasonably practicable. Whatever steps you take, exposure MUST NOT be above the national exposure standard for the substance for the relevant period. If possible, you must reduce exposure without the use of personal protective equipment.

If a risk assessment identifies that monitoring is needed you must:

- make sure monitoring is undertaken as soon as possible;
- record the results;
- ensure a worker who may be exposed to a hazardous substance at the workplace is given a copy of the record; and
- allow a worker who may be exposed to inspect the record at any reasonable time.

Monitoring is the periodic and/or continuous sampling of the air at a workplace to check exposure to a hazardous substance.

4.14.2 DEALING WITH HAZARDOUS SUBSTANCES

There are two principal components which must be considered when dealing with hazardous substances:

- information provisions; and
- assessment and control provisions.

4.14.2.1 RISK ASSESSMENT

Carrying out a risk assessment enables you to assess causes of health risks related to the use of a hazardous substance. It helps you to make a judgement about the risks, and to decide on control measures that are to be put in place. The risk assessment must include:

Personal protective equipment should be:

- properly selected for the individual and task, and of an approved type;
- readily available;
- clean and functional;
- used when required; and
- maintained by appropriately trained staff.

Employees should be trained in use of personal protective equipment, including its:

- appropriate selection and fitting;
- maintenance and storage; and
- use and limitations.

Suitable personal protective equipment should be selected and used in accordance with relevant Australian Standards (published by Standards Australia).

In some emergency situations more specialised personal protective equipment may be required.

4.14.2.2 MAINTENANCE AND SERVICING

A system should be established which will allow early detection of any defect in plant or equipment which could result in a reduced level of protection. Defects should be identified by routine maintenance including:

- visual checks at appropriate intervals to ensure that control measures are being used properly;
- periodic inspection of administrative and operational control measures; and
- testing and preventive service.

Provision should be made for maintenance to be carried out by trained and competent personnel.

Where engineering control measures are used to control exposure, they should be thoroughly examined and tested at specified intervals to ensure performance is consistent with that stated in the assessment report.

Prevention servicing procedures should be established. These procedures should specify:

- which control measures require servicing;
- the nature of the servicing needed;
- the frequency of the service;
- who is responsible for the servicing;
- how any defects noted must be corrected; and
- performance testing and evaluation.

The nature of the servicing will depend on the particular control measure under consideration and the consequences of deterioration or failure of the control measure. The examination and test should be no more extensive than is necessary to disclose any defect or any latent defect. Similar considerations should be used to determine suitable intervals between servicing. The frequency should be matched to the extent of the risk in the event of failure or deterioration of the control measure. The frequency of servicing may need to be increased with the increasing age of the control measure concerned.

All necessary cooperation should be given to the person carrying out the service examination and test to enable it to be carried out correctly and fully. A record of maintenance must be kept for the length of time that the equipment and plant is in operation.

4.14.2.3 EMERGENCY PROCEDURES

In spite of the implementation of all practicable control measures, a leak, spill or uncontrolled release of a hazardous substance could still occur. Established emergency procedures, procedures for safe disposal of the substance and sufficient suitable personal protective equipment should be used, where appropriate, to enable the source of the release to be safely identified and repairs to be made. All those not directly concerned with the emergency should be excluded from the area of contamination.

4.14.2.4 MAINTENANCE, EXAMINATION AND TEST OF CONTROL MEASURES

The mine owner and manager should check that control measures perform as originally intended and continue to prevent or adequately control exposure of employees to hazardous substances.

REFERENCE DOCUMENTS

National Model Regulations for the Control of Workplace Hazardous Substances (NOHSC: 1005 (1994).

National Model Regulations for the Control of Scheduled Carcinogenic Substances (NOHSC: 1011 (1995).

National Standard for the Control of Inorganic Lead at Work (NOHSC: 1012 (1994).

Approved Criteria for Classifying Hazardous Substances (NOHSC: 1008 (1994).

Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment (NOHSC: 1003 (1995).

National Code of Practice for the Control of Workplace Hazardous Substances (NOHSC: 2007 (1994).

National Code of Practice for the Labelling of Workplace Substances (NOHSC: 2012 (1994)).

National Code of Practice for the Preparation of Material Safety Data Sheets (NOHSC: 2011 (1994)).

National Code of Practice for the Control of Scheduled Carcinogenic Substances (NOHSC: 2014 (1995)).

AS 1940 – 1993 The Storage and Handling of Flammable and Combustible Liquids.

AS 2106 – 1980 Methods for the Determination of the Flashpoint of Flammable Liquids (Closed Cup).

AS 2985 – 1987 Workplace Atmospheres – Method for Sampling and Gravimetric Determination of Respirable Dust.

AS 2986 – 1987 Workplace Atmospheres – Organic Vapours – Sampling by Solid Adsorption Techniques.

AS 3544 – 1988 Industrial Vacuum Cleaners for Particulates Hazardous to Health.

AS 3640 – 1989 Workplace Atmospheres – Method for Sampling and Gravimetric Determination of Inspirable Dust.

"Employers and Hazardous Substances", DTIR Workplace Brochure 023, Queensland.

"Workers and Hazardous Substances", DTIR Workplace Brochure 024, Queensland.

"Management of Hazardous Substances on Mine Sites".

"Vital Information for Hazardous Substances", Safety Line, The Magazine, WorkSafe, Western Australia.

"MSDS: What is Adequate Information?", Western Australia, Department of Occupational Health, Safety and Welfare.

"Material Safety Data Sheets", Queensland Department of Employment and Vocational Training and Industrial Relations.

"Code of Practice for the Control of Workplace Hazardous Substances", WorkCover Authority of New South Wales.

"Identification of Hazardous Substances, Risk Assessment and Control", Safety Line, WorkSafe Western Australia.

"Boral OH&S Manual", Boral.

4.14.3 ISOCYANATES, POLYURETHANE

4.14.3.1 PROPERTIES

Polyurethane compounds are formed by the reaction between an organic isocyanate and a polyhydroxy compound. This is the classic two-part mix which, when reacted, forms a highly resistant long-wearing surface coating.

The isocyanate raw material can present a significant hazard in its own right. Use of the two parts should be in accordance with described procedures, or good working practices for the handling and use of hazardous materials.

The polyurethane material is generally considered to be non-toxic. Under normal ambient conditions, cured polyurethane exists as a stable inert solid.

Nevertheless, application of any form of heat, at sufficiently high temperatures, can result in decomposition of the stable structure and the liberation of toxic vapours.

The decomposition products will vary, depending upon the temperatures and the specific polyurethane in use.

The more common decomposition products include hydrogen cyanide, carbon monoxide and oxides of nitrogen.

4.14.3.2 APPLICATIONS

Polyurethane can be a useful polymer compound in underground applications.

Particular value can be obtained from using the material in diamond (or other permanent) drill collars as an aid to installing collar pipes and providing an effective seal. The material is also well suited to other sealing or binding applications where an expanding polymer product is required.

Polyurethane should not be used underground in mines in any situation where there may be a fire or flame or heating to such a degree that the material may smoulder or catch fire.

Major concerns with polyurethane stem from its relatively high flammability and the toxic compounds generated from any combustion.

Two-part polyurethane can combust if too much accelerator is added during its preparation, which will lead to excessive heat (possibly open burning) and the same toxic combustion products.

Control of manufacture and preventing any ignition of the finished product are the only available methods to prevent fire.

4.14.3.3 EMERGENCY RESPONSES

If polyurethane is used underground then the following points should be considered.

Material Safety Data Sheets (MSDSs) should be obtained from the manufacturer prior to the commencement of any work with the material.

Adequate training on safety procedures, mixing and quality control for operators is needed.

As far as practical, sites of polyurethane use should be at the end of a ventilation circuit – so that any products of fire would move directly to exhaust without passing over any other work site(s).

Selected sites should be recorded, and this information – together with specific handling/firefighting information – be available for emergency personnel.

Recording of polyurethane use should be included in the Site Safety Management System to ensure a permanent record is maintained.

4.14.4 CYANIDE

4.14.4.1 GENERAL

Cyanide is a general term indicating the presence of the cyanide ion (CN-). There is a large family of chemical compounds referred to as cyanides and each member of this group contains the cyanide ion. It is this cyanide ion that is responsible for cyanide poisoning.

Significant quantities of cyanide are used in the gold-mining industry in the process is known as Carbon in Pulp (CIP), Carbon in Leach (CIL) and heap leaching.

It is essential that employees be provided with adequate information about cyanide to ensure there is no risk of adverse health effects (both in and outside the workplace) due to the presence of cyanide.

Information or training programs should be provided which include a description of hazard areas, details of potential health effects and procedures for controlling exposure to cyanide compounds.

Exposure to cyanide can result in death and it is important that programs be put in place to monitor and control cyanide levels wherever the material is present in the workplace.

4.14.4.2 CONTROL STRATEGIES

Some important terms used in this Guideline are listed below:

Peak means a concentration limit of cyanide in air that is not calculated as a time weighted average and that should not be exceeded even instantaneously.

Cyanide means cyanide compounds which contain the cyanide ion (CN-).

Plant means a plant wherein cyanide is used in or in connection with mining.

This sections relates to cyanide of standard type and form.

A cyanide program should protect people from:

- ingestion and inhalation of fumes, gases, dust and vapours; and
- skin absorption of gases, aqueous solutions and salts of cyanide.

Everyone who handles cyanide should be:

- adequately instructed in the hazards of using cyanide; and
- trained to operate all safety equipment, including vehicles, pumps, fire protection equipment and breathing apparatus provided to combat an emergency situation.

Appropriate equipment and protective clothing should be made available. It should be capable of protecting persons engaged in the safe storage, handling and transport of cyanide on the mine.

Regular inspections of such equipment are needed to ensure it is fit for use and monthly tests/checks should be recorded in a report.

The mine operator should keep the nearest hospital informed that cyanide is being used at the mine and develop a strategy with the hospital if cases of poisoning are suspected.

Good personal hygiene should be promoted, especially the washing of hands and face after handling cyanide.

Food, beverages, and/or tobacco should not be consumed within areas where cyanide solutions are employed.

Any cyanide spillage or leakage should be immediately cleaned up and disposed of in a safe manner.

When treatment operations at a mine are terminated, all cyanide should be neutralised, disposed of, or removed from the site to eliminate hazard to any person.

The mine operator should ensure that prior to the cessation of operations the results of all tests show no toxic cyanide compounds remain on the mine.

Strong cyanide solutions may need to be identified by colour different from any other solutions in use within the plant or mine.

4.14.4.3 EXPOSURE

Showers should be provided close to where the compounds, solutions or gases are being used.

Where cyanide exposure can be expected, the general manager should ensure that:

- emergency and first aid procedures are displayed in a prominent position; and
- all persons working with cyanide are instructed in the procedures necessary for emergency treatment.

4.14.4.4 PROTECTIVE CLOTHING

Appropriate dust and gas respirators, eye protectors, impervious gloves and other protective clothing need to be provided for everyone who may be exposed in areas where cyanide is used.

This protection needs to be:

- a clean location and maintained in good order and condition; and
- cleaned at regular intervals to ensure it is safe and effective when used.

Respirator cartridges should be changed regularly and dates of change noted.

Full body protection may be needed in some circumstances to prevent absorption into the body through the respiratory system and the skin.

Protection should be provided for everyone who may be at risk of exposure.

4.14.4.5 WORKPLACE ASSESSMENT

The Peak imitation exposure standards are:

- for airborne cyanide salts – 5 milligrams of cyanide per cubic metre TWA; and/or
- hydrogen cyanide gas – 10 parts per million of hydrogen cyanide per cubic metre.

4.14.4.6 MONITORING AND SAMPLING

Sampling and tests for airborne cyanide salts and hydrogen cyanide gas should be:

- carried out by using appropriate methods; and
- carried out at regular intervals.

A cyanide program may need to specify that sampling wells or trenches should be placed below any earth tanks, tailings pond or leach pond containing cyanide solutions in order to monitor any solution loss that may contaminate groundwater.

The operating efficiency of fans or other appliances, and means of suppressing or collecting dust, should be regularly examined.

The operation and maintenance of any metering or monitoring device used in connection with the emission or control of airborne cyanide salts or hydrogen cyanide gas should be calibrated on a routine basis.

The results of all monitoring and sampling undertaken and of every check, test or examination carried out in connection with the use of cyanide should be recorded and reported to the general manager.

4.14.4.7 STORAGE

A person should be appointed to be responsible for cyanide storage.

Cyanide should be and stored in a well – ventilated, secure enclosure.

All non-returnable cyanide containers should be washed clean or otherwise decontaminated before they are removed from the mixing area.

The washwater derived from cleaning of the cyanide containers should be directed into the mill or tailings circuit or securely held in an isolating package.

In the storage area all cyanide containers should be marked clearly – advising of the contents, volumes, concentrations and hazards, with signs complying with AS 1319 Safety Signs for the Occupational Environment.

Only dry chemical fire extinguishers should be used for firefighting purposes in cyanide storage areas.

In no cases should water be used to combat a fire in cyanide storage areas. Acids, nitrates, peroxides and chlorates should be stored in a separate building away from cyanide. This avoids any contamination of the cyanide.

Where concentrated liquid cyanide is stored in tanks exceeding 1,000 litres, a bund should be constructed to locally contain any leakage.

The bund should be constructed of compacted clay and be capable of retaining at least 100 per cent of the stored volume.

The bunded area should be kept clean at all times. No person should enter the tank used for cyanide preparation until it has been tested for fumes, gases or vapours and declared a safe area. A permit to enter and confined space procedures should be adopted.

Persons involved in testing and or cleaning should wear and use protective clothing and equipment provided for that purpose.

4.14.4.8 PLANT OR MINE CONTROLS

Fencing

When extra security is needed the plant or mine should be fenced.

Entrance to the plant or mine should be provided by a man-and shock-proof gate. This should be kept locked at all times when the plant or mine is closed down.

Poison notices should be posted at prominent places.

Such poison signs should comply with AS 1319 Safety Signs for the Occupational Environment.

Escape of cyanide

Control on measures should be set in place to prevent the escape of cyanide from the mine, treatment plant and tailings area.

Diversionary channels should be constructed to minimise runoff into the mine, treatment plant or tailings area.

Adequate freeboard on retention structures should be provided around the mine, treatment plant and tailings area to cater for runoff during rainy spells.

The cyanide discharged from the mine, plant and tailings areas should be neutralised to ensure any effluent is acceptable for discharge into recirculation circuits.

Before excess volumes of cyanide solution are disposed of they should first be made alkaline, and then rendered inert by adding sufficient ferrous sulphate, or hypochlorites. An adequate stock of these chemicals should be maintained for this purpose. This operation should be carried out slowly to dilute the solution with other liquids in the disposal systems.

After cyanide solution has been run into any drain the drains or channel should be flushed immediately with large quantities of water.

Appropriate authorities should be notified prior to such any disposal action of this nature.

Pipelines

A pipeline used for the conveyance of cyanide should comply with AS 1345 Identification of the Contents of Piping, Conduits and Ducts (incorporating Amdt 1).

The pipeline should be reasonably protected from mechanical damage and if possible bunded to prevent escaping fluids leaving the mining lease.

Discarded pipelines and equipment should be destroyed to prevent their reuse.

Potable water outlets or other water outlets should also be identified and kept separate from those conveying cyanide solution.

Ventilation

Where mechanical ventilation is installed to exhaust cyanide vapours the duct should be at least 3 metres above ground level or working area to permit safe dispersal.

Dangerous cyanide-bearing emissions should be entrapped and exhausted so that no person may be exposed to higher concentration of airborne cyanide salts and hydrogen cyanide gas as specified in the above paragraph on Workplace Assessment.

An analysis of the exhausted products from the mechanical ventilation system may be needed to determine whether suppression measures are required to reduce airborne cyanide salts or hydrogen cyanide gas to an acceptable level.

Mixing

Cyanide solutions should not be mixed in a tank which has been used for copper sulphate mixing, zinc sulphate mixing, or other acidic material.

Tanks used for mixing cyanide solutions should be used for no other purpose.

Cyanide solutions should not be mixed by air agitation methods.

4.14.4.9 UNDERGROUND FILL

When tailings for underground fill is used, and may contain cyanide, a risk assessment should be conducted to evaluate and control exposure to persons during placement.

Tailings used for construction purposes other than for filling stopes underground should be treated when necessary to destroy the toxic compounds.

Adequate ventilation should be maintained through any workings which are being filled with tailings containing cyanide or other material to safeguard anyone working or travelling in the area.

4.14.4.10 EQUIPMENT MAINTENANCE

Inspection, cleaning and repairing of tanks and other equipment used for solutions of cyanide should be undertaken by a competent person.

Any tank undergoing maintenance should be completely drained of all cyanide solution as completely as possible and any encrustation or deposits which may be loosened by maintenance work should be removed and disposed of in such a manner as not to present a further hazard to any person. A permit to enter is required and confined work space procedures should be adopted.

The atmosphere in any tank undergoing maintenance should be tested for the presence of hydrogen cyanide and cyanide salts to ensure it does not contain a dangerous airborne concentration of these or other materials before a person is permitted to enter a tank.

Any tank undergoing maintenance should be flushed with fresh water and fresh air in order to ensure a best working environment and an adequate oxygen supply.

While any person is working in the tank it should be supplied with a continuous flow of clean air.

Equipment used in the inspection, cleaning and repairing of a tank should be washed and vented after use.

If airborne concentrations of hydrogen cyanide or cyanide (salts) exceed the acceptable limits, immediate action to eliminate the cause of the elevated airborne cyanide concentration will be needed.

4.14.5 ASBESTOS AND ASBESTIFORM MINERALS

The presence of asbestos in the mining industry and the potential for exposure, arises from a number of sources:

- naturally occurring in material being mined, both waste and ore;
- products or waste produced during processing operations, eg crushing and screening; and
- materials and compounds used in a wide range of applications throughout the mining industry, for example: brakes, gaskets, lagging and insulation.

Note: There have been concerted efforts to remove asbestos-containing materials and components and to ban their use throughout the mining industry.

Nevertheless, it is possible that these sources of asbestos may remain for some time until all planned removal/banning programs take full effect. In the situations encountered in the mining industry, exposure levels are generally minimal and the potential for adverse health effects is low.

However, the effects of exposure to asbestos may be insidious and only become manifest in the long-term (after 15 or more years).

NOHSC have prepared a number publications regarding the control of abestos hazards. These include:

NOHSC: 2002 Code of practice for the safe removal of asbestos. (1988).

NOHSC: 3002 Guide to the control of asbestos hazards in buildings and structures. (1988).

NOHSC: 3003 Guidance note on the membrane filter method for estimating airborne asbestos dust. (1988).

4.14.5.1 ASBESTOS OCCURRENCE

Asbestos is the generic term for naturally occurring fibrous crystalline silicate minerals. There are two major groups of asbestos.

The serpentine group contains chrysotile (commonly termed white asbestos), the most abundant form of asbestos. The amphibole group contains amosite (brown or grey asbestos), crocidolite (blue asbestos), tremolite, actinolite and anthophyllite.

During exploration activities, diamond drill cores through an orebody and associated country rock represent a very small cross section, and the statistical probability of core drilling intersecting isolated veinlets of asbestos is low.

Conversely, in quarries and open cuts a complete exposure of large surfaces is made and the probability of exposing or detecting fibres is much greater.

In underground development, where the surface exposure is somewhere between these two extremes, small veinlets are occasionally found.

4.14.5.2 RESPONSIBILITY

Mine owners and operators have a responsibility in relation to asbestos to:

- provide and maintain, so far as practicable, safe and healthy work environments and practices generally, and have written policies on the control of asbestos;
- comply with legislative provisions;
- provide adequate instruction and training for employees and supervision of health and safety measures;
- consult with employees, their representatives and organisations and the government organisation on the control of exposure to airborne asbestos;
- anticipate the need for the control of asbestos risks to be initiated in any particular case;
- provide appropriate protective clothing and equipment and hygiene procedures and personal decontamination facilities; and
- prepare, complete, and submit documents for obtaining necessary approvals.
- consult on health and safety matters generally and on measures that may need to be taken on asbestos in occupied areas, on machinery and equipment;
- keep themselves informed of advice given by competent persons in relation to inspections and meet health and safety commitments;
- cooperate on any reasonable request for the variation to work hours and hours of work; and
- advise members of their obligations and responsibilities under occupational health legislation.

Employees have a responsibility in relation to asbestos to:

- comply with instructions given for their own safety and health and that of others generally and in work procedures related to asbestos;
- cooperate with supervisors and managers in their fulfilment of legislative obligations;
- take care of their safety and health and that of others, and abide by their duty of care provided for in legislation;
- report immediately to their supervisor any perceived safety or health risk;
- wear and maintain in good order all protective clothing and apparatus provided by the manager or supervisor for personal protection and maintain same in good order; and

- ensure all equipment is in good working order.

For asbestos mine tailings rehabilitation projects and by agreement, the property owner's (or owners') responsibilities may be handled by the organisation responsible for letting the tender to rehabilitate the mine tailings.

Consultation

Full consultation, involvement and information sharing should occur between mine operators and employees through a well-established consultative mechanism.

Adequate consultation and involvement of all employees should occur at each of the inspection, identification, evaluation and control processes and should consider individual and collective problems.

Adequate consultation should be established between persons residing in close proximity to the site and every effort should be made to understand the concerns of such persons and to achieve a satisfactory resolution.

4.14.5.3 IDENTIFICATION OF ASBESTOS

The types of potentially airborne dusts and types of potentially airborne asbestos dust should be identified prior to the commencement of the operation and should be continued during the mining, processing and rehabilitation process to ensure the appropriate dust limits are applied.

The identification of dust particles and fibres should be made from airborne dust samples and from samples collected from ore rock and excavated mine tailings where possible.

Dust identification should be carried out by competent people.

All relevant data from visual inspections of airborne asbestos should be systematically recorded in a dust assessment register, which is made available to all parties.

4.14.5.4 IDENTIFICATION OF HAZARDS

As stated, the major hazard from asbestos is by inhalation. The mine operator should initiate a system for the reporting, recording and action taken to correct the malfunction of machinery and protection equipment from threatening the safety of persons on and off the mine site.

Material should be handled in such a way that it does not present a significant health risk.

The concentrations of airborne asbestos fibres and other dust where applicable should be evaluated using the Membrane Filter Method.

The health hazards associated with the exposure to asbestos dust include mesothelioma, lung cancer and other pulmonary conditions. For further information on the health hazards of asbestos, see Appendix 4.4.

Adequate controls should be established and maintained to minimise exposure.

4.14.5.5 RISK ASSESSMENT

A risk analysis should be conducted by competent persons when the methods of mining, treatment, rehabilitation and duration of the project have been determined. The assessment should consider the risk to employees and members of the public.

It is desirable to project for the shortest reasonably feasible duration in order to achieve risk factors not greatly in excess of other industries and to aim for a wet process to minimise the risk.

The following principles apply when handling asbestos:

- The ultimate aim is that no person be exposed to airborne asbestos.
- The method of handling of asbestos should be determined by the condition and location of the asbestos.
- Asbestos presents a risk only if fibres of a respirable size. become airborne and the potential exists for persons to inhale them. The risk to health increases as the number of fibres inhaled increases.
- No person should be exposed to risk of inhaling asbestos in the course of employment without being provided with full information of the occupational health and safety consequences of exposure and appropriate control strategies.
- No person should be exposed to risk of inhaling asbestos whether employed or

residing in close proximity to the handling of asbestos.

- At present, it is not possible to assess whether there is a level of exposure in humans below which an increased risk of cancer would not occur.

Accordingly, exposure should always be limited to the minimum level feasible.

Persons employed in the handling of asbestos-bearing rock, tailings or soils should be suitably protected.

The recognised occupational exposure standard is that recommended by Worksafe Australia. That exposure is 0.5 fibres per millilitre of air for asbestos dust – chrysotile, and 0.1 fibres per millilitre of air for asbestos dust – amosite or crocidolite.

The recognised method used to monitor and determine the exposure of persons and levels of asbestos-bearing dusts is the Membrane Filter Method as endorsed by Worksafe Australia.

Areas or storage facilities containing asbestos should be labeled or have appropriate warning signs.

4.14.5.6 MONITORING

An airborne asbestos monitoring program is necessary in order to determine whether the precautions and work procedures are being applied in a satisfactory manner, and that permitted asbestos exposure levels are not exceeded.

Air monitoring is not intended to be used as a preventive or control measure, but as a check at intervals, which may be random, in order to ensure that control procedures are operating satisfactorily and that workers are not being exposed to harmful environments.

The location and frequency of air monitoring is very much dependent upon the method of operation, the air quality of workplaces, the monitoring history at the particular site and the possible consequences of future releases.

The need for further monitoring and its frequency should be determined on the basis of the results obtained. Problem areas, or neighbouring regions with a high occupancy of unprotected persons, should be monitored routinely every shift until control is achieved to an acceptable level. Consistently clear areas may only require a random sample.

The determination of airborne asbestos concentrations should be made in accordance with the detailed method set out in NOHSC Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Dust.

Briefly, this determination is achieved by drawing an accurately measured volume of air through a specially prepared membrane filter and thereafter counting the number of asbestos fibres collected on this filter, using an optical microscope. These data can then be used to calculate a result for personal samples (cf. below) which may be compared to the recommended exposure standard. Comparison with this exposure standard is only valid if the detail of this method is observed.

Static air samples (which may be taken over a short period) at a fixed location can only serve as an indicator of the effectiveness of contamination control. Comparisons between samples taken for engineering control and the recommended exposure standard are not valid. Worker exposure can only be estimated from personal samples attached to, and taken within, the breathing zone of the individual. These personal samples should preferably extend over an entire shift, or at least 4 hours.

Since the measurement of airborne asbestos concentration is an important and highly skilled process, the monitoring should only be carried out by suitably trained personnel who have been instructed in the sampling techniques and analytical procedures.

It should be noted that the Membrane Filter Method is the only technique which can be used to determine compliance with the asbestos exposure standard, and where monitoring is undertaken to this end, it must be done by that method and should be performed by personnel registered by the National Association of Testing Authorities, Australia (NATA) or government-accredited, when available. However, because of the four-hour sampling period required, and the subsequent time needed for sample preparation and counting, it may not be of sufficiently informative value during the course of, for example, short-term asbestos disturbance, control, or removal operations. In such circumstances more reliance should be placed upon frequent visual inspections.

The results of air monitoring should be made available to workers in the area, and the site supervisor notified immediately if the fibre count exceeds the recommended level.

4.14.5.7 PERSONNEL REGISTERS

The mine owner or operator engaged to complete a mine rehabilitation project should maintain a personnel register which should contain the following information:

- the full name of all persons employed;
- the duration of employment;
- address;
- age;
- occupation(s);
- dust monitoring results;
- training;
- issue of personal protection; and
- medical examinations.

4.14.5.8 RISK CONTROL

An asbestos management program should be seen as part of an organisation's overall approach to risk management. Where the evaluation process has revealed a likelihood of exposure to asbestos fibres, all practicable steps should be taken to ensure that employees are not unnecessarily exposed. A thorough examination of work practices is an essential preliminary action.

Procedures designed to ensure that employees are not exposed to asbestos to an extent likely to cause danger to their health should then be adopted.

The procedures required may include:

- engineering controls;
- safe working procedures;
- personal protective equipment;
- cleaning, decontamination and waste disposal;
- education and training;
- airborne dust monitoring; and/or
- medical surveillance.

Consultation should accompany each step.

The control of asbestos hazards should utilise the most appropriate method applicable to the particular circumstances. Based upon the assessment of the condition of the asbestos, the possibility of erosion of mine tailings dumps and the potential for exposure of personnel to airborne asbestos, the methods of control should be established.

4.14.5.9 REQUIREMENTS FOR OPERATION

Establishment of site

Any area containing asbestos should be proclaimed a restricted area and the boundary of the restricted area enclosed by a fence with signs fixed thereon at specified intervals.

Entry into the restricted area should be restricted to personnel directly engaged in the asbestos removal or persons on official business.

The distance of the boundary fence from the mine site may be determined in consultation with the appropriate authority.

Planning and programming of operation

Major points for early consideration include:

- safety of personnel;
- identification of types of asbestos involved;
- for an asbestos tailings rehabilitation operation, program of commencement and completion dates, although it should be recognised that unforeseen problems with the operation cannot always be ascertained prior to removal work commencing;
- responsibility for the supply and application of fencing, waste containers and warning signs;
- transport facilities;
- availability of water, power (electricity), heat, light and drainage;
- waste disposal responsibilities and clean-up requirements;
- notification to, and approval from, regulating authorities where necessary; and
- responsibility for air monitoring.

Mining earthmoving

Where machinery is used for mining or earthworks:

- wherever possible, wet methods of dust control are preferable and should be used;
- vehicular movement on the site should be restricted as a precautionary measure;
- water-spreading tanker trucks should be used in conjunction with earthmoving machinery, especially on roads;
- water sprays should be used on or in conjunction with machinery as necessary, especially on roads;
- air conditioned cabins should be provided on all static plant and earthmoving machinery, and a program for maintenance of filters;
- scrapers should not be used on rock containing asbestos.

Additional underground precautions

- Exposed asbestos in situ underground (in solid face or roof) should be isolated with appropriate sealants or bonding agents, eg epoxy-based paint, shotcrete or cement grout.
- Underground airflows should be routed to avoid contamination of working places.

Maintenance and cleaning procedures

For the maintenance and cleaning of machinery and other items:

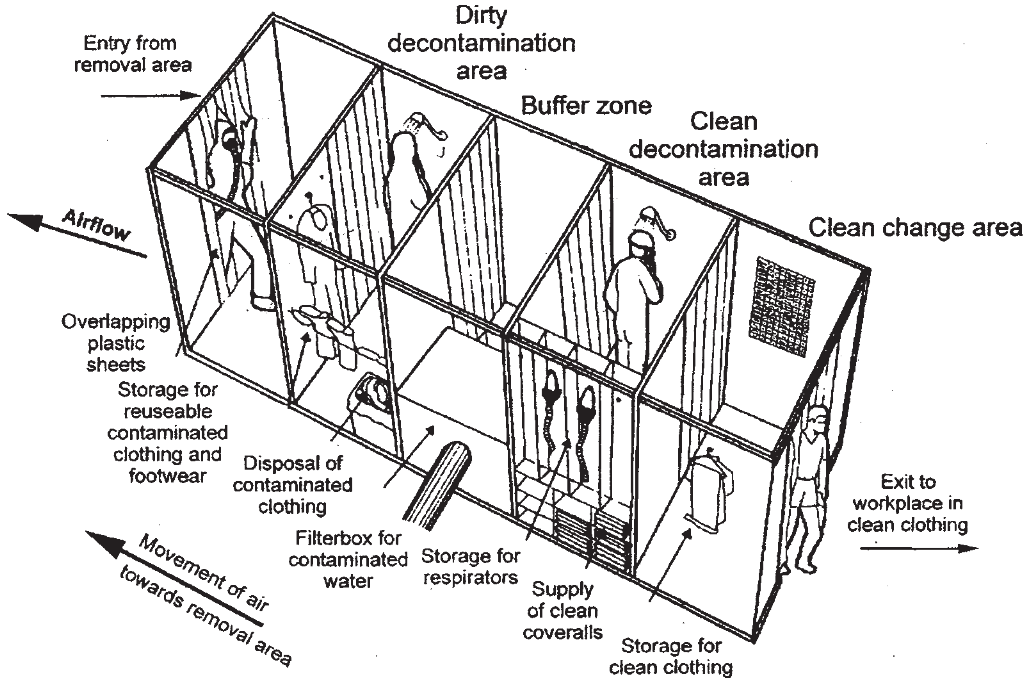
- all vehicles should be hosed down at a designated area at the end of each shift to remove accumulated dust;
- cabins of all vehicles on site should be cleaned regularly using water or a vacuum cleaner approved for use with asbestos;
- vehicles should be thoroughly washed before leaving the site;

General hygiene

Those working with asbestos materials need a high standard of hygiene and good housekeeping to ensure that asbestos dust is not taken from the workplaces to other environments.

Work clothing should not be taken home or worn away from the work site.

Figure 4.19 Decontamination facilities



People should not eat, drink or smoke at the asbestos-bearing site as this would require the removal of respirators, potentially exposing workers to high concentrations of asbestos dust.

Decontamination facilities

In many instances, the only satisfactory method of providing appropriate changing facilities is by the provision of a mobile or specially constructed on-site unit.

A decontamination facility, which includes showering facilities, should be located within the restricted area and on the boundary of the restricted area. This facility will allow persons on completing work to remove their clothing, shower and dress with normal clothes and exit via a door which faces an opening at the boundary of the restricted area.

Changing facilities where a decontamination unit is inappropriate

Where the decontamination facilities described earlier are deemed to be inappropriate, the operator should provide a modified changing facility.

This facility should contain four separate sections, including:

- contaminated clothing/equipment area;
- work clothes locker area;
- shower facilities; and
- clean clothes locker area.

It should be installed near the restricted area boundary fence and be adequately ventilated.

Offices, first aid room and parking

All offices, first aid room and parking facilities should be located outside the restricted area and preferably near the property boundary or access gate from the public road,

All offices and first aid room should be positively ventilated with filtered air and be supplied with clean wholesome water.

Waste collection and disposal

Asbestos-contaminated articles, residue from cleaning change rooms, gloves, masks and other equipment should be placed in containers such that the integrity or security of this containment is not damaged during handling and transportation.

All asbestos-contaminated waste material should be buried at the site, preferably with the mill tailings.

Protective equipment

The degree of respiratory protection required is determined by the nature of the project, the type of asbestos and the potential for exposure to dust.

Respiratory protective equipment used in asbestos site work should conform to the requirements of Australian Standards AS/NZS 1715 Selection, Use and Maintenance of Respiratory Protective Devices and AS/NZS 1716 Respiratory Protective Devices.

Supervisors should be familiar with these recommendations and should ensure the provisions are adhered to at all times. Arrangements should be made for regular inspections and servicing of non-disposable respirators.

Protective clothing

Asbestos does not enter the body through the skin, and has no harmful effect on the skin. Thus working in an asbestos environment itself does not call for the wearing of any special skin covering, although any asbestos deposited on the skin and in the hair must be scrubbed off before leaving the decontamination area.

The selection of protective clothing is therefore determined not by asbestos exposure but by climate, degree of physical exertion required, the other hazards involved in the work, and ease of decontamination.

As several variables influence the type and amount of clothing worn in an asbestos environment, decisions on what is appropriate in the particular circumstances should always be based on consultation between mine managers and employees.

The laundering of protective or work clothing in workers homes should be strictly prohibited.

Vacuum cleaning equipment

All vacuum cleaning equipment used in association with asbestos removal should conform with the requirements of the appropriate Australian Standard AS 3544 Industrial Vacuum Cleaners for Particulates Hazardous to Health. In particular, all extracted air should pass through a HEPA filter before discharge into the atmosphere.

Inspection of equipment

All equipment used for the removal of asbestos-based material should be listed in a register containing details of the examination, state of equipment and repair (if any) should be maintained.

Suppression of dust

Every effort should be made to minimise the generation of dust and minimise asbestos dust exposure.

Sources of dust must be sprayed or saturated with water or water with surfactant to suppress airborne dust.

Labelling and warning signs

Material containing asbestos should be labelled in an approved manner.

These warning signs should be placed on containers which hold asbestos ore, asbestos-bearing rock and asbestos mill tailings, as well as containers for disposal of contaminated equipment, clothing and materials.

Labels used for this purpose must identify the material as containing asbestos and should comply with Australian Standard AS 1216 Labels for Dangerous Goods.

All warning signs should comply with Australian Standard AS 1319 Safety Signs for the Occupational Environment.

An example of these signs is shown below.

CAUTION ASBESTOS
RESPIRATORY PROTECTION
MUST BE WORN
NO ADMITTANCE – ASBESTOS
REPORT TO MINE MANAGER

An alternative international symbol may also be used for labelling of asbestos-containing products.

4.14.5.10 TRAINING AND EDUCATION

Prior to engagement in the specified work, all asbestos workers should be instructed in the relevant aspects of asbestos health hazards, safe working procedures, and the wearing and maintenance of protective clothing and equipment.

4.14.5.11 MEDICAL SURVEILLANCE

It is generally accepted that medical examination of workers exposed to asbestos cannot detect asbestos-related disease at a stage where intervention could lead to recovery. The primary prevention should be directed to reducing or eliminating exposure.

Nevertheless, it is recommended that all workers in all potentially hazardous trades should receive health surveillance through the workplace.

The frequency of examinations may be determined on the basis of the findings at the initial examination, including factors such as the past history of occupational asbestos exposure. This may require liaising with an occupation hygienist concerned in environmental management.

4.14.5.12 MINE CLOSURE OR TAILINGS REHABILITATION

On completion of operations, all mobile equipment and plant within and outside the restricted area should be decontaminated.

All contaminated clothing, protective equipment, respirators and all asbestos-contaminated materials should be buried on site.

4.14.5.13 ASBESTOS APPENDICES

APPENDIX 4.4

Risk of asbestos-related disease (based extensively on report by Dr I Young, WorkCover Authority.)

Asbestos-related disease is the result of the inhalation of respirable fibres. The fact that a fibre can be inhaled does not mean that it is respirable. A respirable fibre is one that remains suspended in the inspired air stream and can reach the periphery of the lung. The term respirable fibre should be defined in the Document along conventional lines, ie in terms of its geometry.

Asbestosis

Exposure

The risk is dose-dependent. Dose is a function of the concentration of respirable fibres in the inspired air and the duration of exposure.

It appears that of the most commonly used varieties the risk is higher with the amphiboles than chrysotile. In industry, even in "the bad old days" when levels of 100 respirable fibres/millilitre (fibres/ml) were not uncommon the disease was unusual with less than 5 years of heavy exposure. Since the mid 1970s it is probable that 10 years to 15 years is the minimum exposure.

There is a time lag of 15 years to 30 years between exposure and the development of disease. The subsequent development of disease is independent of exposure continuing during that interval. This latent interval does not appear to be as dose-dependent as is the risk of disease.

Prognosis

The prognosis for asbestosis cases is related to the severity of the disease. Once established, the condition is chronic and progressive, even when the original exposure was relatively remote in time – although the condition may remain stationary for many years. Continuing exposure appears to have little influence on the rate of progression.

Lung cancer

The association of lung cancer with asbestos exposure was first suggested in 1935. Richard Doll is usually credited with confirming the association in 1955. He demonstrated a 10–fold increase in risk for bronchogenic carcinoma in United Kingdom asbestos textile workers employed for more than 10 years – and whose employment commenced prior to 1930. However, the association had been accepted in Germany in 1943 for the purpose of compensation.

There is a time lag between exposure and diagnosis. Duration of the time lag is related to the intensity of the exposure. Fifteen years appears to be the minimum latent interval, and the peak incidence occurs 20 years to 30 years after the onset of exposure.

The effects of tobacco smoking and asbestos have been regarded as synergistic, which would lead to an exceptionally increased risk amongst smoking asbestos workers. This proposition has been recently re-examined and it is suggested that the combined risks may be additive only.

With regard to dose and risk for carcinoma of the lung: when assessing the risk of any carcinogenic agent it is customary to assume that there is no safe threshold of exposure, ie any dose is associated with an increased risk, no matter how small that increase in risk may be. Due to problems in detecting a small increase in incidence above the background level, and difficulties in accurately assessing past exposure levels retrospectively amongst asbestos workers, this assumption may be impossible to confirm empirically.

However, it does appear that in practice, amongst non-smoking asbestos workers at least, the risk may only be significantly increased with exposure levels similar to that associated with the development of asbestosis.

It has been suggested that it is precisely only those who have developed asbestosis that may develop lung cancer as a result of their asbestos exposure, and even that the presence of fibrosis is a necessary precursor to its development.

Malignant mesothelioma (of pleura or peritoneum)

Australia leads the world in the incidence of malignant mesothelioma as a result of the crocidolite mine at Wittenoon – and this rate is steadily rising.

The number of Australian workers dying from mesothelioma has almost tripled in the past 10 years. In 1981, 110 deaths were recorded, compared to 314 last year.

A total of 2,051 cases have been notified in the past ten years. 1,141 of those cases were between 1986 and 1990 and 910 between 1980 and 1985. It is projected that a further 6,000 cases will occur over the next 20 years!

The majority of mesothelioma cases are pleural and asbestos related. Only 26% of those reportedto the Australian Mesothelioma

Surveillance Program between 1979 and 1985 had no evidence of occupational or other asbestos exposure.

The risk is dose-dependent. However, the risk of developing mesothelioma is increased at far lower levels of exposure than for carcinoma of the lung. The risk is much higher with crocidolite exposure.

There is a long latent interval between exposure and the recognition of the condition, ranging up to 40 years. The median time of survival after diagnosis, nine months with or without treatment, is very short. Clearly prevention is the only approach.

Pleural plaques

Pleural plaques are localised areas of pleural thickening which occur over the parietal pleura. From experience they are the most common expression of past occupational asbestos exposure. They are symptomless and diagnosed by their appearance on a chest X-ray.

The significance of pleural plaques is that they are markers of past asbestos exposure. They do not predispose to malignant mesothelioma.

Bilateral diffuse pleural thickening

Diffuse pleural thickening of both the visceral and parietal pleura may be associated with some restriction and impairment of lung function. The condition is now accepted by the United Kingdom Social Security Act as an asbestos disease which may cause disability eligible for compensation.

Risk from low levels of exposure

Low level here refers to:

- the levels found generally in regulated industry; and
- the levels found in schools, public buildings, and outdoors.

There are three major variables that determine the risk of exposure to asbestos.

- Fibre type.
- Fibre dimensions.
- Dose.

Fibre type

The risk of asbestos-related disease is greater with the amphibole asbestos minerals than with chrysotile. This is particularly so with crocidolite exposure, with the risk for malignant mesothelioma.

Fibre dimensions

Experimentally, short fibres (<5 microns) appear to cause neither fibrosis nor tumour. The majority of fibres found in schools, public buildings, and outdoors are short. In asbestosis the number of fibres <3microns diameter, and >5 microns in length are important. For malignancies even thinner (<0.25microns), and longer (>8 microns) fibres are the most potent.

Dose

Dose is usually regarded as a function of the duration of exposure and the level of exposure (ie the fibre count). In practice, the situation may be far more complex, with interactions between these two variables which have not been clarified.

Levels found in public buildings and outdoors are usually less than 0.0005 fibres/millilitre for fibres >5microns in length. At these levels there appears to be no risk for asbestosis. The question comes down then to the risk for malignant disease – in particular, carcinoma of the lung and malignant mesothelioma.

Carcinoma of the lung

This is discussed above. The risk in non-smoking asbestos workers in the absence of asbestosis is now thought to be low or negligible.

Malignant mesothelioma

Fibre counts of up to 1 million fibres/gram of dried lung tissue have been measured at autopsy in occupationally unexposed Sydney males.

The background incidence rate of malignant mesothelioma is 1 million person years. This suggests that the lungs can harbour relatively high levels of asbestos and that the risk from low levels of exposure may not be great.

REFERENCE DOCUMENTS

AS/NZS 1715 – 1994 Selection, Use and Maintenance of Respiratory Protective Devices.

AS/NZS 1716 – 1994 Respiratory Protective Devices.

AS/NZS 2161 Occupational Protective Gloves

AS/NZS 2210 Occupational Protective Footwear.

AS 3544 – 1988 Industrial Vacuum Cleaners for Particulates Hazardous to Health.

Health and Safety Notes – Asbestos – An Outline of Legislation Requirements and Sources of Information. WorkCover Authority NSW October 1989.

National Health and Medical Research Council (NHMRC): Code for the Safe Removal of Asbestos-based Thermal/Acoustic Insulating Materials. NHMRC Canberra 1979 (Amended 1981).

US Department of Labor; Occupational Safety and Health Administration (OSHA): Work Practices and Engineering Controls for Major Asbestos Removal, Renovation and Demolition Operations – Non Mandatory. Appendix F Section 1926.58, 1986.

Health and Safety Commission (UK): Work with Asbestos Insulation and Asbestos Coating – Approved Code and Guidance Note, HMSO, London, 1985.

NOHSC: 2002 Code of practice for the safe removal of asbestos. (1988).
NOHSC: 3002 Guide to the control of asbestos hazards in buildings and structures. (1988).

NOHSC: 3003 Guidance note on the membrane filter method for estimating airborne asbestos dust. (1988).

WA Department of Minerals & Energy, Medical Bulletin No. 5 Cynaide Poisining, January 1999.

DANGEROUS GOODS CLASS	SUB CLASS	DESCRIPTION
Class 1 – Explosives		Substances and articles used to produce explosions or pyrotechnic effects.
	Class 1.1	Explosives with a mass explosion hazard.
		Examples: TNT, nitroglycerine, ANFO.
	Class 1.2	Explosives with a projection hazard, but not a mass explosion hazard.
		Examples: bombs, anti-hail rockets.
	Class 1.3	Explosives with a fire hazard and either a minor blast hazard or a minor projection hazard, or both, but not a mass explosion hazard.
		Examples: propellant powder, display fireworks.
	Class 1.4	Explosives which present no significant hazard.
		Examples: toy fireworks, safety cartridges.
	Class 1.5	Explosives which are very insensitive, but have a mass explosion hazard.
		Examples: proprietary explosives such as Detapower.
	Class 1.6	Explosives packaged so that they are extremely insensitive, and do not pose a mass explosion hazard.
Class 2 – Gases		These are gases which have been compressed, liquefied or dissolved under pressure.
	Class 2.1	Flammable gases.
		Examples: acetylene, hydrogen, LP gas.
	Class 2.2	Non-flammable, non-toxic gases.
		Examples: oxygen, nitrogen, air, airgon.
	Class 2.3	Poisonous gases – gases liable to cause death or serious injury to human health if inhaled.
		Examples: ammonia, chlorine, carbonmonoxide.
		Note: Packages of Class C1 and Class C2 must not carry a Flammable Liquid Class Label.
Class 3 – Flammable Liquids		These are liquids which can be ignited and will burn.
	Class 3 PG I	Highly flammable liquids – liquids with an initial boiling point not greater than 35˚C.
		Examples: diethyl ether, carbon disulfide.
	Class 3 PG II	Highly flammable liquids – liquids with an initial boiling point greater than 35˚C, and a flash point less than 23˚C.

		Examples: petrol, acetone, ethyl methyl ketone, ethanol.
	Class 3 PG III	Flammable liquids – liquids with a flash point of 23°C or more, but less than or equal to 61°C.
		Examples: kerosene, mineral turpentine.
	Class C1	Combustible liquids – liquids with a fire point less than their boiling point, and a flash point greater than 61°C, but less than or equal to 150°C.
		Examples: dieseline, home heating oil.
	Class C2	Combustible liquids – liquids with a fire point less than their boiling point, and a flash point greater than 150°C.
		Examples: lubricating oil, peanut oil.
Class 4 – Flammable Solids		
	Class 4.1	Flammable solids, self-reactive and related substances and desensitised explosives – solids easily ignited and readily combustible.
		Examples: nitrocellulose, phosphorus, matches, hexamine.
	Class 4.2	Substances liable to spontaneous combustion.
		Examples: aluminium alkylís, white phosphorus.
	Class 4.3	Substances which emit flammable gases when in contact with water.
		Examples: aluminium phosphide, calcium carbide.
Class 5 – Oxidising Substances		
	Class 5.1	Oxidising agents.
		Examples: hydrogen peroxide, calcium hypochlorite (dry pool chlorine), ammonium nitrate.
	Class 5.2	Organic peroxides (liquid or solid).
		Examples: methyl ethyl ketone peroxide, benzoyl peroxides, cumyl hydroperoxide.
Class 6 – Poisonous and Infectious Substances		These are poisonous (toxic) and infectious substances (excluding poisonous gases).

	Class 6.1(a)	Poisonous substances – substances of PG I or PG II (which may be solids or liquids) which are liable to cause death or serious injury to human health if inhaled, swallowed or absorbed through the skin. Examples: cyanides, arsenic compounds.
	Class 6.1(b)	Harmful (toxic) substances – substances of PG III which are harmful to human health if swallowed, inhaled or absorbed through the skin. Examples: lead acetate.
	Class 6.2	Infectious substances – substances containing micro-organisms that are known or believed to cause disease in humans or animals. Examples: vaccines, pathology specimens. (Contact the Health Department and the Environmental Protection Agency for more information)
Class 7 – Radioactive Substances		These are materials or combinations of materials which spontaneously emit ionising radiation. Examples: thorium nitrate, uranium hexaflouride. (For more information on radioactive substances contact the Environmental Protection Agency)
Class 8 – Corrosives		These are substances (either solids or liquids) which will damage living tissue, goods or equipment on contact, by chemical action. Examples: hydrochloric acid, sodium hypochlorite (liquid pool chlorine), sodium hydroxide (caustic soda).
Class 9 – Miscellaneous Dangerous Goods		These are substances and articles which have potentially dangerous properties that are relatively minor, or are not covered by any of the classes already described. Examples: aerosols, polyester beads, polychlorinated biphenyls, Goods lithium batteries. The orange label indicates a vehicle is carryinmixed load of Dangerous Goods (for transport only).

4.15 FUMES

4.15.1 UNDERGROUND DIESEL FUMES

4.15.1.1 INTRODUCTION

This topic is dealt with in detail in a publication by the NSW Mineral Council: "Diesel Emissions in Underground Mines – Management and Control". This is available as a printed version from the Minerals Council, or on their website. This section does not aim to reproduce the content of the Minerals Council document.

There are two basic means of controlling exposure of personnel to contaminants from diesel exhaust:

- minimising emissions, and
- providing adequate ventilation.

Both approaches are necessary, since toxic components are always present in diesel exhaust. If both approaches are implemented well, toxic components from the exhaust should be diluted to acceptable levels.

Testing is also necessary, to check the adequacy of control measures:

- diesel engines should be tested at regular intervals to detect deterioration in the quality of emissions, and
- surveys of ventilation will reveal inadequacies in the various work areas in the mine.

Since the ultimate goal is to minimise the exposure of personnel to toxic components, occasional surveys should be conducted of the levels of exposure experienced by some personnel in areas which are suspected of being the worst.

In addition to implementing control measures, and carrying out testing, it is highly desirable to incorporate an audit system, which will check and document that the controls and the testing are being implemented as they are designed to be, and that the results obtained are reliable.

4.15.1.2 PERSONAL EXPOSURE TO DIESEL EXHAUST

Gases

Limits for diesel exhaust gas exposure

Exposure limits for a number of air contaminants, including some produced by diesel engines, are given in the NSW Minerals Council publication. Note the overriding requirement that exposure to contaminants not specified in the list should not be present in concentrations, which exceed limits prescribed by Worksafe.

The thinking in some areas of occupational health is that toxic contaminants have an additive effect. On this basis, if one component is present in a concentration equal to its exposure limit, no other contaminant should be present; if several components are present, each should be well below its exposure limit. Each limit should therefore be regarded as a maximum, and lower concentrations should be the aim.

Sampling air for diesel exhaust exposure

At the low concentrations, which must be measured to check on personal exposure, it is not possible to collect samples in bags and store them. If this is tried, the contaminants in the air will coat the walls of the bag, leading to noticeably measured low results.

Gas detector tubes are a practical means of measuring personal exposure. They are available for a wide range of gases, they do not require the sample to be stored, and they give a good indication (but not a precise measurement) of the level of exposure. One drawback of these tubes is that they cannot be calibrated, because each tube is used once only.

There are portable instruments which measure some gases at the low levels required. Most of these are 'electrochemical', and their measurement cells deteriorate gradually; they must be re-calibrated periodically, and the cells replaced when they can no longer be adjusted to read correctly.

Analysis of air samples

If the testing is done by detector tube or portable analyser, there is no further analysis to be done. If samples have been collected using other techniques (impinger etc), the analysis will normally be completed by the laboratory which specified the sampling method.

Airborne particles

Particles from diesel exhaust are often referred to as "diesel particulate matter" (DPM). They are basically carbon, but carry gaseous components of the exhaust adsorbed onto the surface, making them considerably more dangerous than ordinary carbon. They are an obvious air contaminant from a diesel engine, and are associated with poor combustion of fuel. A turbocharged engine is especially likely to emit particles (smoke) when the engine is accelerated; this is because the engine is commonly over-fuelled for a few seconds until the turbocharger increases the air available for combustion.

Target levels for airborne diesel particulates

Mine atmospheres should not contain more than 0.2mg/m^3 of diesel particulate matter (soot) being the level that has been identified that effects of irritation are minimal – NSW Minerals Council 1999. This equates approximately to the proposed workplace limit of 0.16 mg/m^3 total carbonfor metalliferous mines from the USA Mine Safety and Health Administration.

Sampling airborne diesel particulates

Personal exposure to airborne diesel particulates is measured in the same way as other airborne dust particles, but using a glass-fibre filter. If the correct filter is used, and in the absence of other sources of carbon such as coal dust, the two determinations (airborne dust and airborne diesel particulates) may be carried out on the one filter. If coal dust is present, special sampling techniques may allow diesel particulates to be identified and measured separately because of their particle size.

The details of a sampling method are given in the section on Airborne Dust Monitoring.

Analysis of airborne diesel particulates

Where no other carbonaceous (carbon-bearing) material is present, the diesel particulates collected on a filter can be oxidised, and the loss in weight determined. However sulphide ores can also be oxidised, so the process is carried out in a plasma ashing furnace, which operates at a low temperature and uses low-pressure ozone to oxidise carbon without affecting sulphides. The residue on the filter can then be used to determine exposure to other respirable dust.

Special sampling methods must be are used in coal mines, because the coal dust and the diesel particulates are both basically carbon.

Details of the method are given in the section on Airborne Dust Monitoring.

4.15.1.3 VENTILATION AIRFLOW

Maximum engine exhaust emissions

The raw exhaust of diesel engines discharging to atmosphere below ground should not contain contaminants with concentrations exceeding the values required by each State or Terriroty.

Determination of air flow

For the purpose of designing overall mine air flows, it is common for a minimum quantity of 0.06 to 0.1 m^3/s/kW to be used. A sample calculation for determining airflow about a diesel engine is shown in Appendix 4.5.

The airflows suggested as necessary to ventilate diesel engines are based on the maximum concentrations of contaminants in the raw exhaust, and the dilutions necessary to reduce these to exposure standards. Newer engine control technology may be capable of substantially reducing the emissions from engines.

Older engines at times produce emissions higher than those recommended. It should be remembered that exhaust gases are analysed under steady-state conditions, but a turbocharged engine under acceleration may briefly exceed the

measured values by a considerable margin.
The new engine control technology prevents emissions of carbon monoxide, oxides of nitrogen and smoke ever being as high as previously measured.

If lower airflow requirements are to be set, they should be based on a careful analysis of the machine in operation. It may be that the limiting factors will be heat production, or carbon dioxide emissions.

Allowance should also be made for local concentrations around the engine which will be higher than the calculated average diluted exhaust. Especially at lower ventilation rates, it may be necessary to assist mixing of exhaust with ventilation air. The engine fan can assist if the exhaust gas exits at a suitable point, or some kind of 'fume dilutor' may be required.

4.15.1.4 CONTROL MEASURES FOR DIESEL EMISSIONS

It has been the requirement in the past that engines used underground should be fitted with an exhaust conditioner, although engines below 100kW have been exempt from this where the raw exhaust contained less than 1,000 parts per million of carbon monoxide.

Exhaust conditioners can be of several types:

- water scrubbers are still very common in coal mines, but are now rarely used in metal mines; they have little effect on the gases in exhaust emissions, but may significantly reduce particulates;
- catalytic converters when clean can substantially reduce carbon monoxide, aldehydes and hydrocarbon emissions; and
- ceramic and other particulate filters are extremely effective in removing smoke from the exhaust stream and also provides catalytic action to reduce CO_2 and aldehydes.

Other control measures include:

- appropriate selection of engine type, for best emissions – pre-combustion engines (indirect injection) are generally much cleaner than direct injection engines, with electronic engine-management systems are becoming available on diesel's;
- selection of fuel, both to obtain cleaner emissions and ensure a low sulphur content (a limit of 0.3% sulphur is specified by some authorities, and Federal Government legislation will lower the limit to 0.05% for automotive diesel fuel);
- careful storage, handling and dispensing of fuel to minimise contamination;
- frequent maintenance of the air intake system, to ensure that filters do not become blocked;
- on turbocharged engines, fitting and correctly adjusting a smoke control device (such as an air/fuel ratio control device) to minimise diesel particulate matter; and
- training operators of turbocharged machines to open the throttle progressively (over a couple of seconds) rather than suddenly.

4.15.1.5 DIRECT TESTING OF GASES IN DIESEL EXHAUST

Gases in diesel exhaust

Diesel engines emit several different gaseous toxic components, only a few of which have prescribed limits: carbon monoxide, and the two oxides of nitrogen – nitric oxide and nitrogen dioxide. These are not the main irritant components of diesel exhaust, but they are recognised as being toxic, and are relatively easy to measure.

The main irritant components are members of the aldehyde class of compounds, some of which are found in diesel exhaust. Only one formaldehyde, not the most irritant one, can be readily measured with gas detector tubes. A laboratory process similar to that described earlier in "Sampling of Air for Diesel Exhaust Exposure" can be used; the sampling is much quicker, because of the higher concentrations, but the laboratory techniques are far from simple. Routine sampling for aldehydes is therefore not feasible.

The goal then is to measure gases which can be tested easily, and which will give a good assessment of the clean operation of the engine.

When a laboratory tests an engine it will measure carbon dioxide in addition to the other gases. This is mainly to determine the operating condition of the engine at the time of the test and, in particular, the ratio of fuel to air. This could also be measured by gas detector tube if required.

The way in which the exhaust is sampled will depend on the way in which it is to be analysed. But there is a great advantage in using a bag to collect samples even when the sample is to be analysed immediately.

Details of a practical method of collecting exhaust gas in a bag, whether for immediate analysis or for temporary storage, are given in Appendix 4.6: "Using Bags to Collect Samples".

Using gas detector tubes

Where gas detector tubes are being used, the following points should be observed:

- Check the integrity of the pump by inserting a new detector tube in the pump, squeezing the pump, and watching for the pump to expand; if there is noticeable movement, the pump needs servicing.
- Follow the directions of the tube manufacturer, taking care to comply with any temperature requirements.
- Allow the pump to expand fully between strokes; this is indicated by either a chain under tension, or an indicator on the pump.
- Many tubes have two scales – a high range with few pump strokes, and a lower range with more pump strokes. Operate the pump for the smaller number of strokes first then, without disconnecting from the sample bag or tube, observe the reading on the appropriate scale. If the reading is reasonably low on this scale, continue with the extra pumps for the low scale, and read the tube on this scale.
- Some colour changes are difficult to read, and the end point is sometimes uneven. For a final reading, rotate the tube in the hand in the best available lighting to find the average position of the last discolouration of the tube.

If portable or laboratory analysers are to be used, sample must be suitably conditioned (filtered, and water removed) to prevent the instrument being contaminated. Follow the instructions of the supplier.

Particulates

The problem of smoke has been discussed briefly in "Airborne Particles", under the section on Personal Exposure to Diesel Exhaust. While the transient (short-term) emission of smoke from a turbo-charged engine can be a major contributor to air contamination, it is not easy to measure. The simple field measurement of exhaust smoke is done on an engine under constant load (as with the gas measurements).

An alternative method, which is capable of monitoring the transient smoke from turbocharged engines on acceleration, uses an opacimeter – an instrument which directly measures the "blackness" of exhaust emissions. One type of opacimeter is mounted across the end of the exhaust pipe, and readings are displayed digitally and output electrically on a readout unit.

Limits

A standard for smoke emissions under constant load is still being determined, but it appears likely that, for a time, the measurements will be made with a Bosch smoke meter. This draws a fixed volume of exhaust through a filter paper, and a separate device is later used to measure the discolouration of the paper on a scale from 0 (no change) to 10 (completely black). The test is quite sensitive, and very clean exhausts can give values around 0.2, while 3 denotes a rather dirty exhaust.

A standard for on-road vehicles is depicted in the following graph. There is a strong case for working to lower limits in the underground mining environment.

Sampling and measurement

A procedure for sampling and measuring smoke emissions is given in Appendix 4.7, Measuring Smoke Emissions with the Bosch Smoke Meter.

4.15.1.6 APPENDICES

APPENDIX 4.5

Calculation of airflow about a diesel engine

It is common for a minimum airflow quantity of 0.06 to 0.1 m^3/s to be applied for each kW of power employed in a part of a mine. As an example, if engines totalling 300 kW rated power are to be used in a part of a mine, an airflow of 300*0.06, or 18 mΔ/s or more, should be provided.

APPENDIX 4.6

Using bags to collect samples

A very effective bag for collecting exhaust gas samples, or any other gas samples which can be stored in bags, is the liner from the familiar wine cask – emptied of its intended contents. These bags have a capacity of about 4.5 litres. When purchased as a gas sampling bag, they come fitted with a more appropriate connection. They can be protected against rough handling by a denim cover.

Equipment required

- one (1) sample bag for each sample or, if samples are to be stored, two (2) bags per sample, and a source of dry nitrogen;
- one (1) copper cooling coil or other device which will allow exhaust gas to cool to a temperature at which it can be passed through a flexible tube (of vinyl or rubber); the cooling device needs to be fitted to the sampling connection on the exhaust system, usually by a flare fitting;
- a flexible tube to connect the cooling device to the sample bag; this may be of vinyl or rubber, and not too long, but long enough to allow the sampler to stand in a safe position while the machine is operated on load; a push-on connector may be needed to connect the line to the bag;
- a pump, such as a large hand aspirator bulb, may be useful to assist in the rapid filling of the sample bag; and
- an appropriate method of analysis; this could be gas detector tubes or portable analyser(s), or larger laboratory-style analysers.

Procedure

- Decide how the engine can best be placed under load, and make sure that the machine operator is aware of what is required.
- Consider where the sampler should be positioned, and safety aspects, such as:
  - is the sampler adequately protected against noise?
  - can the machine slew sideways if a wheel slips?
  - what would happen if the sampler loses footing?
  - will there be adequate communication between sampler and operator with the noise of the machine operating on load, or should a third person be involved?
- Empty the sample bag either:
  - by rolling it up diagonally, starting from the corner furthest from the outlet; or
  - by pumping it empty with an aspirator bulb. (However, if using a pump, be careful that the bag does actually empty; the bag can block the outlet internally, preventing a pump from drawing out the remaining gas.)
- Connect the cooling coil to the exhaust sample connection, and the tube to the cooling coil.
- Place the engine under load; allow a few seconds after it has stabilised for the tube to flush, then connect the bag to the sample tube and allow it to almost fill (or pump it if using a pump).
- Crimp the tube connection, and take the machine off load.

If samples will not be analysed within 10 minutes, they must be taken using a two-bag system, as follows (or some other equally effective means of preventing loss of oxides of nitrogen):

- Before commencing sampling, at least half-fill an empty sample bag with nitrogen.
- Collect raw exhaust from the engine in a second (empty) bag, in the manner described above.
- Immediately connect the two bags together, and squeeze some of the raw exhaust into the bag containing nitrogen.
- Seal both bags.

  Loss of oxides of nitrogen is much slower in the dilute sample, and when both bags are analysed, the correct original value can be determined using the formula:

$$\text{Correct NOx} = \text{NOx in dilute sample} \times \frac{\text{Co in raw sample}}{\text{Co in dilute sample}}$$

Measuring smoke emissions with the Bosch smoke meter.

Sampling

A sample could be taken from a connection on the exhaust system, but it would be more usual to take it from the end of the exhaust pipe. (This may not be feasible if a water scrubber is fitted.)

- Clamp the probe (supplied with the Bosch instrument) on the end of the exhaust, and operate the engine under load.
- Depress the plunger, and load the sampling device with a clean filter paper.
- Operate the engine under load as described in the section on exhaust gases, and when it is stable, squeeze the aspirator bulb to release the plunger.
- Take the engine off load; remove the filter paper and either measure immediately or label and store in a clean container for measurement later.

Measurement

The measurement of the filter paper is carried out in accordance with the instruction supplied with the Bosch meter. The following points may be helpful:

- The background has an effect on the measurement. Several unused filter papers form a white background which will give consistent readings.
- Set the zero on the instrument using a clean filter paper. Hold the 'O' button for several seconds while the instrument adjusts the zero.
- Take an average of the reading on a filter by measuring at about three points scattered around the centre.
- There may be a slight difference between readings on the two sides of the paper. If unsure which was the face exposed to the exhaust, measure both sides and take the higher reading. (Marks on the paper can give clues as to which way it was mounted in the sampling device.)

REFERENCE DOCUMENTS

Diesel Emissions in Underground Mines – Management and Control: NSW Minerals Council.

Diesel Engine Systems for Underground Coal Mines: AS 3584, – 1991.

Guidelines for Diesel and Operator Environment Testing in Underground Coal Mines: MDG29, NSW Department of Mineral Resources.

Diesel Particulate in Coal mines – Questions and Answers: Joint Coal Board (now part of Coal Services Pty Ltd).

Australian Design Rule 30 for Diesel Exhaust Smoke Emissions, issued by the Department of Transport, February 1984.

4.16 EXPLOSIVES USE

4.16.1 GENERAL

Explosives should be manufactured, handled, stored, conveyed and used in or about mines in a manner which is safe.

The usage, storage, manufacture and conveyance of explosives in or about mines should generally be in accordance with Australian Standards.

Explosives should be protected from fire, impact, loss, spillage, deterioration, theft and accidental initiation so as to minimise the risk to the safety of any person.

No one should retain, remove or otherwise dispose of explosives other than in the proper running of the mine. Theft and misuse is treated very seriously.

The mine operator need to designate people to use and handle explosives.

4.16.2 EXPLOSIVES MANAGEMENT

4.16.2.1 PERSONS HANDLING EXPLOSIVES

No one under the age of 18 years should be allowed to handle, charge or fire explosives.

There should be no smoking while handling, charging or using explosives, nor within the vicinity of explosives, initiating system, or accessories.

There should only be enough explosives on hand to meet the shift's requirements.

4.16.2.2 STORAGE

Magazines should be of a construction and in a location which minimises risks of theft, fire and impact, and which minimises the effect of any detonation during storage, and also minimises any adverse impact from storage. The maximum quantity of explosives should be displayed on the door of the magazine or storage area and adequate ventilation provided.

Detonators and explosives should be stored in separate magazines. If explosives and detonators are stored in the same magazine, they should be kept separated by a solid intervening fireproof barrier.

Igniter cord, safety fuse and fuse lighters must be kept in a cool, dry place away from fire and separate from other explosives and detonators.

A means of maintaining an accurate record of all incoming, outgoing and current stocks of explosives should be instituted. This may consist of a board, magazine log book, or other means.

The theft or loss of explosives or any unaccountable stock shortages of explosives should be reported immediately to an Inspector and to Police.

The following should be considered in the design and construction of underground magazines.

- the magazine should be located away from any shaft or main mine access;
- the magazine should be located away from essential infrastructure, such as crib rooms and workshops;
- the magazine should be located so that the possible effects of an explosion will not adversely impact upon winders, electrical substations, pump stations, ventilation equipment or other important installations or equipment;
- fumes from any accidental fire or explosion should travel away from where people are working and away from escape routes;
- any existing boreholes which may intersect the magazine walls must be securely plugged;
- the magazine area must be kept free of water and away from drainage dumps;
- the magazine area and surrounds must be kept clear, swept regularly and unencumbered with combustible materials;
- the quantity of explosives stored in underground magazines should be kept to a minimum consistent with the safe movement of explosives. The amount required for one week's supply is a useful guide;
- vehicles should have to make at least one 90 degree turn to access a magazine to minimise hazards of out of control vehicles;
- magazine doors shall open outwards; and

- the security requirements for doors of underground magazines and locking mechanisms must be equivalent to other magazine types.

4.16.2.3 SIGNAGE

Ensure that all open and accessible places are fenced off with appropriate warning signs erected. The signs should be durable, easily identifiable and positioned off the ground. Standard danger signs are preferred and should clearly indicate the nature of the hazard, such as “Charged Face No Unauthorised Entry” or “Explosives in Use No Unauthorised Entry”.

Appropriate signage should be displayed on all vehicles and equipment used in explosives transportation and charging activities.

Temporary storage of explosives should be guarded and signs erected. A flashing light could also be used to clearly indicate its location.

4.16.2.4 TRANSPORT

Explosives when taken from a magazine or supply point for use should be conveyed directly to the workings in a securely covered case or canister or other suitable container in a manner which minimises risks of initiation.

4.16.3 CHARGING AND FIRING

4.16.3.1 CHARGING OF EXPLOSIVES

It is very important to dissipate any electrostatic charges generated whilst pneumatic charging with explosives.

Be aware that charges fired inside or in contact with any piece of timber below ground at a mine may lead to a fire. A watch may need to be kept to detect any smouldering of the timber.

Before any hole is charged it should be checked and cleaned out.

4.16.3.2 MASS BLASTS

Mass blasts are defined as those where the number of charges to be fired or the quantity of explosives to be used is such that charging and firing cannot be completed within one working shift.

Control systems may need to be developed to record the place, amount of explosives and dates of charging and firing for each blast.

It is important that the type of explosives selected and used will not deteriorate significantly during the charging process and period prior to detonation.

Signs and temporary barricades may need to be erected to restrict entry and warn of danger.

Vehicles being used in a charged area must be incapable of causing pre-ignition of explosive charges through heat or stray current. The use of radio communication equipment at the mine should be strictly controlled to prevent pre-ignition.

The firing point should be chosen to avoid air blasts, secondary explosions and fly rock damage.

4.16.3.3 INITIATION OF EXPLOSIVES

A shift coming on should not commence work until a proper check of the previous shift’s firing has occurred and the workplace is declared safe.

Where different faces underground are fired at the same time, parties stationed in a more remote position from a safe area should fire first.

Good communication between the parties is essential to ensure the safety of all personnel involved. Firing should be done at designated blasting times and all persons should withdraw to a safe area.

Electric initiation

Advice on equipment, precautions, tests and procedures for electric initiation is outlined in AS 2187.

Immediately before firing, the series circuit should be tested by an ohmmeter or other method to determine continuity and appropriate resistance. It should be assumed when testing that an explosion might occur and precautions must be taken to choose the test location carefully.

Blasting machines

An exploder should be tested at regular intervals to ensure that it is fit for its designed task.

Use of mains firing

Electricity from ordinary power or lighting cables should not normally be used for firing shots.

However, where mains power (electricity) is used:

- a firing switch should be installed between the source of power (electricity) and the firing conductors, and insulated and protected so as to ensure a total absence of current leakage into the firing cables except when the switch is closed;
- the firing and any other switch used should be placed in a fixed switch box, which is provided with a lock and so constructed that it cannot shut unless the switch is in the short circuit position;
- there should be only one key issued for use for each switch box and kept in the custody of an authorised person, and in no circumstance should it pass from that person's custody while on duty;
- firing conductors should be provided and fitted with plugs capable of connecting them to appropriate sockets in the switching apparatus;
- wiring, switch, switch box or other equipment of a firing circuit should not be earthed;
- the firing switch should not be connected to the source of power (electricity) nor should any electrical contact be made to the firing switch until all people have left for a safe place;
- prior to connecting power (electricity) to the firing switch, the circuit to each of the explosive charges should be tested from a safe place; and
- immediately after firing or attempting to fire the charge or charges, the shotfirer should disconnect the firing conductors from the switching apparatus and lock the switch boxes.

4.16.4 HAZARDS

4.16.4.1 STORMS

Procedures should be developed for times when an electrical or dust storm, of sufficient intensity to be dangerous, appears imminent. Shaft sinking and adit operations are particularly at risk from conducted lightning strikes. The procedures might include:

- all people working in or near an area where explosives are stored or manufactured should be withdrawn to a safe area;
- all vehicles conveying explosives should be returned to a safe place until the storm activity has passed; and
- explosives and detonators which are not yet used should be returned to the magazines.

4.16.4.2 MISFIRES

When a hole is known to have misfired and is left unattended, a barricade or other obstruction with a danger notice should be placed to advertise the misfire and to prevent an inexperienced person interfering with the hazards. A safe system of work should be developed to handle misfires and include:

- re-entry time for misfires as per manufacturers recommendations;
- decision process on refiring;
- refiring process;
- ground control requirements;
- recovery process if not refired;
- reporting and recording process; and
- notification to supplier.

4.16.4.3 DUST

Blasting should be carried out in open cut and quarry operations in such a way that dust from the blast does not create a concern for neighbours.

4.16.4.4 ENTRY AFTER BLASTING

Fumes and toxic gases arising from the explosion should have been effectively dispersed before re-entry of any persons. Senses of sight and smell should be sufficient for most determinations, but oxygen deficiency is a real risk, particularly in small underground headings such as rises, and mine atmospheres should be tested. A safe system of work should be developed for re-entry and include:

- no one to enter the underground workings on the exhaust side of the ventilation until the ventilation circuit has been cleared of fumes and dust;
- required time for dust and fume clearance;
- method or system to ensure breathable air quality;
- assessment of blast results;
- hazards identified, rectified or barricaded and checked for misfires;
- visual inspection requirements of excavation or pit walls in the blast zone;
- clearance communication process;
- persons authorised to conduct re-entry; and
- contingency plan for non-completion of the re-entry procedure.

Where there is the possibility of voids in the blast there should be special procedures for re-entry.

4.16.4.5 DISPOSAL OF UNWANTED EXPLOSIVES

Old or deteriorated explosives must be destroyed by proper procedures, bearing in mind the recommendations of the manufacturer.

All sites should develop a procedure for the safe disposal or destruction of explosives.

Generally explosives may be destroyed by either detonation, or by burning. They must never be buried. Refer to AS 2187 Explosives: Storage, transport and use.

4.16.5 SULPHIDE ORE DUST EXPLOSIONS

The operating mechanisms of sulphide dust explosions (SDE) are not presently fully understood. It is, however, important that the problems of such explosions are appreciated so that operating practices, in areas prone to such explosions, can be implemented. A fundamental requirement of this is training personnel to recognise areas which are likely to support SDE, and the various methods available to either prevent SDE occurring or to minimise the effects of such explosions to people or property. A system of reporting and documentation of such explosions should also be established.

Operators should understand what an SDE is; how SDEs occur; the dangers of such explosions, including the effects of the gaseous products of such explosions; and should have knowledge of appropriate practices which should be used in areas likely to support such explosions. Additionally, operators should be able to identify areas which may support SDE, as well as to recognise both the gaseous and particular products of SDE. They should be aware of any system of reporting SDE occurrences and understand the importance of such reporting. They should also be aware of the use and limitations of the various self rescuers available.

4.16.5.1 PREDICTION

The nature of ore capable of generating an SDE is not clearly defined, but is related to the sulphur content of the ore and its mineralogy, including grain size. Ores containing appreciable quantities of pyrite and pyrrhotite are considered to be particularly at risk. Many other sulphide dusts are known to explode. As a general rule of thumb, any ore containing a sulphur content of 20 percent or more should be regarded as potentially explosive and precautionary measures should be implemented. Some ore, due to its mineralogy, will produce a dust of disproportionately high sulphur content. SDEs have occurred in orebodies with a sulphur content as low as 11 percent. Operational experience will identify mineralogical zones in an orebody where the risk of SDE is high.

Prediction of SDE potential areas should start with the collection of exploratory mineralogy data, which can be manipulated by geostatistical methods to define areas of high sulphur content. These areas should be clearly marked on geological maps of the orebody so that precautionary measures can be implemented during mining. As further data are collected, this mapping of SDE potential areas can be further clarified.

Experience obtained in mining the orebody will reveal high risk areas for SDE. Additionally, examination of the ore faces during mining of high risk areas will enable the collection of detailed mineralogical data, which can later be used to help predict SDE. These data should also be recorded on geological plans and will be of great help in any post-explosion evaluation. Any occurrences of SDE should be fully documented and marked on mine plans, so that trends in SDE potential within an orebody can be observed. This documentation should start with reporting of SDE occurrences on shift report forms. Further documentation should be comprehensive, detailing all aspects of the blasting method employed, explosives used and the effects of the explosion. Details of mineralogy and explosion products should be included if possible.

4.16.5.2 PREVENTION

The classical explosion triangle shows that fuel, oxygen and an ignition source are required for an explosion to occur. Inhibiting any two components in the system will prevent an explosion.

Various techniques have been used to prevent and limit the occurrence of SDEs. Research work to date has shown that use of limestone, short delays in blasting and water sprays are all ineffective in preventing explosions. However, dust explosions can be prevented by:

- covering all exposed explosives; and
- using adequate stemming.

The research has also shown the importance and value of monitoring for sulphur dioxide following all blasting activities, no matter how small. It has also shown that controls which might have been added to the earlier controls (which were generally regarded as insufficient) would not have been effective. These possibilities included:

- limiting all blasts to a maximum duration of 120 milliseconds;
- using permitted explosives; and
- clearing the mine of all personnel before any blasting or, alternatively, providing fresh air bases and oxygen self-rescuers.

What has not been shown yet by research includes:

- detonating cord restrictions;
- stemming specifications;
- enclosing of all explosives (including detonating cord and detonators);
- sulphur dioxide monitoring procedures; and
- popping or plastering hazards, especially in drawpoints and crushers.

A single hole can cause an SDE. There is no value therefore in limiting blasting to short delay detonators or to any particular duration of blast.

While information is now much better than four years ago, there is still a need to take a conservative approach. It is reasonably certain that the very low strength signal tube will not cause a dust explosion, while a cord of 3.75 g/m can cause a dust explosion. It is also reasonably certain that stemming of at least 600 mm (0.6 m) in length in standard development rounds will prevent a dust explosion emanating from stemmed blastholes, but stemming requirements for stope blasting are not known.

Popping activities are strong possibilities for dust explosions and probably should only take place with normal stope firings when the mine is cleared. Proper monitoring of exhaust air will detect a dust explosion, which is not detected otherwise, and allow for precautions to be taken before return to work.

The use of stone dust to make the combustible sulphide dust inert has been tried. However, the quantities of stone dust required are prohibitively large. In addition to this, difficulties in dispersing this dust make the method impractical. Consequently, this method should not be used to prevent or inhibit SDE.

A method used in controlling SDE is washing down of exposed surfaces. The use of air-water sprays alone is not sufficient and sprays have questionable value under any circumstance.

Washing down exposed surfaces does not prevent the development of primary dust explosions caused by ignition of the dust cloud developed during blasting, but does help to lower the availability of fuel for a secondary explosion, thus preventing propagation of an explosion through the mine workings. Caution should be taken when washing down because water jets may cause some dust dispersion.

The surfaces of cut-and-fill stopes and development headings can be cleaned with a water jet using normal underground water pressure. Washing down a large open stope is difficult due to the inaccessibility and size of the roof, walls and floor. A high pressure water jet may be required to reach difficult locations in an open stope and the design of new stopes in high risk ore bodies should incorporate access drives at selected points to facilitate washing down the surfaces. Preferably these accesses would be drill drives.

To have any effect, washing down should be extended to, say, 20 m from the face in development headings, and at least 20 m on both the intake and return airways of a stope. Always consider the potential of an explosion to propagate through the workings, particularly in massive ore bodies. Washing down should be performed immediately prior to charging and sufficiently close to firing time to ensure that the process is effective.

Water sprayed on the walls and floors of a stope reduces the likelihood of an explosion in previously deposited dust and, due to the agglomeration of the wet particles, tends to reduce the mass of dust raised when broken rock hits the walls and floor of the stope. Airborne dust may also be suppressed if the spray droplets are small enough. The presence of a dense cloud of micro-droplets of water within a stope may quench the flame of a potential ignition source or the flame front of a developing explosion, but more work needs to be done to determine whether this method provides real protection.

If water sprays are used, they should be located so that a dense fog of water persists over the blast area.

In a development heading, sprays should be directed at the face. Similarly, water sprays for stopes should cover the blast area. These sprays in open stopes should be positioned in draw points and drill drives, and it would be better to set up sprays to create a fog within the stope.

Additional air-water sprays could be used in the drill drives and extraction levels of open stopes as barriers. Such semi-permanent installations would be appropriate. These should be located a minimum of 15 m and no further than 45 m on both the intake and return air sides. Water sprays help to dissolve sulphur dioxide (SO_2) produced in an SDE, which will result in sulphurous acid forming. This sulphurous acid will slowly oxidise to produce sulphuric acid.

Watering down practices and the use of air-water sprays may also be used for secondary blasting. This includes popping of oversize material, bombing of drawpoints and ore-passes, and any other secondary blasting which is performed in areas capable of supporting an SDE. This includes ore handling facilities. Always consider the potential of a secondary SDE and implement preventative measures.

Some thought has been given to removing oxygen from the explosion triangle. When blasting, the air in the blast area is displaced to some degree by the inert explosion gases produced during detonation of high explosives. If the oxygen content of the air is reduced to below 12 percent, it is unlikely that an SDE will occur. The volume of gases produced in a development blast are not generally sufficient to displace the air fast enough to reduce the oxygen content in order to prevent an SDE. However, in open stopes, during the early stages of production, the void volume is comparatively small, and a small number of charged holes may provide sufficient inert gas to reduce the oxygen content below the minimum concentration necessary for an explosion when fired. As the stope is mined out, the void space increases and a large mass of explosive will be required to produce a sufficient volume of inert gases to prevent an explosion. Thus the firing of multiple rows of holes is more likely to produce an inert atmosphere. Paradoxically, watering down of the stope is comparatively easy when the stope void is small and becomes more difficult as the stope void increases in size. The displacement of oxygen by inert explosion gases cannot be relied upon to inhibit an SDE.

Blasting practices are also important when firing in areas which have potential for SDEs. Lower detonation velocity explosives may assist in preventing an SDE, but this is not yet determined.

The practice of using stone dust for stemming is ineffective. Not only is it an ineffective stemming material, but it may lead to the development of higher exhaust temperatures than would be developed if comparatively coarse stemming is used. Furthermore, multiple firings of stopes and headings should be restricted, as this practice may result in the formation of an explosive dust cloud in areas nearby to the blast which have yet to be fired.

Some recent experiences would indicate that standard detonating cord may cause an SDE. Consequently, 10 g detonating cord should not be used in drawpoints, ore passes or normal firings where the sulphur content is high.

4.16.5.3 DETECTION

All firings in SDE potential areas should be detonated electrically from an approved firing box in an approved location, only after all personnel have retreated to a safe location. Consider the gaseous products of an SDE, their effect on the ventilation system and the potential for an explosion propagating through a massive sulphide orebody, when designating these approved locations.

An SDE will not always be detected at a firing point. If an SDE has occurred, it is preferable to detect its occurrence remotely before personnel return to their working areas. This can be achieved through the use of SO_2 detectors located in return airways. Exhaust air can be monitored either through the use of permanent gas monitoring systems, or manually through the use of portable SO_2 detectors or gas detection tubes. Small dust explosions may not generate sufficient quantities of SO_2 to be detected in return airways if the detection equipment is not sufficiently sensitive.

Remote detection can not indicate precisely where a SDE has occurred. Thus, working areas need to be inspected before personnel return to their working places. Inspections should be made by at least two persons, one of them being a supervisor.

Portable SO_2 detectors or gas detection tubes should be used for sampling mine air. If a contaminated atmosphere is encountered it will be apparent due to the pungent odour of SO_2 and the offensive odour of hydrogen sulphide (H_2S). Olfactory warning (detecting a smell) can be lost if H_2S is present in concentrations in excess of 50 ppm (parts per million). Thus the smell of the gases cannot be relied upon to give adequate warning of a toxic atmosphere.

4.16.5.4 RE-ENTRY

Danger exists to all personnel entering areas which are highly contaminated. Consequently, inspections should involve the gradual entry into potentially contaminated atmospheres, combined with regular testing of mine air. Persons inspecting should also be equipped with either filter self rescuers designed for SO_2-contaminated atmospheres or self-contained self rescuers. No other underground personnel should be allowed to return to their working areas until those areas have been checked.

It is impracticable to check all underground areas for sulphur-bearing gases. However, the danger exists of these gases accumulating in an area away from the explosion site. Thus it is important that fresh air bases are established regularly throughout the mine workings and that self rescuers are available at these bases. Self-c ontained self rescuers, rather than filter self rescuers for SO_2 atmospheres, are a superior choice of equipment. This is because they can be used in other contaminated atmospheres, as well as highly contaminated atmospheres where the toxic gas concentrations are so high as to make the filter self rescuer useless. The issuing of all-purpose, self-contained self rescuers to underground personnel is prudent.

Clearing of fumes relies upon effective ventilation. As a result of an SDE, large volumes of gases are generated which could reverse ventilation in a local area, or on a large scale depending upon the magnitude of the explosion. This can cause tripping of fans, particularly those used for auxiliary ventilation in development headings and stopes. If this occurs, long delays will be experienced in clearing of fumes unless the fans can be restarted. To avoid the need for personnel to enter a contaminated atmosphere, fans or fan electrical equipment should be located in main airways. The process used for fan re-starting should follow the same precautionary measures as used in checking working areas.

The mines evacuation procedure should cater for the possibility of an SDE. Additionally, the firefighting and rescue equipment should be selected so that an H_2S or an SO_2 atmosphere can be detected and entered. Personnel should be fully trained to deal with such an event, including how to treat others affected by exposure to H_2S or SO_2.

4.16.5.5 TRAINING

Shotfirers and charging crews should be trained in the same way as operators, but should also be aware of the correct methods of firing in SDE-prone areas, especially covering any exposed explosive and using adequate stemming. Charging crews should be fully trained in the various preventative techniques employed, especially hosing down.

Supervisors should be trained in the same way as charging crews, but should also be responsible for ensuring that the correct preventative measures are implemented. Additionally, supervisors should be aware of the ventilation requirements for areas prone to SDE and of the effects that such explosions can have on the ventilation system. Supervisors represent the first line in documenting SDEs and any such explosions should be investigated and documented.

Engineers responsible for ventilation should have a full knowledge of both the gaseous and particulate products of SDE and the effects of such explosions on the ventilation system. An efficient sulphur dioxide monitoring system will help detect the occurrence of an SDE. Sufficient ventilation should be provided to ensure the clearing of fumes and the ventilation network should be designed to ensure that these fumes do not pose a danger to underground personnel. It is important that airflows in dusty SDE potential areas are not as high as could cause suspension of dust particles.

REFERENCE DOCUMENT

AS 2187. Explosives – Storage, Transport and Use (known as the SAA Explosives Code).

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PART 5

EQUIPMENT AND MACHINERY

UPDATED January 2004

PART 5: EQUIPMENT AND MACHINERY

5.1 HAZARD AWARENESS

5.1.1 SLIP, TRIPS AND FALLS

Access to fixed plant in the form of fixed ladders, portable ladders, walkways and platforms is discussed in Part 5.5 - Crushing, Screening and Conveyor Machinery.

Identification of hazards in relation to falling

To assist in identifying where a person may fall, consideration should be given to:

- injuries arising from falls that have occurred at the workplace or other similar workplaces;
- (near miss) incidents or accidents related to falls at the workplace or other similar workplaces;
- relevant codes of practice and guidance notes;
- consultation with employees to find out what problems they may have in performing their jobs;
- consultation with safety and health representatives and safety and health committees;
- consultation with self-employed persons or contractors to find out if they are having or likely to have problems in performing their jobs;
- walk-through inspections of the workplace; and
- records or statistics which indicate potentially unsafe work practices.

As part of the hazard identification, risk assessment and control process, procedures and work practices should be closely addressed. Safe work practices and documented procedures should be established before work practices and documented procedures should be established before work commences. These should be drawn up in a consultative approach by all interested parties.

Factors which can cause a fall

These include:

- moving from one surface to another;
- the surface is not capable of supporting a load;
- openings or holes are not identified or protected;
- open edges are not protected;
- levels change;
- handgrip is lost;
- surfaces are slippery (for example, surfaces are wet or polished or oily in the case of new steelwork);
- footwear is unsuitable;
- equipment, tools, rubbish are causing obstructions in work areas;
- ladders are used incorrectly;
- clothing is caught;
- surfaces move;
- there is sudden acceleration or deceleration;
- lighting is unsatisfactory;
- weather conditions are bad (for example, heavy rain or wind is present);
- people are struck by a moving or falling object;
- exposure to chemicals or electricity in some circumstances; and
- fall arrest systems and devices are used incorrectly.

5.1.2 VEHICLE-MOUNTED PLATFORMS

All vehicle mounted platforms, including extendible boom platforms should be in compliance with AS 2359 Powered Industrial Trucks (known as the SAA Industrial Truck Code). Aerial lifts should not be field-modified except by manufacturer. Any repairs should be made using original equipment, manufacturer parts.

5.1.3 GENERAL SAFETY PRECAUTIONS

General safety precautions are as follows:

- only personnel specifically trained should operate aerial lifts;

- prior to moving aerial lift vehicles, the ladder bucket and outriggers should be stowed in place, with lifting device in a zero energy state;
- lift controls should be tested prior to use to verify proper and safe working conditions;
- employees should always stand firmly on the floor of the basket;
- employees should not sit or climb on the edge of the basket or use planks, ladders, or other devices for a work position;
- a body harness should be worn with a lanyard attached to the boom or basket when working from an aerial. Attachment to adjacent structures, poles and/or equipment is prohibited;
- manufacturer-specified load ratings should not be exceeded;
- when in use, brakes should be set and outriggers, if equipped, positioned on solid footing and wheels chocked;
- aerial lifts should not be moved when the boom is elevated and the basket is occupied unless the lift has been specifically designed for such operation;
- articulating boom and extendible boom platforms should have dual controls, one control located in the operator basket, the other being located for use at ground level. Controls should be readily marked with the lower control unit serving as the override. When the lift is occupied, ground level controls should not be used without the operator's permission except in emergency circumstances; and
- equipment should not be operated within five metres of overhead high-voltage lines. Any fall protection equipment, including body harnesses, lanyards, and lifelines used to arrest an actual employee fall, should be destroyed and replaced immediately following an incident.

5.1.4 WORKING/WALKING SURFACES

Walking becomes second nature, so people don't pay attention when they walk from one place to another. Most slips and trips end up in falls, but they have special qualities that should be addressed.

A slip occurs whenever there is too little friction or traction between your feet and the surface you are walking on. Three common causes of slips are:

- constantly wet surfaces;
- occasional spills; and
- weather hazards.

5.1.4.1 WET INDOOR SURFACES

The risk of slipping on wet indoor surfaces can be cut down by the following tips:

- shorten your stride to keep your centre of balance under you;
- walk with your feet pointed slightly outward, creating a stable base; and
- make wide turns at corners.

5.1.4.2 TRACTION AND FOOTWEAR

To reduce the risk of slipping:

- wear slip-resistant footwear appropriate for your job;
- use special sole patterns which are specifically engineered for slippery work areas;
- use abrasive strips to increase traction;
- post signs to warn of wet areas; and
- clean up spills when you see them. If that is not possible, draw attention to the spill in some way so that others will see it and go around. Later, report the problem to the appropriate authorities so that it can be cleaned up.

5.1.4.3 BAD WEATHER

Outdoors in bad weather you can reduce the risk of slipping if you:

- slow down to react to a change in traction;
- wear slip-resistant shoes or overshoes, and carry your work shoes;
- wear sunglasses when outdoors in ice and snow to help you see possible hazards; and

- be careful of wet shoes on a dry floor; they can be just as slippery as dry shoes on a wet floor.

5.1.4.4 OPENINGS

Every floor opening should be provided with a secured cover or a guardrail.

Ladderway floor openings, hatchways and chute openings should have guardrails and toeboards to protect employees when these are open.

Manholes or infrequently used trapdoors or pits should be guarded by a cover. While the cover is not in place, the opening should be protected by removable standard railings. Toeboards should also be used if the space is to be entered.

5.1.4.5 SLIP-RESISTANT MATERIALS

Abrasive coatings can be applied to concrete, metal and wood surfaces to increase the Coefficient of Friction (COF) and reduce the risks of slips and falls. Many of these products can be applied like paint; others can be trowelled on in a thin coat. These coatings are formulated to resist grease, oil, water and a wide range of chemicals. Most paint and building supply companies handle these materials. It is important, however, to purchase the correct product for your particular problem, since some are enamels or epoxies, which contain a rough, hard, gritty material with a high COF.

There are also a number of skid-resistant products that can be purchased in strips or rolls. These may have a pressure-sensitive backing or be applied with a special glue. They are designed for easy application to stair treads, ramps and other hazardous walking and working surfaces.

Another effective skid-resistant material is rubber or rubber-like mats. This material is long-wearing and skid-resistant on both the top and bottom sides. Hard rubber or hard rubber-like mats are ineffective because they have a low COF when wet.

The following comments could be useful:

- owners, managers and supervisors should make a commitment to prevent accidental slips, trips and falls by establishing policies and practices;
- regular frequent inspections of working and walking areas should be conducted to identify environmental and equipment hazards which could cause slips, trips and falls. Special attention should be given to the working and walking surfaces, housekeeping, lighting, vision, stairways and ladders. Immediate corrective action should be taken;
- extensive safety training on the prevention of slips, trips and falls should be provided for all new employees. Regular retraining should be provided for all employees. Special attention should be given to proper walking, carrying, climbing and descending stairways, ladders, vehicles and equipment. Unsafe practices should be corrected immediately;
- all workers should wear proper footwear for their work and environment whether in the office, shop, plant or field;
- no riders should be permitted on tractors, trucks or other self-powered or towed equipment unless a safe seat or workstation is provided; and
- all slips, trips and falls, with or without injury, should be reported, recorded and thoroughly investigated. Corrective action to prevent such a repeat occurrence should be taken immediately.

REFERENCE DOCUMENTS

Code of Practice – Prevention of Falls at Workplaces, Worksafe, Western Australia.

Preventing Injuries from Slips, Trips and Falls, William J Becker, University of Florida.

5.1.5 CONFINED SPACES

5.1.5.1 INTRODUCTION

The Australian Standard AS 2865 Safe Working in a Confined Space provides comprehensive information to use in confined spaces. A checklist is also included in Part 4 Working Environment, Section 4.3.5.1.

5.1.5.2 DEFINITIONS

AS 2865 defines confined spaces in Section 4.3.5 and Section 6.2.

AS 2865 does not apply to underground mining and tunnels in construction or work at other than atmospheric pressure.

AS 2865 defines a competent person as someone with a combination of training, education and experience, enabling them to perform a specified task correctly.

Definitions will usually include some of the following characteristics:

- partial or substantial enclosure;
- not intended or primarily designed as a workplace;
- may have restricted means of entry and exit;
- may have inadequate ventilation to sustain breathing if occupied for some work processes;
- may be subject to oxygen depletion or the presence of contaminant gases due to chemical or biological reactions within the space;
- may be situated so as to receive and contain a buildup of gases or vapours;
- may contain poisonous, flammable or suffocating gases or vapours which are the residues of materials usually stored in the space;
- may contain solids which will not support a person, leading to submersion and suffocation;
- may contain machinery or other physical hazards; and
- is at atmospheric pressure during occupancy.

5.1.5.3 EXAMPLES OF CONFINED SPACES

- Storage tanks, tank cars, process vessels, silos and other tank-like compartments usually having only a minimum size entry opening.
- Open-topped spaces such as degreasers or pits which may not have good natural ventilation.
- Pipes, sewers, tunnels, shafts, ducts and similar structures.
- Any shipboard spaces entered through a small hatchway or manhole, cargo tanks, cellular double bottom tanks, duct keels, coffer dams, ballast and oil tanks, and void spaces, but not including dry cargo holds.
- Company-specific examples include: cement and flyash silos, sawdust storage, stockpile reclaim tunnels, steel vessels and containers under fabrication, LP gas vessels, concrete mixers, truck mounted agitators and gas regulator stations.

5.1.5.4 RISK ASSESSMENT

Section 10 of AS 2865 Safe Working in a Confined Space mentions the need for risk assessment by a competent person.

A sample risk assessment sheet is shown in appendix C of the AS 2865.

5.1.5.5 ENTRY PERMITS

Entry Permits with written approval from the employer are required under Section 13 Risk Control of AS 2865.

Appendix G of AS 2865 gives a sample permit.

5.1.5.6 STAND-BY PERSONS

Stand-by persons are required where there is a risk to health and safety – see Section 13.9 of the AS 2865 Safe Working in a Confined Space.

5.1.5.7 HAZARDS IN A CONFINED SPACE

Inspecting, testing, cleaning, repairing or entering a confined space may result in the following hazards:

- toxic gas or vapours from materials in the tank (for example, gradual release from sludge or scale);
- flammable gas or vapours with potential for fire or explosion;
- lack of oxygen causing asphyxiation (for example, from inadequate ventilation during work on the tank);

- scalding or burning from accidental opening of a steam valve;
- drowning in liquid left in the space;
- electric shock (for example, from portable equipment such as lights, tools and other equipment taken into the confined space);
- injury from moving mechanical equipment such as stirrers, mixers, conveyors that are unintentionally started;
- burial beneath solids;
- injury from direct contact with corrosive materials or dermatitis-producing chemicals; and
- physical hazards, such as falling, slipping, injury from falling objects and tools.

5.1.5.8 ASSOCIATED HAZARDS

These include:

- noise;
- extremes of temperature;
- radiation;
- manual handling;
- slips and trips;
- infection; and
- excavation collapse.

5.1.5.9 LEGAL OBLIGATION

Legislation in all countries places on employers and others both general and specific duties in safeguarding the health and safety of people required to enter and work in confined spaces. (In Australia, reference to Acts, Regulations and to AS 2865 Safe Working in Confined Space is recommended before site procedures are compiled.) Actions required may include all or some of the following:

- a written safe work method;
- a permit system for entry to confined spaces where entry is only permitted after the manager responsible for the site, or his/her representative, is satisfied that all adequate safety procedures are being adopted. The general manager's or representative's signature is obtained on the permit and on completion of the work the site is reinspected and the permit signed again;
- regular documented training of operators, observers and first aid personnel;
- atmospheric testing within the confined space (for example, oxygen, carbon monoxide, poisonous gases, flammable vapours);
- ventilation, cleaning and purging of the confined space;
- provision of respiratory protective devices, with consideration being given to air supply or distant breather equipment in some circumstances;
- provision of safety harnesses, lifelines and other rescue equipment;
- provision of an observer outside of the confined space but in visual contact (or other communication) with the person inside;
- the isolation/lockout of mechanical equipment within the confined space;
- the isolation/lockout of energy which operates the confined space (for example, rotary kiln);
- the isolation/lockout of delivery pipes, chutes, conveyors or similar which could introduce materials (solid, liquid, gaseous) to the confined space;
- signposts and barricades to prevent inadvertent entry and signs to indicate (person inside) when work is being carried out; and
- consideration of the work to be carried out as regards temperature, fatigue, posture, manual handling, mechanical handling and the generation of fumes, dust and noise.

5.1.5.10 SAFETY PROCEDURES FOR CONSIDERATION

Many plants have cement, flyash, lime, silica fume or other fine materials stored in bins or silos. Where there is no possibility of the presence of poisonous gases or flammable vapours, the following minimum provisions should apply:

- access hatches are locked such that all entry is positively controlled and entries notified by the mine operator, or his/her nominee;

- an observer is stationed outside the hatchway and controls the lifeline so that the person inside can be hauled out in an emergency;
- a spare set of emergency equipment, including lifeline and respiratory protective device should be available for the observer in case that person has to enter the confined space to effect a rescue; and
- the observer, or some other person available close by, is trained in resuscitation and rescue techniques.

In cases where entry is required to pits, tanks or other confined spaces where there is even the slightest chance that atmospheric contaminants are present, all precautions indicated in the fourth point (resuscitation and rescue) above must be considered. This will apply to inground pits, sumps and tanks at all times and to any vessel which has contained liquid and gaseous materials. Welding and similar operations which generate fumes will require fume extraction equipment in addition to all other precautions.

5.1.5.11 DESIGN SPECIFICATIONS FOR A CONFINED SPACE

The hazards involved in working in a confined space are minimised at the design stage and during the initial installation of the equipment.

If the following features are incorporated into the design of a confined space, hazards are minimised:

- adequate entries and exits;
- outlets and facilities for cleaning that remove or minimise the need to enter the space;
- ventilation to prevent build-up of contaminants or combustible materials;
- cladding or lining materials that are durable, require minimal cleaning and do not react with materials within the confined space;
- structure and mechanical parts designed for safe and easy maintenance;
- fixed lighting that permits safe entry, working conditions and exit from the confined space;
- fixed ladders, platforms and walkways;
- warning signs at the entry to the confined space to caution unauthorised employees not to enter; and
- means to isolate energy sources.

5.1.5.12 ENTRIES AND EXITS

Every confined space should have an adequate exit - a manhole is the minimum. The manhole can be rectangular, oval or circular in shape. It should be at least 450mm long and 400mm wide (circular manhole requires a diameter of at least 450mm).

The manholes for confined spaces on mobile plant should be at least 400mm long and 350mm wide (a circular manhole requires a diameter of at least 400mm).

A manhole or exit from a confined space requires a 1.2m minimum clearance above. If powerlines, hoses, ventilation ducts are required in the confined space, a second manhole is required.

5.1.5.13 SAFETY OF ELECTRICAL EQUIPMENT AND SERVICES

Fixed lighting and other permanently wired electrical equipment in a confined space require the following:

- connection to an earth-free extra low voltage supply from an isolating transformer located outside the confined space; and
- additional earth bonding to the confined space enclosure and protection through an earth leakage circuit breaker (ELCB) device located outside the confined space.

5.1.5.14 CHECKLIST

Below is a checklist of considerations before entry to confined spaces takes place.

- Are confined spaces thoroughly emptied of any corrosive or hazardous substances, such as acids or caustics, before entry?
- Are all lines to a confined space, containing inert, toxic, flammable, or corrosive materials valved off and blanked or disconnected and separated before entry?

- Are all impellers, agitators, or other moving parts and equipment inside confined spaces locked-out if they present a hazard?
- Is either natural or mechanical ventilation provided prior to confined space entry?
- Are appropriate atmospheric test performed to check for oxygen deficiency, toxic substances and explosive concentrations in the confined space before entry?
- Is adequate illumination provided for the work to be performed in the confined space?
- Is the atmosphere inside the confined space frequently tested or continuously monitored during conduct of work?
- Is there an assigned safety stand-by employee outside of the confined space, when required whose sole responsibility is to watch the work in progress, sound an alarm if necessary and render assistance?
- Is the stand-by employee appropriately trained and equipped to handle an emergency?
- Is the stand-by employee or other employees prohibited from entering the confined space without lifelines and respiratory equipment?
- Is there any question as to the cause of an emergency?
- Is approved respiratory equipment required if the atmosphere inside the confined space cannot be made acceptable?
- Is all portable electrical equipment used inside confined spaces either grounded and insulated, or equipped with ground fault protection?
- Before gas welding or burning is started in a confined space, are hoses checked for leaks, compressed gas bottles forbidden inside of the confined space, torches lightly only outside of the confined area and the confined area tested for an explosive atmosphere each time before a lighted torch is to be taken into the confined space?
- If employees will be using oxygen-consuming equipment such as torches and furnaces in a confined space, is sufficient air provided to assure combustion without reducing the oxygen concentration of the atmosphere below 19.5% by volume?
- Whenever combustion-type equipment is used in a confined space, are provisions made to ensure the exhaust gases are vented outside of the enclosure?
- Is each confined space checked for decaying vegetation or animal matter which may produce methane?
- Is the confined space checked for possible industrial waste which could contain toxic properties?
- If the confined space is below the ground and near areas where motor vehicles will be operating, is it possible for vehicle exhaust or carbon monoxide to enter the space?

Warning

Many people have died when they have entered a confined space to rescue a person who has collapsed. Avoid this by ensuring that harnesses and lifelines are used. No person should be allowed to enter any confined space without means of life support and without rescuers standing by.

REFERENCE DOCUMENTS

Boral OH&S Manual, Boral.

AS 2865 Safe Working in a Confined Space.

Occupational Health and Safety Manual, Pioneer Concrete NSW P/L.

OSHA's Self-Inspection Checklists, Confined Spaces Safety Information Commission, OSHA.

5.2 HAZARDOUS PLANT

5.2.1 EQUIPMENT GUARDING

The following section on equipment guarding has been obtained by using AS 4024 Safe Guarding of Machinery and AS 1755 Conveyors Safety Requirements to modify the US Department of Labor, Mine Safety and Health Administration – MSHA's Guide to Equipment Guarding for Metal and Non-Metal Mining. For further information, refer to the above Australian Standards.

The illustrations in this section show specific application of guards using expanded metal. This is done to simplify the drawings. In no way should this be misunderstood to mean that all guarding must utilise expanded metal. However, the use of expanded metal or sizing screens does have several advantages. Some of these advantages are as follows.

The area guarded can be inspected without removing the guard.

Grease fittings and oil cups can be placed through the small–openings without cutting large holes in the guard. (Large holes should not be cut in guards to gain access to grease fitting – grease fittings should be extended so that lubrication can be accomplished from a safe location). Holes in guards should not permit access to dangerous nip points.

At most operations this material is readily available (for example, worn screen cloth).

In certain circumstances, the use of expanded metal guards serves to allow smaller particles of spilled material to pass through the guard with minimal buildups.

5.2.1.1 BASIC PRINCIPLES OF GUARDING

Many accidents result from moving machinery hence persons working on or around machinery must be protected. In devising protection against moving machinery and machine parts, the goal should be to make it as effective as possible. All possible contingencies should be considered, including acts of thoughtlessness and foolhardiness, in guarding machinery to prevent injuries.

An effective machine guard should have certain characteristics in design and construction. Such a guard should:

- comply with AS 4024.1 Safeguarding of Machinery – Part 1: General Principles;
- be considered a permanent part of the machine or equipment;
- afford maximum protection;
- prevent access to the danger zone during operation;
- be convenient; it should not interfere with efficient operation;
- be designed for the specific job and specific machine, with provisions made for oiling, inspecting, testing, adjusting and repairing machine parts;
- be durable and constructed strongly enough to resist normal wear; and
- not present a hazard in itself.

When the installation of guards is contemplated, persons who have a specific interest in them should be consulted. The opinion of the operator of the machine, the supervisors, the maintenance personnel and the greaser should be consulted. However, it must be kept in mind that protective guards placed around moving machinery should be positioned so that the moving equipment or pinch point which present a hazard cannot be reached.

Materials for guards should be carefully selected. For most installations, guards of bar stock, sheet metal, perforated metal, expanded metal or heavy wire mesh are more satisfactory than those of other materials.

The larger guards frequently are of pipe or a structural steel frame supporting wood, solid sheet metal or wire mesh that will provide a positive barrier against moving parts.

Guards of wood have limited applications; their lack of durability and strength, relatively high maintenance costs and flammability are objectionable.

Handrails and toe-boards are generally not considered to be effective as guards.

5.2.1.2 THE TECHNIQUES OF MECHANICAL GUARDING

It is recognised that in any given situation – a hazard-creating motion or action – may frequently be guarded in a number of ways, several of which may be satisfactory. The selection of a guarding method to be used may depend upon a number of things – space limitations, production methods, size of stock, frequency of use and still other factors may be important in making the final decision. Moving machine parts, nip points and pinch points must be guarded individually rather than restricting access to the areas by installing fencing. It is not the intent of this section to suggest which method of guarding is the best for a given situation, but rather to show that there are a number of ways to guard each different condition.

This will be done by illustrating typical situations, which may be guarded by a variety of methods.

Each illustration is marked correct or incorrect

Figure 5.1

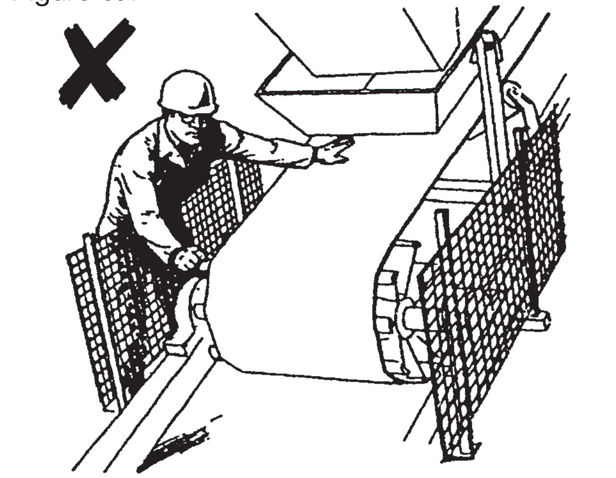
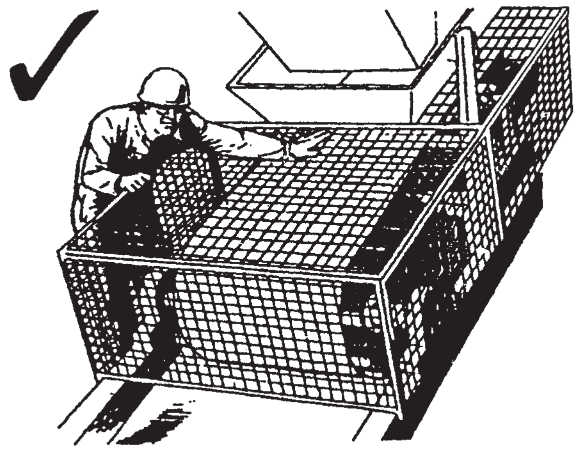


Figure 5.2



Figures 5.1 and 5.2 Self-cleaning tail pulley

Figure 5.1 shows a self-cleaning tail pulley with an inadequate guard. This should not be accepted as being guarded. The guards are placed so the fins and pinch points are exposed.

This type of pulley should be totally guarded as shown in Figure 5.2. The guard also covers the pinch point created by the transfer chute.

Figure 5.3

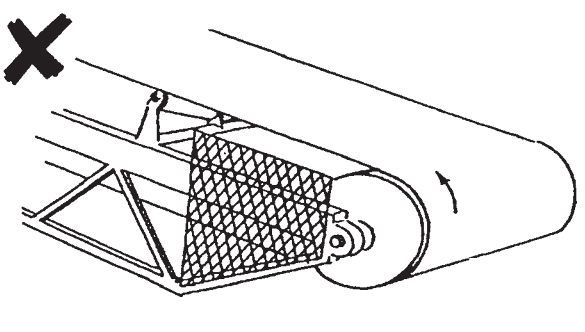
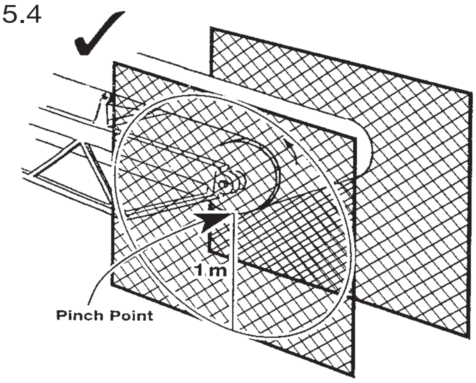


Figure 5.4



Figures 5.3 and 5.4 Guarding of pinch point

The guard for the tail pulley in Figure 5.3 does not cover the pinch point and therefore is not effective.

Side guards are only effective when placed close to the pulley and extending a distance sufficient so the pinch points cannot be reached from the front, the back or the top. As a rule of thumb, a minimum distance of 1 metre should be used.

A smooth pulley can be totally enclosed, as depicted in Figure 5.4, or guarded along the sides as shown in Figure 5.4.

Figure 5.5

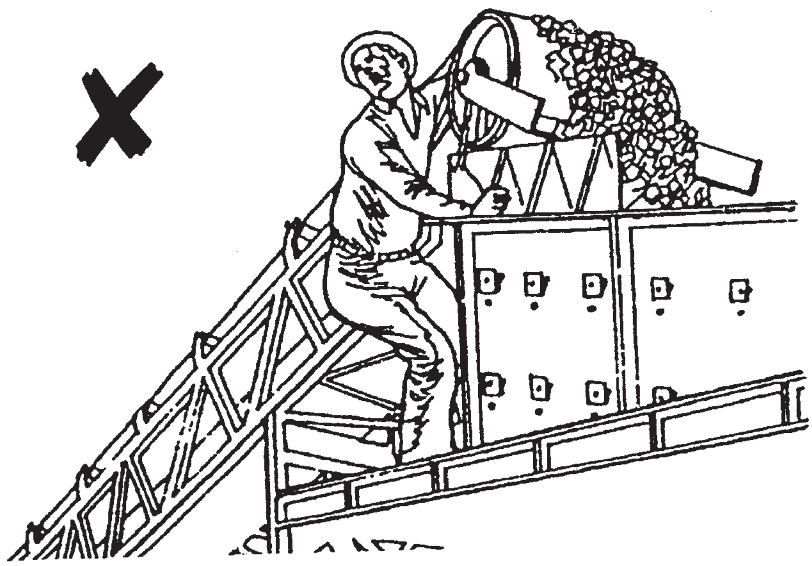


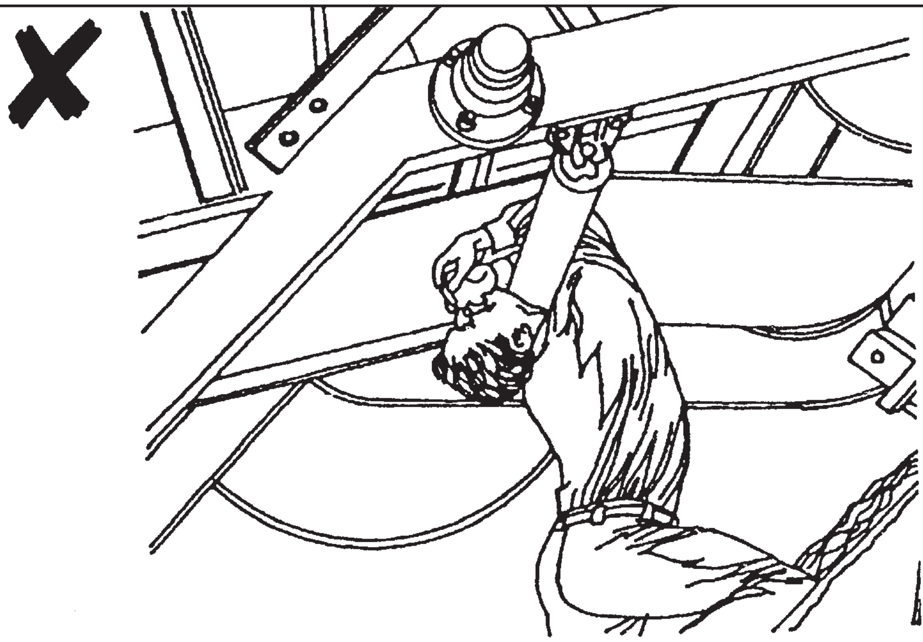
Figure 5.5 Underground head pulley

Remote areas protected by location need not be guarded. However, if work is performed at such location as shown in Figure 5.5, the equipment must by de-energized and locked out and a temporary safe means of access provided before any work is started.

The use of ladders should be avoided wherever practical, particularly for permanent and semi-permanent installations where regular access is required.

The reason for guarding return idlers is shown in Figure 5.6. They should be guarded if someone

Figure 5.6



Figures 5.6 and 5.7 Return idlers

could be injured while working or passing underneath the belt. It is reasonable to expect these types of accidents where the idlers are less than 2.5m above the walking surface.

Guarding of return idlers is critical where a change in direction takes place at the idler because higher belt tension may mean a trapped person can not release themselves.

The pinch points of return idlers can be guarded in various ways. Individual guards may be appropriate in some instance (as depicted in Figures 5.7b and 5.7c), or a guard may prevent access to a series of return idlers (as depicted in Figure 5.7a).

Figure 5.7a shows one method of guarding return idlers. Notice that grease fittings can be assessed without removing the guard. The mesh openings should be large enough to allow fines to fall through, but not large enough for a person's hand to go through.

Figures 5.7b and 5.7c show another acceptable way of guarding return idlers.

The guard can be installed with or without the end caps provided the nip point can not be accessed. The bottom of individual guards may be left open (Figure 5.7c) to allow fines to fall through, provided the pinch point which can cause injury is effectively guarded.

Figure 5.7a

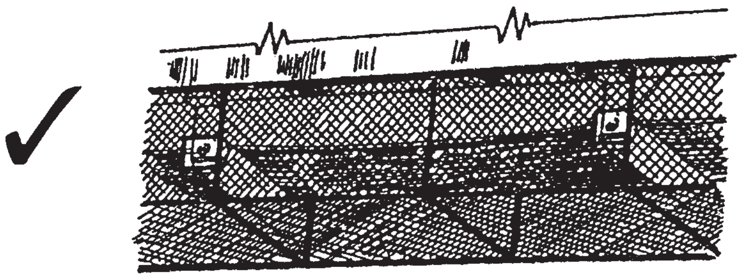


Figure 5.7b

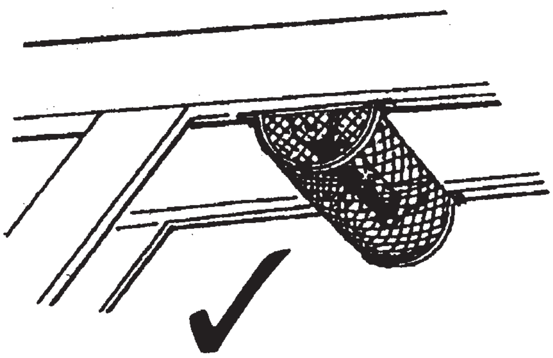
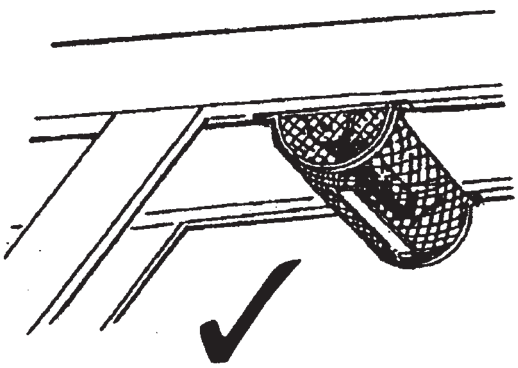
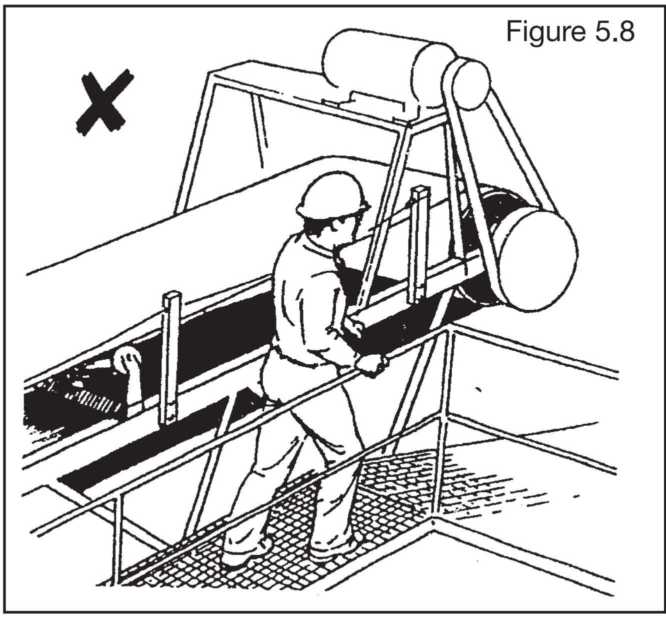
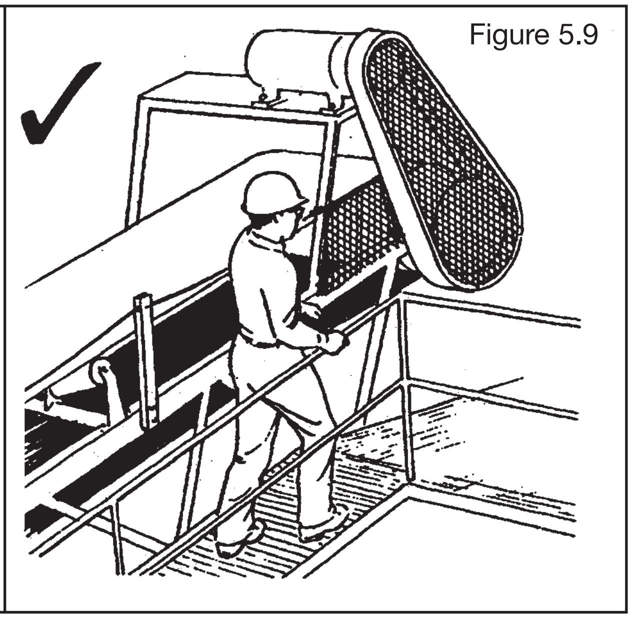


Figure 5.7c





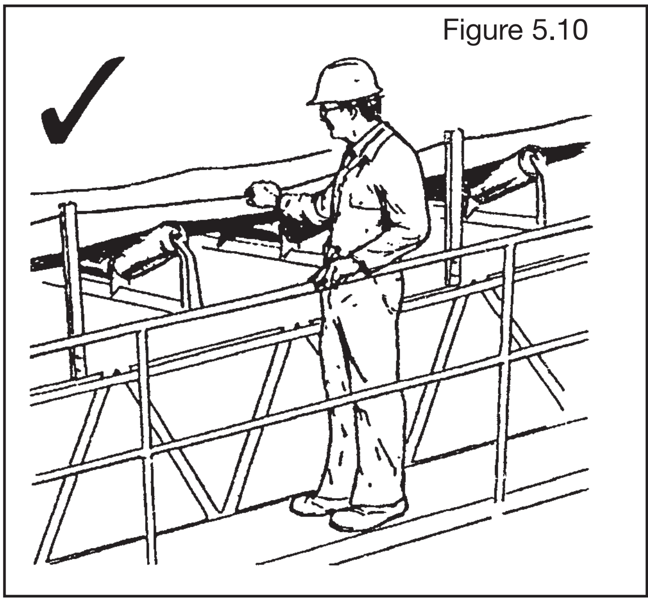


Figures 5.8 and 5.9 Head pulley and drive unit

An unguarded head pulley and drive unit is shown in Figure 5.8.

Figure 5.9 Shows the guard in place

The head pulley guard is extended so the pinch point cannot be reached.



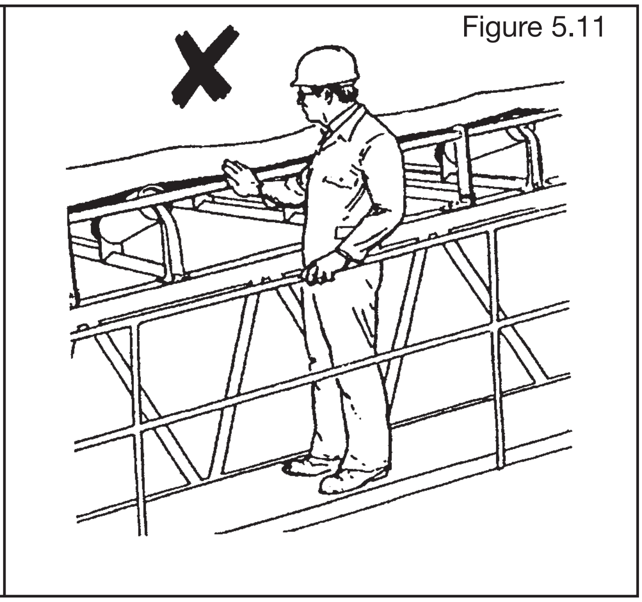


Figure 5.10 Emergency stop cord

Figure 5.11 Belt protection railing

A stop cord along a conveyor belt with a walkway is shown in Figure 5.10.

The stop cord must be located so that it can be reached by a person who falls on or against the belt. The stop cord must also be sufficiently taut to assure the conveyor drive motor will be de-energized when the cord is pulled.

AS 1755 Conveyors – Safety Requirements should be used when the walkway is part of the conveyor, or where persons travel alongside conveyors at ground level.

In this drawing, a railing is installed along the conveyor. This must not be considered as a guarded conveyor. The railing is placed away from and slightly above the belt to prevent contact with the moving belt. An emergency stop pull wire and prestart warning system is still required.

Figure 5.12

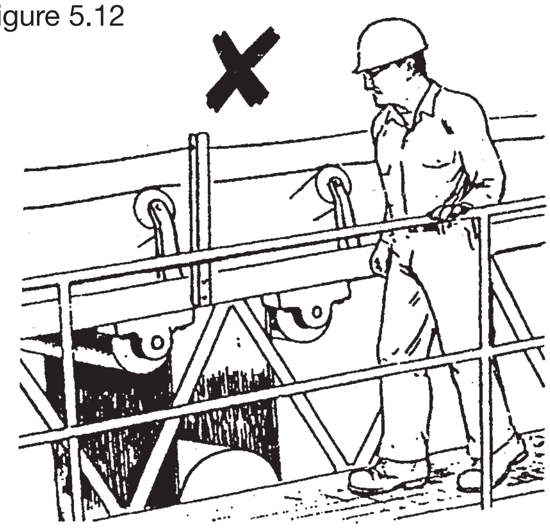


Figure 5.13

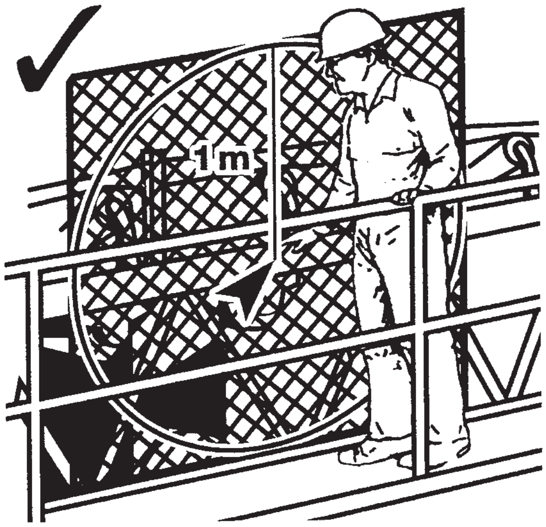
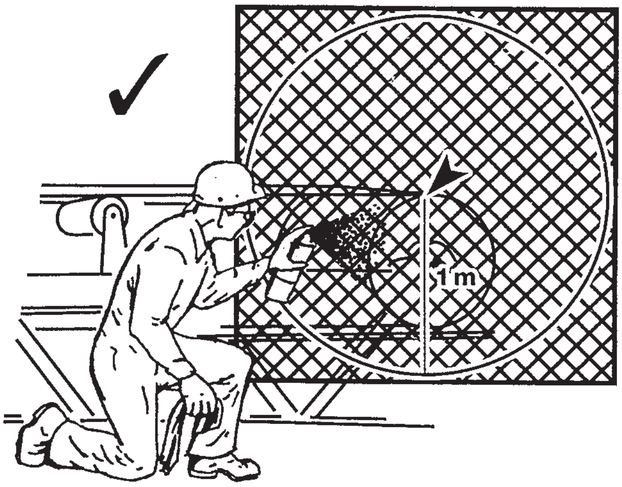


Figure 5.14



Figures 5.12 and 5.13 Take-up pulley

An unguarded take-up pulley is shown in Figure 5.12. The structure of the conveyor should not be considered as a guard.

A simple guard (as shown in Figure 5.13) can be installed to prevent access to the pinch points.

Figure 5.14 Applying belt dressing

Belt dressing shall not be applied manually while belts are in motion, unless an aerosol-type dressing is used. When dressing other than pressurised-typed is applied, the conveyor must be de-energised and locked.

Figures 5.15 and 5.16 Belt counterweights

The pinch points of take-up pulleys are sometimes located a sufficient distance above the ground to be guarded by location. They are normally equipped with heavy counterweights. The guard in Figure 5.15 prevents access to this suspended load area.

Figure 5.16 shows a suspended conveyor with the guides blocked by a bar to prevent the counterweight from dropping to ground level in case of belt breakage. Cables, for additional safety, are fastened to the structure. It is recommended that the area below the counterweight is also guarded, however, if this is not practical then cables may be adequate if they are designed to absorb the impact of the counterweight and pulley assembly when it travels its maximum possible distance in the event of the belt breaking.

Figure 5.15

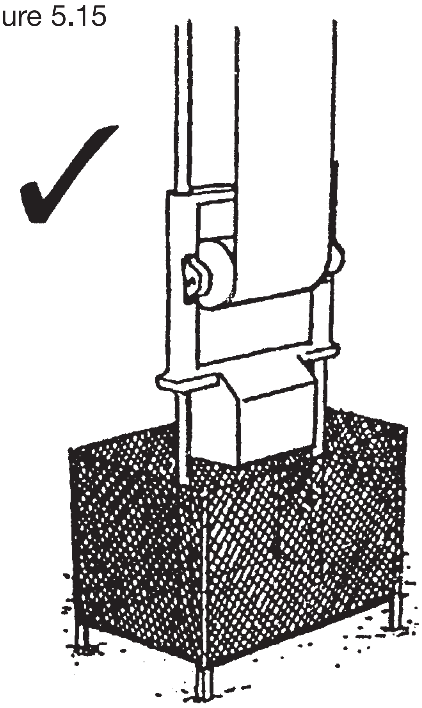
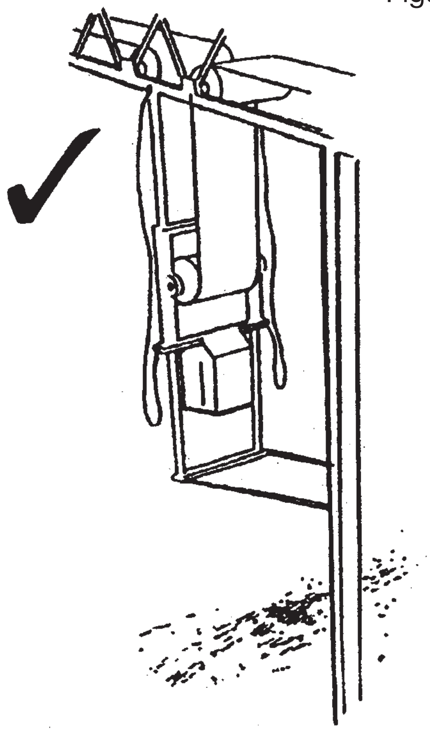


Figure 5.16



Figures 5.17 and 5.18 Drive shaft

All drive shafts (Figure 5.17) shall be guarded, as shown in Figure 5.18.

NOTE: Even plain rotating shafts are dangerous as they can catch clothing. Protruding set screws, keys and key ways make rotating shafts more dangerous.

Figure 5.17

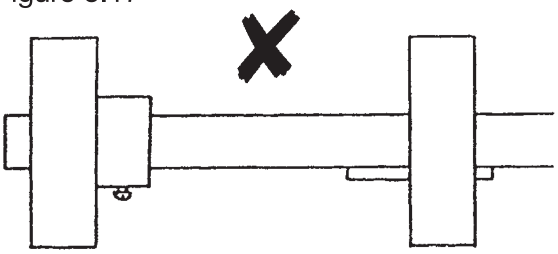
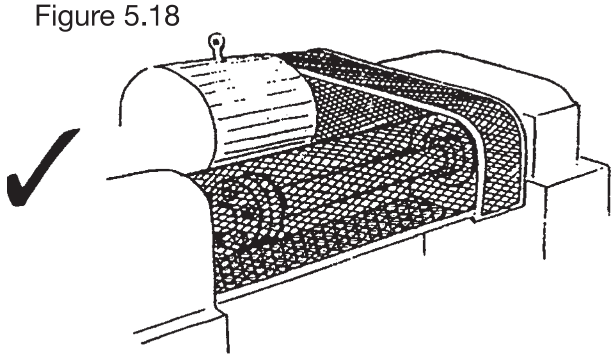


Figure 5.18



Figures 5.19 and 5.20 Drive shafts

A power-off shaft with universal joints is shown in Figure 5.19.

This type of shaft is primarily used for portable crushing equipment and can best be guarded as shown in Figure 5.20.

The guard is constructed of two halves, totally enclosing the drive shaft.

A drive coupling is shown in Figure 5.21.

Couplings of this type should be totally enclosed as shown in Figure 5.22.

Figure 5.19

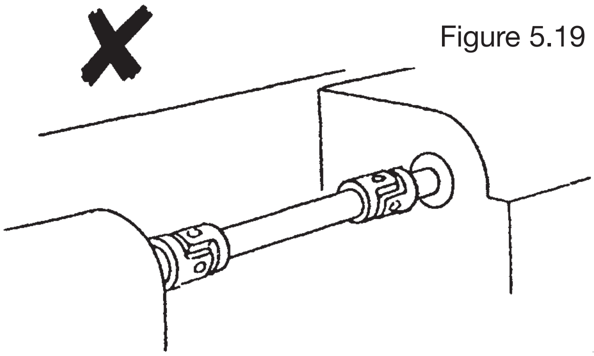


Figure 5.20

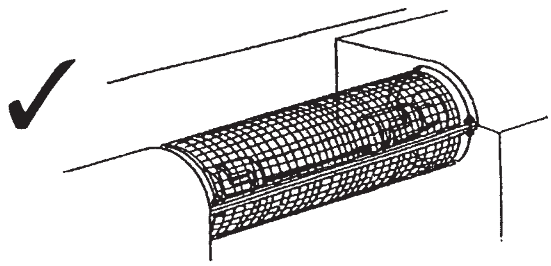


Figure 5.21

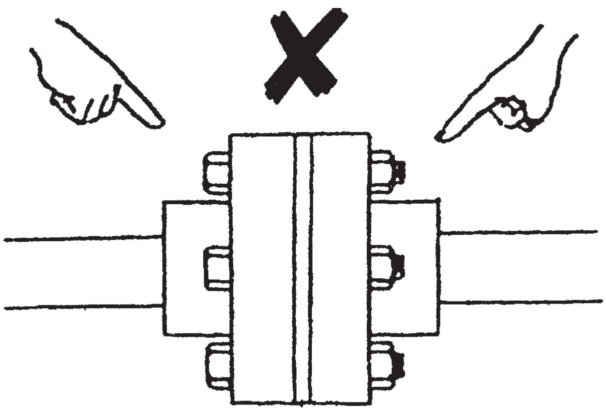
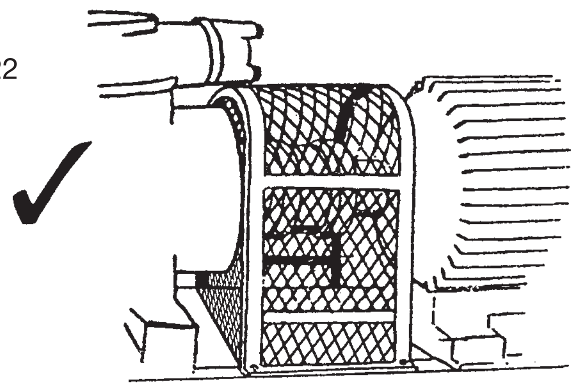


Figure 5.22



Figures 5.21 and 5.22 Drive coupling

Figures 5.23 and 5.24 Drive belt and pulley

A guard for a drive belt and pulleys is shown in Figure 5.23. This type of guard is not adequate because the belts and pulleys are accessible from the back.

The belts and pulleys should be totally enclosed as shown in Figure 5.24.

Figure 5.23

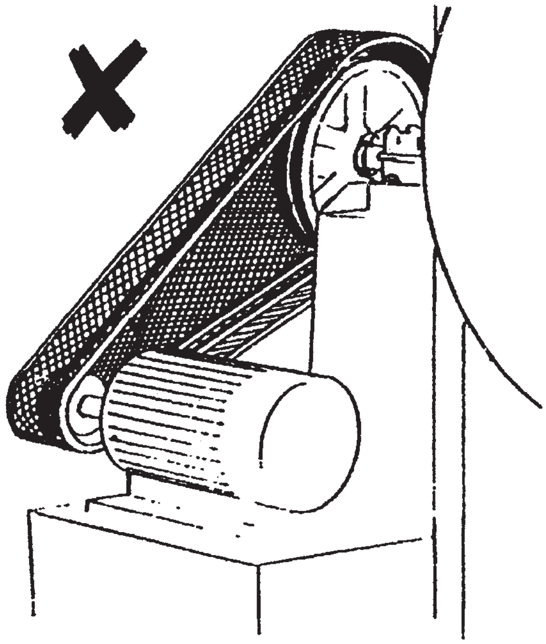
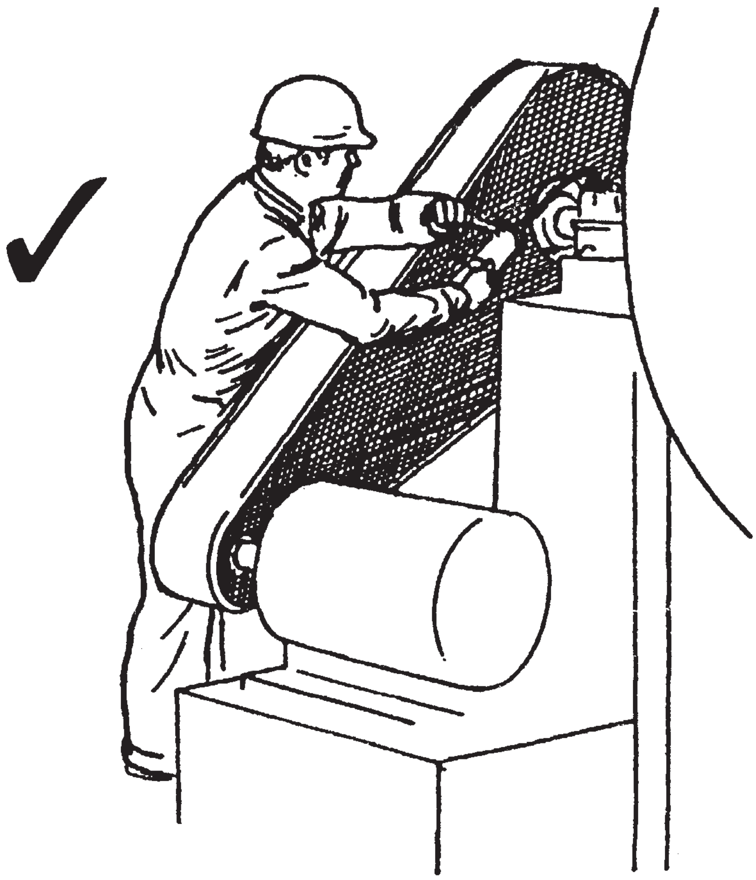


Figure 5.24



Figures 5.25 and 5.26 Drive belt and pulley

Whenever hazards are created by belt breakage to persons working or travelling nearby, as shown in Figure 5.25, the drive should be totally enclosed, as shown in Figure 5.26.

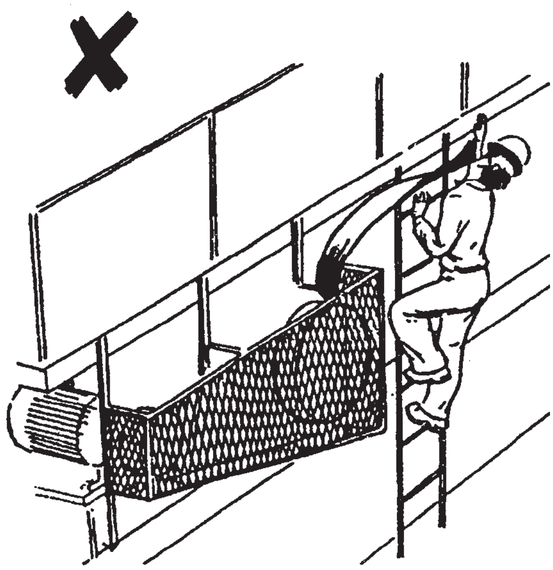


Figure 5.25

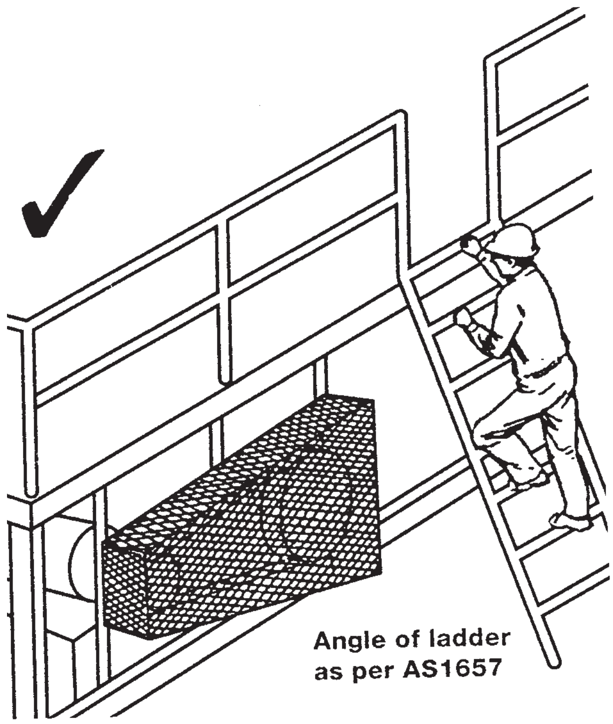


Figure 5.26a

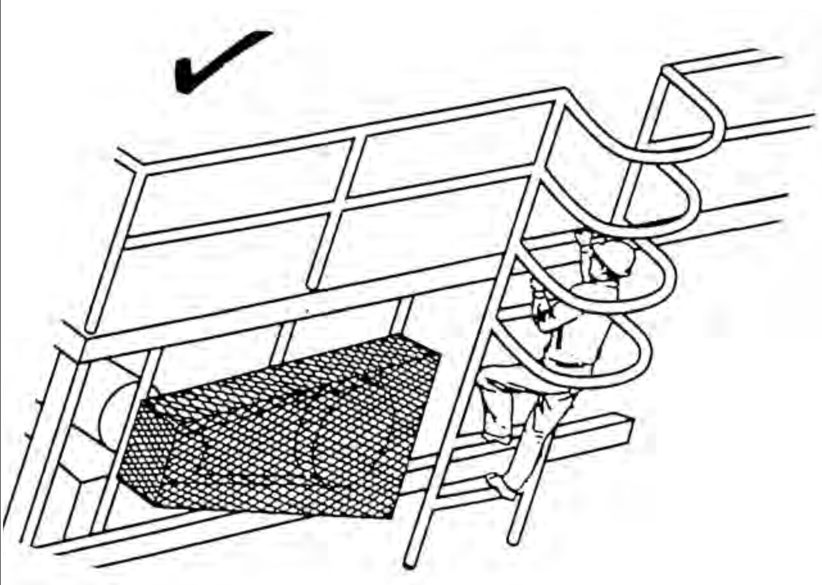


Figure 5.26b

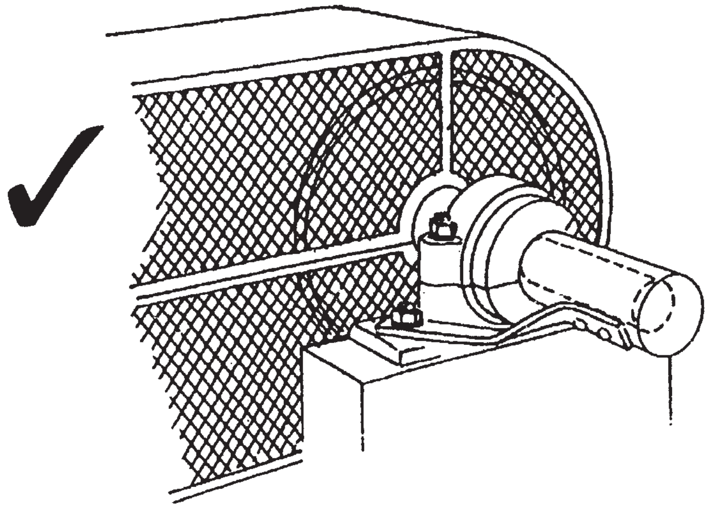
Figure 5.27 Protruding shaft ends

An effective way of guarding protruding shaft ends is shown in Figure 5.27. A simple sleeve with an end cap is placed over the shaft, thereby preventing any contact.

As a rule, shaft ends should be guarded whenever they protrude past the end of the bearing cap.

All shafts with a keyway or other protrusion or hole other than in the center, regardless of the distance they protrude, shall be guarded.

Figure 5.27



Figures 5.28 and 5.29 Fan inlet

Fan inlets should be guarded regardless of location, not only to prevent contact with fan blades, but also where free flying blades would create a hazard.

Figure 5.28

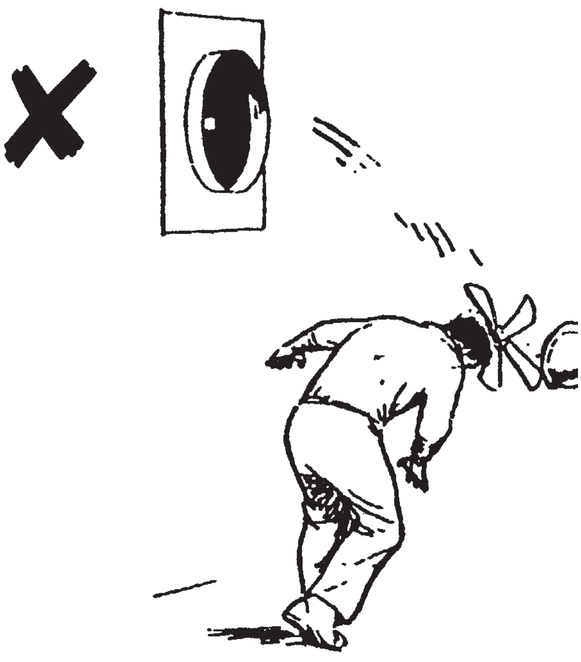
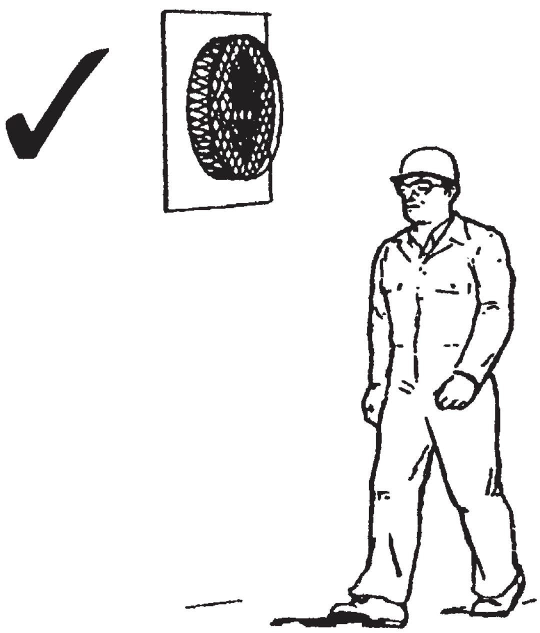


Figure 5.29



Figures 5.30, 5.31 and 5.32

Figure 5.30 shows a flywheel guarded by location (2.5m). A build-up of material can, at times, place the flywheel within easy reach, as shown in Figure 5.31 and therefore the flywheel should be guarded.

Where it is not necessary to totally enclose the flywheel, a guard as shown in Figure 5.32 may be used.

If a build-up of material places the unguarded flywheel within reach, it must be guarded.

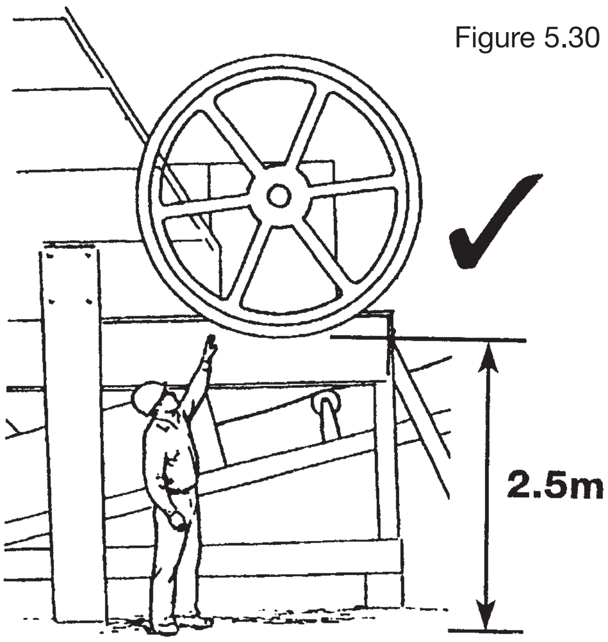


Figure 5.30

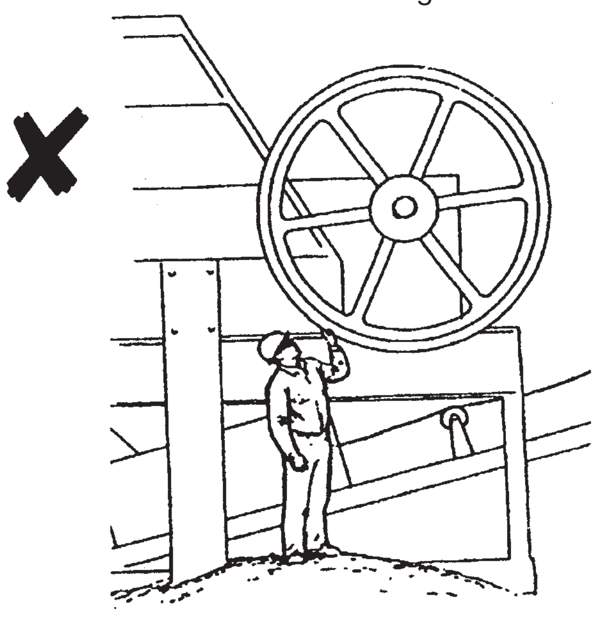


Figure 5.31

Figure 5.32

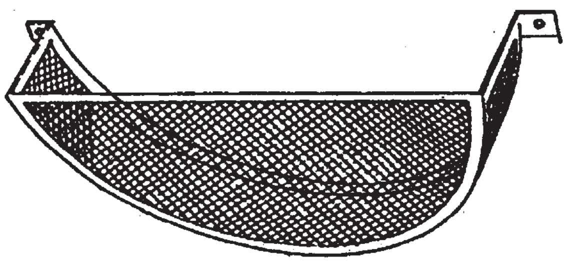


Figure 5.33 Classifier

Figure 5. 33 shows a classifier on the right, which is not guarded effectively. As shown on the left, protective fencing should be installed to restrict access or guarding can be fitted to the existing handrails.

Figure 5.34 Dryer

Figure 5.34 shows a dryer with a railing restricting access to the area. This should not be considered as a guard, since the pinch points are exposed and present a hazard to servicing personnel. Trunnions can be guarded in a practical manner as shown on the following page.

Figure 5.33

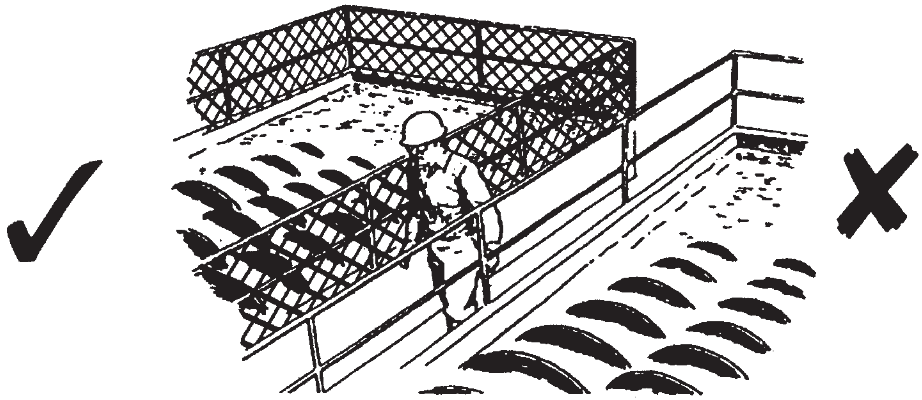


Figure 5.34

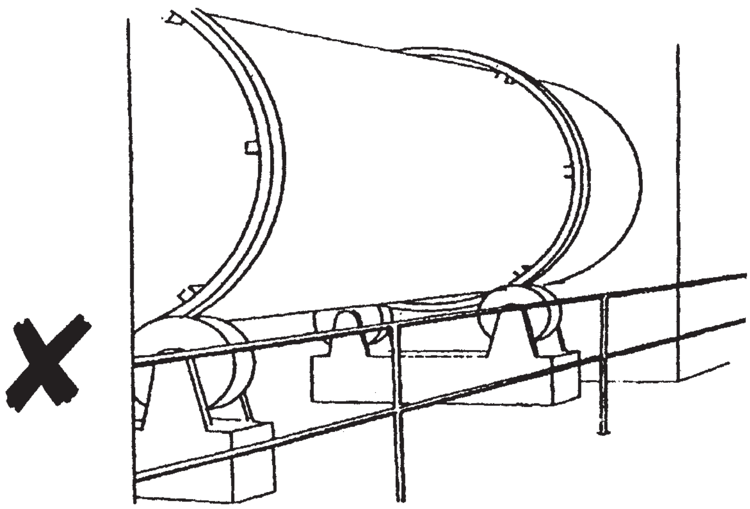


Figure 5.35 Trunnions

Figure 5.35 shows the trunnions with individual guards. This is an effective way to cover pinch points. The grease fittings can be entered through the guard so servicing can be done while the dryer is in motion.

Need to consider possibility of reversing dryer (if a jam up occurs), also close fitting of guards around rollers can be difficult.

Fully guard both sides as periodically drier direction may be reversed for a period or for maintenance.

Guarding is also required to prevent contact with the barrel of the dryer if anything protrudes from the surface.

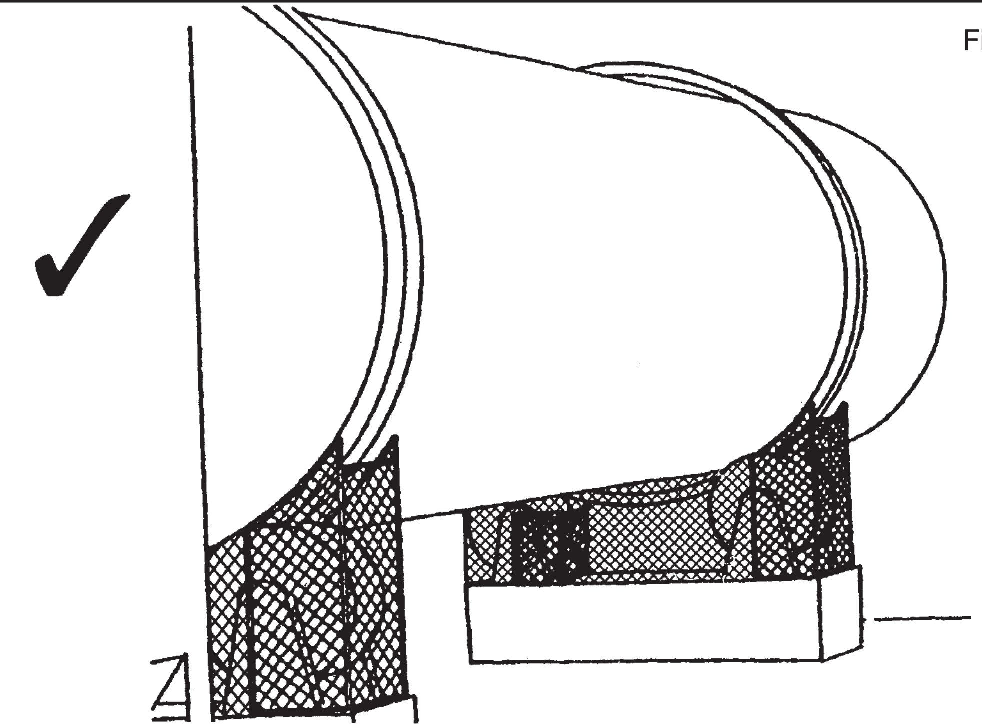


Figure 5.35

REFERENCE DOCUMENTS

MSHA's Guide To Equipment Guarding For Metal and Non Metal Mining, Mine Safety and Health Administration, US Department of Labor.

AS 1657 – 1992 Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation.

5.2.2 BOILERS AND UNFIRED PRESSURE VESSELS

5.2.2.1 GENERAL

All boilers and unfired pressure vessels and associated controls, safety equipment and piping should be constructed, installed, maintained and inspected in accordance with the relevant Australian Standards to ensure that the equipment is safe to operate.

5.2.2.2 EXEMPTION

Nothing contained in this Part applies to, or in respect of:

- pressure vessels where used in the braking systems of motor vehicles or other mobile equipment; or
- the design or construction of pressure vessels for use only in the braking systems of motor vehicles or other mobile equipment.

5.2.2.3 CERTIFICATE

A copy of the certificate in force relating to any boiler or unfired pressure vessel should be readily available for inspection on the mine site so that operators can be satisfied that the equipment has been checked.

5.2.2.4 IDENTIFICATION NUMBER

Every boiler or unfired pressure vessel in use at a mine should bear a number which matches the number shown on the certificate of inspection so that records can be checked readily.

5.2.2.5 DEFINITION OF BOILER INSPECTOR

An accredited Inspector is one of the following:

- a person employed by the inspecting authority;
- a person who provides an independent inspection service for owners of pressure equipment; or
- a person employed by an owner of pressure equipment, where the inspecting authority is satisfied that the owner's inspection organisation meets the requirements of AS/NZS 3788 – 2001 Pressure Equipment – In-service Inspection.

Note: Except in the case of the third category above, no boiler Inspector who makes, alters, repairs, owns, sells or is interested in the sale of any boiler or unfired pressure vessel can issue such a certificate in respect of any such boiler or unfired pressure vessel.

5.2.2.6 ANFO LOADERS

Ammonium Nitrate Fuel Oil (ANFO) explosive pressure loaders should be marked with a number, hydrostatically tested when new, and inspected for damage at six month intervals or less, including regulators and safety valves and a hydrostatic test.

5.2.2.7 AIR MAINS

Air mains from stationary compressors and compressed airlines should have sufficient traps to remove accumulations of water, so that water is not allowed to blow through the pipes to the working faces nor to enter compressed air powered equipment.

REFERENCE DOCUMENTS

AS 1200 Pressure Equipment.

AS 1210 SAA Unfired Pressure Vessels Code.

AS 1228 Pressure Equipment – Boilers.

AS 2593 Boilers – Unattended and Limited Attendance.

AS/NZS 3788 Pressure Equipment – In-service Inspection.

AS 4297 Underground Mining – Stationary Air Compressors.

5.3 TOOLS

5.3.1 EXPLOSIVE-POWERED TOOLS

5.3.1.1 GENERAL

Explosive-powered fastening tools used on a mine site should be designed, used, inspected, repaired and stored as set down by AS/NZS 1873 Powder-actuated (PA) Hand-held Fastening Tools.

5.3.1.2 QUALIFIED OPERATOR

A qualified operator means a person who:

- loads, unloads, attempts to load, unload or fire an explosive-powered tool;
- is over the age of eighteen years;
- has been thoroughly trained in the correct use and adjustment of the particular type of explosive-powered tool to the extent necessary to operate the explosive-powered tool safely; and
- has been fully instructed as to the dangers associated with explosive-powered tools and the precautions to be taken in respect to them.

5.3.1.3 USE

An explosive-powered tool should not be used unless:

- it is of a type and model which has been approved; and
- it is used by a qualified operator.

REFERENCE DOCUMENT

AS/NZS 1873 Powder-actuated (PA) Hand-held fastening tools.

5.3.2 ABRASIVE WHEELS

5.3.2.1 TOOLS AND GRINDING/CUTTING WHEELS

Correct grinding/cutting wheels should be selected for a specific duty. Such wheels must only be used with an arbor to suit the machine and wheel.

The safe maximum rotation speed of the wheel should match the machine to be used.

The wheel should have no visible cracks, or damage, and be fitted correctly to the machine.

The diameter of the wheel arbor should be of the correct size for the type and size of grinding/cutting wheel it will carry. The wheel washer and collar should be of the correct diameter and thickness and made with the correct recess to grip the wheel firmly. The wheel washer and collar should be of the same diameters. The nut which holds the wheel on the arbor and the washer against the wheel should be of sufficient size and strength to do the job.

5.3.2.2 OPERATION

Operators should receive adequate training in the use of grinding/cutting wheel equipment.

Users should check that all tools are in a safe operating condition.

Operating speeds of all grinding and cutting tools, using abrasive discs, should be checked with a tachometer to ensure the tool is operating at the manufactures recommended speed.

With the exception of cone-shaped wheels and small mounted points, all wheels should be operated under or inside a guard, designed to protect the operator.

Electrically-powered portable grinders and cut-off machines should be protected by an earth leakage unit. The power cable needs to be suitable for the rating of the tool and be in good condition.

The hose connected to an air-powered tool should be secured with a safety clip to prevent the hose from detaching. The air hose needs to be rated for the pressure to be used and be in good condition.

Air-operated grinders have air motors which reach their maximum power at approximately 50% of their free running speed. In other words, a tool at either rest or full running speed, is doing no work and develops no horsepower. To have a tool run at free speed (within proper safety limits) and at maximum power, governors are used. They should be checked regularly.

Steps commonly observed for a grinder operating at 4500 rpm include:

- first squirt some oil into the inlet bushing to ensure all internal parts are cleaned and lubricated;
- turn the tool on and check the free rpm which can be read from the spindle of the tool, which reading should be between 4200 rpm and 4400 rpm; and
- check that the governor is operating correctly by loading the tool down (applying pressure to the output spindle with a piece of wood).

As most air grinders do not have gears, they operate at relatively high speeds.

It is essential that the spindle carrying the grinding wheel runs true, and that the bearings are in good condition; otherwise, the spindle will vibrate considerably, causing rapid wear and increase the possibility of wheel breakage. Be sure spindle attachments such as chucks, collets, and arbors run true with the spindle to avoid vibration.

Note: Tools should be operated according to the manufacturer's recommendations.

5.3.2.3 MAINTENANCE

All tools used with abrasives are subject to damage from the dust. The ventilating and moving parts should be cleaned with an air hose. Occasionally, portable grinders should be disassembled and all parts cleaned.

Guards, particularly on portable machines, should be checked for cracks and loose fasteners.

The speed of air-operated grinders/cutting wheels should be checked regularly.

Grinding wheels should be dressed periodically to keep the wheel face clean and straight. A damaged wheel should be removed immediately.

The tool rest should be adjusted so that the gap between the wheel and the rest is no greater that 1.5 mm.

Flange nuts should be checked to see that they have not worked loose.

Note: Tools should be maintained and repaired in accordance with the manufacturer's recommendations.

5.3.2.4 PERSONNEL PROTECTION

- Goggles should be worn at all times when grinding.
- Dust masks should be worn as appropriate.
- Suitable clothing should be worn to prevent burns or cuts.
- There should be adequate lighting and ventilation when using abrasive equipment.

REFERENCE DOCUMENT

AS 1788 Abrasive Wheels.

5.3.3 GAS CUTTING, WELDING AND HEATING

5.3.3.1 GENERAL

The control of risks in the use of oxygen and fuel gases (acetylene, or liquified petroleum gas [LPG]) involves considerations of the operator's competence, equipment, work procedure and the surrounding environment.

5.3.3.2 OPERATOR EDUCATION

Those who use oxygen and fuel gases (acetylene or LPG) in mines to cut, weld or heat must have attained a satisfactory level of competence in use of the procedure.

5.3.3.3 OPERATOR PROTECTION

Goggles with the correct shade of filter should be used.

Suitable protective clothing should be worn – that is, gloves, aprons and shoes (boots).

Oxygen or another gas should not be used to dust clothes or work.

An appropriate respirator should be worn when working on lead, lead-bearing materials, steel coated with lead paints, cadmium-coated materials, zinc-coated materials or any objects containing metals giving off toxic fumes.

5.3.3.4 EQUIPMENT

Inspection of equipment should be made before it is used. Faulty items should be replaced immediately. Items to inspect include cylinder regulators, flashback arrestors, hoses, couplings, torches and tips.

The manufacturer's advice should be heeded.

Hoses should be protected from sparks, hot slag, hot objects, sharp edges or open flames.

If hoses are burnt in a flashback they should be replaced.

When oxygen and fuel gases (acetylene or LPG) are used in a mine shaft, an automatic hose reel should be used.

5.3.3.5 WORKING IN A SHAFT, RISE, PASS, LIFT, PIT OR CLOSED VESSEL

Cylinders should be located above the cutting point so that sparks, slag and molten material cannot fall on hoses or on fusible plugs.

A suitable fire extinguisher and water hose should be located nearby.

The area should be deluged with water if flammable material is present (for example, timber shaft frame, which cannot easily be protected, and where significant impact from a fire would result).

Molten metal, slag and sparks must be prevented from falling down shafts, onto flammable material, into chemical storage areas, onto Linatex, conveyor belts, polyurethane screens, etc.

Further advice on precautions, including obtaining permits to work is available in AS 1674 Safety in Welding and Allied Processes.

When work is to be performed in confined spaces, the requirements of AS 2865 Safe Working in a Confined Space may apply.

5.3.3.6 FIRE PROTECTION

While oxygen will not burn, it vigorously supports and accelerates combustion, causing flammable materials to burn with great intensity.

Oil or grease in the presence of oxygen may ignite spontaneously and burn violently.

A suitable fire extinguisher should be located nearby. The operator should be aware where other firefighting equipment is located.

Work areas should be clear of all rubbish and flammable material.

Where flammable material cannot be removed it should be suitably protected.

The operator should ensure that his/her clothing is not oily.

All mines should have a written procedure for inspecting a location after welding, cutting or heating has been performed, to ensure fires do not occur.

5.3.3.7 STORAGE AND HANDLING OF GAS CYLINDERS

- Cylinders should be stored at least 15 metres from fuel bays, fuel outlets and mobile equipment under repair.
- Cylinders should be housed behind a fireproof partition.
- Storage areas should be fitted with suitable heat deluge water spray systems and a notice indicating that this is an approved storage area for oxidants and acetylene bottles.
- Storage areas should be fitted with locking doors, level floors and should be raised at least 150 mm above the surrounding floor.

- Dry powder extinguishers should be positioned not less than 8 metres, nor more than 10 metres, from the storage areas.
- Never sling or lift a cylinder by the valve cap or guard.
- Cylinders should only be lifted in approved cradles.
- Where possible, use an approved cylinder trolley for transporting cylinders, even for a short distance.
- Leave the valve protection caps/guards in place when cylinders are not in use.
- Keep cylinder valve outlets clean and free from contaminants, particularly oil and water.
- Do not use cylinders as rollers or supports, or for any purpose other than that for which they are designed.
- Never permit oil, grease or other readily combustible substances to come into contact with the valves of cylinders containing oxygen, nitrous oxide or other oxidants.
- Do not subject cylinders to abnormal mechanical shocks which may cause damage to their valves or safety devices.
- Never attempt to repair or modify cylinder valves or safety relief devices.
- Damaged valves or threads should be tagged and reported immediately to the shift foreman/shift boss.
- Cylinders in bulk (more than two) should only be transported underground in approved containers with the cylinders secured.
- Up to two cylinders may be transported in a shaft conveyance if they are secured.
- All cylinders should be kept upright, empty or full, away from any sources of heat, electrical circuits and oil or grease.
- Cylinder valves should be tightly closed when not in use.
- Cylinder keys should be left in position when gas cylinder valves are open. Only standard keys should be used to open cylinder valves.
- Oxygen cylinders should not be stored with cylinders of acetylene or near highly combustible material.
- Acetylene cylinders should be kept upright whether in use or in store, full or empty.
- Oxygen and acetylene cylinders should be fitted with a flashback arrestor when in use. Flashback arrestors should also be fitted to the handpiece.
- All oxygen and acetylene cylinders should be placed on a stable footing and be secured by chain when ready for use or stored.
- When cylinders are used in a cage or on a stage they should be chained upright to a rigid support.
- Cylinders should be made secure when they are being transported.
- Cylinders should be returned to safe storage area when a cutting job is completed.

5.3.3.8 BACKFIRES AND FLASHBACKS

A (backfire) is a momentary extinguishment or burning-back of the flame into the blowpipe tip. It is caused by touching the tip against the work, by particles entering the tip and obstructing the gas flow, or by overheating the tip. The trouble will sometimes clear itself immediately. If the work is hot enough, the blowpipe will then re-light automatically.

“Back feeding” or “reverse flow” of fuel gas or oxygen causes the gases to become mixed in the blowpipe, the hose, the regulator, or in the cylinder. This is a condition in which worn or malfunctioning torch valves allow different gases to mix dangerously in gas hoses. It occurs when the torch tip becomes plugged, when pressure is bled from the equipment by turning off the cylinder valves with torch valves open, and when pressure is exhausted from the fuel gas cylinder while the torch is in use. If these gases ignite, a flashback occurs, possibly with an explosive and devastating result. A flashback is the burning-back of the flame into the blowpipe or the ignition of an explosive mixture in one of the gas lines. Flashbacks can burn right back into the tubing. However, external damage does not always make itself evident following a flashback. Frequently, the only sign is a cloud of carbon smoke issuing from the welding tip when the blowpipe valves are open. The least amount of damage caused by a flashback is the burning of the inside of the hose lining which, if repeated over a period of time will result in disintegration of the hose.

In the case of flashbacks, the following procedures apply.

- Flashback into the blowpipe (this creates a shrill hissing sound as the flame burns at the mixer). If such flashback occurs, close the blowpipe oxygen valve at once. Then close the fuel gas valve. Wait a few moments to be sure the flame inside the blowpipe has had a chance to burn out.
- Flashback into the rubber tube. If such a flashback occurs, close the cylinder valves immediately.

Note: It is recommended that flashback arrestors should be fitted to all gas torches and oxygen and acetylene bottles when in use. This will prevent the potential for flashbacks to initiate an explosion in the gas cutting/welding/ heating equipment. Flashback arrestors should conform to the requirements of AS 4603 – Flashback Arrestors.

5.3.3.9 LIGHTING A GAS TORCH

Before lighting a torch, the assembled connections should be checked for gas tightness with soapy water or the equivalent, and not a flame.

Before lighting the torch for the first time each day, hoses should be purged individually. This consists of allowing each gas to flow through its respective hose separately, for long enough to purge (get rid of) any flammable gas mixture in the hose. Hoses should not be purged into confined spaces or near ignition sources.

5.3.3.10 HOT WORK PERMITS

Cutting and welding and often processes such as brazing and cutter grinding are commonly referred to as hot work activities. (AS 1674 – Safety in Welding and Allied Processes defines hot work as grinding, welding, thermal oxygen cutting or heating and other related heat producing or spark producing operations.) Potential health safety and property hazards result from the fumes gases sparks, hot metal and radiant energy produced during hot work. Hot work equipment which may produce high voltages or utilise compressed gases also require special awareness and training on the part of the worker to be used safely. Appropriate steps need to be taken to minimise fire hazards such as the removal or guarding of combustible materials and when possible restricting hot work to specially designated areas.

It is essential to have control over hot work operations in areas with potential risk. A hot work system is a good method of ensuring that adequate safe guards are taken prior to, during and after all hot work.

A hot work permit should be issued by the mine operator. For an example of a hot work permit, refer to AS 1674. Where continuous work is being carried out a blanket permit may be issued for a number of days, however the hot work site should be inspected by the person authorising the work at least twice daily to ensure that the work is being carried out safely and in accordance with the condition set out in the hot work permit.

The permit should state the potential hazards of the area concerned and set out the precautions to be taken.

The following are some of the hazardous areas which contain high potential for serious consequences if exposed to hot work:

- within 6 metres of any explosive magazine or any place where explosives are stacked, stored or placed;
- within 10 metres of any battery on charge (batteries on charge produce explosives hydrogen gas);
- above or within 15 metres of any exposed or unprotected combustible material;
- in or within 15 metres of any fuel store or refuelling station;
- within 15 metres or directly above a vessel which carries or may have carried diesel oil or other petroleum products;
- within 15 metres or directly above any area from which spillage of petroleum products may have accumulated;
- within 15 metres or directly above any area in which ammonium nitrate may have accumulated; and
- in or within 15 metres of any vertical opening including a shaft drums or containers which have held or suspected to have held chemicals, fuels or flammable liquids.

5.3.3.11 SAFE AREAS

There are areas where hot operations can reasonably take place at any time provided that the equipment is in good condition and safe operating procedures are followed (for example, workshops, open areas in plant away from combustible materials). Safe areas should be inspected on a regular basis to ensure that equipment is in good condition and that there are no fire hazards present.

5.3.3.12 PREPARATION OF WORK SITES

Preparation of work sites may vary from situation to situation and according to circumstances one or more of the following procedures may need to be observed:

- prior to issuing a hot work permit, the mine operator should inspect the hot work area to ensure the site and the equipment requiring hot work is properly prepared to prevent the danger of fire, explosion or exposure to toxic gases;
- remove any flammable or combustible liquids or flammable gases and relocate at least 15 metres away from the area. Alternatively provide physical barriers to liquids, vapours and gases between the storage and heat source;
- ventilate the area to ensure the atmosphere does not contain flammable vapours;
- sweep floors and wet them down, check walls and horizontal surfaces for collection of dusts and lints and if necessary sweep and wet down as for floors. If the area is outdoors, clear away combustible materials such as vegetation, sawdust, wooden pallets, and soak the area concerned;
- plug all drains, floor openings and pipe gutters within the vicinity of the hot work area, to prevent the possibility of sparks, slag or hot metal off cuts falling onto combustible materials;
- disconnect electrical sources;
- provide ample fire protection equipment such as fire extinguishers, fire blankets and fire hoses;
- assign a person to act as a fire watch for uncontrolled sparks, slag and hot metal off cuts; and
- when the mine operator is satisfied the area is satisfactorily prepared for the work proposed, a hot work permit can be issued, signed by himself/herself and the maintenance personnel or contractor responsible for carrying out the work.

5.3.3.13 RESTORATION OF THE WORK SITE

On completion of the hot work, the person responsible for carrying out the work should inspect the area to ensure it is safe, fill in the completion time on the hot work permit and return it to the person who originally authorised the work.

The mine manager or nominated responsible person should inspect the work area approximately 30 minutes after receiving notice that the job has been completed to check that the area is safe and free from smouldering debris. When he/she is satisfied that the area is safe, the hot work permit should be signed and filed.

5.3.3.14 TRAINING

All persons performing hot work should be trained in proper equipment operation, handling and storage of welding materials, compressed gas safety, chemical hazards, and in working procedures, including the written hot work permit. Additional training may also be necessary in the proper selection and use of personal protective equipment. Training in confined space entry is necessary before working in such areas.

5.3.3.15 CONFINED SPACES

Refer to previous Part 5.1.5 on confined spaces. When performing welding or cutting in a confined space the following additional considerations are necessary:

- ventilation is a prerequisite to work in confined spaces;
- gas cylinders and welding machines should be left outside;
- heavy portable equipment mounted on wheels should be securely blocked;
- whenever a welder must enter a confined space through a small opening or manhole, means should be provided to quickly remove

him in the event of an emergency. Safety belts and lifelines used for this purpose should be attached to the welder's body so that his body cannot be jammed in a small exit opening;

- an attendant with knowledge of preplanned rescue procedures should be stationed outside to observe the welder at all times. He must be capable of putting rescue operations into effect;
- when arc welding is suspended for any substantial length of time, all electrodes should be removed from the holders, and the holders located so that accidental contact cannot occur. The machine should be disconnected from the power source; and
- to prevent accidental gas leakage, torch valves should be closed and the fuel-gas and oxygen supply to the torch shut off outside the confined area whenever the torch is not to be used for a substantial period of time. Where practicable, the torch and hose should be removed from the confined space.

Three factors in arc and gas welding govern the amount of contamination to which welders may be exposed. These factors are:

- dimensions of space where welding is to be done (ceiling height is especially important);
- number of welders; and
- possible evolution of hazardous fumes, gases, or dust according to metals involved.

General Requirements

Mechanical ventilation is needed when:

- space is less than 10,000 cubic feet per welder;
- ceiling height in room is less than 5 metres; and
- in confined spaces, or where welding space contains partitions or other structural barriers which may obstruct cross ventilation.

Mechanical ventilation at a minimum rate of 2,000 cubic feet per minute per welder, except where local exhaust hoods, booths, or airline respirators are provided. Natural ventilation is considered sufficient for welding or cutting where the restrictions above are not present.

5.3.3.16 VENTILATION IN CONFINED SPACES

Adequate ventilation should be provided to prevent accumulation of toxic fumes or possible oxygen deficiency. This includes not only the welder, but also helpers and other personnel in the immediate vicinity. All make-up air that is drawn into the area of operation must be clean and respirable.

5.3.3.17 PERSONAL PROTECTIVE EQUIPMENT

The minimum protective equipment to be used is shown below.

Minimum Protective Equipment

PROCESS	HAZARD	PERSONAL PROTECTION
Gas cutting and welding	Radiation	Goggles with appropriate filters and clothing
	Burns	Gloves, footwear with suitable head wear for overhead cutting
Arc welding (manual)	Burns	Full face protection shields with filters
	Radiation	Adequate clothes, gloves and footwear
Electric shock grinding, and chipping	Hard particles	Goggles and hearing protection
Plasma cutting adequate clothing	Fumes	Goggles with appropriate filters and
	Radiation	Gloves, footwear and suitable head wear for overhead cutting

Recommended Respiratory Protection

Process	Shop Welding		Field Welding	
	Ventilation Good	Ventilation Poor	Ventilation Good	Ventilation Poor
Manual arc welding	Not Required	Fume mask – use fume mask if fumes are excessive, ie working with galvanised metal	Not required – use fume mask if fumes are excessive, ie working with galvanised metal	Not required
Tig/Mig	Not Required	Fume mask	Not required	Fume mask
Gas cutting/welding	Not Required	Fume mask – use fume mask if fumes are excessive, ie working with galvanised metal	Not required – use fume mask if Fumes are excessive, ie working with galvanised metal	Not required

REFERENCE DOCUMENTS

Boral OH&S Manual, Boral.

Welding Cutting and Brazing Program, University of North Carolina at Greenborough.

Welding Institute of Australia.

Technical Note 7.

Technical Note 20 – Repair of Steel Pipes.

AS 1674 Safety in Welding and Allied Processes.

AS 2030 Gas Cylinders Code.

AS 2865 Safe Working in a Confined Space.

AS 4603 Flashback Arresters – Safety devices for use with fuel gases and oxygen or compressed air.

AS 4332 Storage and Handling of Gases in Cylinders.

MDG 25 Guideline for Safe Cutting and Welding Operations at Coal Mines and Coal Preparation Plants. NSW Department of Mineral Resources.

5.4 MAINTENANCE AND REPAIRS

5.4.1 GENERAL

Badly maintained, untidy, run-down, unpainted machinery indicates a lack of responsibility and commitment which can lead to the development of unsafe workplace conditions and procedures. These conditions can be avoided by a program of planned maintenance.

5.4.2 PLANNED MAINTENANCE

Planned maintenance brings many advantages:

- routine checks by operators can prevent breakdowns and premature wear which can lead to losses to the company and may place people at risk;
- maintenance personnel are able to reduce or eliminate risks to themselves by planning lockout procedures, access, materials handling and other procedures in advance;
- repairs are more likely to be permanent rather than temporary patch-ups, which may not be reliable and often end up as the permanent solution until the next breakdown;
- production personnel are less likely to be exposed to risks when malfunctioning machinery demands manual intervention;
- down time is planned and results in less disruption of personnel and production; and
- maintenance costs are controlled and hence allow the best utilisation of resources.

5.4.3 HEALTH AND SAFETY REQUIREMENTS

- Legislation places a general obligation on companies to maintain equipment in a safe operating condition.
- Controls, emergency stops, access and guarding systems, must be maintained in full functional order. Priority for this should be no less than for the maintenance of any other part of a machine.
- Machines that are designed to function automatically should be maintained in this condition to avoid the need for operators to intervene manually and hence place themselves at risk.

Items which are solely or predominantly for the health and safety of employees must receive a high priority for maintenance. These will include:

- all personal protective equipment;
- air filters and air conditioners in dusty or hot environments;
- seats and controls on mobile machines;
- windows; and
- dust seals.

5.4.4 ROUTINE MAINTENANCE TASKS

5.4.4.1 CHECKLISTS

Checklists should be prepared and used for routine tasks as outlined below. These should include all tasks and be based on machinery manufacturers recommendations and company experience. The use of these checklists will provide information for operators, supervisors and managers.

5.4.4.2 DAILY CHECKS

Daily checks should include the following:

- oil levels for lubrication and hydraulics;
- coolants levels;
- fuel levels;
- filters checked for cleanliness;
- operations of instruments;
- functioning of controls;
- effectiveness of brakes and other safety devices;
- electrical connections and switches;
- condition of tooling; and
- reporting leaks, wear, damage, presence and effectiveness of guarding.

Safe operating procedures must be observed while carrying out the above maintenance tasks.

5.4.4.3 SUGGESTED AIDS IN SCHEDULING MAINTENANCE

These include:

- manufacturer's handbooks and maintenance schedules;
- card index or similar logs of maintenance performed on major plant items;
- site asset list(s);
- outside diagnostic services (for example, SOS scheduled oil sampling);
- site maintenance schedules/checklists; and
- computer based schedules which include reminders and completion of audit reports.

5.4.4.4 BREAKDOWN MAINTENANCE

Unplanned maintenance activities often present a greater risk of injury than the normal operation of plant and machinery. For this reason, greater control and supervision will be required. It would be an advantage to have a plant breakdown procedure or checklist.

The following issues should be addressed.

- Who is responsible for maintenance activities?
- Who will supervise these?
- How will communication and consultation with employees occur?
- How will plant and machinery be made safe?
- What procedure will be used for hazard identification, risk assessment and risk control?
- What specific safe work procedures and permits will be used (for example, lockout, hot work, confined spaces)?
- How will safe access be provided (for example, fixed access, scaffolding, elevating work platforms)?
- How will heavy or bulky items be moved (for example, cranes, fork lifts, trolleys)?
- How will services be proved (for example, light, compressed air, electricity, water, ventilation)?
- How will spillages of flammables, combustibles or pollutants be controlled?
- What emergency equipment will be required (for example, fire extinguishers, Self Contained Breathing Appraratus (SCBA), rescue harness, first aid kit)?
- How will pedestrian and vehicle access be controlled?
- What facilities will be needed for the temporary storage of tools, parts and scrap?
- What will be needed to properly clean up after the job?
- What start up precautions will be needed (for example, all guards replaced, all adjustments made, all controls functioning properly, all emergency stops operational, observation and close supervision)?

5.4.4.5 DEFECT NOTICE PROCEDURE

A defect notice procedure:

- provides all employees with an easy way to advise their supervisors of problems with plant and equipment; and
- enables management to keep records of the corrective work carried out.

Defect Notice cards should be readily available and all employees encourage to use them. In particular, this procedure should be included with induction programs.

When a defect is found, the details on the card are completed (preferably by the person finding the defect) and the card is then given to the supervisor or manager as appropriate. This person then signs and dates the card when received and gives it to the appropriate section to carry out the work. On completion, the card is noted accordingly and returned to the supervisor or manager. All cards are to be retained for seven years.

To ensure that information relating to the defect is communicated to other employees who may not be present when the defect is reported, it is recommended that a duplicate of the card, in the form of a tag, is completed and fixed to the relevant item of plant or equipment. If operations of the defective plant or equipment is likely to cause accidents or injury, an "Out of Service" tag should be affixed.

REFERENCE DOCUMENT

Boral OH&S Manual, Boral.

5.5 CRUSHING, SCREENING AND CONVEYOR MACHINERY

5.5.1 GENERAL

- All fixed machines should be stable and secure with all moving parts properly guarded. Guards should be of a suitable robust design.
- The blades on all power driven saws and similar equipment should be properly guarded.
- All controls should be accessible and properly labelled. In particular, ensure that emergency stop buttons are fitted to all power-driven machinery.
- Where excess dust is generated, extraction and collection systems should be installed and maintained.
- All power driven machinery should be serviced and maintained as per any applicable maintenance service requirements or standards.
- Noise generated by plant and machinery should be kept to a minimum through purchasing control and good design techniques (note – the national standard of 85 dB(A) should be applied when purchasing new equipment).

5.5.2 PRIMARY FEED

5.5.2.1 TRAFFIC HAZARDS

Vehicle movements in the area of the primary stockpile and feed can be hazardous. To prevent vehicle accidents, close attention to the haulage layout is necessary. Precautions should include:

- clear visibility;
- adequate width roadways;
- speed restrictions;
- give way signs; and
- pedestrian safety.

5.5.2.2 DUST HAZARDS

Dust can be hazardous by impairing visibility. It may also present a health hazard. Precautions to allay dust produced in the primary feed area should include:

- water or approved soluble oil applied to roadways and ramps to reduce dust produced by vehicles; and
- water sprays installed at primary feed stockpiles and the primary hopper.

5.5.2.3 ROCK CHIPS

Flying rock chips can present a hazard when trucks dump in stockpiles or into the hopper. It is important that personnel are not exposed to this hazard. Where exposure cannot be eliminated, proper protective equipment is to be worn.

5.5.2.4 FALLING ROCKS

Around the primary feed area, rocks may fall off vehicles or stockpiles. Adequate protection is required to prevent falling rocks doing harm.

5.5.2.5 PRIMARY FEED HOPPER

This is a hazardous area. Precautions to take should include:

- stop block to prevent vehicles entering the hopper;
- sufficient capacity of the hopper to prevent spillage over sides;
- adequate construction to carry weight;
- water sprays to allay dust;
- tipping signals;
- hearing protection required due to high noise levels when rock is being dumped, or minimising the noise by lining the hopper with rubber; and
- examining for explosives in muck pile.

5.5.3 CRUSHING

5.5.3.1 FALLING ROCKS

Can occur at any crushing stage due to overflow of hoppers or crushers. Precautions should include:

- adequate hopper storage;
- operator protection;

- keep clear warnings in hazard areas; and
- controlled feed.

5.5.3.2 ROCK CHIPS

Flying rock chips can occur at any crushing stage. Precautions may include:

- operator protection through enclosed cabins, or screens;
- eye protection;
- keep clear warnings in hazard areas; and
- design of plant to minimise this hazard.

5.5.3.3 DUST HAZARDS

This is a hazard which can occur throughout the crushing operation. Precautions may include:

- water sprays;
- enclosures, particularly where water sprays may not be effective. Enclosures usually require extractor fans and dust collectors;
- operator protection in enclosed cabins with positive pressure ventilation; and
- approved dust respirators for operators exposed to dust hazard.

5.5.3.4 NOISE HAZARDS

Noise is a hazard that occurs at every crushing stage. Precautions that can be taken include:

- operator cabins to be soundproofed;
- bins and transfer points can be lined with rubber or other absorbent materials;
- motors properly muffled;
- noisy motors and other machinery enclosed in acoustically lined enclosures;
- proper, approved hearing protection to be worn where noise hazard exists; and
- noise surveys to determine the hazardous areas.

5.5.3.5 BLOCKAGES

Many accidents occur during the hazardous operation of clearing blockages in crushers. These accidents are often serious and sometimes fatal. Precautions should include:

- where there is a possibility of an operator falling into a crusher while working on a blockage, he should be wearing an approved safety belt and rope securely attached. Barriers should also be installed around crushers;
- proper safety equipment should be worn at all times when clearing blockages. Example: hard hats, safety glasses, gloves, safety boots;
- no tipping signal and/or barriers activated to prevent further material being dumped; and
- proper tools used to clear blockages. Remote controlled equipment such as rock breakers and hoists are desirable but where manual tools are required, care must be taken to avoid injury.

Spalling

Where spalling is required, the crusher should be turned off and stationary. Eye protection, foot and leg protection must be worn.

Hooking

Where it is necessary to hook rocks, the hook is to be constructed of lightweight steel and have a handle that can be readily released. In many situations, it is hazardous to use a hook near a crusher while it is operating, and in these instances a remote-controlled mechanical hook, or hydraulic breaker should be used.

Barring

Using steel bars for leverage is hazardous and should be avoided where possible. Back strains, hand and leg injuries can occur in addition to often more severe injuries as a result of being struck by the bar. The crusher must be turned off and stationary before barring commences. Proper length bars should be used and the operator so positioned that he cannot lose balance or expose himself to hazards.

Wedging

Using steel wedges to free blockage in jaw crushers is hazardous and should be avoided. Where the employer considers wedging necessary, precautions are to be taken to prevent operators being struck by wedges ejected from the crusher. Care in the construction of the wedge and operator positioning are important aspects for protection.

5.5.3.6 STEEL IN CRUSHER

Any steel such as tools or foreign objects, can be hazardous if it gets into a crusher. Operator protection must be considered in the design of crushing facilities. Magnets and audio visual warnings should be installed to detect steel in the process.

5.5.3.7 EXPLOSIVES

Undetonated explosives can sometimes enter crushers where due care is not exercised with misfires. Operator protection from this occurrence should be considered in the design of operator stations.

5.5.3.8 FALLING PERSONS

Most crushers are elevated. To avoid accidents from persons falling, all elevated platforms should have adequate hand rails and kick boards installed.

5.5.3.9 FLYWHEELS AND OTHER MOVING PARTS

Moving parts such as flywheels, drive shafts and belt drives can be hazardous if they are not properly guarded. Guards are to be sufficient that accidental injury is not possible.

5.5.4 SCREENING

5.5.4.1 MOVING PARTS

Moving parts such as V-belts, rollers, drive chains, flywheels and counterweights must be sufficiently well-guarded as to prevent accidental injury.

5.5.4.2 DUST HAZARDS

Dust from screening is a health hazard at many screening operations. Varying amounts of water, from wet screening to mist sprays can be used to eliminate or minimise this hazard. In some cases, it is necessary to enclose sources of dust, which to be effective, may required a dust extraction system.

5.5.4.3 NOISE HAZARDS

Screening is usually a noisy process. By lining hoppers and chutes with rubber or other absorbent materials, the levels can be reduced. Balancing of vibrating screens is important to avoid structures vibrating and contributing to noise levels. Operator protection is an important consideration when designing screening plants. Operator's cabins should be soundproofed as much as possible. In some cases, it is necessary to enclosed the screens in buildings. Some hearing protection, depending on noise levels produced, is required when in the vicinity of operating screens.

5.5.4.4 SPILLAGE

Screens can sometimes stall or overload, resulting in spillage of rock. This can be hazardous to persons in the vicinity, so protection is required.

5.5.4.5 VIBRATION

Vibration from screening and crushing operations can cause welds to break bolts to loosen. This may create unsafe situations and should be monitored. Vibration can also pose a health hazard when operators are exposed for long durations.

5.5.4.6 CONFINED SPACE

Confined spaces from screening and crushing operations may create unsafe situations and should be monitored. Refer to section 5.1.5 for further information.

5.5.5 CONVEYORS

5.5.5.1 MOVING PARTS

Conveyor belts have several hazardous moving parts:

- tail drums;
- head drums;
- rollers and return idlers;

- counterweights;
- drive belts and chains; and
- conveyor belts loaded from chutes or hoppers.

Moving parts of conveyors should be guarded in accordance with AS 1755 Conveyors – Safety Requirements.

5.5.5.2 EMERGENCY STOP CONTROLS

AS 1755 requires that conveyors be fitted with emergency stop controls.

Simply the requirements are as follows:

- inaccessible conveyors which are 2.5 m above ground or walkway levels should have emergency stop controls at ground or walkway level with no more than 100 m spacings between emergency stop controls; and
- conveyors closer than 2.5 m from the floor or normally accessible walkways or platforms shall have emergency stop controls readily accessible and operated by a pull wire/ lanyard type system.

The pull wire/lanyard stop control is appropriate for most situations as regardless of where a person is standing by the conveyor, he can usually reach the lanyard.

A review of the likely area of access will highlight the most appropriate location for the pull wire.

Where access is provided on both sides of a conveyor, stop controls are also required on each side. Emergency stop controls should also stop all downstream feed conveyors or processes.

Lanyards should be supported at least every 6 m. Breaking, slackening or removal of the lanyard shall automatically stop the conveyor unless the pull wire is electrically monitored for continuity.

Emergency stop buttons should conform to the following:

- coloured red;
- suitable and prominently marked;
- readily accessible; and
- mushroom head manually operated, automatic lock off with manual reset.

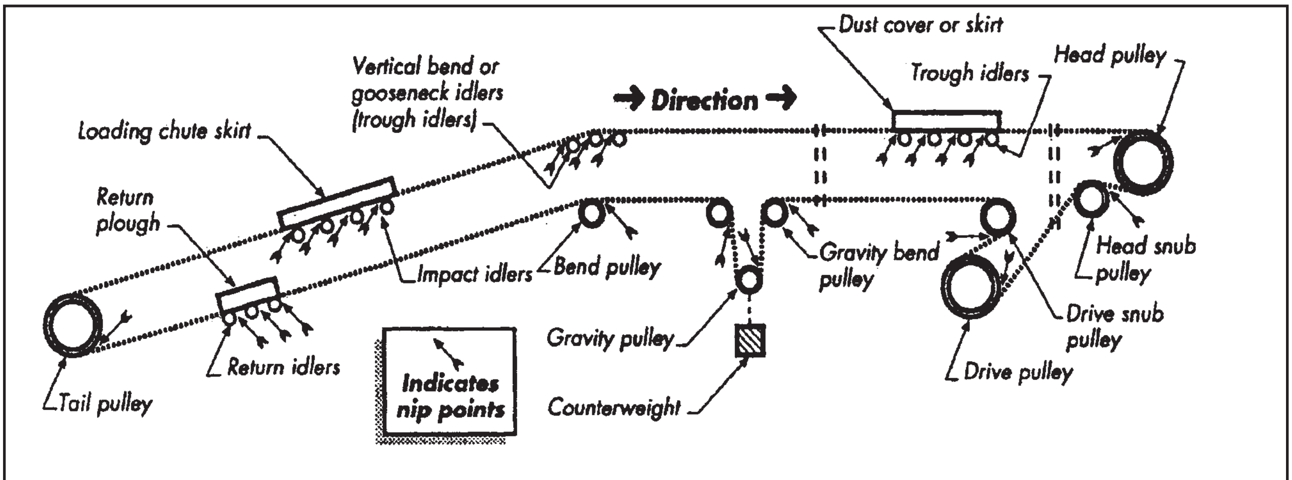
All moving machinery should be guarded to protect against the possibility of injury. The guards should be fixtures of the machinery, interlocked where possible, or needing tooling for removal. Interlocked means the removal of the guard prevents the equipment from running or being started.

For mining operations where only trained personnel have access, lift off guards are permitted, but pre-start warning devices and pull wire stop controls are required.

A single bolt fitted to lift off guards may improve safety as it reduces the speed of access to potentially moving components. Appropriate clothing should always be worn when working with this equipment. Loose clothing, long hair, jewellery easily become caught in the moving parts of machinery.

Machine/conveyor guards can range from a simple wire mesh cover, to a complicated system

Figure 5.36 Nip points (indicated by arrows) on conveyors



preventing access through physical locks and/or electrical interlocks. The problem with guards is that, if they are poorly designed and make the operation or maintenance of the machinery difficult, employees will remove or override them.

Guards fitted to new machinery and in-house built guards are commonly found to be inadequate, particularly in respect to their design specifications (for example, holes in mesh large enough to still allow access to the hazard). With regard to the legislation, there is no specific requirement which says that machine or conveyor must be guarded in any particular way. It is just required to be effectively guarded.

Other general consideration should include:

- lubrication and routine maintenance facilities should be incorporated away from the danger area or if practicable outside of the guard enclosure; and
- where the above is not practicable, moveable guards or covers should be interlocked with the drive or energy supply to the parts being guarded so that their removal will stop the operating conveyor.

Where interlocking devices are not practical, administrative procedures requiring shut off and lock out of the energy supply must be implemented.

5.5.5.3 PRESTART WARNING SYSTEM

A pre-start warning system shall be installed on every conveyor. This provision need not apply to conveyor and has access to a manually operated pre-start warning system.

Before the conveyor system starts the automatically operated pre-start warning system shall alert people to the fact that the conveyor is commencing operation and potential danger exists. The system shall be in the form of an appropriately timed visual or audible warning given to the conveyor starting.

Where auditory or visual warnings are provided they shall not be a substitute for physical safeguards. Auditory or visual warnings shall be duplicated or overlapping and shall be monitored or inspected periodically to ensure adequate levels of safety.

5.5.5.4 ISOLATION PROCEDURE

Isolation and/or lockout (tagging) procedures are closely associated with machinery guarding.

Whenever a guard is to be removed from a machine or conveyer, specific procedures should be in place to ensure that the machine/conveyor cannot be started while a person is working on the unguarded hazard.

These procedures can incorporate a combination of:

- interlock switches on the guard;
- isolation and locking or tagging procedures on the switches;
- standard written isolation procedures; and/or
- written Special Circumstance Procedures (where the machine/conveyor may have to be run for testing or adjusting without the guard being operative).

Interlocks may in some instances prove impractical as they frequently fail in the harsh conditions of a quarry environment, and further more, they can be quite easily overridden, if not correctly installed, either intentionally or unintentionally.

5.5.6 SURGE PILES AND STOCKPILES

5.5.6.1 BURIAL

Access to hazard areas should be restricted, barricaded and warning signs posted.

5.5.6.2 COLLAPSE

Collapse of compacted stockpiles can be a hazard to those working on top or below them. Care is to be taken where loading from stockpiles has created a face.

5.5.6.3 WET MATERIAL

Water saturation of stockpiles and surge piles can be hazardous. Sudden runs of large volumes of material can result. With surge piles and buried feeders this can be particularly hazardous. Proper drainage is required and care is to be taken after heavy rainfall or flooding.

5.5.6.4 DUST HAZARD

Dust from stockpiles can be hazardous and should be controlled by wetting by fine misting sprays or enclosure in building fitted with dust extraction systems.

5.5.6.5 TRAFFIC HAZARD

Stockpiles change in size, shape and location. Care is to be taken that traffic is controlled by signs and other means so that accidents are avoided.

5.5.6.6 FALLING MATERIAL

This hazard exists mainly where elevated discharge of materials is utilised. Consequently, warning signs should be posted and access restricted.

5.5.7 RECLAIM TUNNELS

5.5.7.1 DANGEROUS MOVING PARTS

Exposed moving parts such as tail drums, chute doors, conveyor rollers, feeders, belt and chain drives, require guards sufficient to prevent accidental injury. Emergency switches and pull ropes should be installed and operable in reclaim tunnels. Gates can be installed to prevent unauthorised entry.

5.5.7.2 FIRE

Conveyor belts present a fire hazard. This can be a particular problem in reclaim tunnels due to restricted access and lack of ventilation.

5.5.7.3 ENTRAPMENT

Entrapment can occur in reclaim tunnels due to runs of wet muck or chutes that malfunction. Care is to be taken that no person is exposed to this hazard.

5.5.7.4 INSUFFICIENT LIGHTING

Lighting should be sufficient to properly illuminate machinery and areas in reclaim tunnels.

5.5.7.5 INSUFFICIENT VENTILATION

Where personnel are required to enter reclaim tunnels, adequate ventilation is to be maintained and accessible.

5.5.8 WASHING PLANTS AND PONDS

5.5.8.1 MOVING PARTS

Washing plants have moving parts such as screw classifiers which may be hazardous if not properly guarded or otherwise protected.

5.5.8.2 WET AND SLIPPERY SURFACES

Water around washing plants and ponding areas can create slippery surfaces that may be hazardous to vehicular or pedestrian traffic.

5.5.8.3 DEEP WATER OR VISCOUS SLURRY

Ponding areas or slurry, in which it is not possible to swim, can present a drowning hazard and should be securely fenced. Warning signs should also be in place. Where traffic moves adjacent to ponds, adequate bunding or barriers should be in place to prevent vehicles accidentally entering the pond.

5.5.8.4 FLOODING

The breaching of ponding embankments may present a hazard. Care in location and construction is required to eliminate this hazard.

5.5.8.5 STABILITY OF EMBANKMENT

Erosion may undercut or weaken embankments. Regular checks should be made to prevent this situation becoming hazardous.

5.6 ACCESS TO PLANT

5.6.1 FIXED LADDERS

Fixed platforms, walkways, stairways and ladders should comply with the requirements of Australian Standard 1657.

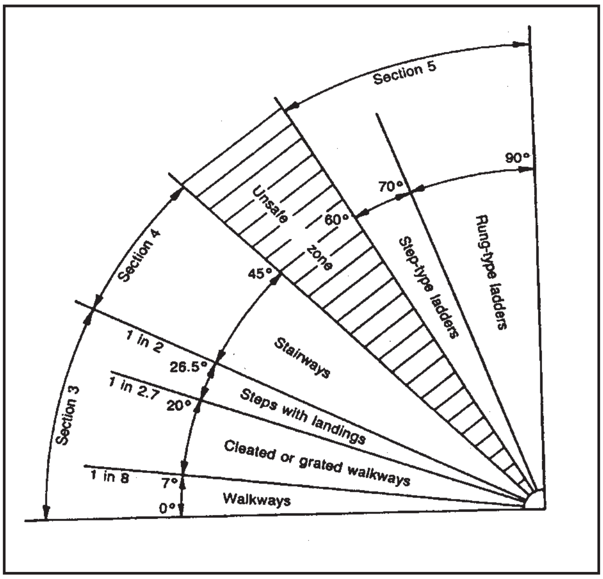
Note: The use of ladders for areas requiring frequent access should be avoided where practicable. Preference should be given to stairways.

5.6.2 RUNG LADDERS

Rung ladders should be constructed as follows:

- angle of slope between 60 and 75 degrees. Although rung ladders beyond 75 degrees are not in breach of the standard, they are not universally accepted and should be reviewed. Ladders with a slope of greater than 75 degrees (refer to Figures 5.26a and 5.26b).

Figure 5.37 Limits of slope



- the ladder should not be less than 375 mm wide and not more than 525mm wide;
- rungs should be spaced no less than 250 mm and no more than 300 mm apart, except in ladders shorter than 1.5 m, where the minimum spacing may be 200 mm. All spacings must be equal;
- rungs should be of solid material not less than 20 mm diameter;
- where the ladder provides access to a platform or walkway, the styles of the ladder should extend no less than 900 mm above the opening. The width between the extended styles should be no less than 525 mm and the top rung should be level with the landing;
- where a person may fall 6 m or more, a ladder cage should be fitted or the ladder should have a fall protection safety device installed. Access to ladders where safety devices are provided should be restricted to authorised personnel;
- the clearance behind ladders affixed to walls, should be no less than 200 mm; and
- timber ladders should not be used in situations where they are constantly exposed to weather or other conditions likely to promote decay.

5.6.3 STEP LADDERS

Step ladders should be designed as follows:

- angle of slope between 60 and 70 degrees;
- minimum clear width of 450 mm;
- treads should be no less than 100 mm deep and multi-rung treads are not acceptable;
- the rise should be not less than of 200 mm and not more than 250 mm;
- the vertical distance between landings should not exceed 6 m; and
- where a person can fall more than 6 m the ladder system should be enclosed.

5.6.4 PORTABLE LADDERS

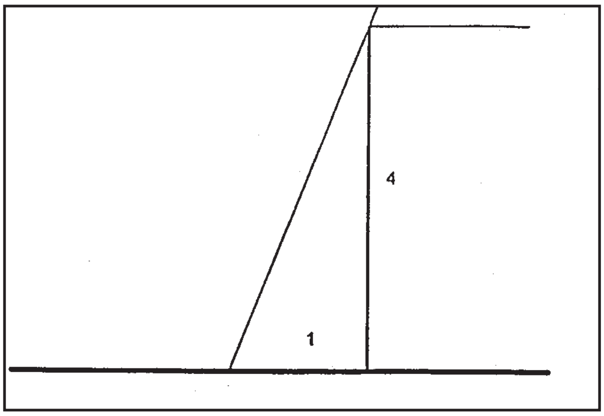
The following should apply:

- the top three rungs should not be stood upon when using the ladder;
- all ladders should be tied off at the top to prevent them slipping down or off, or sliding along, supporting structures;
- when a ladder is being used to gain access to work platforms, mezzanine floors or the like,

they must extend at least 1 metre above the platform or landing;

- ladders should have good secure non-slip feet fitted;
- when placing a ladder for use it should always be at a slope of approximately 1 in 4 (75 degrees) for example, 1 metre out from a wall for every 4 metres up (see Figure 5.38); and
- damaged ladders should be removed from service and tagged or preferably destroyed.

Figure 5.38 Correct ladder angle for safe use 1 in 4, or 75°



5.6.5 TIMBER PORTABLE LADDERS

- These should not be painted (this can hide cracks or defects in the timber).
- The steel banding on stiles or below rungs should not be removed.

5.6.6 METAL PORTABLE LADDERS

- These should not be used when carrying out work on live electrical equipment.
- They should also not be painted as this can hide defects in the welds.

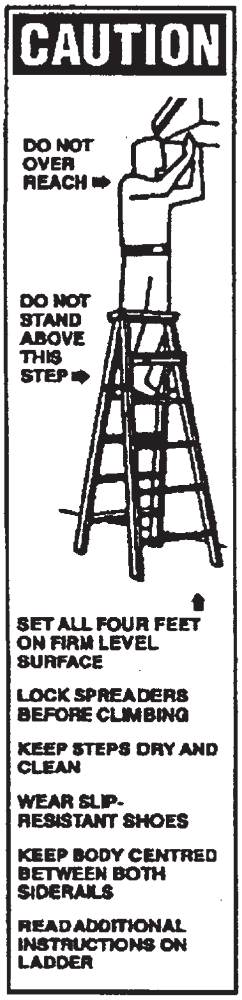
5.6.7 PORTABLE EXTENSION LADDERS

- The overlap of adjacent sections should be no less than 3.5 rungs.
- They must have well-maintained runners, guides and extensions devices.
- They must have adequate and well-maintained locking devices.

5.6.8 PORTABLE STEP LADDERS

- Step ladders are be fitted with a spreader connecting the back legs to the stiles. When the legs are fully open the spreader should be fully engaged. The ladder should not be used with chains or other non-fixed supports. With the ladder fully open the spread between the back legs and the stiles should be between 500 mm and 660 mm per metre-length of stile.
- All four legs should be fitted with good secure non-slip feet.
- The top cap and the two top treads (rungs) should not be used for standing on (see Figure 5.39).

Figure 5.39 Use of portable step ladders



5.6.9 WALKWAYS AND PLATFORMS

Some of the specific requirements that apply to walkways and platforms are:

- the minimum clear width of any walkway should be 550 mm;
- walkways and platforms should be fitted with guard railings of between 900 and 1100 mm in height;
- toe boards of at least 100 mm should be fitted to elevated walkways or platforms;
- walkways with an angle of between 7 and 20 degrees should be constructed of expanded metal mesh or cleated. Where the angle exceeds 20 degrees, steps with landings should be installed; and
- elevated walkway and platform floors should be slip resistant, even, and be designed so that objects cannot fall through to the area below. Gaps in metal plates should not exceed 100 mm.

5.6.10 STAIRWAYS

Stairways should be constructed as follows (see Figure 5.40):

- have a minimum clear width of 600 mm;
- an angle of between 26.5 and 45 degrees;
- a rise of no less than 150 mm and no more than 215 mm;
- a going of no less than 215 mm and no more than 305 mm;
- have an actual tread depth of at least 10 mm greater than the going; and
- all stairs should be fitted with a handrail between 800 and 1,000 mm when measured from the nosing of any tread. Stairways greater than 1,000 mm in width should be fitted with a handrail to both sides.

5.6.11 BINS AND HOPPERS

Warning signs restricting access are necessary and procedures for safe entry are necessary.

Construction of bins and hoppers should be sufficient to hold the weight fully loaded. Damage to supports sometimes occurs and should be carefully examined and repaired. Corrosion should also be monitored

REFERENCE DOCUMENTS

AS 1755 Conveyors – Safety Requirements.

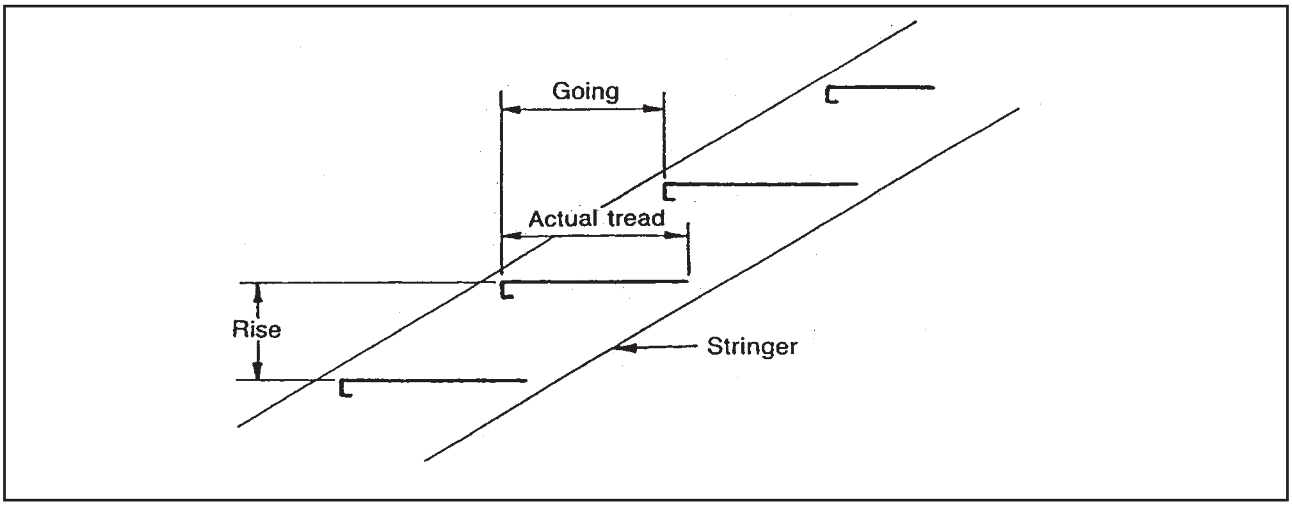
AS 1657 Fixed Platforms, Walkways, Stairways and Ladders.

Guidelines For Identifying Hazards Association With Crushing and Screening Plants in Mines and Quarries, ISBN 0-478-00167-3, Ministry of Commerce, Mining Inspection Group, New Zealand.

AS/NZS 1892 Portable Ladders.

Quarry SAfe OHS Resource Manual, Quarry SAfe Group Health and Safety, South Australia.

Figure 5.40 Rise, going and actual tread depth



5.7 DREDGES (OPEN AND STILL WATER)

5.7.1 GENERAL

Dredges and associated equipment used for recovery, preparation and discharge should be designed, operated, maintained and inspected according to good engineering practices. This section is aimed primarily at dredges other than those used on still water.

5.7.2 DESIGN

Factors to consider include:

- buoyancy calculations and tests should be made by a qualified naval architect who certifies the dredge's worthiness;
- toilet facilities should be readily available;
- hatchways and all other deck openings should be fitted with watertight seals or safeguarded by coamings not less than 400 millimetres (0.4 m) in height;
- a dredge or other vessel used for mining should be fitted:
  - where necessary for communicating between operators, with voice communications or with an electric return signalling system between the winch room and the discharge end of the screen;
  - fore and aft on each side with a device that sounds an alarm whenever the freeboard is less than the minimum requirement;
  - with a pendulum or device to show at all times the list of the vessel and to sound an alarm when the list to either side exceeds the maximum permitted; and
  - with an automatic electrical or mechanical device to stop the bucket line in the event of an overload; and with a means of indicating the dredging depth;
- all exposed gearing, belting or machinery should be kept fenced; and
- on any dredge which is not entirely covered in, the sides of the uncovered portion of the hull should be fitted with stanchions not more than 2500 millimetres (2.5 m) apart and also with two substantial handrails or tightly stretched wires or chains, the lower rail, wire or chain not being more than 250 millimetres (0.25 m) above the deck. These may be made removable for the purpose of taking material on board the dredge, but should be kept in position at all other times.

5.7.3 SAFETY

A dredge or other vessel other than small, one-operator dredges, when used for mining, should be provided with life-saving appliances including:

- a lifebuoy, a light line not less than 15 metres in length, and a boat-hook near the bow and the stern of the dredge on the port and starboard side;
- a boat containing a light line not less than 15 metres in length and a boat-hook and equipped ready for use with oars and rowlocks or some other suitable method of propulsion;
- a looped wire line securely fastened around the outside of the pontoons 150 millimetres (0.15 m) above the water line; and
- a supply of life jackets sufficient for the maximum number of persons likely to be on board the dredge at any time.

Every member of a dredge crew when employed in boat work or in outboard work on the dredge should be suitably trained to use lifesaving appliances.

All lifesaving appliances should be kept in conspicuous places within easy reach and when damaged or lost should be immediately renewed.

A person should not step on a bucket or chain when it is in motion.

The maximum number of persons that may be carried at one time in a dredge or other vessel used in mining operations should be fixed after considering the number and capacity of lifesaving appliances, and a notice stating this information should be kept posted on the dredge or vessel.

5.7.3.1 OPERATION AND MAINTENANCE

An operating procedure for the safe operation and regular maintenance of the dredge should be developed.

Testing and recording of tests required

Tests should be made each day, with records kept on the dredge. These tests should include:

- soundings of all hull compartments, freeboard at the bow and stern both port and starboard and, in respect of bucket dredges, the dredging depth or angle of ladder while the dredging depth is recorded automatically; and
- a test of the automatic alarm bell.

Information

Everyone on the dredge should be informed of hazards and precautions.

Access gangway to be provided

Every dredge working close to a bank should be provided with a gangway not less than 750 millimetres (0.75 m) wide and of sufficient length to reach from the bow of the dredge to the bank or tailings dump. The gangway should be provided with a substantial handrail at each side and be secured to the deck of the dredge. Care should be taken with the location of the gangway or mooring ropes to avoid these ropes catching on the handrails.

Warning notices for the public

Warning notices should be posted where head lines or side lines cross a path or other thoroughfare.

Operating provisions

A dredge should not be started until:

- the operator has signalled the intention to the member of the crew in charge of other equipment which may be affected; and
- that crew member has replied with an all-clear signal.

After the automatic overload-stopping device has come into operation, digging should not commence until the winch operator has ascertained to the operator's satisfaction that the overload has been cleared.

The interior of the hull compartments should be kept clean and reasonably free of water except for such compartments in which the storage of ballast is required.

Requirements for freeboard of dredge

The dredge should not have less than 150 millimetres (0.15 m) of freeboard at any point of the deck under its worst condition.

5.7.3.2 HEADLINES AND SIDELINES

Unless there are valid reasons or unless a securely anchored deflecting sheave between the anchor and the dredge is used, the head lines and side lines of every dredge should have free and unobstructed play between the anchor and dredge.

Every anchor for a head line or side line should be of adequate strength.

While a dredge is operating, work should not be allowed in the vicinity of any head lines or within the danger zone – that is the triangle formed by the head and the traverse of the dredge across the face, other than for authorised persons travelling in the vicinity of the dredge head line.

5.8 ORE-CONVEYING SLURRY PIPELINES

5.8.1 GENERAL

A long-distance ore-conveying slurry pipeline (not being a tailings pipeline or the like) should be properly designed, used and maintained.

5.8.2 DESIGN

Buildings, machinery and all associated equipment in recovery, preparation and discharge facilities should be designed and constructed in accordance with relevant codes and good engineering practice.

Discharge facilities should include provision to clean the water in the slurry before it is released.

The slurry and pipeline should be designed to ensure a homogeneous flow throughout the length of the pipeline.

The design, fabrication, installation, inspection and testing of the pipelines should meet the requirements of AS 4041 Pressure Piping, except that the permissible design stresses specified in that Code should be (in accordance with the classification of the location of the pipeline as specified in AS 1697, (known as the SAA Gas Pipeline Code):

Class 1 location	1.0 S;
Class 2 location	1.0 S;
Class 3 location	0.84 S;
Class 4 location	0.67 S

where S is the permissible design stress specified in AS 4041 Pressure Piping.

Working pressures assumed in the design of the pipeline should be verified by test under actual working conditions when the pipeline is completed.

In determining the pipe wall thickness, an allowance should be made for reduction in thickness due to wear and/or corrosion over the estimated life of the pipeline. However, a pipeline or section of pipeline should be renewed when the calculated stress in the worn or corroded section exceeds the permissible design stress by 12%.

The pipeline should be provided with a warning system to indicate loss of slurry along the length of the pipeline, and operators must be sufficiently trained to be able to evaluate the effects of the rate of change of pressure drop.

Protection should be provided for the pipeline when it is exposed to accidental damage by any external means and:

- pondage should be provided to contain the slurry discharged by any installed pressure release device on the pipeline; and
- the pipeline should be designed and located to minimise deleterious effects due to leakage from or failure of the pipe or any associated structure.

In critical areas where any leak or discharge from the pipe could endanger life or health, the line must be enclosed in a trough or channel which is capable of containing the full volume of such leak or discharge.

Where a pipeline may be inadvertently damaged, suitable notices should be posted in order to minimise the possibility of such damage.

5.8.3 OPERATION AND MAINTENANCE

An operating procedure designed to ensure the safe operation of the pipeline and the slurry preparation and discharge facilities should be compiled for the commissioning of the pipeline. The procedure should include:

- procedures to be followed when charging, operating and closing down the pipeline;
- pressure, flow and slurry density controls and action to be taken when the specified limits are exceeded;
- action to be taken when an unplanned discharge of slurry occurs along the pipeline;
- action to be taken when the pipeline plugs or blocks up for any reason; and

- methods used to determine wear and corrosion in the pipeline and frequency of tests and inspections, as well as action to be taken when sections of the pipeline have to be renewed.

The day-to-day operation of a pipeline should be controlled and supervised by a trained person familiar with the operating procedures of the pipeline.

The pipeline and associated structures should be inspected on a regular basis for integrity of the pipeline and its associated structures.

5.9 LIFTING EQUIPMENT

5.9.1 LIFTING EQUIPMENT USED UNDERGROUND

5.9.1.1 PERSONNEL WINCHES

This Part should only be referred to where it is determined by risk assessment that guidelines in Part 6 – Shafts and Winding and Hoisting Systems are not applicable.

Winches used for raising and lowering people should:

- meet the requirements of AS 1418 Cranes, Hoists and Winches;
- be suitable for the application for which it is to be used;
- have a positive-drive mechanism which requires power for both raising and lowering and does not permit free fall;
- have two fail-safe braking systems and an application of the brakes will restrict a let out of rope to no more than two times the drum circumference in millimetres, and in addition:
- the braking systems should be designed to fail to the “brake-on” position in the event of a loss of motive power, by the application of a mechanical device;
- the mechanical device should be capable of applying a braking force twice that needed to hold the maximum allowable load for that particular winch; and
- the operating lever should be self-centering to the “brake-on” position.

On purchasing a personnel winch, a written procedure should be developed for the operation, maintenance testing and overhaul of that winch. Operating, maintenance and overhaul procedures should have been indicated by the manufacturer.

Records of operation, testing, maintenance and overhauls should be kept.

Modifications to winches as supplied by the manufacturer should be made only within the bounds of good, safe engineering practice.

Anyone who travels in the bosun’s chair or kibble should:

- be secured by a harness-type safety belt to the winch rope when travelling, and when attaching the safety belt to the rope it should be independent of the conveyance connection and be of the shortest practicable length; and
- be acquainted with the code of signals or communication system.

Communications should be by means of a knocker line and bell, intercom phones, buzzer line, 2-way radio or whistle rather than by shouting.

A bosun’s chair should have a rigid seat to allow the person sitting in the chair to have some freedom of movement.

A bosun’s chair should be connected to the winch rope by means of an engineered connection including wedge-type sockets according to AS 2740 Wedge-type Sockets (not bulldog grips or clamps) capable of withstanding an impact loading.

Any conveyance used should have all main load–bearing components designed with a minimum factor of safety of 10:1. No screwed components in tension should be used.

The driver should be properly trained and be in attendance for the whole period in which the winch is in operation carrying people.

The winch should be mounted on anchor pads, properly installed and capable of restraining the winch under its maximum rated rope pull. The method of bolting a sheave block to the backs should follow a set work procedure. At least two anchor bolts inclined at not more than 30 degrees to the vertical, and not in line with the resultant of the hoisting forces, are generally required in order to prevent the sheave block from being pulled out.

Air-operated winches should have:

- an air supply (to a personnel winch) which has a suitably high mechanical strength and is protected against damage to prevent the failure of the power supply;
- an air gauge connected into the air supply line to indicate to the driver of the winch that there is the correct amount of air pressure available; and
- a minimum amount of air pressure allowable for a driver to operate a winch of 400 kPa, and in accordance with the manufacturer’s specifications.

Electrically-operated winch cables should be well sheathed and protected against damage, incorporate earth leakage protection, and there should be an indicator to show that the power (electricity) is on or off.

Ropes used should be of the non-rotating type with a factor of safety of 8:1. Sheave blocks which are bolted to backs or erected on head frames should be of sufficient strength, with a factor of safety of 10:1 to hold the maximum load.

All leads to winches should be kept free of obstruction or falling objects.

The fleet angle between lead blocks and drums should not exceed 3 degrees for plain drums or 5 degrees for grooved drums.

The winch should be protected from water and other contamination that could enter the brakes and reduce the brake stopping or holding ability.

A clutch should not be fitted to a winch used for personnel travel.

Winches used for depths greater than about 50 metres should be fitted with depth indication and the travel-way should have guides for the conveyance.

Before the commencement of each work period, the winch driver should check the rigging (including the rope), winch (including air lines) and signalling devices to be satisfied about their safety.

The safe operating procedure should include a written procedure in case of an emergency.

5.9.2 CRANES AND HOISTS

5.9.2.1 GENERAL

Cranes and hoists should be constructed, installed, maintained and inspected in accordance with the relevant Australian Standards and be suitable for the duty required.

5.9.2.2 TRAINING

Anyone who operates any crane or hoist should be appropriately trained and authorised by the manager.

5.9.2.3 DEFINITION OF A CRANE INSPECTOR

An accredited Inspector should be one of the following:

- a person employed by an inspecting authority; or
- a person who provides an independent inspection service.

5.9.2.4 MOBILE CRANES – ELECTRICAL HAZARDS

In this clause, unless the contrary intention appears:

Close proximity means:

- in relation to electrical apparatus where the difference in voltage between conductors within the apparatus or to earth does not normally exceed 132 kilovolts – 4 metres; and
- in all other cases – 7 metres.

Crane means crane or hoist of the mobile, crawler or walking type.

De-energised means disconnected - for all sources of electrical power.

Electrical apparatus means any live electrical aerial conductor whether bare or covered with insulating material; and every machine, transformer, switchgear, equipment or fitting in which there are live exposed conductors used or designed for use to convey electricity. It does not include any electrical apparatus where the difference in potential between the conductors in the apparatus, or to earth, is less than or equal to 32 volts.

Exposed means bare, or not effectively covered with insulating material, or not effectively guarded by either a fixed barrier or a fixed metal shield.

Person in charge means the person who is authorised by the manager or his/her representative to see to the performance of any task related to a crane.

The mine operator should establish a written Mobile Crane – Electrical Hazards procedure for cranes operating near electrical hazards to prevent injury to the crane operator. A procedure could include a requirement that before a crane is driven on to the site, and again before the crane is set in position on the site, the person in charge of the crane and the person in charge of the work should thoroughly examine the site and its approaches in order to determine whether there is a need to take precautions against electrical hazards that might result from the movements of the crane.

If there is any danger, the person in charge of the crane and the person in charge of the work should:

- de-energise or remove the apparatus from the site or securely protect it by fencing or other effective safeguards; or
- where this is not reasonably practicable, provide buffers, stops or devices to prevent any part of the crane and any person operating it from coming within close proximity of the electrical apparatus.

Someone other than the driver may be needed to observe the presence of electrical apparatus and the movements of the crane and to to the driver of any impending danger. This person should not at the same time perform any other duty. (Note: Workcover makes the provision of a safety observer mandatory in its safety guide for moving plant on construction sites.)

There should be a notice in the operator's cabin, warning of electrical hazards in connection with the operation of the crane in the presence of electrical apparatus.

When a crane is travelling to and from a working site, the distance of 4 metres as specified in the definition of close proximity may be reduced to 2 metres for voltages not exceeding 11 kilovolts, and only then in accordance with the precautions set out above. (Note: AS 3007.5 Electrical Installation specifies a minimum clearance of 2.3 metres for voltages between 1100 (one thousand one hundred) volts and 33,000 volts).

In addition, when travelling to and from a working site, the boom of the crane should be securely fixed in the boom down position.

If a load is being transported by a mobile crane, the area traversed is part of the working site and the provisions for restricting the operations of the crane within close proximity of electrical apparatus should be met.

Note: The section on energy states the following.

Basic requirements

Overhead electricity lines should be designed, installed and maintained according to the requirements of the Electricity Supply Association of Australia (ESAA) Guidelines for Design and Maintenance of Overhead Distribution and Transmission.

Clearances may need to be increased above published values where operations associated with mining and treatment take place near the overhead electricity line.

Consideration of sag due to hot weather and electrical faults needs to be considered.

Consideration of adverse and damp weather needs to be considered.

Signs should be installed at appropriate places to warn of the presence of overhead lines. The signs should state the voltage and the maximum height of any vehicle that can travel under the overhead lines.

Overhead lines should be accessible for inspection purposes – in particular access needs to be available at night and in poor weather.

5.9.2.5 CLEARANCE TO MOBILE EQUIPMENT

It should be noted that rear dump trucks and other vehicles that can raise parts above their normal level commonly contact overhead lines and overhead cables with rear dump trays, even when warning devices of the tray raised are often fitted. Consideration should be given to routing overhead lines away from traffic routes, haul roads etc or raising the overhead lines to a height where safety clearances can not be encroached upon.

Where overhead lines pass over work areas, roads, maintenance areas or parking areas and where mobile drilling, excavating, loading, hauling or lifting equipment is used in normal mining operations, conductors should be placed so that the clearances specified in AS 3007 Electrical Installations are always maintained between the conductors and the mobile equipment, any of its extensions, people on the equipment or items with which they may be in contact.

When determining this clearance, take account of conditions which give the least clearance between the overhead line and mobile equipment. The condition which gives the least ground clearance, ie, maximum sag condition, should be considered. To non-horizontal surfaces, swinging conditions from wind should also be considered.

For mobile equipment, consider the condition that gives the maximum distance above the ground of the equipment. For example, in the case of a dump truck, this would be when the body is fully raised and springs and tyres are at maximum extension (after a bump); and in the case of a drilling rig, its mast in the vertical position.

For vehicles that have a long overhang (such as the jib of a mobile crane) the ground clearance considered may need to be when the vehicle (with jib down) is passing over the crest of a hill causing the overhanging part to have a greater clearance to the ground than if the ground was level.

Where dump/tipper trucks regularly pass underneath overhead lines, consideration should be given to erecting warning signs and devices (for example, goal posts).

Where floating plant is used the maximum possible pond level should also be considered. Such level may be due to raising of water table, pump failures, etc.

Notes:

- Ground clearance is the perpendicular distance between the ground and the conductor. That distance is the smallest arc which can be drawn from the conductor, the ground being tangent to it.
- Maximum distance above the ground is also the perpendicular distance to the ground.

Provided overhead lines (electricity or “power”) are installed and maintained with clearances to mobile equipment as specified in this guide, the equipment to which these clearances relate may be used without restrictions.

Where this equipment is used in areas where these clearances may not apply, or equipment which was not considered in determining these clearances is used on the site, considerations for the use of this mobile equipment should be made. These considerations should be made within the framework of risk management systems. The following should be considered as a minimum.

Basic consideration

Before mobile equipment, not regularly used on site, is used on the site, work out the likelihood of the clearance between the mobile equipment and the overhead line being below that specified. The results will make clear any action to fix the problem.

Initial determination

At first, work out the likely clearances needed by comparing the known minimum ground clearances of overhead lines on the site with the maximum height above the ground of the mobile equipment, its load, any item of the equipment extended to its full height, or persons on the equipment.

Should this comparison show that the clearances specified can always be maintained, the equipment may be used without restrictions, provided the road surface is not increased in height due to ballast and grading.

Site inspection

Should the first calculation show that the clearances specified cannot always be maintained, a thorough inspection of the route to be taken and the work to be carried out on the site should be made. That inspection should determine clearances between the mobile equipment and the overhead line. This should be worked out by physically checking the height of the vehicle and the ground clearance of the line with suitable measuring devices (for example, a high voltage operating stick of appropriate voltage rating for determining conductor heights).

Isolation requirements

Should the site inspection show that the clearances specified may not be maintained, the overhead line should be isolated, short circuited and earthed as detailed.

Removal requirements

Should the site inspection show that movement of the mobile equipment could cause damage to the overhead line, the overhead line should be disconnected and removed from the site as detailed in AS 3007 Electrical Installations.

REFERENCE DOCUMENTS

AS 1418 Cranes, Hoists and Winches.

AS 2549 Cranes – Glossary of Terms.

AS 2550 Cranes – Safe Use.

5.10 MOBILE PLANT AND MACHINERY – SURFACE AND UNDERGROUND

5.10.1 GENERAL

This Part covers the safety aspects of mobile and transportable equipment used at quarries, open cut and underground mines. It also covers both electric and diesel-powered equipment unless otherwise specifically mentioned. Included are many of those items that have been identified as requiring specific attention in order to provide a safe product, but it by no means covers all possible details that should be reviewed by both the manufacturer, purchaser, owner, operator and site contractor.

This Handbook should be used whenever new equipment is designed or purchased, when equipment is overhauled, when used equipment is purchased and when site contracts are being considered.

In no way is the Handbook intended to restrict innovative design.

Unless otherwise specified, the appropriate Australian Standards should apply. Where Australian Standards have not been published, appropriate International Standard Organisation for (ISO) or Society of Automotive Engineers (SAE) standards should be used.

Review of accident and near miss incident data

Note: A cooperative approach between manufacturers, statutory authorities and mine operators is required to eliminate equipment accidents.

To minimise the risk of repetitive accidents, the manufacturers, in conjunction with mine owners and statutory authorities, should maintain a comprehensive list of accident statistics and relevant details for the same or comparable equipment. These statistics should be reviewed and corrective action taken, as far as is practical, to avoid further accidents.

Any review of accidents should include but not be limited to slips, falls, fires, collisions and all serious bodily injuries and fatalities.

Statutory authorities are a source of industry accident and incident data.

5.10.1.1 MANUFACTURER'S COMPLIANCE STATEMENT

Note: It is not always clear to the purchaser to what guidelines and/or standards the purchased equipment is designed and manufactured.

The manufacturer should provide the purchaser with the following:

- a brief statement of compliance, variation or reason for non-compliance with each item mentioned in this Handbook;
- any further information requested within this Handbook or as considered being appropriate to ensure the safe operation and maintenance of the plant; and
- results of tests and a statement of compliance with all requirements in accordance with Australian or other relevant Standards.

5.10.1.2 DOCUMENTATION

Maintenance and operational manuals should be included with each machine.

The manuals should include the relevant electrical/hydraulic/pneumatic schematic diagrams, parts list, component ratings and section on recommended maintenance periods and procedures, including safety precautions to be taken.

When alterations are made to any system, diagrams should be updated immediately by the appropriate personnel and details distributed to ensure hazards are not created by the use of incorrect information.

A comprehensive list of all safety devices and their function should be included in the manual. This list should be split into those provided with the equipment and those that are not provided but which are available as an option.

The manuals should also include all the necessary limits of the equipment supplied. Such limits should be in accordance with a relevant Standard (Australia, ISO or SAE). Limits should include but not be necessarily limited to:

- maximum grade (%):
  - loaded
  - unloaded
  - other variable where applicable
- maximum cross grade (%):
  - loaded
  - unloaded
  - other variable where applicable
- maximum load (tonnes):
  - level conditions
  - on range of grades
  - other variable where applicable
- maximum speed (km/h):
  - under above conditions.

5.10.1.3 DESIGN

The manufacturer in the design and manufacture of the equipment should address all relevant ergonomic aspects of the equipment.

5.10.1.4 NOISE

The noise emitted from any equipment should not exceed a sound pressure level of 85 dB(A-Log) when measured at a point 10 m distant from the equipment as illustrated on page 6, AS 2012 Acoustics should be fitted to the plant engine exhausts and should have a minimum octave band noise reduction of 28 dB in the 125 Hz octave band.

A statement should be provided detailing anticipated noise levels in dB(A) for the plant under operation and high idle conditions as perceived by the operator and a bystander, all in accordance with AS 2012.

In addition, noise levels in dB(A) for the plant under operating and high idle conditions as perceived by the operator and bystander, all in accordance with AS 2012 (Parts 1 and 2) should be provided by the manufacturer/supplier.

5.10.1.5 LABELLING

The labels required should include the following where applicable:

- A compliance plate displayed in a prominent position showing:
  - the electrical approval numbers;
  - the date of manufacture;
  - the tare and gross weight of equipment;
  - the axle loads;
  - the maximum number of personnel for which seating is provided; and
  - maximum operating grade and load limit for that grade.
- Individual labels displayed in suitable positions should cover the following areas.
  - Towing instructions – for towing the equipment if inoperable, including maximum load to be towed.
  - A warning sign adjacent to all rotating fans.
  - A warning at all accumulators that pressure must be safely released before work commences.
  - A warning on any spring-applied brake chamber that it contains a spring under compression.
  - An operator checklist within the control compartment denoting the minimum operator's checks prior to operating the machine. The checklist should be constructed of engraved brass, "Traffolyte" or similar.
  - A warning that hearing protection must be worn where personnel are required for operational or maintenance activities if noise level exceeds 85 dB(A) at any location on the equipment.
  - Green and red zones should mark minimum safe operating pressure on the pressure gauges of hydraulic and/or pneumatic braking systems, preferably.

- Danger signs and other signs as considered necessary by the manufacturer should be placed in appropriate positions on the equipment.
- A warning that the park brake, and other devices where necessary, should be applied before leaving the equipment.
- Identification of all controls including direction of movement where applicable in accordance with AS 2956 or ISO 6405 Earth Moving Machinery.
- Location of brake wear indicators.
- Emergency stops.
- All other safety devices that the manufacturer considers necessary.
- Any automatic/self–starting machinery or machinery started remotely should be identified as such.
- Location of isolation points.
- Location of lifting points.
- Safe working distances from powerlines.
- The required driver action in event of a fire occurring, such as:
  - do not endanger yourself by attempting to get down from moving equipment;
  - bring machine to a stop with implements lowered and park brake on;
  - shut down engine;
  - activate fire suppression system if system required;
  - use extinguisher if required; and
  - leave vehicle if safe to do so.

Note: Where there is a risk of the tyres exploding after a fire, the machine is to be isolated for 24 hours.

5.10.2 DESIGN FEATURES

5.10.2.1 OPERATOR CABIN

Protective structures

Enclosing protective structures, where applicable, should be designed and maintained to Australian Standards: AS 2294 Earthmoving Machinery – Protective Structures (ISO 3164, 3449, 3471); AS 1636 Agricultural Wheeled Tractors – Roll-Over Protection Structures – Criteria and Tests (ISO 3463, 5700), and AS 2359 (Parts 1 and 2) SAA Industrial Truck Code – Design and Manufacture, and Operation.

There have been numerous cases of operators being fatally or seriously injured by being crushed when the equipment that they were operating rolled over. It has been demonstrated that the risk of death or injury is significantly reduced when a protective structure is fitted to the cabin and the operator is wearing a correctly adjusted seat belt.

In this section:

- Falling-Object Protective Structure (FOPS) means a system of structural members arranged to reduce the possibility of crushing of the operator if a rock or other object falls on the cabin, or in the case of passengers, protection for those people; and
- Roll-Over Protective Structure (ROPS) means a system of structural members arranged to reduce the possibility of the crushing of the operator if the machine overturns.

A “Falling-Object Protective Structure” should be fitted to items of equipment and machinery such as load-haul-dump (LHD) units, dump trucks, rollers, dozers, and rubber-tyred drilling rigs and personnel carriers, used principally in the underground workings of a mine.

A “Roll-Over Protective Structure” should be fitted to items of equipment and machinery such as wheeled prime-movers, wheeled off-highway dump trucks, rubber-tyred and crawler mounted dozers, scrapers, graders, loaders and tractors (with or without attachment) used mainly on the surface workings at any mine or quarry.

A “Roll-Over Protective Structure” should be fitted to items of equipment and machinery such as small agricultural wheeled tractors.

A “Falling-Object Protective Structure” or “Roll-Over Protective Structure” should conform with the requirements of AS 2294 Earth Moving Machinery, except for small agricultural wheeled tractors, which should conform with AS 1636 Tractors or any equivalent Standard.

Items of equipment or machinery to which this Part applies should be provided with “Falling-

Object Protective Structure" or "Roll-Over Protective Structure" as appropriate.

If it is considered impracticable to meet Standards requirements, the general manager will need to determine alternative effective safety precautions.

If a "Falling-Object Protective Structure" or "Roll-Over Protective Structure" suffers discernible deformation as a result of an accident, the equipment or machine should not be used until the structure has been replaced or restored to a condition which, in the written certified opinion of the manufacturer, the manufacturer's agent or a qualified mechanical or structural engineer, is at least equal in strength to the structure as originally fitted.

The headboards/spillboards of rear dump trucks are not considered to be an effective ROPS.

Personal seat restraints

Even with a rollover protective structure, an operator can be seriously injured if thrown around the cabin or thrown out of the cabin during a rollover.

Personal restraining mechanisms should be designed and installed under the equipment manufacturer's instructions and wherever possible factory-fitted to the machinery where seats are provided in mobile vehicles and on stationary machines working above or below ground on a mine.

The personal restraining mechanisms and anchorages should be designed and maintained to Australian Standards: AS 2664 Earthmoving Machinery – Seat Belts and Seat Belt Anchorages (ISO 6683); and AS/NZS 1891 Industrial Safety Belts and Harnesses.

The machine operator's working space, passenger carrying space, cabin or working platforms should be designed to minimise as far as practicable any protuberances or sharp edges which could cause injury in the event of an accident.

Passenger seats should be fitted with a restraining device to provide the same level of protection to any occupants within the machinery or vehicles.

These seats and devices should be used exclusively for safely carrying and securing persons.

On no account should these seats be used to carry goods or ancillary equipment.

The full harness:

- should be used in all cases as the preferred type of personal restraining mechanism;
- should be made of tough, resilient, non-combustible material incapable of generating noxious or toxic fumes if burned;
- should be of sufficient strength and calibre to hold a person safely in the event of unplanned movement of the equipment caused by operator error or initiated by an external event within the mine;
- should be securely anchored to the seat of the machinery rather than the floor to maintain driver comfort as large seat to floor movement can occur; and
- wherever possible should be fitted to the special requirements of the manufacturer.

Enviromental vibrations

Adequate preventative measures should be taken to prevent excessive vibration being transmitted to the driver or operator during the operation of any equipment. The transmitted vibration during operations should not exceed the levels specified by the relevant Australian Standard (AS 2955.6 Earth Moving Machinery is one of these Standards).

Noise

Cabins should be totally enclosed and soundproofed where necessary.

Noise levels within the operator's cabin should be such that:

- the operator does not require ear protection;
- the daily dose for an eight (8) hour period, as detailed in AS 1269 Occupational Noise Management, does not exceed 0.33 during normal operation of the plant (with the air-conditioner on the "high" setting); and
- the recorded measurement taken at the operator's ear must not exceed an Equivalent Continuous Log A – Weighted Sound pressure level, inside the cabin of large rear dump trucks 75 and for other equipment 85 dB (A-Log), as described in AS 2012 Acoustics.

Air-conditioning

Air-conditioning should be designed and operated in accordance with Standards Australia Handbook SAA HB 40 The Australian Refrigeration and Air Conditioning Code of Good Practice, and International Standard (ISO 102630).

The air-conditioner intake location should be located to avoid exhaust emissions, and areas where significant fuel and heat sources are present or where fumes from a fire may be expected to concentrate.

The heater should have isolating valves fitted to both supply and return lines adjacent to the engine to allow changing of heater hoses and/or core without disturbance to the engine cooling system.

The system should comply with the requirements of the Ozone Protection Act 1989 – No. 208 and any other relevant legislation.

Dust

To reduce the chance of dust entering a closed operator's cabin, supply filtered external make-up air sufficient to maintain a positive pressure of 10 mm water gauge inside the operator's cab with windows and doors closed. The system should make adequate allowance for deterioration of door and window seals.

Ergonomics

Seating

The driver's seat should be a high-backed type where suitable (may not be for dozers), fully suspended and adjustable and comply with AS 2955 Earth Moving Machinery.

Visibility

Driver visibility should be maximised (for example, auxiliary equipment should be located where it will not interfere with visibility).

The manufacturer should provide a drawing identifying the driver's field of vision in all directions.

Reference should be made to ISO 5006/2 and 5006/3 in the review of visibility.

Windscreen washing and wiping facilities should be provided.

Windows should be capable of being opened, preferably by sliding.

Heating and demisting should be provided and should be capable of adequately demisting the operator's cabin window.

The mounting of the air conditioner and accessories should not interfere with driver visibility.

Controls

Instrumentation and operators controls should comply with AS 2956 Earth Moving Machinery.

The controls should be located within the zones of comfort and reach as detailed in AS 2956/5 or ISO 6682.

The operating controls should be clearly marked to show their function and mode of operation in accordance with the following Standards – AS 2956/4 or ISO 6405/2.

Emergency stops should be provided.

A horn should be provided for use as a manually-worked warning device.

If a horn is air-operated, then a back-up warning device should be provided (for example, for electric start trucks where air is not available until the engine is operating).

Automatically initiated pre-start warning devices should be provided where appropriate for the equipment type. This applies particularly to drag lines and large shovels and other large equipment where it is difficult for the driver to ensure that no one is exposed to a hazard if the equipment is started.

An automatic audible reversing alarm should be provided on all trucks, loaders, graders, scrapers and the other plant.

Design

Two means of exit should be provided from all operators' cabs. This may be achieved by a second door or a push-out window or panel which should be suitably marked.

All windows should be fitted with safety glass or equivalent.

5.10.2.2 ACCESS

Spacing and design of steps, ladders and walkways should be in accordance with AS 1657 Fixed Platforms, Walkways, Stairways and Ladders and AS 3868 Earth Moving Machinery as a minimum, but should, in addition, conform with the following:

- AS 3868 should be used where the required access is 2 metres or less from ground level. AS 1657 should be used where required access exceeds 2 metres from ground level.
- At least one means of easy egress and at least one means of emergency egress should be provided from the drivers cab to the ground. At least one of these should not be in the vicinity of a potential fire source.
- Vertical ladders should be avoided wherever possible.
- Stairs should be provided wherever practical.
- Retractable stairs or ladders should be considered wherever possible, particularly for loaders, overburden drills, rear dump trucks and shovels.
- Flexible bottom steps should be avoided.
- The bottom step should not be more than 400 m from normal ground level.
- Handrails should be in a continuous length without sudden changes of direction to facilitate evacuation with minimal visibility.
- Walkway surfaces should be self-cleaning and non-slip.

5.10.2.3 AUXILIARY EQUIPMENT

Lighting

Lighting and marking should comply with SAE J1029 unless otherwise specified.

For large equipment, such as face shovels, emergency lighting should be supplied to assist in the evacuation of the equipment.

All trucks, loaders, rubber-tyred dozers, graders and other trackless plant should be provided with the following.

- Lights visible from the side and arranged in strips to assist in identifying the length of the plant should be provided. This applies in particular to diesel-powered overburden drills and dump trucks but should also be considered for other equipment.
- Dual direction indication blinker lights should be provided at the front and rear of equipment (each blinker point has two separate lights).
- Dual service brake operation indication lights readily visible from the rear of the plant should be provided.
- Where retard braking is provided by other than service brakes, dual indication lights, visible from the rear of the plant, should be provided (electric retard brakes).
- Reversing lights and alarms should be provided on all rubber-tyred plant. The lights should generally be initiated automatically when reverse is selected (electric retard brakes).
- Main access ways should be adequately lit without interfering with driver visibility.
- Adequate reflectors and/or reflective tape should be provided on all plant to make it readily visible from any direction and hence reduce the likelihood of a collision (with a broken down item of plant). This includes but is not limited to:
  - the front headboard or highest extremity of all trackless plant to provide visibility in undulating terrain; and
  - the sides of all plant to assist in identifying the length of the plant.

General

Dump trucks should be so designed that the tail from one vehicle is not able to enter the cab of another vehicle.

This should not be achieved by any means which restricts the driver's visibility, such as moving the driver's cab further back.

Extended bumper bars should be considered for some vehicles where they are considered practical (can reduce impact injuries and reduce damage to vehicles).

Rear dump trucks only: rear dump tray interlocks and warning devices

A warning device should be provided in the operator's cabin to indicate when the rear dump tray is elevated. The device should be visual and/or audible, and located so that the operator readily notices it.

When the rear dump tray is elevated, propulsion in the forward and reverse direction should be inhibited. A defeat switch should be provided to over-ride the propulsion inhibits in the forward direction only, so that when operated and held in position, forward propulsion is possible. When released the defeat switch should automatically return to a position where ALL propulsion is inhibited with the rear dump tray raised. The defeat switch should not effect the operation of the rear dump tray raised warning device.

The defeat switch should be located within the zone of comfort, as defined in AS 2956.5 Earthmoving Machinery – Instrumentation and Operator's Controls, Part 5 – Zones of Comfort and Reach for Controls.

5.10.2.4 MECHANICAL AND HYDRAULIC COMPONENTS

Brakes

Definitions

'Service brake system' means a system used to stop and momentarily hold a machine.

'Secondary brake' means a system used to stop a machine in the event of any failure in the service brake system.

'Park brake system' means a system used to hold a stopped machine stationary for prolonged periods.

'Personnel vehicles' means vehicles of load capacity of one tonne and under.

'Service vehicles' means fork-lifts, tractors.

'Road trucks' means vehicles over one tonne capacity, not purpose-built for mining and not off-highway plant.

'Off-highway plant' means rubber-tyred loaders, dump trucks, dozers, scrapers and purpose-built plant for use in a mine.

All braking systems should comply with the relevant Australian, ISO or SAE Standards and should be fail safe.

Park brake

All machines should be equipped with a parking brake system capable of being applied and released from the operator's position.

The parking brake system should have the capability of holding the machine stationary on a 1 in 5 grade as described in AS 2958 Earth-Moving Machinery, with the machine at maximum gross machine mass including all accessories and capacities according to the manufacturer's specifications. Safety chocks may also be fitted and chained to the vehicle.

The parking brake system when applied should maintain the parking performance despite any contractions of the brake parts, exhaustion of energy or leakage of any kind.

Service brake

Service braking systems should be designed as dual circuit systems.

The use of single circuit brake systems should only be considered if all risk scenarios have been considered and measures taken to effectively eliminate or minimise risk.

All split brake systems should be supplied with a means of readily identifying when excessive differential pressure between the two sections occurs. This may be achieved by use of an indicator light readily visible to the driver.

Secondary brake system

Identification should be in accordance with AS 2956.4 Earthmoving Machinery – Instrumentation and Operators Controls, Part 4 – Symbols, or – clearly marked "EMERGENCY STOP" or "IMMEDIATE SHUTDOWN" and in accordance with the principles of AS 1319 Safety Signs for the Occupational Environment.

The brake control should be in the operator's cabin, and located within the zone of reach, as defined in AS 2956.5 Earthmoving Machinery – Instrumentation and Operators Controls, Part 5 – Zones of Comfort and Reach for Controls, and located so as to minimise the risk of inadvertent operation.

The brake control should also be in the vicinity of the normal boarding point onto the machine, and located so that both large and small operators can reach the device from a position on the ground at the boarding point.

These stops should not be located in front of blower fans or airflows (may direct fire to control point).

Emergency stops should be fail-safe, that is, not need power to shut down the engine.

On activating the emergency stop device, the device should latch either electrically or mechanically, so that the actuation can only be reversed by a deliberate action; the machine should not restart automatically.

The emergency stop device should be designed such that the operation of the emergency stop is a deliberate action.

A stop should be initiated by pushing a large red button.

It should be possible to relieve the pressure from hydraulic systems, steering systems, accumulators and pressurised fuel tanks from the vicinity of one of the emergency stop points at ground level (to permit pressure which may be fuelling a fire to be relieved).

Oil-immersed braking systems should be so designed that the temperature never reaches the flash point for the oil. Air or hydraulic energy storage for service brake application independently from the requirements of other consuming systems should be provided.

Consideration should be given to eliminate, or minimise so far as practicable, locking of the wheels.

An effective interlock should be provided to protect against the equipment being driven with the brakes applied. A spring return emergency interlock over-ride control is permitted.

Brake systems monitoring

Brake Drag Indication - A suitable warning device should be provided to monitor residual brake pressure.

A warning light easily visible from the driver's seat and/or audible alarm should be used to monitor the state of all pressurised braking systems (reference SAE J1473).

Where practical consideration should be given to a visual means of indicating an imminent brake fault.

A clearly identifiable means of externally monitoring brake wear and the required adjustment range should be displayed. Absence of this feature may require more frequent dismantling of brakes to assess the degree of wear.

Suitable connecting points for checking pressures of all braking systems should be provided.

The temperature of any oil-immersed braking system should be monitored. Monitoring should be visible from the driver's seated position.

A means of using on-board measurement for maintenance checking (or at least indication) of equipment deceleration should be provided where practical for the equipment type. A portable means of recording brake application frequency and length of application should be available. This should be suitable for easy installation on the equipment when required for checking purposes.

Automatic operation of brakes

If service brake system pressure drops below 50%, the emergency brakes should be automatically applied.

If the engine stops inadvertently, the emergency brakes should apply automatically.

If the door to the driver's cab is opened, the park brake should apply automatically and this brake should remain on until manually released at the normal control valve.

The automatic rate of application of the brakes should not exceed the safe application rate.

A warning device that effectively indicates to the driver that the braking system is about to apply automatically should be provided (reference SAE J1152 and SAE J1472).

Personnel vehicles

Personnel vehicles designed in accordance with Australian Vehicle Design Rules for use on public roads should comply with the relevant transport (or equivalent) legislation requirements for the braking system having regard to the mass of the vehicle.

Personnel vehicles used underground should be fitted with disc brakes preferable oil immersed.

Inspection, testing, repair and modifications

A brake test should be performed and recorded immediately after any repairs or adjustments to the braking system of any mobile plant. There should be a systematic testing of brakes for all mobile plant that takes into account the type and duty of the plant, the loads carried, the slopes traversed, the general conditions of the mine environment, traffic and pedestrian flows and maintenance procedure.

General

The use of fire resistant brake fluid should be considered for all non oil-immersed hydraulic brake systems.

Brake lining material should not contain asbestos.

Brake operation indication lights should be provided.

Engine compartment

The location of services including fuel, hydraulic oil and electric power within the engine compartment should be avoided wherever possible.

Any services required to be in the engine compartment should be effectively shielded from hot spots and protected from wear and the potential for physical damage during maintenance work.

All fuel and hydraulic circuits within the engine compartment should comply with the following:

- All pipes/hoses should be constructed of fire-resistant material and should be routed away from hot engine surfaces.
- Should the latter be impracticable, then an effective shield is required between the pipe/hose and any adjacent components, which have operating surface temperatures in excess of 150°C.
- All pipes/hoses should also be routed in a manner which will give them maximum mechanical protection.
- All connections should be of a type designed to minimise leakage of fluid.
- A firewall should be considered, particularly for loaders. This should separate the engine (heat source) from the hydraulics (fuel source). The firewall should be so designed that engine ventilation is not interfered with.
- Where possible hydraulic components should not be located where main ventilating air will cause leaking oil to be spread over the engine compartment.
- Radiator caps for cooling systems should be fitted with a means of safely relieving pressure to prevent personnel from being burnt.

Steering

All equipment fitted with power steering should be capable of manual operation in the event of engine or power failure so that the equipment can be brought safely to rest.

Emergency steering in accordance with SAE J53 should be provided on all tractor scrapers, wheel loaders, graders and dumpers (as defined in SAE J116).

Wheels and rims

The manufacturer of wheels and rims should recommend:

- The maximum permissible wheel loads, speeds and tyre pressure.
- Procedures for servicing wheel rims, including, in particular, multi-piece wheel rims.
- Clear limits of tolerances, permissible wear and other permissible defects of wheels and rim components.

Note: Wheels and rims for earth moving machinery should be maintained and repaired in accordance with AS 4457 – Earth Moving Machinery.

Pressure vessels

Pressure Vessels of capacity greater than 30 litres should comply with AS 1210 – Unfired Pressure Vessels.

Pressure vessels whose capacity is 30 litres or less which do not comply with AS 1200 – Pressure Equipment should comply with at least one of the following:

AS 2971 – Serially Produced Pressure Vessels or SAE J10 – Automatic and Off-Highway Air Brake Reservoir Performance and Identification Requirements.

A drain line with a manual valve should be provided to drain the lowest point of all air receivers. This line and valve should be suitably protected against accidental damage during transport.

Use of a parallel automatic drain valve in addition to the manual valve is recommended.

The manufacturer should provide a current Certificate of Inspection issued by a Licensed Boiler Inspector.

Fluid systems

Hydraulic systems and components should comply with AS 2671 Hydraulic Fluid Power and AS 4024 Safeguarding of Machinery.

Flexible hoses should be compatible with the fluid used and the maximum system pressure and temperature.

The factor of safety for hoses should be a minimum of 4 to 1 based on hose burst pressure to maximum working pressure for the maximum operating temperature.

Hydraulic hose should comply with the provisions of AS 3791 Hydraulic Hose.

Where a hydraulic system incorporates an accumulator, the attachment to the accumulator should be by means of a minimal length adaptor and flexible hose. Fittings should be located or otherwise guarded to provide mechanical protection. A manual bleed valve should be fitted to allow pressure relief for maintenance. This should preferably be accessible from ground level. Fluid should return to tank.

Accumulators should be securely installed.

The use of nylon or PVC piping for pneumatic control systems of safety related items would be acceptable only in cases where loss of pressure within these systems causes the system to fail to safety. All such piping should be adequately protected and shielded from contact with hot and/or sharp surfaces.

Elastomeric (rubber type) hose should not be used between an air compressor and air receiver. Teflon with steel braid may be satisfactory. All hoses should be suitably heat resistant.

Air compressors should comply with ISO 5388 Stationary Air Compressor – Safety Rules and Code of Practice or other Australian Standard as applicable.

All air, hydraulic, fuel, refrigerant and fire suppression hoses should be routed separately and suitably clamped (to prevent vibration and pulsation causing fretting between services leading to hose and cable failure).

Guards and shields

Guards and shields should comply with AS 2958.2 or ISO 3457 and AS 4024.1.

Shields should be fitted as follows:

- in the wheel areas where any hydraulic hoses may be damaged by impact; and
- in the vicinity of the turbo charger to prevent hydraulic oil spraying on hot surfaces, provided that they do not trap fuel or oil around the turbo.

Guards should be fitted as follows:

- in the vicinity of every fan;
- in the vicinity of every moving component that is readily accessible;
- in the vicinity of any access way where a person may contact moving machinery or wire ropes;
- any other areas required to be guarded by regulations mentioned in Section 1; and
- any other areas as identified from accident statistics or risk assessments.

The engine compartment should be effectively shielded from the driver's compartment and from the two means of egress from the driver's compartment.

Any covers, shields or guards, if not constructed from steel, should be constructed from fire-resistant material if the failure of the material may put an operator at risk when a fire occurs. The degree of fire resistance should suit the size of the fire that may eventuate and should provide protection for at least 2 hours. This specifically applies to engine covers of large rear dump trucks as well as most other large equipment.

Comparative fire resistance may be obtained by testing to ASTM 1354, ISO 5660 or AS 1530 Methods for Fire Tests on Building materials.

A rear dump truck should be provided with a means of restraining the dump body when in the raised position for inspection or maintenance. This should consist of pins or slings or chocks, and should have a safety factor 4 to 1 when applied to the maximum possible down load that can be exerted on the dump body when the dump body is in the raised position.

Towing

Towing of equipment which is inoperable.

A means of towing should be recommended by the manufacturer and provisions should include the following:

- the towing attachment should be designed to a minimum safety factor of 2.5 times the maximum rated towing capacity of the towing equipment;
- the maximum weight (gross load) for towed equipment should be as per the towing equipment manufacturer's recommendation;
- a means of releasing fail safe brakes;
- a means of steering or guiding the towed equipment;
- a means of adequately braking the equipment system; and
- limitations and requirements of the towing system.

Note: If towing is impractical then this should be stated by the manufacturer.

5.10.2.5 ELECTRICAL COMPONENTS

Definitions

Live parts

Any equipment, apparatus or device that is at a potential different to the main body of the machine.

Active conductors

Any conductor which is maintained at a potential different to the main body of the machine.

Protection point

Any part of the machine where a protective device or assembly of protective devices is installed (ie, dashboards), or where sub circuits are taken off (ie, at starter motors, starter solenoids).

Machine

Dozers, rear dump trucks, transportable compressors, scrapers, graders, excavators, compact rollers, loaders, tractors, diesel pumps, transportable generating sets, etc.

Protective device

Circuit breaker, fuse, etc.

For other definitions, see AS/NZS 3000 Electrical Installations

General requirements

Safe and sound practice

Equipment should be installed in accordance with the appropriate requirements of this document and the generally accepted principles of safe, sound and good electrical engineering practice.

Fixing and supports

All fixings, fastenings and supports should be of adequate strength and arranged to protect the wiring and associated electrical equipment from mechanical failure.

General protection against damage

All electrical parts of a machine should be adequately protected against damage which might be reasonably expected to result from mechanical injury, exposure to weather, water, excessive dampness, corrosive fumes, accumulation of dust/debris, steam, oil, grease, fuel, high temperature, or any other circumstances to which the machine may be exposed.

For maintainability and ease of cleaning, enclosures and devices may need to be rated as high as IP57. The customer/user should take this into consideration when specifying their requirements.

Protection of live parts

All live parts should be arranged so that a short circuit or arcing, either between live parts or between live parts and other conductive material, will not take place under the normal conditions of service. All connections should be made so that they cannot slacken or overheat under normal conditions of service.

Mechanical protection of cables, conductors and wiring looms

All wiring reticulated about the machine should be enclosed in suitable mechanical protection (ie, flexible conduit, rigid conduit, or any other suitable material), and should be arranged and located so that regular visual inspections can be easily made, and it is not in contact with any hot surfaces or harnessed with fuel lines, brake lines, oil lines, pneumatic lines, or hydraulic lines.

Wiring enclosed within cabinets, components, junction boxes, etc, should be suitably loomed, harnessed and supported.

Where wiring is to be threaded through conduits, partition walls, the wiring should be adequately glanded or bushed, and where wiring protective covering terminates at a partition wall (electrical cabinet) it should be adequately fixed to the point of termination.

Special care should be taken not to locate electrical wiring where it may be damaged during maintenance or repair, by being struck by falling objects or by being walked upon.

Segregation of wiring systems

Wiring of fire protection systems should not be enclosed with wiring of any other system, except for the purpose of termination at the point of supply.

Circuits that are not provided with electrical protection should be segregated from all other circuits by barriers, conduits, etc.

Prohibited connections

No equipment which is in an unsafe condition should be connected or remain connected to a machine or part of a machine.

Unused equipment and cables

All unused parts of an electrical installation on a machine should be completely disconnected from the source of supply and marked, stating the location of the opposite end of the circuit and the status of the interconnecting cable (open circuit, healthy, short circuit).

Disconnected wiring which remains in association with wiring that is in use should be terminated or insulated, and means taken at both ends to prevent inadvertent reconnection

Circuit diagrams and manuals

Each machine should be supplied with an accurate electrical schematic diagram, showing all components and conductor markings. Where plug and socket arrangements are used, their location should be noted on the schematic diagram.

Manuals should be supplied with each machine. The manuals should include relevant electrical diagrams, parts list, cable schedule, component ratings and a section on recommended maintenance periods and procedures, including safety precautions to be taken.

When any circuit alterations are made, the electrical schematic and wiring diagrams should be updated immediately by the appropriate personnel and details distributed to ensure hazards are not created by use of incorrect information.

Prototype machines may be exempt from the requirements of this clause, until the machine is deemed acceptable. This is provided systems are adopted to enable an accurate determination of the electric circuit status at any time.

Labelling

Circuit identification

At each protective device, there should be a label of durable material, securely fastened, indicating the circuit or sub circuit being supplied by that protective device, and the rating of that device. If it is impracticable to label according to this, each protective device should be identified by a code. A legend plate relating the code for the relevant circuit and the rating of the device should be placed in a conspicuous position and be made of a durable material. Any such coding system should be clearly shown on the electrical schematic and wiring diagrams. It is recommended labels and legend plates are fastened in position with screws or similar devices, or any other reliable method.

Cable marking

Each conductor should be marked at every point of termination in accordance with the machines electrical schematic diagram. The marking should be of a durable material that is readily cleaned.

Jump starting

Warning labels should be placed on the machine indicating the maximum number of starts in relation to time. The jump start facilities should be clearly marked indicating the operating voltage.

Battery isolator

It should be marked "Battery Isolator" or words to that effect, or with an appropriate symbol.

General arrangement – control and protection

If it is impracticable or undesirable to protect certain circuits with electrical protective devices. Where this is the case, additional precautions should be taken to minimise the risk of the circuit failing. Such additional precautions should be one, more than one, or all of the methods described below.

- Additional mechanical protection.
- Suitable location.
- Adequate harnessing and support.
- Segregation from other circuits, energy sources, and fuels.

The general arrangement, control and protection of circuits and equipment should be such that the installation operates satisfactorily with regard to the following.

- Selection of cables.
- Arrangement and functionality of circuits.
- The control of circuits, by suitable switching arrangements.
- The protection of circuits from overload and short circuit conditions.
- The selection, design and location of switches and ancillary equipment normally used on machines.
- The operation and arrangement of switches, push buttons or other devices should be such that their inadvertent operation should not cause any danger to plant operators or plant.

Size and type of cable and conductors

General

Cables should be selected having regard to the following criteria.

- The current-carrying capacity as determined from the cable insulant, and installation methods.
- Voltage drop.
- Short-circuit performance as determined from the characteristics of the protective device.
- Mechanical strength.

All cables that reticulate about the machine should be enclosed in conduit or other protective measures of adequate strength, oil, water and fuel resistance.

Current carrying capacity

The maximum load current to be carried by every cable should not be greater than the current-carrying capacity of the cable.

Current rating of control devices

Every switch, fuse, push button, and circuit breaker should have a current rating not less than the maximum demand of the circuit it controls.

Current rating of protective devices

Protective devices should be arranged to automatically disconnect the active conductors of a circuit in the event of an overload or a short circuit or both. These devices should be provided to interrupt any overcurrent flowing in the circuit before any damage is caused by thermal effects. Circuit breakers should not be automatic reset devices.

Location of protective devices

It is preferrable to have all protective devices congregated in a common enclosure. If this is not possible, and protective devices are placed at various points about a machine, they should be installed in appropriate enclosures (such as to prevent ingress of dust and moisture as far as is practicable).

Control of circuits

A battery isolator switch should be installed in a suitable position so as to avoid any danger from switching off the supply of electricity. It should be located as close as practicable to the batteries and be easily accessible. It does not preclude the installation of additional isolating switches at other positions. It should control the whole of the installation, except as explained below.

The following parts of the installation need not be controlled by a main isolating switch. Additional care should be taken with regard to mechanical protection and electrical protection of these circuits:

- Fire protection system.
- Two-way radio systems.
- Lighting circuits used specifically for access on and off machines.

Protection of circuits

Every circuit or sub-circuit outgoing from the protection point should be protected at the protection point by a circuit protective device.

Specific cables

Cables connected directly to battery terminals and battery isolation switches should be in separate conduits or other suitable protection and should be positioned to facilitate regular visual inspections.

Special requirements

Emergency curcuits

Circuits installed to supply devices that are to be used in an emergency should be dedicated for that purpose. Protective devices may be undesirable in such circuits. If no electrical protection is provided, additional precautions should be taken (that is, additional mechanical protection fitted to the cables, segregation from other circuits from the point of supply to the component) so as to minimise the possibility of a fault occurring.

Jump starting

The jump start facility (plug/socket) should be located as close as practicable to the machine batteries and should be located to minimise the risk of igniting any gas liberated from the battery.

Consideration should be given to cable ratings on machines in relation to the capacity of jump start supplies.

Consideration should be given to prevent the inadvertent connection of incorrect voltage jump start supplies (that is, 12V to 24V).

Alternator charging circuits

The cable from the alternator that supplies charging current to the batteries should be rated for the alternator output. Careful consideration should be given to the location of protective devices in the charging circuit.

12V Circuits tapped off a 24V supply

The battery isolators should be double pole and designed to break both positive and negative poles. It is recommended that the practice of using different voltage levels from the same DC source be avoided.

Articulated vehicles

Articulated joints should be bridged by an equipotential bond positioned to avoid damage and connected to the machine frame, on both sides of the articulated joint. It should be of a size no less than the negative connection at the battery.

Lighting circuits

Consideration should be given to the arrangement of the lighting circuits such that if a fault occurs, only one side of the vehicle lights fail to operate.

Batteries

Batteries should be secure, well-ventilated, located so as to facilitate maintenance and prevent undue accumulation of dirt and debris. They should have sufficient clearance between terminals and frame and be protected against damage and inadvertent short circuits.

Starting circuits

Consideration should be given to the co-ordination of starting currents, starting times and cable size, such that the main cables do not deteriorate due to heat under normal starting conditions and onerous starting conditions.

Location of relays and wwitches

Relays and switches used in relation to fuel flow should be located such that the possibility of sparking igniting spilt fuel is eliminated.

Engine shut-down in an emergency

Facilities should be provided to allow the operator to shut down the engine without danger in of an emergency.

Isolation of electrical power in an emergency

Provisions should be made to facilitate isolation of electrical power from the source of supply (batteries) in an emergency such that its operation will not endanger the operator.

Connection of one pole of the batteries to the machine frame

This connection should be made directly to the machine frame or to any other part of the machine that does not rely on continuity via components that are bolted together. Where equipotential bonds are used to bridge bolted components, they should be capable of carrying the maximum current expected at that point.

5.10.3 FIRE PROTECTION

5.10.3.1 FIRE EXTINGUISHERS

As a minimum, fire extinguishers of a suitable type and capacity should be installed on all mobile plant. The extinguisher should be fitted at a location on the plant that is least likely to catch fire. It should be easily detached by a person from ground level, and have gauges that are easily read.

All fire extinguishers should be maintained in accordance with AS 1851 Fire Protection Equipment, Maintenance and the supplier's recommendations.

The following minimum size of fire extinguishers should be used, based on engine rating:

- Less than 100kW 30B(E): 2 – 3kg
- 101 to 200 kW 60B(E): 4. – 8kg
- <200kW 80B(E): 6 – 11kg

5.10.3.2 FIRE-SUPPRESSION SYSTEM

A risk assessment should address whether the plant should be fitted with a fire suppression system that will deliver extinguishant from a bulk container through pipes or tubes to a number of key areas on the mobile plant.

Design

The firefighting system should be designed to provide protection from fires that may be initiated from all heat sources that may result in injury to personnel if not suppressed, and any other heat sources as deemed appropriate to afford effective protection for the equipment.

The items to be considered include, but are not limited to:

- the volume of the area to be covered.
- the ventilation of the area to be covered.
- the quantity of fuel, including diesel fuel, oil or other combustible material that may be available to feed the fire.
- the areas where ignition is more easily initiated (turbo charger of a diesel engine).
- the storage, type and application of the extinguishing agent should be non-injurious to all personnel likely to come into contact with the system in either the stored or discharged condition.
- pressurised carbon dioxides systems are not preferred (because of the danger of asphyxiating personnel).
- a detailed guide for the charging/filing of firefighting systems should be provided. This system should include but not be necessarily limited to the requirements detailed in the relevant Australian Standard.
- firefighting system extinguishants should comply with any legislative requirements covering the use of ozone-depleting compounds (for example, NSW Ozone Protection Act 1989 and associated Regulations).

Type selection

Selection of a manually-operated fire suppression system as against an automatically-operated fire suppression system should be reviewed to ensure that the risk or hazards to personnel are comparable to that afforded by an automatic system for the equipment protected.

All automatic fire suppression systems should be interlocked so that the equipment cannot be operated if the fire suppression system is disabled or faulty.

Note: Many drivers forget to stop the engine when abandoning a vehicle, with the result that damage to equipment can become worse. A number of drivers have been more severely injured because a fire was still being fed by the engine while they evacuated the vehicle.

A fail-safe shut-off valve system should be fitted to the fuel supply line where the equipment is fitted to an internal combustion engine. For automatic systems, this valve system should operate in the following sequence:

- Warning given to the operator (visual and audible) that a fire has been detected on board.
- A timer to delay engine shut down activates for a pre-determined time that suits the equipment type and mine conditions. Typical times are given as:
  - Rear dump trucks, water carts, rubber-tyred dozers and similar – 30 to 40 seconds.
  - Bulldozers, front-end loaders, graders, drill rigs and similar – 15 to 20 seconds.
- When that time has expired, the engine should automatically shut down, and when the engine shut-down is complete, the fire suppression system should activate.

The system should allow for manual override of the automatic sequence to allow response by the operator when needed.

All automatic fire-suppression systems should, where appropriate, be interlocked so that the equipment cannot be operated if the fire suppression system is disabled or faulty.

Electrical operation of system

Each portion of an electrical installation that supplies a fire protection system should be separately controlled by a switch which is additional to the main switch used to control other components of the equipment. The switch should be clearly marked to indicate the equipment that it controls, and marked “IN THE EVENT OF FIRE, DO NOT SWITCH OFF”.

All controls should fail to safety unless a back-up power supply system is provided.

Loss of electric power should not prevent manual operation of the fire extinguishing system.

Wiring systems should be capable of maintaining an adequate supply to the equipment when exposed to fire.

Visual indication of the operational state of the fire extinguishing system should be provided to the equipment operator. The indication should be visible to the operator from the normal driving position.

Activation of system

For some systems it may be useful to switch an automatic system to manual operation. If this feature is provided, it should only be possible to carry out the switching function from the driver’s normal operating position.

Clear indication of the selected mode of operation should be visible from the driver’s normal driving position.

Manually operated controls to trigger the system should be provided:

- within the operator’s compartment and located for easy access by the seated operator; and
- adjacent to the bottom of the normal access ladder or walkway, to the operator’s compartment, readily accessible from ground level.

Control lines should be arranged so that failure of any one line would not prevent the system operating when initiated from another activation point.

All hoses should be at least single wire braid and be fire resistant when tested to AS 1180-10b with acceptance to AS 2660 Hose and Hose Assemblies or, alternatively, satisfy schedule 2G of the US Bureau of Mines or comply with type 1 or 3 hose specifications as listed in ISO 6805.

Visual indication should be provided for the equipment operator to show whether the system is ready for operation or has been discharged.

Pressure vessels

All cylinders that may be subject to internal pressure should be suitably protected by a relief system to prevent inadvertent pressurisation in excess of the safer working pressure.

The relief system should be secured and sealed to prevent tampering.

All pressure vessels used as components of the system should comply with the requirements of the relevant Australian Standard.

REFERENCE DOCUMENTS

AS 1891 – 1983 Industrial Safety Belts and Harnesses.

AS 2294 – 1990 Earth-moving Machinery – Protective Structures.

AS 2359 Industrial Trucks (known as the SAA Industrial Truck Code).

AS 2664 – 1983 Earthmoving Machinery – Seat Belts and Seat Belt Anchorages.

AS 2958.1 – 1988 Wheeled Machines – Performance Requirements and Test Procedures for Braking Systems.

AS 3868 – 1991 Earth-moving Machinery – Design Guide for Access Systems.

AS 4024 (Int) – 1992 Safeguarding of Machinery: General Principles.

AS 4041 – 1992 Pressure Piping.

AS/NZS 4240 – 1994 Remote Controls for Mining Equipment.

AS 4297 – 1995 Underground Mining – Stationary Air Compressors.

AS 4457 – 1997 Earth-moving machinery – off–highway rims and wheels – maintenance and repair.

SAA HB40 – 1992 The Australian Refrigeration and Air Conditioning Code of Good Practice.

International Standards

ISO 3411 – 1982 International Standard entitled, Earthmoving Machinery – Human Physics Dimensions of Operator and Minimum Operator Space Envelope [cv. AS 2953.2–1988].

ISO 5353 International Standard entitled, Earthmoving Machinery Human Physics Dimensions of Operators and Minimum Operator Space Envelope [cf. AS 2953.3 – 1988].

ISO 6682 International Standard entitled, Earthmoving Machinery – Zones of Comfort and Reach of Controls [cf. AS 2956 – 1988].

NSW Department of Mineral Resources.

MDG 1 – 1995 Guidelines for Free Steered Vehicles – Underground Coal Mines.

MDG 15 – 1995 Guidelines for Surface Mobile and Transportable Equipment for Use in NSW Coal Mines.

5.11 MOBILE EQUIPMENT USED ON THE SURFACE

Mobile equipment used on the surface of mines and quarries includes haul trucks, dozers, excavators, loaders, graders, scrapers, fork lifts and other mobile machinery. It is important to remember that site specific procedures are necessary for all versions of the different types of mobile equipment that are in service.

5.11.1 GENERAL OPERATIONAL ISSUES

To ensure vehicle safety, operations should:

- ensure the safety of vehicles;
- ensure the competence of the drivers; and
- develop safe work procedures.

Each of these is now discussed in more detail.

5.11.1.1 SAFETY OF THE VEHICLES

Safety of the fleet

Although most accidents occur on the open road, ensure care is also given to preventing accidents occurring on the roads, traffic ways and parking areas of the property.

Ensure the safety of employees and visitors to the plant by regulating traffic flow within the plan and quarry confines – use appropriate signs and other measures. Where necessary, conduct additional training programs outlining precautions and control measures.

Ensure that appropriate statutory requirements are enforced and that standard traffic signs are used, where appropriate.

There are problems associated with maintaining a fleet of vehicles for the open road. These include:

- the drivers of the vehicles normally operate away from direct supervision;
- the complexity of the road transport system; and
- influence of other factors, such as alcoholism, drugs, long hours of driving.

Vehicle maintenance and records

Establish a system of preventative maintenance to ensure that all vehicles are properly and regularly maintained.

Each vehicle must comply with statutory requirements for roadworthiness.

Ensure each vehicle has a record book that details the following:

- daily use;
- faults or damage from accidents; and
- general condition, including the condition/operation of items essential for safe use.

Each vehicle should have a record that shows:

- when service/maintenance is required;
- record of any work carried out on the vehicle; and
- costs associated with the above.

The operation should also have records that show the vehicles accident history, including any reference to the drivers, damage/replacement costs and any personal injuries.

Ensure any accident is thoroughly investigated by line managers to establish the causes of the accident and actions to prevent similar accidents in the future.

Scheduling vehicles

Ensure vehicles are in good operating condition before being scheduled to carry a load. Ensure each vehicle is capable of handling loads within their legal load limits and within any legal limitations for the journey selected.

Ensure schedules allow for:

- proper maintenance between journeys;
- security checks;
- stability of the loads carried; and
- the load limit on bridges/roads.

5.11.1.2 COMPETENCE OF THE DRIVERS

To encourage a commitment to safety, consideration should be given to driver motivational programs, including recognition of excellent safety performance and ensuring that:

- vehicle maintenance and housekeeping is rigidly enforced;
- undesirable driver performance is recognised and controlled;
- desirable driver performance is reinforced; and
- drivers understand their legal obligations under the appropriate Motor Traffic Act and other legislation.

Driver selection

When selecting a driver, take note of:

- employee selection procedures;
- past driving experience (particularly related to the job requirements);
- obtain signed clearance for request for information from RTA records on driving points system record and overloading breaches;
- class of driving licence;
- knowledge of the vehicle and its proper operation;
- physical condition and emotional stability, including the need for a medical examination, especially for long distance drivers;
- ability to perform a road test over a similar route to the one normally driven in the type of vehicle employed, to drive and deliver the operation's product;
- previous accident and overloading history.

Training

For people operating large vehicles or mechanical plant, the operation must train staff and may issue certificates of competency. Include the following as part of induction training for company drivers:

- policy and procedures relating to safe driving and vehicle operation, the issue of appropriate licences and legal liability;
- road safety concepts, including knowledge of road laws and emergency procedures;
- vehicle operation, including regular checks of its condition;
- correct and safe methods for securing loads;
- the need to check the load during transport;
- emergency procedures for vehicle accidents and/or spillage of hazardous loads;
- correct loading of all vehicles within legal load limits; and
- environmental procedures for vehicle accidents and/or spillage of chemicals and/or hazardous chemicals.

Ensure that drivers receive the following ongoing training:

- specific skill training for dirt roads, off-road conditions, trailer equipment, fog, ice or snow, as appropriate;
- safety procedures for acid washing of units;
- elements of defensive driving; and
- effects of alcohol, drugs and medication on driving ability.

Influences on driver ability

Driving skills and abilities are impaired by a range of physical and psychological factors including:

- inappropriate scheduling resulting in very long hours at the wheel;
- medical conditions, such as defective hearing or poor eyesight;
- emotional problems;
- incorrect selection of vehicle for the intended task;
- effects of driving in high temperatures or high humidity; and
- serious effects caused by carbon monoxide, from a vehicle operated with a sub-standard or faulty exhaust system.

5.11.1.3 SAFE WORK PROCEDURES

General safety rules for personnel driving around quarries

An example of general safety rules is given below.

All employees should be aware and understand the rules. They should be given to all new employees and contractors with any vehicles operating within the quarry.

- Always drive your vehicle at a safe and controlled speed. Where applicable, speed limits and restrictions are indicated by signs and must be observed.
- Under wet conditions, where roads are curved, especially ramps, operators must reduce speed according to the prevailing conditions.
- Seat belts must be worn in all quarry vehicles.
- Overtaking of heavy equipment by light vehicles must be done with extreme caution.
- Drivers are to observe all signs erected along haulage roads. Road signs overrule any other rules.
- Empty dump trucks give way to loaded trucks.
- All off road vehicles and mobile plant (excluding excavators) must be fitted with Roll Over protection (ROPS) and Falling Object Protection (FOPS).
- Light vehicles of any kind must always give way to heavy vehicles.

Heavy haulage vehicles

- Heavy haulage vehicles must give way to road maintenance vehicles, such as watercarts, graders and wheeldozers.
- A minimum distance of 60 metres must be kept between dump trucks travelling on haul roads, especially on ramps. Dump trucks must not overtake any vehicle. However, they may overtake road maintenance vehicles if it is safe to do so, only where the driver has a clear view of the road ahead and behind.
- Keep a safe distance between dump trucks when waiting to load or tip.
- Dump trucks are not to reverse to the loader until signalled by the loader operator. The loader should be stationary with a raised bucket prior to reversing to the load point. Any collision between a loader and truck is the truck driver's responsibility.
- Dump trucks must have at least a 3 metre clearance when parked side by side.
- Dump trucks must not push other vehicles.
- If a dump truck or quarry vehicle must be parked on a down grade, steering wheels must be turned into the safety bank, wheels blocked and parking brakes applied.

Quarry products – road transport vehicles

- All safety signs in the quarry must be obeyed. These include speed signs, no entry to certain areas and warning signs of different hazards around the quarry workings.
- On entering the quarry, if drivers are unsure where to go, they must report to the weighbridge, where instructions will be given and a map supplied.
- CB radios can be used to communicate with the loader driver. Drivers should obey instructions from the loader driver as to the positioning of the truck for loading. While the truck is being loaded, the driver must remain in the cab. Under no circumstances should anyone approach the loader, without first gaining the operator's attention and then waiting until the loader's bucket is lowered to the ground.
- Trucks must give way to all quarry mobile equipment.
- If directed to load from under bins, use the platform provided for pulling the lanyard or lever. A hard hat and boots should be worn if drivers are moving about in these areas.
- Tipping should be kept as close to the main pile as possible. Never tip-off on a corner. If a safe place can not be found to tip, call the loader driver or weighbridge attendant for further instructions. Only tip on even ground.

- Never drive under the raised bucket of a loader. Approach the loader a metre or so out from the bucket and allow the loader to move out to you.

Any hazards, faults or unsafe working conditions must be reported immediately to the supervisor.

Modern mobile equipment is fitted with features that provide optimum protection for operators in the event of an abnormal situation, such as a rollover. Such features include ROPS or FOPS for driver stations and seat belts. To obtain the maximum benefit of these features, procedures need to incorporate the manufacturer's requirements.

Some general comments follow below, which may assist in the development of procedures.

REFERENCE DOCUMENT

Occupational Health and Safety Manual, Pioneer Concrete NSW Pty Limited.

5.11.2 EXCAVATORS

5.11.2.1 GENERAL

Excavator operation is skilled and important work. The safe operation of an appliance is in both the owner's and the operator's hands, and to prevent accidents it is essential that the operatives receive good training and thorough preparation to fit them for their work.

As there are so many makes, types and models of excavators, and each type and model has been designed for a specific range of work under certain conditions, definite information cannot be set down in a concise form to cover all excavators.

Excavators and loaders are entirely dependent on gravity against overturning. The effects on loads of uneven, soft or sloping surfaces are critical, all having an important influence on the stability of the machine. Independent braking systems on the rear wheel also create instability. Both pedals should be welded together or equalising gear fitted to the dual braking pedals.

With this in mind, stabilisers have been designed and fitted to all hydraulic small type back hoes. They should be used in the correct manner. The stabiliser which is on the lower side of uneven surfaces should be grounded first. Suitable packing should be placed under them in soft ground.

An excavator may also have practical limitations, such as tyre capacities and axle strengths. Excavators have been designed for a specific range of work and it is essential that the work performed is kept within the range.

The safe working load should be displayed on the machine if it is to be used for slinging loads, or work other than earth moving.

Loads should only be attached to the machine on approved lugs or lifting devices not slung around the blade of the bucket.

Tyre pressures also play an important part in stability. Correct air pressures should be maintained and extreme care taken when pressurising tyres containing water for ballast.

A driver should not only demonstrate that he can safely drive an excavator. He is also required to have a satisfactory knowledge of the mechanical parts of the machine and be responsible for the making of regular inspections and the prompt reporting of unsafe conditions.

5.11.2.2 PRE-START

Drivers, duties prior to operating an excavator are to:

- know the safe working load and under what conditions the excavator can be used;
- check the condition of the tyres and their pressures or track gear if used. They need to know what precautions are necessary to pressurise tyres containing water as ballast;
- check the condition of the ropes and anchorages if used. Wire rope should be used if stretched, kinked, knotted, or corroded, or where ten per cent of the total number of wires in the rope are broken within a length of eight times the diameter of the rope. For example, in a 12 millimetres (mm) diameter 6/24 rope (144 wires), no more than 14 wires are broken in any 96 millimetres of length;
- ensure the ropes are correctly wound onto their drum and that too much rope does not exist for the height of the drum flanges. A

rule for the safe load of a wire rope in kilograms is – diameter in millimetres squared, multiplied by 8. Example – 12 mm diameter rope is 12 x 12 x 8 = 1150 kilograms (kg) = 1.15 tonne (t);

- only approved types of rope anchorages should be used. These are, the thimble eye splice with rope spliced with the correct number of tucks against the lay. The swaged ferrule splice with its thimble or hard eye and the wedge socket with the rope fitted so that the pull is in a direct line with the attaching point of the fitting. Bulldog clips and the like are not acceptable;
- check for any loose bolts, pins, broken or badly worn gearing, sheaves and for any loose or missing keeper plates or pins;
- check the mechanical condition of the brakes, linings, bands for cracks and mechanical linkages. Ensure they are guarded against the entry of oil or water;
- ensure all guards and safety devices are replaced after adjustments, repairs or other work requiring the removal of protective equipment;
- ensure the excavator has been greased. Moving parts must be stopped before any greasing, adjusting or cleaning takes place;
- check the mechanical condition of the operating controls;
- check the mechanical condition of the travelling brakes. Where a tractor-type back hoe is used and is fitted with an independent separate brake for each rear wheel, a locking device must be used to ensure that both wheels brake evenly at all times;
- check the mechanical condition of the limiting devices;
- check for any gear which has been haphazardly placed on the machine;
- check the internal combustion engine services; and
- check the electric and hydraulic services.

5.11.2.3 OPERATION

On starting an excavator, the driver must:

- ensure all controls are in the neutral position before starting the motor;
- be in the correct driving position and seated correctly, so as to take control if the machine moves. Do not stand on tracks or near wheels;
- check that all persons are clear of the operating range of the bucket;
- ensure any gear placed in the driver's cabin is not fouling any controls;
- ensure that the bucket has been placed in a safe position;
- check all controls for operation, direction and marking;
- check the road travelling brakes for efficiency;
- check for the satisfactory operation of the limiting devices;
- ensure that all tyres are in good condition and evenly and correctly inflated to maker's specifications and if water or solid ballast is required to check if its level is correct. This is most important in the case of large wheeled rubber tyred loaders, as fast road travel is hazardous with incorrectly inflated or worn tyres;
- prior to digging, take into account the ground conditions. Never work close to loose banks or open trenches unless properly battered or timbered. Stabilisers must be in position and packed if necessary. They prevent unnecessary movement and hold the weight of the machine of the tyres;
- when digging in virgin ground, break up the hard surface first before attempting large bites;
- at all times make proper provision for placement of dug-out earth and never place it too close to the edge of the trench;

- never undermine large rocks, trees or buildings and never dig too close under you own machine;
- watch out for underground services such as gas, water, telephone or electrical conduits. If in doubt as to their location, make enquires;
- keep any part of the excavator at least 4 metres clear of overhead powerlines of up to 132,000 volts and at least 7 metres clear of overhead powerlines which are above 132,000 volts. A warning notice is to be displayed in the crane cabin;
- Not make jerky, sudden movements with any controls. This results in damage to the machine and inefficient work;
- never allow any person to ride on the machine while travelling or operating unless a Department of Industrial Relations passenger's seat has been installed and approval granted by the Chief Inspector for persons to ride on the crane.
  It is the operator's responsibility to ensure this; and
- always leave the bucket on the ground when not in use.

5.11.3 FRONT-END LOADERS

5.11.3.1 OPERATION

- Before loading, check the cubic capacity of the bucket and the type of material to be handled to ensure overloading does not occur.
- At all times carry a loaded bucket as close to the ground as possible, to just clear ground obstructions. Do not raise the bucket to unloading height until reaching the dumping point. The dangers of a high bucket are instability, obstructed vision and the possibility of striking overhead obstructions.
- When travelling on sloping surfaces with a loaded bucket, always keep the bucket facing uphill and never travel sideways on a steep incline. If necessary, prepare the sloping surface by cut and fill before taking loads up or down.
- Never travel in reverse before looking behind to check for persons or obstructions in your intended path.
- Major factors in accidents during truck loading operations include truck position, driver location and traffic flow. Loader operators should move cautiously, especially in congested areas.
- The loader operator and the truck driver should agree where the driver will stay when the truck is being loaded; either in the cab, or away from both loader and truck – never on the truck body.
- Persons are not to ride in the bucket.
- To avoid cave-in, never work close to loose edges. Remember the loaded machine is extremely heavy when back filling deep trenches, work at 90 degrees to its edge.
- Buckets should always be grounded when the operator leaves the cab. A bucket left elevated for any reason should be securely blocked.
- Equipment left unattended should be locked or made inoperable so that any unauthorised person, particularly a child, cannot start the engine.

5.11.4 FORKLIFTS

An employer must ensure that every person who operates a forklift is competent to do so. He must ensure that the operator has been trained and assessed in the safe operation and health and safety procedures.

Types of forklift accidents which can cause injuries include:

- being struck by a moving forklift;
- the forklift tipping over and overturning;
- collision with other vehicles or stationary objects;
- part of the operator's body protruding out of the cabin and hitting an object; and
- losing the load.

5.11.4.1 FORKLIFT HAZARDS

These situations can cause fork lifts to overturn:

- driving fast;
- turning sharply (a cornering forklift can overturn at 6 km per/hr or less);
- turning on sloping ground;
- travelling with a load raised;
- working on uneven or sloping ground;
- carrying a load forwards down a slope ;
- carrying an unevenly balanced load; and
- travelling across an incline.

If a forklift overturns, the safest place for the operator is in the cabin, restrained by a seat-belt and if possible, by body restraints built into the seat.

The most common cause of death with these vehicles is when an operator attempts to jump clear of an overturning forklift and is crushed by either the overhead protective guard structure or the mast.

Always stay inside the cab when a forklift overturns.

Do not attempt to jump clear.

5.11.4.2 SAFE WORK PROCEDURES

Examples of safe procedures for operating fork lifts are as follows:

- passengers on fork lifts are strictly forbidden, unless there is a separate seat provided with a restraint;
- other people are to be kept clear when a forklift is operating;
- the operator should take care when moving between artificial and natural light;
- the load is to be made secure and lowered to a safe centre of gravity before carrying;
- sudden stops and starts are to be avoided;
- no part of the operator's body is to protrude beyond the overhead protection;
- ramps are not to be used unless the forklift operator is trained in their use;
- the operator is to remain seated and secured at all times;
- the forklift is to operate within a designated area, separate from pedestrians; and
- the operator is to remain in the cabin when a forklift overturns.

People should never be raised on the forks or a pallet.

If there is no other way to lift a worker, a proper work platform should be used in accordance with Australian Standards.

A safe system of work should include a daily safety check and a requirement to carry out regular maintenance checks.

REFERENCE DOCUMENTS

Forklift Trucks, Employers Guide, Queensland Division of Workplace Health and Safety.

Forklift Safety, CSIRO Safety.

5.11.5 HAUL TRUCKS

5.11.5.1 GENERAL

Operators of haulage trucks should develop a zero tolerance safety attitude. This means that they will not operate equipment that is not properly maintained. Many haulage incidents have occurred from:

- drivers attempting to jump from a truck that is out of control;
- trucks going over the edge at dump point due to over travel or the collapse of the edge of the slope; and
- drivers being run over after parking their truck when the truck rolled.

The operator should know what to do in the case of:

- runaway/roll-over;
- engine failure;
- steering problems;
- brake failure;
- tyre failure; and
- fire.

5.11.5.2 OPERATION

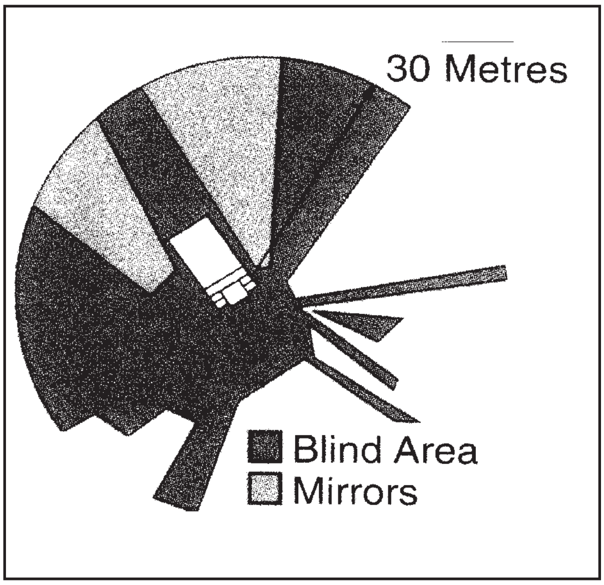
All operators should:

- do a complete walk around inspection of the truck before boarding;
- conduct a safety check of the truck and test systems before driving. Use a buddy system to test lights;
- buckle up and stay buckled;
- put your mind in gear before moving, or putting the truck in gear. Warn people around the truck that it is preparing to move. This is especially true if the truck has been in idle;
- pay attention to the machine and the surroundings. Watch out for animals, people, other vehicles, changing road surfaces, odd sounds, slumping or sloughing slopes, highwall and haul road conditions, downed or low wires, lighting or visibility problems and unusual response of vehicle controls. Tell a supervisor so the problem can be fixed;
- avoid miscommunications and unexpected movements by talking with co-workers before, during and after field repairs or maintenance;
- be aware of changes in conditions: weather, traffic, visibility, haul route, or other work in progress; and
- watch your speed at all times. Set the parking brakes, place all controls in off or shutdown, and turn the wheels into the hill or use chocks when leaving the truck cab for any reason. When using wheel chocks, always place them on the driver's entry side. This will remind you to pick up the chocks before returning to the cab.

5.11.5.3 VISIBILITY

All operators should be totally aware of the restricted visibility which occurs from haul trucks. Below is a typical haulage truck visibility diagram.

Figure 5.41 Haul truck visibility restrictions



5.11.5.4 DUMPING

All operators should:

- follow the dumping procedures used at mine;
- check the dump area: cracks along its top edge, overly steep slopes, sunken areas and soft areas. The weight of the truck near an unstable edge can be enough for it to break loose and cause the truck to go over the edge;
- watch the weather. Rain, melting snow and freezing and thawing can weaken the dump area and lead to unstable slopes;
- make sure the dumping area is level or slopes slightly upward toward the edge. This will help control the truck when backing up;
- be sure the dump area is adequately lighted;
- cross windrows at an angle, one wheel first to prevent jarring the load, the truck and yourself;
- approach the dump site from left to right (when possible);
- keep at least one truck width away from the berm;
- make sure the dumping berm is in place. Contact the appropriate supervisor if it is not.

When backing up, stop at least one truck-length away from the dumping berm to avoid overloading the dump edge;

- keep at least two truck widths apart if more than one truck is dumping at a time to help prevent collisions or weakening the dump area;
- back up perpendicular or at a slight angle to the dumping berm so the truck's left rear tyre approaches the berm first. This can help keep the truck from penetrating or going through the berm;
- do not expect the berms or bumper blocks to stop the truck;
- back up slowly and come to a gradual stop at the dump point. This prevents overloading the truck's rear axle or causing the edge of the dump area to break away;
- stop just before the truck reaches the berm or bumper blocks;
- shift the truck into neutral when dumping;
- set appropriate brakes when dumping;
- do not use the retarder brake when dumping;
- make sure the truck is clear of overhead powerlines, people and other equipment before raising the truck bed and dumping the load – contact kills!;
- watch for material stuck in the truck bed. It can make the machine unstable;
- be sure the truck is clear of overhead powerlines, people and other equipment before lowering the truck bed; and
- completely lower the truck bed before leaving the dump area. For better vision turn left (whenever possible) when leaving the dump area.

Stockpiles

Stockpiles are especially hazardous when there are activities at the top edge and the toe. Loading out material at the toe causes sloughing which can cover the loader. It can also oversteepen the slope, making the top edge of the pile unstable for trucks which may be dumping at the top.

- Pay attention to the stockpile and its surroundings;
- Always dump in an area where there are no activities immediately;
- Never dump over an oversteepened slope; and
- Dump at least one truck-length away from the edge.

Waste dumps

Waste dumps can be soft, weak, loose and have steep slopes which may cause instability. Of special concern are dumps that are constructed by trucks dumping over the dump edge to form angle of repose slopes.

- Check the dump edge for sloughs and cracks along the edge before approaching the dump.
- Look for mid-axle dumping berms.
- Too much moisture can weaken the pile, so be careful!

Bins and hoppers

Watch for overhead obstructions chutes, gratings, stopping blocks and guide rails. Look over the area before pulling in to dump to check for any damage to any of these features. Dumping at these areas is very repetitive and special efforts are needed to maintain driver awareness.

5.11.5.5 HAULAGE ROADS

Haulage road conditions can play a big part in the safety of a mining operation. Poor road conditions can make it much more difficult to operate equipment safely.

Hazardous conditions include: grades that are too steep; roadways that are too narrow; inadequate traffic control signs; unstable slopes; poor drainage; problems due to weather conditions; inadequate sight distance at the crest of hills and around curves; and lack of adequate berms or guardrails.

These conditions can lead to loss of control of the truck, collisions with other vehicles, runaway trucks and trucks going off the roadway and overturning.

Important considerations for keeping haul roads safe include:

- roadways wide enough to allow the safe passage of the largest equipment that uses the haul road surface;
- the width of the roadway should be:
  - one truck operating – at least twice the width of the truck; or

  - two trucks operating – at least three times the width of one truck;
- the curvature of the road should be related to the turning characteristics of the truck;
- the roadway should be kept damp to settle the dust but should not be so wet as to cause the truck to lose traction when turning or braking;
- the manager should determine at what maximum speed trucks can operate safely on any particular haulage way underground. The dimensions of main haulage ways should be sufficient to provide a safe passageway for the largest truck or loader that is to operate in the haulage way. A minimum clearance of 1.8 metres horizontal and 600 mm vertical should be considered;
- the roadway should be regularly watered and graded to ensure that it is maintained in a good and safe condition;
- adequate berms or guardrails on elevated roadways where there is a danger of a vehicle running off the road. Berms higher than axle-height should be used in more critical areas such as steep grades and sharp curves;
- haul road grades compatible with the capabilities of the equipment using them. Steep grades have been a factor in haulage accidents;
- unless designed for specific tasks, and taking into account the nature of the travel way and braking system, ordinary trackless wheeled vehicles should be limited to gradients:
  - on down hauls on the surface, a gradient of 1 in 10;
  - on up hauls on the surface, a gradient of 1 in 5; or
  - on underground roadways, a gradient of 1 in 6;
- traffic signs to control traffic flow and to provide vehicle operators with information (such as speed limits, grades and traffic patterns) to help ensure safe operation;
- roadways that are inspected, maintained and repaired regularly. Special checks should be made after changes in weather conditions;
- drivers trained on any change in traffic patterns. It is especially important that new operators be instructed on the capabilities of the equipment they are operating, and any special driving precautions that should be taken on the mine's haul roads;
- vehicle operators should be alert to, and anticipate, changes in road conditions, especially with changes in the weather;
- operators should promptly inform company officials of any unusual or potentially dangerous road conditions. Examples would be:
  - poorly drained areas;
  - soft shoulders;
  - washed out areas, ruts and gullies;
  - boulders or debris on the roadway;
  - ice and snow drifts;
  - cracks or unstable slopes above or below the roadway; or
  - excessive dust.

5.11.6 ROPS AND FOPS

Falling-Object Protective Structure (FOPS) means a system of structural members arranged to reduce the possibility of crushing of the operator if a rock or other object falls on the cabin, or in the case of passengers, protection for those people.

Roll-Over Protective Structure (ROPS) means a system of structural members arranged to reduce the possibility of the crushing of the operator if the machine overturns.

- a FOPS should be fitted to items of equipment and machinery such as Load-Haul-Dump (LHD) units, dump trucks, rollers, dozers, and rubber-tyred drilling rigs and personnel carriers, used principally in the underground workings of a mine.
- a ROPS should be fitted to items of equipment and machinery such as wheeled prime-movers, wheeled off highway dump trucks, rubber-tyred and crawler mounted dozers, scrapers, graders, loaders and tractors (with or without attachment) used mainly on the surface workings at any mine or quarry.
- a ROPS should be fitted to items of equipment and machinery such as small agricultural wheeled tractors.

- a FOPS or ROPS should conform with the requirements of AS 2294, except for small agricultural wheeled tractors, which should conform with AS 1636 or any equivalent.

If it is considered impracticable to meet standards requirements, the manager will need to determine alternative effective safety precautions.

If a FOPS or ROPS suffers discernible deformation as a result of an accident, the equipment or machine should not be used until the structure has been replaced or restored to a condition which, in the written certified opinion of the manufacturer, the manufacturer's agent or a qualified mechanical or structural engineer, is at least equal in strength to the structure as originally fitted.

Note: Seat belts where fitted should be worn to provide optimum safety for haulpack truck operators in the event of a truck fitted with ROPS rolling over.

REFERENCE DOCUMENTS

Haulage Safety Attitude, Developed By Surface Haulage Safety Task Force in Cooperation With Mine Safety and Health Administration, US Department of Labor.

Mobile Cranes and Overhead Powerlines, Queensland Division of Workplace Health and Safety.

Surface Mine, Powered Truck Haulage Dumping Procedures, Developed By Surface haulage Safety Task Force in Cooperation With Mine Safety and Health Administration, US Department of Labor.

Site Working Procedures, Abax Contracting P/L.

Haulage Roads, MSHA Job Safety Tips, US Department of Labor.

Macmahon – Employee Safety Handbook, Macmahon Holdings Ltd.

AS 2294 – Earth Moving Machinery – Protective structures.

5.11.7 ELEVATING WORK PLATFORM VEHICLES (CHERRY PICKERS)

5.11.7.1 GENERAL

Elevating work platforms are used to raise persons, tools and materials above ground level to perform work.

5.11.7.2 SAFETY HARNESSES

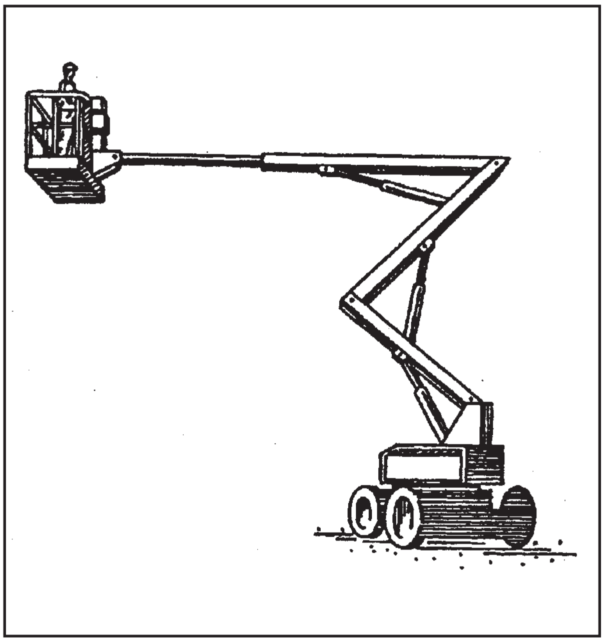
Safety harness should be worn and properly secured at all times by people when aloft. There should be an attachment anchorage point in the basket appropriate for the harness.

5.11.7.3 CONTROLLED DESCENT DEVICES

An elevating work platform should be fitted with a controlled descent device suitable for use for escape from the platform in the case of a power loss.

Personnel working from an elevating work platform should be instructed in the correct use of the controlled descent device.

Figure 5.42 Elevating work platform – boom type



5.11.7.4 SAFE WORKING LOAD

The safe working load as marked on the basket should be observed at all times.

5.11.7.5 CLEANING

Equipment should be maintained in a clean condition and the walkways on the vehicle tray are to be kept tidy and free of obstructions at all times.

5.11.7.6 DAILY INSPECTION

Operators of an elevated work platform should make a daily inspection of the whole unit and give particular attention to following:

- all main components for distortion, dents, damage, burns or cracks. In particular, when a fibreglass insert is incorporated in the upper boom it should be closely examined for cracks or damage;
- the inflation pressure and condition of all tyres;
- the fuel and oil levels of all applicable components;
- all hydraulic hoses;
- evidence of excessive oil leaks from the equipment;
- the basket for damage and cleanliness;
- the operation of all controls through their maximum working range;
- the basket levelling, steel wire cables and levelling linkages for wear;
- the operating speed of the basket in all directions of travel;
- the condition of the safety harness and the anchorage point to which it will be attached;
- the operation of the parking brake, especially where it is automatically operated by an interlock with the boom;
- the operation of the hydraulic accumulator unit and/or the emergency, battery-operated hydraulic pump;
- the condition of all accessories, that is, slewing crank handle, emergency pump switch and key, wheel chocks, road marker cones, warning notices, flashing lights and spot lights; and
- all defects should be repaired to the manufacturer's specifications by a competent person or verified as being within acceptable limits before the elevated work platform is operated at a work site.

5.11.7.7 TRAVEL PROCEDURE

Elevated work platform drivers must:

- ensure that the boom is in the travelling position and firmly resting in the travelling support frame with basket and boom retainers affixed before the vehicle is moved;
- ensure that, where the vehicle is fitted with outriggers or spring lockouts, the outriggers are retracted and pinned or that the spring lockouts are disengaged before the vehicle is moved;
- be constantly aware that equipment on the vehicle is higher than the cabin. The height of the elevated work platform is displayed on a notice in the cabin;
- be aware that, for particular elevated work platform units, the equipment on the vehicle overhangs the front and/or rear of the vehicle. Care should be taken to allow for these overhangs, when manoeuvring close to buildings, vehicles or other obstructions; and
- not travel with the basket in the elevated position;

Vehicles are permitted to travel short distances with a person in the basket, provided that:

- the basket is in the travelling position in the travelling support frame;
- the person is wearing an approved safety harness correctly attached to an anchorage point in the basket;
- the road speed of the vehicle is limited to 5 km/h (walking pace) and the driver takes special care, and
- the travelling is made on ground level.

Reverse only to position the vehicle at the work site, not to move between work sites. Whenever possible reverse the vehicle under the guidance of an observer, so positioned to permit an unobstructed view of both the intended path of the vehicle and the driver.

Consider the location of hazards associated with the surrounding conditions at the work site. Ditches, manholes, culverts and the like should always be regarded as possible hazards.

5.11.7.8 SETTING UP AT THE WORK SITE

Persons required to operate elevated work platforms in the course of their duties should, before going aloft, ensure that:

- the position of the vehicle is satisfactory for the task to be undertaken;
- wheels, and outriggers where fitted, are on a sound footing. Avoid soft ground, side slope or other conditions that may affect the stability of the unit. Elevated work platform units should not be used where the vehicle slope in any direction exceeds 5 degrees, or the slope indicator, if fitted, is outside the safe region;
- the parking brake has been firmly applied;
- for an elevated work platform unit without outriggers, one pair of wheels has been chocked. For elevated work platform units with outriggers, the front wheels have been chocked. Heavy timber baulks may be required beneath outrigger pads where they may damage a surface or if the surface is soft or uneven;
- spring lockouts, where provided, have been fully engaged;
- the area is clear of personnel before lowering the outriggers; and
- all persons are clear of the path of the basket and the booms while the basket is being lowered to the entry position.

5.11.7.9 RESCUE PROCEDURE

All elevated work platform operators should be adequately trained in rescue procedures for the type of elevated work platform prior to operation.

REFERENCE DOCUMENTS

Australian Standards

AS 2210 Industrial Safety Belts and Harnesses.

AS/NZS 1891 Industrial Fall-Arrest Systems and Devices.

5.12 MOBILE CRANES

5.12.1 EARTHMOVING MACHINERY USED AS CRANES

5.12.1.1 GENERAL

Lifting loads by earthmoving machinery in lieu of a crane should always be treated as an occasional practice.

Lifting loads by earthmoving machinery should not be applied in situations where access is difficult, either due to uneven ground conditions, or where the space to manoeuvre the machine bucket is difficult or dangerous. Such lifting situations are best undertaken by a mobile crane.

Written concession/approval should be sought from the manufacturer or his agent before any conversion of the machine for use as a crane takes place.

5.12.1.2 COMPETENT PERSONS

The general manager should ensure that the operation of the machine as a crane is under the supervision of an operator who has expertise in the following areas:

- estimating loads;
- estimating centre of gravity of a load;
- methods of slinging of loads by means of wire rope slings and chains;
- correct selection of wire ropes, chains, shackles, pins, eyebolts;
- careful planning of the lift before commencement;
- recognised signal system; and
- periodic inspection of bucket for cracks at points of high stress.

5.12.1.3 DESIGN OF ATTACHMENTS

The design of a structure, other than those specifically designed for use on a machine by the manufacturer, should be properly designed by a competent engineer using the Australian Standards.

The hydraulic circuit of the lifting apparatus should be fitted with a valve or valves which should prevent any sudden drop of a suspended load in the event of a hydraulic hose failure.

Loads suspended from bucket via a lifting lug.

The maximum allowed rated load or safe working load (SWL) should not exceed 70% of the machine manufacturer's rated bucket load, that is, SWL = 0.7 x machine bucket rated load. A test load based on 125% of the allowed rated load (or SWL) should be suspended from the lifting lug and the machine bucket and arms extended fully through the working arc to prove the load and the stability of the vehicle.

Proof load = SWL x 125%.

Loads suspended from a fly jib fixed to the bucket

When designing a jib-type structure, the forces load on the machine bucket, the lifting arms and linkages which are imposed by the jib and its load should be considered, in addition to the jib design.

AS 1418 Crane Code Part 1 General Requirements should be used for the design of the structure.

A jib design for attachment to a specific machine bucket should not be interchanged with a different machine or bucket unless it has been designed for that purpose.

The safe working load should be clearly marked on the jib. Where necessary, the safe working loads for the different lifting points along the jib should be clearly marked and a load chart for the nominated luffing angles fixed in the vehicle operator's cabin in a position visible to the vehicle operator.

Lifting lug

The lifting lug should be designed to lift the proof load with a factor of safety of 6.

The SWL should be marked near the lug or at some other suitable place on the machine.

The lifting lug should be welded to the bucket in a position that will allow the best means of controlling the load to be lifted, and allow the suspended chain or wire-rope sling a path that does not come in contact with the sharp edge of the bucket. The lifting lug should be fully welded to the bucket, using electrodes that are comparable with the bucket and lug materials. Where necessary a backing plate should be fitted to distribute the forces into the bucket.

A suitably sized shackle should be used to connect the chain or shackle to the lifting lug.

Attaching a load to a bucket by means other than a lifting lug designed for that purpose is not advisable.

5.12.1.4 PRECAUTIONS TO BE TAKEN BY THE VEHICLE OPERATOR

A load should not be lifted if the vehicle operator's visibility is restricted, unless a person is available to signal to the vehicle operator. Such a person must stand well clear of the lifting/lowering manoeuvre.

A vehicle operator should always remain at the controls of the vehicle, until the lifted load has been lowered to a place of rest and made safe.

No person should be underneath the bucket or load during the lifting/lowering manoeuvre.

A load should not be attached to the bucket teeth. Only attach the sling or chain to the lifting lug fitted.

The chain or wire rope sling should not foul against a sharp edge of the bucket, during the lifting/lowering manoeuvre.

The vehicle should always be on level ground.

The load for which the machine has been tested for lifting should not be exceeded.

The operator of the vehicle is responsible for the lift and it is his duty to ensure that the correct lifting equipment is selected and properly used.

The operator of the vehicle should ensure that all the lifting equipment has been inspected for defects and is clearly marked with a safe working load tag.

REFERENCE DOCUMENT

AS 1418 – Crane and Hoist Code

5.12.2 CRANE MAN LIFT BOXES ON MINES

5.12.2.1 GENERAL

The control of risks in the use of man-lift boxes involves considerations of the competence of the crane drivers and persons using the boxes, equipment, work procedure, design and the surrounding environment.

5.12.2.2 COMPETENT PERSONS

The crane driver should be suitably qualified to operate the crane that is to be used.

The person in charge of the man-lift-box should be a person who has been trained in the correct use of the man-lift-box and associated equipment.

5.12.2.3 OPERATIONAL REQUIREMENTS

A man-lift-box may be used with a crane to provide access to equipment at the mine inaccessible by other practical means.

Work from man-lift boxes should only be carried out when weather conditions are such that safe operation of the lift-box can be ensured.

Effective steps should be taken to ensure that the crane, man-lift box and occupants will not come into contact with live electrical apparatus or conductors.

Other loads should not be lifted or supported by the crane while it is supporting a man-lift-box.

Provision should be made to prevent the man-lift box from rotation while suspended from the crane, for example, use a swivel hook.

Ground conditions must be suitable for the support of the crane and outriggers (where applicable) and the safe working load capacity of the crane.

Outriggers are required to be used in conjunction with all mobile cranes.

With mobile cranes, the travelling motion should not be used while men are in the man-lift box. Motions of slewing, lifting and hoisting should be restricted to the minimum necessary and should be carried out at slow speeds with great care.

When man-lift boxes are used with electric overhead travelling cranes, the motion of lifting, hoisting and travel should be restricted to the minimum necessary and should be carried out at slow speeds with great care.

Tools and equipment may be carried in the man-lift-box to its safe lifting capacity.

An effective communication system should be provided between the crane driver and a person in the man-lift box. This person should be deemed to be in charge of the man-lift box while it is attached to the crane.

Note:

- It is preferred that the crane driver be within visual range of the man-lift box at all times.
- Where overhead travelling cranes are operated by radio control, a person should be stationed at the emergency stop station or crane isolator.

5.12.2.4 DESIGN AND CONSTRUCTION REQUIREMENTS

A man-lift box should comply with the following:

- it should be clearly marked with its tare weight, the minimum permitted load and the maximum number of persons to be hoisted;
- the load should not include more than 3 men;
- the factor of safety for the box should be a minimum of 8 to 1 based on ultimate tensile strength and assuming that all the load is spread over 2-legs of the 4-leg bridle;
- a perimeter guard rail with a height above floor level of at least 1.0 metre is required;
- kick-plates are to be provided in accordance with Standards Australia AS1657 – Fixed Platforms, Walkways, Stairways and Ladders: Design, construction and installation;
- if an entry door is provided, then it should open inwards and be provided with a locking device positioned to prevent inadvertent operation;
- all sides are to be fully enclosed with at least heavy duty metallic mesh;
- the sides may be fitted with strategically located slots to allow working through the side of the box;
- the floor is to be suitable non slip material which cannot be seen through, such as chequer plate; and
- appropriate anchoring for personal safety harness should be provided.

The crane-lift box and connections for the suspension bridle should be designed and constructed in accordance with SA AS 4100 – Steel Structures and AS/NZS 1554 – Structural Welding Steel.

The man-lift-box suspension bridle should comply with the following:

- a 4-leg bridle should be used;
- the factor of safety for the bridle and attachments should be a minimum of 8 to 1, based on the ultimate tensile strength and assuming that all the load is spread over 2-legs. A tag with the safe working load marked on it should be fixed to the bridle;
- the legs should be sufficient length to provide a minimum distance of 1 metre between the crane hook and any person standing in the man-lift box. In addition, the length of the bridle leg should not be less than the length of the longest side of the box base; and
- the bridle should be permanently attached to the box.

All cranes used to suspend man-lift boxes should comply with the following requirements:

- the crane and hook should have a safe working load capacity of at least 1.5 tonnes for any operating position of the man-lift box;
- a safety hook or suitable safety chain should be used which prevents accidental displacement of any ring or links which may be attached thereto;
- the crane must be driven to raise and lower the man-lift box. If the crane has free fall capability, it must be latched and locked to prevent its use;

- crane controls when released by the operator should return automatically to neutral and apply the brakes; and
- an effective automatic device to indicate or prevent overwinding should be provided.

Mobile cranes should also comply with the following requirements:

- fly jibs are not permitted unless the fly jib has a capacity of at least 1.5 tonnes, the fly jib is positively locked onto the crane; and
- hydraulic or fluid pressure rams used for hoisting or luffing should have at their fluid outlet connection a device that will prevent the load or jibhead from descending at a speed greater than 0.5m/s should a loss of pressure occur in the fluid connecting line.

5.12.2.5 INSPECTION AND TESTING

The following inspections are required to be carried out immediately prior to each occasion that a man-lift box is to be used:

- all crane hoist wire ropes should be visually examined to ensure that there are no defects that may impair the safe use of the man-lift box;
- all crane controls and overwind protection should be tested to ensure correct operation;
- the man-lift box and attachments should be thoroughly examined to ensure they are adequate for the purpose intended;
- for mobile cranes the ground should be examined to ensure that the crane and outriggers are adequately supported;
- ensure electrical apparatus and overhead wiring are isolated as required; and
- trial operate the man-lift box and crane by moving the box to the work area without any passengers.

REFERENCE DOCUMENTS

NSW Department of Mineral Resources.

MDG 8 – Requirements for Man-Lift-Box

Suspended from a Crane for Use in Coal Mines.

5.12.3 SURFACE MOBILE CRANES AND OVERHEAD POWERLINES

Overhead powerlines pose a considerable risk to the health and safety of workers. Crane drivers are often required to lift loads next to powerlines. The lifting plan and areas where cranes are located are not always adequate. Additional hazards may be caused by using cranes of inadequate capacity, as cranes may be required to operate closer to lines. (Cranes of inadequate capacity should not be used at all – the risk of contact with overhead lines will increase significantly if the crane is not of adequate capacity).

5.12.3.1 HIERARCHY OF CONTROL

The following alternatives are listed in order of decreasing preference.

- Eliminate the hazard by using an alternative plant which can not encroach on specified distances.
- The preferred option is to have the power disconnected and earthed by the power company and ensure documentation is provided. (de-energise and isolate the supply and obtain documentary evidence of the continuing isolation of the power supply before proceeding with the work).
- Set up the crane in a position that eliminates or minimizes the hazard.
- Use a crane with greater lifting capacity to ensure it can be placed in the safest possible location and away from powerlines.
- Mechanically limit the hoisting and slewing or other movement of the crane.
- Provide ground barriers to limit the travel of the crane.
- Use properly maintained non-conducting tag lines to control the load.
- Operate cranes at a safe distance from powerlines, as prescribed by AS 2550.1– Cranes (AS 3007.5 specifies minimum clearances, as does WorkCover).

The workplace health risk assessment should be conducted before any mobile crane or lifting device is used on any site. If any risk of possible contact with powerlines is identified, the preferred option is for lines to be immediately de-energised and earthed.

5.12.3.2 MINIMUM CLEARANCE

Follow minimum clearances specified in AS 2550 Cranes – Safe Use Part 1: General Requirements.

Minimum clearances:

- not exceeding 66 kV (usually on poles): 2.0 metres; and

  kV (usually on towers): 6.0 metres (WorkCover specifies 3 metres clearance to up to 132,000 volts and 6 metres from 132,000 to 330,000 volts:

Unless the contrary intention appears, Close Proximity means:

- in relation to electrical apparatus where the difference in voltage between conductors within the apparatus or to earth does not normally exceed 132 kilovolts – 4 metres; and
- in all other cases – 7 metres.

Notes:

- Allowances for sag and sway must be made. Where the possibility of approaching the distances above exists, consideration should be given to using a safety observer. (Note: WorkCover safety guides make the use of an observer mandatory.)
- Atmospheric conditions can be such that these minimum clearance distances may have to be increased. Such atmospheric conditions could be from rain, snow, sleet, fog, mist, industrial pollution, high humidity, bushfires, etc.

5.12.4 SAG AND SWAY IN OVERHEAD POWERLINES

5.12.4.1 SAG

The sag within a span of powerline can vary greatly during the day. The amount of sag in any span is dependent on:

- span length;
- conductor material;
- conductor tension;
- temperature; and
- the electrical load or electrical faults.

The temperature of the line can vary dramatically within short periods (ie, half an hour), due to the amount of current (electrical load) flowing in the conductors, resulting in large increases of sag. This variation of electrical load is not normally detectable by a person observing the conductor and can result in unsafe clearances from people and structures.

In spans less then 50 metres, variations in sag can be as high as 1 metre for conductors subjected to normal temperature variations.

In longer spans, the variation of sag may be up to 2 metres. The variation of sag on a transmission line, supported by towers, is in the order of 4 metres for the usual 400 metre span although greater sag variations may be experienced in specific instances.

5.12.4.2 SWAY

All overhead powerlines sway. The sway is often caused by wind passing over the line or by objects bumping the line supports or the conductor. Allowance should be made for possible increase in wind speed after work is commenced.

When working to the side of an electric line, additional clearance must be allowed for the amount of sway that can be expected in that span. The amount of sway that is possible is dependent on the sag in the span of the line. An additional distance equivalent to the maximum expected sway in the line should be added to all required clearances.

REFERENCE DOCUMENTS

AS 2550 Cranes – Safe Use.

AS 3007.5, Mobile Cranes – Electrical Hazards and Clearances.

Mobile Cranes and Overhead Powerlines, Queensland Division of Workplace Health and Safety.

NSW WorkCover Safety Guide for moving plant on construction sites.

5.13 MOBILE EQUIPMENT USED UNDERGROUND

5.13.1 DIESEL-POWERED

5.13.1.1 EXHAUST GAS EMISSION CONTROLS (UNDERGROUND ONLY)

Diesel engines of less than 100 kiloWatts (kW) in power should not need to have exhaust conditioners fitted where the raw exhaust from the engine contains less than 1000 parts per million (ppm) of carbon monoxide.

Exhaust conditioners may be needed for engines of greater than 100 kW in power to reduce exhaust emissions to acceptable levels.

A review of the mine's ventilation air requirements should be conducted, taking into account the total power of engines operating in an air flow.

The undiluted exhaust gases of diesel engines underground should not contain more than 1,500 ppm of carbon monoxide and not more than 1,000 ppm of oxides of nitrogen nor 900 ppm of nitric oxide.

The exhaust gases of diesel engines should be sampled and analysed on a regular basis to detect any necessary adjustments or repairs to satisfy air contamination prevention requirements.

Engine exhaust gases should be discharged at a point remote from the engine and the operator. At the exhaust point they should immediately be diluted with the surrounding air.

5.13.1.2 HAZARDS

The operation of diesel engine powered equipment in underground mines needs to be managed to effectively address a range of specific hazards. Predominately diesel engines used underground power free steered vehicles.

The hazards listed below are matters that should be considered prior to the introduction of new vehicles at the mine and which should continue for the full period of operational duty. Hazards include:

Fire

- fuel spill/spray on hot engine components;
- hydraulic oil spraying on hot exhaust systems;
- oil leaking on hot engine components;
- fuel spill during refuelling;
- faulty retarder;
- vehicle driven;
  - Brakes jammed; and
  - Park brake applied.
- cleaning materials:
  - Use of flammable pressurised spray cleaning products; and
  - Cleaning materials left in the engine bay after completion of maintenance.
- electrical:
  - Wiring short circuit;
  - Worn cabling; and
  - Battery earthing cable.

Operator/passenger protection

- fall of roof or sides; and
- vehicle tip/roll over.

Vehicle operation

- vehicle runaway when unattended;
- brake failure;
- loss of control;
- proximity of persons on foot;
- proximity of other vehicles;
- proximity of remote controlled vehicle operator;
- operating speed;
- road surface condition/grade;
- roadway roof and width clearances;
- load being transported; and
- visibility.

The above list of hazards should be used where relevant in determining the hazards that may be present for:

- electrically powered vehicles; and
- fixed diesel engine powered equipment.

5.13.1.3 EQUIPMENT MODIFICATIONS AND REPAIRS

Alterations and modifications to diesel equipment or machinery should not be carried out without completing a risk assessment. The assessment should include consultation with the equipment manufacturer.

Competent people must carry out modifications that have been endorsed, including any design requirements.

All modifications and repairs must be recorded using the operation, documents control procedures.

5.13.1.4 ENGINE COMPARTMENT

The location of services including fuel, hydraulic oil, lubricating oil, other oils, and electric power within the engine compartment should be avoided where ever possible.

Any services required to be in the engine compartment should be effectively shielded from hot spots and suitably protected from wear and the potential for physical damage during maintenance work.

All hydraulic oil, lubricating oil, and other oil circuits within the engine compartment should comply with the following:

- All hoses should be constructed to AS 3791 Hydraulic Hoses and be routed away from hot engine surfaces.
- All pipes and/or hoses should be covered so that oil from any leaks cannot contact any exposed metal surface where the temperature exceeds 200°C under any condition of equipment use. This is to include compressors and all other heat sources. If this is not possible, the exposed metal surface may require shrouding or heat shielding to reduce the temperature to less than 200°C.
- All pipes and or hoses should be covered so that fuel from any leaks cannot contact any exposed metal surface where the temperature exceeds 80°C under any condition of equipment use. This is to include compressors and all other heat sources.
- All fuel systems should be installed so that fuel cannot leak onto any engine component under any conditions of equipment use.
- All engine exhaust systems should be installed so that no flames or glowing particles can be emitted within the engine compartment under any conditions of equipment use.
- All pipes and or hoses should also be routed in a manner which will give them maximum mechanical protection.

A firewall or a barrier should be installed to separate the engine compartment from the hydraulics components.

The firewall or barrier should be designed so that engine ventilation and cooling remains satisfactory.

All engine covers (bonnets) should be made from non-flammable material.

Hydraulic components should be located where main ventilating air will not cause leaking oil to be spread throughout the engine compartment.

5.13.2 LOCOMOTIVES

5.13.2.1 DEFINITIONS

This Part relates to locomotives used primarily below ground as defined.

Locomotive: A vehicle which moves from place to place under its own power and which is intended to pull one or more wagons, trolleys, skips, trucks or cars for the conveyance of ore, mullock or other materials, or persons. A locomotive may travel on rails or independently on tyres of caterpillar type tracks.

Storage battery locomotive: A locomotive in which the motive power is produced by an electric motor supplied with electricity from a battery contained in the locomotive or train.

Electric trolley locomotive: A locomotive in which the motive power is produced by an electric motor supplied with electricity from a trolley wire conductor.

Trolley wire conductor: An overhead electric wire that electricity can be supplied to the locomotive electric motor through a current collector.

Current collector: A device that is connected to the locomotive through which electricity is conveyed from the trolley wire conductor to the locomotive.

Underground rail: A device installed to safely distribute the weight of a locomotive and assist in directional control.

5.13.2.2 DESIGN

Every locomotive should have an ergonomically designed driving position, efficient brake, speed indicator, efficient headlight, flashing light, and fire extinguisher.

5.13.2.3 CONTROLS

Designs of locomotives should prevent the controls being operated unless the driver is seated in the locomotive. The seat should be designed so that the driver has clear vision in the direction of travel when seated.

Control handles should be arranged so that they cannot be removed when motive power is connected to the locomotive.

A deadman switch should be provided or the control handle be so arranged that motive power can only be supplied to the driving wheels of the locomotive when the deadman switch or the control handle is depressed and held in the depressed position by the driver.

Efficient brake

Sufficient braking capacity should be provided on each train so that when applied it causes a retardation rate of at least 0.1 metre/second/second with maximum loading on the train and the train travelling downhill on its steepest operating grade in the mine.

Brakes that can be applied by the driver by direct mechanical action should be provided on each locomotive. These manually applied mechanical action brakes must be capable of retarding the train with its maximum load travelling downhill on its steepest grade in the mine.

Brakes that are applied automatically when motive power to the driving wheels of the locomotive is removed should be provided on each locomotive. These automatically applied brakes should be capable of retarding the train with its maximum load travelling downhill on its steepest operating grade in the mine, at a retardation rate of at least 0.1 metres/second/second.

Speed indicator

A speed indicator should be fitted in each locomotive that can be readily seen by the driver, for locomotives which on level road have a speed of more than 3 metres/second.

Efficient headlight

An efficient headlight which has an effective range of at least 60 metres should be fitted to each locomotive, together with a means for giving an audible warning signal which can be heard distinctly at a distance of 60 metres, with the locomotive in view. (When a locomotive is pushing a rake of trucks, a headlight should be placed on the leading truck.)

Note: Alternatives to pushing a rake of trucks should be considered.

Flashing light

A flashing light that is able to be seen at a distance of at least 60 metres should be attached:

- to the rear of the last vehicle of every train; or
- to the rear of the locomotive when it operates without attached vehicle or vehicles.

Fire extinguisher

A suitable type of portable fire extinguisher must be provided in each locomotive. The extinguisher must be in easy reach of the driver.

5.13.2.4 LOCOMOTIVE BATTERIES

In general, battery connections should be kept tight and clean and battery cells and trays should be kept free from accumulations of moisture and dust.

The batteries of storage battery locomotives should be:

- installed in a part of the locomotive which is strongly constructed of non-flammable material;
- adequately ventilated;
- so arranged that accidental or unauthorised interference is minimised; and
- easily accessible for inspection, repairs and filling with electrolyte.

5.13.2.5 BATTERY CHARGING AND REPAIR STATIONS

Charging locomotive batteries should only be carried out with the battery box covers open to:

- permit hydrogen and any electrolytic spray to be carried away by the ventilating air; and
- permit inspection and cleaning.

Smoking or use of open flames, arc welding or other sparking tools should not be carried on in the charging station while batteries are being charged.

Storage battery charging and repair stations should be:

- constructed of non-flammable material;
- well ventilated with fresh air, which, in order, should first pass the charging apparatus, then the batteries, and go as directly as possible to the upcast airway;
- provided with sufficient fire-fighting equipment for combating outbreaks of fire; and
- equipped so that spillage of water or electrolyte is minimised.

Except in cases of emergency, the repair or inspection of batteries should be carried out only in a charging and repair station and performed by a trained person only.

5.13.2.6 OPERATION AND MAINTENANCE

Drivers

Drivers should:

- not drive a locomotive if it has any defect liable to affect its safe running;
- inspect the condition of each roadway he/she is required to use and should not travel on any roadway which is unsafe;
- report any defect or damage to the driver's supervisor;
- not leave locomotives unattended unless (parking) brakes have been applied and controls have been placed in a neutral position and so arranged to prevent unauthorised interference; and
- be given adequate training in the operation of the locomotive.

An examination procedure which addresses all operational issues should incorporate checks by trained people other than the driver.

Roads should be checked regularly for clearance and freedom from obstructions, and for the state of the track, ventilation, state of the roof and sides, and general safety.

Operating conditions

Conditions of operation should maintain that:

- the maximum load to be hauled by each locomotive and the maximum speed of trains on each road should be determined and made known to operators;
- caution notices should be posted in the roadway whenever special precautions are necessary to ensure the safe running of trains;
- in a conspicuous place in the cab of the locomotive there is a notice setting the maximum speed, load and any other conditions;
- a minimum clearance of about 0.3 metres be maintained between the top of the loaded train and any obstruction;
- where a driver does not have clear visibility in the direction of travel, or is unable to see the roadway or trucks ahead of the locomotive, a person should assist the driver and have visibility in the direction of travel in order to avoid collisions;
- no one other than the driver or shunter should ride on a locomotive or train unless authorised;

- people should only be carried on a train in a properly designed and approved car so that persons apart from the train crew travel only in special vehicles where fixed seats for passengers are provided and provisions for easy boarding and alighting are made;
- people and materials should not travel on the same train unless special arrangements are made; and
- a locomotive should not be used on gradients which exceed a slope of 1 in 12, unless specially designed for those slopes.

5.13.2.7 TROLLEY WIRE INSTALLATIONS

An electric trolley locomotive with an ancillary trolley wire should not be installed or used in or about any mine without precautions being taken to prevent inadvertent contact of the wire.

REFERENCE DOCUMENTS

AS 3751 – Underground Mining – Slope Haulage – Couplings, Drawbars, and Safety Chains.

NSW Department of Mineral Resources.

MDG 2 – Guide for the Construction of Locomotives for Use in Underground Coal Mines.

5.13.3 REMOTE-CONTROLLED LOAD-HAUL-DUMP EQUIPMENT

5.13.3.1 INTRODUCTION

The safe and efficient use of load-haul-dump (LHD) equipment on remote controls is a complex operation. It has to be assumed that the equipment can operate out of control and that a systematic approach is required for its safe use.

Efficient operation and prevention of injury to personnel can be achieved through having an appropriate working environment, adequately engineered equipment, safe operating procedures and practices, adequate maintenance practices and a process for information transfer.

5.13.3.2 MINE DESIGN

Stope Design

Stope and drawpoint design should allow for the provision of safe work locations.

Safe work locations

A safe work location is an area that the LHD equipment cannot physically enter.

Consideration for safe work locations include:

- cuddies in the walls of drawpoints or tramming drives, where the shape of the cuddies will create sufficient shadow zones or be of insufficient size for the LHD unit to enter;
- provided there is sufficient angle between the drawpoint and tramming drive, a suitable “shadow” zone that the LHD cannot turn into on the corner of the drawpoint access and drive;
- in the cases of wide drawpoints, it may be possible to erect or place piles of dirt or concrete blocks to provide safe operating positions; or
- the use of tele-remote equipment which should provide the operator with a safe operating environment.

Plans

Safe work locations should be adequately communicated to operators and supervisors.

5.13.3.3 FACILITIES

Training

Operators should be trained in accordance with the mine’s operating procedures for remote-controlled LHD equipment. Training and accreditation should be specific to the manufacture and model of the equipment used.

A regular review of the operator’s system knowledge should be made.

Lighting

Good lighting in the area of operation is important.

Protection of personnel other than the operator

There should be a suitable means of communication to inform other personnel that a remote LHD is operating and to inform the operator that other personnel have entered the area.

Risk assessment

A risk assessment should be performed for the whole operation of the remote-controlled system, including the transmitter, receiver and the machine to which it is to be fitted.

The transmitter, receiver and the machine to which it is to be fitted should be set up to at least comply with AS 4240 – Remote Controls for Mining Equipment.

Register of equipment

The mine should keep a register of all remote-controlled units that are to be used on the mine. Every remote-controlled unit on the site should have the brand, serial number and frequency recorded on the register.

Transmitter/receiver frequencies

The mine should ensure that no two remote-controlled units on the site have the same frequency.

All remote receivers and transmitters should be clearly marked with individual serial numbers.

Command verification

All remote-controlled equipment should at least comply with AS 4240.

Commissioning

Initial commissioning should be performed in a non-production capacity from a safe work location.

5.13.3.4 SAFE WORK PRACTICES

An appropriate operating manual incorporating both the mine's safe work practices and the manufacturer's operating manual should be developed.

Operators should know if the remote-controlled machine operated normally when it was last used.

From a safe work location, pre-start and regular interval mid-shift checks should be carried out. All functions should be tested, with special reference to emergency stop, transmitter tilt, park and service brake functions.

It is important that the transmitter is turned off prior to the operator approaching the LHD machine to operate it manually.

There should be a means of communicating drawpoint conditions between shifts. Operators need to know the hazards that an open drawpoint represents.

There should be an after-use report that can be communicated to the next operator. If there is any malfunction during the shift the remote set should be withdrawn from service until the fault is found and rectified.

The mine should develop a safe system of work to recover an LHD which has stopped in a stope.

Barriers

In addition to safe work locations, electronic barriers between the operator and machine may be used. At times, it may be necessary for the operator to leave the safe work location to gain a better view of the machine's operation. At no time should the machine to be driven within five metres of any person who is not in a safe work location.

5.13.3.5 MAINTENANCE

The receiver should be disconnected whenever any welding is carried out on the loader.

The mine must keep records of all malfunctions and communicate these malfunctions to the original equipment manufacturer.

Monthly

The transmitter, receiver and loader interface should be inspected by a competent person each month.

The transmitter and receiver should be routinely tested once a month or after having had internal repairs, on a suitable simulator.

Tagging Procedure

There should be a well-understood tagging system that negates the risk of an operator using a remote set that has previously malfunctioned.

The tagging procedure should also allow for relevant information to be passed on to the technician when a unit is in need of repair.

REFERENCE DOCUMENTS

AS/NZS 4240 – Remote Controls for Mining Equipment.

NSW Department of Mineral Resources

MDG 5001 Mine Safety Review Guidelines for Design of Remote Controlled Mining Equipment

MDG 5001a Mine Safety Review Assessment. Document to Accompany Guidelines for Design of Remote Controlled Mining Equipment.

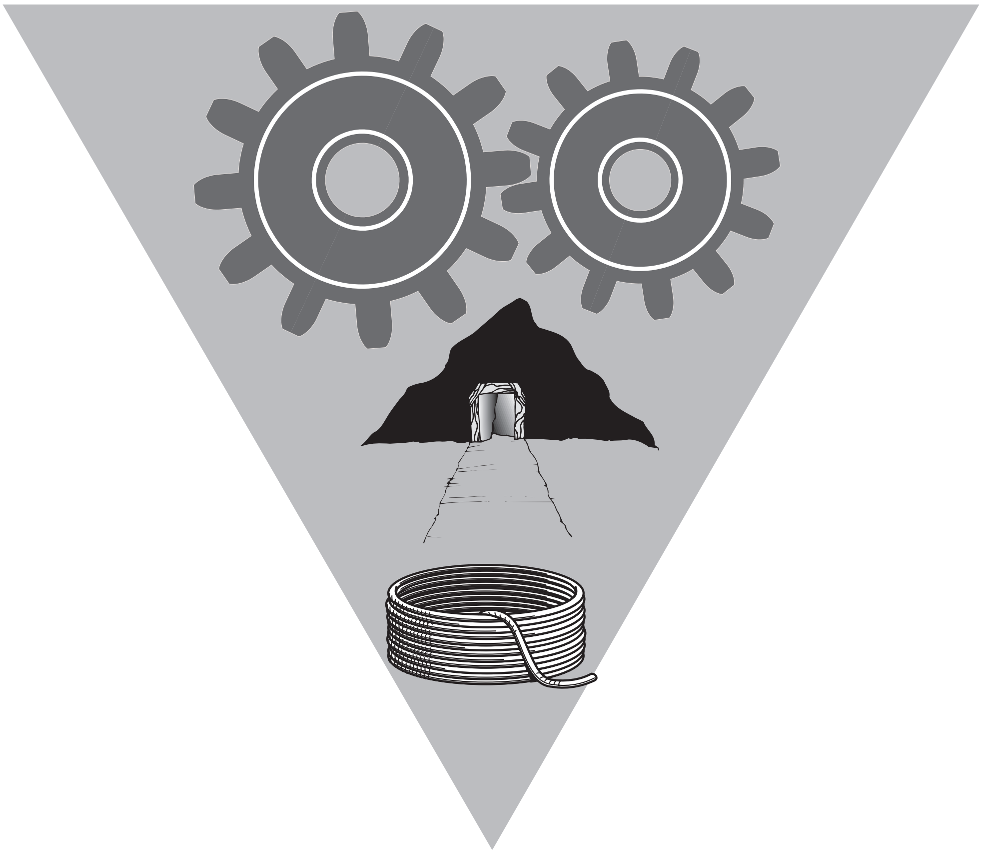
MDG 5002 Mine Safety Review Guidelines for Use of Remote Controlled Mining Equipment.

MDG 5002a Mine Safety Review Assessment Document to Accompany Guidelines for Use of Remote Controlled Mining Equipment.

MDG 5004 A Study of the Risky Position Behaviour of Operators of Remote Controlled Mining Equipment.

PART 6

SHAFTS, WINDING AND HOISTING SYSTEMS



UPDATED 8 NOV 2002

6.1 GENERAL

This part applies to hoisting arrangements where the depth exceeds 30 metres.

Any means of hoisting material from below ground should be designed, installed and maintained to perform safely.

Prior to the installation of any haulage system or any means of transporting persons or material in a shaft of a mine (which exceeds 30 metres in depth), the mine operator should consider:

- a plan or plans showing the location of the shaft or other mine openings together with the general layout of the proposal;
- details including the factors of safety of winding machinery and shaft conveyances;
- details of rope types and sizes and all attachments to be used, including details of duties and factors of safety;
- design details of the headframe and associated facilities and provision to be made against overwinds; and
- a risk assessment of the whole shaft system.

6.2 HEADFRAMES AND WINDERS

Headframes should be designed and constructed to conform with the provisions of AS 3785 Underground Mining–Shaft Equipment.

6.2.1 DRUMS AND SHEAVE WHEELS

Drums and sheave wheels should be designed and manufactured in accordance with AS 3785 Underground Mining–Shaft Equipment.

6.2.2 FENCING, GATES, SHAFT ENTRANCES SUPPORTED

All shaft entrances from the bottom of every shaft to the head sheaves should have proper gates or be properly and securely fenced, railed or covered, and the temporary removal of any fence or cover requires proper precautions to be used to prevent people falling down the shaft.

6.2.3 CHAIRS AT PLATS

Where shaft conveyances are used for materials handling, then at those plats where hauling operations are carried on, chairs or bearers or some other appliances that can safely support the cage should be fixed. Chairs are also known as catches or dogs, or keeps, cf. Keps (refer Section 6.8.8). In the case of chairs or bearers, a lever or handle should be fitted. Where links are fitted, they should have a handle which allows it to be placed in the carrying position or the conveyance raised without possible danger to the person performing the duty, especially catching fingers.

The chairs should be designed so that they cannot be withdrawn while the weight of the shaft conveyance is resting on them to avoid any slack rope tightening suddenly.

6.2.4 GUIDES IN SHAFTS

In larger vertical shafts (for example over 50 metres in depth), guides which allow control of the load should be provided. These should comply with AS 3785.6 Underground Mining–Shaft Equipment: Part 6 Guides and Rubbing Ropes for Conveyances.

6.2.5 OVERWIND PREVENTER TO BE PROVIDED

Devices should be installed at the winder which will remove the power (energy) from the winder and automatically apply the brakes, bringing the winder to rest before any conveyance, counterweight or rope attachment reaches any permanent obstruction to its passage.

6.2.6 OVERWIND CONVEYANCE ARRESTER TO BE PROVIDED

Overwind apparatus should also be installed in the shaft (including the headframe). In the case of drum winding, the overwind protection equipment is in addition to detaching hooks.

6.3 WINDING ENGINES

6.3.1 WINDING ENGINE INDICATORS AND GAUGES REQUIRED

Every winder should be provided with:

- depth and speed indicators driven from the sheave or drum shaft; and
- a dial or gauge to show whether or not power (energy) is available at the engine.

A winder should not be used for winding while a depth or speed indicator is disconnected, except for drum end cuts or other maintenance.

6.3.2 STOP SWITCH OR CONTROL REQUIREMENTS FOR WINDERS

Every winder should be provided with a stop switch or control for the purpose of stopping the winder and that switch or control should be placed within easy reach of an operator.

6.3.3 CONTROL OF WINDING SPEED FOR WINDERS

Every winder should be provided with an effective automatic contrivance in full and fixed engagement with the winder to prevent overspeeding, and:

- the shaft conveyance should not be able to exceed a speed 10% greater than the maximum designed speed;
- the speed of the shaft conveyance should be controlled in any part of the shaft to predetermined limits; and
- the shaft conveyance should not be able to exceed a speed of 2 metres/second when being landed at the lowest entrance to, or at the bottom of, the shaft.

6.3.4 CONTROL SELECTION DEVICE TO BE AVAILABLE TO AUTHORISED PERSONS ONLY

If the winder is controlled by more than one method, the device for selecting any control method should be available only to those authorised by the manager.

6.3.5 ENGINE CAPACITY

Every winding engine should be capable of raising the maximum unbalanced load from the bottom of the shaft or winze.

6.3.6 OVERWIND BACKING-OUT DEVICE UNDER MANUAL CONTROL

Any device provided to permit backing out from an overwind position should respond to manual control only and permit withdrawal from the overwind position only.

6.3.7 CONTROL OF WINDING ACCELERATION AND DECELERATION

A cage or skip in which people are travelling should not be accelerated or decelerated at a rate greater than 1.5 metres/second/second. In cases of an emergency, deceleration of the cage or skip should not be less than 2 metres/second/second or more than 5 metres/second/second

6.3.8 BRAKE

The brake on a winder should comply with the requirements of AS 3785 Underground Mining– Shaft Equipment (dealing with winder braking systems) covering :

- single component design; and
- two brakes/drum.

All engines used for raising or lowering people or hauling materials should be provided with an adequate brake which has the ability to stop the maximum load moving in a downward motion from maximum speed within a reasonable time.

6.3.9 USE OF SERVICE BRAKE

While people are embarking or disembarking from a cage, the service brake should be fully applied.

6.3.10 INTERLOCKING OF SHAFT DOORS AND WINDER CONTROLS REQUIRED

When a winder is being used for carriage of people and its operation is under push-button control, it should be incapable of motion unless all shaft doors and the cage doors in connection with that winder are properly closed. However, provision may be made to open shaft doors when a winder is being used for the carriage of materials and when the conveyance is close to a landing and the winder is under creep control.

6.3.11 USE OF PUSH-BUTTON CONTROLS

Push-button controls located at any landing should only be accessible to a person inside a cage when the cage door is open.

Where push-button control of the winder from within the cage is arranged for, a stop button should be provided which, when operated, will cause the winder to stop.

6.3.12 PRECAUTIONS AGAINST FIRE

Winder rooms should have appropriate fire-extinguishing apparatus.

Where a winder is situated in a headframe or tower of a shaft, effective precautions may be needed to prevent any flammable liquid used in connection with the winder or any apparatus in the headframe or tower from entering the shaft or affecting the brakes.

Where a winder room is situated in a headframe or tower over a shaft, suitable automatic apparatus should be provided to extinguish any fire that may break out.

6.4 WINDING ROPES

6.4.1 WINDING ROPE SPECIFICATIONS AND HISTORY

Winding rope specifications and history should be kept at the mine while the rope is in use.

Before a rope which has previously been in service can be used for any winding purposes, a complete history of the rope and the details of the proposed duty should be acquired and from this it should be determined if the rope can be safely used for that duty.

6.4.2 WINDING ROPES RECORDS

Records should be kept which show:

- name of shaft in which the rope is used;
- compartment of shaft in which the rope is used;
- date when the rope was put on;
- dates of any rope shortening;
- dates of any rope recapping;
- dates of destructive and non-destructive rope testing;
- date when the rope was taken off and the reason for taking it off;
- dates of examination, cleaning and oiling of ropes, and appliances required; and
- date and cause of slack rope accident(s).

Every entry in the record book should be signed by the person responsible.

6.4.3 REQUIREMENTS FOR GUIDE ROPES AND RUBBING ROPES

Guide ropes and rubbing ropes should conform to AS 3785.6 Underground Mining–Shaft Equipment: Part 6 Guides and Rubbing Ropes for Conveyances, and be of locked coil or round rod construction, unless it can be shown that the rope has the required specifications to complete its duty safely.

A guide rope or rubbing rope should not be used before the number, size, length, disposition, method and type of attachment of the rope and the tension force used with the rope has first been carefully examined.

6.4.4 SPLICED ROPES

Winding ropes should not have been spliced. Splicing for rope attachments may be used if it can be shown that the rope will have adequate strength and performance characteristics.

6.4.5 CAPPED ROPES

Rope cappings should be prepared in compliance with AS 3637.3 Underground Mining–Winding Suspension Equipment: Part 3 Rope Cappings.

A capped rope should not be used at any time unless the capping has been made within a period of six months immediately preceding that time and the capping complies with the minimum factor of safety as applied to the rope.

A rope which has been recapped should not be used in any winder unless, on the last occasion on which it was recapped, the rope was cut off at least 150 millimetres (0.15m) away from the mouth of the socket and the wires checked for signs of damage.

6.4.6 FACTORS OF SAFETY OF ROPES AND DISCARD PROVISION

- Factors of safety may be specified in relevant statutory requirements. A rope should be withdrawn from use when:
  - physical inspection shows that the rope appears to be damaged and unsafe for the use to which it is subjected; or
  - the breaking force of the rope by tensile test is less than 90% of the breaking force of that rope when new.

The factor of safety should be calculated by dividing the breaking strength of the rope, as given in the manufacturer's certificate, by the sum of the maximum load to be hoisted, plus the total weight of the rope in the shaft when fully let out.

- Generally, the minimum factor of safety of every guide rope and rubbing rope should be 5.

  Factors of safety for ropes are also discussed in Sections 6.8 Friction Winding and 6.9 Drum Winding.

6.5 SHAFT CONVEYANCES

6.5.1 DESIGN OF CAGES, SKIPS, KIBBLES, STAGES AND COUNTERWEIGHTS

The design and construction of each shaft conveyance should conform with AS 3785.4 Underground Mining–Shaft Equipment: Part 4 Conveyances for Vertical Shafts.

6.5.2 CAGES USED FOR TRANSPORTING PEOPLE IN SHAFTS

Except during shaft-sinking operations, a suitable cage or skip should be provided to raise or lower people in deep (ie more than 50 m) shafts.

The maximum number of people allowed to ride at any one time in a cage or other conveyance should be fixed by the manager, and that number should be kept posted at the brace and each stopping place.

When it is necessary to transport people in ore skips, they should not be raised or lowered in a shaft unless they are standing on the bottom of the skip or on a platform provided for that purpose.

6.5.3 COUPLING LINKS FOR SHAFT CONVEYANCES

Chains, other than a short coupling chain attached to a conveyance, should not be used for shaft conveyances because of their failure mode.

Where coupling links are attached to a shaft conveyance, there should be at least two of those short chains for each coupling. Each chain should be of identical dimensions, and be parallel and vertical.

Each chain should be capable of supporting 10 times the total load.

6.5.4 DESIGN REQUIREMENTS FOR CAGE, SKIP AND COUNTERWEIGHT ATTACHMENTS

Attachments of a rope to a conveyance or counterweight should allow for movement in two planes normal to each other.

Screwed attachment members should not be used in tension.

An item of attachment other than a chain should not be welded.

An open hook should not be used in any hoisting operation.

Items of attachment of a rope to the body of a shaft conveyance or counterweight (including cappel , shackle, link, chain, pin or swivel) and other items of attachment should be manufactured and tested according to AS 3637 Underground Mining–Winding Suspension Equipment.

6.5.5 SHAFT CONVEYANCES–TESTING AFTER REPAIRS, SHAFTWORK AND STOPPAGE

- A shaft conveyance should not be used for raising or lowering people until it has made at least one complete trip up and down the working portion of the shaft following:
  - any stoppage for repairs which may affect the safe running of the winding engine;
  - any repairs to the shaft, shaft conveyance, or counterweight;
  - any stoppage in shaft hoisting exceeding four hours duration; or
  - the occurrence of any seismic event which may affect the guides.

- Items of attachment should not be subjected to any heat treatment other than the initial heat treatment performed by the manufacturer.
- Items of attachment should be discarded on or before completion of a period.

6.5.6 WINDING INSTALLATIONS–INSPECTIONS AND RECORDS

6.5.6.1 INSPECTION PROCEDURE

There should be a systematic and regular inspection procedure for examining:

- the winding rope or ropes while they are travelling at a slow speed and their attachments to the conveyances and counterweights, the brakes, depth indicators, the cages and their safety devices, the head sheaves and every external part of the winder installation;
- the shaft guides and the winding compartments generally, balance ropes while they are travelling at a slow speed, the automatic winding controls and the signalling arrangements generally;
- the structure of the rope for the purpose of discovering the amount of deterioration, and all detaching and suspending hooks and safety devices which should be examined, cleaned and oiled;
- automatic contrivances to prevent overwinding;
- detaching hooks by dismantling, cleaning, gauging for deformation, checking for corrosion and other imperfections, and testing with appropriate crack-detection equipment; and
- the winding engine and auxiliary equipment and every item of attachment, namely in the case of chains, chain links, shackles, pins and pin holes, by measurement for wear; and, in the case of every attachment, by checking for deformation, corrosion or other imperfections, and by testing with approved crack-detection equipment.

6.5.6.2 ROPE INSPECTION

For the purposes of an inspection of a rope:

- the rope should be thoroughly cleaned at all places that are particularly liable to deterioration and at other places (less than 30 metres apart); and
- the person inspecting the ropes should note the condition of the rope externally and as far as possible internally, and the diameter of rope and the lay length of the rope at any point of reduced diameter.

6.5.6.3 DEFECT RECORDS

In every winding engine room, there should be a system of record-keeping. That system should allow a record of any peculiarities, behaviour or effects out of the ordinary in the running of the engine motors, and any defects in any of the winding machinery, that warrant repair or alterations. The system should allow defect records to be reported and a history maintained.

6.5.6.4 COMMUNICATIONS

Where two or more drivers are employed on the same engine in rotation of shifts, a system should be established for communicating any peculiarities of the engine motors or winding machinery between the drivers.

6.6 SIGNALLING

6.6.1 COMMUNICATIONS OR SIGNALLING IN A SHAFT

A shaft in which a cage, skip or kibble is used should be provided with appropriate means of communication or signalling to and from every entrance in use to (and from) the winding engine room.

6.6.2 SIGNALS TO BE RETURNED

In the case of manual winders and signal bells, the winding engine driver should return all signals received prior to carrying out the action required by that signal.

6.6.3 CODE OF SIGNALS TO BE DISPLAYED

The means of communication should be readily understandable, and any code of signals clearly posted in full view of the engine driver. That code should also be displayed at each working plat and the brace.

6.6.4 RESTRICTION ON VOICE COMMUNICATION

Communication by word of mouth should not be made up or down a deep shaft, except through a telephone or by a radio installed for the purpose of such communication.

6.6.5 CODE OF SIGNALS

Where bells are fitted, a code of signals should be considered for the following actions:

- “Stop”when in motion. Signal must be returned by driver. (6 bells are used at Broken Hill mines to clear the cage);
- “Hold Fast” when stationary, a danger signal. Signal to be returned by the driver and conveyance not be moved until release signal (6 bells) has been given;
- lower;
- lower slowly;
- hoist;
- hoist slowly;
- persons on, hoist to surface;
- change to hoist from a different level (throw in or out of gear) – this signal must not be given while the conveyance is in motion. Signal to be returned;
- release conveyance from “Hold Fast” signal (1 long bell). Signal to be returned by driver before a command signal is given;
- fire warning;
- materials or tools on. Drive slowly;
- accident signal to be followed after a pause by the signal for the level where the conveyance is required.

The conveyance is raised or lowered, as required, in accordance with a series of signals tht are unique to each level in the mine.

If safety fuse is used for firing in a shaft or winze-sinking operation, the following should be considered:

- firing warning;
- hoist persons to surface or brace.

Upon receiving the firing warning signal the winder or hoist driver should raise the conveyance by giving the drum of the engine at least one full revolution and then lower it again as a sign that all is ready to hoist. The driver should then stand ready at the engine until the signal “Persons on, hoist to surface” is received and hoisting commences carefully.

When an engine is in use for timbering or repairing a shaft, the signals must be regarded as meaning “Lower cautiously” and “Hoist cautiously”.

6.7 OPERATION OF WINDER

6.7.1 AVAILABILITY OF WINDER OPERATOR

While any person is underground in a mine from which the usual means of exit is by means of a winding engine:

- a trained person should be readily available on the mine to operate in manual mode if necessary;
- a winding engine should be ready for use at all times; and
- someone should be continuously available on the surface to receive any communication from underground.

6.7.2 REMOVAL OF POWER

The source of power (energy) to a winding engine or hoist should not be cut off until the full range of consequences of this action are fully considered.

6.7.3 TRAINING

A person employed as a shaft attendant (platman, skipman, braceman or lander) should have adequate training and be competent for the work.

6.7.4 AGE OF SHAFT ATTENDANT

A person under the age of eighteen years should not be employed as a shaft attendant.

6.7.5 WHIMS, WHIPS AND WINDLASSES

Whims, whips and windlasses should be provided with a stopper, pawl or other reliable holder, and not be used to raise or lower people.

Cages or conveyances suspended on a single rope should not be used for transporting people unless the cage and the shaft is equipped to prevent the free fall of the cage down the shaft in the event of a rope failure.

Everyone working or travelling in a conveyance in a shaft should be protected overhead from falls of rock or material.

6.7.6 PEOPLE TRAVELLING WITH EQUIPMENT

People should not carry or convey any tools, steel, pipes, timber, explosives, vehicles, rails or any other material in a hoisting conveyance with themselves, except where:

- transporting personnel or whereby the safety of personnel is involved;
- transporting rock or materials, whereby the safety of personnel is not involved;
- transporting rock in a shaft used exclusively for that purpose;
- transporting a machine or part of a machine at a speed of less than 2 metres/second;
- balance ropes;
- small tools, gear or materials are in a container, or the equipment is an instrument;
- gear cannot protrude outside the cage;
- any tools or materials are required by persons engaged in repairing a shaft;
- a locomotive driver is travelling with a locomotive, so long as the driver is in the top deck and the locomotive is in the bottom deck or slung beneath the conveyance;
- a shaft attendant travels with explosives; or
- firefighting and/or rescue equipment is conveyed.

No one should ride in a deck or a multi-deck cage while a load other than passengers is in a higher deck.

Except for watching a load slung under a cage, no one should ride in a cage when equipment, long timber, rails or materials of similar form is slung below the cage.

6.7.7 WINDER DRIVER MEDICAL EXAMINATION

A winder should hold a certificate from a legally qualified medical practitioner, stating freedom from deafness, defective vision, epilepsy, disease of the heart and any other infirmity likely to interfere with the efficient discharge of duties or which might cause the person to lose control of the engine.

6.8 FRICTION-WINDING

6.8.1 APPLICATION

This Part applies to every winding engine on which the rope or ropes are driven by friction.

6.8.2 ROPE SAFETY FACTOR

The load applied to any rope or set of winding ropes used for friction winding should not at any time in its working life result in a factor of safety which is less than the appropriate factor related to its application. Minimum factors of safety should be related to the following applications:

Each set of winding ropes used to suspend a cage in any friction-winding apparatus should be determined by specific formula.

6.8.2.1 PERSONNEL TRANSPORTATION

For the purpose of the above, the factor of safety can be defined as

$F1 = 1.0+[4.5(R+C)]/[R(1+0.0051L^{0.5})-13.5]$,

where

F1 = the factor of safety (personnel);

R = the ratio of the diameter of the winding sheave to the diameter of the winding rope;

C = 35 where there is not a nearby deflecting sheave, or 43 where there is a nearby deflecting sheave; and

L = the vertical distance in metres between the level of the top of the highest winding sheave and the level at which the winding ropes meet the suspension gear of the cage when at its lowest position in the shaft.

6.8.2.2 MINERALS OR MATERIALS TRANSPORTATION

For the purposes of the above, the factor of safety can be defined as

F2 = F1 - 1.0, where

F2 = the factor of safety (minerals or materials), and

F1 = the factor of safety (personnel).

6.8.3 TESTING OF FRICTION-WINDER ROPES

Every rope used on a friction winder should be non-destructively tested to determine that the rope has not fallen below its required factor of safety.

6.8.4 PERIOD OF SERVICE OF FRICTION-WINDER ROPES

The period of service of any rope used for friction-winding should be based on the risk assessment of the shaft system.

A rope should be discarded before reaching the periods of service when it shows signs of:

- broken wires in any section equal to the length of one external lay;
- a rapid increase in the rate of stretch over the normal stretch noted during service;
- marked corrosion; or
- any other unsafe condition.

6.8.5 USE OF ROPE DRESSING RESTRICTED

Rope dressing which would in any way increase the danger of slippage on the friction-winder driving sheave should not be used.

6.8.6 MEANS FOR ADJUSTING OR EQUALISING ROPE TENSION

Multiple winding ropes on friction-winders should be attached to the cage, skip or counterweight through apparatus designed to load the ropes as uniformly as practicable. Where the attachments are connected directly to the cage, skip or counterweight, they should be provided with means for adjusting their length and means for indicating unequal tension between ropes.

6.8.7 SHEAVE WHEELS

The driving sheave diameter of a friction-winder should be larger in the case of lock coil rope than of any other rope, and is based on the diameter of the rope.

The coefficient of friction between the rope treads on the driving sheave and the winding ropes must be such that there will be no slip under normal out of balance loading, acceleration and retardation.

The grooves in a multi-grooved sheave should be of substantially the same rope diameter.

6.8.8 KEPS OR CHAIRING DEVICES

In friction winding, keps or chairing devices should be installed in such a way as to prevent fouling of a shaft conveyance.

6.8.9 DETACHING

Detaching appliances for cages, skips or counterweights should not be provided.

6.8.10 DEFLECTION SHEAVES

The diameter of any friction-winder deflecting sheave should not be less than 0.9 times the diameter of the corresponding driving sheave.

The angle of contact of the rope on a deflecting sheave should be sufficient to prevent the rope slipping on the sheave.

6.8.11 SHAFT SUMP

The shaft sump should be kept clear of water, debris or other material to an extent that will prevent the balance ropes from regularly contacting any build-up of water, debris or other material.

6.8.12 SHAFT SUMP INSPECTION

The space between the lowest stopping point and the shaft sump should be equipped with ladders or other suitable means of access to permit proper inspection and maintenance of that part of the shaft and the equipment.

6.8.13 LOADING LIMITATIONS FOR FRICTION-WINDERS

A friction-winder should not be loaded to the extent that would require more than 70% of the available braking torque to stop and hold the driving sheave.

6.8.14 BRAKES

The driving sheave of a friction-winding engine should be provided with two or more brakes, which:

- should be fitted in such a way that they can be applied by a winding engine driver without leaving the operating position;
- when applied by the means provided for use by a winding engine driver, other than by a stop switch, will be capable of producing a braking torque relating to its application;
- under the maximum out-of-balance static torque that will be applied to the winder sheave by the normal loads to be carried by the winder;
- however applied, will produce a braking torque not greater than 70% of that which will cause the winding rope to slip on the driving sheave based on the minimum sliding coefficient of friction between the rope and the sheave;
- however applied, will act directly on the winder drum sheave and be designed, adjusted and maintained to safely stop and hold the cage or skip under all conditions of loading, direction of travel and speed;
- can be applied manually by the winding engine driver, irrespective of the action of any safety device that may act to apply the brakes;
- will be automatically applied if the supply of power (energy) to the winder fails or if the pressure of any fluid or other medium used as a means of controlling the brakes falls below a safe level;
- should be provided with a steel tension member between individual sole plates of brake shoes; and
- is designed in such a way that the failure of any one component will not prevent the winder from being brought safely to rest.

Push-button and automatically controlled friction-winders should also be provided with a suitable device that will automatically apply the brake before it becomes worn sufficiently to affect its safe operation.

Every part of every braking system should have a factor of safety not less than 10, provided that screwed members in tension should have a minimum factor of safety of 15.

6.8.15 SPEED INDICATORS FOR FRICTION-WINDERS

Friction-winders used for raising or lowering people or materials should be provided with a speed indicator driven from a sheave shaft that can be readily seen by a winding engine driver.

6.8.16 SYNCHRONISING DEVICE TO BE PROVIDED

Friction-winders should be provided with a device that will automatically synchronise the depth indicator and the position of the cage of a skip in the shaft. This synchronising adjustment should take place only while the brakes are applied and the winder is stopped.

6.8.17 SLIP AND DIRECTION INDICATORS

Friction-winders should be provided with:

- a device that will indicate slip of the rope relative to the driving sheave and that will stop the winder if a predetermined rate of slip is exceeded; and
- a device for indicating in which direction the driving sheave is turning.

6.9 DRUM-WINDING

6.9.1 APPLICATION

This Part applies to every winding engine on which the rope is wound on to a drum.

6.9.2 ROPES

The drum and winding ropes factors of safety are determined by their usage and operational severity.

The load applied to any rope used for drum-winding should not at any time in its working life result in a factor of safety that is less than the appropriate factor listed below, where

L equals the depth of wind in metres, specified in relation to the relevant proposed use.

Suggested and more commonly used criteria include the following:

PROPOSED USE	MINIMUM FACTOR OF SAFETY
Transporting personnel, or where the safety of personnel is involved	7.5 - 0.001L
Transporting rock or materials, where the safety of men is not involved	5.5 - 0.0003L
Transporting rock in a shaft used exclusively for that purpose	4.5
Transporting a machine or part of a machine at a speed of less than 2 metres/second	5

6.9.3 TESTING

Unless there is a good history developed, ropes used for winding should be recapped at intervals to ensure the integrity of the capping based on risk management controls.

Also at regular intervals, a short length (at least 2 metres) should be cut off the shaft conveyance and counterweight end of the rope and sent to a recognised testing station for destructive testing.

At the end of about the first year after a new rope has been installed, sufficient rope should be cut from the shaft conveyance and counterweight end to enable a breaking and elongation test to be made of the rope which has repeatedly passed over the sheave.

When there are two or more layers of rope wound on to any winding engine drum, the rope should be cropped at the drum at yearly intervals, in a manner to change the position of crossover points on the drum.

Where the drum end of the rope is cropped, it should be reattached and rewound in a way that recognises the characteristics of the rope and the duty under which it works.

6.9.4 FLANGES ON DRUMS

Where drum-winders are used for raising or lowering people, horns or flanges should be fitted and also, if the drum is conical, other appliances which are sufficient to prevent the rope from slipping.

6.9.5 DRUM-WINDER BRAKES

Drums should be provided with one or more brakes which:

- are fitted in such a way that they can be applied by a winder driver without leaving the operating position;
- however applied, act directly on the winder drum, and are designed, adjusted and maintained to safely stop and hold the cage or skip under all conditions of loading, direction of travel and speed;
- can be applied manually by a winding engine driver, irrespective of the action of any safety device that may act to apply the brake or brakes;
- will be automatically applied when the supply of power (energy) to the winder fails or when the pressure of any fluid or other medium used as a means of controlling the brakes falls below a safe level;
- are provided with a steel tension member between individual sole plates of brake shoes; and
- will be automatically applied if a fault occurs in the control circuit of push-button-controlled winders.

Braking systems of drum winders should be designed so that the failure of any one component will not prevent the winder from being brought safely to rest.

Push-button and automatically controlled drum winders should also be provided with a suitable device, which will automatically apply the brake before it becomes worn sufficiently to affect its safe operation.

Every part of the braking system of a drum winder should have a factor of safety not less than 10, provided that screwed members in tension should have a minimum factor of safety of 15.

At the time of installation, the drum, when unclutched, should be capable of supporting a conveyance 2.5 times the normal mass.

6.9.6 DRUM-WINDER–DECLUTCHING

In the case of a winding engine provided with two drums, people should not, except in the case of emergency, be raised, supported or lowered in a conveyance connected with the engine while one of the drums is out of gear.

A single drum-winder or a double drum-winder with one drum loose on the shaft, should not be used for lowering people if the brakes are the only means of halting the descent of the conveyance.

In the case of a double drum-winder with one drum out of gear, that drum should be prevented from revolving whilst out of gear.

6.9.7 CONVEYANCES

- Cage to be supported during repairs
  - When repairs are being made to the clutch or brakes of a winding engine, and where ropes are attached to the drums, the skip or cage should be removed or firmly supported by means other than the rope while the work is in progress.
- Safety appliances on cages
  - Cages in which people are transported should be fitted with a suitable appliance to prevent its sudden fall down the shaft in the event of the rope or winding system failure and every cage on an automatic winder should be fitted with a slackrope detector.
  - The safety appliances on cages should be tested regularly by a drop test.
- Testing of cages
  - New or repaired cages should not be used in a shaft until proof-loaded with twice the mass normally hoisted.

6.10 SHAFT-SINKING

6.10.1 USE OF A CRANE

A crane is a method used to hoist the broken rock from the initial surface excavation, and from the shaft, to a depth of about 50 metres, except when the shaft perimeter has been traversed by any structure which could be an obstruction to the free passage of the conveyance.

The load lifted by a crane in shaft-sinking operations should not exceed 50% of the normal safe working load permitted.

The crane should be of a slewing type and be located in a fixed position during the hoisting and dumping operations.

An appropriate method of signalling should be installed to communicate with the driver.

People may be hoisted from a shaft excavation by means of a crane, provided that:

- the person travels in a kibble or similar conveyance and uses a safety belt when more than one third of their body is outside the conveyance; and
- the person is within sight of another who can communicate signals to the crane driver.

People should not remain in the shaft excavation while the crane is being used to hoist broken rock by means of a grab.

A crane may not be used to move a sinking scaffold unless safety chains are kept in position on the scaffold until it has been raised or lowered by more than two metres. This will prevent jerking.

6.10.2 MEANS OF TRAVEL PROVIDED IN SHAFT-SINKING

Where a permanent ladderway is to be installed in a shaft, it should be installed from the surface to the bottom of a shaft during sinking operations where a sinking stage is not used.

Where a sinking stage is used, a chain ladder should be provided for travel from the shaft bottom to the stage.

6.10.3 SHAFT DOORS

During shaft-sinking operations, when people are in the shaft, spillage should not be allowed to fall down the shaft during dumping operations. Common practice is for a door or doors covering the sinking compartment to be provided at the collar of the shaft while sinking operations are in progress. Doors should be kept closed when people, tools or materials are being loaded or unloaded from the kibble or skip at the collar of the shaft, or when the kibble or skip is being dumped.

6.10.4 WARNING OF OBSTRUCTION IN SHAFT

The position of any doors or other shaft protective devices, which when moved into the haulage way or travel area of a shaft, would interfere with the free passage of the conveyance, should be indicated to a winder driver.

6.10.5 SHAFT-SINKING PENTHOUSE

When a shaft is to be sunk below any level that is being worked, it should be protected below that level by a securely constructed penthouse.

6.10.6 SHAFT TIMBER TO HAVE BEARER SETS

Where timber is used to line a shaft, bearer sets or other means of support should be provided between working levels or at distances not greater than about 60 metres apart.

6.10.7 SIGNALS FOR SHAFT-SINKING

Special signals may be used in a shaft-sinking operation, but they should be made known to all people who may use the signals.

Figure 6.1 Box timbering in shafts

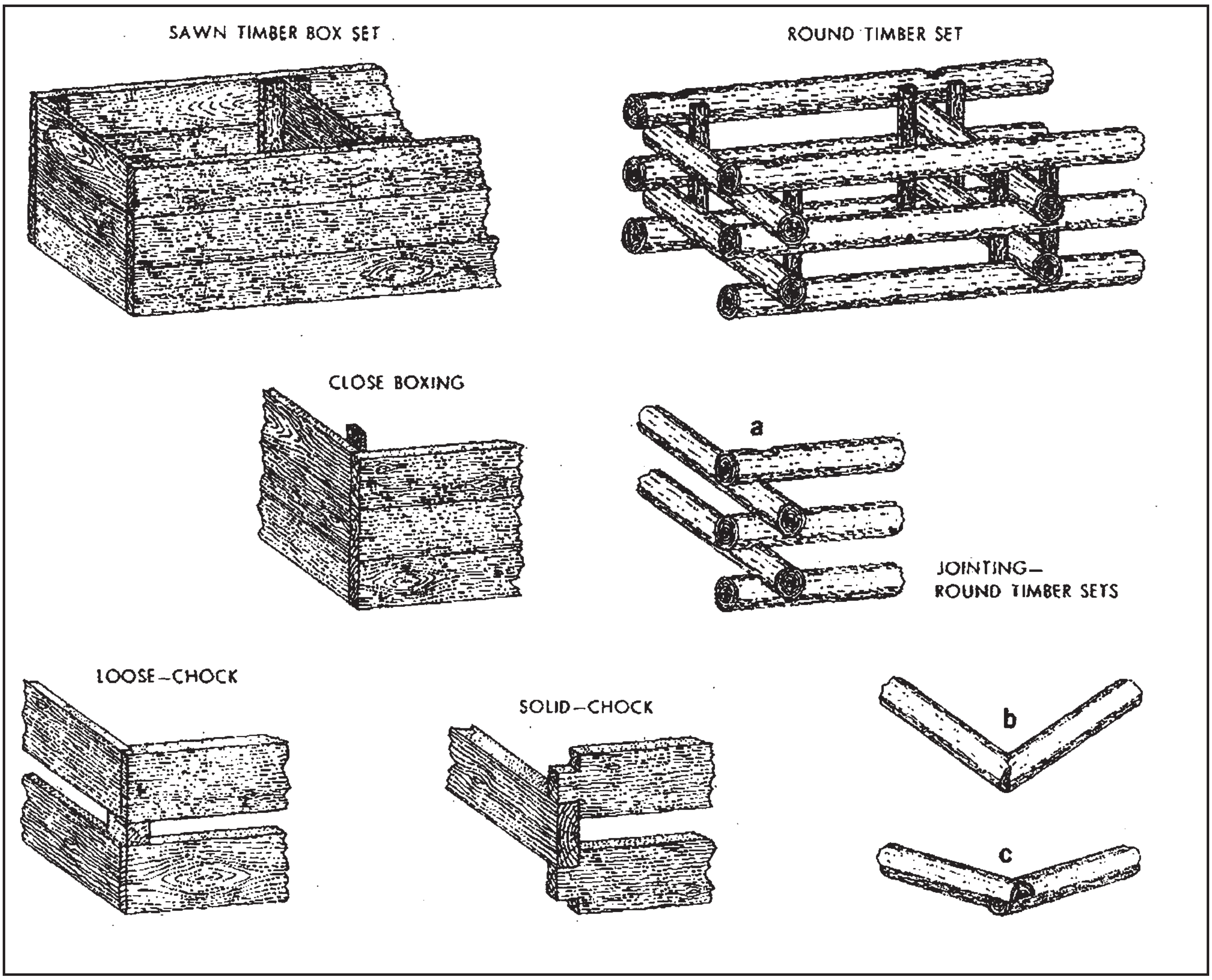


Figure 6.2 Shaft collar set with dividers

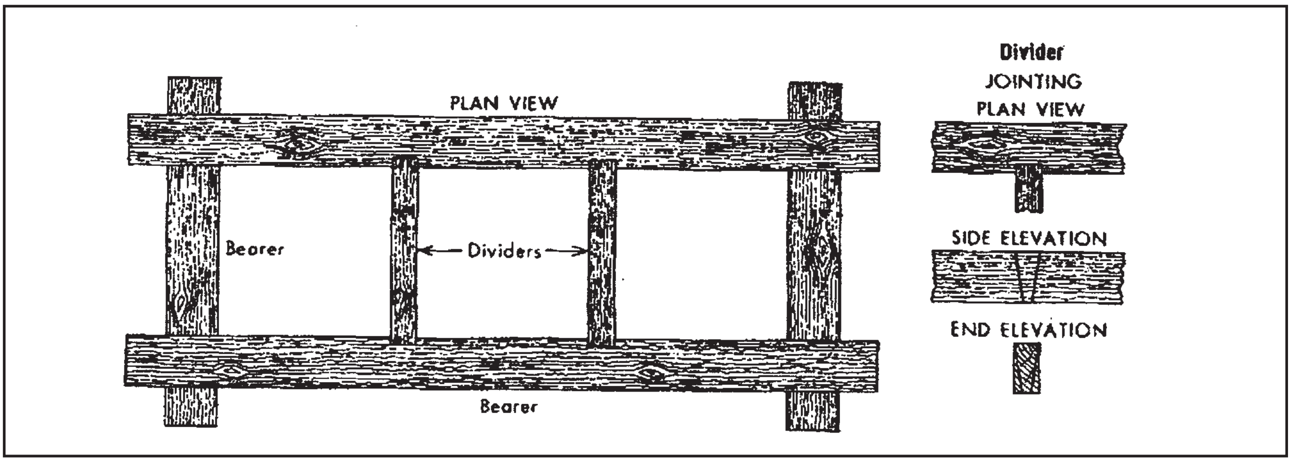


Figure 6.3 Shaft plumbing, using corner plates

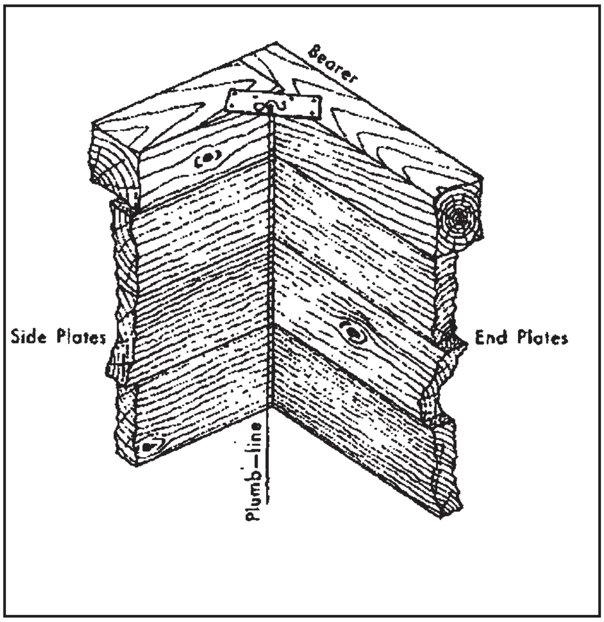
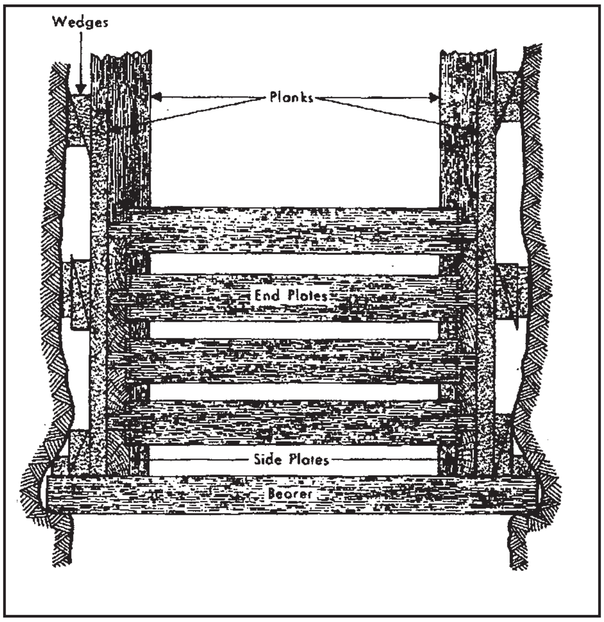


Figure 6.4 Shaft bearers, also showing wedging and blocking



6.10.8 ROPES

- The minimum factors of safety used in shaft-sinking operations will depend on the application that is:
  - for ropes hoisting people and materials or rock, (7.5 - 0.001L) where L equals the depth of wind in metres; and
  - for ropes raising and lowering a sinking stage, 6.
- A stage rope generally does not need to be recapped.
- The provisions relating to the history, inspection, maintenance and discarding of winding ropes and attachments should apply to winding ropes used in shaft-sinking operations, except that for winding ropes used to support a shaft-sinking stage:
  - a regular (eg monthly) inspection should check for the incidence of broken wires, any obvious reduction in diameter, marked corrosion, and any other unsafe condition;
  - there should be a regular (eg monthly) rope lubrication with a suitable lubricating compound; and
  - the period of service of any such rope should not exceed two years without a thorough examination.

6.10.9 SHAFT-SINKING KIBBLE AND ATTACHMENTS

When the depth of a shaft exceeds about 50 metres, a suitable kibble and monkey arrangement or other appropriate conveyance should be used for haulage purpose in the shaft.

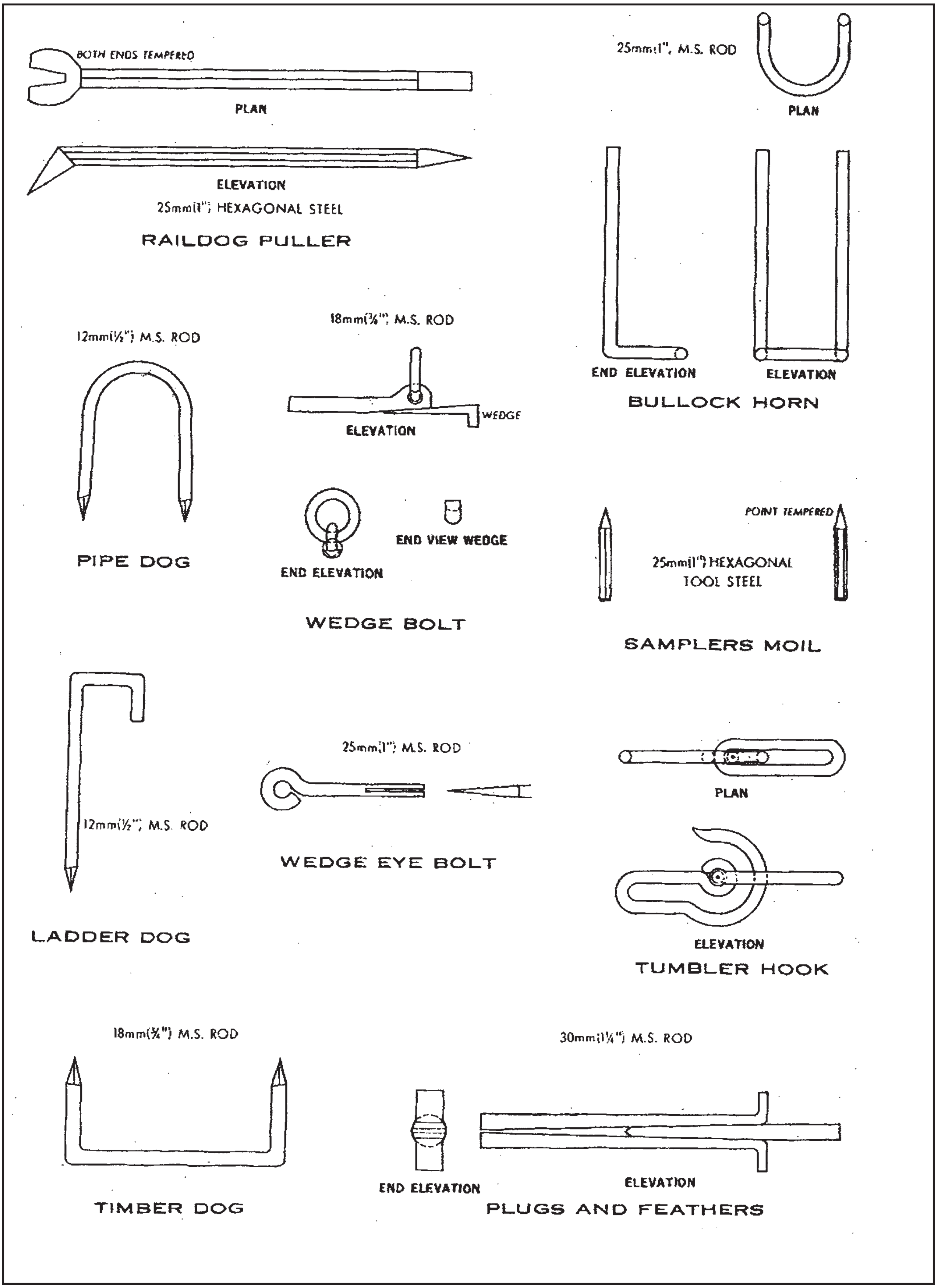
A sinking kibble or "monkey" should be provided with an overhead cover for protection of persons from falling objects.

A kibble used in a shaft-sinking operation should be of robust construction and be of a shape which would prevent it from catching on any obstruction during its travel in the shaft.

A kibble may be suspended by a bridle or by means of at least three chains, equally spaced around the perimeter of the kibble top.

Chains used for the suspensions of such a kibble should be of identical dimensions and strength and be of sufficient length to ensure that the included angle at the apex of the suspension of any two chains is not greater than 60°.

Figure 6.5 Fitting and fixing



A kibble or skip in shaft-sinking should not be filled with loose rock above its brim nor hoisted away whilst any material adheres to its outside surface.

6.10.10 SHAFT-SINKING METHOD OF FIRING

Firing in shaft-sinking operations should be initiated by means of electricity, and initiated from the surface or other safe location.

When a deep shaft is being sunk in rock formation and it is not practicable to clear everyone from the shaft before initiating the blast, short cross-drives or refuges should be formed at regular intervals.

Refuges should always be kept clear, and nothing done to restrict their access.

6.10.11 SHAFT-SINKING STAGES

Stages used in shaft sinking/shaft maintenance should be securely fenced to prevent people from falling, and be designed to eliminate the possibility of the stage overturning. Even so, it may be necessary for those on the stage while it is being moved to wear safety belts in the event that a rope breaks or the stage moves unevenly.

REFERENCE DOCUMENTS

Australian Standards

AS 3637 Underground Mining–Winding Suspension Equipment

AS 3785 Underground Mining–Shaft Equipment

NSW Department of Mineral Resources' Division of Mine Safety and Environment–Safety Operations Guidelines

MDG 12–Friction Winder Design

MDG 26–Mine Winder Ropes

MDG 33–Drum Winders

PART 7

OTHER REFERENCES

PART 7: OTHER REFERENCES

7.1 GLOSSARY OF TERMS

Abutment	The areas of unmined rock at the edges of a stoping block that carry many large regional loads. Generally a zone of support for ground arching.
Accident	An event which results in, or is likely to result, in injury, illness or damage (this also includes dangerous occurrence and near miss).
Acclimatisation	The physiological adaptation of the human body to increased heat stress resulting in increased tolerance to that stress.
Air cooling power (ACP)	Takes into account the dry bulb and wet bulb temperatures, wind speed, and other factors such as radiant heat, essentially the ability of air to cool the body. This ability is strongly influenced by the clothing and PPE worn, the heavier the clothing, the more difficult it is for air to cool the body. (Brake, Donahue & Bates 1998.)
Arching	The transfer of rock stress or load from an active mining area, eg stope back, to a more stable area or abutment; this may result in the release of rock blocks.
Audit	Systematic examination against defined criteria to determine whether activities have been carried out in line with planned arrangements, whether the arrangements have been implemented effectively, and whether these arrangements are suitable to achieve stated aims and objectives.
Batter slope	The sections of rock mass between catch berms within pit walls - usually excavated to a specific inclination/angle from the horizontal.
Bedding plane slip	Relative movement or slip of continuous bedding planes or foliation planes in response to large areas of stope wall moving into a void, filled or unfilled. May be observed in areas where extensive stoping has been carried out in a well-bedded rock mass.
Bedding planes	Planes of weakness in the rock that usually occur at the interface of parallel beds or laminae of material within the rock mass.
Body Core Temperature	The temperatur of the deep core tissues in the body.
Buttress	A body of material either left unmined or placed against a section of the pit wall to prevent continued movement or propagation of wall failure.
Cable bolts	One or more steel reinforcing strands placed in a hole drilled in rock, with cement or other grout pumped into the hole over the full length of the cable. A steel face-plate, in contact with the excavation perimeter, is usually attached to the cable by a barrel and wedge anchor. The cable(s) may be tensioned or untensioned. The steel rope strand may be plain strand or modified to improve the load transfer between the grout and the steel strand.

Catch berm	The width of lateral ground (bench) separating successive batter slopes. The purpose of the catch berm is to both reduce the overall angle of the pit walls, and to catch any loose material or local scale rock mass failures, thus reducing the risk of injury to the workforce at the base of the pit.
Catch fence	A fence constructed either vertically or at an angle to the vertical at the required off-set distance from the toe of a slope. The purpose of the catch fence is to catch any loose material falling from overlying blocky ground, thus reducing the risk to the workforce at the base of the pit walls.
Checklist	A reminder of what you're looking for and a record of what you found.
Communication	Process of passing on information in a variety of ways so that the receiver understands the same message as the transmitter intended to give.
Competency	Ability to apply appropriate skills and knowledge for the effective and efficient completion of a job or task in a variety of situations.
Compressive stress	A stress or pressure that tends to push or clamp objects together. The state of stress found in the rock mass before mining occurs. Tends to hold the rock mass together.
Consultation	Seeking information or advice from another person taking into account their feelings, interests and expertise.
Contractor	Provider of services to a person or organisation and who is not a direct employee.
Controlled drilling and blasting	The art of minimising rock damage during blasting. It requires the accurate drilling and placement and initiation of appropriate explosive charges in the perimeter holes to achieve efficient rock breakage with least damage to the remaining rock around an excavation.
Cooling power index (W/m^2)	The measure the velocity of air in watts per square metre.
Core risk program	Managed program developed too effectively eliminate/minimise high-risk activities in a specific workplace.
Destressed zone	A zone of rock around the perimeter of an excavation where the rock stress field has exceeded the strength of the rock mass at some time during its mining history. The rock mass is in a post-peak loading condition and it may be capable of carrying significant loads with low levels of lateral confinement being provided by reinforcement.
Dilution	The contamination of ore with barren wall rock during stoping operations.
Dip	The angle a plane makes with the horizontal.
Discontinuity	Any significant mechanical break or fracture of negligible tensile strength in a rock.

Document control	A system of managing, distributing and controlling documents.
Dowel	An untensioned rock bolt, anchored by full column or point anchor grouting, generally with a face plate in contact with the rock surface.
Dry bulb temperature	Is the temperature of the cur, commonly used and referred to in weather reports (Brake Fulker 1999)
Earthquake	The local shaking, trembling or undulation of the ground surface and the radiated seismic energy caused most commonly by sudden fault slip, volcanic activity or other sudden stress changes in the Earth.
Elastic	Capable of sustaining stress without permanent deformation. Tending to return to its original shape or state when the applied stress is removed.
Elastic limit	See yield point.
Emergency	High risk situations that if not controlled could lead to disaster.
Expert	Those who do the job and have particular experience, skills and knowledge.
Fault	A naturally occurring plane or zone of weakness in the rock along which there has been movement. The amount of movement can vary widely.
Fill	Waste sand or rock, cemented or uncemented in any way, used either for support, to fill stope voids underground, or to provide a working platform or floor.
First aid injury/illness	Work related injury/illness requiring first aid treatment on site only.
Foliation	Alignment of minerals into parallel layers; can be planes of weakness in rocks.
Footwall	The rock below the orebody.
Forms	Documentation used to record and support program and procedures.
Friction rock stabilisers	Steel reinforcing elements, typically a “C” shaped shell, that are forced into holes drilled in the rock. Frictional forces between the side of the hole and the element to generate forces to limit rock movement. The anchorage capacity of the device depends on the anchorage length above any plane of weakness and the frictional interference between the bore-hole wall and the outer surface of the shell. Anchorage capacity is dependent on the hole diameter and the effective anchorage length in solid ground.
Geology	The scientific study of the Earth, the rock of which it is composed, and the changes which it has undergone or is undergoing.
Geological structure	A general term that describes the arrangement of rock formations. Also refers to the folds, joints, faults, foliation, schistosity, bedding planes and other planes of weakness in rock.

Geotechnical engineering	The application of engineering geology, hydrogeology, soil mechanics, rock mechanics and mining seismology to the practical solution of ground control challenges.
Ground control	The ability to predict and influence the behaviour of rock in a mining environment, having due regard for the safety of the workforce and the required serviceability and design life of the openings.
Hanging wall	The rock above the orebody.
Hazard	Source of potential harm.
Health assessments	Medical assessments that focus on determining the ability of a person to perform particular tasks/jobs safely.
Health surveillance	Monitoring of individuals for the purpose of identifying changes in health status that may be due to occupational exposure to a hazard.
Heat illness	Debilitating condition brought on by exposure to heHat stress and including heat rash, heat syncope (heat collapse), heat exhaustion, heat stroke, neurological disorders (ie, nausea, loss of coordination, lethargy, concentration lapses) and dehydration.
Heat strain	The physiological response to heat stress that may or may not result in heat illness.
Heat stress	The sum of environmental and metabolic heat loads on the individual (Lyne, B, 1999).
Heat stress index	The index eligible for selection for use in the management procedure/plan that must be a recognised heat stress mangement index that is technically documented. Some of these indicies include; air cooling power, thermal work load, or Wet bulb globe temperature. Indices include: • Effective Temperature (ET) • Corrected Effective Temperature (CET) • Air Cooling Power (ACP) • Thermal Work Limit (TWL) • Wet Bulb Globe Temperature (WBGT)
Heat stroke	A life threatening advanced state of heat illness characterised by a failure of the body's thermo-regulatory system. In essence, the body sends too much blood to the surface of the skin in an attempt to cool itself down. This blood is diverted away from organs (eg, the heart), which then begin to shut down.
Heat Trigger Level	A trigger level may be singular or a combination of measureable factors that, when reached require and specify the action to be taken. Factors such as air velocity, wet bulb, dry bulb, body core temperature, time or other matter as agreed with the workers involved, may be used.

Illness/disease	Usually results from long or repeated exposure to a hazardous agent eg noise-induced hearing loss, silicosis, dermatitis.
Induced stress	The stress that is due to the presence of an excavation. The induced stress depends on the level of the in-situ stress and the shape of the excavation.
Injury management plan	Activities associated with ensuring an early, safe and durable return to work following workplace injury.
Injury	Usually the result of a single, traumatic event where the harm or hurt is immediately obvious such as a cut, burn and strain.
In-situ stress	The stress or pressure that exists within the rock mass before any mining has altered the stress field.
Inspection	Looking for hazards in the workplace using an ordered, scheduled and documented approach.
Instability	Condition resulting from failure of the intact rock material or geological structure in the rock mass.
Job safety analysis (JSA)	Systematic breakdown of a job into tasks/steps in order to identify hazards, assess risks and select the best control.
Joint	A naturally occurring plane of weakness or break in the rock, along which there has been no visible movement parallel to the plane.
Kinematic analysis	Considers the ability or freedom of objects to move without reference to the forces involved.
Knowledge	Ability to obtain and retain theoretical information relating to a specific subject and being able to research further information.
Loose	Rock that should be removed by scaling to make the workplace safe.
Lost time injury/illness	Work related injury/illness where the affected person is unable to complete the next shift.
Medical/hospital injury/illness	Work related injury/illness requiring medical or hospital treatment.
Metabolic Heat	The total sum of heat generated by the activity of working muscles, and by the activity of other body organs and processes.
Mineral resource	An in-situ mineral occurrence quantified on the basis of geological data and an assumed cut-off grade only. More correctly referred to as an Identified Mineral Resource. Strict professional and technical criteria exist for the determination of mineral resources.
Mining induced seismicity	The occurrence of seismic events in close proximity to mining operations. During and following blast times there is usually a significant increase in the amount of seismic activity in a mine. Mining-induced seismicity is commonly associated with volumes of highly-stressed rock, sudden movement on faults or intact failure of the rock mass.

Notifiable accidents/incidents	Categories of accidents/incidents that must be reported to statutory authorities.
Ore	Part of an ore reserve. See ore reserve.
Ore reserve	That part of a mineral resource that is considered to mineable in terms of tonnage and grade following an appropriately detailed study of the technical and economic criteria and data. The plural may also used to refer to a list of known ore zones that a mine has identified as being suitable for mining at some time in the future. Strict professional and technical criteria exist for the determination of ore reserves.
Overhead Work	Work that is carried out above shoulder height, usually with upper body muscle groups. Overhead work requires considerably more effort that work below shoulder height and therefore generates more stress and more metabolic heat.
Overbreak	The excess rock broken outside the design perimeter of an underground excavation. Overbreak increases the amount of rock to be moved and may reduce mining efficiency. It may also increase the amount of barring down and ground support required.
Pillar	An area of ore left to support the overlying rock or hanging wall. There are temporary pillars recovered at sometime in the future and permanent pillars left in place for the life of the mine.
Plane of weakness	A naturally-occurring crack or break in the rock mass along which movement can occur.
Plastic	Capable of deformation at constant stress once the yield point is exceeded. The ability of a material to undergo permanent deformation without returning to its original shape or failing.
Policy	A general statement of an organisation's (or an operation's) aims, commitment, responsibilities and resources necessary to achieve a particular objective.
PPE	Personal Protective Equipment.
Positive performance indicators	Defined measurable outcomes that provide a tool for comparison to actual performance (may also be referred to as health and safety target).
Procedure	Step-by-step description of what's to be done and by whom.
Program	Grouping of various activities or strategies employed to manage a particular function or hazard.
Principal	Person or organisation that purchases the services provided by contractor.

Ravelling	The gradual failure of the rock mass by rock blocks falling/ sliding from the opening perimeter under the action of gravity, blast vibrations or deterioration of rock strength. A gradual failure process that may go unnoticed. The term unravelling is also used to mean the same thing.
Reinforcement	The use of tensioned rock bolts and cable bolts, placed inside the rock, to apply large stabilising forces to the rock surface or across a joint tending to open. The aim of reinforcement is to develop the inherent strength of the rock and make it self-supporting. Reinforcement is primarily applied internally to the rock mass.
Release of load	Excavation of rock during mining removes or releases the load that the rock was carrying. This allows the rock remaining to expand slightly due to the elastic properties of the rock.
Review	Overview of health and safety performance.
Risk	The combination of the likelihood of a specific unwanted event and the potential consequences if it should occur.
Risk assessment	A process that involves measurement of risk to determine priorities and to enable identification of appropriate level of risk treatment (used also to describe the overall process of risk management).
Risk control	Selection/implementation of strategies to prevent/control hazards.
Risk management process	The overall description of the steps taken to manage risk identify, assess and control.
Risk rating	The category or level or risk assigned following risk assessment (such as high, medium and low).
Rock bolt	A tensioned bar or hollow cylinder, usually steel, that is inserted into a drill hole in the rock and anchored by an expansion shell anchor at one end and a steel face plate and a nut at the other end. The steel face plate is in contact with the rock surface.
Rock mass	The sum total of the rock as it exists in place, taking into account the intact rock material, groundwater, as well as joints, faults and other natural planes of weakness that can divide the rock into interlocking blocks of varying sizes and shapes.
Rock mass strength	Refers to the overall physical and mechanical properties of a large volume of rock which is controlled by the intact rock material properties, groundwater and any joints or other planes of weakness present. One of the least well understood aspects of geotechnical engineering.
Rock mechanics	The scientific study of the mechanical behaviour of rock and rock masses under the influence of force fields.
Rock noise	Sounds emitted by the rock during failure, may be described as cracking, popping, tearing and banging.

Rockburst	The instantaneous failure of rock causing a sudden violent expulsion of rock material at the surface of an excavation. Can be a serious hazard to people and equipment. Sometimes used to describe a seismic disturbance to a surface or underground mine where damage results to the mine structure or equipment.
Safe work procedure (SWP)	Step by step description of the safest and most effective way to carry out a particular job. May also be known as: - Safe Operating Instruction - Task Instruction - Work Instruction - Work Method Statement
Scaling	The art and function of making the ground safe using a scaling bar to locate and remove loose rock from the walls, face and backs of the workplace. Loose or potentially unstable rock is prised off the rock surface with a scaling bar. Also referred to as barring down.
Scaling bar	A solid steel bar with a straight chisel point at one end and a heel and toe chisel point at the other end, used to remove loose potentially unstable rock. Hollow aluminium bars, fitted with steel chisel tips at each end, can provide longer reach in high headings.
Seismic event	Earthquakes or vibrations caused by sudden failure of rock releasing stored strain energy. Not all seismic events produce damage to the mine structure, hence all seismic events are not necessarily rockbursts.
Seismicity	The geographic and historical distribution of earthquakes.
Seismology	The scientific study of earthquakes by the analysis of vibrations transmitted through rock and soil materials. The study includes the dynamic analysis of forces, energy, stress, duration, location, orientation, periodicity and other characteristics.
Shear	A mode of failure where two objects or pieces of rock tend to slide past each other.
Shear stress	A stress that tends to cause an object to slide.
Shotcrete	Pneumatically applied cement, water, sand and fine aggregate mix that is sprayed at high velocity on the rock surface and is thus compacted dynamically. Tends to inhibit blocks ravelling from the backs, walls and face of an excavation.
Skills	Practical ability to apply theoretical knowledge to particular situations.
Slabbing	Unstable slabs of rock formed by close spaced foliation or bedding planes in the backs or walls. Can also be caused by high stress levels that produce flat slabs parallel to the walls or backs.
Slope	Any continuous face of rock mass within the overall pit wall (without stepping/berms).
Smooth blasting	The use of closely spaced parallel perimeter holes charged with low strength explosives, fired after the main round. Can be used to reduce blast damage to the rock mass and improve rock stability.

SMP	Safety Management Plan.
Spalling	Stress induced failure of the rock mass that results in small, thin, curved, sharp edged pieces of rock ejected or falling from the backs or walls of an excavation. Generally accompanied by rock noise, usually associated with high rock stress.
Stope	An excavation where ore is extracted on a large scale.
Stope lift	A horizontal slice of ore mined from the back of a stope. Generally applied to cut and fill stoping methods.
Strain	The change in length per unit length of a body resulting from an applied force. Within the elastic limit strain is proportional to stress.
Strength	The largest stress that an object can carry without breaking. Common usage is the stress at failure.
Stress	May be thought of as the internal resistance of an object to an applied load. When an external load is applied to an object, a force inside the object resists the external load. The terms stress and pressure refer to the same thing. Stress is calculated by dividing the force acting by the original area over which it acts. Stress has both magnitude and orientation.
Stress field	A descriptive term to indicate the pattern of the rock stress (magnitude and orientation) in a particular area.
Stress shadow	An area of low stress level due to the flow of stress around a nearby excavation, eg a large stope. May result in joints opening up causing rock falls.
Strike	The bearing of a horizontal line in a plane or a joint.
Subdrill	The length of blast hole which extends beyond the next bench floor level. Subdrill is included in the blast design to provide adequate broken rock subgrade for developing working benches.
Support	The use of steel or timber sets, concrete lining and steel liners, that are placed in contact with the rock surface to limit rock movement. The rock mass has to move on to the support before large stabilising forces are generated. Support is applied externally to the rock mass.
Tensile	The act of stretching of material. Tensile forces can cause joints to open and may release blocks causing rock falls.
Tectonic forces	Forces acting in the Earth's crust over very large areas to produce high horizontal stresses which cause can earthquakes. Tectonic forces are associated with the rock deforming processes in the Earth's crust.
Tensile stress	A stress that tends to cause a material to stretch. Can cause joints to open and may release blocks causing rock falls.

Ultramafic rock	Typically, dark coloured rocks that have been intruded into the Earth or extruded underwater in a marine environment. May have been altered by heat and pressure producing foliation in the rock. They can be low strength, sheared and altered and a potential source of challenging ground conditions.
Wall	A wall can refer to a section of, or the complete profile of, the perimeter of an open pit excavation.
Wedge	A block of rock bounded by joints on three or more sides that can fall or slide out under the action of gravity, unless supported.
Wet bulb globe temperature (WBGT)	Is the temperature at which water evaporates into the air (at a particular Dry bulb temperature) once equilibrium between water and air has occurred. It is very much more important than the dry bulb temperature to physiologist as the evaporation of sweat is released to the partial pressure of water vapour in the air (in effect, the humidity). Knowing any two of dry bulb temperature, wet bulb temperature or humidity (along with barometric pressure) will allow calculation of the third. (Brake fulker 1999). It is not the temperature of water vapour in air.
Windrow	A continuous mound of loose material, of appropriate height, placed at the toe or crest of a slope as a barricade to falling objects or to prevent personnel/mine equipment from falling inadvertently down pit walls. (Can also be referred to as a bund).
Winze	An internal connection between two levels constructed by developing downward.
Yield point	The maximum stress that a material can sustain without permanent deformation or rupture. The limit of proportionality between stress and strain. Also known as the elastic limit.
VRT – Virgin rock temperature	The temperature of undisturbed surrounding rock strata. This temperature increases with depth and is a result of the flow of heat from the earths core to the surface. The Virgin Rock Temperature is modified by the local affects of groundwater and geothermal anomalies.
Yield point	The maximum stress that a material can sustain without permanent deformation or rupture. The limit of proportionality between stress and strain. Also known as the elastic limit.

7.2 JURISDICTIONAL DESCRIPTIONS

Information for this section is sourced from the Chief Inspector of Mines web site, www.agso.gov.au/ccim, at the time of publication.

7.2.1 NEW SOUTH WALES

7.2.1.1 PORTFOLIO ARRANGEMENTS

Minister for Mineral Resources	Hon E O'beid
Director-General, Department of Mineral Resources	A. Coutts
Director, Mine Safety and Environment	G. Terrey
Assistant Director, Safety Operations	R. Regan
Assistant Director, Environment	K. Hollands
Assistant Director, Performance Improvement	R. Morrison

7.2.1.2 LINE RESPONSIBILITY

Director, Mine Safety and Environment reports to Director-General, Department of Mineral Resources.

Chief Inspector of Coal Mines and Assistant Director Safety Operations to Director, Mine Safety and Environment.

Chief Inspector of Mines (Metalliferous) to Director, Mine Safety and Environment.

7.2.1.3 MINISTERIAL COUNCIL ON MINERALS

The Director-General is a member of the Standing Committee of Officials, which supports the Ministerial Council on Minerals with responsibilities for minerals.

7.2.1.4 LEGISLATIVE ARRANGEMENTS

Existing

Occupational Health and Safety Act 2000 No. 40 and Regulations 2001.

Coal Mines Regulation Act 1982 No. 67 and various regulations.*

Mining Act 1992 No. 29.

Mines Inspection Act 1901 No. 75 and General Rule 2000.*

Dangerous Goods Act 1975 No. 68 and various regulations.

Petroleum (Onshore) Act 1991 No. 84 and various regulations.

Petroleum (Submerged Lands) Act 1991 No. 13 and various regulations.

Environmental Planning and Assessment Act 1979 No. 203 and various regulations.

* Associated legislation under the umbrella of the OHS Act 2000.

Proposed

A new regulatory model is being considered.

The Coal Mines Regulation Act and the Mines Inspection Act are currently being reviewed.

Coverage

Coal: Underground and open-cut mines and associated surface operations including environment. Coverage related to activities, equipment and is influenced by mining lease boundaries.

Metalliferous: Underground and open-cut mines and associated surface operations. Coverage related to activities, equipment and is not influenced by mining lease boundaries. Metalliferous includes extractive industries.

Operational Responsibilities

Mines Inspectorate

The Director, Mines Safety and Environment is currently addressing the recommendations from the Mine Safety Review. This includes devolution of environmental issues from inspectors to an environmental unit within the Division. The Division has restructured, setting clear priorities, and is changing its skills profile, reviewing and formalising its process, and computerising its "management information system".

7.2.2 NEW ZEALAND

7.2.2.1 PORTFOLIO ARRANGEMENTS

Department of Labour,
OSH Service

General Manager, Workplace Health and Safety	R. Hill
Business Adviser (Mining)	G. Munro
Acting Chief Inspector of Mines, Quarries and Tunnels	J.Walrond

7.2.2.2 LINE RESPONSIBILITY

Business Adviser (Mining) to National Operations Manager, Operations Policy Unit, Chief Inspector of Mines, Quarries and Tunnels to Branch Manager, OSH Service.

7.2.2.3 LEGISLATIVE ARRANGEMENTS

Existing

Extractives inspectors are appointed under the Health and Safety in Employment Act (HSE Act) 1992 to cover the mining, coal mining, quarrying, tunnelling, geothermal and petroleum industries. All workplace inspectors are appointed under this Act.

Some Extractives inspectors are also appointed as enforcement officers under the Crown Minerals Act 1991. This is the statute under which mining privileges are issued.

Due to the large number of Coal Mining Licences and Mining Licences that were issued prior to the introduction of the Crown Minerals Act, and the subsequent repeal of the Coal Mines Act 1979 and the Mining Act 1981, most inspectors have obligations in a range of environmental matters which form consent conditions.

Regulations administered by the Extractives Inspectors include the HSE Regulations 1995, the HSE (Mining Administration) Regulations 1996, the HSE (Mining - Underground) Regulations 1999, the HSE Petroleum (Exploration and Extraction) Regulations 1999 and the HSE Pipelines Regulations 1999. The Geothermal Regulations remain in place under the now–repealed Geothermal Energy Act.

Operational Responsibilities

The operational responsibilities of extractives inspectors can be broadly described as the administration and enforcement of health and safety in the mining industry. There is a strong emphasis on health and safety education.

Other responsibilities include work program approvals for all operations licensed under the repealed legislation referred to above, legislation reviews, participation in Mines Rescue Trust Board and liaison with local government organisations in respect of work program approvals under the Crown Minerals Act.

The extractives inspectorate is funded from the allocation granted to the OSH Service of the Dept. of Labour.

7.2.3 NORTHERN TERRITORY

7.2.3.1 PORTFOLIO ARRANGEMENTS

Minister for Business, Industry and Resource Development	Paul Henderson
Chief Executive Officer Dept of Business, Industry & Resource Development	Peter Blake
General Manager Minerals & Energy	Brian Ely
Director of Mines	Tony McGill
Manager, Engineering & Technical Support	Tim Gosling
Chief Government Mining Engineer	Kee Hah

7.2.3.2 LINE RESPONSIBILITY

General Manager, Minerals & Energy reports to the Chief Executive Officer.

Director of Mines reports to the General Manager, Minerals & Energy.

Manager-Engineering & Technical Support to Director of Mines.

Chief Government Mining Engineer to Manager-Engineering & Technical Support.

7.2.3.3 MINISTERIAL COUNCIL ON MINERALS

The Chief Executive Officer is a member of the Standing Committee of Officials, which supports the Ministerial Council on Minerals.

7.2.3.4 LEGISLATIVE ARRANGEMENTS

Existing

Mining Act (2001)

Mining Management Act 2001

The Mining Management Act (2001) commenced on 1 January 2002. The new Act repeals the Mine Management Act and the Uranium Mining (Environment Control) Act. It expands the requirement to obtain an Authorisation before carrying out mining activities from uranium mining to all mining and to exploration involving substantial disturbance. The new Act makes no reference to the Chief Government Mining Engineer and mines inspectors are replaced by Mining Officers. Operators for mines are required to submit a mining management plan when applying for the Authorisation and this will require at least annual review.

Coverage

The Mining Management Act (2001) deals with the safety, health and environmental aspects of exploration, mining and rehabilitation activities involving underground and open cut metalliferous mining, mining of barren rock and extractive minerals (eg sand, gravel, soil, etc.) irrespective of tenure. Tenure is granted under the Mining Act, but conditions relating to OHS and environmental management are included in an Authorisation issued under the Mining Management Act. The detail of the OHS and environmental management plans are incorporated into the Mining Management Plans for the mining site.

Operational responsibilities

Mining Officers located within Mines Division monitor and enforce the management, safety, health and environmental requirements for exploration, mining and rehabilitation activities. This is done by inspecting, auditing and educating industry personnel on the standards sought by the government.

7.2.4 QUEENSLAND

7.2.4.1 PORTFOLIO ARRANGEMENTS

Minister for Natural Resources and Minister for Mines	Stephen Robertson
Director-General, Department of Natural Resources and Mines	Terry Hogan
Deputy Director-General, Mines	Bryan Coulter
Executive Director, Safety and Health	Peter Dent
Chief Inspector of Mines	Peter Minahan
Deputy Chief Inspector of Mines (Coal)	Brian Lyne
Deputy Chief Inspector of Mines (Metalliferous)	Roger Billingham

7.2.4.2 LINE RESPONSIBILITY

Deputy Director-General reports to the Director General.

ED Safety and Health Division reports to the Deputy Director-General, Mines.

Chief Inspector reports to the ED Safety and Health Division.

Deputy Chief Inspectors report to the Chief Inspector.

7.2.4.3 MINISTERIAL COUNCIL ON MINERALS

The Deputy Director-General, Mines is a member of the Standing Committee of Officials, which supports the Council, with responsibilities for minerals.

The Natural Resources area of the Department of Natural Resources and Mines has extensive involvement with the Natural Resource Management Ministerial Council, which replaced ANZECC.

7.2.4.4 LEGISLATIVE ARRANGEMENTS

Existing

Coal Mining Safety and Health Act 1999 and Coal Mining Safety and Health Regulation 2001.

Mining and Quarrying Safety and Health Act 1999 and Mining and Quarrying Safety and Health Regulation 2001.

Note:

1. The majority of the elements of the two Acts are identical, but the regulations are different.

2. Workplace Health and Safety Act 1995 specifically excludes mines.

Coverage

Coal: Underground and open-cut mines and associated surface operations. Does not cover railways, ports, environmental or tenure issues.

Metalliferous: Underground and open-cut mines, concentrators, smelters, quarries with blasting and crushing, exploration. Where ports and rail are integral to mine they are covered by the Act. Smelters and refineries remote from minesites are excluded from the Act. Does NOT cover environmental or tenures issues.

Mining tenures covered by Mineral Resources Act, administered by Department of Natural Resources and Mines. Environmental issues are covered by the Environment Protection Agency

Operational responsibilities

Mines Inspectorate works closely with Explosives Inspectorate and Petroleum & Gas Inspectorate (also in Safety and Health Division).

They are not involved in administration of environmental or tenure issues.

They work as one inspectorate covering coal and metalliferous issues.

7.2.5 VICTORIA

7.2.5.1 PORTFOLIO ARRANGEMENTS

Minister for Energy and Resources	C Broad
Secretary - Department of Natural Resources and Environment	C Munro
Executive Director, Minerals and Petroleum, Victoria	S Ashby (A/g)
Manager, Minerals and Petroleum Regulation	R King
Chief Mining Inspector (CMI)	G McLaughlan
Chief Inspector of Quarries (CIQ)	J Mitas

7.2.5.2 LINE RESPONSIBILITY

Executive Director of Minerals and Petroleum, Victoria Reports to the Secretary of Department of Natural Resources and Environment.

Manager of Minerals and Petroleum Regulation to Executive Director of Minerals and Petroleum, Victoria.

CMI & CIQ to Manager of Minerals and Petroleum Regulation.

Ministerial Council on Minerals, Standing Committee of Officials representative S.Ashby (A/g).

7.2.5.3 LEGISLATIVE ARRANGEMENTS

Mineral Resources Development Act 1990 - coal and metalliferous mines.

Extractive Industries Development Act 1995 - quarries.

Occupational Health and Safety Act 1985 - for quarries, offshore petroleum facilities and oil & gas pipelines (currently not mines).

Dangerous Goods Act 1985 - for the manufacture, storage and use of explosives within licensed mining and extractive sites.

Coverage

Mining: The Mineral Resources (Health and Safety) Regulations 1991 and/or the Mineral Resources (Health and Safety in Large Opencut Mines) Regulations 1995 cover all work within a mining licence area.

Extractive: The Extractive Industry Regulations 1996 and Occupational Health and Safety Act 1985 and regulations cover extractive operations within a licensed Work Authority area. Mines Inspectors, by agreement with the Victorian WorkCover Authority (VWA), administer the OHS Act and regulations within the Work Authority area (excluding manufacturing and processing plants).

Officers of the VWA administer the legislation dealing with processing plants such as brick pressing, block making and concrete plants.

Explosives: The Dangerous Goods (Explosives) Regulations 2000 cover the manufacture, storage and use of explosives within the boundaries of the mining licence/Work Authority.

Operational responsibilities

The Minerals and Petroleum Regulation unit is involved in all stages from mining licence/work authority application to mine and/or extractive site closure. Staff includes mining engineers, environmental specialists and generalist technical officers. Work is team based (by region) and all staff cover general OH&S and environmental matters. Mining engineers handle higher level OHS matters, and higher level environmental matters are dealt with by specialist environmental officers.

7.2.6 WESTERN AUSTRALIA

7.2.6.1 PORTFOLIO ARRANGEMENTS

Minister for State Development

Director-General, Department of Mineral and Petroleum Resources	Jim Limerick
State Mining Engineer (General Manager - Mining Safety)	Martin Knee
Director Mining Operations & Explosives and Dangerous Goods	Malcolm Russell

7.2.6.2 LINE RESPONSIBILITY

State Mining Engineer reports to Director who reports to Executive Director (Statutory Operations) who, in turn, reports to the Director-General with a separate reporting channel direct to the Minister on certain matters.

7.2.6.3 MINISTERIAL COUNCIL ON MINERALS

The Director-General is a member of the Standing Committee of Officials, which supports the Council.

7.2.6.4 LEGISLATIVE ARRANGEMENTS

Existing

Mines Safety and Inspection Act (1994) covers both metalliferous and coal mining

Proposed

Independent external review (mandated in the statute itself) of the operation of the MSI Act is currently underway.

Regulations are to be reviewed (internally) following the completion of the review of the Act.

Coverage

The Act covers all mining activity, including exploration, construction and development, quarries, and metalliferous mining and processing, refineries and downstream processing, and mineral export facilities and major iron ore railways.

Operational responsibilities

The operational organisation of the Department is under review following the amalgamation of the former Departments of Minerals and Energy and Resources Development.

One significant change is the establishment of a Statutory Operations Group under an Executive Director with a direct reporting line to the Minister as well as via the Director General. This group encompasses mining and petroleum safety and environmental matters, mineral and petroleum titles, land access and native title issues in relation to minerals and petroleum and royalties.

7.3 LEGISLATIVE CROSS-REFERENCE

As mining legislation moves from a prescriptive regime to a systems-based safety management approach, mine sites are required to develop site-specific solutions to health and safety issues. To help develop those solutions it is planned to provide information that links legislative requirements and objectives with this Handbook. This material may be provided in any future update.

As a result, you are encouraged to develop this section by creating your own cross-reference between the regulatory requirements of your State or Territory with this Handbook. This will help in identifying what elements have been considered in the development of the safety management systems adopted by the operation.

7.4 AUSTRALIAN STANDARDS AND OTHER CODES

7.4.1 AUSTRALIAN STANDARDS

The following Australian Standards may provide useful information when seeking specific guidance on occupational health and safety related matters.

PART 1 ADMINISTRATION MANAGEMENT, RESPONSIBILITIES, DOCUMENTATION AND SAFETY SYSTEMS

Management

AS 1470-1986	Health and Safety at Work - Principles and Practices.
AS 1885	Measurement of Occupational Health and Safety Performance.
AS 2124 - 2000	General Conditions of Contract.
AS 4368-1996	Mine Plans - Preparation and Symbols.
AS/NZS 4801:2001	Occupational Health and Safety Management Systems - Specification with guidance for use.
AS/NZS 4804:2001	Occupational Health and Safety Management Systems - General guidelines on principles, systems and supporting techniques.
ISO 9001	Quality Systems - Model for Quality Assurance in Design Development Production, Installation and Servicing.
ISO 9002	Quality Systems - Model for Quality Assurance in Production Installation and Servicing.
ISO 9003	Quality Systems - Model for Quality Assurance in Final Inspection and Test.
ISO 9004	Quality Management and Quality Systems Elements Part 1: Guidelines.

Risk Management

AS/NZS 3931 (Int) - 1995	Risk Analysis of Technological Systems - Applicable Guide.
AS/NZS 4360 - 1999	Risk Management.

Injury/Illness Reporting

AS 1885	Describing and Reporting Occupational Injuries and Diseases Safety Signage Supplement 1 - 1991.
AS 1319-1994	Safety Signs for the Occupational Environments (and Appendices).
AS 1614	Safety Signs for Mines and Tunnels.
AS 2342-1992	Development, Testing and Implementation of Information and Safety. Symbols and Symbolic Signs.
AS 3166	Safety Signs for High Voltage Electricity.
AS 3790	Safety Triangles for Motor Vehicles.
AS 1742, 1743, 1744	Safety Signs for Road Traffic Control.

PART 2 PROCEDURES AND PROCESSES

Emergencies

ISO 3193	Rules for the Design & Use of Safety Signs for the Occupational Environment.
AS 1851 - (Parts 1 - 16)	Maintenance of Fire Protection Equipment.
AS 1851.1 - 1995	Portable Fire Extinguishers and Fire Blankets.
AS 1851.2 - 1995	Fire Hose Reels.
AS 1851.3 - 1995	Automatic Fire Sprinkler Systems.
AS 1851.4 - 1994 (Amdt - 1997)	Fire Hydrant Installations.
AS 1851.5 - 1981	Automatic Smoke/Heat Venting Systems.
AS 2419.1 - 1994 (Amdt - 1996)	System Design, Installation and Commissioning.
AS 2419.2 - 1994	Fire Hydrant Values.
AS 2792 - 1992	Fire Hose - Delivery Layflat.
AS 2444 - 2001	Portable Free Extinguishers and Fire Blankets - Selections and Location.
AS 2441 - 1988	Installation of Fire Hose Reels.
AS 3745 - 2002	Emergency Control Organisation & Procedures for Buildings.
AS 4603-1999	Flashback Arresters - Safety devices for use with Fuel Gases and Oxygen or Compressed Air.

PART 3 PEOPLE

Personal Protective Equipment Workplace Atmosphere

AS/NZS-1715 - 1994	Selection, Use and Maintenance of Respiratory Protective Devices.
AS/NZS-1716 - 1994 (Amdt - 1996)	Respiratory Protection Devices.
AS 3544-1988	Industrial Vacuum Cleaners for Particulates Hazardous to Health.

Safety Helmets

AS 1800-1998	The Selection, Care and Use of Industrial Safety Helmets.
AS 1801-1997	Industrial Safety Helmets (incorporating Amendment 1).

Eye Protection

AS 1336-1997	Recommended Practices for Eye Protection in the Industrial Environment.
AS/NZS 1337-1992 (Amdt - 1997)	Eye Protection for Industrial Applications.
AS/NZS 1338-1992 (Amdt - 1997)	Filters for Eye Protectors.
AS 1607 - 1989	Sunglasses and Fashion Spectacles Part 1 Safety Requirements.

Gloves

AS/NZS 2161-1 to 9 2000/01	Occupational Protective Gloves.
AS 2225 - 1994 (Amdt - 1996)	Insulation Gloves for Electrical Purposes.

Footwear

AS/NZS 2210	Occupation Protective Footwear.
AS/NZS 2210.1 - 1994	Guide to Selection, Care and Use.
AS/NZS 2210.1 - 1994 (Amdt - 1998)	Specification.

Welding

AS 1674 - 1997	Safety in Welding and Allied Processes.
AS 1674-1 - 1997	Fire Precautions.
AS 1674.2 - 1990	Electrical.
AS 1796-2001 (Amdt - 2002)	Certification for Welders and Welding Supervisors.

Body Protection

AS 3765 - 1990	Clothing for Protection Against Hazardous Chemicals.
AS 3765.1 - 1990	Protection Against General of Specific Chemicals.
AS 3765.2 - 1990	Limited Protection Against Specific Chemicals.

PART 4 WORKING ENVIRONMENT

Buildings and Structures

AS 1530 - 1 to 5 - 1989	Methods for Fire Tests on Building Materials, Components and Structures.
AS 1657 - 1992	Fixed Platforms, Walkways, Stairways and Ladders - Design, Construction and Installation.
AS/NZS 1560 - 1999	The Design and Installation of Corrugated Fibre-Reinforced Cement Roofing and Wall Cladding.
AS 1664 - 1997	Aluminium Structures.(also known as the SAA Aluminium Structures Code).
AS 1668 - 1998	The use of Mechanical Ventilation and Air-Conditioning in Buildings.
AS 1680 - 1998	Interior Lighting.
AS 1720 - 1997 (Amdt - 1998)	Timber Structures (also known as the SAA Lift Code).
AS 2208 - 1996 (Amdt - 1999)	Safety Glazing Materials for Use in Buildings (Human Impact Considerations).
AS 2243 - 1990/2002	Safety in Laboratories (10 parts).
AS 2601 - 2001	The Demolition of Structures.
AS 2982 - 1997	Laboratory Construction.
AS 3600 - 2001	Concrete Structures.
AS 4100 - 1998	Steel Structures.
AS/NZS 2002	Air-Handling and Water Wystems of Buildings - Microbial Control .
AS/NZS 3666 4576 - 1995	Guidelines for Scaffolding.
AS/NZS 4801 - 2001	Occupational Health and Safety Management Systems - Specification with Guidance for Use.
AS/NZS 4804 - 2001	Occupational Health and Safety Management Systems - General Guidelines on Principles, Systems and Supporting Techniques.

Height Safety

AS/NZS 1576 - 1995	Scaffolding.
AS/NZS 4576	Guidelines for Scaffolding.
AS/NZS 1891 - 1995/2001	Industrial Fall Arrest Systems and Devices.
AS1170 - 1994	Minimum Design Loads on Structures (also known as the SAA Loading Code).
AS 1170.2 - 1989	Wind Loads.
AS 1418.10 - 1996	Elevating Work Platforms.
AS/NZS 1891.3 - 1983	Industrial Fall - Arrests Systems and Devices.
AS 2210	Industrial Safety Belts and Harness - Selection, Use and Maintenance.

Ladders

AS 1892.1 - 1996	Portable Ladders - Metal.
AS 1892.2 - 1992	Portable Ladders - Timber.

Confined Space

AS 2865 - 1995	Safe Working in a Confined Space.

Vibration

AS 2670 - 2001	Evaluation of Human Exposure to Whole Body Vibration.
AS 2763 - 1988	Vibration and Shock - Hand Transmitted Vibration Guidelines for Measurement and Assessment of Human Exposure (ISO 5349).
AS 2973 - 1987	Vibration and Shock - Human Response Vibration - Measuring Instrumentation.
AS 2993.1 - 1987	Vibration and Shock Dynamic Characteristics of the Human Body - Drawing Point Importance of the Human Body
AS 3658 - 1989	Vibration and Shock - Mechanical Vibration and Shock Affecting Humans - Vocabulary (ISO 5805).

Noise

AS 1259-1990	Acoustics - Sound Level Meters.
AS 1269 - 1998	Occupational Noise Management.
AS 1270 - 2002	Acoustics - Hearing Protectors.
AS 2012.1 & 2-1990	Acoustics - Measurement of Airborne Noise Emitted by Earth-Moving Machinery and Agricultural Tractors - Stationary Test Condition.
AS/NZS 2399 - 1998	Acoustics - Speculation for Personal Sound Exposure Meters

Dust

AS 1715 - 1994	Selection Use and Maintenance of Respiratory Protective Devices.
AS 1716 - 1994	Respiratory Protective Devices.
AS 3640 - 1989	Workplace Atmospheres - Method for Sampling and Gravimetric Determination of Respirable Dust.
AS 2986 - 1987	Workplace Atmospheres - Organic vapours - Sampling by Solid Absorption Techniques.

Ultra Violet Radiation

AS 2604 - 1998	Sunscreen Products - Evaluation and Classification.
AS 1337 - 1992 (Amdt - 1994)	Eye Protectors for Industrial Applications.
AS 1607 - 1990	Sunglasses and Fashion Spectacles Part 1 - Safety Requirements.

Hazardous Substances

AS 1216.1 - 1998	Classification and Class Labels for Dangerous Goods.
AS 1345 - 1995	Identification of the Contents of Piping, Conducts and Dusts.
AS 1940 - 1993	Storage and Handling of Flammable Combustible Liquids.
AS 3544-1988	Industrial Vacuum Cleaners for Particulates Hazardous to Health.
AS 3580 - 1 to 13 1990/2001	Methods for Sampling and Analysis of Ambient Air .
AS/NZS 3580.12.1:2001	Methods for Sampling and Analysis of Ambient Air - Determination of Light Scattering - Integrating Nephelometer Method.

Dangerous Goods

AS 1216 - 1998	Classification, Hazard Identification and Information Systems for Dangerous Goods.
AS 1216.1 - 1984	Classification and Class Labels for Dangerous Goods.
AS 1216.2 - 1981	Hazardous Chemical Emergency Action Code.
AS 1216.3 - 1981	NFPA Hazardous Identification System.
AS 1216.4 - 1981	UN Substance Identification Numbers.
AS 1883-1992	Guide to Maintenance and Supervision of Insulating Oils in Service .
AS 2030 - 1985/1999	The approval, filling, inspection, testing and maintenance of cylinders for the storage and transport of compressed gases (also known as the SAA Gas Cylinders Code).

Hazardous Areas

AS/NZS 1596 - 2002	The Storage and Handling of LP Gas
AS 2337 - 1999	Gas Cylinder Test Stations.
AS/NZS 2430 - 1987/1997	Classification of Hazardous Areas (9 Parts)

Explosives

AS 2187 - 1993/1998	Explosives - Storage, Transport and Use (known as SAA Explosives Code).
AS 2601 - 2001	The Demolition of Structures.

Flammable and Combustible Liquids

AS 1940 - 1993	The Storage and Handling of Flammable and Combustible Liquids.
AS 2106 - 1999	Methods for the Determination of the Flashpoint of Flammable Liquids (closed cup).

Energy Sources

AS 1768 - 1991	Lightning Protection.
AS/NZS 1802 - 1995	Electric cables - Reeling and trailing - For underground coal mining purpose.
AS 1824.1 - 1995	Definitions, Principles and Rules (IEC 71-1 1993).
AS 1824.2 - 1985	Application Guide (IEC 71-2 and IEC 72-3).
AS 2006 - 1986	High Voltage AC Switchgear and Control gear Circuit Breakers for Rated Voltages above 1000v.
AS 2067 - 1984	Switchgear Assemblies and Ancillary Equipment for Alternating Voltages Above 1KV.
AS 2086 - 1996	High Voltage AC Switchgear and Control gear - Metal Enclosed - Rated Voltages above 1KV up to and including 72.5 KV (IEC 298).
AS 2467 - 1981	Maintenance of Electrical Switchgear.
AS 2790 - 1989	Electricity generating sets - Transportable (up to 25kW).
AS 2802 - 2000	Electric Cables - Reeling and Trailing - for Mining and General Use/other than Coal Mines.
AS 3000 - 1998	Electrical Installations - Buildings, Structures and Premises (SAA wiring Rules).
AS 3007 - 1987	Electrical Installation - Surface Mines and Associated Processing Plant.
AS/NZS 3008 - 1998	Electrical Installations - selection of Cables.
AS 3008.1 - 1989	Cables for Alternating Voltages up to and including 0.6/1 KV.
AS 3010 - 1988	Electrical Installations - Supply by Generating Set - Internal Combustion Engine Driven Sets.
AS 3859 - 1991	Effects of Current Passing Through the Human Body.
AS 4242 - 1994	Earth-Moving Machinery and Ancillary Equipment for Use in Mines - Electrical Wiring Systems at Extra-Low Voltage.
AS/NZS 3017 - 2001	Electrical Installations - Testing Guidelines.
AS/NZS 3108 - 2001	Approval and Testing Specifications - Particular Requirements for Isolating.

Transformers and Safety Isolating Transformers

AS 2380 - 1 to 9 - 1987/1994	Electrical equipment for explosive atmospheres - Explosion-protection techniques.
AS/NZS 2381.1 - 1999	Electrical equipment for explosive atmospheres - Selection, installation and maintenance - General requirements.
AS 238 - 2 to 7 1989/1995	Electrical equipment for explosive atmospheres - Selection, installation and maintenance.
AS 3190 - 2002	Approval and Test Specification - Residual Current devices (current - operated Earth Leakage Devices).
AS 3439 - 1993	Low Voltage Switchgear and Controlgear assemblies.
AS 3760 - 1990 - 2001	In Service Safety Inspection and Testing of Electrical Equipment.
AS 3851 - 1991 - 1992	The Calculation of Short - Circuit Currents in Three Phase AC Systems.
AS 3865 - 1991	Calculation of the Effects of Short-Circuit Currents.

Isolation

AS 1755 - 2000	Conveyors - Design, Construction, Installation and Operation - Safety Requirements.
AS 4024.1 - 1996	Safeguarding of Machinery - Part 1 - General Principles.
AS 1319 - 1994	Safety Signs for the Occupational Environment.

PART 5 EQUIPMENT AND MACHINERY

Mobile Equipment

AS/NZS 1125 - 4240 - 1994	Remote Controls for Mining Equipment.
AS 1180 - 1972	Methods of Test for Hose made from Elastomeric Materials.
AS 1636 - 1996	Tractors - Roll–Over Protective Structures - Criteria and Tests - Conventional Tractors.
AS 1851.1 - 1995	Maintenance of Fire Protection Equipment - Portable Fire Extinguishers and Fire Blankets.
AS/NZS 1873.1 - 1994	Powder-Actuated (PA) Hand-Held Fastening Tools - Selection, Operation and Maintenance.
AS 2294 - 1997	Earthmoving Machinery - Protective Structures.
AS 2359 - 1996	Industrial Trucks (SAA Industrial Truck Code).
AS 2359.1 - 1995	Design and Manufacture.
AS 2359.2 - 1985	Operation.
AS 2664 - 1983	Earthmoving Machinery - Seat Belts and Seat Belt Anchorages.
AS 2671-1983	Fluid Power - Hydraulic Systems and Components.
AS 2740-2001	Wedge-Type Sockets.
AS 2955 - 1 to 9 - 1988	Earth-Moving Machinery - Tests and Measurements.
AS 2956 - 1 to 6 - 1988	Earth-Moving Machinery - Instrumentation and Operator's Controls.
AS 2958 - 1988/2000	Earthmoving Machinery - (4 Parts).
AS 2987 to 2988-1987	General Conditions of Contract for the Supply of Equipment with or without Installation.
AS 3584 - 1991	Diesel Engine Systems for Underground Coal Mines.
AS 3791 - 1991	Hydraulic Hose.
AS 3868 - 1991	Earth Moving Machinery - Design Guide for Access Systems.
AS 4457 - 1997	Earth-Moving Machinery - Off-Highway Rims and Wheels - Maintenance and Repair.

Fixed Plant

AS/NZS 1200 - 2000	Pressure Equipment.
AS 1210 - 1997	Unfired Pressure Vessels SAA Unfired Pressure Vessels Code.
AS 1228 - 1997	Pressure Equipment - Boilers

AS 1657 - 1992	Fixed Platforms, Walkways, Stairways and Ladders Design, Construction and Installation.
AS 1697 - 1981	Gas Transmission and Distribution Systems (known as the SAA Gas Pipeline Code).
AS 1755 - 2000	Conveyors - Design, Construction Installation and Operation - Safety Requirements.
AS 2593 - 2001	Boilers - Unattended and Limited Attendance.
AS 2660-1991	Hose and Hose Assemblies - Air/water - For Underground Coal Mines.
AS 2971 - 2002	Serially Produced Pressure Vessels.
AS 3768 - 1990	Boilers and Pressure Vessels - In-Service Inspection.
AS/NZS 3788 - 2001	Pressure Equipment - In-Service Inspections.
AS 4041 - 1998	Pressure Piping.
AS 4297-1995	Underground Mining - Stationary Air Compressorss
AS 4332-1995	The Storage and Handling of Gases in Cylinders.

Dredges

AS 4451-1 to 4-1997	Small Craft - Steering Systems - Wire Rope and Pulley Systems for Sailing Craft.

Cranes and Hoists

AS 1418-1 - 1999/2002	Cranes (including Hoists and Winches - Parts 1 to 18).
AS 1666 - 1995	Wire-Rope Slings.
AS 2549 - 1996	Cranes - A Glossary of Terms.
AS 2550 - 1994/2002	Cranes - Safe Use.

Machine Guarding

AS 4024.1 - 1996	Safeguarding of Machinery Part 1: General Principles.
AS 4024.2 - 1998	Safeguarding of Machinery Part 2: Presence Sensing Systems.

Hot Work

AS 1554 - 1983/2000	Structural Steel Welding (known as the SAA Structural Steel Welding Code - Parts 1 to 3).
AS/NZS 1554 - 1994/2000	Structural Steel Welding (Parts 1 to 6).
AS 1674	Safety in Welding and Allied Processes.
AS 1338 - Part 1 -1994	Filters for the Protection Against Radiation Generated in Welding and Allied Operations.
AS 2430 - 1987	Classification of Hazardous Areas - Part 3.

Abrasive Wheels

AS 1788	Abrasive Wheels.
AS 1788.1 - 1987	Design Construction and Safeguarding.
AS 1788.2 - 1987	Selection Care and Use.

Piping

AS 1345 - 1982	Identification of Contents of Piping, Conduits and Ducts.
AS 1345C - 1982	Wallchart - Pipeline Identification.

PART 6 SHAFTS, WINDING AND HOISTING SYSTEMS

AS 3637	Underground Mining - Winding Suspension Equipment.
AS 3637.1 - 1989	General Requirements.
AS 3637.2 - 1989	Detaching Hooks.
AS 3637.3 - 1989	Rope Cappings.
AS 3637.4 - 1989	Draw Bars and Connecting Links.
AS 3637.5 - 1989	Rope Swivels and Swivel Hooks.
AS 3637.6 - 1991	Shackles and Chains.
AS 3751-1990	Underground Mining - Slope Haulage - Couplings, Drawbars, and Safety Chains .
AS 3785	Underground Mining - Shaft Equipment.
AS 3785.1 - 1990	Drum Winding Overwind Safety Catch Systems.
AS 3785.2 - 1991	Friction Winding Arresting Systems.
AS 3785.3 - 1990	Drum Winding Gripper Systems.
AS 3785.4 - 1992	Conveyances for Vertical Shafts.
AS 3785.5 - 1991	Headframes.
AS 3785.6 - 1992	Guides and Ribbing Ropes for Conveyances.
AS 3785.7 - 1993	Sheaves.
AS 3785.8 - 1994	Personnel Conveyances in other than Vertical Shafts.

For further information refer to the latest catalogue of Australian Standards and complete listing published by:

Standards Australia
Head Office and Administration
286 Sussex Street
Sydney NSW 2000
Mail
GPO Box 5420
Sydney NSW 2001
Telephone: (02) 8206 6000
Facsimile: (02) 8206 6001

Customer Service
Telephone: 1300 654646
Facsimile: 1300 454949
E-mail: sales@standards.com.au
Internet: www.standards.com.au

7.4.2 OTHER CODES

NSW Department of Mineral Resources

Mechanical Design Guidelines - MDG 1 to MDG 9 Series.

Mechanical Design Guidelines - MDG 10 to MDG 31 Series.

Mechanical Design Guidelines - MDG 32 to MDG 39 Series.

Mining Design Guidelines - MDG 1001 to MDG 1009 Series.

Mining Design Guidelines - MDG 1010 to MDG 1029 Series.

Electrical - MDG 2003 to MDG 2004 Series.

General Mining Documents - MDG 3001 Series.

System Safety Accident Investigation - MDG 3002 Series.

Summary of Reportable Accidents & Dangerous Occurrences - MDG 3003 Series.

Special Reports - MDG 3004 Series.

Vibration Related Back Injuries - MDG 3005 Series.

Test Report Criteria - Equipment and Materials - MDG 3006 Series.

Hydraulic Safety - MDG 3007 Series.

List of Coal Mines - MDG 3008 Series.

Safety Alerts - MDG 3009 Series.

Significant Incident Reports - MDG 3010 Series.

List of MDG's - MDG 3011.

Safety Communiqué - MDG 3012 Series.

Case Study - MDG 4001 Series.

Mine Safety Review - MDG 5001 Series.

7.5 USEFUL WEB SITE OH&S LINKS

The following list of internet sites provide statistical reports, guidelines, safety alerts and many other forms of information in relation to health & safety issues.

International

- www.msha.gov-Mine Safety and Health Administration (MSHA) of the United States Department of Labour.
- www.cdc.gov/niosh/ - National Institute for Occupational Safety and Health (NIOSH) US federal agency responsible for conducting research and making recommendations for the prevention of work-related disease and injury.
- www.gov.on.ca/lab/ohs - Ministry of Labour Occupational health and safety - Canada.
- www.hse.gov.uk/- Health and Safety Executive - British government agency.
- www.icmm.com - International Council of Mining and Metals.
- www.osh.dol.govt.nz - New Zealand's Health and Safety Net.
- www.ccohs.ca - Canadian Centre for Occupational Health and Safety.

Australia/National

- www.minerals.org.au - Minerals Council of Australia.
- www.nohsc.gov.au - National Occupational Health and Safety Commission (Worksafe) - Australian Federal Government agency.
- www.workcover.act.gov.au - ACT Workcover.
- www.comcare.gov.au - Comcare Australia.
- www.agso.gov.au/ccim - Conference of Chief Inspectors of Mines.
- www.industry.gov.au - Federal Department of Industry, Tourism & Resources.
- www.miningitab.com.au - National Mining Industry Training Advisory Body (NMITAB) provides a forum for employers and employees to influence the direction of vocational education and training policies.
- www.standards.com.au - Australian Standards.
- www.ausimm.com.au - Australasian Institute of Mining and Metallurgy.
- www.quarry.com.au - Institute of Quarrying Australia.
- www.smenet.org - Society for Mining, Metallurgy and Exploration.
- www.amma.org.au - Australian Mines and Metals Association.
- www.nightshift.com - Night Shift initiative serving the shiftwork community.
- www.austlii.edu.au - Australasian Legal Information Institute.
- www.reflections.com.au/MiningandExploration/ - Australian Mining and Exploration news and information.

New South Wales

- www.minerals.nsw.gov.au - Department of Mineral Resources.
- www.nswmin.com.au - NSW Minerals Council.
- www.workcover.nsw.gov.au - WorkCover.

Northern Territory

- www.dbird.nt.gov.au - Department of Business, Industry & Resource Development.
- www.ntminerals.org.au - Northern Territory Minerals Council (under construction).
- www.nt.gov.au/wha - Work Health Authority.

Queensland

- www.nrm.qld.gov.au/mines - Queensland Department of Natural Resources and Mines.
- www.qmc.com.au - Queenslands Mining Council.
- www.detir.qld.gov.au - Department of Employment and Training, Department of Industrial Relations.
- www.warden.qld.gov.au - Mining Warden's Court of Queensland.

- www.mishc.uq.edu.au - University of Queensland, Minerals Industry Safety and Health Centre.
- www.qmitab.com.au - Queensland's Mining Industry Training Advisory Board.
- www.mishc.uq.edu.au - Minerals Industry Safety and Health Centre (MISHC), University of Queensland centre.
- www.whs.qld.gov.au - Workplace Health and Safety.
- www.workcover.qld.gov.au- WorkCover.

South Australia

- www.pir.sa.gov.au - Department of Primary Industries & Resources.
- www.resourcessa.org.au - South Australian Chamber of Mines and Energy.
- www.maqohsc.sa.gov.au - Mining and Quarrying Occupational Health and Safety Committee.
- www.workcover.com - WorkCover.

Tasmania

- www.mrt.tas.gov.au - Department of Infrastructure, Energy and Resources.
- www.tasminerals.com.au - Tasmanian Minerals Council.
- www.wsa.tas.gov.au - WorkCover.

Victoria

- www.nre.vic.gov.au - Department of Natural Resources and Environment.
- www.vicmins.com.au - Minerals and Energy Council.
- www.workcover.vic.gov.au - WorkCover.

Western Australia

- www.dme.wa.gov.au - Department of Mineral & Petroleum Resources.
- www.mineralswa.asn.au - Chamber of Mines and Energy.
- www.safetyline.wa.gov.au - Department of Consumer and Employment Protection.
- www.workcover.wa.gov.au - WorkCover.

7.6 WORK IN PROGRESS

This section contains a number of topics under development or to be developed in response to:

- new or recently identified health and safety concerns;
- incidents; and
- developments in other areas/sections of the industry, other industries and other countries.

The table is structured to show the second tier numbering system used in the Handbook and topics listed by bullet points have been identified to be included in any future edition or are under development or to be developed.

Generally, the document type may be classified as a code, standard, guideline, guidance note, recognised standard or applied guideline (legislation based) or an approved code of practice (referenced at law).

Part 1 Administration – Management, Responsibilities, Documentation and Safety Systems

Reference/Topic	Document Type	Comments/ reason for development	Status/Action	Responsibility/Contact
1.1 INFORMATION RESOURCES				
1.2 DOCUMENT CONTROL • Approvals & authorisations	Guideline	Identified health and safety concerns	To be commenced	New South Wales Department Of Mineral Resources – G Terrey terreyg @minerals.nsw.gov.au
1.3 RESPONSIBILITIES AND ACCOUNTABILITIES • Government commitment	• Guideline	Identified health and safety concerns	To be commenced	New South Wales Department Of Mineral Resources – G Terrey terreyg @minerals.nsw.gov.au
- Investigations - Boards of inquiry	- Guidance note - Guidance note			
• Inspection of Underground Coal Mine Workings	Recognised Standard		Drafting ready for approval	Queensland Department of Natural Resources and Mines
1.4 POLICIES AND MANAGEMENT PLANS				
1.5 RISK MANAGEMENT		Also guideline	Drafting	
• Control of Formal Risk Management Practices	Recognised Standard			Queensland Department of Natural Resources and Mines
1.6 CONTRACTOR MANAGEMENT				
1.7 HAZARD AND WORK INJURY REPORTING SYSTEM	Guideline	Identified health and safety concerns	To be commenced	New South Wales Department Of

Part 2 Procedures and Processes

2.1 COMMUNICATION AND CONSULTATION				
• Consultation	Guideline	Develop in line with new OH&S Act	Draft	New South Wales Department Of Mineral Resources – G Terrey terreyg @minerals.nsw.gov.au
2.2 SAFE OPERATING PROCEDURES				
2.3 WORKPLACE INSPECTION				
2.4 ACCIDENT INVESTIGATION				
• Learning the lessons	Guideline	Identified health and safety concerns	To be commenced	New South Wales Department Of Mineral Resources – G Terrey terreyg @minerals.nsw.gov.au
2.5 EMERGENCY PLANNING AND RESPONSE				
• Underground Emergency Preparedness Management Plan	MDG 1022 Guideline	Update/revision	last update 24/9/99	New South Wales Department Of Mineral Resources – R Leggett and G McDonald-leggettr@minerals.nsw.gov.au mcdonalg@minerals.nsw.gov.au
• Quality of Stonedust Sampling and analysis of roadway dust in underground coal mines	Recognised Standard		Drafting	Queensland Department of Natural Resources and Mines
2.6 PURCHASING				

Part 3 People

3.1 ACCESS TO THE MINE				
3.2 PEOPLE WORKING ALONE				
3.3 LABOUR HIRE				
3.4 EMPLOYEE MANAGEMENT				
3.5 TRAINING AND DEVELOPMENT				
3.6 HEALTH AND FACILITIES				
• Fitness for Work				
- Fatigue - Physical fitness - Psychological fitness	• Guidelines - Guidance note - Guidance note - Guidance note		Draft	New South Wales Department Of

3.7 ERGONOMICS	Guideline	To be a dedicated section	To be commenced	New South Wales Department Of Mineral Resources – G Terrey terreyg @minerals.nsw.gov.au
3.8 MANUAL HANDLING				
3.9 PERSONAL PROTECTION				
Part 4 Working Environment				
4.1 DESIGN AND PLANNING				
4.2 EXPLORATION				
4.3 CONSTRUCTION, BUILDINGS AND STRUCTURES				
4.4 MINE WORKINGS				
• Development activities and associated hazards • Mine closure	• Guideline	Identified health and safety concerns	To be commenced	New South Wales Department Of Mineral Resources – G Terrey terreyg @minerals.nsw.gov.au
• Inrush	• Guideline MDG 1024 Guideline	Update/revision	last update 2/8/99	New South Wales Department Of Mineral Resources - I Anderson andersoi@minerals.nsw.gov.au
4.5 GROUND STABILITY				
• Rock burst	Guideline			
4.6 TREATMENT AND PROCESSING PLANTS		Identified health and safety concerns	To be commenced	New South Wales Department Of Mineral Resources – G Terrey terreyg @minerals.nsw.gov.au
• Crushing and screening plants • Processing plants • Bitumen plant • Concrete batching plant	• Guideline • Guideline • Guideline			
4.7 ESSENTIAL SERVICES		Identified health and safety concerns	To be commenced	New South Wales Department Of Mineral Resources – G Terrey terreyg @minerals.nsw.gov.au
4.8 ENERGY SOURCES	• Guideline			
• Hydraulic and mechanical power • Radiant and thermal				

4.8.2 ELECTRICITY				
• The safe use of electricity in mines	Guideline	Identified health and safety concerns	Under development	Victorian Department of Natural Resources and Environment
4.9 VIBRATION				
4.10 NOISE				
4.11 WORKPLACE TEMPERATURES				
• Heat Management		Different requirements for coal and metal	Under review	Queensland Department of Natural Resources and Mines
4.12 DUST				
4.13 VENTILATION				
• System Components • Risk Assessment • Design aspects • Document Control • Gas Outbursts • Ventilation Training	• Guideline • Guideline • Guideline • Guideline	Identified health and safety concerns	To be commenced	New South Wales Department Of Mineral Resources – G Terrey terreyg@minerals.nsw.gov.au
• Ventilation Control System	• Guideline • Guideline			
• Auxillary Fans in Underground Coal Mines	MDG 1023 Guideline	Update/revision	last update 10/9/99	New South Wales Department Of Mineral Resources - R Regan reganr@minerals.nsw.gov.au
4.14 HAZARDOUS SUBSTANCES				
• Crystalline Silica • Arsenic • Hydrogen Fluoride • Flammable Chemicals • Bitumen • Lead • Diesel, Oils	MDG 1021 Guideline • Guideline • Guideline • Guideline	Update/revision Identified health and safety concerns	last update 3/9/99 To be commenced	New South Wales Department Of Mineral Resources - G Cowan cowang@minerals.nsw.gov.au New South Wales Department Of Mineral Resources – G Terrey terreyg

4.15 FUMES				
4.16 EXPLOSIVES USE				
• Use of explosives in underground coal mines • Administrative controls • Document control • Flyrock	MDG 1012 Guideline • Guideline • Guideline • Guideline	Identified health and safety concerns	last update 9/8/99 To be commenced	New South Wales Department Of Mineral Resources - A Ryan ryant@minerals.nsw.gov.au New South Wales Department Of Mineral Resources – G Terrey terreyg @minerals.nsw.gov.au
Part 5 Equipment and Machinery				
5.1 HAZARD AWARENESS				
5.2 HAZARDOUS PLANT				
5.3 TOOLS				
• Auger • Band Tool • Concrete mixer	• Guideline • Guideline	Identified health and safety concerns	To be commenced	New South Wales Department Of Mineral Resources – G Terrey terreyg @minerals.nsw.gov.au
• Use of Cutting and Welding Equipment in Underground Coal Mines	• Guideline MDG 1019 Guideline	Update/revision	last update 30/9/99	New South Wales Department Of Mineral Resources - R Regan reganr @minerals.nsw.gov.au
5.4 MAINTENANCE AND REPAIRS				
5.5 CRUSHING, SCREENING AND CONVEYOR MACHINERY				
5.6 ACCESS TO PLANT				
5.7 DREDGES (OPEN AND STILL WATER)				
5.8 ORE-CONVEYING SLURRY PIPELINES				
5.9 LIFTING EQUIPMENT				
5.10 MOBILE PLANT AND MACHINERY				
5.11 MOBILE EQUIPMENT USED ON THE				
SURFACE 5.12 MOBILE CRANES				
5.13 MOBILE EQUIPMENT USED UNDERGROUND • Construction and use of non				
Flameproof vehicles in underground coal mines 5.14 RAISE BORING				
	Recognised Standard			Queensland Department of Natural Resources and Mines

Part 6 Shafts, Winding and Hoisting Systems

6.1 SHAFTS AND WINDERS GENERAL				
6.2 HEADFRAMES AND WINDERS - SHAFTS + 30M				
6.3 WINDING ENGINES				
6.4 WINDING ROPES				
6.5 SHAFT CONVEYANCES				
6.6 SIGNALLING				
6.7 FRICTION-WINDING				
6.8 DRUM WINDING				
6.9 SHAFT SINKING				

PART 8

FEEDBACK

UPDATED 8 NOV 2002

8. FEEDBACK

Your comment on this Guideline will be very helpful in reviewing and improving the document.

Please copy and complete the Feedback Sheet and return it to:

C/- Conference of Chief Inspectors of Mines

in your State or Territory.

Western Australia

State Mining Engineer
Mining Operations Division
Department of Mineral & PetroleumResources
Mineral House
6th Floor 100 Plain Street
EAST PERTH WA 6004

Northern Territory

Chief Government Mining Engineer
Department of Business Industry & Resource Development
GPO Box 3000
DARWIN NT 0801

Tasmania

Chief Inspector of Mines
Workplace Standards Authority
Tasmania Development and Resources
PO Box 56
ROSNY PARK TAS 7018

New South Wales

Chief Inspector of Mines
Director Mine Safety and Environment
Department of Mineral Resources
PO Box 536
ST LEONARDS NSW 1590

Victoria

Chief Mining Inspector
Minerals and Petroleum Victoria
Department of Natural Resources and Environment
PO Box 3100
BENDIGO MAIL CENTRE VIC 3550

Queensland

Chief Inspector of Mines
Department of Mines and Energy
Queensland Minerals and Energy Centre
61 Mary Street
BRISBANE QLD 4000

South Australia

Chief Inspector of Mines
Primary Industries and Natural Resources South Australia
GPO Box 1671
ADELAIDE SA 5001

Commonwealth

Mineral Resources and Advice
Minerals Division Geoscience Australia
GPO Box 378
CANBERRA ACT 2601

New Zealand

Chief Inspector of Mines Quarries and Tunnels
OSH Service Department of Labour
PO Box 3705
WELLINGTON NEW ZEALAND

Papua New Guinea

Chief Inspector of Mines
Department of Mineral Resources
Mines Division
PO Box 375
Konedobu NCD
PORT MORESBY NEW GUINEA

FEEDBACK SHEET

MINERALS INDUSTRY SAFETY HANDBOOK

Type of operation

☐ Quarry ☐ Open Cut ☐ Underground ☐ Exploration ☐ Other

Type of mineral

☐ Metalliferous ☐ Extractive ☐ Industrial Sand ☐ Coal ☐ Other

Number of people employed? ______________________________

How did you use, or intend to use, this Handbook? ______________________________

____

____

What do you find most useful about the Handbook? ______________________________

____

____

What do you find least useful? ______________________________

____

____

Do you have any suggested changes to the Handbook? ______________________________

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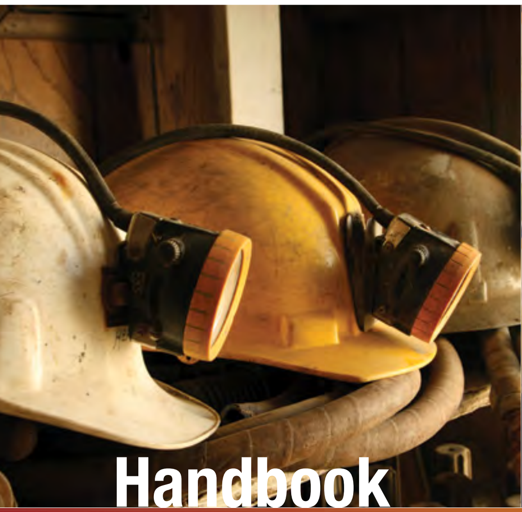
Government of **Western Australia**
Department of **Mines and Petroleum**
Resources Safety



Handbook

Safety and health representatives

under the *Mines Safety and Inspection Act 1994*

Disclaimer

Reference

Department of Mines and Petroleum, 2014, Safety and health representatives – handbook: Resources Safety, Department of Mines and Petroleum, Western Australia, 9 pp.

ISBN 978 1 922149 35 0

This publication is available on request in other formats for people with special needs.

This publication is also available in digital format (PDF) online at www.dmp.wa.gov.au/ResourcesSafety

Further details of publications produced by Resources Safety can be obtained by contacting:

Resources Safety
Department of Mines and Petroleum
100 Plain Street
EAST PERTH WA 6004

Telephone: + 61 8 9358 8002 (general queries)
+ 61 8 9358 8154 (publication orders)

NRS: 13 36 77
Facsimile: + 61 8 9358 8000
Email: ResourcesSafety@dmp.wa.gov.au
(general queries)

RSDComms@dmp.wa.gov.au
(publication orders)

Foreword

Congratulations on being elected as a safety and health representative under the *MInes Safety and Inspection Act 1994*. Safety and health representatives are without a doubt the ambassadors of safety in the workplace.

You have been chosen to represent your workmates in matters of occupational safety and health. Your important role is to help identify, communicate and respond to safety and health issues within your workplace.

Keep this handbook close at hand as a day-to-day ready reference guide. Other sources of more detailed information are listed at the back of the handbook.

Remember:

Safety and health representatives are not safety and health officers or coordinators and they are not responsible for solving safety and health problems in the workplace. That's still up to the employer. But the safety and health representative is an important link between employers and employees.

Why safety and health representatives are important

It makes sense for employers and employees to talk to each other about safety at work.

Safety and health representatives can make a difference.

A safety and health representative is the key to communication by making it easier to exchange ideas and concerns about safety between employers and employees.

Safety and health representatives raise and discuss safety issues and concerns with employers and/or managers so they can work together and arrive at solutions to make the workplace safe.

Employees sometimes feel more comfortable using their safety and health representatives to raise an issue or present an idea about occupational safety and health than going directly to management.

When everyone works together as a team, great things can happen, such as improving work conditions and keeping people safe. You can tell when you walk into a workplace that operates this way – employees feel involved, people are more committed to working safely, the working environment is happier, people want to work harder, productivity is higher, and there are less accidents and injuries.

The *Mines Safety and Inspection Act 1994* encourages employers and employees to talk to each other about safety matters and work together, particularly through elected safety and health representatives and occupational safety and health committees.

The commitment and efforts of safety and health representatives have helped reduce occupational injury and disease rates in Western Australia in recent years.

The Act and framework of occupational safety and health law

The *Mines Safety and Inspection Act 1994* is a valuable tool for safety and health representatives.

The Act describes the duties, functions and responsibilities of all people who play some part in the safety and health of people at work. It promotes consultation and cooperation between the relevant parties about safety in mining workplaces.

The Act also places significant legal duties on individuals, known as the "general duty of care". A general duty of care applies to all people at workplaces to take care of their own safety and to take care of others' safety.

Together with the Act, the following information makes up the framework of occupational safety and health law. You will need access to the Act and some of the documents listed below. As part of the legal obligation to support safety and health representatives, your employer must make them available if requested.

- **Mines Safety and Inspection Regulations 1995**

  The regulations set minimum requirements for specific hazards and work practices in mining operations.

- **Codes of practice**

  These provide strategies to assist workplaces to comply with occupational safety and health laws in Western Australia

- **Guidelines and guidance notes**

  These cover a broad range of issues, hazards and topics relevant to workplaces.

- **National codes of practice, national standards and the Australian Standards**

  These establish national guidelines and minimum standards across Australia.

Notification

The *Mines Safety and Inspection Act 1994* requires the person conducting the election for a safety and health representative to advise the person elected, the employer and the State Mining Engineer of the result. Notification forms are available from the Resources Safety website.

Upon receipt of the election notification, a resources package is sent to the newly elected representative. The representative is also added to Resources Safety's mailing list to receive future safety and health information and *Resources Safety Matters* magazines.

> **The Act provides an important and necessary protection for safety and health representatives elected in accordance with the Act. You cannot be sued for damages for anything arising from having performed, or failed to perform, any function related to your position as a safety and health representative. However, you do have the same responsibilities and general duties of care as any other employee.**

Training

Once elected as a safety and health representative, you have the right to attend an accredited course within 12 months of being elected. However, to enable you to fulfil all of your functions, you should try to enrol in an accredited introductory training course within the first three to six months of being elected.

Safety and health representatives who have previously completed an accredited introductory course are not required to complete the course again, but may attend training to refresh or update their knowledge if they wish to do so following re-election or at the employer's recommendation.

In mining, you are free to choose, within reasonable limits, which training course to attend. This choice should be made from the list of accredited providers on the Resources Safety website in consultation with your employer and any other relevant parties at the workplace, such as the safety and health committee or a relevant union.

Completion of the introductory safety and health representatives course with the addition of a work-based project gives you the option to have your training recognised as a *Certificate III in Occupational Safety and Health* within the vocational education and training system. This option is entirely voluntary. If interested, talk to your training provider when you get to the course.

Your functions as a safety and health representative

Under the Act, a safety and health representative has the necessary powers to carry out a number of very important functions in the workplace areas that they are elected to represent.

This could be for one workplace, more than one workplace, an area of the workplace or a workforce group, such as a particular shift roster.

Function	Comment
To regularly inspect the workplace areas you were elected to represent at agreed times and frequency.	You can make an inspection with prior notice every 30 days; however, wherever possible, you and your employer should agree on the number and type of workplace inspections to be carried out. Types of inspections may include: • regular general inspections • regular inspections of particular activities, processes or areas • inspections arising from employees' complaints • inspections after substantial changes to the workplace • inspections after an accident or dangerous incident. After an inspection, you should report to the employer about any safety and health issue identified during the inspection. The report should be in writing, although hazards needing quick action should be verbally reported immediately. You should also inform employees about any workplace hazards and potential risks identified during the inspection. Checklists can be a useful tool when carrying out workplace inspections. Checklists should be developed in consultation with your employer. *The First Step*, a WorkSafe publication, has checklists that may be useful as a starting point. A fixed checklist of items can be limiting, so keep it open-ended. You should discuss the completed checklist with the employer and safety and health committee (if there is one) to help identify solutions to hazards identified. As a safety and health representative, you may accompany an inspector on an inspection of your workplace, if requested by the inspector.

Function	Comment
To immediately investigate the scene and details of any accident, dangerous incident or risk of serious injury or harm to any person.	After an accident or dangerous incident, the employer should take immediate steps to prevent the incident happening again. The employer must notify you immediately after an accident or dangerous incident. Depending on the situation, you may choose to investigate on your own or agree to a joint investigation with the employer. Examples of dangerous incidents that you may need to investigate include: • an incident that could have caused fatal or serious injuries • a falling object landing close to an employee • failure of a sling or lifting device • uncontrolled release of a hazardous chemical or substance • spillage resulting from failed valves, connections or hoses • failure of plant or equipment • collapse of a building or structure. Safety and health issues identified by safety representatives should be raised with the employer according to the steps agreed upon. Under the *Mines Safety and Inspection Act 1994*, the scene of a serious accident is off limits until the relevant person gives the all clear.
To keep up to date with workplace safety and health information provided by the employer and liaise with government and other bodies.	The employer has a duty to make safety and health information available to you. You can also liaise directly with Resources Safety or other organisations to find out more about safety matters.
To report hazards in the workplace to the employer.	You must report any hazard or potential hazard to your employer or your employer's representative. You could recognise a hazard or find out about a hazard before management becomes aware of it.
To refer any matters that you think should be considered by the committee, where there is a safety and health committee for the workplace.	You have an important role in identifying matters that should be considered by the safety and health committee.
To consult and cooperate with the employer on safety and health matters.	You must consult and cooperate with management on all safety and health matters relevant to the work area and employees you represent.
To liaise with employers and employees about safety and health matters.	You have a responsibility to advise management of the views of the employees you represent. To do this effectively you should discuss the matter with the employees and reach a common view, if possible, before meeting with the employer. You also have an important role in passing on information about safety and health matters to the employees that you represent.

Provisional improvement notices

A provisional improvement notice (PIN) is a notice issued by an elected and qualified safety and health representative about a safety and health issue in the workplace.

A PIN is similar to an improvement notice issued by an inspector. Your power to issue a PIN improves your effectiveness as a safety and health representative. However, there is no requirement for you to issue a PIN if you choose not to.

Qualified to issue PINs

Before being able to issue a PIN, you must be qualified. Being qualified means you have completed the accredited introductory safety and health representative training course, which includes a section about PINs.

Before you issue a PIN

Before you can issue a PIN you must do the following:

- be of the opinion that the person is breaching, or has breached either a provision of the relevant Act or regulation, and the circumstances make it likely that the breach will continue or be repeated
- have consulted with the person who will receive the PIN, and another safety and health representative at the workplace (if you are able to do so)
- ensure you only issue the PIN for the workplace/s you are elected to represent (or where there is at least one worker you were elected to represent).

Who can be issued with a PIN?

You can issue a PIN to anyone who has a duty of care under the Act. This includes public bodies, companies, associations, employees, employers, principal contractors, host employers and anyone for whom someone else does work. If a PIN is issued to an employee, the employee must give a copy to their employer (e.g. for a mine, the mine manager).

You cannot issue a PIN to a trading or a registered business name. Rather it must be issued to individuals or the corporations carrying out the business.

How to issue a PIN

The PIN must be in writing and specify:

- your opinion that there is a breach of the relevant Act, and this breach is likely to continue or be repeated
- the reasons for your opinion
- the provisions of the Act or regulation you consider are being breached
- the date when the breach is to be remedied (you must allow **more than seven days** from the day the PIN is issued)
- a brief summary of the right to have the notice reviewed by an inspector.

To assist, Resources Safety has produced a PIN pro forma that may be used. It can be downloaded from the Resources Safety website or contact Resources Safety.

Right of review

Recipients must comply with the PIN by the remedy date stated on the PIN, or they may seek to have it reviewed before the remedy date elapses. Failure to comply is an offence under the Acts.

A request for an inspector to review a PIN must be made in writing to Resources Safety. The PIN is suspended to allow time for review. The inspector may affirm the PIN, modify the PIN or cancel the PIN. If the inspector affirms, or affirms and modifies, the PIN it has the effect of becoming an improvement notice issued by an inspector.

Keeping records

Keeping records of tasks related to your functions is an important part of being a safety and health representative. These may include:

- daily diary of safety and health events
- monthly planner for inspections, meetings and follow-up
- copies of issued PINs
- list of job procedures for hazard identification and risk analyses
- photographs of relevant plant and equipment
- reports of your inspections
- interviews with employees
- copies of agendas and minutes of employee meetings and safety and health committee meetings
- hazard information relevant to the workplaces or workgroup for which you were elected.

Employer's duties to representatives

The Act encourages employers to work with you as a safety and health representative and set out duties for your employer to support you.

These employer duties are to:

- make safety and health information available in relation to hazards, plant, substances used, the systems of work and the safety and health of the employees at the workplace

  Note: Safety and health information includes information such as material safety data sheets (MSDS) for any hazardous substances used in their workplace, accident investigation reports or accident summaries, details of notices issued by inspectors, results of testing such as noise levels or atmospheric testing and statistical information. However, there are exceptions. Employers are not required to provide representatives with employees' personal medical information without consent, nor are they required to disclose trade secrets
- allow you to be present at any interview on safety and health between the employer (or the employer's representative) and an employee, whenever the employee requests
- consult with you on any changes in the workplace that may affect employees' safety and health
- notify you of any accidents or dangerous incidents
- allow you to take time off work, with pay, to perform your functions and attend accredited training courses
- pay for course fees and associated costs for you to attend accredited introductory training
- provide assistance and access to facilities to help you carry out your functions (e.g. access to a desk, telephone, typing and photocopying facilities, storage, use of a meeting room and notice boards).

If a Resources Safety inspector visits your workplace, your employer or employer's representative, once notified of the visit, must advise you and any other safety and health representatives of the inspector's visit.

Discrimination

Under the Act, it is an offence for an employer or prospective employer to disadvantage somebody because that person:

- is or has been a safety and health representative or a member of a safety and health committee
- performs or has performed any function as a safety and health representative or committee member
- gives or has given assistance to an inspector, safety and health representative or committee member
- makes or has made a complaint about workplace safety and health to the employer, a fellow employee, inspector, safety and health representative or committee member.

A safety and health representative who has been disadvantaged may have grounds to lodge a claim with the Occupational Safety and Health Tribunal. The tribunal may order reinstatement and/or compensation.

Safety and health committees

A safety and health committee can be established if any employee requests a committee, or the employer decides to establish one. The State Mining Engineer can direct the appointment of a committee.

Each workplace can choose the best committee structure to suit its operation. For example, a small exploration company might have one committee across several sites. A large earth-moving contractor, however, might choose to have one committee with several subcommittees, one for each mining operation.

Workplaces can also choose the composition of their occupational safety and health committee provided the safety and health committee is made up of half or more employee representatives. The committee may include elected safety and health representatives and also may have other employees elected by the employees to represent them. Other members can be employers and/or the employer representatives.

The functions of a safety and health committee are to:

- enable and assist consultation and cooperation between employers and employees
- help to initiate, develop and implement safety and health measures
- keep informed about safety and health standards in similar workplaces
- make recommendations on safety and health rules, programs, measures and procedures
- ensure information on hazards is kept where it is readily accessible
- consider and make recommendations about changes that may affect the safety and health of employees
- consider matters referred to it by safety and health representatives
- perform other functions prescribed in the regulations or given to the committee, with its consent, by the employer.

With regard to workplace safety and health, the committee may deal with:

- policy development
- monitoring programs
- emergency procedures
- training and supervision
- trends in accident and illness reports
- resolution of safety and health issues.

Resolution of issues

The best way to resolve safety and health issues is for the parties in the workplace to agree on procedures that help to resolve the issues before they become disputes.

The Act requires employers, safety and health representatives and employees to resolve safety and health issues by following relevant procedures for the workplace. If no procedures have been developed, then the procedures in the regulations must be followed. If the issue cannot be resolved and there is both a safety and health representative and a safety and health committee, the safety and health representative must refer the issue to the committee for resolution.

If an issue remains unresolved, either the employer or a safety and health representative may request an inspector to attend the workplace. Inspectors only become involved after they have satisfied themselves that an attempt has been made to resolve the matter at the workplace as required by the Act.

Inspectors can issue improvement or prohibition notices or take whatever action they consider appropriate under the Act. Alternatively, an inspector may decide that no action is required.

Right to refuse unsafe work

The Act allows employees to refuse work if they have reasonable grounds to believe the work is dangerous and there is an immediate risk of serious injury or harm to themselves or others in the workplace. The employer and the safety and health representative must be notified.

Employees do not need the employer's permission to leave the work area if they risk imminent and serious harm by remaining. The employer can give employees other work to do away from the danger.

The matter has to be resolved by the employer and the safety representative or committee, or employees, just like other safety and health issues. If these people cannot resolve the matter, they may then request an inspector to attend the workplace.

If there are any unresolved problems related to pay or benefits, an employee or the employer can refer the case to the Occupational Safety and Health Tribunal.

Disentitled employee

A disentitled employee is an employee who leaves the workplace without authorisation or refuses to undertake alternative work. It is an offence to pay a disentitled employee or for a disentitled employee to receive benefits where the employee:

- does not have reasonable grounds to believe that to continue to work would expose him or her or any other person to the risk of imminent and serious injury or harm
- leaves the workplace without the employer's authority
- refuses alternative work
- refuses to work on the grounds that another employee refuses to work.

Disqualification of safety and health representatives

The Occupational Safety and Health Tribunal can disqualify a safety and health representative. As a safety and health representative you can be disqualified if:

- you are found to have acted with the intention of harming your employer or your employer's business
- you use or disclose information obtained from your employer not connected with your functions under the Act as a safety and health representative, with the intention of harming your employer or your employer's business
- you have failed to adequately perform your functions under the Act.

Note: The misuse of PINs may meet one or more of the above criteria.

Information and support

Resources Safety provides a variety of publications to assist in the prevention of work-related injury and disease, including codes of practice and guidelines.

All publications are available on the Resources Safety website or contact Resources Safety at RSDComms@dmp.wa.gov.au for printed copies. A wide range of safety and health general information, solutions to work safety problems and interactive educational services are also available online.

A safety and health representative page has been set up for you to find relevant information quickly and easily at www.dmp.wa.gov.au/ResourcesSafety

Queries relating to the functions of a safety and health representative can be directed to mineshreps@dmp.wa.gov.au

The WorkSafe library at 1260 Hay Street, West Perth, is open to the public and is also a great source of occupational safety and health information.

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