

PART 5

EQUIPMENT AND MACHINERY



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PART 5: EQUIPMENT AND MACHINERY

5.1	HAZARD AWARENESS	11
5.1.1	SLIP, TRIPS AND FALLS	11
5.1.2	VEHICLE-MOUNTED PLATFORMS	11
5.1.3	GENERAL SAFETY PRECAUTIONS	11
5.1.4	WORKING/WALKING SURFACES	12
5.1.4.1	Wet indoor surfaces	12
5.1.4.2	Traction and footwear	12
5.1.4.3	Bad weather	12
5.1.4.4	Openings	12
5.1.4.5	Slip-resistant materials	13
	Reference documents	13
5.1.5	CONFINED SPACES	13
5.1.5.1	Introduction	13
5.1.5.2	Definitions	13
5.1.5.3	Examples of confined spaces	14
5.1.5.4	Risk assessment	14
5.1.5.5	Entry permits	14
5.1.5.6	Stand-by persons	14
5.1.5.7	Hazards in a confined space	14
5.1.5.8	Associated hazards	15
5.1.5.9	Legal obligation	15
5.1.5.10	Safety procedures for consideration	15
5.1.5.11	Design specifications for a confined space	16
5.1.5.12	Entries and exits	16
5.1.5.13	Safety of electrical equipment and services	16
5.1.5.14	Checklist	16
	Reference documents	17
5.2	HAZARDOUS PLANT	18
5.2.1	EQUIPMENT GUARDING	18
5.2.1.1	Basic principles of guarding	18
5.2.1.2	The techniques of mechanical guarding	18
	Reference Documents	31
5.2.2	BOILERS AND UNFIRED PRESSURE VESSELS	31
5.2.2.1	General	31
5.2.2.2	Exemption	31

	5.2.2.3	Certificate	32
	5.2.2.4	Identification number	32
	5.2.2.5	Definition of boiler inspector	32
	5.2.2.6	ANFO loaders	32
	5.2.2.7	Air mains	32
		Reference documents	32
5.3	TOOLS		33
	5.3.1	EXPLOSIVE-POWERED TOOLS	33
	5.3.1.1	General	33
	5.3.1.2	Qualified operator	33
	5.3.1.3	Use	33
		Reference documents	33
	5.3.2	ABRASIVE WHEELS	33
	5.3.2.1	Tools and grinding/cutting wheels	33
	5.3.2.2	Operation	33
	5.3.2.3	Maintenance	34
	5.3.2.4	Personnel protection	34
		Reference document	34
	5.3.3	GAS CUTTING, WELDING AND HEATING	34
	5.3.3.1	General	34
	5.3.3.2	Operator education	34
	5.3.3.3	Operator protection	34
	5.3.3.4	Equipment	35
	5.3.3.5	Working in a shaft, rise, pass, lift, pit or closed vessel	35
	5.3.3.6	Fire protection	35
	5.3.3.7	Storage and handling of gas cylinders	35
	5.3.3.8	Backfires and flashbacks	36
	5.3.3.9	Lighting a gas torch	37
	5.3.3.10	Hot work permits	37
	5.3.3.11	Safe areas	37
	5.3.3.12	Preparation of work sites	37
	5.3.3.13	Restoration of the work site	38
	5.3.3.14	Training	38
	5.3.3.15	Confined spaces	38
	5.3.3.16	Ventilation in confined spaces	39
	5.3.3.17	Personal protective equipment	39
		Reference documents	40

5.4	MAINTENANCE AND REPAIRS	41
5.4.1	GENERAL	41
5.4.2	PLANNED MAINTENANCE	41
5.4.3	HEALTH AND SAFETY REQUIREMENTS	41
5.4.4	ROUTINE MAINTENANCE TASKS	41
5.4.4.1	Checklists	41
5.4.4.2	Daily checks	41
5.4.4.3	Suggested aids in scheduling maintenance	42
5.4.4.4	Breakdown maintenance	42
5.4.4.5	Defect notice procedure	42
	References document	42
5.5	CRUSHING, SCREENING AND CONVEYOR MACHINERY	43
5.5.1	GENERAL	43
5.5.2	PRIMARY FEED	43
5.5.2.1	Traffic hazards	43
5.5.2.2	Dust hazards	43
5.5.2.3	Rock chips	43
5.5.2.4	Falling rocks	43
5.5.2.5	Primary feed hopper	43
5.5.3	CRUSHING	43
5.5.3.1	Falling rocks	43
5.5.3.2	Rock chips	44
5.5.3.3	Dust hazards	44
5.5.3.4	Noise hazards	44
5.5.3.5	Blockages	44
5.5.3.6	Steel in crusher	45
5.5.3.7	Explosives	45
5.5.3.8	Falling persons	45
5.5.3.9	Flywheels and other moving parts	45
5.5.4	SCREENING	45
5.5.4.1	Moving parts	45
5.5.4.2	Dust hazards	45
5.5.4.3	Noise hazards	45
5.5.4.4	Spillage	45
5.5.4.5	Vibration	45
5.5.4.6	Confined space	45
5.5.5	CONVEYORS	

45		
	5.5.5.1	Moving parts 45
	5.5.5.2	Emergency stop controls 46
	5.5.5.3	Prestart warning system 47
	5.5.5.4	Isolation procedure 47
5.5.6		SURGE PILES AND STOCKPILES 47
	5.5.6.1	Burial 47
	5.5.6.2	Collapse 47
	5.5.6.3	Wet material 47
	5.5.6.4	Dust hazard 48
	5.5.6.5	Traffic hazard 48
	5.5.6.6	Falling material 48
5.5.7		RECLAIM TUNNELS 48
	5.5.7.1	Dangerous moving parts 48
	5.5.7.2	Fire 48
	5.5.7.3	Entrapment 48
	5.5.7.4	Insufficient lighting 48
	5.5.7.5	Insufficient ventilation 48
5.5.8		WASHING PLANTS AND PONDS 48
	5.5.8.1	Moving parts 48
	5.5.8.2	Wet and slippery surfaces 48
	5.5.8.3	Deep water or viscous slurry 48
	5.5.8.4	Flooding 48
	5.5.8.5	Stability of embankment 48
5.6		ACCESS TO PLANT 49
	5.6.1	FIXED LADDERS 49
	5.6.2	RUNG LADDERS 49
	5.6.3	STEP LADDERS 49
	5.6.4	PORTABLE LADDERS 49
	5.6.5	TIMBER PORTABLE LADDERS 50
	5.6.6	METAL PORTABLE LADDERS 50
	5.6.7	PORTABLE EXTENSION LADDERS 50
	5.6.8	PORTABLE STEP LADDERS 50
	5.6.9	WALKWAYS AND PLATFORMS 51
	5.6.10	STAIRWAYS 51
	5.6.11	BINS AND HOPPERS 51
		Reference documents 51

5.7	DREDGES (OPEN AND STILL WATER)	52
5.7.1	GENERAL	52
5.7.2	DESIGN	52
5.7.3	SAFETY	52
	5.7.3.1 Operation and maintenance	53
	5.7.3.2 Headlines and sidelines	53
5.8	ORE-CONVEYING SLURRY PIPELINES	54
5.8.1	GENERAL	54
5.8.2	DESIGN	54
5.8.3	OPERATION AND MAINTENANCE	54
5.9	LIFTING EQUIPMENT	56
5.9.1	LIFTING EQUIPMENT USED UNDERGROUND	56
	5.9.1.1 Personnel winches	56
5.9.2	CRANES AND HOISTS	57
	5.9.2.1 General	57
	5.9.2.2 Training	57
	5.9.2.3 Definition of a crane inspector	57
	5.9.2.4 Mobile cranes – electrical hazards	57
	5.9.2.5 Clearance to mobile equipment	58
	Reference documents	60
5.10	MOBILE PLANT AND MACHINERY – SURFACE AND UNDERGROUND	61
5.10.1	GENERAL	61
	5.10.1.1 Manufacturer’s compliance statement	61
	5.10.1.2 Documentation	61
	5.10.1.3 Design	62
	5.10.1.4 Noise	62
	5.10.1.5 Labelling	62
5.10.2	DESIGN FEATURES	63
	5.10.2.1 Operator cabin	63
	5.10.2.2 Access	66
	5.10.2.3 Auxiliary equipment	66
	5.10.2.4 Mechanical and hydraulic components	67
	5.10.2.5 Electrical components	71
5.10.3	FIRE PROTECTION	75
	5.10.3.1 Fire extinguishers	75
	5.10.3.2 Fire-suppression system	75
	Reference documents	77

5.11	MOBILE EQUIPMENT USED ON THE SURFACE	78
5.11.1	GENERAL OPERATIONAL ISSUES	78
5.11.1.1	Safety of the vehicles	78
5.11.1.2	Competence of the drivers	79
5.11.1.3	Safe work procedures	80
	Reference document	81
5.11.2	EXCAVATORS	81
5.11.2.1	General	81
5.11.2.2	Pre-start	81
5.11.2.3	Operation	82
5.11.3	FRONT-END LOADERS	83
5.11.3.1	Operation	83
5.11.4	FORKLIFTS	83
5.11.4.1	Forklift hazards	84
5.11.4.2	Safe work procedures	84
	Reference documents	84
5.11.5	HAUL TRUCKS	84
5.11.5.1	General	84
5.11.5.2	Operation	85
5.11.5.3	Visibility	85
5.11.5.4	Dumping	85
5.11.5.5	Haulage roads	86
5.11.6	ROPS AND FOPS	87
	Reference documents	88
5.11.7	ELEVATING WORK PLATFORM VEHICLES (CHERRY PICKERS)	88
5.11.7.1	General	88
5.11.7.2	Safety harnesses	88
5.11.7.3	Controlled descent devices	88
5.11.7.4	Safe working load	89
5.11.7.5	Cleaning	89
5.11.7.6	Daily inspection	89
5.11.7.7	Travel procedure	89
5.11.7.8	Setting up at the work site	90
5.11.7.9	Rescue procedure	90
	Reference documents	90
5.12	MOBILE CRANES	91
5.12.1	EARTHMOVING MACHINERY USED AS CRANES	91

5.12.1.1	General	91
5.12.1.2	Competent persons	91
5.12.1.3	Design of attachments	91
5.12.1.4	Precautions to be taken by the vehicle operator	92
	Reference document	92
5.12.2	CRANE MAN LIFT BOXES ON MINES	92
5.12.2.1	General	92
5.12.2.2	Competent persons	92
5.12.2.3	Operational requirements	92
5.12.2.4	Design and construction requirements	93
5.12.2.5	Inspection and testing	94
	Reference documents	94
5.12.3	SURFACE MOBILE CRANES AND OVERHEAD POWERLINES	94
5.12.3.1	Hierarchy of control	94
5.12.3.2	Minimum clearance	95
5.12.4	SAG AND SWAY IN OVERHEAD POWERLINES	95
5.12.4.1	Sag	95
5.12.4.2	Sway	95
	Reference documents	95
5.13	MOBILE EQUIPMENT USED UNDERGROUND	96
5.13.1	DIESEL-POWERED	96
5.13.1.1	Exhaust gas emission controls (underground only)	96
5.13.1.2	Hazards	96
5.13.1.3	Equipment modifications and repairs	97
5.13.1.4	Engine compartment	97
5.13.2	LOCOMOTIVES	97
5.13.2.1	Definitions	97
5.13.2.2	Design	98
5.13.2.3	Controls	98
5.13.2.4	Locomotive batteries	98
5.13.2.5	Battery charging and repair stations	99
5.13.2.6	Operation and maintenance	99
5.13.2.7	Trolley wire installations	100
	Reference Documents	100
5.13.3	REMOTE-CONTROLLED LOAD-HAUL-DUMP EQUIPMENT	100
5.13.3.1	Introduction	100
5.13.3.2	Mine design	100

5.13.3.3	Facilities	100
5.13.3.4	Safe work practices	101
5.13.3.5	Maintenance	101
	Reference documents	102
INDEX		103

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 tests 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 kept 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.

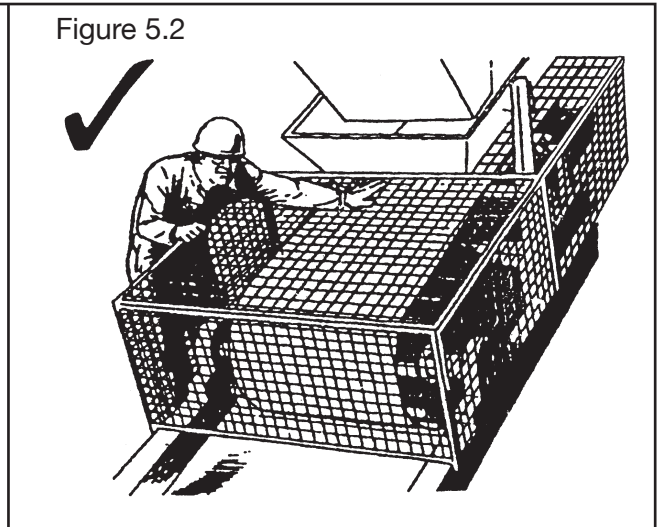
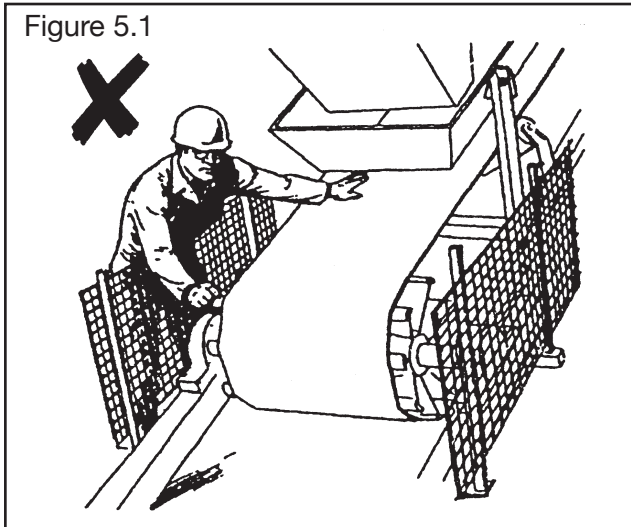
5.2.1.2 THE TECHNIQUES OF MECHANICAL GUARDING

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.

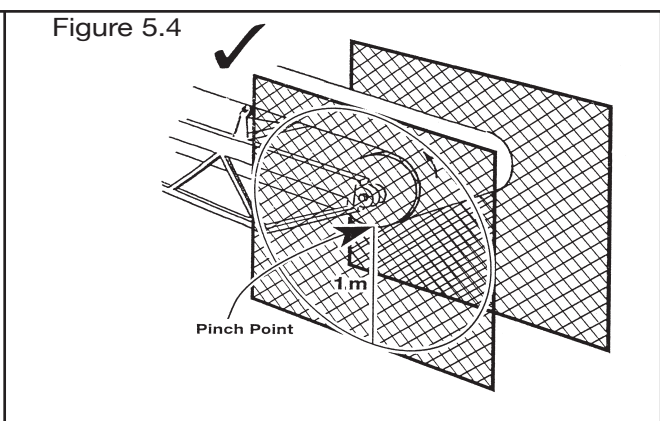
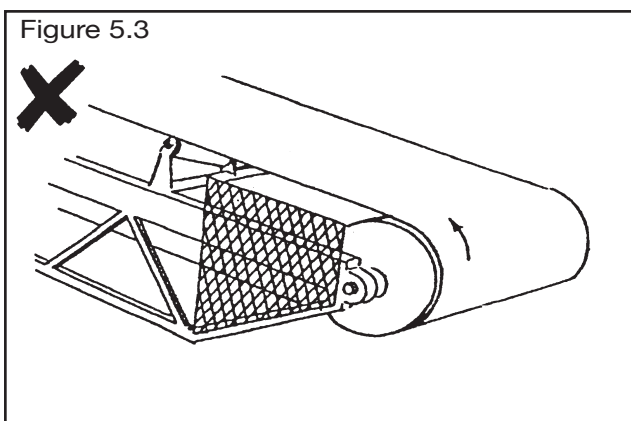
Each illustration is marked correct or incorrect



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.



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.

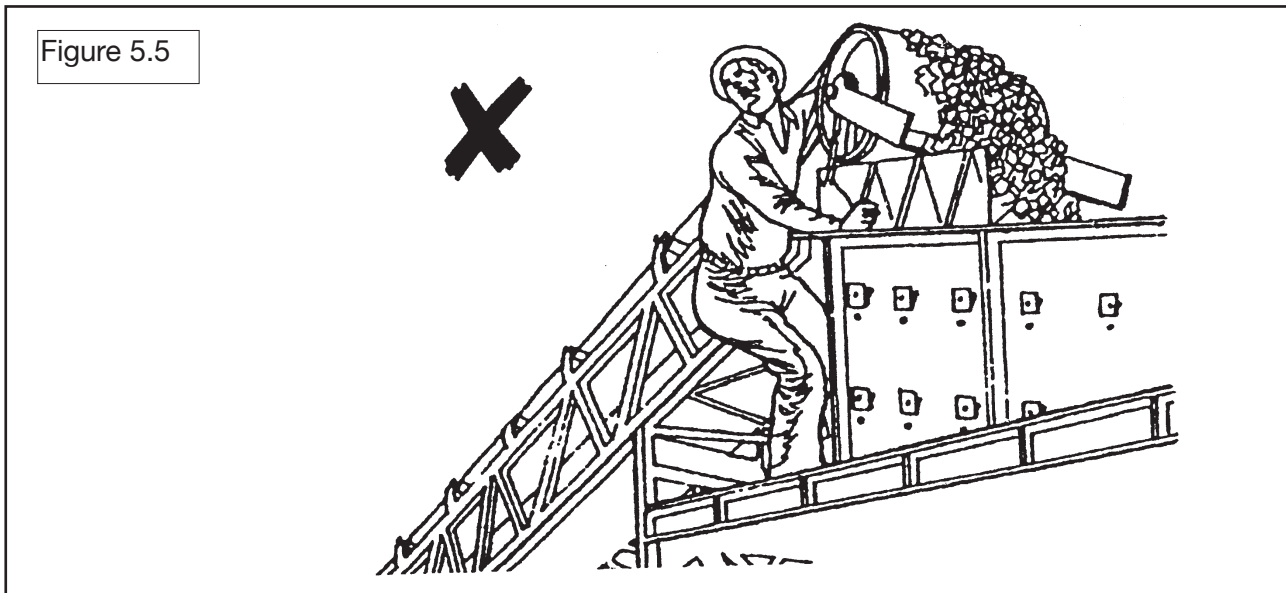
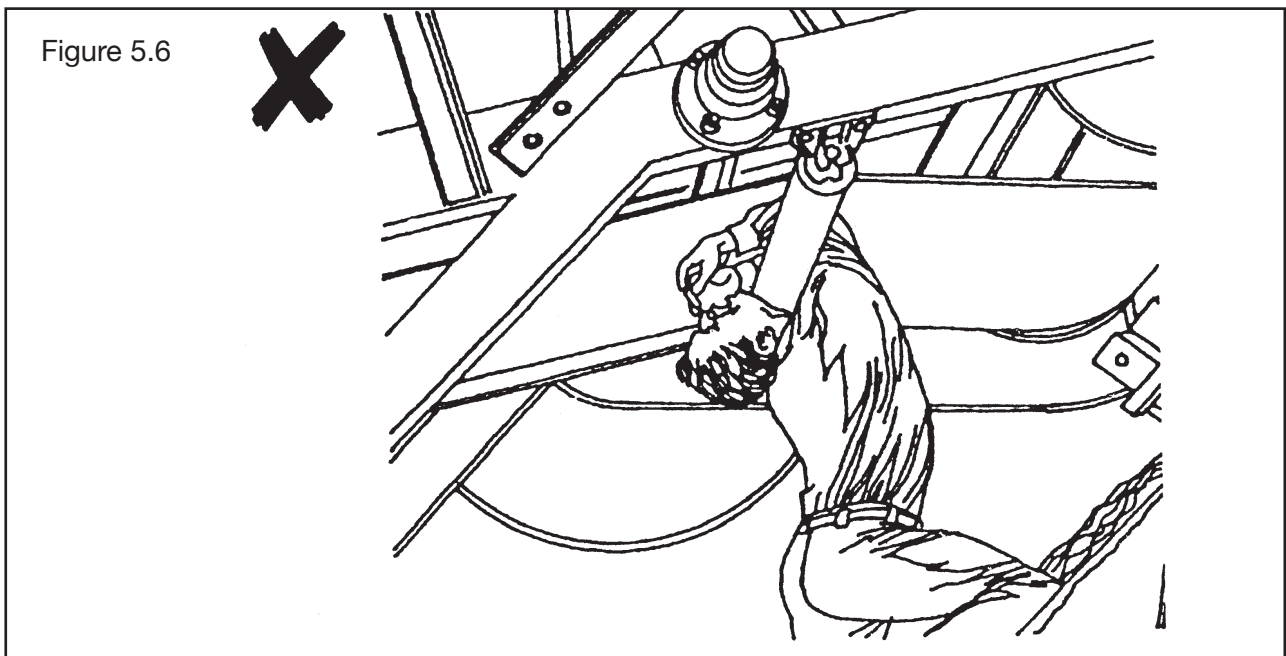


Figure 5.5 Underground head pulley

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 be 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



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.

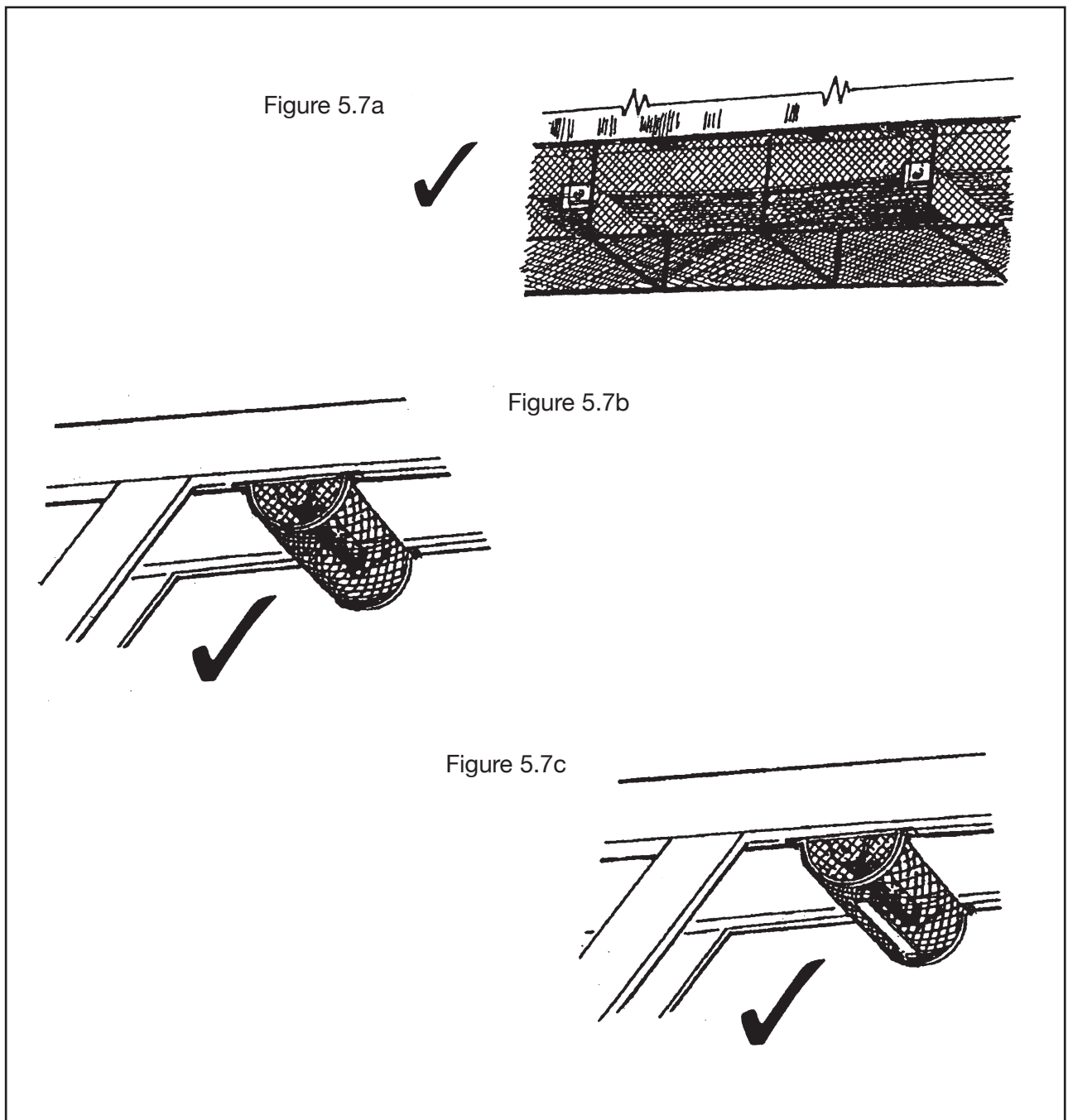
Guarding of return idlers is critical where a change in direction takes place at the idler because higher belt tension may mean a trapped person can not release themselves.

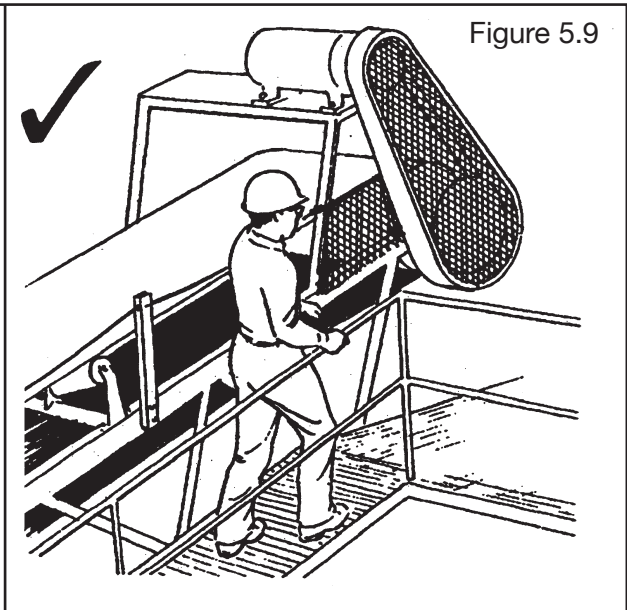
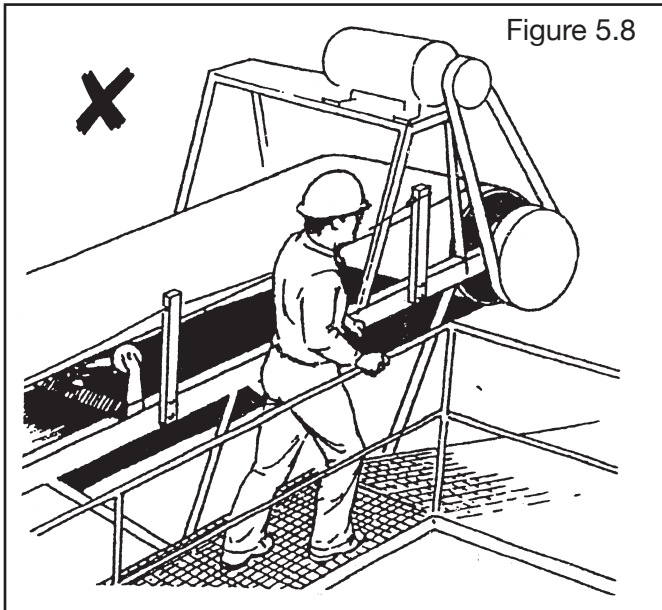
The pinch points of return idlers can be guarded in various ways. Individual guards may be appropriate in some instance (as depicted in Figures 5.7b and 5.7c), or a guard may prevent access to a series of return idlers (as depicted in Figure 5.7a).

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.





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.

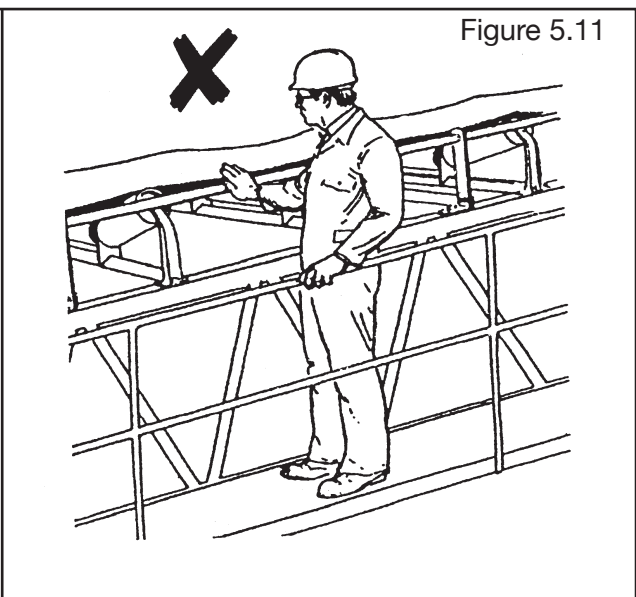
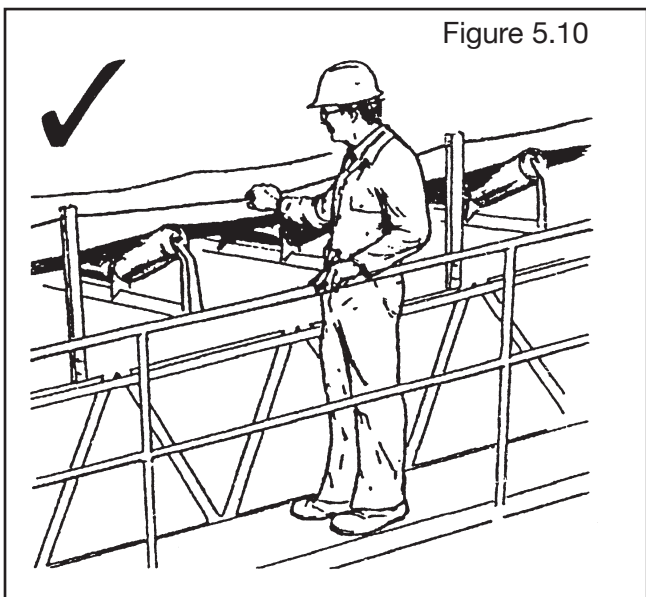


Figure 5.10 Emergency stop cord

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

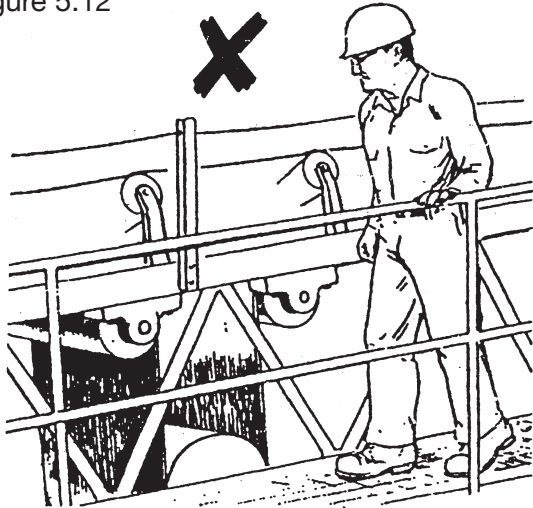


Figure 5.13

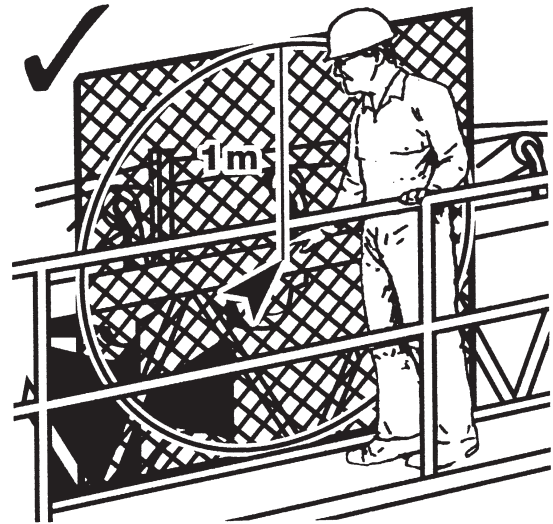
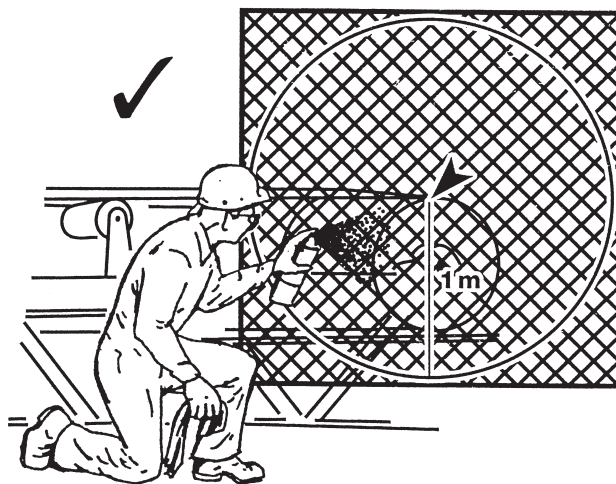


Figure 5.14



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

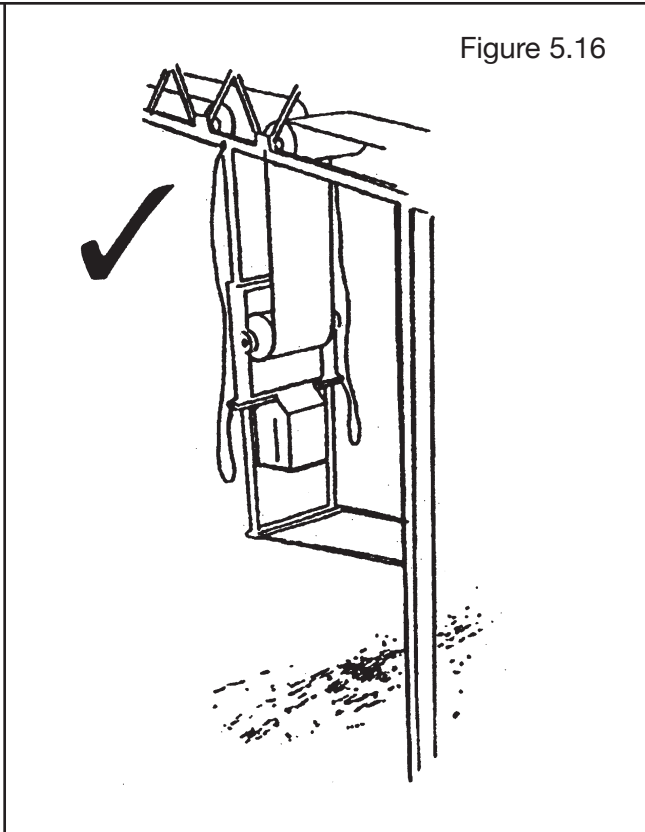
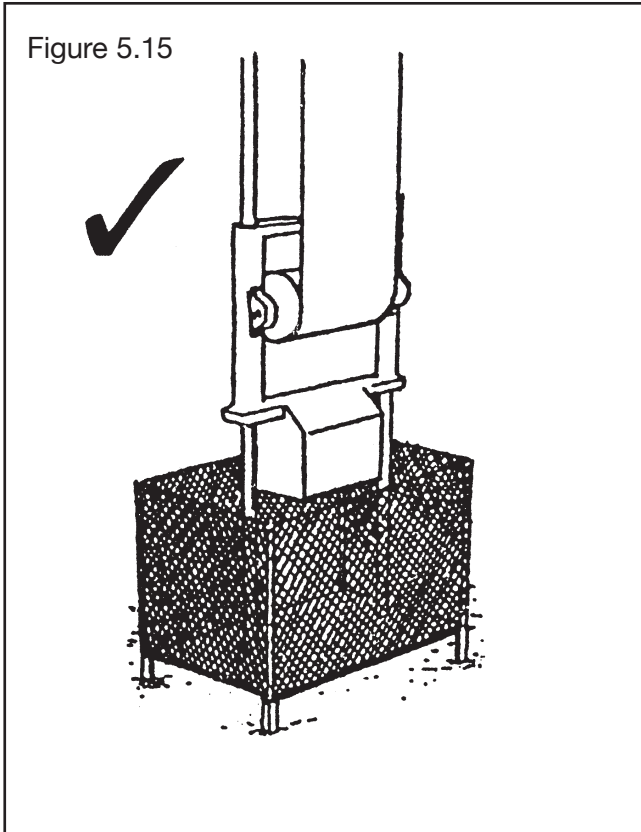
Belt dressing shall not be applied manually while belts are in motion, unless an aerosol-type dressing is used. When dressing other than pressurised-type is applied, the conveyor must be de-energised and locked.

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

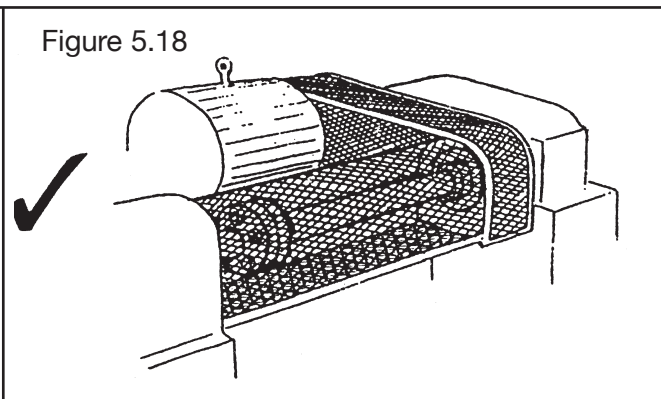
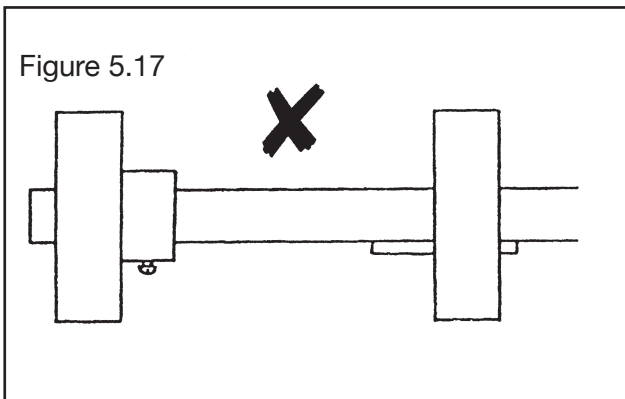
the counterweight from dropping to ground level in case of belt breakage. Cables, for additional safety, are fastened to the structure. It is recommended that the area below the counterweight is also guarded, however, if this is not practical then cables may be adequate if they are designed to absorb the impact of the counterweight and pulley assembly when it travels its maximum possible distance in the event of the belt breaking.



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.



Figures 5.19 and 5.20 Drive shafts

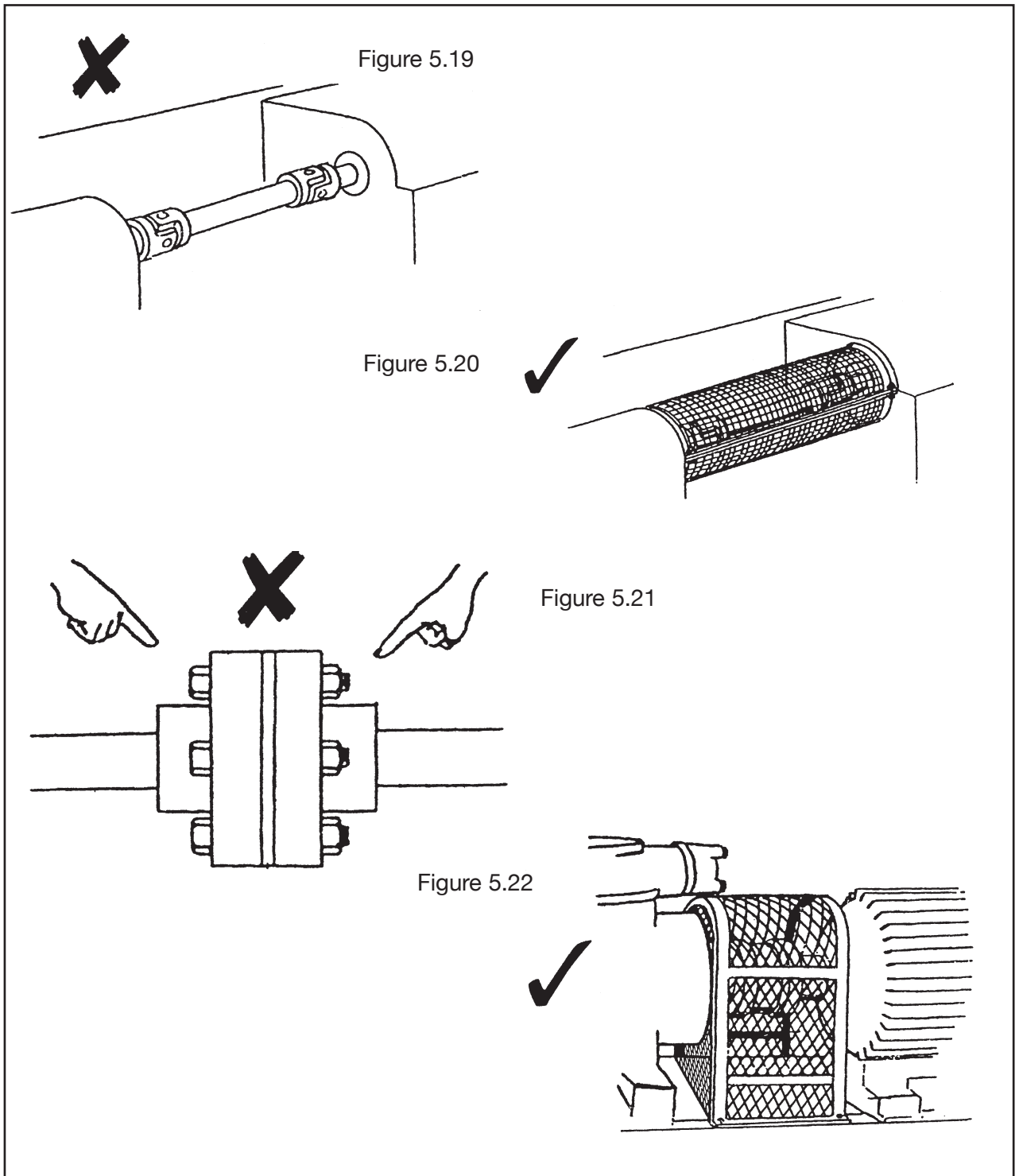
A power-off shaft with universal joints is shown in Figure 5.19.

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.



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.

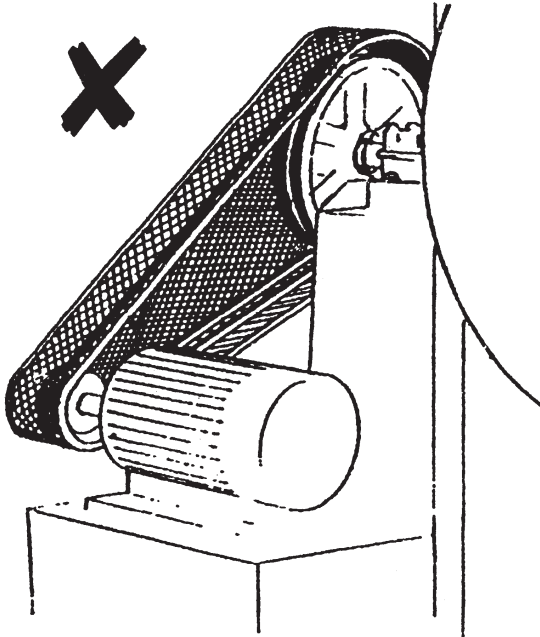
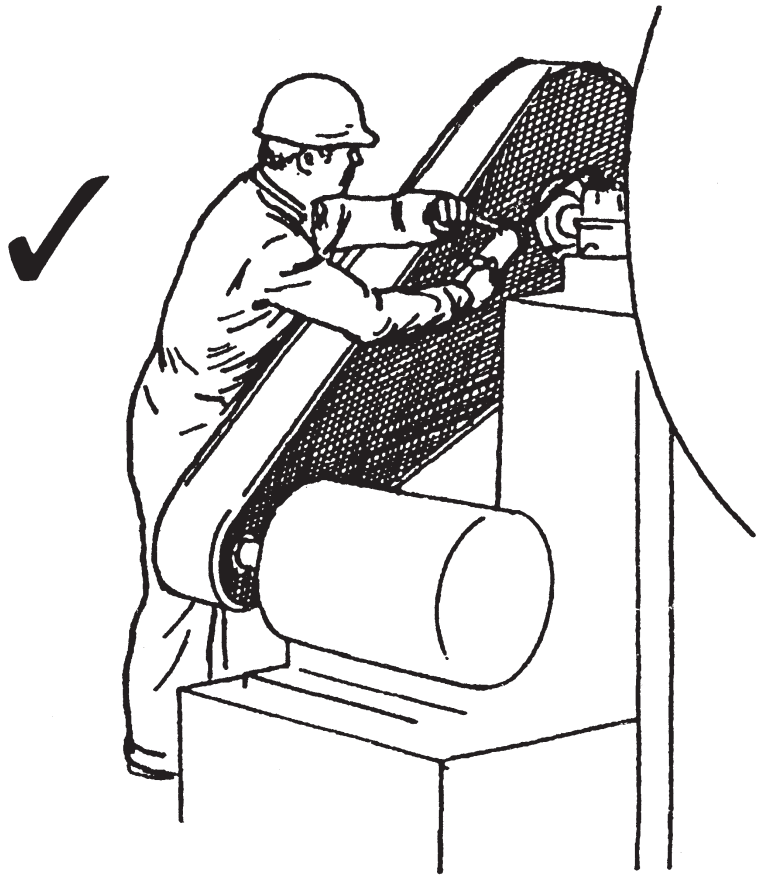


Figure 5.23

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.

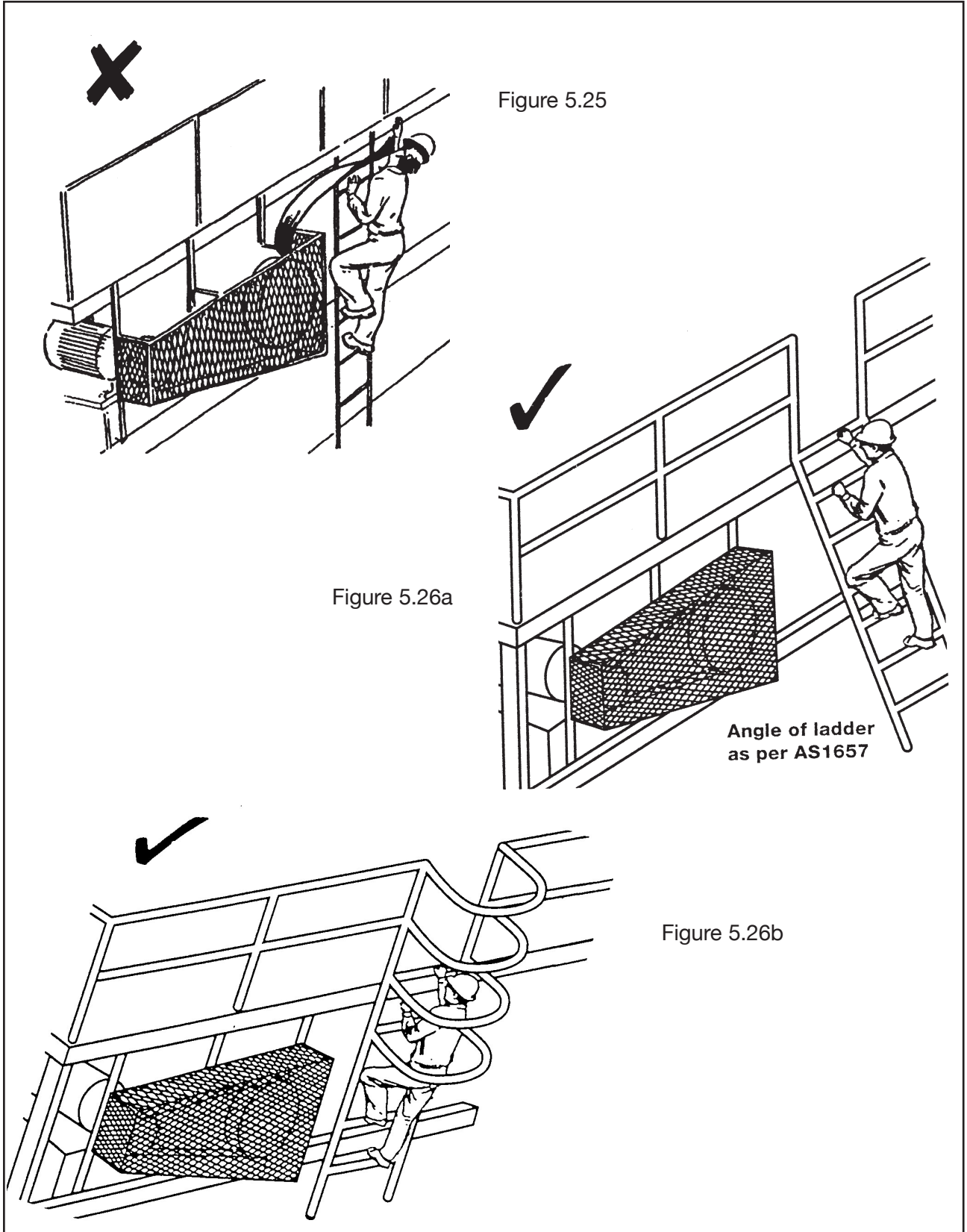
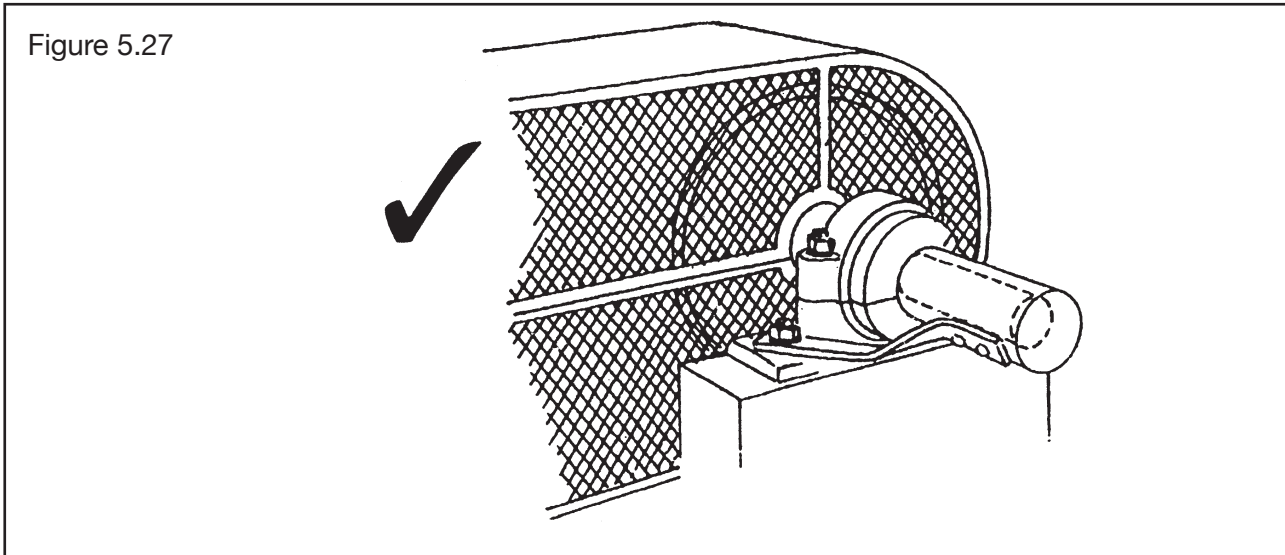


Figure 5.27 Protruding shaft ends

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.

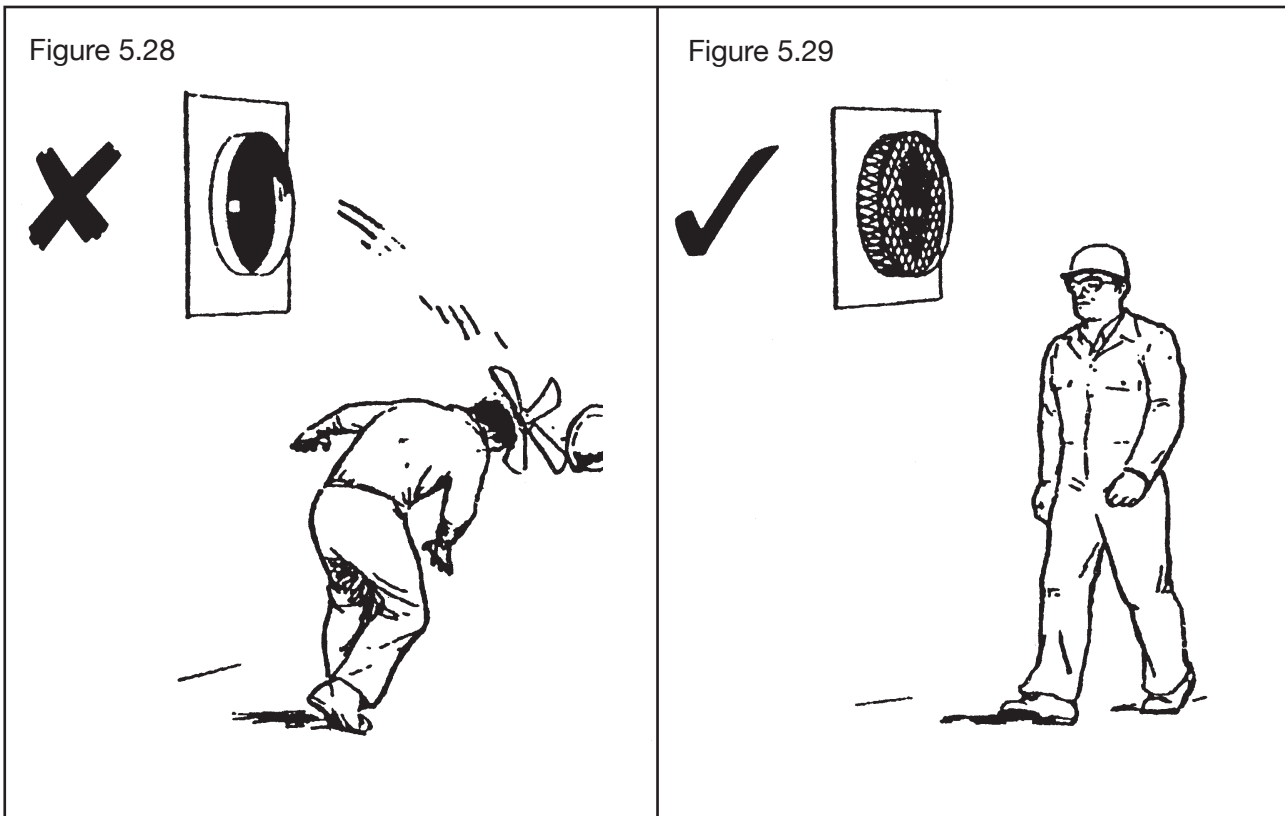
All shafts with a keyway or other protrusion or hole other than in the center, regardless of the distance they protrude, shall be guarded.



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.



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.

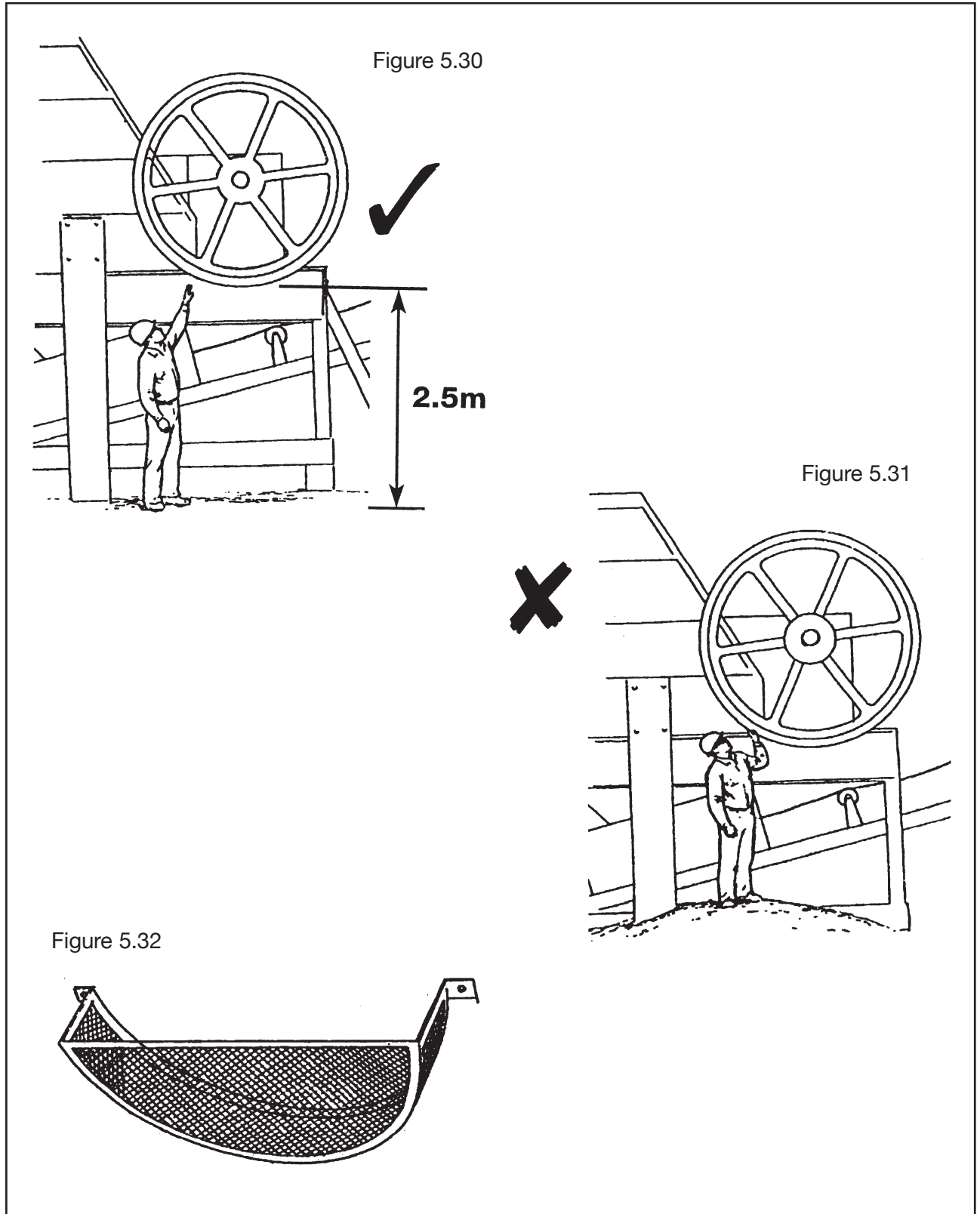


Figure 5.33 Classifier

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.

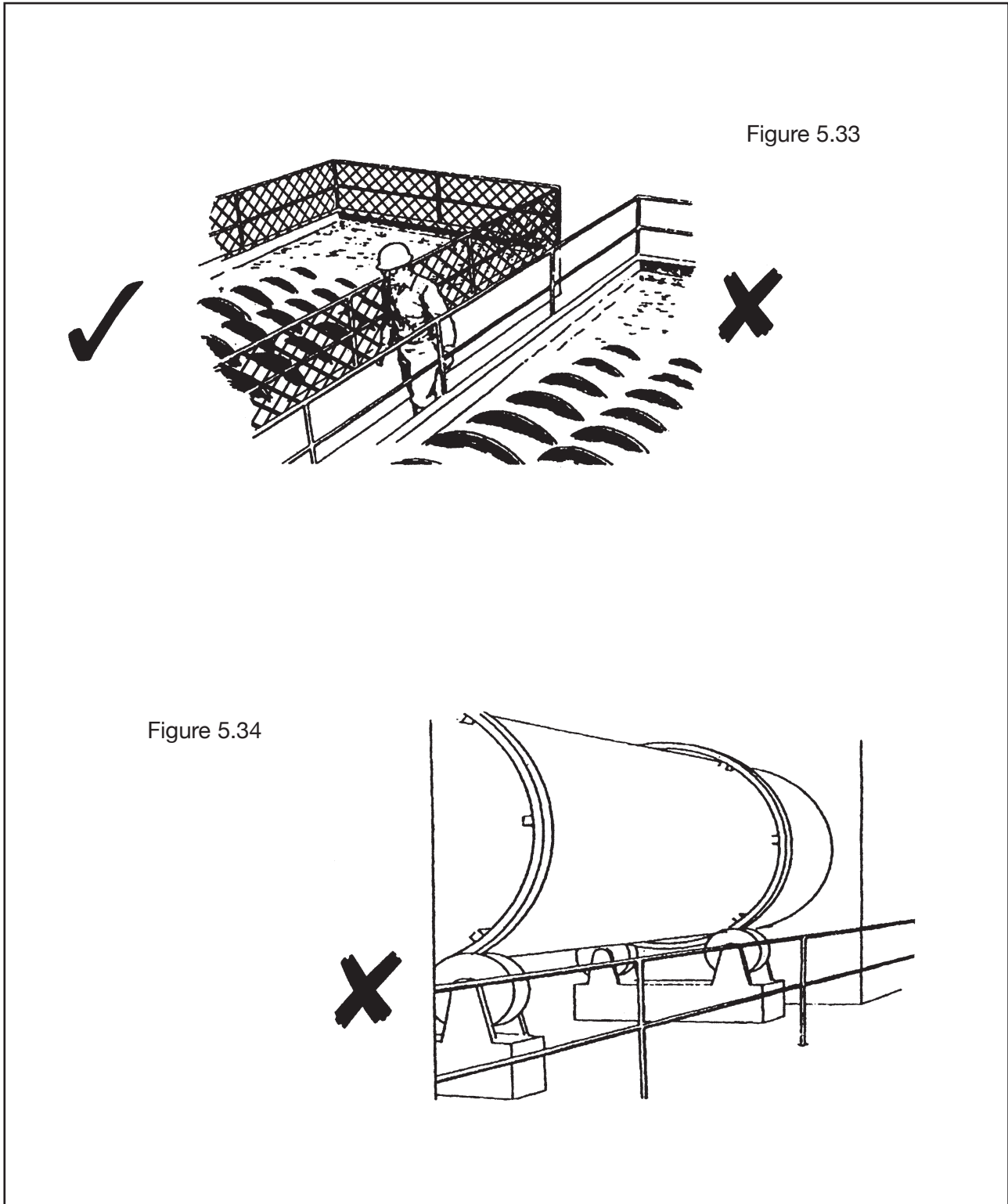


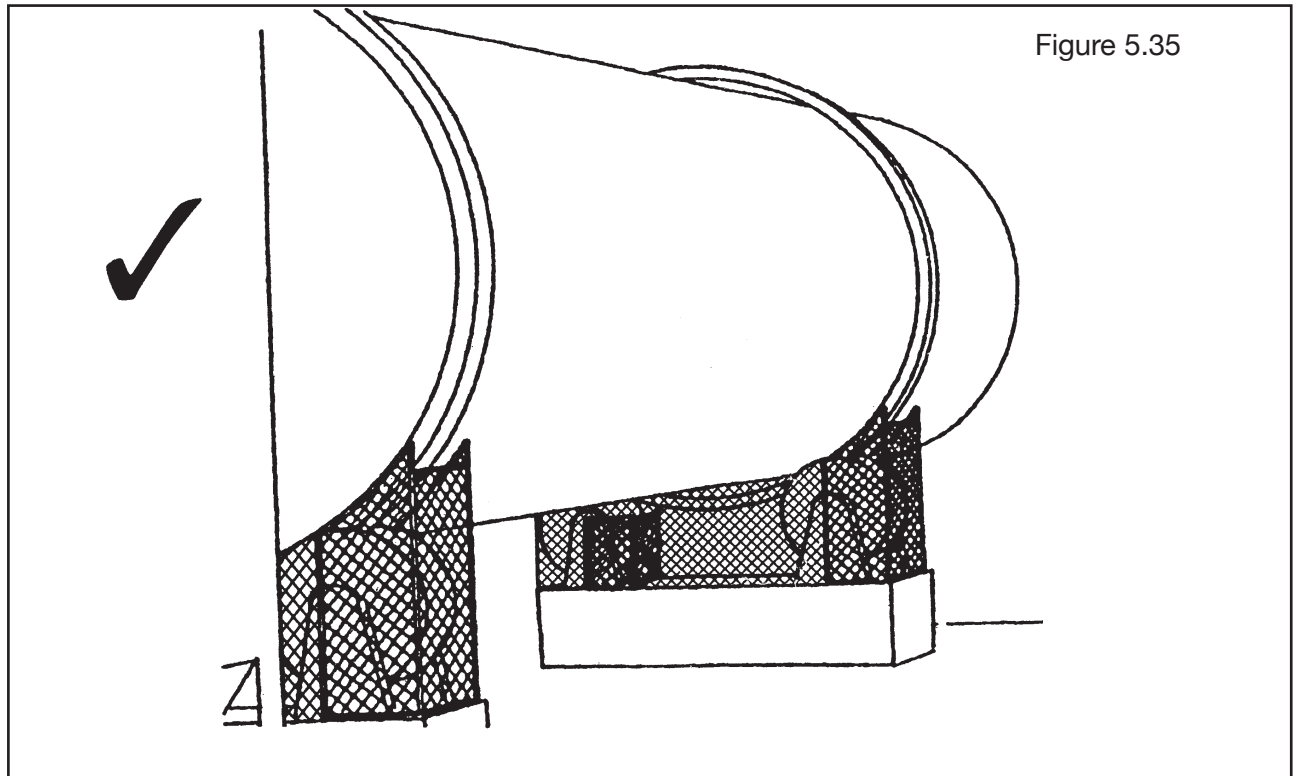
Figure 5.35 Trunnions

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.



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 than 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.

Minimum Protective Equipment

PROCESS	HAZARD	PERSONAL PROTECTION
Gas cutting and welding	Radiation Burns	Goggles with appropriate filters and clothing Gloves, footwear with suitable head wear for overhead cutting
Arc welding (manual)	Burns Radiation	Full face protection shields with filters Adequate clothes, gloves and footwear
Electric shock grinding, and chipping	Hard particles	Goggles and hearing protection
Plasma cutting adequate clothing	Fumes Radiation	Goggles with appropriate filters and Gloves, footwear and suitable head wear for overhead cutting

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.

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 Gas cutting/welding	Not Required Not Required	Fume mask Fume mask – use fume mask if fumes are excessive, ie working with galvanised metal	Not required Not required – use fume mask if Fumes are excessive, ie working with galvanised metal	Fume mask 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 provided (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 Apparatus (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 require 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 enclose 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.

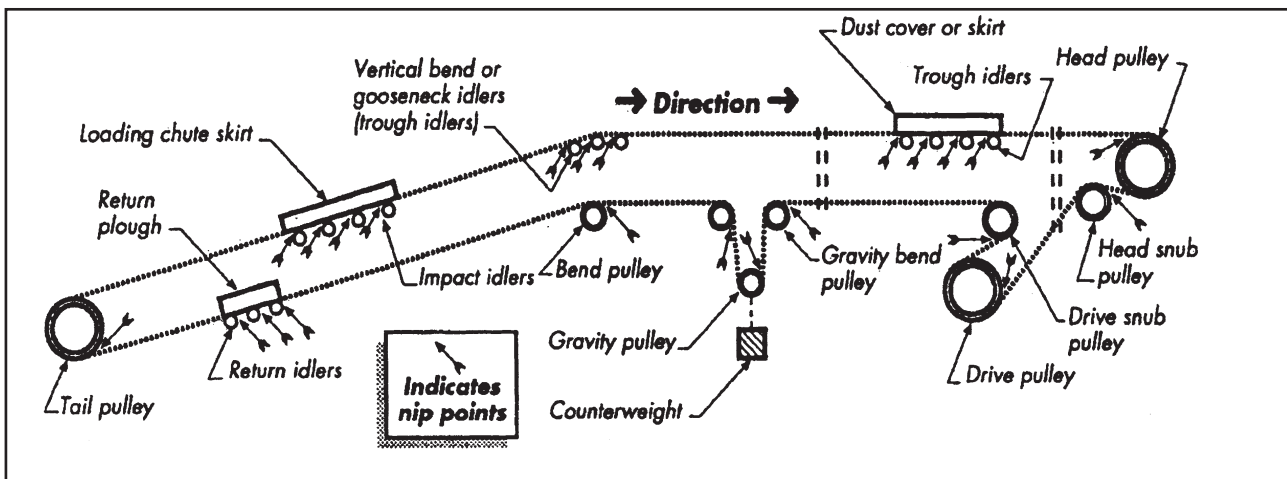
All moving machinery should be guarded to protect against the possibility of injury. The guards should be fixtures of the machinery, interlocked where possible, or needing tooling for removal. Interlocked means the removal of the guard prevents the equipment from running or being started.

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 conveyor, 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.

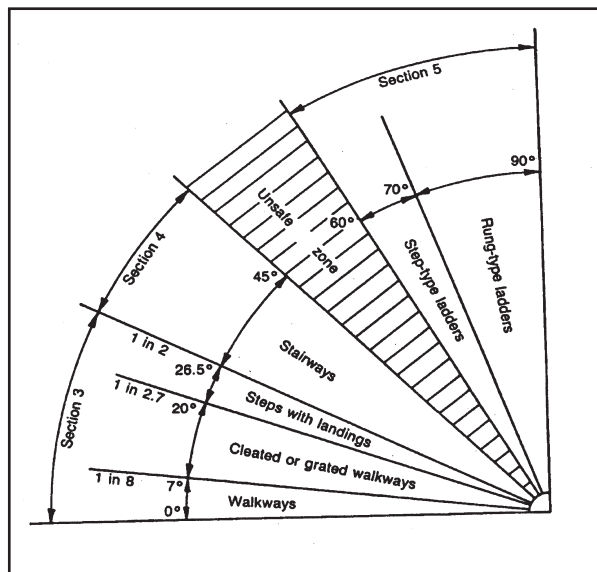
Note: The use of ladders for areas requiring frequent access should be avoided where practicable. Preference should be given to stairways.

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 525 mm 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

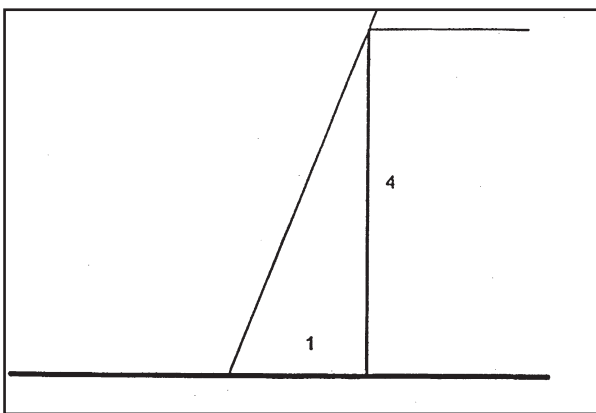
The following should apply:

- 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

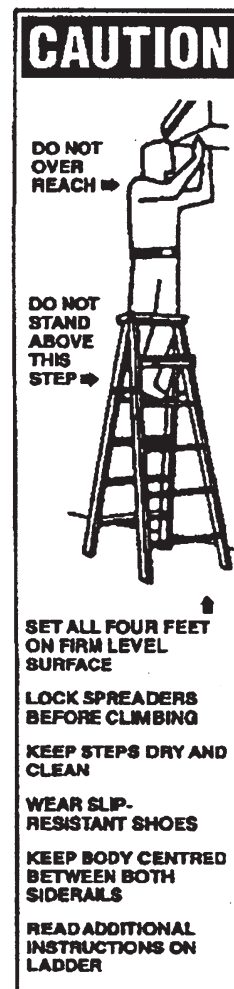
- The overlap of adjacent sections should be no less than 3.5 rungs.
- They must have well-maintained runners, guides and extensions devices.

- They must have adequate and well-maintained locking devices.

5.6.8 PORTABLE STEP LADDERS

- Step ladders are 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.

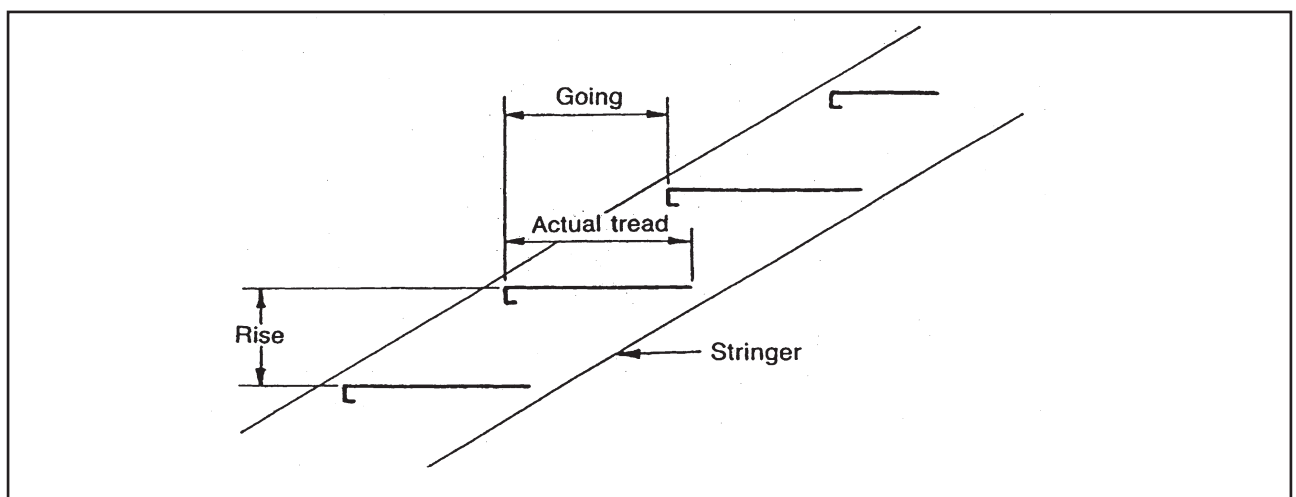
AS 1657 Fixed Platforms, Walkways, Stairways and Ladders.

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 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.

Environmental 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 preferable 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 circuits

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 switches

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-tired 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.

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.

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.

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 wheel loaders.
- 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 $12 \times 12 \times 8 = 1150$ 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 your 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.
- 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.

5.11.3 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.

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

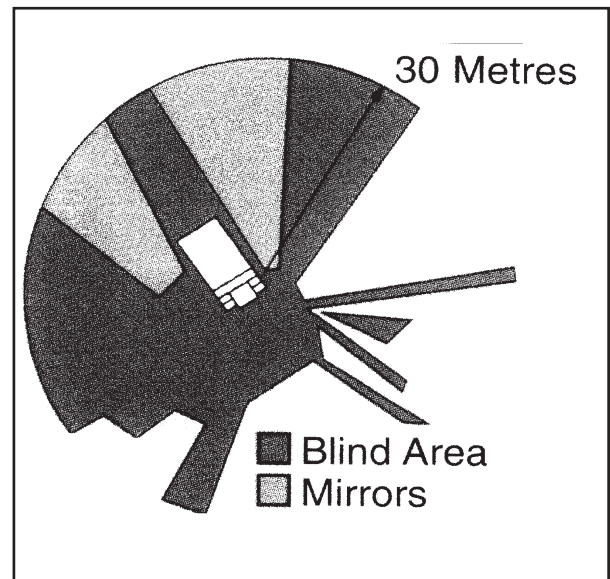
All operators should:

- 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 HARNESES

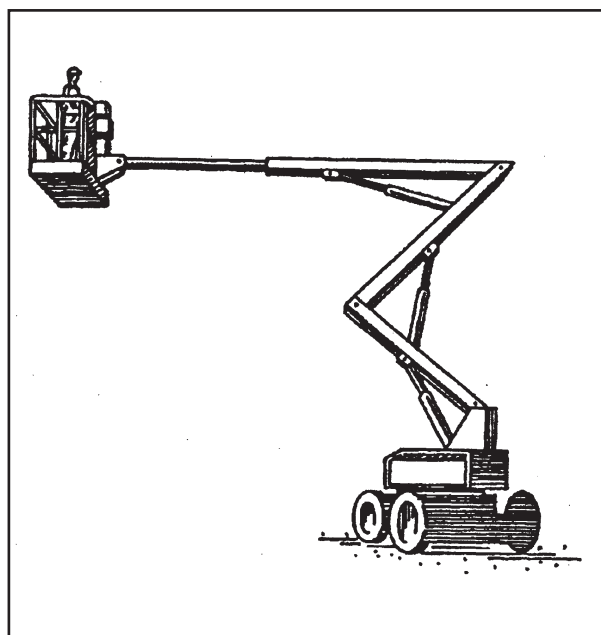
Safety harness should be worn and properly secured at all times by people when aloft. There should be an attachment anchorage point in the basket appropriate for the harness.

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, $SWL = 0.7 \times \text{machine bucket rated load}$. 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 = $SWL \times 125\%$.

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 than 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 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.

A		Fire	14, 32-34, 37-38, 40, 48, 62, 64, 66 68, 70, 72-76, 84, 94, 98
Accidents	10, 18, 20, 42, 44, 48, 60, 78, 81, 83, 87	Fork lifts	42, 78, 82, 84
Australian Standards	18, 31, 57, 60, 62, 64, 84, 90	G	
B		Grinders	33-34
Berms	86	Guarding	16, 18, 20, 26, 28-29, 31, 37, 41, 45
Braking	31, 56, 62, 66-68, 70, 76, 80, 86, 98		
C			
Confined Space	12, 14-17, 34, 36, 38-39, 42, 45		
Conveyors	14-15, 22, 44-46, 51		
Cranes	42, 56-57, 22, 44-46, 51		
Crushers	42-44		
Cutting	18, 32, 34, 36, 38-39		
Cylinders	34-36, 38, 76		
D			
Diesel Engines	96		
Dredges	50		
Dust	15, 32, 34, 38, 41-44, 46, 64, 70, 73, 84, 87, 98		
E			
Excavators	69, 78, 80		
Exhaust Gases	16, 96		
F			

H		Roll-Over Protection	61
Hazards	10, 12, 14, 16,24, 35-38, 42-44, 51-52 56-58, 61, 72, 74, 78, 80, 82, 88, 94-97, 100	S	
Hoists	44, 56, 60	Shafts	14, 22, 24, 26, 34, 44, 56
Hot Work Permit	38	Slurry	48, 52, 54
I		T	
Incidents	11, 84	Tagging System	100
Isolation	13, 45, 47, 59, 63, 74, 94	Trips and Falls	9, 13
L		W	
Locomotives	96, 98, 100	Welding	14, 16, 34-36, 38-39, 93, 99, 101
M			
Mobile Equipment	31, 35, 56-59, 76, 80, 94		
P			
Permit System	14		
Planned Maintenance	41		
Platforms	10, 12, 16, 30, 42, 44, 46, 49, 51, 64, 88, 90, 92		
Pressure Vessels	64, 88, 90, 92		
Protective Equipment	30-31, 69, 76		
R			
Remote Controls	77, 100, 102		
Risk Assessment	10, 12, 42, 56, 73, 93, 97, 100		

