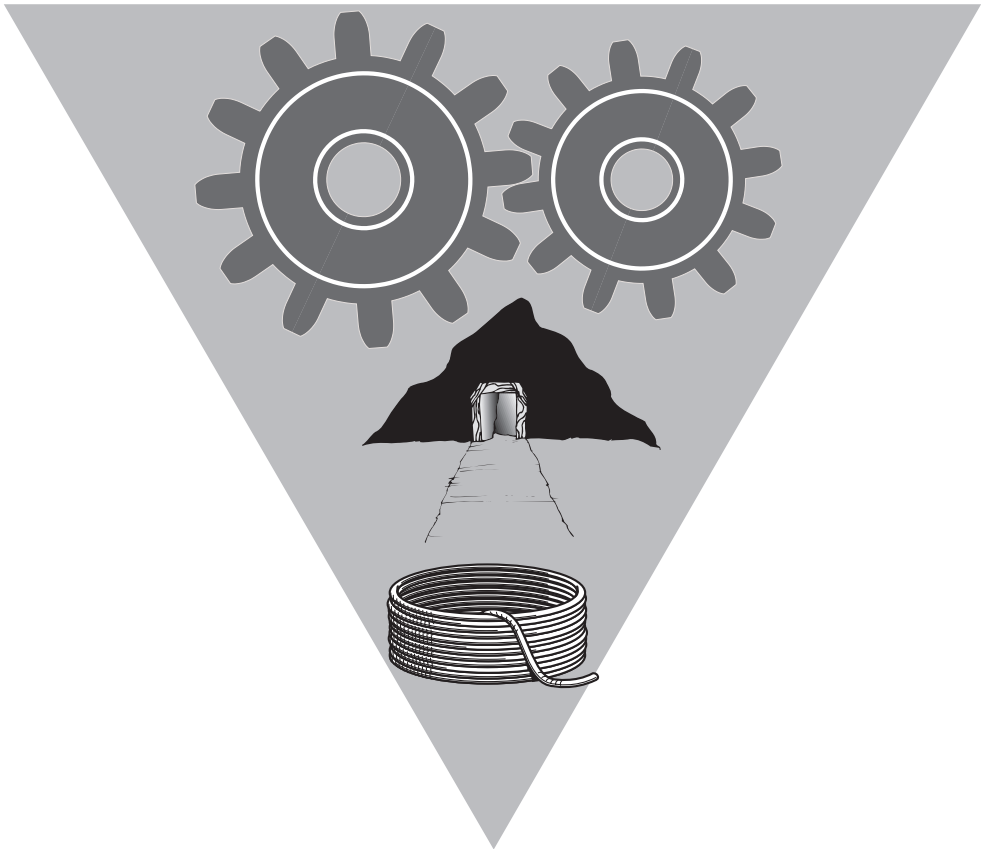
PART 6

SHAFTS, WINDING AND HOISTING SYSTEMS



UPDATED 8 NOV 2002

PART 6: SHAFTS, WINDING AND HOISTING SYSTEMS 7

6.1 GENERAL

This part applies to hoisting arrangements where the depth exceeds 30 metres.

Any means of hoisting material from below ground should be designed, installed and maintained to perform safely.

Prior to the installation of any haulage system or any means of transporting persons or material in a shaft of a mine (which exceeds 30 metres in depth), the mine operator should consider:

- a plan or plans showing the location of the shaft or other mine openings together with the general layout of the proposal;
- details including the factors of safety of winding machinery and shaft conveyances;
- details of rope types and sizes and all attachments to be used, including details of duties and factors of safety;
- design details of the headframe and associated facilities and provision to be made against overwinds; and
- a risk assessment of the whole shaft system.

6.2 HEADFRAMES AND WINDERS

Headframes should be designed and constructed to conform with the provisions of AS 3785 Underground Mining–Shaft Equipment.

6.2.1 DRUMS AND SHEAVE WHEELS

Drums and sheave wheels should be designed and manufactured in accordance with AS 3785 Underground Mining–Shaft Equipment.

6.2.2 FENCING, GATES, SHAFT ENTRANCES SUPPORTED

All shaft entrances from the bottom of every shaft to the head sheaves should have proper gates or be properly and securely fenced, railed or covered, and the temporary removal of any fence or cover requires proper precautions to be used to prevent people falling down the shaft.

6.2.3 CHAIRS AT PLATS

Where shaft conveyances are used for materials handling, then at those plats where hauling operations are carried on, chairs or bearers or some other appliances that can safely support the cage should be fixed. Chairs are also known as catches or dogs, or keeps, cf. Keps (refer Section 6.8.8). In the case of chairs or bearers, a lever or handle should be fitted. Where links are fitted, they should have a handle which allows it to be placed in the carrying position or the conveyance raised without possible danger to the person performing the duty, especially catching fingers.

The chairs should be designed so that they cannot be withdrawn while the weight of the shaft conveyance is resting on them to avoid any slack rope tightening suddenly.

6.2.4 GUIDES IN SHAFTS

In larger vertical shafts (for example over 50 metres in depth), guides which allow control of the load should be provided. These should comply with AS 3785.6 Underground Mining–Shaft Equipment: Part 6 Guides and Rubbing Ropes for Conveyances.

6.2.5 OVERWIND PREVENTER TO BE PROVIDED

Devices should be installed at the winder which will remove the power (energy) from the winder and automatically apply the brakes, bringing the winder to rest before any conveyance, counterweight or rope attachment reaches any permanent obstruction to its passage.

6.2.6 OVERWIND CONVEYANCE ARRESTER TO BE PROVIDED

Overwind apparatus should also be installed in the shaft (including the headframe). In the case of drum winding, the overwind protection equipment is in addition to detaching hooks.

6.3 WINDING ENGINES

6.3.1 WINDING ENGINE INDICATORS AND GAUGES REQUIRED

Every winder should be provided with:

- depth and speed indicators driven from the sheave or drum shaft; and
- a dial or gauge to show whether or not power (energy) is available at the engine.

A winder should not be used for winding while a depth or speed indicator is disconnected, except for drum end cuts or other maintenance.

6.3.2 STOP SWITCH OR CONTROL REQUIREMENTS FOR WINDERS

Every winder should be provided with a stop switch or control for the purpose of stopping the winder and that switch or control should be placed within easy reach of an operator.

6.3.3 CONTROL OF WINDING SPEED FOR WINDERS

Every winder should be provided with an effective automatic contrivance in full and fixed engagement with the winder to prevent overspeeding, and:

- the shaft conveyance should not be able to exceed a speed 10% greater than the maximum designed speed;
- the speed of the shaft conveyance should be controlled in any part of the shaft to predetermined limits; and
- the shaft conveyance should not be able to exceed a speed of 2 metres/second when being landed at the lowest entrance to, or at the bottom of, the shaft.

6.3.4 CONTROL SELECTION DEVICE TO BE AVAILABLE TO AUTHORISED PERSONS ONLY

If the winder is controlled by more than one method, the device for selecting any control method should be available only to those authorised by the manager.

6.3.5 ENGINE CAPACITY

Every winding engine should be capable of raising the maximum unbalanced load from the bottom of the shaft or winze.

6.3.6 OVERWIND BACKING-OUT DEVICE UNDER MANUAL CONTROL

Any device provided to permit backing out from an overwind position should respond to manual control only and permit withdrawal from the overwind position only.

6.3.7 CONTROL OF WINDING ACCELERATION AND DECELERATION

A cage or skip in which people are travelling should not be accelerated or decelerated at a rate greater than 1.5 metres/second/second. In cases of an emergency, deceleration of the cage or skip should not be less than 2 metres/second/second or more than 5 metres/second/second

6.3.8 BRAKE

The brake on a winder should comply with the requirements of AS 3785 Underground Mining–Shaft Equipment (dealing with winder braking systems) covering :

- single component design; and
- two brakes/drum.

All engines used for raising or lowering people or hauling materials should be provided with an adequate brake which has the ability to stop the maximum load moving in a downward motion from maximum speed within a reasonable time.

6.3.9 USE OF SERVICE BRAKE

While people are embarking or disembarking from a cage, the service brake should be fully applied.

6.3.10 INTERLOCKING OF SHAFT DOORS AND WINDER CONTROLS REQUIRED

When a winder is being used for carriage of people and its operation is under push-button control, it should be incapable of motion unless all shaft doors and the cage doors in connection with that winder are properly closed. However, provision may be made to open shaft doors when a winder is being used for the carriage of materials and when the conveyance is close to a landing and the winder is under creep control.

6.3.11 USE OF PUSH-BUTTON CONTROLS

Push-button controls located at any landing should only be accessible to a person inside a cage when the cage door is open.

Where push-button control of the winder from within the cage is arranged for, a stop button should be provided which, when operated, will cause the winder to stop.

6.3.12 PRECAUTIONS AGAINST FIRE

Winder rooms should have appropriate fire-extinguishing apparatus.

Where a winder is situated in a headframe or tower of a shaft, effective precautions may be needed to prevent any flammable liquid used in connection with the winder or any apparatus in the headframe or tower from entering the shaft or affecting the brakes.

Where a winder room is situated in a headframe or tower over a shaft, suitable automatic apparatus should be provided to extinguish any fire that may break out.

6.4 WINDING ROPES

6.4.1 WINDING ROPE SPECIFICATIONS AND HISTORY

Winding rope specifications and history should be kept at the mine while the rope is in use.

Before a rope which has previously been in service can be used for any winding purposes, a complete history of the rope and the details of the proposed duty should be acquired and from this it should be determined if the rope can be safely used for that duty.

6.4.2 WINDING ROPES RECORDS

Records should be kept which show:

- name of shaft in which the rope is used;
- compartment of shaft in which the rope is used;
- date when the rope was put on;
- dates of any rope shortening;
- dates of any rope recapping;
- dates of destructive and non-destructive rope testing;
- date when the rope was taken off and the reason for taking it off;
- dates of examination, cleaning and oiling of ropes, and appliances required; and
- date and cause of slack rope accident(s).

Every entry in the record book should be signed by the person responsible.

6.4.3 REQUIREMENTS FOR GUIDE ROPES AND RUBBING ROPES

Guide ropes and rubbing ropes should conform to AS 3785.6 Underground Mining–Shaft Equipment: Part 6 Guides and Rubbing Ropes for Conveyances, and be of locked coil or round rod construction, unless it can be shown that the rope has the required specifications to complete its duty safely.

A guide rope or rubbing rope should not be used before the number, size, length, disposition, method and type of attachment of the rope and the tension force used with the rope has first been carefully examined.

6.4.4 SPLICED ROPES

Winding ropes should not have been spliced. Splicing for rope attachments may be used if it can be shown that the rope will have adequate strength and performance characteristics.

6.4.5 CAPPED ROPES

Rope cappings should be prepared in compliance with AS 3637.3 Underground Mining–Winding Suspension Equipment: Part 3 Rope Cappings.

A capped rope should not be used at any time unless the capping has been made within a period of six months immediately preceding that time and the capping complies with the minimum factor of safety as applied to the rope.

A rope which has been recapped should not be used in any winder unless, on the last occasion on which it was recapped, the rope was cut off at least 150 millimetres (0.15m) away from the mouth of the socket and the wires checked for signs of damage.

6.4.6 FACTORS OF SAFETY OF ROPES AND DISCARD PROVISION

- Factors of safety may be specified in relevant statutory requirements. A rope should be withdrawn from use when:
  - physical inspection shows that the rope appears to be damaged and unsafe for the use to which it is subjected; or
  - the breaking force of the rope by tensile test is less than 90% of the breaking force of that rope when new.

The factor of safety should be calculated by dividing the breaking strength of the rope, as given in the manufacturer's certificate, by the sum of the maximum load to be hoisted, plus the total weight of the rope in the shaft when fully let out.

- Generally, the minimum factor of safety of every guide rope and rubbing rope should be 5.

  Factors of safety for ropes are also discussed in Sections 6.8 Friction Winding and 6.9 Drum Winding.

6.5 SHAFT CONVEYANCES

6.5.1 DESIGN OF CAGES, SKIPS, KIBBLES, STAGES AND COUNTERWEIGHTS

The design and construction of each shaft conveyance should conform with AS 3785.4 Underground Mining–Shaft Equipment: Part 4 Conveyances for Vertical Shafts.

6.5.2 CAGES USED FOR TRANSPORTING PEOPLE IN SHAFTS

Except during shaft-sinking operations, a suitable cage or skip should be provided to raise or lower people in deep (ie more than 50 m) shafts.

The maximum number of people allowed to ride at any one time in a cage or other conveyance should be fixed by the manager, and that number should be kept posted at the brace and each stopping place.

When it is necessary to transport people in ore skips, they should not be raised or lowered in a shaft unless they are standing on the bottom of the skip or on a platform provided for that purpose.

6.5.3 COUPLING LINKS FOR SHAFT CONVEYANCES

Chains, other than a short coupling chain attached to a conveyance, should not be used for shaft conveyances because of their failure mode.

Where coupling links are attached to a shaft conveyance, there should be at least two of those short chains for each coupling. Each chain should be of identical dimensions, and be parallel and vertical.

Each chain should be capable of supporting 10 times the total load.

6.5.4 DESIGN REQUIREMENTS FOR CAGE, SKIP AND COUNTERWEIGHT ATTACHMENTS

Attachments of a rope to a conveyance or counterweight should allow for movement in two planes normal to each other.

Screwed attachment members should not be used in tension.

An item of attachment other than a chain should not be welded.

An open hook should not be used in any hoisting operation.

Items of attachment of a rope to the body of a shaft conveyance or counterweight (including cappel , shackle, link, chain, pin or swivel) and other items of attachment should be manufactured and tested according to AS 3637 Underground Mining–Winding Suspension Equipment.

6.5.5 SHAFT CONVEYANCES– TESTING AFTER REPAIRS, SHAFTWORK AND STOPPAGE

- A shaft conveyance should not be used for raising or lowering people until it has made at least one complete trip up and down the working portion of the shaft following:
  - any stoppage for repairs which may affect the safe running of the winding engine;
  - any repairs to the shaft, shaft conveyance, or counterweight;
  - any stoppage in shaft hoisting exceeding four hours duration; or
  - the occurrence of any seismic event which may affect the guides.

- Items of attachment should not be subjected to any heat treatment other than the initial heat treatment performed by the manufacturer.
- Items of attachment should be discarded on or before completion of a period.

6.5.6 WINDING INSTALLATIONS– INSPECTIONS AND RECORDS

6.5.6.1 INSPECTION PROCEDURE

There should be a systematic and regular inspection procedure for examining:

- the winding rope or ropes while they are travelling at a slow speed and their attachments to the conveyances and counterweights, the brakes, depth indicators, the cages and their safety devices, the head sheaves and every external part of the winder installation;
- the shaft guides and the winding compartments generally, balance ropes while they are travelling at a slow speed, the automatic winding controls and the signalling arrangements generally;
- the structure of the rope for the purpose of discovering the amount of deterioration, and all detaching and suspending hooks and safety devices which should be examined, cleaned and oiled;
- automatic contrivances to prevent overwinding;
- detaching hooks by dismantling, cleaning, gauging for deformation, checking for corrosion and other imperfections, and testing with appropriate crack-detection equipment; and
- the winding engine and auxiliary equipment and every item of attachment, namely in the case of chains, chain links, shackles, pins and pin holes, by measurement for wear; and, in the case of every attachment, by checking for deformation, corrosion or other imperfections, and by testing with approved crack-detection equipment.

6.5.6.2 ROPE INSPECTION

For the purposes of an inspection of a rope:

- the rope should be thoroughly cleaned at all places that are particularly liable to deterioration and at other places (less than 30 metres apart); and
- the person inspecting the ropes should note the condition of the rope externally and as far as possible internally, and the diameter of rope and the lay length of the rope at any point of reduced diameter.

6.5.6.3 DEFECT RECORDS

In every winding engine room, there should be a system of record-keeping. That system should allow a record of any peculiarities, behaviour or effects out of the ordinary in the running of the engine motors, and any defects in any of the winding machinery, that warrant repair or alterations. The system should allow defect records to be reported and a history maintained.

6.5.6.4 COMMUNICATIONS

Where two or more drivers are employed on the same engine in rotation of shifts, a system should be established for communicating any peculiarities of the engine motors or winding machinery between the drivers.

6.6 SIGNALLING

6.6.1 COMMUNICATIONS OR SIGNALLING IN A SHAFT

A shaft in which a cage, skip or kibble is used should be provided with appropriate means of communication or signalling to and from every entrance in use to (and from) the winding engine room.

6.6.2 SIGNALS TO BE RETURNED

In the case of manual winders and signal bells, the winding engine driver should return all signals received prior to carrying out the action required by that signal.

6.6.3 CODE OF SIGNALS TO BE DISPLAYED

The means of communication should be readily understandable, and any code of signals clearly posted in full view of the engine driver. That code should also be displayed at each working plat and the brace.

6.6.4 RESTRICTION ON VOICE COMMUNICATION

Communication by word of mouth should not be made up or down a deep shaft, except through a telephone or by a radio installed for the purpose of such communication.

6.6.5 CODE OF SIGNALS

Where bells are fitted, a code of signals should be considered for the following actions:

- "Stop"when in motion. Signal must be returned by driver. (6 bells are used at Broken Hill mines to clear the cage);
- "Hold Fast" when stationary, a danger signal. Signal to be returned by the driver and conveyance not be moved until release signal (6 bells) has been given;
- lower;
- lower slowly;
- hoist;
- hoist slowly;
- persons on, hoist to surface;
- change to hoist from a different level (throw in or out of gear) – this signal must not be given while the conveyance is in motion. Signal to be returned;
- release conveyance from "Hold Fast" signal (1 long bell). Signal to be returned by driver before a command signal is given;
- fire warning;
- materials or tools on. Drive slowly;
- accident signal to be followed after a pause by the signal for the level where the conveyance is required.

The conveyance is raised or lowered, as required, in accordance with a series of signals tht are unique to each level in the mine.

If safety fuse is used for firing in a shaft or winze-sinking operation, the following should be considered:

- firing warning;
- hoist persons to surface or brace.

Upon receiving the firing warning signal the winder or hoist driver should raise the conveyance by giving the drum of the engine at least one full revolution and then lower it again as a sign that all is ready to hoist. The driver should then stand ready at the engine until the signal "Persons on, hoist to surface" is received and hoisting commences carefully.

When an engine is in use for timbering or repairing a shaft, the signals must be regarded as meaning "Lower cautiously" and "Hoist cautiously".

6.7 OPERATION OF WINDER

6.7.1 AVAILABILITY OF WINDER OPERATOR

While any person is underground in a mine from which the usual means of exit is by means of a winding engine:

- a trained person should be readily available on the mine to operate in manual mode if necessary;
- a winding engine should be ready for use at all times; and
- someone should be continuously available on the surface to receive any communication from underground.

6.7.2 REMOVAL OF POWER

The source of power (energy) to a winding engine or hoist should not be cut off until the full range of consequences of this action are fully considered.

6.7.3 TRAINING

A person employed as a shaft attendant (platman, skipman, braceman or lander) should have adequate training and be competent for the work.

6.7.4 AGE OF SHAFT ATTENDANT

A person under the age of eighteen years should not be employed as a shaft attendant.

6.7.5 WHIMS, WHIPS AND WINDLASSES

Whims, whips and windlasses should be provided with a stopper, pawl or other reliable holder, and not be used to raise or lower people.

Cages or conveyances suspended on a single rope should not be used for transporting people unless the cage and the shaft is equipped to prevent the free fall of the cage down the shaft in the event of a rope failure.

Everyone working or travelling in a conveyance in a shaft should be protected overhead from falls of rock or material.

6.7.6 PEOPLE TRAVELLING WITH EQUIPMENT

People should not carry or convey any tools, steel, pipes, timber, explosives, vehicles, rails or any other material in a hoisting conveyance with themselves, except where:

- transporting personnel or whereby the safety of personnel is involved;
- transporting rock or materials, whereby the safety of personnel is not involved;
- transporting rock in a shaft used exclusively for that purpose;
- transporting a machine or part of a machine at a speed of less than 2 metres/second;
- balance ropes;
- small tools, gear or materials are in a container, or the equipment is an instrument;
- gear cannot protrude outside the cage;
- any tools or materials are required by persons engaged in repairing a shaft;
- a locomotive driver is travelling with a locomotive, so long as the driver is in the top deck and the locomotive is in the bottom deck or slung beneath the conveyance;
- a shaft attendant travels with explosives; or
- firefighting and/or rescue equipment is conveyed.

No one should ride in a deck or a multi-deck cage while a load other than passengers is in a higher deck.

Except for watching a load slung under a cage, no one should ride in a cage when equipment, long timber, rails or materials of similar form is slung below the cage.

6.7.7 WINDER DRIVER MEDICAL EXAMINATION

A winder should hold a certificate from a legally qualified medical practitioner, stating freedom from deafness, defective vision, epilepsy, disease of the heart and any other infirmity likely to interfere with the efficient discharge of duties or which might cause the person to lose control of the engine.

6.8 FRICTION-WINDING

6.8.1 APPLICATION

This Part applies to every winding engine on which the rope or ropes are driven by friction.

6.8.2 ROPE SAFETY FACTOR

The load applied to any rope or set of winding ropes used for friction winding should not at any time in its working life result in a factor of safety which is less than the appropriate factor related to its application. Minimum factors of safety should be related to the following applications:

Each set of winding ropes used to suspend a cage in any friction-winding apparatus should be determined by specific formula.

6.8.2.1 PERSONNEL TRANSPORTATION

For the purpose of the above, the factor of safety can be defined as

$F1 = 1.0+[4.5(R+C)]/[R(1+0.0051L^{0.5})-13.5]$,

where

F1 = the factor of safety (personnel);

R = the ratio of the diameter of the winding sheave to the diameter of the winding rope;

C = 35 where there is not a nearby deflecting sheave, or 43 where there is a nearby deflecting sheave; and

L = the vertical distance in metres between the level of the top of the highest winding sheave and the level at which the winding ropes meet the suspension gear of the cage when at its lowest position in the shaft.

6.8.2.2 MINERALS OR MATERIALS TRANSPORTATION

For the purposes of the above, the factor of safety can be defined as

F2 = F1 - 1.0, where

F2 = the factor of safety (minerals or materials), and

F1 = the factor of safety (personnel).

6.8.3 TESTING OF FRICTION-WINDER ROPES

Every rope used on a friction winder should be non-destructively tested to determine that the rope has not fallen below its required factor of safety.

6.8.4 PERIOD OF SERVICE OF FRICTION-WINDER ROPES

The period of service of any rope used for friction-winding should be based on the risk assessment of the shaft system.

A rope should be discarded before reaching the periods of service when it shows signs of:

- broken wires in any section equal to the length of one external lay;
- a rapid increase in the rate of stretch over the normal stretch noted during service;
- marked corrosion; or
- any other unsafe condition.

6.8.5 USE OF ROPE DRESSING RESTRICTED

Rope dressing which would in any way increase the danger of slippage on the friction-winder driving sheave should not be used.

6.8.6 MEANS FOR ADJUSTING OR EQUALISING ROPE TENSION

Multiple winding ropes on friction-winders should be attached to the cage, skip or counterweight through apparatus designed to load the ropes as uniformly as practicable. Where the attachments are connected directly to the cage, skip or counterweight, they should be provided with means for adjusting their length and means for indicating unequal tension between ropes.

6.8.7 SHEAVE WHEELS

The driving sheave diameter of a friction-winder should be larger in the case of lock coil rope than of any other rope, and is based on the diameter of the rope.

The coefficient of friction between the rope treads on the driving sheave and the winding ropes must be such that there will be no slip under normal out of balance loading, acceleration and retardation.

The grooves in a multi-grooved sheave should be of substantially the same rope diameter.

6.8.8 KEPS OR CHAIRING DEVICES

In friction winding, keps or chairing devices should be installed in such a way as to prevent fouling of a shaft conveyance.

6.8.9 DETACHING

Detaching appliances for cages, skips or counterweights should not be provided.

6.8.10 DEFLECTION SHEAVES

The diameter of any friction-winder deflecting sheave should not be less than 0.9 times the diameter of the corresponding driving sheave.

The angle of contact of the rope on a deflecting sheave should be sufficient to prevent the rope slipping on the sheave.

6.8.11 SHAFT SUMP

The shaft sump should be kept clear of water, debris or other material to an extent that will prevent the balance ropes from regularly contacting any build-up of water, debris or other material.

6.8.12 SHAFT SUMP INSPECTION

The space between the lowest stopping point and the shaft sump should be equipped with ladders or other suitable means of access to permit proper inspection and maintenance of that part of the shaft and the equipment.

6.8.13 LOADING LIMITATIONS FOR FRICTION-WINDERS

A friction-winder should not be loaded to the extent that would require more than 70% of the available braking torque to stop and hold the driving sheave.

6.8.14 BRAKES

The driving sheave of a friction-winding engine should be provided with two or more brakes, which:

- should be fitted in such a way that they can be applied by a winding engine driver without leaving the operating position;
- when applied by the means provided for use by a winding engine driver, other than by a stop switch, will be capable of producing a braking torque relating to its application;
- under the maximum out-of-balance static torque that will be applied to the winder sheave by the normal loads to be carried by the winder;
- however applied, will produce a braking torque not greater than 70% of that which will cause the winding rope to slip on the driving sheave based on the minimum sliding coefficient of friction between the rope and the sheave;
- however applied, will act directly on the winder drum sheave and be designed, adjusted and maintained to safely stop and hold the cage or skip under all conditions of loading, direction of travel and speed;
- can be applied manually by the winding engine driver, irrespective of the action of any safety device that may act to apply the brakes;
- will be automatically applied if the supply of power (energy) to the winder fails or if the pressure of any fluid or other medium used as a means of controlling the brakes falls below a safe level;
- should be provided with a steel tension member between individual sole plates of brake shoes; and
- is designed in such a way that the failure of any one component will not prevent the winder from being brought safely to rest.

Push-button and automatically controlled friction-winders should also be provided with a suitable device that will automatically apply the brake before it becomes worn sufficiently to affect its safe operation.

Every part of every braking system should have a factor of safety not less than 10, provided that screwed members in tension should have a minimum factor of safety of 15.

6.8.15 SPEED INDICATORS FOR FRICTION-WINDERS

Friction-winders used for raising or lowering people or materials should be provided with a speed indicator driven from a sheave shaft that can be readily seen by a winding engine driver.

6.8.16 SYNCHRONISING DEVICE TO BE PROVIDED

Friction-winders should be provided with a device that will automatically synchronise the depth indicator and the position of the cage of a skip in the shaft. This synchronising adjustment should take place only while the brakes are applied and the winder is stopped.

6.8.17 SLIP AND DIRECTION INDICATORS

Friction-winders should be provided with:

- a device that will indicate slip of the rope relative to the driving sheave and that will stop the winder if a predetermined rate of slip is exceeded; and
- a device for indicating in which direction the driving sheave is turning.

6.9 DRUM-WINDING

6.9.1 APPLICATION

This Part applies to every winding engine on which the rope is wound on to a drum.

6.9.2 ROPES

The drum and winding ropes factors of safety are determined by their usage and operational severity.

The load applied to any rope used for drum-winding should not at any time in its working life result in a factor of safety that is less than the appropriate factor listed below, where

L equals the depth of wind in metres, specified in relation to the relevant proposed use.

Suggested and more commonly used criteria include the following:

PROPOSED USE	MINIMUM FACTOR OF SAFETY
Transporting personnel, or where the safety of personnel is involved	7.5 - 0.001L
Transporting rock or materials, where the safety of men is not involved	5.5 - 0.0003L
Transporting rock in a shaft used exclusively for that purpose	4.5
Transporting a machine or part of a machine at a speed of less than 2 metres/second	5

6.9.3 TESTING

Unless there is a good history developed, ropes used for winding should be recapped at intervals to ensure the integrity of the capping based on risk management controls.

Also at regular intervals, a short length (at least 2 metres) should be cut off the shaft conveyance and counterweight end of the rope and sent to a recognised testing station for destructive testing.

At the end of about the first year after a new rope has been installed, sufficient rope should be cut from the shaft conveyance and counterweight end to enable a breaking and elongation test to be made of the rope which has repeatedly passed over the sheave.

When there are two or more layers of rope wound on to any winding engine drum, the rope should be cropped at the drum at yearly intervals, in a manner to change the position of crossover points on the drum.

Where the drum end of the rope is cropped, it should be reattached and rewound in a way that recognises the characteristics of the rope and the duty under which it works.

6.9.4 FLANGES ON DRUMS

Where drum-winders are used for raising or lowering people, horns or flanges should be fitted and also, if the drum is conical, other appliances which are sufficient to prevent the rope from slipping.

6.9.5 DRUM-WINDER BRAKES

Drums should be provided with one or more brakes which:

- are fitted in such a way that they can be applied by a winder driver without leaving the operating position;
- however applied, act directly on the winder drum, and are designed, adjusted and maintained to safely stop and hold the cage or skip under all conditions of loading, direction of travel and speed;
- can be applied manually by a winding engine driver, irrespective of the action of any safety device that may act to apply the brake or brakes;
- will be automatically applied when the supply of power (energy) to the winder fails or when the pressure of any fluid or other medium used as a means of controlling the brakes falls below a safe level;
- are provided with a steel tension member between individual sole plates of brake shoes; and
- will be automatically applied if a fault occurs in the control circuit of push-button-controlled winders.

Braking systems of drum winders should be designed so that the failure of any one component will not prevent the winder from being brought safely to rest.

Push-button and automatically controlled drum winders should also be provided with a suitable device, which will automatically apply the brake before it becomes worn sufficiently to affect its safe operation.

Every part of the braking system of a drum winder should have a factor of safety not less than 10, provided that screwed members in tension should have a minimum factor of safety of 15.

At the time of installation, the drum, when unclutched, should be capable of supporting a conveyance 2.5 times the normal mass.

6.9.6 DRUM-WINDER–DECLUTCHING

In the case of a winding engine provided with two drums, people should not, except in the case of emergency, be raised, supported or lowered in a conveyance connected with the engine while one of the drums is out of gear.

A single drum-winder or a double drum-winder with one drum loose on the shaft, should not be used for lowering people if the brakes are the only means of halting the descent of the conveyance.

In the case of a double drum-winder with one drum out of gear, that drum should be prevented from revolving whilst out of gear.

6.9.7 CONVEYANCES

- Cage to be supported during repairs
  - When repairs are being made to the clutch or brakes of a winding engine, and where ropes are attached to the drums, the skip or cage should be removed or firmly supported by means other than the rope while the work is in progress.
- Safety appliances on cages
  - Cages in which people are transported should be fitted with a suitable appliance to prevent its sudden fall down the shaft in the event of the rope or winding system failure and every cage on an automatic winder should be fitted with a slackrope detector.
  - The safety appliances on cages should be tested regularly by a drop test.
- Testing of cages
  - New or repaired cages should not be used in a shaft until proof-loaded with twice the mass normally hoisted.

6.10 SHAFT-SINKING

6.10.1 USE OF A CRANE

A crane is a method used to hoist the broken rock from the initial surface excavation, and from the shaft, to a depth of about 50 metres, except when the shaft perimeter has been traversed by any structure which could be an obstruction to the free passage of the conveyance.

The load lifted by a crane in shaft-sinking operations should not exceed 50% of the normal safe working load permitted.

The crane should be of a slewing type and be located in a fixed position during the hoisting and dumping operations.

An appropriate method of signalling should be installed to communicate with the driver.

People may be hoisted from a shaft excavation by means of a crane, provided that:

- the person travels in a kibble or similar conveyance and uses a safety belt when more than one third of their body is outside the conveyance; and
- the person is within sight of another who can communicate signals to the crane driver.

People should not remain in the shaft excavation while the crane is being used to hoist broken rock by means of a grab.

A crane may not be used to move a sinking scaffold unless safety chains are kept in position on the scaffold until it has been raised or lowered by more than two metres. This will prevent jerking.

6.10.2 MEANS OF TRAVEL PROVIDED IN SHAFT-SINKING

Where a permanent ladderway is to be installed in a shaft, it should be installed from the surface to the bottom of a shaft during sinking operations where a sinking stage is not used.

Where a sinking stage is used, a chain ladder should be provided for travel from the shaft bottom to the stage.

6.10.3 SHAFT DOORS

During shaft-sinking operations, when people are in the shaft, spillage should not be allowed to fall down the shaft during dumping operations. Common practice is for a door or doors covering the sinking compartment to be provided at the collar of the shaft while sinking operations are in progress. Doors should be kept closed when people, tools or materials are being loaded or unloaded from the kibble or skip at the collar of the shaft, or when the kibble or skip is being dumped.

6.10.4 WARNING OF OBSTRUCTION IN SHAFT

The position of any doors or other shaft protective devices, which when moved into the haulage way or travel area of a shaft, would interfere with the free passage of the conveyance, should be indicated to a winder driver.

6.10.5 SHAFT-SINKING PENTHOUSE

When a shaft is to be sunk below any level that is being worked, it should be protected below that level by a securely constructed penthouse.

6.10.6 SHAFT TIMBER TO HAVE BEARER SETS

Where timber is used to line a shaft, bearer sets or other means of support should be provided between working levels or at distances not greater than about 60 metres apart.

6.10.7 SIGNALS FOR SHAFT-SINKING

Special signals may be used in a shaft-sinking operation, but they should be made known to all people who may use the signals.

Figure 6.1 Box timbering in shafts

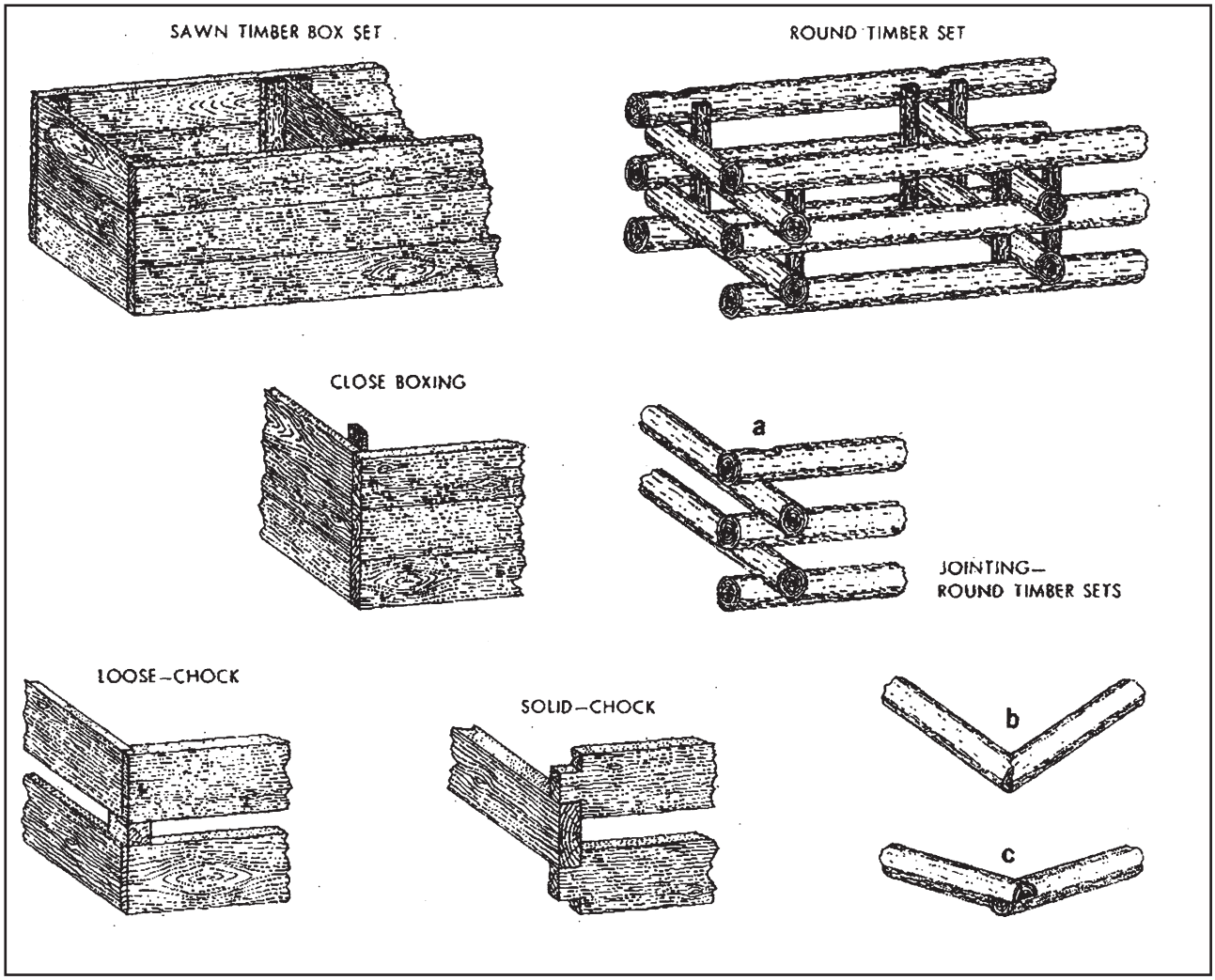


Figure 6.2 Shaft collar set with dividers

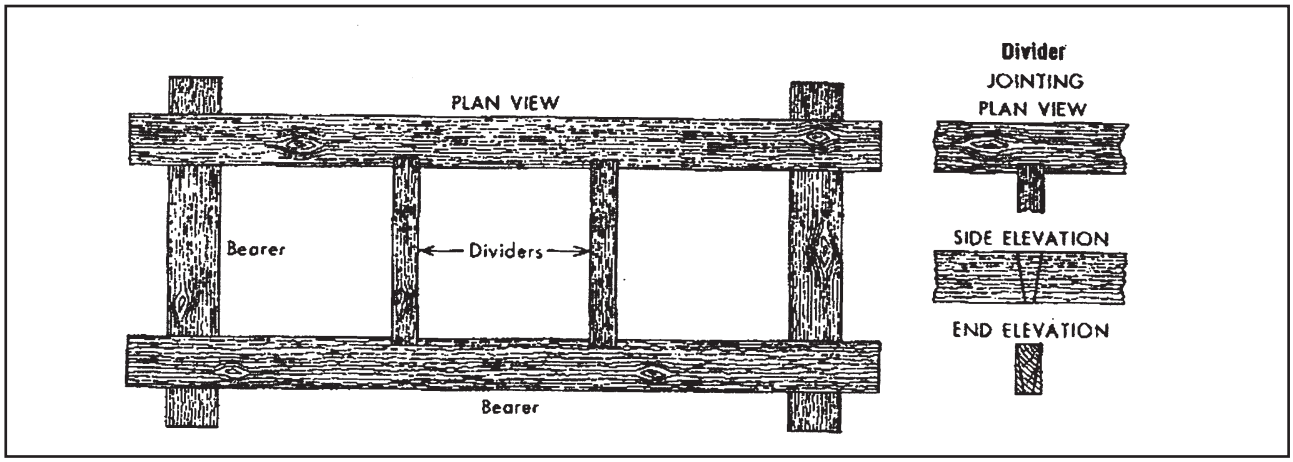


Figure 6.3 Shaft plumbing, using corner plates

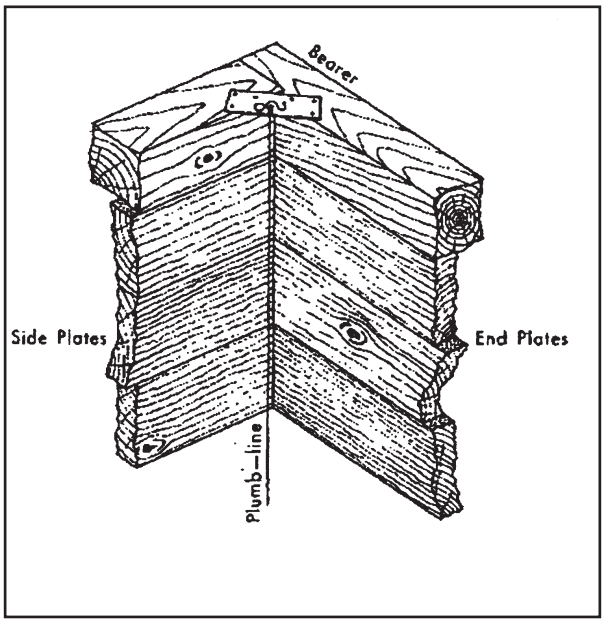
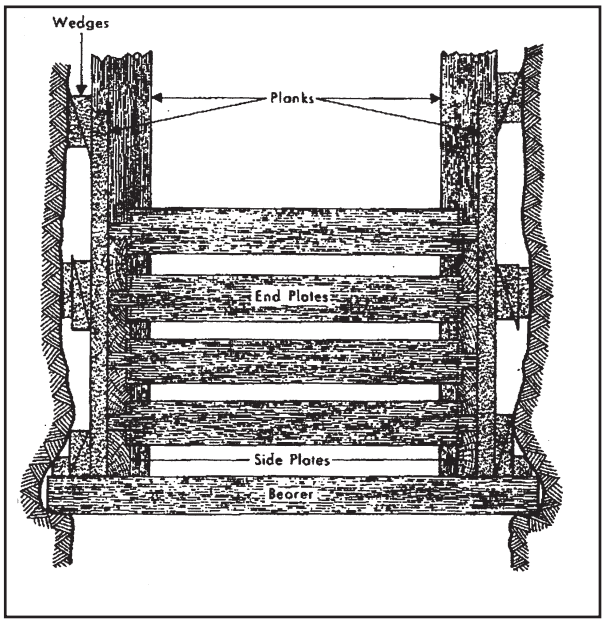


Figure 6.4 Shaft bearers, also showing wedging and blocking



6.10.8 ROPES

- The minimum factors of safety used in shaft-sinking operations will depend on the application that is:
  - for ropes hoisting people and materials or rock, (7.5 - 0.001L) where L equals the depth of wind in metres; and
  - for ropes raising and lowering a sinking stage, 6.
- A stage rope generally does not need to be recapped.
- The provisions relating to the history, inspection, maintenance and discarding of winding ropes and attachments should apply to winding ropes used in shaft-sinking operations, except that for winding ropes used to support a shaft-sinking stage:
  - a regular (eg monthly) inspection should check for the incidence of broken wires, any obvious reduction in diameter, marked corrosion, and any other unsafe condition;
  - there should be a regular (eg monthly) rope lubrication with a suitable lubricating compound; and
  - the period of service of any such rope should not exceed two years without a thorough examination.

6.10.9 SHAFT-SINKING KIBBLE AND ATTACHMENTS

When the depth of a shaft exceeds about 50 metres, a suitable kibble and monkey arrangement or other appropriate conveyance should be used for haulage purpose in the shaft.

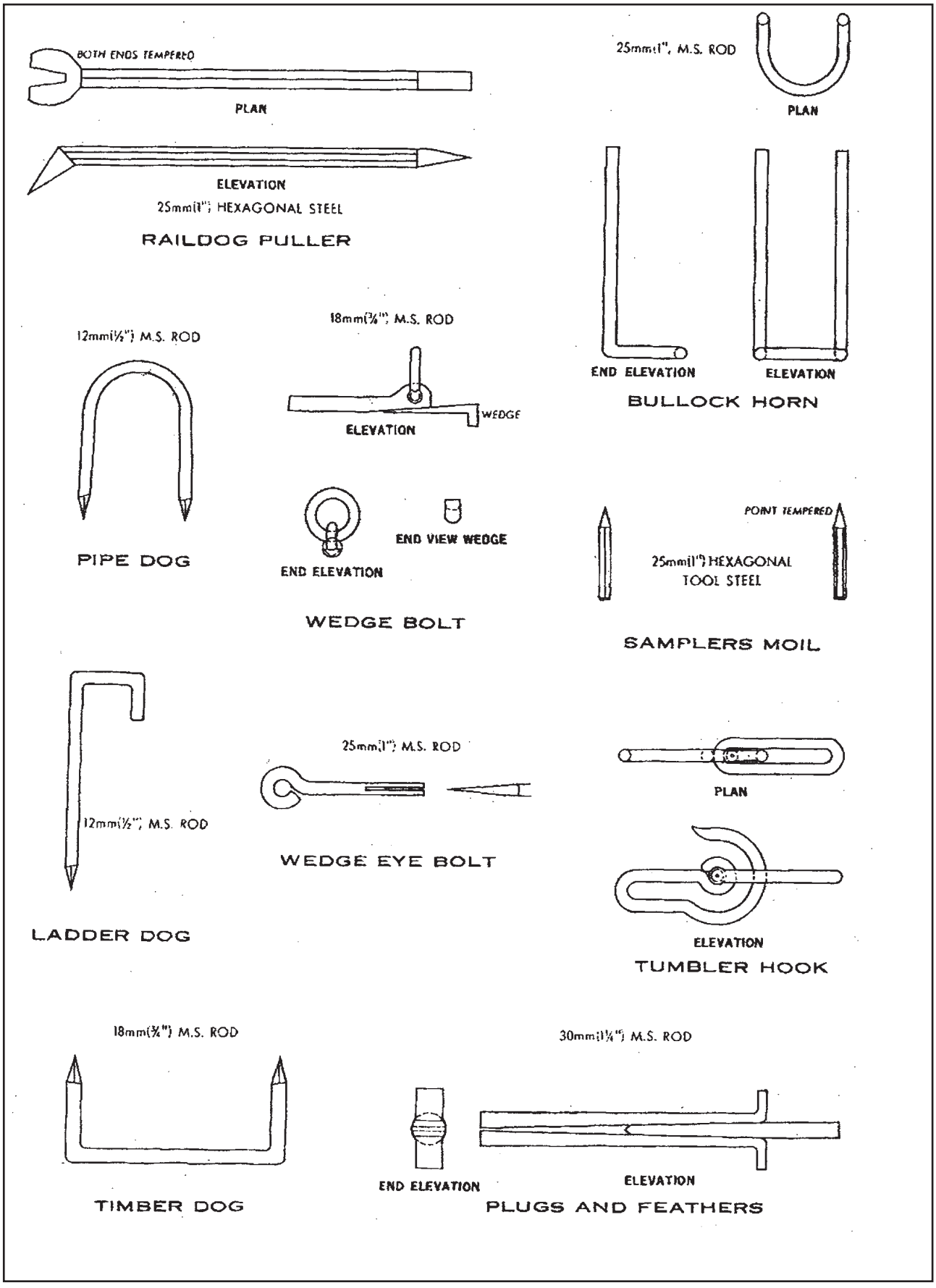
A sinking kibble or “monkey” should be provided with an overhead cover for protection of persons from falling objects.

A kibble used in a shaft-sinking operation should be of robust construction and be of a shape which would prevent it from catching on any obstruction during its travel in the shaft.

A kibble may be suspended by a bridle or by means of at least three chains, equally spaced around the perimeter of the kibble top.

Chains used for the suspensions of such a kibble should be of identical dimensions and strength and be of sufficient length to ensure that the included angle at the apex of the suspension of any two chains is not greater than 60°.

Figure 6.5 Fitting and fixing



A kibble or skip in shaft-sinking should not be filled with loose rock above its brim nor hoisted away whilst any material adheres to its outside surface.

6.10.10 SHAFT-SINKING METHOD OF FIRING

Firing in shaft-sinking operations should be initiated by means of electricity, and initiated from the surface or other safe location.

When a deep shaft is being sunk in rock formation and it is not practicable to clear everyone from the shaft before initiating the blast, short cross-drives or refuges should be formed at regular intervals.

Refuges should always be kept clear, and nothing done to restrict their access.

6.10.11 SHAFT-SINKING STAGES

Stages used in shaft sinking/shaft maintenance should be securely fenced to prevent people from falling, and be designed to eliminate the possibility of the stage overturning. Even so, it may be necessary for those on the stage while it is being moved to wear safety belts in the event that a rope breaks or the stage moves unevenly.

REFERENCE DOCUMENTS

Australian Standards

AS 3637 Underground Mining–Winding Suspension Equipment

AS 3785 Underground Mining–Shaft Equipment

NSW Department of Mineral Resources' Division of Mine Safety and Environment–Safety Operations Guidelines

MDG 12–Friction Winder Design

MDG 26–Mine Winder Ropes

MDG 33–Drum Winders