GUIDELINES

NSW GOVERNMENT | Industry & Investment

GUIDELINE FOR

BOLTING and DRILLING

PLANT IN

MINES

Part 1: Bolting plant for strata support in underground coal mines

MDG 35.1

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FOREWORD

Over the past several years there has been an increase in the number of injuries involving drilling and bolting plant in mines. The MDG 35 series of guidelines deals with the risks associated with the use of drilling and bolting plant in mines.

Part 1 provides guidance on bolting plant for strata support in underground coal mines.

Part 2 provides guidance on portable hand held bolters and is derived from MDG 5:1994

Since the transition from timber roof supports to roof bolts, rib bolts, mesh and W-straps the use of bolting plant in underground coal mines has markedly increased. Between 1999 and 2008 incident data, from Coal Services Pty Ltd, identifies almost 800 injuries relating to the roof or rib bolting plant or process (refer Appendix C – Incident Statistics). Injuries have ranged from strains through to severe entanglements.

This *Guideline for Bolting and Drilling Plant in Mines - Part 1 Bolting Plant for Strata Support in Underground Coal Mines* has been compiled to assist in formulating a management system approach for the design and safe use of bolting plant for strata support in underground coal mines. It should be used when assessing the safety aspects of bolting plant.

This guideline provides a good industry benchmark for engineering standards and fit for purpose equipment. It can be considered good industry practice for mitigating the risks associated with the use of bolting equipment in underground coal mines. It provides practical guidance to prevent injury to people.

This is a Published Guideline.

The principles stated in this document are intended as information to assist industry to devise safety standards. Designers, manufacturers, owners and users of bolting plant should rely upon advice, skills and experience in applying safety standards to be observed in individual workplaces. Adherence to the guideline does not itself assure compliance with the general duty of care.

The State of New South Wales and its officers or agents including individual authors or editors will not be held liable for any loss or damage whatsoever (including liability for negligence and consequential losses) suffered by any person acting in reliance or purported reliance upon this guideline.

The constructive evaluation and input provided by mine engineers and manufacturers of bolting plant is gratefully acknowledged in the development of this guideline.

The MDG 35.1 *Guideline for Bolting and Drilling Equipment in Mines, Part 1: Bolting plant for strata support in underground coal mines* was distributed to industry for consultation and through the Coal Industry Safety Advisory Committee.

A feedback sheet is provided in the Appendix. Constructive information is required to assist in improving industry guidelines.

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SECTION 1 PURPOSE AND SCOPE

1.1 TITLE

This is MDG 35.1, the *Guideline for bolting and drilling plant in mines, Part 1: Bolting plant for strata support in underground coal mines.*

1.2 PURPOSE

The purpose of this guideline is to minimise risks to health and safety of people from the use of bolting plant for strata support in underground coal mines. Historically such risks from bolting plant have included injury from:–

a) people being struck by material from the roof and/or rib (small or large);

b) people becoming entangled in rotating parts of the bolting rig;

c) people becoming trapped or squashed in moving parts of the bolting rig;

d) manual handling during the bolting process;

e) failure of hydraulic hoses and other hydraulic components; and

f) slips, trips and falls.

To minimise risks to health and safety, it is envisaged these hazards and other foreseeable risks associated with the use of bolting plant be:–

(i) identified and assessed at the design/manufacture/supply stage with appropriate risk controls being implemented; and

(ii) assessed through the risk management process by the user of bolting plant, with appropriate risk controls and a safe system of work being implemented.

1.3 SCOPE

This guideline provides guidance to assist in identifying, assessing and controlling the risks to health and safety from the use of bolting plant for strata support in underground coal mines.

This guideline covers the lifecycle of bolting rigs and bolting plant. Consideration should be given to the relevant parts of –

- MDG 41, *Guideline for fluid power system safety at mine*;
- MDG 1, *Guideline for free steered vehicles in underground coal mines*; and
- MDG 39 (as amended), *Handbook for approval assessment of transport braking systems on free-steered vehicles in underground coal mines.*

NOTES:

1. Adherence to guidelines does not of itself assure compliance with a general duty of care.
2. MDG 35.1 typically does not duplicate recommendations in MDG 1, MDG 39 nor MDG 41.
3. This guideline does not cover portable hand held bolters. These are covered in MDG 35.2, *Guideline for bolting and drilling plant in mines, Part 2: Portable hand held roof bolters in underground coal mines*.
4. This guideline is intended to assist in the evaluation of risk but may not comprehensively cover all safety related aspects of bolting plant as designs and operating environments may give rise to other hazards and risks.
5. This guideline does not generally give quantitative information as it is not the intent to restrict innovative design.
6. MDG 1 and MDG 39 are being revised to include all mobile plant in underground coal mines.

1.4 APPLICATION

This guideline applies to all bolting plant intended for installation of strata support in underground coal mines, such as:–bolting platforms; mobile bolting plant; self propelled bolters; miner bolter and longwall face bolter.

This guideline should be considered by designers, manufacturers, suppliers, hirers, contractors, owners, users and coal operators when:–

a) undertaking risk assessments to fulfil occupational health and safety obligations;

b) reviewing the adequacy of risk controls following an incident;

c) assessing/ auditing current standards and practices;

d) designing, manufacturing, altering and/or supplying bolting plant (new or previously used);

e) operating or using bolting plant;

f) altering, maintaining, repairing or overhauling bolting plant;

g) site contracts are being negotiated, such as hiring of plant; and when

h) introducing bolting plant to a mine on the first occasion or to different strata conditions on the first occasion.

1.5 APPLICABLE LEGISLATION

Principal legislation for coal mine safety includes –

a) The *Occupational Health and Safety Act 2000* (The *OHS Act 2000*);

b) The *Occupational Health and Safety Regulation 2001* (The *OHS Regulation 2001*);

c) The *Coal Mine Health and Safety Act 2002* (The *CMHS Act 2002*); and

d) The *Coal Mine Health and Safety Regulation 2006* (The *CMHS Regulation 2006*).

Note: Details of the legislation can be found at www.legislation.nsw.gov.au,

1.6 REFERENCES

A partial list of associated documents is included in Appendix A for reference.

1.7 ABBREVIATIONS

AS/NZS	Australian / New Zealand Standard
ATRS	Automated Temporary Roof Support
I & I NSW	Industry & Investment NSW
IT	Integrated Tele-handler
HSMS	Health and safety management system
ISO	International Organisation for Standardisation
JSA	Job Safety Analysis
LHD	Load Haul Dump
MDG	Mining Design Guideline
MSHA	Mine Safety and Health Administration, refer http://www.msha.gov
OEM	Original Equipment Manufacturer
PPE	Personal Protection Equipment
QDS	Quick Detach System
SMS	Safety Management System
SWP	Safe Work Procedure
TRS	Temporary Roof Support

1.8 DEFINITIONS

For the purpose of this document the definitions below apply.

1.8.1 Alter

In relation to plant, means change the design of, add to or take away from the plant if the change may affect health or safety, but does not include routine maintenance, repair or replacement.

1.8.2 Ancillary controls

Those controls which are not used in performing the bolting or drilling function but are used to service and configure the mobile bolting plant to suit roadway conditions such as, but not limited to –

a) driving / tramming the mobile plant;

b) deploying operator protective systems, such as TRS, canopy, roof guard, rib shield;

c) floor / stab jacks;

d) extendable platform; and

e) cable reel, boom control, mode select, brake valve, towing valve, etc.

1.8.3 Automated temporary roof support (ATRS)

A device to provide temporary roof support from a location where the bolting plant operator is protected from roof falls.

Note: This is the MSHA definition in 30 CFR § 75.201, refer www.msha.gov/

1.8.4 Bolting function

Includes the drilling process and installing strata support bolts.

1.8.5 Bolting plant

Plant used to install and secure strata / ground support bolts in the roof, rib or floor of a roadway and includes the bolting rig, the rib bolter and the machine in which the bolting rig or rib bolter is installed upon. For example, miner bolters, road headers, self propelled bolters, mobile bolting plant, bolting platforms.

1.8.6 Bolting rig

The machine used in the bolting process, capable of drilling a hole in the strata, inserting the support bolt and developing torque to the bolt to apply strata support and includes, the drill motor, the drill mast, the control bank and other associated components.

1.8.7 Bolting platform

Any platform fitted with a minimum of one bolting rig, which is transported by a mobile plant carrier, such as; QDS platform bolters on LHDs, ITs, tracks, monorails, etc.

1.8.8 Coal operator

Has the same meaning as operator in the *Coal Mine Health and Safety Act 2002*.

1.8.9 Competent person

A person who has, through a combination of training, education and experience, acquired knowledge and skills enabling that person to perform a specified task correctly.

1.8.10 Defect management system

A system that outlines the actions to be taken when a fault is identified by documenting —

a) instructions to be undertaken;

b) the details of the defect; and

c) actions taken to rectify the fault.

1.8.11 Emergency stop device

A manually actuated control device used to initiate an emergency stop function.

1.8.12 Ergonomics

Is the science and practise of designing plant, processes, and environments to accommodate human limitations, and make optimal use of human capabilities.

More simply put - considering principles of ergonomics in equipment design means designing equipment for people. The application of ergonomics principles enhances people's safety and productivity.

Notes:

1. The Human Factors and Ergonomics Society of Australian Inc maintains a directory of Certified Professional Members (see www.ergonomics.org.au)
2. Note: Guidance for ergonomics can be found in AS 4024; *Practical Ergonomics* by Barbara McPhee, available through the Coal Services Health and Safety Trust, www.coalservices.com.au; and specific examples of application to underground coal mining equipment can be found in the report of ACARP project C14016 *Reducing injury risks associated with underground coal mining equipment* by Robin Burgess-Limerick. This report, including a handbook can be obtained from ACARP (www.acarp.com.au) or via www.burgess-limerick.com.

1.8.13 Geotechnical engineer

A qualified and competent person with engineering expertise in analysing and assessing strata (geological) failure modes, performance and loading criteria.

1.8.14 Guard

Part of a machine specifically used to provide protection by means of a physical barrier.

1.8.15 Isolation and energy dissipation

A procedure which consists of all of the four following actions:

a) Isolating (disconnecting, separating) the machine (or defined parts of the machine) from all

power supplies.

b) If necessary (for instance in large machines or in installations), locking (or otherwise securing) all the isolation units in the isolation position.

c) Dissipating or restraining (containing) any stored energy which may give rise to a hazard.

Note: Energy may be stored in –

i) mechanical parts continuing to move through inertia;

ii) mechanical parts liable to move by gravity;

iii) capacitors, accumulators;

iv) pressurised fluids; and

v) springs.

d) Verifying isolation and/or energy dissipation is achieved.

Note: Best practice is to provide a lockable means of isolation.

1.8.16 Life cycle

Includes design, manufacture, construction or installation, commissioning, operation, maintenance, repair decommissioning and disposal.

1.8.17 Massive failure

A catastrophic failure of the strata into the installed strata support.

1.8.18 Must

Indicates a mandatory legislative requirements, (i.e. a requirement of an Act or Regulation)

1.8.19 Mobile bolting plant

Any specifically designed bolting plant, used for the purpose of bolting and with a self contained traction system.

1.8.20 Operator(s)

The person(s) who has control over the bolting rig and includes any assistant as required for the drilling and bolting process.

1.8.21 Operator protective canopy

A physical barrier designed to protect the operator from a roof fall or from large falling material (coal or stone, or both) from above the operators work station.

1.8.22 Operator protective guard

A physical barrier designed to protect the operator from small falling material (coal or stone, or both) from above the operator's work station.

1.8.23 Operator protective system

Any system or means (risk control) of preventing injury to the operator(s) from material falling from either the roof or rib.

Note: It may include any combination of operator protective structures, supported roof, supported rib, meshed roof or rib, geotechnical assessments, systems of work (strata failure management plan), PPE etc, to reduce the risk to the lowest level reasonably practicable.

1.8.24 Operator protective structure

A physical mechanical structure that protects the operator, such as a Temporary Roof Support (TRS), rib protection shield, protective guard, protective canopy, etc.

1.8.25 Protective device

Safety devices (other than a guard) which eliminate or reduce risk, alone or associated with a guard.

Note: AS 4024.1201 provides details on a range of safety protective devices.

1.8.26 Plant

Includes any machinery, equipment or appliance.

1.8.27 Primary bolting controls

Frequently used controls that are normally used by the operator to perform the bolting and drilling functions during the installation of strata support such as –

a) rotation;

b) timber jack; and

c) feed.

1.8.28 Reasonably foreseeable misuse

Use of a machine in a way not intended by the designer, but which may result from readily predictable human behaviour.

1.8.29 Remote control

Means the manual control of bolting plant by an operator from a position within natural visual and audible range.

1.8.30 Rib bolter

A bolting rig that is used for drilling and supporting the side walls of the heading.

1.8.31 Rib protection shield

An operator protective device designed to limit or deflect any rib failure from the operator's workspace.

1.8.32 Risk

Combination of the probability of occurrence of harm and the severity of that harm.

1.8.33 Risk analysis

Combination of the specification of the limits of the machine, hazard identification and risk estimation.

1.8.34 Risk assessment

Overall process comprising a risk analysis and risk evaluation.

1.8.35 Risk management

The systematic application of management policies, procedures and practices to the tasks of communication, establishing the context, identifying, analysing, evaluating, treating, monitoring and reviewing risk.

1.8.36 Safe speed of operation

An operating speed sufficiently slow such that an operator can recognise and avoid a potential hazard.

1.8.37 Safety critical system

Those risk controls that are essential for the safe use of bolting plant, the malfunction of which would immediately increase the risk of injury or damage to health.

Note: Generally there are two types of safety critical systems –

(i) safety specific, specifically intended to achieve safety; such as two handed control, sequencing, guard

interlocks, emergency stop, operator protective devices; and

(ii) safety related, non-safety specific; such as manual control during set-up, speed, temperature control, etc.

1.8.38 Safe guarding system

A system of safety measures consisting of the use of a combination of guards and other protective devices (safeguards) to protect persons from hazards which cannot be reasonable eliminated or sufficiently limited by design.

1.8.39 Secondary controls

Infrequently used controls that are normally used by the operator to position and configure the bolting rig before carrying out the drilling and bolting functions, such as –

a) tilt;

b) traverse;

c) slew;

d) rig raise;

e) rib slide;

f) side shift;

g) shield tilt;

h) gripper;

i) guide clamp; and

j) percussion.

1.8.40 Self propelled bolters

Any specifically designed machine, requiring an external traction system and having a minimum of one bolting rig, such as a longwall face bolter.

1.8.41 Semi automatic

Automation of the drilling part of the bolting process.

1.8.42 Shall

Indicates a statement that is strongly recommended.

1.8.43 Should

Indicates a statement that is recommended.

1.8.44 Single handed operation

Any manual control requiring the use of a single hand in order for the function to operate at a safe speed of operation.

1.8.45 Skin failure

A failure around installed roof or rib supports. It includes both large material and small brat falling.

1.8.46 Strata failure management plan

A management plan which identifies assesses and controls hazards arising from strata failure.

Notes:

1. This is a mandatory requirement under clause 32 of the *CMHS Regulation 2006* and is specific to each mine.
2. The strata failure management plan should be prepared in consultation with a competent geotechnical engineer.

1.8.47 Supported rib

Any portion of the roadway outbye the last line of permanently installed rib support, or otherwise as determined and documented by the mines strata failure management plan.

1.8.48 Supported roof

Any portion of the roadway outbye of the centre line of the last line of permanently installed roof support or as otherwise determined and documented by the strata failure management plan.

1.8.49 Repair

Restore back to original design condition

1.8.50 Temporary roof support (TRS)

Reactive support onto the strata to hold up the immediate roof area above the operator and includes an ATRS.

A short duration reactive support applied to the strata providing support to the immediate roof (between the last line of support and the temporary roof support) in order to protect the operator during support installation.

1.8.51 Two-handed operation

A protective device(s) that requires at least simultaneous actuation by both hands in order to initiate and to maintain hazardous machine functions, thus providing a protective measure only for the person who actuates it.

1.8.52 Use of bolting plant

Means work from, operate, maintain, inspect or clean bolting plant.

1.8.53 Users of bolting plant

Means any company or person which owns or has control of bolting plant where the bolting plant is used by the company's employees or employees of another company including coal operators, hire companies, contracting companies and the like.

SECTION 2 GENERAL REQUIREMENTS

2.1 OCCUPATIONAL HEALTH AND SAFETY

2.1.1 Legislative framework

The Occupational Health and Safety legislative framework for mechanical engineering safety on mine sites is represented by the diagram in Appendix B – OH&S Legislative Framework for Mining in NSW.

This diagram highlights the hierarchy of legislation and the legislative considerations when managing mechanical engineering safety on a mine.

2.1.2 OHS Act 2000 and OHS Regulation 2001

The *OHS Act 2000* and the *OHS Regulation 2001* requires:

Designers, manufacturers and suppliers of plant must:

- ⇒ ensure plant is safe and without risk to health or safety when properly used;
- ⇒ provide adequate information about the plant to persons to which the plant was supplied to ensure its safe use; and
- ⇒ identify any foreseeable hazards that have potential to harm health or safety, assess the risks and take action to eliminate or control the risks.

Employers must ensure the health, safety and welfare of its employees and others at the employer's place of work through a process of risk management and consultation. That duty extends to:

- ⇒ ensuring that plant provided for use is safe and without risk to health when properly used,
- ⇒ ensuring that systems of work and the working environment are safe and without risk to health; and
- ⇒ providing information, instruction, training and supervision as necessary to ensure health and safety is provided,

Notes:

1. This guideline provides guidance towards meeting these requirements.
2. Designers, manufacturers and suppliers of plant and employers are advised to consult the *OHS Act 2000* and the *OHS Regulation 2001*, particularly Chapter 5 Plant, for details of these requirements.
3. To effectively consider this guideline, designers, manufacturers, suppliers of plant and employers need to be aware of these requirements and have systems and procedures in place to apply them.

2.1.3 Control of risk

The OHS regulation requires risks (that cannot be reasonably eliminated) to be controlled in the following order:

a) Substitute the hazard to a hazard giving risk to a lesser risk.

b) Isolate the hazard from people at risk.

c) Minimise the risk by the use of engineering means.

d) Minimise the risk by administrative means (e.g. safe work procedures, training, instruction, information).

e) Use of personal protective equipment (PPE).

Note: A combination of methods may be required to minimise the risk to the lowest level reasonably practicable.

2.1.4 Consultation

Employers are required by the *OHS Act 2000* and *OHS regulation 2001* to consult with employees when taking steps to assess and control workplace risks.

Notes:

1. The *CMHS Act* has additional requirements for consultation.
2. Further guidance can be obtained in the *OHS Consultation* Code of Practice 2001 by WorkCover NSW.

2.2 STANDARDS / GUIDELINES

All bolting plant should be designed, manufactured, operated and maintained in accordance with the manufacturer's recommendations and relevant Australian, ISO DIN or SAE standards (refer Appendix 7.1).

2.3 MANAGEMENT SYSTEMS

The management of bolting and drilling plant should be an integral part of the mines Health and Safety Management System (HSMS) which should be consistent with AS 4801.

Note: Further guidance can be found in AS 4804 and HB 205. Refer also clause 14 of the *CMHS Regulation 2006*.

Designers, manufacturers, suppliers, users and coal operators should be able to demonstrate that each of the following has been addressed:

a) Hazard identification
b) Risk assessment
c) Risk management procedures
d) Consultation with all stakeholders
e) Provision of adequate information
f) Provision of adequate instruction and training
g) Provision of adequate supervision
h) Monitoring
i) Review
j) Revision

2.3.1 Hazard identification

All hazards must[1] be identified and dealt with so that they are eliminated or controls established to minimise the risk. This should be carried out for every stage of the plant in its lifecycle.

Note: see AS/ISO 31000 and MDG 1010 for further information.

Specific hazards associated with strata support (bolting) and drilling activities which may lead to personal injury may include but not be limited to:–

a) rotating and percussion machinery;
b) stability of the machine/plant;
c) mechanical energy;
d) electrical energy;
e) hydraulic energy;
f) potential hazards due to the environment (strata fall, noise, dust, water, strata gases);
g) biomechanical energies (poor ergonomics and repetitive work);

[1] Refer Chapter 2 & Chapter 5 OHS Regulation

h) thermal energy;

i) excessive noise;

j) excessive dust;

k) excessive vibration; and

l) ground subsidence.

This is not an exhaustive list and there may be other hazards present, refer also clause 1.2.

2.3.2 Factors not commonly considered

Factors not commonly considered which may increase the risk include (but are not limited to):–

a) human error factors, especially control selection errors and control direction errors;

b) inadvertent contact with controls;

c) inconsistent control layout such as differences between machines and handing from the operators position;

d) fatigue;

e) poor work practices;

f) change in procedures or the environment;

g) cumulative musculoskeletal injuries including repetitive strain injury (RSI);

h) working at heights;

i) high pressure fluids and fluid injections;

j) poor visibility and poor illumination;

k) congested work area;

l) slippery and wet environment;

m) the failure of safety critical components or systems;

n) strata failure; and

o) inrush.

2.3.3 Consultation

All stakeholders, including designers, manufacturers, owners and employees should be consulted when –

a) identifying bolting and drilling system hazards and assessing or reviewing their risks;

b) decisions are made about measures to control those risks;

c) introducing or altering the procedures for controlling those risks;

d) changes, defects or incidents occur;

e) in the development, implementation and review of the mine SMS; and

f) after an audit has been carried out

2.3.4 Risk assessment

Designers, manufacturers and users of bolting plant must[2] carry out risk assessments to identify all hazards (refer 2.3.1), assess the risks arising from those hazards and implement appropriate risk controls, refer 3.2.2 and 5.1.1.

[2] Refer Chapter 2 and Chapter 5 OHS Regulation

These risk assessments shall be suitable detailed and documented.

All risk assessments shall be consistent with recognised risk standards such as – MDG 1010, AS 4024:1301, AS4024:1302, IEC/ISO 31010 and the *National Minerals Industry Safety and Health Risk Assessment Guideline*, refer http://www.mishc.uq.edu.au/.

Design risk assessments (refer 3.2.2) and operational risk assessments (5.1.1) should address the following, as appropriate:

a) Risk to health and safety of people in the vicinity that may be affected by the use of bolting plant.

b) Risk to health and safety of people from the bolting plant over its full life cycle, including operation, inspection, testing, maintenance and repair.

c) Identify the risk to property, production and the environment.

d) Control risk to the lowest level reasonably practicable, refer 2.1.3.

e) Determine if the recommendations in this guideline be adopted or rejected.

f) Determine any additional criteria that may be required for specific circumstances.

g) Develop safe systems of work.

h) Ensure the bolting plant is fit for the specified purpose.

i) Maintenance requirement to ensure the bolting plant is safe to use.

j) The instruction and training requirements.

k) Evaluate alternatives to those recommendations of this guideline.

2.3.5 Safe systems of work

Safe systems of work must[3] be supplied by the designer/manufacturer. These systems of work should be reviewed and new systems developed/maintained by the owner of the bolting plant relevant to site specific conditions.

2.3.6 Instruction, training and competencies

All persons involved with bolting activities including designers, supervisors, operators and maintenance should be trained and assessed for their competencies.

The minimum acceptable competencies for particular types of works should be nominated under the OHS requirements.

Records of competency should be maintained and available for audit. The training and assessment of competencies extends to all levels including management and contractors.

Persons with appropriate knowledge, skills and experience should carry out training.

2.3.7 Supervision

All people involved with bolting activities should be reasonably supervised according to their competencies, experience, age and the task at hand.

2.3.8 Audit, monitor and review

Bolting plant and bolting management systems should be audited, monitored and reviewed at appropriate periodic intervals through its lifecycle.

In particular, a review should be carried out during any change management process.

2.3.9 Revision

Bolting plant should be revised, where applicable, after an audit or review has taken place.

[3] Refer clause 95 OHS Regulation

2.4 INFORMATION

Designers, manufactures, suppliers and hirers must[4] supply sufficient information to users of bolting plant to enable them to fulfil their obligations with respect to occupational health and safety (identifying hazards, assessing risks arising from those hazards, controlling those risks, providing information), refer clause 3.2.2.2.

This information should be contained in the plant safety file and should be provided before supply of the bolting plant.

Users of bolting plant must[5] provide all persons involved in the installation, commissioning, use and testing of bolting plant all available information concerning health and safety about the plant.

2.5 PLANT SAFETY FILE

Safety related aspects of bolting plant should be fully documented. These records should be maintained in a plant safety file which covers the lifecycle of the system, as appropriate. The plant safety file should contain the following information:

a) Design specifications, performance and conditions as specified in clause 3.1.

b) Design documentation as specified in clause 3.12.

c) Hazard identification and risk assessment documents.

d) Risk control methods.

e) Identification of all safety critical systems and their safety category or integrity level.

f) Consultation records*.

g) Commissioning and test results.

h) Permits and authorisations as required*.

i) Maintenance records, safety inspections and test reports.

j) Change of procedures, monitoring, audit and review reports.

k) Reports of accidents and safety statistics*.

l) Training and competency records*.

m) Plant alterations.

n) Electrical/Mechanical certifications, test certificates, registrations, etc., as applicable.

o) Validation of compliance with standards, guidelines, etc.

The records should be stored and maintained in such a way that they are readily retrievable and protected against damage, deterioration or loss.

Note: A plant safety file may not necessarily be one complete document, but may refer to where the information can be obtained see * above.

2.6 ACCIDENT REVIEW

A co-operative approach between designers, manufacturers, statutory authorities and coal operators is required to eliminate further bolting plant incidents.

The owners and operators of bolting plant should provide to the plant designer/manufacturer details of relevant incidents.

The designer/ manufacturer should notify all owners and operators of any safety related incidents that they become aware of and their recommendation to rectify the defect. (e.g. Safety Alerts, Technical

[4] Refer Chapter 5 OHS Regulation

[5] Refer Clause 144 OHS Regulation

Bulletins, etc.), refer http://www.I & I NSW.nsw.gov.au/minerals/safety.

2.7 ALTERATIONS AND REPAIRS

Alterations to bolting plant must not be carried out unless the person carrying out the alterations fulfils the duties of a designer under the *OHS Regulation 2001*. A risk assessment shall identify the alterations are safe and are able to be done without reduction to the overall plant safety.

Alterations of safety critical parts require a review of the safety integrity level or category.

Alterations to plant shall be designed and implemented under the direction of the original designer or otherwise by a competent engineer.

Repairs to plant are to be at least as functionally efficient and strong as they were before the failure or damage.

The end user should conduct an operational risk assessment on the modified plant before putting the machine into operation. This risk assessment should ensure that no new hazards are introduced unless appropriate controls are implemented.

For any alteration and in conjunction with a change management process all standards and documentation should be reviewed.

2.8 GUIDELINE ASSESSMENT

Relevant parts of this guideline should be carried out by designers and users of bolting plant.

These considerations should include –

a) identification of which clauses of this guideline are relevant to the particular bolting plant for its safe use; and

b) an assessment against these relevant clauses for possible risk controls or alternatives which provide an equivalent level of safety.

SECTION 3 DESIGN AND MANUFACTURE

3.1 INFORMATION TO BE PROVIDED TO THE DESIGNER

Users of bolting plant must[6] provide to the designer all relevant information about matters relating to the bolting plant that may affect health and safety.

This information should include, (but not be limited to) –

a) the intended use including functional, operational and performance requirements;

b) bolting/drilling/support design parameters such as depths, patterns and requirements;

c) operational performance;

d) modes of operation and intended process of bolting;

e) environmental conditions, e.g. roadway profiles;

f) consumables specifications and storage/handling requirements;

g) geotechnical report for operator protection systems, refer 3.6.2;

h) geology and strata information; and

i) any other information requested by the designer for matters that may affect health and safety.

3.2 GENERAL DESIGN REQUIREMENTS

3.2.1 General

Bolting plant, bolting rigs and bolting platforms shall be designed, manufactured, constructed and tested using good engineering principles to ensure the bolting plant is fit for the specified purpose and can provide safe operation over the intended design lifecycle of the system.

Note: Chapter 5 of the *OHS Regulation 2001* stipulates specific requirements for the design and manufacture of plant.

The design of the system should allow reasonable access to all parts that require adjustment, cleaning or service. All routine maintenance and servicing actions should be possible without the removal of fixed guards, where practicable.

Sharp edges on the plant which could injure people should be avoided.

Provision should be made to secure all loads associated with the bolting and drilling activities, such as materials storage.

A system for the safe handling and loading of consumable materials such as: drills, bolts, chemicals, plates, etc. should be specified. The handling system should minimise reach distance and exposure to hazards where practicable. This handling system should be designed and developed in consultation with the user's specific site requirements.

Note: The handling system should include both positioning of consumables on the bolting plant and moving consumables from the bolting plant to the drill rig area.

Health hazards from the bolting and drilling process such as air exhaust, dust etc should be identified and should minimise exposure of the operator while at his station by all practicable means.

Lifting points should be provided and clearly marked to safely lift the plant or major components that could cause a hazard to employees.

[6] Refer clause 144 OHS Regulation

3.2.2 Hazard identification, risk assessment and control

3.2.2.1 General

Designers of bolting plant must[7] carry out a risk assessment(s) to –

a) identify all foreseeable hazards associated with the use of bolting plant (refer 2.3.1, 2.3.4 and 3.5.1);

b) evaluate/assess all risks of harm to the safety of any person arising from the identified hazards; and

c) implement appropriate risk controls and design requirements to control the risk to a level as low as reasonably practicable.

In designing risk controls the designer must make sure that –

(i) safe access to the components of the bolting plant can be gained for the purpose of operation, maintenance, adjustment, repair and cleaning; and

(ii) the designer has given regards to ergonomic principles.

The designers risk assessment must cover the lifecycle risks and should be carried out in consultation with the end user. The design risk assessment should consider reasonably foreseeable misuse and should review previous accidents, incidents relating to similar plant, where practicable.

The designers risk assessments must[8] be reviewed whenever –

- there is evidence the original risk assessment is no longer valid; or
- they are provided with information regarding a design fault that may affect health or safety.

Note: refer *OHS Regulation 2001* Chapter 5.

3.2.2.2 Information by designer/manufacturer

The designer/manufacturer must[9] provide information on risk controls necessary for the safe use of the bolting plant. This information must include the following, but not be limited to –

a) information on identifying hazards, assessing risks arising from the hazards and controlling risks from the use of the bolting plant;

b) the purpose of the bolting plant;

c) testing or inspections requirements;

d) installation, commissioning, operation, maintenance, inspection, cleaning requirements;

e) systems of work for the safe use of the bolting plant; and

f) emergency procedures.

Note: emergency procedures may include use of emergency stops, function overrides, etc. as appropriate for the bolting plant.

3.2.2.3 Safety critical systems

All safety critical functions required for the safe use of the bolting plant should be identified and documented by the designer.

Through a risk assessment process the designer should determine the required minimum safety integrity level or the required minimum category level for each identified safety function and should design an appropriate safety critical system to control the risk.

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[7] Refer clause 89 OHS Regulation

[8] Refer clause 88 OHS Regulation

[9] Refer clause 96 OHS Regulation

The assessment and validation of safety critical systems should be in accordance with an appropriate recognised standard, such as – AS 4024:1501 and 4024:1502, or AS/IEC 62061, or AS/IEC 61508 or other similar standards.

The validation risk assessment should be in the form which systematically analyses the failure modes and integrity of each safety critical system.

Note:

1. A Failure Modes and Effects Analysis (FMEA), fault tree analysis, quantitative risk assessment, or similar analytical systematic methods are suitable.
2. Guidance can be found in AS 4024.1301, AS 4024.1302, IEC/ISO 31010 and the *National Minerals Industry Safety and Health Risk Assessment Guideline*.

3.2.2.4 Human-plant interactions

The design risk assessments shall consider, through the bolting process maps, the following factors for safe human-plant interaction:

a) Limitations of human capabilities.

b) Human actions critical to safety and the consequences to safety of human error in these actions.

c) Integration of human performance into systems and their operation.

Note: Guidance is given in ISO 13407, AS 4024:1401, and AS 4024:2601.

3.2.2.5 Ergonomics

The designer shall consider safety related aspects of ergonomic issues for persons carrying out –

a) repetitive work when addressing the layout of all bolting plant components and their use; and

b) maintenance work when addressing the layout of all bolting plant components and their use.

An ergonomic assessment on the layout of all operator controls should be carried out. The assessment should be carried out by a suitably competent person.

Notes

1. The Human Factors and Ergonomics Society of Australia Inc maintain a directory of Certified Professional Members (see www.ergonomics.org.au).
2. Guidance for ergonomics can be found in AS 4024; Practical Ergonomics by Barbara McPhee, available through the Coal Services Health and Safety Trust, www.coalservices.com.au; and specific examples of application to underground coal mining equipment can be found in the report of ACARP project C14016 Reducing injury risks associated with underground coal mining equipment by Robin Burgess-Limerick. This report, including a handbook can be obtained from ACARP (www.acarp.com.au) or via www.burgess-limerick.com.

3.3 GUARDING OF MOVING AND ROTATING PARTS

An effective safe guarding system(s) shall be provided to prevent access to all danger points or areas on the bolting plant where people may become injured from moving parts, rotating parts, nip/shear points and contact with hot surfaces.

Note: The safe guarding systems should minimise the risk to the lowest level reasonably practicable in accordance with clause 3.2.2.

The safe guarding systems shall be provided with consideration to AS 4024.1201, AS 4024.1202, AS 4024.1601, AS 4024.1602, AS 4024.1603, AS 4024.1604, AS 4024.2601. The integrity of the safe guarding systems should be identified and assessed in accordance with clause 3.2.2.3.

Safe guarding systems should be designed to make bypassing or defeating (whether deliberate or by accident) as difficult as is reasonably possible and provide minimal interference with operational functions in order to reduce any incentive to defeat them.

Typical safe guarding systems may include, but be not limited to –

a) physical guards (interlocked if guard needs to be regularly removed for operational reasons);

b) speed of operation of the bolter components;

c) two handed operation;

d) sensitive protective devices, such as presence devices, pressure mats, etc;

e) controlled or reduced force (thrust or rotation);

f) pinch point preventers (e.g. buffers, spacer stops or bump stops);

Note: These devices assist in preventing crush injury between the head plate and feed frame.

g) deflectors from pinch / shear points; and

h) other forms of protective devices.

The level of safe guarding systems required should be appropriate to the level of risk for the particular function as determined by the design risk assessment.

Note: A combination of guards and protective devices may be required to achieve the required level of protection.

Fixed, rigid guards on moving parts should not create an additional nip or shear hazard.

Where two handed operation is required, it should be designed with consideration to ISO 13851 and AS 4024:2601.

Note: AS 4024.2601 (DR07432 CP) is a draft Australian Standard revision of ISO 13851 under review.

3.4 BOLTING FUNCTION

3.4.1 Bolting rig operation

A series of bolting process map(s) or sequence(s) defining the designed bolting rig operation process, including the operator protection system should be provided by the designer. This should cover the entire bolting cycle. This map should be developed using the information provided by the end user and in consultation with the user, refer 3.1.

The design risk assessment should identify the hazards and assess the risks at each stage. The process map should identify the risk controls for each stage in the process.

Note: An example of a typical bolting process map is included in 7.5, Appendix E.

3.4.2 Single person operation

Each individual bolting rig should be designed for single person operation.

Notes:

1. There are additional risks when two or more people are required to operate or interact with the same bolting rig.
2. Rib bolters require more direct interaction and are statistically more hazardous.

Where single person operation is not practicable then a risk assessment shall identify:–

a) the required operators positions;

b) the number of operators; and

c) the additional hazards and required additional risk controls.

3.4.3 Drill motors

The chuck of a drill motor should have a smooth surface to prevent catch points in the event it is accidentally touched by the operator.

The number of interactions between the operator and the drill motor should be minimised. A chuck that suits both drilling and bolting functions without using a bolt tightening device (dolly) should be used where practicable.

A means of securing both the rotating drilling steel and the bolt tightening device (dolly) in the drill head should be provided.

Notes:

1. This means allows the operator to drill holes and install bolts without stabilising a drill/bolt with his hand.
2. Injuries have occurred from operator interaction with moving components of the drill rig.

3.4.4 Gas ignition prevention

Where there is a risk of gas ignition with wet drilling in an automatic mode, water flow monitoring should be provided on each drill rig. The water flow monitoring should stop the drilling function when the water flow and/or pressure are insufficient to prevent a blocked drill.

Note: Undetected blocked drills have previously resulted in a fire or gas ignition.

3.4.5 Drill guides

A system of guiding the drill steel, such as head plates, should be incorporated.

Manually operated mechanical drill guides should not be used unless otherwise safe guarded.

Notes:

1. Operators have been injured from pinch points on manually operated drill guides.
2. Bolting washers or gripper jaws may be used to guide the drill steel.

Head plates should positively retain the roof bolt plate or butterfly during the bolting and drilling functions.

3.4.6 Gripper jaws

Gripper Jaws to hold the drill steel or cable bolt should be included in the head plate where extension drills and cable bolts are used.

A load holding device should be provided on the gripper jaw function in order to prevent the drill/bolt falling.

Note: The function of the load holding device is to prevent the drill from falling in the event of power failure or oil dissipation away from the gripper jaw cylinder load holding valve.

3.4.7 Drill steels

Drill steel selection should consider resistance to bending.

A safe means of pulling out a jammed drill steel from the strata should be provided.

Note: Consider the use of gripper jaws as a safe means.

3.5 BOLTING CONTROLS

3.5.1 General

The primary bolting controls, the secondary controls and the ancillary controls should be designed to minimise the risks to health and safety.

Risks associated with bolting controls which should be considered by the designer include, but not limited to –

a) entrapment / entanglement during operation or maintenance activities;

b) incorrect selection of controls by operators;

c) inadvertent or accidental operation;

d) incorrect adjustment of controls by maintenance people;

e) incorrect functionality - layout of controls, orientation inconsistent with direction of movement;

f) incorrect movement – up and down, in and out (from non-standardisation of controls between different manufacturers);

g) unsafe speed of operation allowing the operator to be caught; and

h) cumulative and/or repetitive loading being applied to parts of people's bodies.

Bolting controls shall be protected to prevent accidental contact by external objects such as operator or falling material (roof or rib).

Bolting controls which are identified as safety critical controls shall be designed with the appropriate safety integrity level (refer 3.2.2.3).

Where the failure of solenoid or pilot operated control valves increases the risk to safety, spools should be monitored, where practicable. Bolting controls should be positioned so that the operator is located under a permanently supported roof or otherwise under an operator protection system which provides an equivalent level of safety, refer clause 3.5.14.

Bolting controls should be located at each operators work station and within the operators reach envelope. Where this cannot be practically achieved, a risk assessment should determine alternative risk controls, e.g. rapid face bolters, longwall face bolters.

Note: AS 4024.1801. AS 4024.1802 and AS 4024.1803 provides ergonomic data on safe reach dimensions for operator controls.

3.5.2 Remote controls

All remote operated bolting rig controls shall comply with AS 4240, MDG 5001 and MDG 5002 as applicable.

3.5.3 Emergency stop controls

3.5.3.1 General

Emergency stop facilities shall be provided in accordance with AS 4024:1604, AS 4240, or AS 3000, as applicable and shall –

a) be designed to be fail safe with the appropriate safety integrity level, refer 3.2.2.3.

b) be prominent, clearly and durably marked

c) not be affected by circuit malfunction.

d) shut down all power in a time as short as reasonably practicable.

e) remain in the off position until it is manually reset.

The resetting of emergency stop devices shall not cause the bolting plant, bolting rig or associated other plant to operate.

3.5.3.2 Emergency stop location

As a minimum, emergency stop controls shall be located at –

a) each tramming station; and

b) within reach of each bolting rig control station.

The location of the emergency stop device shall be readily accessible to the operator during normal operation.

The location of the emergency stop shall not place the operator or any part of his body within any danger zone.

Note: Where there are two operators operating the same bolting rig each operator should have access to a bolting rig stop.

3.5.4 Bolting rig isolation valves

Individual hydraulic isolation valves to remove hydraulic power to the drill rig controls should be provided.

Note: This should be done in consultation with the end user to enable the drill rig to comply with site specific isolation procedures.

Where provided, drill rig isolation should comply with MDG 40.

Where hydraulic isolation valves are used for the purpose of removing hydraulic power to bolting rig controls, a risk assessment should be carried out to determine the level of isolation and work activities. They should comply with the following:

a) Be on the supply side of the hydraulic circuit to each work area (e.g. a single bolter or a number of bolters).

b) Be located at the control station or in close proximity to the operator.

c) The individual hydraulic isolation valves shall be lockable.

d) Readily accessible and user friendly.

e) Be clearly identified (labelling).

f) Be easily distinguishable from an Emergency Stop.

g) Have a means to test the valve is closed.

Notes:

1. Remember to isolate other areas if there is any interaction of other components (shovel, boom and other rigs etc). This area should be considered in the risk assessments.
2. Best practice is to use full isolation and lockout when working on bolting plant.

3.5.5 Bolting rig stop

An individual bolting rig stop at the bolting rig operator's workstation should be considered.

When fitted, this device should stop and interrupt hydraulic energy to the bolting rig controls and should stop all bolting and drilling functions for that particular bolting rig.

Note:

1. This should be done in consultation with the end user to enable the drill rig to comply with site specific isolation procedures.
2. A bolting rig stop may also meet the requirements of an emergency stop (refer clause 3.5.3.1 and AS 4024.1604).

3.5.6 Manual controls

3.5.6.1 General

The choice of manual controls should be appropriate for the operation being initiated such as push button used for on off controls, levers proportional controls etc. Unless required by automatic, semi automatic or gripper jaw functions, all manual controls should automatically return to neutral when released by the operator.

The neutral position on manual controls should be easy to find.

The neutral position on a manual control valve should not hold stored pressure on the actuator side of the valve in order to prevent unintended movement. Pressure should divert back to tank or exhaust, unless required by the plant function.

If any function has more than one manual control station then effective protection or interlocking shall be provided to control the risk associated with dual operation.

3.5.6.2 Direction of operation

The direction of operation of manual controls should be consistent with the direction and response/movement of the actuator or the plant, where practicable, refer ***Table 1***.

Where horizontal levers are used to control the extension of a timber jack to either the roof or rib, an upward movement of a horizontal control should be employed to cause extension.

Where horizontal levers are used to control drill feed to the roof or rib, an upward movement of a horizontal lever should be employed to cause feed.

Where vertical levers are used to control extension of a timber jack to roof or rib, a movement of the vertical lever away from the operator should be employed to cause extension.

Where vertical levers are used to control drill feed, a movement of the vertical lever away from the operator should be employed to cause feed.

Notes:

1. AS 4024:1906 provides guidance on general principles, group 1 is preferable.
2. Recommendations regarding direction control-response relationships are provided in the final report of ACARP Project C16013 Principles for the reduction of errors in bolting control operation. Refer http://www.burgess-limerick.com/download/C16013final.pdf

Nature of Actuator	Nature of Action	Direction of Action
Handwheel, handle, etc	Rotation clockwise	Clockwise
	Rotation anti-clockwise	Anti-clockwise
	Vertical motion upwards	Upwards
	Vertical motion downwards	Downwards
Grip, lever, push-pull button, etc. with essentially linear motion	Horizontal motion right	To the right
	Horizontal motion left	To the left
	Horizontal motion forward	Away from the operator
	Horizontal motion backward	Towards the operator

Table 1 – Classification of control actions- Group 1 (AS4024.1906)

3.5.6.3 Manual control locations

Manual controls should be positioned such that they are –

a) located within the operators reach envelopes at each tramming, bolting and ancillary work station, where practicable;

   Note: AS 4024.1903 provides guidance.

b) in similar locations for similar types of plants, to assist operators who may regularly operate different plants; and

c) arranged so that the controls are handed identically, irrespective of the location on the bolting plant, where practicable. e.g. the right hand lever should operate the same function on both sides of the bolting plant, refer appendix 7.7.

   Notes:

   1. It may not be practicable for some functions to be handed identically, such as where the control needs to be within reach of the drill.

2. Different manufacturers may have different locations for the same function. This may create a hazard to operators where different manufacturers bolting rigs are located in the same workplace.

3.5.6.4 Two-handed operation

Two handed operation should be designed with due consideration to AS 4024:2601.

Defeating of the two handed control feature should be prevented as far as reasonably practicable. Consideration should be given to reasonably foreseeable misuse.

Note:

1. To reduce operator interaction with the bolting rig during operation.
2. Two handed manual controls only protect the operator. They may not protect others in the vicinity of the bolting rig.

3.5.6.5 One-handed operation

Where one handed operation of primary and secondary controls is used all drilling and bolting functions shall be limited to a safe speed of operation, in accordance with clause 3.5.11

3.5.7 Modes of operation

The design risk shall determine the modes of operation for the mobile bolting plant and isolation requirements. Modes for consideration include –

a) a bolting mode to allow all bolting functions;

b) a maintenance mode for carrying out maintenance or servicing function; and

c) a tramming mode to allow the bolting plant to move forward.

3.5.8 Control recognition

Primary bolting controls should be clearly distinguishable from –

a) other primary controls; and

b) secondary controls.

Note: This is to establish their significance. For example, control extended slightly beyond each other, separated (positioned), etc., see appendix 7.5.

Where handles (levers) are used for primary bolting controls they shall be shaped in accordance with *Table 2* below, were practicable.

The control design shall incorporate a means of ensuring that the shaped handles cannot be inadvertently fitted to the incorrect lever during maintenance.

Bolting Function	***Shape of Control***
Rotation Control	Three balls in line
Feed Control	Round disk
Timber Jack Control	Rectangle

Table 2 - Primary bolting control shapes

Notes:

1. Incidents have occurred from operators inadvertently operating the wrong control.
2. If joystick control is used to control two separate functions, i.e. rotation and feed, use 3 balls (rotation shape).

3.5.9 Drill rotation and drill feed controls

Drill rotation and drill feed manual controls shall be such that these controls cannot be operated by one hand, unless otherwise protected with a safe guarding system.

Notes:

1. The intention is to prevent single handed operation for drill feed and rotation. Accidents have occurred due to operators using their free hand while drilling and subsequently becoming entangled.
2. Consider AS 4024:2601 for two handed control and control separation distances.
3. For the rotation control, two action operation should be considered in conjunction with an ergonomic assessment, e.g. lift and push/pull to operate the function.

3.5.10 Automatic operation

To initiate either automatic or semi automatic functions a safe guarding system shall be provided so the operator is clear of rotating or moving parts. This system may include two separate controls activated in a particular order. Where provided, these controls should be segregated so they can not be operated simultaneously by one hand.

Note: Consider AS 4024:2601 for control separation distances.

In the event energy to a bolting rig is removed and then later restored (while operating in automatic or semi automatic mode), the automatic / semi automatic function shall be disabled, the bolting rig should not move and the controls should return to the neutral position. The bolting rig shall not move and the automatic or semi automatic function shall be required to be manually reset when energy is restored.

When the automatic cycle is completed, the manually operated automatic select mode shall be disabled or shall return to neutral until manually reactivated, where fitted.

Notes:

1. The intention is to prevent the automatic function operating on more than one cycle.
2. Varying the stop position of the drill motor on the return cycle should be considered.

Consideration should be given to keeping the drill steel positively engaged in the drill motor chuck as it is retracted from the roof.

Notes:

1. Incidents have shown operators have been injured from manually pulling drill steels from the roof.
2. Examples may be slowing rotation of the drill steel, self locking chucks.

3.5.11 Safe speed of operation

When a safe speed of operation is used as a risk control, e.g. one handed operation, it shall be at an operating speed such that an operator can recognise and avoid a potential hazard.

A risk assessment and testing shall determine the safe speed of operation as applied to each particular function and particular application.

Controls for setting safe speed of operation should not be readily adjustable.

Note:

1. The safe speed may be different between functions, (e.g. drill feed and tilt) and may also be different between different bolting plant (e.g. miner bolter, mobile bolter).
2. Consideration should be given to human reaction times in avoiding hazards when determining the safe speed of operation.
3. Safe speed of operation as a single risk control may not be suitable for high consequence risks.
4. Testing in one particular application found that a drill feed rate of 50-70mm/s for one handed manual operation may be sufficiently slow such that the operator could recognise and avoid a potential hazard.
5. AS 2024:2801 provides guidance.

3.5.12 Drill feed

When positioning the drill steel with manual control, the bolting rig control system shall limit the force (pressure) of the drill feed actuator in order to minimise the potential for bending of the drill steel. This force should not be readily adjustable by the operator.

When drilling, a system that automatically assists in preventing the drill steel bending and/or blocking should be considered.

The drill feed force and speed should be capable of being altered to adjust for the different strata conditions or for when cable bolting.

Note:

1. The drill steel positioning force will be different from the drilling force.
2. Best practice is to have a feed back from the drill motor torque to reduce feed force while drilling.
3. Cable bolting may require a higher feed force, there may be a risk created if the force is increased for cable bolting and not reduced for normal roof bolting.

3.5.13 Rib bolters – additional requirements

All requirements of clause 3.5 should be considered, as applicable.

Consideration should be given to rib bolters having the capability to tilt left / right to allow proper alignment of rib bolts with drilled holes, this will accommodate movement of the plant and misalignment.

When the rib bolter is in the parked position, consideration should be given to disabling the extension (timber jack) function.

Notes:

1. Injuries have occurred due to inadvertent operation of the rib bolter extension (timber jack) function.
2. Extra slow final positioning of the rib bolter may be of assistance.

3.5.14 Labelling of primary bolting controls

The handles of primary bolting controls on bolting rigs should be labelled in accordance with ***Table 3*** below and clause 3.11.

Bolting Function	***Label of Control***
Rotation Control	Forward / Reverse
Feed Control	Advance / Retract
Timber Jack Control	Extend / Retract

Table 3 - Labelling of primary bolting controls

Note: The designer may provide a graphic symbol on the name plate for further clarification.

3.5.15 Labelling for secondary controls

Secondary controls on bolting rigs should be labelled in accordance with *Table 4* below and clause 3.11.

Positioning Function	***Label of Control***
Tilt Control	Left / Right Forward / Back
Traverse Control	Left / Right
Rig Raise Control	Raise / Lower
Rib Slide Control	Extend / Retract
Slew Control	Forward / Back Left / Right
Side Shift	Left / Right

Table 4 - Labelling of secondary controls

Note: The designer may provide a graphic symbol on the name plate for further clarification.

3.6 OPERATOR PROTECTION SYSTEMS

3.6.1 General

An effective means to prevent injuries to operators from material falling from either the roof or ribs shall be provided.

The operator shall be able to carry out the strata support process from under –

(i) permanently supported roof and supported rib[10]; and /or

(ii) an operator protection system which provides an appropriate level of protection.

Note: The *OHS Regulation 2001* requires risks to be reduced to the lowest level reasonably practicable in a hierarchical order, refer 2.1.3.

Operators shall be protected from risks associate with mobile bolting plant travelling, such as overturning or the operator hitting fixed objects.

Typical strata operator protections systems which shall be considered by the designer and user are provided in ***Table 5*** below.

[10] The strata failure management plan may determine supported roof or rib criterion, refer clause 1.8.48 and 1.8.47. Refer also *CHMS Regulation 2006* sub-clause 32(n)

Typical risk	Typical Operator Protection Systems
A massive failure of the roof causing fatal or serious injury.	People working under supported roof in accordance with the mine strata failure management plan.
A skin failure of the roof causing fatal or serious injury.	People working under supported roof in accordance with the mine strata failure management plan. People working under the influence of a TRS. People working under the influence of a protective canopy. Note: May be suitable for outbye areas of the mine to clean up roof falls.
A skin failure of the roof causing a minor injury to the operator.	People working under supported roof in accordance with the mine strata failure management plan. Mesh. Operator protective guard. Protective canopy. Flippers on timber jacks. Safe standing zones. Use of gloves.
A massive failure of the rib causing fatal or serious injury.	People working under supported rib in accordance with the mine strata failure management plan.
A skin failure of the rib causing fatal or serious injury.	People working under supported rib in accordance with the mine strata failure management plan. People working under the influence of a rib protection shield.
A skin failure of the rib causing a minor injury to the operator.	People working under supported rib in accordance with the mine strata failure management plan. Ergonomic design to prevent people being in risk areas. Mesh. No standing zones. Hand rails. Use of gloves.

Table 5– Typical operator protection systems

3.6.2 Loading criterion for operator protective structures

When used as a risk control, operator protective structures should be designed to the geological or strata loading conditions as specified by a geotechnical engineer or the mines strata failure management plan.

Note: In the absence of any documented information, operator protective structures may be designed using the loading criteria specified in clauses 3.6.4, 3.6.5, 3.6.6, 3.6.7 and 3.6.8 below, as applicable.

The geotechnical engineer or the mines strata failure management plan should –

a) consider potential for varying strata conditions and use of the bolting plant which may possess a higher risk than that in which the bolting plant was originally intended to be used;

b) state the maximum loading conditions for any TRS, rib protection shield, canopy or protective guard, as required;

c) fully document the determined loading conditions, and fully state any assumptions made in a manner that is auditable at a later date;

d) state the required set load for and minimum footprint for any TRS protective structure;

e) state any conditions or assumptions made in calculating the loading conditions; and

f) state the geographical limitations of the geographical information provided.

Note: If the operator protective structure is design from geotechnical information from a particular mine or mines, mining method, or mining seam, the structure may be inadequate for alterative mines, mining methods or mining seams.

3.6.3 Design of operator protective structures

Where used as a risk control, operator protective structures should be designed using the loading conditions as specified in 3.6.2 above.

The operator protective structures should be certified by a competent mechanical or structural engineer with consideration to AS 4100 or AS 3990.

3.6.4 Temporary roof support (TRS)

When used as a risk control, the TRS system should be designed in accordance with the following:

a) Consist of pads or crossbars which support the roof in advance of the last line of permanent supported roof prior to the strata support cycle and as near as practicable to the bolting rig, refer 7.8.

Note: Consideration should be given to control to prevent the potential for material to slide or canter lever onto the operator.

b) Support the roof above the operators work area.

c) Be designed such that the operators work area does not exceed 1.5m beyond the last line of permanently supported roof, unless otherwise specified by the mines strata failure management plan or geotechnical engineer.

d) Be located within 1.5m to the left or right of the rib, unless otherwise specified by the mines strata failure management plan or geotechnical engineer.

e) Vertical Loading Criteria for TRS

Unless otherwise specified by the mines strata failure management plan or geotechnical engineer (refer 3.6.2), the TRS structure should be designed to support (within the elastic range of the structure) a minimum rated design load (kN) of –

- 22 times the roof area intended to be supported (m^2); or
- 50 kN, which ever is the greater;

Note:

1. This criteria is based on the MSHA ATRS in 30 CFR § 75.201.
2. A TRS is not designed to support the entire weight of the roof but is designed for load stability and to temporary support the local area until fix support is installed.
3. Typically the roof area intended to be supported extends beyond the footprint of the TRS (zone of influence) and may vary according to support spacing. MSHA requires a zone of influence of at least 750mm inbye of the last support.
4. Typically, a TRS with a small pad contact should support at least 50kN per support and is assumed to support roof area of 750mm radius around the TRS.
5. Typically, a TRS with cross pads should support *(kN)=22(kPa)*(L+1.5)*(W+1.5)*, where *L* = length of TRS (m) and *W* = width of TRS (m). It is assumed to support roof area extending 750mm beyond the footprint of the TRS.

f) Incorporate a device capable of withstanding the rated design load of the TRS, such as a load lock, that will stop movement in the event of a failure of a hose or pipe.

g) Have a yielding system to progressively lower the load if the rated design load is exceeded and before any plastic deformation of the TRS structure occurs.

h) Be capable of withstanding the axial and side loading associated with any angle of inclination

of the TRS.

i) Be placed firmly against the roof prior to starting the bolting process and be able to remain in place during the strata support cycle.

j) Have a bearing pressure (set pressure/set force), consistent with the nature of the roof, such that it does not break up the immediate roof when the support is set and/or lowered.

Notes:

1. This requires the set pressure to be able to be varied for changing strata conditions.
2. The actual pressure to be applied will vary depending upon prevailing strata conditions and should be managed by the mine strata failure management plan or geotechnical engineer.
3. It is preferable to design a TRS with a larger support pad (footprint) to minimise the bearing stress on the strata.

k) Be mounted on a support structure suitable for the load.

l) Prevent tramming of the bolting plant when the TRS is set to the roof.

m) After the TRS is set, the strata support process should be able to be carried out without any further adjustments to the TRS, until the roof bolt(s) have been securely anchored.

n) Roof bolter timber jack should not be used for or part of a TRS system unless it is specifically designed for that function.

Note: Currently, bolting rig timber jack may provide some additional roof support, however they are not regarded as a TRS, unless they meet the loading criterion, refer 3.6.2.

o) Have its positioning and setting controls operated from under permanently supported roof or other operator protection system which provides an equivalent level of safety.

p) May be designed in conjunction with other systems to prevent injury to the operator from small brat (small pieces of roof) that may fall.

Note: mesh modules, protective guards and secure strata may be other systems.

q) Labelled with its rated design load and yield capacity, refer 3.6.9.

r) Have controls which are suitably identified, labelled and protected from accidental or inadvertent operation.

s) Be fitted with an emergency stop located in close proximity to the TRS controls, refer 3.5.3.2.

3.6.5 Rib protection shield

When used as a risk control, rib protection shields should be designed in accordance with the following:

a) Provide rib fall protection to limit / deflect rib failure in order to protect the operator.

b) Be capable of protecting the operator from the rib strata in the area of work.

c) Have controls which are operated from a safe position and from under permanent supported roof and supported rib.

d) Be labelled with its rated design capacity, refer 3.6.9.

e) Be designed with consideration to the protection of operators during the operation of the rib shield movement. (e.g. slow speed, required force, pinch points etc)

f) Have controls which are suitably identified, labelled and protected from accidental or inadvertent operation.

g) Be fitted with an emergency stop located in close proximity to the rib shield control system.

3.6.6 Operator protective guard

When used as a risk control, operator protective guards should be designed to prevent small, falling material hitting and injuring the operator during or from the strata support process.

Notes:

1. Mesh modules, TRS, protective guards and secure strata may provide adequate protection.
2. AS 2294.3 may provide some guidance on loading criteria.

3.6.7 Operator protective canopy

When used as a risk control, protective canopies shall be designed in accordance with the following:

a) Capable of protecting the operator from a fall of the roof strata in the area of work.

b) Capable of supporting the mass loading of the roof strata in the area of work.

c) Be designed to elastically support a rated design load of –

   i) Vertical load - have a minimum structural capacity to support elastically a static uniform load of 8.2 tonnes or a force equivalent to a static load of 105 kilopascals distributed uniformly over the greatest plan view area of the canopy roof, whichever is the lesser; and

   ii) Horizontal load - have a minimum structural capacity to support elastically a static uniform load of two tonnes applied horizontally to the edge of the canopy roof in both longitudinal and lateral directions.

   Note: This is an extract of the continuous miner canopy guideline, MDG 17.

3.6.8 Operator protection platform bolting plant

Platform bolting plant and man baskets used for bolting should be designed with an appropriate operator protection system to address the risks with consideration to the above risk controls.

3.6.9 Documentation and labelling

All operator protective systems shall be documented and maintained in the plant safety file, with their designed load rating specified.

All operator protection structures shall be suitably labelled to identity the designed loading criteria.

Note: This may be in the form of a number or marking with the criteria specified in documentation.

3.7 DRY BOLTING

Before designing dry bolting systems the design risk assessment should identify, assess and control any additional risks to wet bolting.

Some factors that should be considered include, (but are not limited to) –

a) dust levels/exposure;

b) noise levels;

c) temperature;

d) frictional ignition;

e) gas;

f) sparking from a static charge (static electricity);

g) ventilation;

h) compressed air and air discharge; and

i) dust disposal.

Dry bolting systems should be fitted with a mechanical dust extraction system to prevent dust from accumulating in the operators work area. The dust extraction system should be located as close as practicable to the source of the dust generation.

The dust extraction system should be designed with consideration to AS 4024:1302 as applicable.

The dust extractive system shall be designed to enable periodic inspection and testing.

The exhaust air should be directed away from any operator.

3.8 NOISE

Appropriate control measures must[11] be taken if exposure to noise at the operator's station exceeds –

a) an 8-hour equivalent continuous sound pressure level, $L_{Aeq,8h}$, of 85 dB(A), or

b) peak levels of 140 dB(C) weighted.

A comprehensive noise survey of the drilling or bolting plant should be conducted and be incorporated in the design documentation.

Notes:

1. The measurement is to be made in accordance with AS/NZS 1269.1
2. Exposure is to be taken at the position of the ears of an operator.
3. The measurement is to be made on the assumption that the person is not wearing any device to protect from noise, such as ear muffs.
4. The *National Standard for Occupational Noise [NOHSC:1007(2000)]* sets the maximum acceptable level of exposure to noise in the workplace, refer www.ascc.gov.au.
5. It is preferable for this noise survey to be carried out in the intended operating environment.

3.9 FLUID POWER

3.9.1 General

All fluid power systems shall be designed with consideration to MDG 41 and AS 2671.

Note: MDG 41 is integral to this guideline and should be read in conjunction with it.

3.10 BOLTING PLANT

3.10.1 General

In addition to the following requirements, bolting plant due consideration shall be given to the relevant parts of MDG 1 or MDG 17 as applicable.

3.10.2 Access to plant

All bolting plant shall have stable and secure work areas.

Where operating platforms are provided, they should be designed with consideration to AS 1657 and AS 3868.

Where there is a risk of a person falling from heights then the design risk assessment should stipulate appropriate controls. Suitably placed anchorage points, designed in accordance with AS 1891, for fall prevention or arrest devices should be installed.

Access and egress to bolting plant should have a three point contact access.

Elevated work platforms shall comply with AS 1418.10 as far as reasonably practicable.

Landing areas should be designed with a non-slip surface with consideration to ease of cleaning.

3.10.3 Reflectors and lights

Adequate reflective media should be provided at each end, the sides and extremities of the bolting and drilling plant.

Adequate illumination should be provided for the bolting work area to enable the operator to work

[11] Refer Clause 49 OHS regulation

safely. The following should be considered:

a) Recognition of operation of controls.

b) Movement around the work area.

c) Interaction points with the bolting rigs.

d) Changes from dark to light areas.

Note: An illumination of 60 to 100 lux has been suitable on some applications.

3.10.4 Pre-start warning device

An automatic audible and/or visual warning device should be activated on an initiation –

a) of traction movement;

b) a change in traction direction; or

c) when bolting and drilling mode is selected.

The selection of warning type, i.e. visual and /or audible, should consider the work environment and personal protection plant normally in use, i.e. hearing protection.

The warning should be for a suitable period of time before the movement commences such that a persons has sufficient time to become aware of the operation.

3.10.5 Brakes

Brakes should be provided on all mobile plant in accordance with the relevant requirements of MDG 1 and MDG 39 (as amended), as applicable.

Self propelled bolting plant should be fitted with a fail safe brake which is spring applied.

Brakes shall be totally enclosed, liquid cooled and limit exposed surface temperatures to a maximum of 150 degrees Celsius.

The brake should hold 120% of its total maximum loaded weight on the maximum specified grade in the direction of travel.

Notes:

1. Bolting plant which is used for transporting person(s) may be required to be design registered under the *OHS Regulation 2001*.
2. MDG 39 has been amended and includes requirements for track mounted plant

3.10.6 Stability

The designer shall specify the maximum operating and transport grade of the bolting plant for its safe operation.

Stability grades shall be clearly defined by manufacturer in documents (tipping forward and sideways).

3.10.7 Tramming

Manual tramming controls shall be positioned to keep operator clear of the path of the plant unless movement of the plant is at a speed sufficiently slow enough such that a risk to the health and safety is not created.

Tramming controls should be located to minimise the potential of injury from movement of the plant or strata.

Hoses and/or cables shall be located to prevent operator tripping while tramming.

The tramming control circuit shall be interlocked to prevent simultaneous drilling while tramming.

Machine Anchor points shall be provided for the attachments of cables and hoses as required.

Safe standing zones or operator location while tramming the plant shall be specified.

3.10.8 Remote controls

All remote operated bolting plant shall comply with AS 4240, MDG 5001 and 5002 as applicable.

3.10.9 Surface temperature

Surface temperature on any part of the bolting plant shall not exceed 150^0 C.

3.10.10 Couplings

Connections between pumps and motors should be flange mounted to reduce the possibility of fire from misaligned flexible couplings.

3.10.11 Material

Bolting and drilling plant should be constructed from non-flammable and antistatic materials where practicable.

NOTE: Hazards to be considered are toxic fumes, flame propagation and static discharge etc , refer MDG 3006 MRT 8.

Exposed Aluminium shall not be used in bolting plant, refer *CMHS Regulation 2006*.

3.10.12 Electrical

All electrical plant shall comply with the *CMHS Regulation 2006*, AS 2290.1, AS 2381, AS 3000, AS 4871, AS 3800 and other relevant Australian Standards.

For all intrinsically safe plant and components, a system diagram shall be provided showing all system components and circuits, the certified parameter limits and the proposed actual system values. These requirements apply to all electrical plant for use underground.

Electrical systems should be assessed against the AS 4871 series of standards

Electrical enclosures should be assessed against AS 3800.

3.11 SIGNS, LABELS AND WARNING NOTICES

3.11.1 General

All signs, labels and warning notices should be designed and installed in accordance with AS 1318 and AS 1319. They shall be –

a) of durable, corrosion resistant construction;

b) permanently attached; and

c) positioned so they are clearly visible.

3.11.2 Labels

The following items should be labelled (but not be limited to):

a) Manual controls.

b) Isolation points.

c) Emergency stops.

d) Hydraulic stops.

e) Mechanical safety stops (mechanical load holding device locations).

f) Safe guarding systems.

g) Areas of excessive temperature.

h) Bolting and drill rig functions.

i) Tare and gross weight of the bolting or drill rig.

j) Plant stability including condition where items are in fully extended position.

k) Warning on accumulators to release pressure before work commences.

l) Warning sign to stand clear of and identify any pinch points (e.g. stab jack).

m) Warning of required PPE to be worn.

n) Protective structures.

3.12 DESIGN DOCUMENTATION

3.12.1 General

The design of the bolting and drilling plant should be fully documented, for the As Built system.

When alterations are being made to the system, documents should be updated as soon as practicable and details distributed to ensure hazards are not created by the use of incorrect information.

Design documentation should be provided to the end user in a plant design safety file, maintained and include:

a) Specification of plant.

b) System design parameters and limitations.

c) Circuit diagrams.

d) Installation testing and commissioning data.

e) Operation and lifecycle maintenance requirements.

3.12.2 Specification of plant

The designer, manufacturer and supplier should provide to the coal operator or other users of bolting plant a specification on the plant as follows:

a) System operating limits and capacities.

b) General arrangement drawings showing the physical dimensions of the plant.

c) Safety critical systems.

d) Hydraulic and pneumatic circuit diagrams.

e) Schematic and logic drawings of power and electrical control facilities.

f) Detailed parts lists of all components including reorder codes.

g) Transport and lifting requirements.

3.12.3 System design parameters

The designer should document all system design requirements including, but not limited to:

a) The purpose and intended operations of the bolting and drilling plant.

b) Intended service lifecycle of the system and its components.

c) Design parameters and assumptions made.

d) Operating duty / cycle of the system and its components.

e) Functional specifications, operating parameters and control logic for control of the system.

f) Operating environment.

g) Safety related information from manufacturers design and engineering, risk assessment.

h) Identification of safety critical systems.

3.12.4 Installation testing and commissioning data

Installation, testing and commissioning procedures should be provided and should not be limited to –

a) identification of hazards, appropriate controls and safe work procedures associated with the

installation, testing and dismantling of the bolting and drilling plant; and

b) testing, inspection and commissioning requirements and documentation.

3.12.5 Operation and lifecycle maintenance requirements

Operation and maintenance manuals shall be provided. These manuals should contain the following information categorised in appropriate sections:

a) Any specific competencies required to operate, maintain or repair the plant.

b) List of safety critical systems of the plant.

c) Process mapping for the complete drilling and bolting cycle, including the setting of the TRS, installation of rib bolts and provision of supplies.

d) Recommended preventative maintenance requirements to maintain the bolting and drilling plant in a safe operating condition.

e) Recommended examinations, inspection and tests, to check if the plant is fit for purpose and safe to operate when properly used.

f) Identification of any hazards involved in maintaining and operating the plant.

g) Recommended operating, training and maintenance manuals shall be provided for the piece of plant for the full life cycle.

h) Energy isolation, dissipation and control.

i) Safe systems of work to carry out maintenance on bolting plant, including setting of controls.

j) Protective plant requirements.

k) Trouble shooting guide.

l) Recommended spares.

m) Emergency procedures.

SECTION 4 INSTALLATION AND COMMISSIONING

4.1 GENERAL

Bolting systems should be installed and commissioned in accordance with the design documentations and specific site requirements.

Note: Typically this section applies to the installing and assembly on bolting plant, whether brand new or after major overhauls of older bolting plant, at workshops, on surface of mines or underground in mines.

The commissioning plans should verify the actual installation against the design requirements.

Results of the examination and tests shall be recorded and kept by the coal operator (or other users of bolting plant) and the organisation carrying out the tests.

A risk assessment should be carried out to identify potential hazards that may arise and methods to controls those risks arising from the installation and commissioning process.

People conducting installation and commissioning of plant shall be trained and assessed for competence.

4.2 COMMISSIONING PLAN

A commissioning program should be developed for the bolting plant. The commissioning plan should consider –

a) potential hazards and risks associated with commissioning the bolting plant;

b) commissioning in accordance with the designers, manufacturers and site specific requirements;

c) examination and tests to prove the correct function and operation of all safety devices and controls;

d) the system is clean and free from contamination;

e) a testing schedule to check, test and operate all functions in a safe manner with consideration to the electrical commissioning checks;

f) documenting results of commissioning checks;

g) a system to identify commissioning is complete and the system is ready for normal operation; and

h) the commissioning examination and tests shall be carried out by competent persons familiar with the system being installed.

4.2.1 Commissioning criteria

Commissioning should test the installation against the design specifications.

Commissioning criteria should be quantifiable and set pass failure limits for each test.

Commissioning criteria compare the system performance when compared against the design criteria or functional specification and should include, but not be limited to the following:

a) Circuit and component pressures, restrictions and flows.

b) Completeness of circuits to drawings, identification and labelling of components.

c) Control device functionality and operability including –

   (i) checking plant function / operation is in accordance with the design criteria, confirm they are suitably labelled and upon re-activation of any safety device the plant will not resume operation;

   (ii) function testing all operation of the bolting plant (including torque test if required and

recorded; and

(iii) checking, testing and adjusting the speed of actuators is as per the design criteria (recorded and compared against the specification), e.g. pressure, slow speed-one hand operation, regulated pressure).

d) Labels and guards are in place.

e) Emergency stop functions.

f) Isolation points and all safety functions are operational.

g) Timing of component movement (speed of function) and full extent of movement, e.g. time to extend a cylinder.

h) Hose layouts and routes (wear points, hose bend radius, movement range).

i) Software functionality.

j) Communication and monitoring system.

k) Set pressure and yield system for the TRS.

l) Protection devices settings and alarms as applicable.

m) Fluid leakage rates.

n) Temperature, vibration and noise.

o) Cleanliness of the hydraulic fluid.

p) Hydraulic fluid specification.

q) The plant has structural integrity.

r) Air entrapment in the system.

s) Wet Commissioning, i.e. observe and check the plant operation during normal production cycle for a period of time (e.g. one week) agreed between the OEM and the mine.

4.2.2 Commissioning procedures

Commissioning procedures should be developed within the overall commissioning plan.

Consultation should be carried out between all relevant stakeholders such as mechanical, electrical and operational departments to determine the commissioning sequence.

Commissioning Procedure (checklist) should identify areas required to be tested. All results should be documented.

Note: These procedures could be for the entire system or could be a number of procedures for individual components of the system.

4.2.3 Commissioning records

Commissioning records should be maintained and stored in the safety file for future reference. As built drawings and specifications should be updated.

4.3 INSPECTION AND TEST PLAN (ITP) - VERIFICATION

An inspection and test plan should –

a) be developed to identify all critical inspections, stops and checks during the installation;

b) verify the system is installed in accordance with the design documentation and the site standards, for example routing of hoses, component locations, etc;

c) be completed prior to the normal operation of the system;

d) be carried out by a person independent to the person that installed the system; and

e) raise a non-conformance report (NCR) where defects or non-conformances are identified.

SECTION 5 OPERATIONAL

5.1 GENERAL

5.1.1 Risk assessment

Users of bolting plant must carry out an operational risk assessment(s) to identify all hazards, assess the risks arising from those hazards and implement appropriate risk controls from the use of bolting plant. The hazards and risks identified in 2.3.1, 2.3.4 and 3.5.1 should be considered. This operational risk assessment must be carried out prior to the bolting plant being used on a mine site.

Note: refer *OHS Regulation 2001* Chapter 2.

This risk assessment should be reviewed and a new operational risk assessment carried out whenever variations in design, use, conditions or environment could change the risk.

An operational site specific risk assessment shall be carried out prior to the bolting and drill rig being used on the mine site.

The risk assessment shall include –

a) each location where strata support or drilling activities are being carried out;

b) specific site requirements in the strata failure management plan;

c) site specific hazards;

d) site competencies;

e) develop safe systems of work before normal operation;

f) proximity to unstable roof and rib; and

g) consideration to the designers operational risk assessment and the intended use.

5.1.2 Use of bolting plant

Users of bolting plant must[12] ensure that –

a) bolting plant is used in accordance with its intended operational envelope and the designers recommendations;

b) bolting plant is not operated unless the operator is supervised and receives adequate information and training;

c) bolting plant is only used for the purpose which it was designed, unless a competent persons assesses that the change does not present an increase in risk to safety;

d) safety features are used as intended by the designer of the bolting plant;

e) the risk of entanglement is controlled by safe guarding systems or otherwise safe systems of work;

f) people do not work between fixed and traversing parts of the bolting plant, where there is a risk to health or safety;

g) persons do not work in the immediate area of remotely or automatically energised parts of bolting plant without appropriate controls and systems of work in place;

h) hot parts are adequately guarded;

i) measures are provided to prevent unauthorised alterations or use of bolting plant;

j) bolting plant is subject to appropriate checks, tests and inspections necessary for safety;

[12] Refer clause 136A OHS regulation

k) bolting plant is withdrawn from operation if there is an immediate risk to safety; and

l) only competent operators adjust the speed or force of the drill feed.

Note: refer *OHS Regulation 2001* Chapter 5.

5.1.3 Competencies

The mine management system, in conjunction with the supplier, shall address the minimum acceptable competencies for particular types of work. Such competencies should be –

1. machine specific;
2. for operators;

   Note: refer black coal competencies, MNCU1053A – Conduct Basic Strata Control Operations, MNCU1054A – Conduct Specialised Strata Control Operations, http://www.skillsdmc.com.au/

3. for maintenance people; and
4. be re-assessed at regular intervals.

Training and assessment of competencies for personnel who use bolting plant (operators) should as a minimum include the following:

a) Knowledge and understanding of the hazards and required controls.

b) Safe operation, inspection and testing of the plant.

c) Operator safety inspections and operational maintenance activities.

d) Reporting of faults and defects.

e) Use of safe guarding systems.

f) Bolting drilling process, standards and systems.

Note: Training may vary depending on the hazard levels associated with the tasks being undertaken.

5.1.4 Supervision

All strata support and drilling activities shall be carried out under the direction of a competent supervisor.

This person shall have sufficient control to ensure that before strata support and drilling activity is commenced the following items have been taken into consideration:

a) The hazards of the location have been identified and the risks assessed.

b) Controls are in place to eliminate or reduce risk.

c) The plant being used has been inspected, is fit for purpose and safe to operate.

d) The bolter operator is aware of potential hazards.

e) The bolting plant is operated in accordance with the mine specific standards and procedures.

5.1.5 Audit, monitor and review

The potential risks to health and safety should be periodically assessed and actions taken to reduce the risk before an incident occurs (e.g. task observation).

Strata support activities should be audited at regular intervals for compliance with the mines HSMS.

All defects associated with bolting plant should be recorded and actions taken to prevent reoccurrence of the defect.

The drilling and bolting activities should be audited, monitored and reviewed at regular intervals. This should include assessment against:

a) this document;

b) the mines Safety Management System;

c) industry benchmarks;

d) Accident and Incident based; and

e) change of operating / environmental conditions.

5.1.6 Revision

The strata support activities should be revised after an audit or review have taken place. The procedures for revision should be documented. It may be necessary to risk assess the changes (e.g. change management procedure).

5.1.7 Responsibility and accountabilities

All personnel associated with strata support activities should understand their areas of accountability and responsibility. This includes contractors.

In other than single person operation the mine / owner / end user will provide procedures to minimise the hazards while operating the bolting plant.

5.2 STRATA SUPPORT

No person shall be placed at an unacceptable risk of injury from strata failure. Risk controls in accordance with clause 3.6 shall be provided to prevent the operator being injured. These risks controls should be determine by risk assessment and should be documented.

Bolting and drilling operations should be carried out in accordance with the mines strata management plan and support rules.

The operator shall be able to carry out the strata support process from under –

(iii) permanently supported roof and supported rib[13]; or

(iv) an operator protection system which provides an appropriate level of protection.

Note: The *OHS Regulation 2001* requires risks to be reduced to the lowest lever reasonable practicable in a hierarchical order, refer 2.1.3.

Typical strata operator protections systems which shall be considered by the designer and user are provided in ***Table 5***.

Damaged drill steels should be disregarded immediately.

5.3 OPERATIONAL STANDARDS AND PROCEDURES

Operational standards and procedures shall cover all work to be undertaken by competent operators and shall include –

a) pre-checks;

b) hazard control;

c) isolation;

d) loading and unloading of supplies;

e) the strata support process, (may include:- bolting and drilling activities, setting TRS, rib bolting, rib protection and supplies, cutting);

f) ventilation;

g) emergency shutdown;

h) normal start/stop;

i) safe standing zone; and

[13] The strata failure management plan may determine supported roof or rib criterion, refer clause 1.8.48 and 1.8.47. Refer also *CHMS Regulation 2006* subclause 32(n)

j) other rules, standards and procedures for safe operation.

5.4 SAFE SYSTEMS OF WORK

5.4.1 General

Site safe systems of work for operating the bolting plant shall be developed from the designers information (refer 3.2.2.2), the operational risk assessment and site specific conditions and standards.

5.4.2 Isolation systems

The isolation of bolt plant should be consistent with the mine safety isolation standard and carried out with consideration to the designers, manufacturers and suppliers information, MDG 40 and AS 4024.1202.

5.4.3 Dry drilling

The increased risk of methane ignition, dust concentration and dust disposal should be assessed and adequately controlled when dry drilling.

Note: wet drilling typically reduces these risks.

Dry bolting hazards should be identified and controlled by the mines dust control management plan which should consider the hazards in clause 3.7.

SECTION 6 MAINTENANCE AND REPAIR

6.1 GENERAL

The coal operator and other users of bolting plant must[14] ensure that in relation to repair and maintenance of bolting plant –

a) necessary facilities and systems of work are provided and maintained; and

b) inspections, maintenance and cleaning is carried out with regards to designers, manufacturers information or otherwise developed by a competent person; and

c) all safety features and warning devices on bolting plant are tested and maintained; and

d) competent persons assess any damage to bolting plant, where the risk to safety is increased; and

e) repair, inspection and testing is carried out by a competent person; and

f) repairs to bolting plant keep the bolting plant within its design limits.

g) if access to the bolting plant is provided, the bolting plant is stopped and a lockout, danger tag, permit or other control measure is used.

Note: refer *OHS Regulation 2001* Chapter 5.

6.2 MAINTENANCE

An appropriate examination, inspection, testing and maintenance system shall be developed and implemented to ensure all bolting plant is fit for purpose, safe and without risks to health when properly used. This system should be developed based on site specific conditions with consideration of the designer's recommendations or otherwise by a competent person.

Where maintenance activities identify a design or manufacture fault that has potential to harm health or safety, then information on the fault shall be provided to the designer, manufacturer or supplier.

The maintenance system should identify where any automatic functions can take place (e.g. shovel to floor when bolting mode is engaged) during maintenance activities. This should be included in the continuous miner and bolter maintenance training.

The coal operator and other users of bolting plant shall keep information regarding the maintenance activities on the bolting plant.

Maintenance personnel should be competent to work on the bolting plant and should be familiar with the designer's maintenance recommendations.

All component repairs and replacements should be carried out to the designers recommended specification in accordance with the mine site procedures.

Overhaul of bolting plant should return the bolting plant to an appropriate design specification.

6.3 MAINTENANCE MANAGEMENT

A maintenance management program shall be incorporated into the operation of bolting plant to ensure satisfactory operation while in service. The program shall include but is not limited to the following:

a) Pre-operational servicing including lubrication requirements.

b) Periodic and or condition based servicing.

c) Periodic inspections.

d) Testing and inspection of safety plant.

[14] Refer clause 137 OHS Regulation

e) Records, including but not limited to reporting overloads and damage.

f) Compliance auditing.

SECTION 7 APPENDICES

7.1 APPENDIX A – ASSOCIATED DOCUMENTS

The following partial list of documents is related to fluid power system safety. This list is provided for information only and it is not a full and comprehensive list of all documents that may be applicable.

7.1.1 Australian Standards

AS 1269.1	Occupational Noise Management
AS 1318	Use of colour for the marking of physical hazards and the identification of certain equipment in industry (known as the SAA Industrial Safety Colour Code)
AS 1319	Safety Signs for the Occupational Environment
AS 1418.10	Cranes, hoists and winches
AS 1657	Fixed platforms, walkways, stairways and ladders - Design, construction and installation
AS 1891	Industrial fall-arrest systems and devices - Safety belts and harnesses
AS 1939	
AS 2290.1	Electrical equipment for coal mines - Introduction and maintenance - For hazardous areas
AS 2294.3	
AS 2381	Electrical equipment for explosive gas atmospheres - Selection, installation and maintenance
AS 2671	Fluid Power-Hydraulic Systems and Components
AS 3000	AS/NZS 3000:2007 (Paperback / PDF) : Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS 3800	Electrical equipment for explosive atmospheres - Repair and overhaul
AS 3836	Reflective Media
AS 3868	Earth Moving Machinery - Design Guide for Access Systems
AS 3990	Mechanical equipment - Steelwork
AS 4024.1201	Safety of Machinery - General principles - Basic terminology and methodology
	Specifies the basic terminology and methodology to be used by designers in achieving safety of machinery.
AS 4024.1202	General principles - Technical principles
	Defines the technical principles required to achieve safety in the design of machinery. Does not deal with injury to domestic animals, property or the environment.
AS 4024.1301	Safety of Machinery - Risks assessment - Principles of risk assessment
	Specifies principles for the procedure of risk assessment by which the knowledge and experience of the harm related to machinery is gathered together to aid in assessing risks during all phases in the life of machinery. Guidance on the information necessary to allow risk assessments to be carried out is provided, as is a brief outline of some of the techniques available.
AS 4024.1302	Safety of Machinery - Risks assessment - Reduction of risks to health and safety from hazardous substances emitted by machinery - Principles and specification for machinery manufacturers
	Provides principles for controlling risks to health resulting from the emission of hazardous substances from machinery.
AS 4024.1401	Safety of Machinery - Ergonomic principles - Design principles - Terminology and general principles
	Specifies the ergonomic design principles and terminology to be followed by designers during the process of designing work equipment, so as to achieve safety of machinery.
AS 4024.1501	Safety of Machinery - Design of safety related parts of control systems - General principles
	Provides safety requirements and guidance on the principles to be used in the design of the safety related parts of machinery control systems. Categories are specified and the characteristics of the safety functions are described.
AS 4024.1502	Safety of Machinery - Design of safety related parts of control systems - Validation

	Specifies the conditions and procedures to be followed for the validation by both analysis and testing of safety functions provided and category achieved by the safety related parts of control systems using the design rationale provided by the designer. When validating programmable electronic systems, this Standard does not provide complete requirements and can require the use of other Standards such as the AS 61508 series.
AS 4024.1601	Safety of Machinery - Design of controls, interlocks and guarding - Guards - General requirements for the design and construction of fixed and moveable guards
	Specifies requirements for the design and construction of fixed and movable guards intended to afford protection from mechanical hazards at machinery.
AS 4024.1602	Safety of Machinery - Interlocking devices associated with guards - Principles for design and selection
	Specifies principles for the design and selection of interlocking devices associated with guards. The principles are independent of the energy sources used on the machine.
AS 4024.1603	Safety of Machinery - Design of controls, interlocks and guards - Prevention of unexpected start-up
	Specifies means incorporated at the design stage intended to prevent an unexpected machine start-up. The means include energy isolation and dissipation. Applies to all forms of energy source including those external to the machine, such as wind, gravity and electro-magnetic.
AS 4024.1604	Safety of Machinery - Design of controls, interlocks and guarding - Emergency stop - Principles for design
	Specifies functional requirements and the principles of design for the emergency stop of machinery without regard to the energy source used to control the functions. It does not apply to hand guided machines, hand held portable machines or to machines where the provision of an emergency stop would not reduce the level of risk to operator or other person.
AS 4024.1701	Safety of Machinery - Human body measurements - Basic human body measurements for technological design
	Provides information and descriptions of anthropometric measurements as the basis for comparing population groups for ergonomists and others involved in the geometric design of places where people work.
AS 4024.1702	Safety of Machinery - Human body measurements - Principles for determining the dimensions required for openings for whole body access to machinery
	Safety of Machinery - Specifies the minimum opening dimensions required to gain whole body access to machinery. The dimensions are more applicable to non-mobile machinery as there may be additional specific requirements for mobile machinery.
AS 4024.1703	Safety of Machinery - Principles for determining the dimensions required for access openings
	Specifies minimum dimensions for access openings in machinery. Values for additional space requirements are provided. Applies primarily to non-mobile machinery, as there may be additional specific requirements for mobile machinery.
AS 4024.1704	Safety of Machinery - Anthropometric data
	Specifies requirements for human body measurements required for calculating the dimensions of access openings in machinery.
AS 4024.1801	Safety of Machinery - Safety distances to prevent danger zones being reached by the upper limbs
	Specifies the minimum safety distances from a barrier to the danger zone of a machine to prevent the danger zone being reached by the upper limbs of a person of age 3 years and above. The Standard is applicable only where safety can be assured by distance alone. The Standard will not provide sufficient protection against radiation or substances emitted from the machine.
AS 4024.1802	Safety of Machinery - Safety distances and safety gaps - Safety distances to prevent danger zones being reached by the lower limbs
	Establishes values for safety distances to prevent access and to impede free access to danger zones of machinery, to prevent their being reached by the lower limbs of persons of 14 years and older. The distances apply where safety can be assured by distance alone and access by the upper limbs is not foreseeable by the risk assessment.
AS 4024.1803	Safety of Machinery - Safety distances and safety gaps - Minimum gaps to prevent crushing of parts of the human body
	Establishes values for the minimum gaps relative to parts of the human body to prevent risk of crushing between two surfaces, at least one of which can move.
AS 4024.1901	Safety of Machinery - Displays, controls, actuators and signals - Ergonomic requirements for the

	design of displays and control actuators - General principles for human interaction with displays and control actuators Specifies general principles to be followed when designing displays and control actuators on machinery to minimize errors on the part of the operator and to ensure an efficient interaction between the operator and equipment.
AS 4024.1902	Safety of Machinery - Displays, controls, actuators and signals - Ergonomic requirements for the design of displays and control actuators - Displays Specifies the ergonomic requirements for visual, audible and tactile displays for use in machinery. It provides guidance on the selection, design and location of displays to avoid potential ergonomic hazards associated with the use of displays.
AS 4024.1903	Safety of Machinery - Displays, controls, actuators and signals - Ergonomic requirements for the design of displays and control actuators - Control actuators Provides guidance for the design, selection and location of manual control actuators so they are adapted to operator needs, are suitable for the control task in question and take into account the circumstances of their use.
AS 4024.1904	Safety of Machinery - Displays, controls, actuators and signals - Indication, marking and actuation - Requirements for visual, auditory and tactile signs Specifies requirements for visual, auditory and tactile methods of indicating safety related information. It sets out a system of colours, signs, marking and other means of indicating hazards and meeting emergencies. In addition, it sets out ways of coding visual, auditory and tactile signals to enable safe use and monitoring of machinery.
AS 4024.1905	Safety of Machinery - Displays, controls, actuators and signals - Indication, marking and actuation - Requirements for marking Specifies the requirements for marking machinery. Provides general rules on marking for identification, safe use in respect of mechanical and electrical hazards and in preventing the hazards arising from incorrect connections.
AS 4024.1906	Displays, controls, actuators and signals - Indication, marking and actuation - Requirements for the location and operation of actuators Specifies the safety related requirements for actuators operated by hand or other parts of the human body at the man-machine interface. It applies to both single actuators, and groups of actuators.
AS 4024.1907	Displays, controls, actuators and signals - System of auditory and visual danger and information signals Specifies a series of both visual and auditory danger and information signals which take into account the level of urgency for the given circumstances. The Standard applies to danger and information signals that have to be perceived and recognized from each other. The Standard does not apply to fields covered by specific Standards or conventions, e.g. fire alarms, public transport or navigation signals.
AS 4024.2601	*DR 07432 CP* : Safety of machinery - Part 2601: Design of controls, interlocks and guarding - Two-hand control devices - Functional aspects and design principles
AS 4100	Steel structures
AS 4240	Remote Control for Mining Equipment
AS 4801	Occupational health and safety management systems - Specification with guidance for use
AS 4804	Occupational health and safety management systems - General guidelines on principles, systems and supporting techniques
AS 4871	Electrical equipment for coal mines, for use underground
AS 4871 series	Electrical equipment for coal mines, for use underground
AS 31000	Risk management – Principles and guidelines
AS 61508	Functional safety of electrical/electronic/programmable electronic safety-related systems - Functional safety and AS 61508
AS 62061	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
HB 205	OHS Risk Management Handbook

7.1.2 ISO Standards

ISO 13407	Human-centred design processes for interactive systems
ISO 13851	Safety of machinery - Two-hand control devices - Functional aspects and design principles
ISO 31010	Risk management - Risk assessment techniques

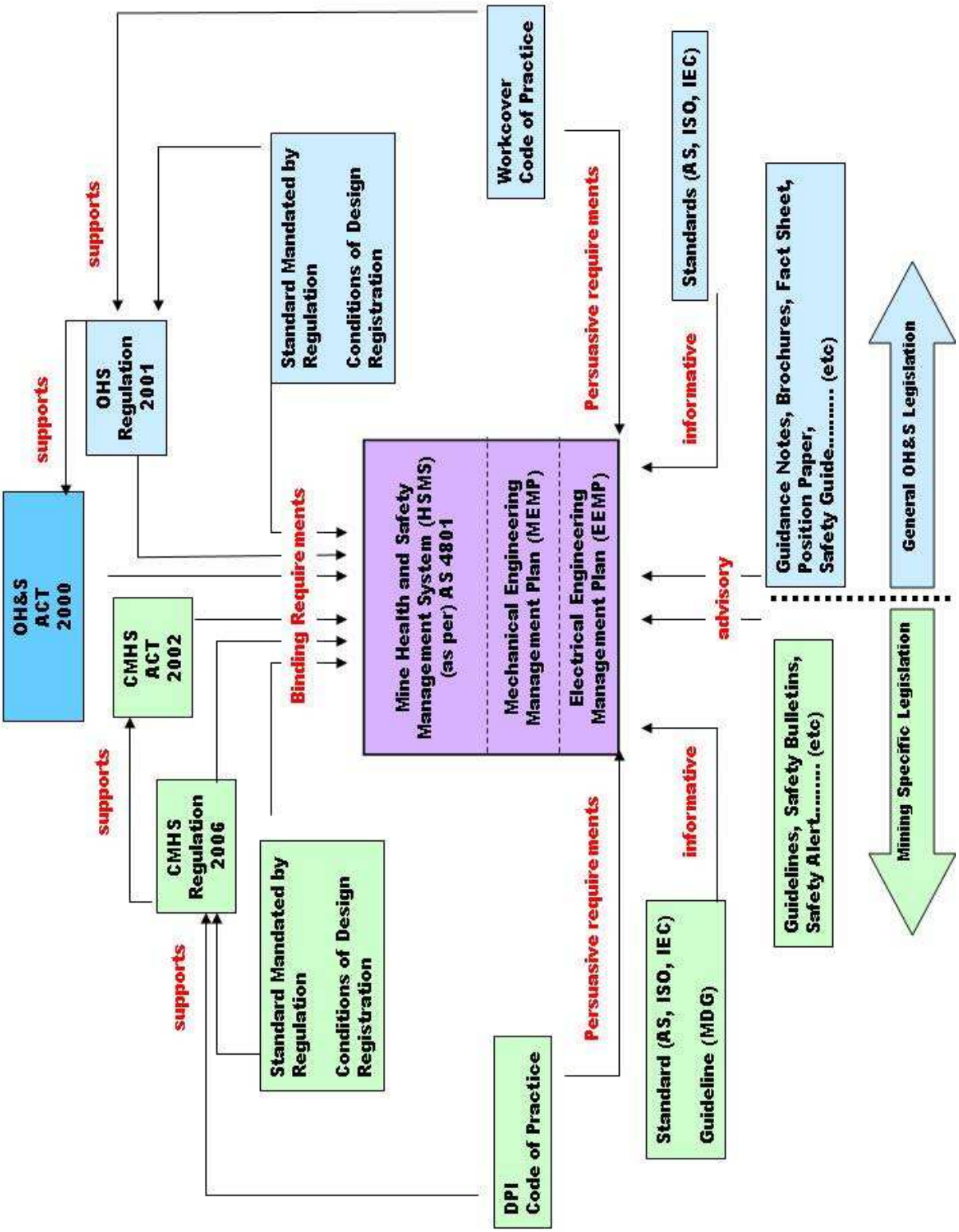
7.1.3 Mining Design Guidelines

refer http://www.I & I NSW.nsw.gov.au/minerals/safety/publications

MDG 1	Guidelines for free steered vehicles
	Note: This guideline is currently under revision and will be revised to include all mobile and transportable equipment in underground coal mines
MDG 5	Portable pneumatically powered rotary roof bolters
MDG 15	Guideline for surface mobile and transportable equipment for use in mines
MDG 17	Mechanical Design Guideline for the Construction of Continuous Miners
MDG 35.2	DRAFT - Guideline for bolting and drilling plant in mines, Part 2: Portable hand held roof bolters in underground coal mines
MDG 39	Handbook for approval assessment of transport braking systems on free-steered vehicles in underground coal mines
MDG 40	Guideline for Hazardous Energy Control (Isolation or Treatment)
MDG 41	Guideline for fluid power system safety at mines
MDG 1010	Risk management handbook for the mining industry
	Note: This guideline is currently under revision
MDG 1017	Roof support guidelines for massive strata conditions
MDG 5001	Mine safety review guidelines for the design of remote controlled mining equipment
MDG 5002	Mine safety review guidelines for the use of remote controlled mining equipment
MDG 3006 MRT 8	Testing of non-metallic materials for use in underground coal mines

7.2 APPENDIX B – OH&S LEGISLATIVE FRAMEWORK FOR MINING IN NSW

The following diagram outlines the Occupational Health and Safety legislative framework for coal mines in NSW.



7.3 APPENDIX C – INCIDENT STATISTICS AND SAFETY ALERTS

7.3.1 Incident Data 2008 - 2008

http://www.I & I NSW.nsw.gov.au/minerals/safety/publications/statistical-publications

7.3.2 Accident report data 1999-2004

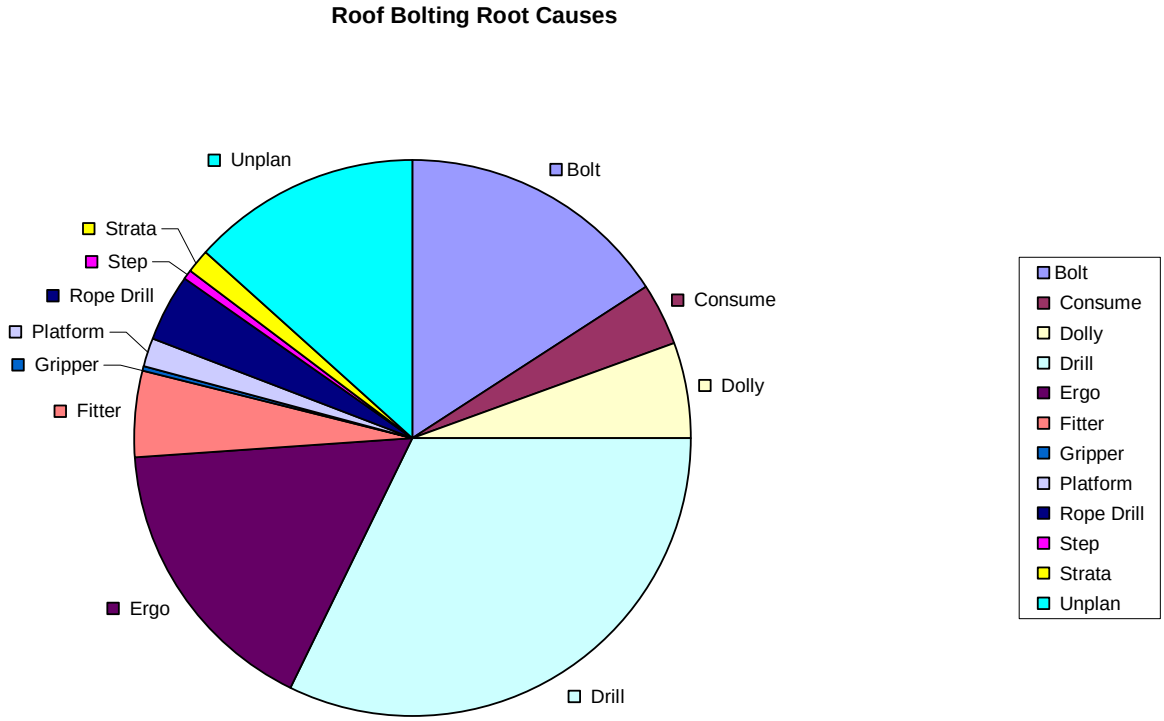
Analysis of Accidents from Roof and Rib Bolting Practices in NSW Coal Mines

Date of Issue: June 2005

The following information is an analysis of data supplied by NSW Coal Services on the accidents involving mobile bolting equipment used in NSW coal mines. The study covers the years from 1999 to 2004 and highlights:

- 292 accidents associated with operating and maintaining roof bolting equipment.
- 55 accidents occurred during some part of the rib bolting process.

The graph below gives a broad breakdown of the root causes of roof bolting injuries.



7.3.2.1 Roof bolter accidents root cause summary

The following is a breakdown of the root causes of injuries from operator interaction during the roof bolting process.

No. of Injuries	Root Cause	Operator Interaction During the Roof Bolting Process	MDG 35 Reference / Controls
4	Bolt	Injury caused by the roof bolt [unspecified]	One handed slow speed operation
2	Bolt - BEND	Crush injuries to fingers caused by the bolt bending	One handed slow speed operation
40	Bolt - PUSH	Mostly manual handling injuries while pushing and holding the roof bolt in the hole.	Manual handling issues not covered in MDG35
11	Consume	Injury from the bolting consumable. i.e. washer plate.	Manual handling issues not covered in MDG35
3	Dolly	Injury caused by the bolt tightening spanner [unspecified]	Guarding, inadvertent operation.
3	Dolly - CHUCK	Injury caused by removing tightening spanner from chuck	Manual Handling Issues
5	Dolly - DROP	Injury caused by tightening spanner falling off nut.	Manual handling issues not covered in MDG35
5	Dolly - GUIDE	Injury caused by guiding tightening spanner onto nut.	3.2.4.1.5. single handed slow speed, reduce pressure
13	Drill	Injury caused by drill [unspecified]	Manual handling issues not covered in MDG35
22	Drill - BEND	Crush injuries to fingers caused by the drill bending	Single handed slow speed, reduce pressure
3	Drill - BREAK	Injury caused by drill breaking.	
30	Drill - CHUCK	Injury caused by removing drill from chuck	Manual handling issues not covered in MDG35
6	Drill - GUIDE	Injury caused by guiding drill through headplate.	Single handed slow speed, reduce pressure, drill guides
5	Drill - PUSH	Injury caused by pushing drill into hole. Two pass drilling	Drill clamps may help. Manual handling issues
12	Drill - ROOF	Injury caused by pulling drill out of roof.	Manual handling issues Slow rotation on drill retraction.
3	Drill - STORAGE	Injury caused by loose drill movement	Manual handling issues not covered in MDG35
49	Ergo	Poor ergonomic access to bolter on host machine.	Ergonomic issues to be addressed by the mine. Manual handling issues not covered in MDG35

No. of Injuries	Root Cause	Operator Interaction During the Roof Bolting Process	MDG 35 Reference / Controls
14	Fitter	Injury during bolter maintenance	3.2.4.6 (d) (e); 3.2.3.11.and 3.2.12. Isolation. Maintenance, training, SWP, Emergency stops. Manual handling issues
2	Gripper	Injury caused by drill gripper while extension drilling	
5	Platform	Injury caused by accessing the bolting platform	Comply with AS 1657
10	Rope Drill	Injury caused while extension drilling	Gripper Jaws, reduced pressure and one handed slow operation.
2	Step	Injury caused by accessing the platform by step.	Comply with AS 1657. Three points of contact.
4	Strata	Injury caused by roof, rib or floor	TRS, and Canopy
13	Unplan	Injury caused by unspecified unplanned movement of bolter	Guarding of controls, slow speed for single handed. Low pressure
2	Unplan - OBJECT	Injury caused by object moving control lever.	Guarding of controls and positioning of controls.
1	Unplan - ROTATION	Injury caused by unplanned rotation of drill motor.	Training, handle shape.
9	Unplan - T/JACK	Injury caused by unplanned movement of timber jack.	Guarding of controls and positioning of controls, one handed slow operation, handle shape.
5	Unplan - TWO PERSON	Injury caused when two people operate one bolter.	Single person operation and guarding
9	Unplan - WRONG LEVER	Injury caused when operator moves wrong control lever.	Guarding of controls, shape of handles, slow speed for single handed. Low pressure, training
292			

7.3.2.2 Roof bolting process summary

To refine the information further the basic steps of the operator interaction during the roof bolting process were analysed as follows:

Root Cause		**Root Cause**	**Root Cause**
Bolting Process	**[187]**	**Controls** **[29]**	**Layout** **[63]**
1 Place Washer	[1] Mesh		
2. Insert drill into roof bolter and set to roof.	[12] Drill	[12] Unplan	[49] Ergo
[40]	[22] Drill - BEND		
	[6] Drill - GUIDE	[2] Unplan - OBJECT	[5] Platform
2.1 Extend drills	[10] Rope Drill		
[17]	[5] Drill - PUSH	[1] Unplan - ROTATION	[2] Step
	[2] Gripper		
3. Position Bolter	[2] Drill		
4. Drill hole	[3] Drill - BREAK	[5] Unplan - TWO PERSON	[4] Strata
5. Remove drill	[30] Drill - CHUCK		
[42]	[12] Drill - ROOF	[9] Unplan - WRONG LEVER	[3] Drill - STORAGE
6. Insert chemical and secure bolt into roof.	[9] Unplan - T/JACK		
	[3] Bolt		
[82]	[38] Bolt - PUSH		
	[11] Consume		
	[3] Dolly		
	[6] Dolly - GUIDE		
	[4] Bolt - BEND		
	[5] Dolly - DROP		
	[3] Dolly - CHUCK		
7. Retract bolter			

In addition, 14 fitters were injured, giving a total of 292 accidents over the six year period.

7.3.2.3 Rib bolting accidents

In relation to accidents during the rib bolting process the following information is on the basic steps of the operator interaction:

Step	Root Cause Bolting	Root Cause Controls	Root Cause Layout
1 Place Washer	[1] Mesh		
2. Insert drill into rib bolter.	[2] Drill	[4] Unplan	[11] Ergo
	[1] Drill - BEND		[1] Hose
	[3] Drill - GUIDE	[1] Unplan - OBJECT	
3. Position Bolter			[3] Platform
4. Drill hole		[2] Unplan - TWO PERSON	[1] Strata
5. Remove drill	[1] Drill - CHUCK		
	[3] Drill - RIB		
6. Insert chemical and secure bolt into rib	[7] Unplan - T/JACK	[2] Unplan - WRONG LEVER	
	[2] Drillhead		
	[5] Bolt - PUSH		
	[1] Consume		
	[1] Dolly		
	[3] Dolly - GUIDE		
7. Retract bolter			

A total of 55 rib bolting accidents over a six year period.

7.3.3 Summary of reportable accidents associated with the operation of drilling equipment

Coal Mines Regulation Act, 1982. Period: July 1989 - October 1996

7.3.3.1 Serious bodily injuries

a) Date: 17/07/90

A miner suffered a fracture to a right rib when he lost his balance, fell from the continuous miner drilling platform and struck the rib. The accident may have been avoided if the continuous miner had been maintained level on a level floor and if the injured person had moved in a less impetuous manner.

b) Date: 08/07/91

A workman sustained three fractured ribs when he was trapped between the body of a continuous miner and a hydraulic machine mounted drill rig mast. At the time of the accident the workman was operating the hydraulic drill rig. He leant over the operational control level to remove a piece of coal which was jammed between the drill rig and the apron plate of the continuous miner. As the workman leant over his left thigh inadvertently pushed the control lever forwards which caused the drill rig mast to suddenly lower thus trapping him. The control lever has since been shrouded and the possibility of a similar accident eliminated.

c) Date: 16/07/91

An experienced engineers fitter suffered a fractured rib due to a slip/stumble/fall as the fitter stepped off the Joy 12CM20 drilling platform to floor level. The area was oily and wet due to previous hydraulic repairs. Improved cleaning of the hydraulic oil off the machine would have reduced the potential for a slip/stumble/fall accident.

d) Date: 14/08/91

An experienced machineman suffered a fractured lumbar vertebra when struck by a fall of roof stone whilst changing drills on a roof bolting machine at the face of a heading. The fall of stone occurred without warning from immediately in front of the last set W strap. Temporary support was not in place. Revised support procedures requiring the use of temporary support have been implemented to prevent recurrence.

e) Date: 24/03/94

A machine miner suffered a fractured left ulna when he was struck by a spinning bent drill steel. The drill steel had jammed and had been bent by the thrust pressure of the hydraulic drill rig in use. The man was struck when he managed to free the drill steel. It appears that hydraulic pressures on the drill head had been set too high and a number of other problems were discovered. A full mechanical investigation is continuing.

f) Date: 19/06/94

The serious bodily injury of a spiral fracture of the right ulna of a member of a roofbolting crew was caused by the combination of the adhesion of his gloved right hand to the roofbolt drill steel and the rotational force applied as he was guiding or holding that drill steel in place.

g) Date: 13/06/95

A machineman engaged in drilling an 8 metre extensometer hole via a Joy 12CM so mounted bolting rig was in the process of releasing a drill steel section with the use of an 18 inch shifter. Apparently he accidentally knocked the rotation lever which caused the shifter to be discharged from off the pre-stationary drill steel striking him in the jaw area inducing a double fracture.

7.3.4 Safety Alerts

The following safety alerts have relevant to strata support in underground coal mines-

Alert No.	Title
SA 08-05	Miners arm injured using drill rig
SA05-05	Drill Rig Serious Injuries
SA04-04	High Pressure Air Hose Burst on Exploration Drill Rig
SA01-13	Fall of coal and stone kills miner
SA01-01	Coal mine fatality from fall of roof
SA00-25	Serious injury while roof bolting
SA99-12	Fatality resulting from a continuous miner crushing injury
SA99-16	Continuous miner drill rig fatally crushes tradesman
SIR94.4	

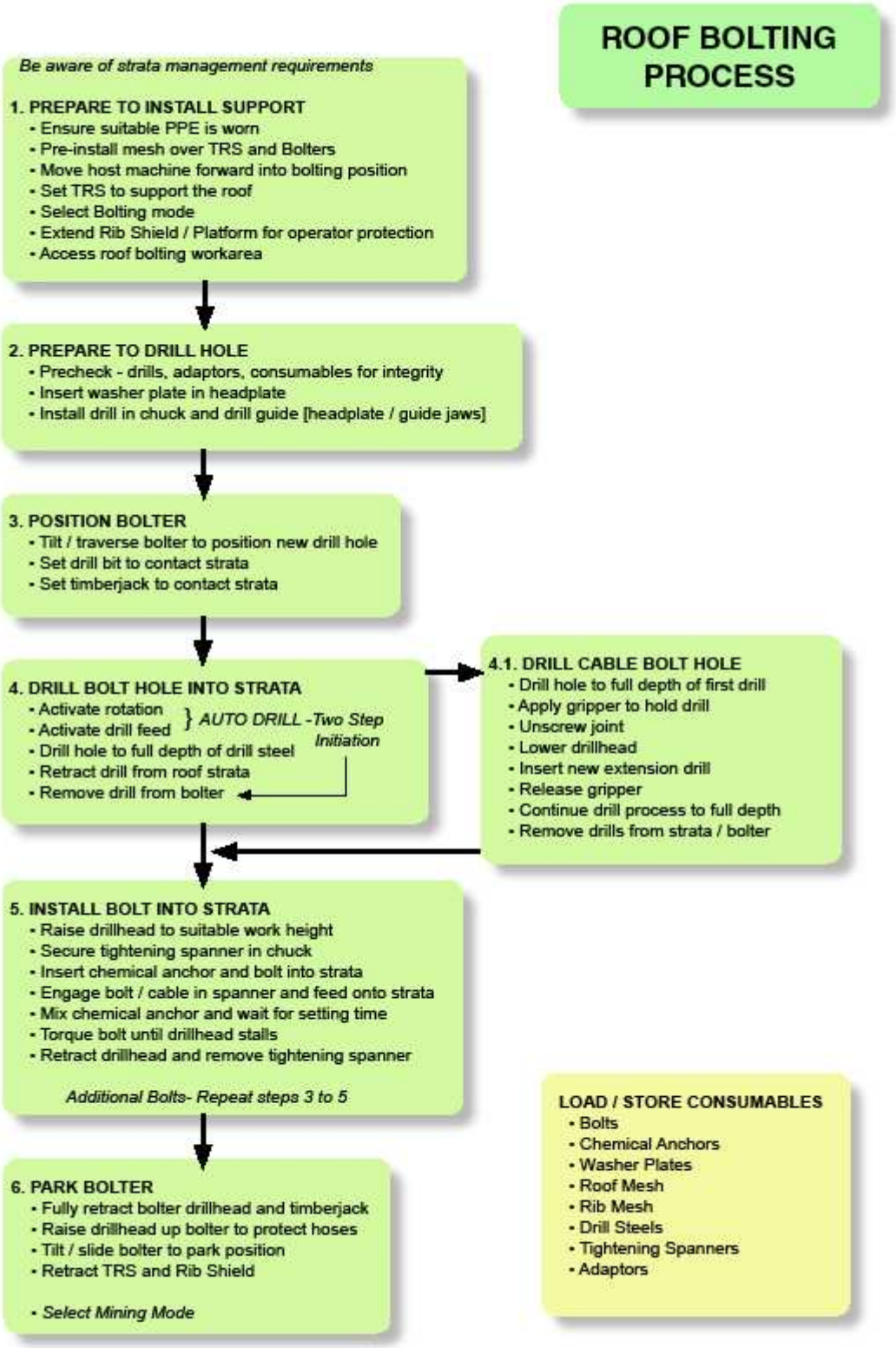
refer http://www.I & I NSW.nsw.gov.au/minerals/safety/safety-alerts

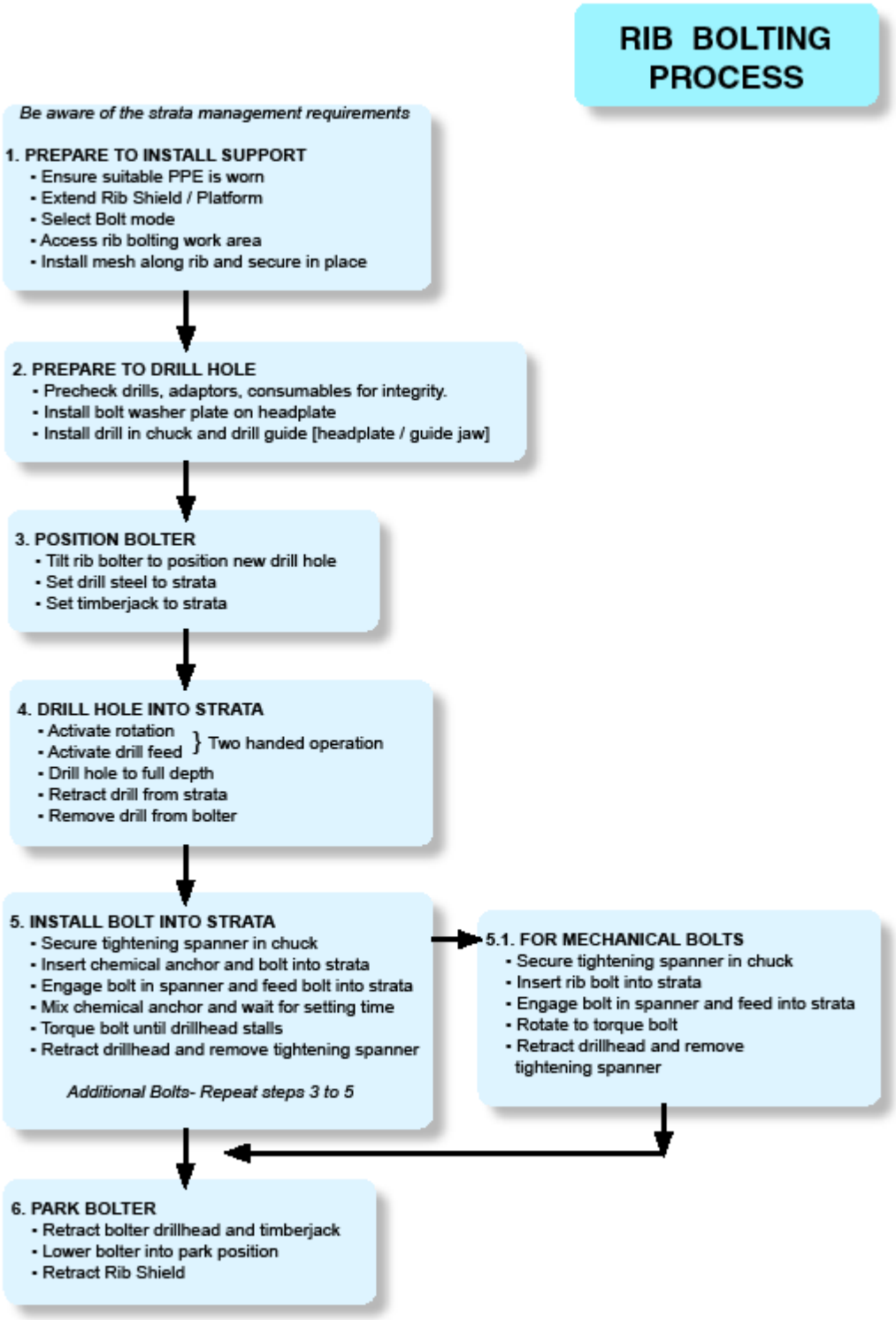
7.4 APPENDIX D – COMMON HAZARDS

For a more extensive list of hazards than the following table, refer to appendix B of AS 4024.1301-2006 - Safety of machinery – Part 1301: Risk Assessment - Principles of Risk Assessment.

Energy source	Hazard	People Consequence
Bio-mechanical	• Ergonomic design failure	• Excessive effort • Human error, human behaviour • Injuries from neglected use of PPE • Slips, trips, falls • Sprains, strains • Unhealthy posture
Chemical	• Dust • Explosion • Fires • Fluids • Fumes • Gases • Mists	• Asphyxiation • Burn injuries • Cancer • Dust • Irritation • Lung damage • Poisoning
Gravity	• Stored potential energy - Weight in elevated machine components	• Crush injuries • Fall injuries
Mechanical	• Crushing • Drawing-in or trapping • Entanglement • Friction or abrasion • Impact • Shearing • Stored potential energy - springs • Unexpected movement	• Amputations • Crush injuries • Entanglement injuries • Impact injuries
Noise	• Excessive noise levels	• Hearing loss • Make errors • Miss alarms or acoustic signals • Tinnitus
Pressure	• Stored potential energy – liquids and gases under pressure	• Fluid injection injuries • Struck by ejected projectiles
Temperature	• Contact with extreme high or low temperature objects • Explosions • Flames • Heat radiation • Hot or cold work environments	• Burns, scalds • Cancer • Freezing • Heat stress • Hypothermia
Vibration	• Hand held machine vibrations	• Neurological, vascular disorders • Whole body vibration damage

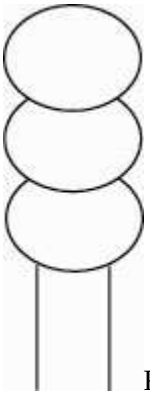
7.5 APPENDIX E – TYPICAL BOLTING PROCESS MAP




RIB BOLTING PROCESS
Be aware of the strata management requirements
1. PREPARE TO INSTALL SUPPORT
• Ensure suitable PPE is worn
• Extend Rib Shield / Platform
• Select Bolt mode
• Access rib bolting work area
• Install mesh along rib and secure in place
2. PREPARE TO DRILL HOLE
• Precheck drills, adaptors, consumables for integrity.
• Install bolt washer plate on headplate
• Install drill in chuck and drill guide [headplate / guide jaw]
3. POSITION BOLTER
• Tilt rib bolter to position new drill hole
• Set drill steel to strata
• Set timberjack to strata
4. DRILL HOLE INTO STRATA
• Activate rotation
• Activate drill feed
} Two handed operation
• Drill hole to full depth
• Retract drill from strata
• Remove drill from bolter
5. INSTALL BOLT INTO STRATA
• Secure tightening spanner in chuck
• Insert chemical anchor and bolt into strata
• Engage bolt in spanner and feed bolt into strata
• Mix chemical anchor and wait for setting time
• Torque bolt until drillhead stalls
• Retract drillhead and remove tightening spanner
Additional Bolts- Repeat steps 3 to 5
5.1. FOR MECHANICAL BOLTS
• Secure tightening spanner in chuck
• Insert rib bolt into strata
• Engage bolt in spanner and feed into strata
• Rotate to torque bolt
• Retract drillhead and remove tightening spanner
6. PARK BOLTER
• Retract bolter drillhead and timberjack
• Lower bolter into park position
• Retract Rib Shield

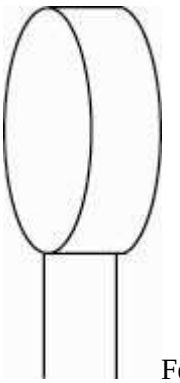
7.6 APPENDIX F– DRILL RIG HANDLES

7.6.1 Rotation handle



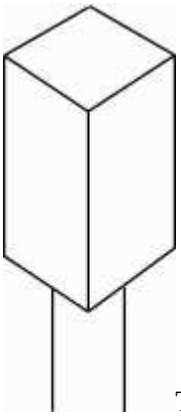
Rotation knob handle (Three Balls)

7.6.2 Feed handle



Feed knob handle (Flat Disk)

7.6.3 Timberjack handle



Timberjack handle (Rectangle Knob Handle)

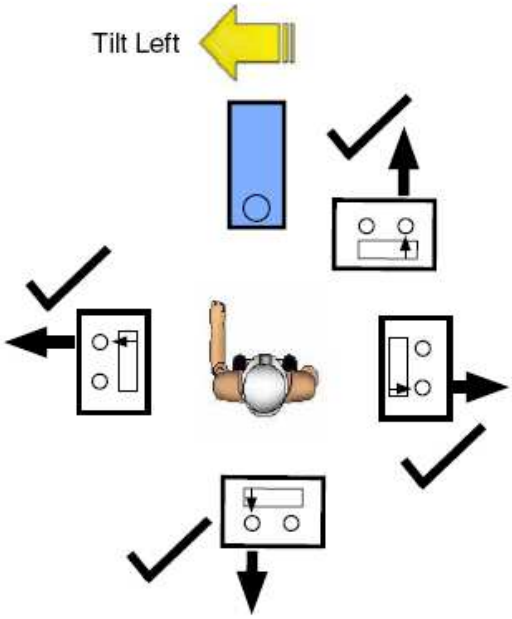
7.7 APPENDIX G – MANUAL CONTROL POSITIONING

Lever movement relates to a preset standard.

To tilt left the operator:

- moves the same hand
- moves hand in same direction

this allows the lever movement to be standardised on 100% of valvebank positions.



7.8 APPENDIX I - TRS EXAMPLES

7.8.1 Types of TRS

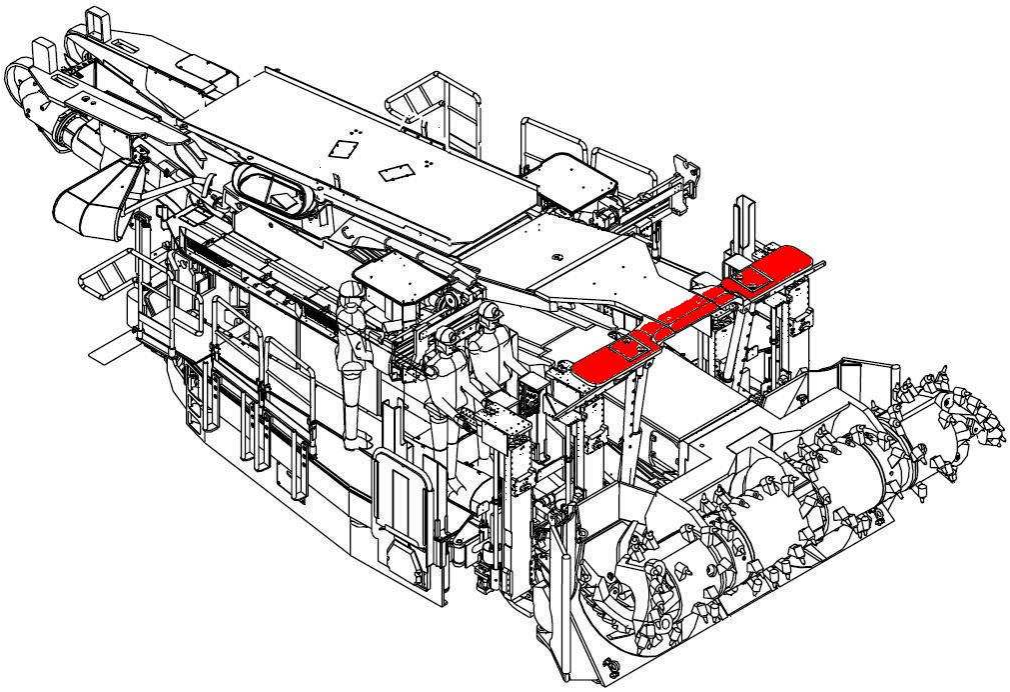


Figure 1 – Cross bar type TRS (preferable)

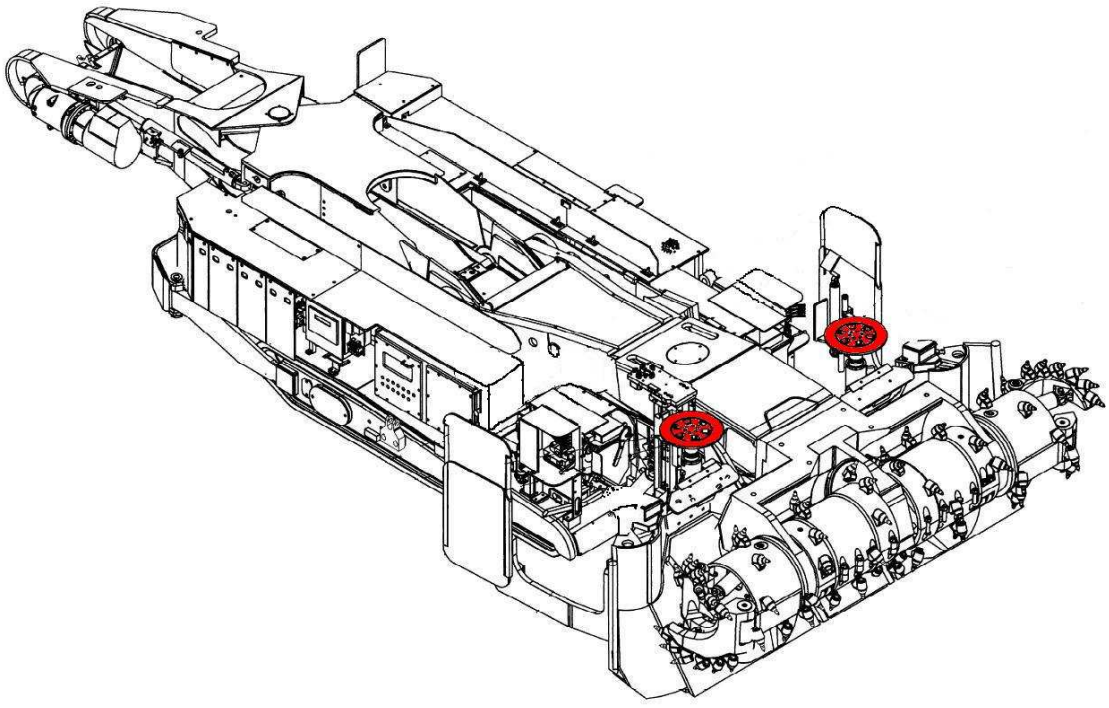


Figure 2 –Pad type TRS

7.9 FEEDBACK SHEET

Your comment on this Guideline will be very helpful in reviewing and improving the document.

Please copy and complete the Feedback Sheet and return it to:

The Senior Inspector of Mechanical Engineering
Industry and Investment NSW
PO Box 344
Hunter Region Mail Centre NSW, 2310

How did you use, or intend to use, this Guideline?

What do you find most useful about the Guideline?

What do you find least useful?

Do you have any suggested changes to the Guideline?

Thank you for completing and returning this Feedback Sheet