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# Guideline for Mobile and Transportable Equipment for Use in Mines

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MDG 15

Produced by  
Mine Safety Operations  
New South Wales  
Department of Primary Industries

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PRIMARY INDUSTRIES**

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## **ACKNOWLEDGMENTS**

We wish to thank the Coal Safety Advisory Committee for their most welcome support of this publication.

## **DISCLAIMER**

The compilation of information contained in this document relies upon material and data derived from a number of third party sources and is intended as a guide only in devising risk and safety management systems for the working of mines and is not designed to replace or be used instead of an appropriately designed safety management plan for each individual mine. Users should rely on their own advice, skills and experience in applying risk and safety management systems in individual workplaces.

Use of this document does not relieve the user (or a person on whose behalf it is used) of any obligation or duty that might arise under any legislation (including the Occupational Health & Safety Act 2000, any other Act containing requirements relating to mine safety and any regulations and rules under those Acts) covering the activities to which this document has been or is to be applied.

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## FOREWORD

This Guideline (MDG 15), *Guideline for Mobile and Transportable Equipment for Use in Mines*, has been compiled to assist Manufacturers, Purchasers, Owners, Operators, Site Contractors and the N.S.W. Department of Mineral Resources Mining Inspectorate when assessing safety aspects of mobile and transportable equipment used at Mines, Surface of Underground Coal Mines and Product Processing Plants (eg, Declared Coal Preparation Plants).

The relevant sections of this Guideline should be used for all mobile and transportable equipment that is not capable of being registered for use on public roads.

This is a 'Published Guideline'. Further information on the status of Guideline in the range of OH&S instruments is available through the N.S.W. Department of Mineral Resources Legislation Update Number 2/2001. The range of instruments include:

- Acts of Parliament
- Regulations made under the Acts
- Standards (AS, ISO, IEC)
- Approved Codes of Practice (under the OH&S Act, Part 4)
- Applied Guidelines
- Published Guidelines
- Guidance Notes
- Technical Reference documents
- Safety Alerts

The principles stated in this document are intended as a general guideline, for the assistance of Owners, Managers, Manufacturers and Designers in devising safety standards for the design and operation of Mobile and Transportable Equipment. Owners and Managers should rely upon the application of risk assessment techniques and experience in applying practices to be observed in individual workplaces.

The State of New South Wales and its officers or agents including 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 these Guidelines.

The constructive evaluation and input provided by Mine Mechanical Engineers, Mine Electrical Engineers, Manufacturers, Suppliers, Electrical and Mechanical Inspectors is gratefully acknowledged in the development of this Guideline.

It is not intended for this Guideline to be retrospective where risk management techniques indicate a satisfactory level of safety exists or to equipment subject to audit and construction in accordance with the 1997 version of design guideline MDG 15.

The review committee has a review time set for each Guideline document that it publishes. This can be brought forward if required. Input and comment from industry representatives will be much appreciated.

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## MAJOR CHANGES TO 1997 VERSION

Major changes to the 1997 version of MDG 15 include:

- (i) Expanded to include mining operations and product process plants in non-coal mines.
- (ii) The document has been reviewed against the NSW Mineral Resources metalliferous document '*Guidelines for Safe Mining*'.
- (iii) Risk management techniques have been introduced into the document.
- (iv) Technological changes to equipment have been incorporated.
- (v) MDG 13 '*Design Guidelines for Fire-Fighting Systems to be Installed in Surface Mobile and Transportable Equipment for use in Coal Mines and Declared Coal Preparation Plants*', has been incorporated into the body of the document.
- (vi) '*Guidelines for Electrical Wiring of Diesel / Electrical Earth Moving Equipment for Open Cut Coal Mines and Declared Coal Preparation Plants*', has been incorporated into the body of the document.
- (vii) Reformatted to assist auditing and clarify areas of ambiguity.

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## **SECTION 1 SCOPE AND PURPOSE**

### **1.1 SCOPE**

This Guideline sets out the safety requirements for the design, manufacture and operation of Mobile and Transportable Equipment for Use in Mines.

Relevant sections should be used for all the foregoing equipment which is not capable of being registered for use on public roads.

It is not intended for this Guideline to apply to underground coal mining equipment designed, and manufactured in accordance with N.S.W Department of Mineral Resources Guideline MDG 1.

This Guideline covers both Electric and Diesel Powered equipment unless otherwise specifically mentioned. It includes many of those items that have been identified as requiring specific attention in order to provide a safe product but it by no means covers all possible details that should be reviewed by the Manufacturer, Supplier, Purchaser, Owner, Operator and Site Contractor.

This Guideline does not generally give quantitative information as it is not intended to restrict innovative design. Where specific values or test procedures are required, advice should be sought from the relevant regulatory body.

#### **1.1.1 Regulations**

This Guideline does not in any way negate or replace legislative requirements.

A list of referred Acts and Regulations for N.S.W. is included in Appendix C.

### **1.2 OBJECTIVE**

The objective of this Guideline is to assist equipment Designers, Manufacturers, Suppliers, Contractors, Users and Owners of mobile and transportable equipment to minimise the risks to health and safety where this type of equipment is used.

### **1.3 APPLICATION**

This Guideline is intended to cover the safety aspects of Mobile and Transportable Equipment used at Mines, Surface of Underground Coal Mines and Product Processing Plants.

It should be used and adhered to when equipment is;

- a) Designed or purchased,
- b) Overhauled
- c) Used equipment is purchased
- d) Site contracts are being considered.

This Guideline should apply to all equipment following its publication. The provisions need not apply where a contract for the supply or overhaul has been entered into prior to that time and the equipment has been audited to the 1997 version of Guideline MDG 15.

### **1.4 RISK MANAGEMENT**

When adopting this Guideline Risk Management techniques need to be used to;

- a) Identify the risk to health and safety of people associated with this type of equipment, and

- b) Identify the risk to equipment, and
- c) To determine if the recommendations in this Guideline be adopted or rejected.

It is intended for this Guideline to highlight areas that may have prevented incidents in relation to this type of equipment in the past. It is not intended for this Guideline to be mandatory.

Shall and should have been used in this document in a risk management context only. Where 'shall' is used the statement is 'strongly recommended' and where 'should' is used the statement is 'recommended'.

#### **1.4.1 Alternatives**

Alternative methods of providing safety based on risk assessment may be used provided that the level of safety offered by alternatives is at least equal to or better than that provided by the methods given in this Guideline.

### **1.5 SECTION REQUIREMENTS**

Mobile and Transportable Equipment should comply with the requirements provided for in each section of this Guideline, where applicable.

### **1.6 RELATED AND REFERENCE DOCUMENTS**

A list of the documents referred to in this Guideline and other documents that are considered relevant is given in Appendix A.

### **1.7 DEFINITION**

For the purpose of this document the definitions below apply.

#### **1.7.1 Contractor**

A person, persons or Company supplying and / or operating equipment at a mine site on behalf of the Owner.

#### **1.7.2 Emergency Brakes**

A system used to stop the equipment in the event of a brake failure. This system may incorporate the secondary brake system.

#### **1.7.3 Fail Safe**

The principles of failure to safety, which is any failure of the machinery, its associated safeguards, control circuits or its power supply that leaves the machinery in a safe condition.

#### **1.7.4 Falling Object Protective Structure (FOPS)**

Means a system of structural members arranged to reduce the possibility of the crushing of the Operator if a rock or other object falls on the cabin, or in the case of passengers, protection for those people.

#### **1.7.5 Firewall**

A non flammable device to separate a heat source from a fuel source.

### **1.7.6 Fire Suppression System**

A system that will deliver extinguishant from a bulk container through pipes or tubes to a number of key areas on the equipment.

### **1.7.7 Hazard**

A source of potentially damaging energy or a situation that may give rise to a personal injury or disease.

### **1.7.8 Mobile Equipment**

A machine capable of being readily moved about while in its operation. It includes, trucks, tractors, excavators, drills, draglines and the like.

### **1.7.9 Operator**

The person or persons given the task of installing, operating, adjusting, maintaining, cleaning, repairing, or transporting the equipment.

### **1.7.10 Owner**

The person or organisation that owns the legal rights to a particular piece of equipment.

Where the equipment is leased or financed such that the legal rights to the equipment is maintained by the finance company and the finance company has no interest in the operation of the equipment then the Owner is the person or organisation that pays the finance company and/or has option to purchase the equipment at the end of the lease or finance period.

### **1.7.11 Park Brake**

A system used to hold a stopped machine stationary for prolonged periods.

### **1.7.12 Potential Fire Source**

A potential source of fuel that will sustain a fire.

### **1.7.13 Practicable**

Practicable having regard to;

- a) The severity of the hazard or risk in question.
- b) The state of knowledge about that hazard or risk and any ways of removing or mitigating that hazard or risk.
- c) The availability and suitability of ways to remove or mitigate that hazard or risk.
- d) The cost of removing or mitigating that hazard or risk.

### **1.7.14 Risk**

The combination of the probability and degree of possible injury or damage to health arising from exposure to any danger zone.

### **1.7.15 Roll Over Protective Structure (ROPS)**

Means a system of structural members arranged to reduce the possibility of the crushing of the Operator if the equipment overturns.

**1.7.16 Safety Device**

A device that eliminates or reduces danger.

**1.7.17 Secondary Brake**

A system used to stop a machine in the event of any failure in the service brake system.

**1.7.18 Service Brake**

A system used to stop and momentarily hold a machine.

**1.7.19 Shall**

Indicates a statement is 'strongly recommended'.

**1.7.20 Should**

Indicates a statement is 'recommended'.

**1.7.21 Supplier**

The manufacturer or local agent that sells and / or maintains the equipment.

**1.7.22 TKPH**

Tonnes, Kilometres per hour, refer AS 4457.

**1.7.23 Transportable Equipment**

Equipment that, from the nature of its use, requires to be moved to a new position regularly, from time to time between periods of operation. It includes pumps, generators, lighting towers, drills, highwall auger, mobile crushing plants and the like but excluding transformers.

## **SECTION 2 GENERAL REQUIREMENTS**

### **2.1 RECOGNISED PUBLISHED STANDARDS - GENERAL**

Unless otherwise specified, the appropriate Australian Standards shall apply as a minimum standard. Where Australian Standards have not been published the appropriate ISO or SAE Standards shall apply.

A partial list of Australian Standards, ISO equivalent standards and SAE Standards is included in Appendix A.

#### **2.1.1 Standard Dates**

Where this Guideline specifies standards with a specific date it is appropriate that current standards apply at the date of manufacture.

#### **2.1.2 Standard of Risk Assessment**

Where a Risk Assessment is required under this Guideline the requirements of AS/NZS 3931 and AS 4360, or N.S.W. Department of Mineral Resources guidelines MDG 1010 and MDG 1014, or equivalent standards shall be followed.

### **2.2 COMPLIANCE STATEMENT**

The Supplier should provide to the Owner the following:-

- a) A statement of compliance to this document including;
  - (i) A list of variations or reason for non compliance with each item mentioned. A marked up and signed copy of these guide-lines may be used.
  - (ii) A Risk Assessment identifying equivalent levels of safety for all variations and recommendations that have not been adopted.
- b) Any further information requested within these guide-lines or considered to be appropriate to ensure the safe operation and maintenance of the equipment.
- c) Any information as required by legislation.
- d) Results of test reports and a statement of compliance with all requirements in accordance with Australian or other relevant Standards.

### **2.3 DOCUMENTATION**

Documentation shall be supplied by the Manufacturer and Supplier and maintained by the Owner of the equipment.

All documentation provided by the Manufacturer / Supplier must be for the 'As Built' equipment.

'As Built' drawings should include after market components installed by the Supplier.

The manuals shall include the relevant 'As Built' electrical, hydraulic, pneumatic schematic diagrams, parts lists, major components ratings and a section on recommended maintenance periods and procedures, including safety precautions to be taken.

Electrical circuit diagrams to include termination details.

All hydraulic and pneumatic symbols shall be in accordance with AS 1101.1 or ISO 1219.1 Graphic symbols for general engineering - Hydraulic and pneumatic systems

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

As a minimum the documentation shall also include:

### **2.3.1 Installation, Testing and Dismantling Procedures and Results**

Installation, testing and dismantling procedures and results shall be provided and shall contain the following information as a minimum but be not limited to:

- a) Identification of hazards and appropriate controls associated with the installation, testing and dismantling of the equipment.
- b) Safework procedure associated with the installation, testing and dismantling of the equipment. The limits of travel of all moving elements should be shown.
- c) A copy of all results and procedures in regards to testing, setup and commissioning of the system should be maintained.
- d) Transport and lifting requirements for the equipment and its major components including;
  - (i) Component weights and dimensions.
  - (ii) Jacking weights.
  - (iii) Lifting, jacking and support stand locations.

### **2.3.2 Operation and Maintenance Instructions**

Operation and maintenance manuals shall be provided. These manuals shall contain the following information categorised in appropriate sections as a minimum but be not limited to:

- a) Recommended preventative maintenance requirements to maintain the equipment in a safe operating condition, including lubrication, ongoing adjustments, tests, setting of controls, etc.
- b) Recommended inspection, examination and testing schemes to check if the equipment is safe to operate.
- c) Identification of any hazards involved in maintaining and operating the equipment, including fire risk, confined spaces, etc.
- d) Energy isolation and control.
- e) Safework procedures to carry out maintenance on the system, including setting of controls.
- f) Protective equipment requirements.
- g) Trouble shooting guide

### **2.3.3 Synopsis of Plant**

The Manufacturer and Supplier shall provide the following information on the equipment being supplied:

- a) Equipment operating limits and capacities as detailed in Section 2.6, 'Accident Review'.
- b) Detailed General Arrangement drawings showing the physical dimensions of the equipment including all extremities and all limits of application.
- c) Hydraulic and pneumatic drawings and schematics.
- d) Schematic and logic drawings of power and control facilities.
- e) Detailed parts lists of all components including reorder codes

### **2.3.4 Towing Instructions**

As a minimum towing instructions shall be provided for each of the following:

- a) For towing the equipment if inoperable.
- b) For towing a load.
- c) Maximum load to be towed, including tow point ratings.
- d) Direction of pull.

### **2.3.5 Modifications to Standard Equipment**

The Manufacturer, Supplier or Contractor shall provide schedules of all modifications that have been carried out to the 'As Built' equipment.

Some of these modifications may require approval of the Mine Manager before the equipment is used on the mine site.

### **2.3.6 Safety Devices**

A comprehensive list of all safety devices and their function shall be provided by the Manufacturer.

The list shall be split into;

- (i) Those provided with the equipment, and
- (ii) Those which are not provided with the equipment, but which are available as an option with the equipment.

## **2.4 SAFETY REQUIREMENTS**

### **2.4.1 Identification of Hazards**

Hazard identification in relation to the equipment shall be in accordance with AS 4024.1, Section 4 and other relevant standards and shall be provided to the Owner with the equipment when supplied.

### **2.4.2 Operational Risk Assessment**

On the introduction of any equipment to a mine site, an Operational Risk Assessment shall be conducted to identify operational risks associated with that equipment. Part of that risk assessment should include accident reviews.

### **2.4.3 Isolation and Energy Dissipation**

Procedures shall be supplied by the Manufacturer and maintained and developed by the Owner for the safe isolation and / or energy dissipation. They should be available for all activities associated with the installation, operation and maintenance of the equipment.

A person shall not carry out repairs to equipment unless the energy source is isolated and cannot be reconnected accidentally before it is safe to do so.

The system of isolation adopted should incorporate a tagging system, a locking system or permit system and in any case shall also include a method for ensuring that isolation and / or energy dissipation is effectively established.

Isolation and energy dissipation should be carried out in accordance with AS 4024.1.

#### **2.4.4 Safework Procedures**

Safework procedures shall be supplied by the Manufacturer and maintained and developed by the Owner. They should be available for all activities associated with the installation, operation and maintenance of the equipment.

#### **2.4.5 Training**

All Supervisors, Operators and Maintenance Personnel should be formally trained.

Training should include as a minimum but be not limited to the following:

- a) Knowledge and understanding of hazards and the required controls.
- b) Equipment safety procedures, including emergency procedures.
- c) The correct and safe way of operating and maintaining the equipment.
- d) Understanding the purpose and function of safeguards which protect personnel.
- e) Reporting of faults and defects.
- f) Use of protective equipment.
- g) Statutory requirements.
- h) Automatic and manual fire systems

### **2.5 MAINTENANCE**

The Owners and Operators must ensure that all equipment is kept in a fit state for work, is appropriately guarded and protected and is provided with adequate access for operation, maintenance and inspection.

#### **2.5.1 Modifications & Repairs**

Modifications or repairs to equipment must not be carried out unless a risk assessment has shown that the modifications or repair is safe and is able to be done without reduction to safety.

Structural alterations to equipment must be designed and implemented under the direction of a competent Structural or Mechanical Engineer.

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

### **2.6 ACCIDENT REVIEW**

A co-operative approach between Manufacturers, Statutory Authorities and mine Operators is required to eliminate equipment accidents.

In order to minimise the risk of repetitive accidents the Manufacturers and Owners should maintain a comprehensive list of accident statistics and relevant details for the same or comparable equipment. These statistics should be reviewed and corrective action taken, as far as is practical, to avoid further accidents.

The Owners and Operators of mobile and transportable equipment shall provide to the equipment manufacture details of all incidents in relation to the equipment.

The Manufacture shall notify all Owners and Operators of any safety related incidents that they become aware of from time to time and their recommendation to rectify such defect. (e.g. Safety Alerts, Technical Bulletins, etc.)

Any review of accidents should include but not be limited to slips, falls, fires, collisions and all serious bodily injuries and fatalities.

The statistics covering reportable significant accidents and occurrences by statute may be obtained from the individual mine or from the Department of Mineral Resources Mining Inspectorate Chief Inspector's Annual Report.

## **2.7 LIMIT OF EQUIPMENT APPLICATION**

The Manufacturer shall provide to the Owner all the necessary limits of operation for the equipment supplied. Such limits shall be in accordance with a relevant Standard (Australian, ISO or SAE). Examples of such limits are as follows:

### **2.7.1 Maximum Working Grade (%)**

- (i) Loaded @ maximum gross vehicle mass (GVM). (as built).
- (ii) Unloaded.
- (iii) Tipping.
- (iv) Fully loaded with park brake applied.
- (v) Other variables where applicable.

### **2.7.2 Maximum Cross Grade(%)**

- (i) Loaded @ maximum GVM. (as built).
- (ii) Unloaded.
- (iii) Tipping.
- (iv) Other variables where applicable.

### **2.7.3 Maximum Load (tonnes)**

- (i) Level conditions.
- (ii) On range of grades.
- (iii) Other variables where applicable.

### **2.7.4 Maximum Speed (Km/h)**

- (i) On level conditions.
- (ii) On range of grades.
- (iii) Other variables where applicable.

### **2.7.5 Brakes**

- (i) Park brake load / slope limits.
- (ii) Dynamic brake limits (speed/brake effect envelope).
- (iii) Service brake limits.

## **SECTION 3 REQUIREMENTS FOR DESIGN AND MANUFACTURE**

### **3.1 ACCESS TO EQUIPMENT**

#### **3.1.1 General**

Spacing and design of steps, ladders and walkways shall be in accordance with AS 1657 and AS 3868 as a minimum but should in addition conform with the following:-

- a) Australian Standard AS 3868 shall be used where the height of the required access platform is 2 metres or less from ground level, and
- b) Australian Standard AS 1657 shall be used where the height of the required access platform exceeds 2 metres from ground level.

Equipment Operators and maintenance personnel should be able to carry out normal duties without leaving a designated walkway, access platform, or the ground. Where this is not practicable and there is a potential that a person could fall more than 2000 mm then a harness attachment point shall be provided.

#### **3.1.2 Ladders and Stairs**

The following requirements apply:

- a) Vertical ladders should be avoided where ever possible.
- b) Stairs shall be provided where ever practical.
- c) Retractable stairs or ladders shall be considered where ever practicable, particularly for loaders, overburden drills, rear dump trucks, excavators and shovels.
- d) Flexible bottom steps shall be avoided unless there is no practicable alternative.
- e) The bottom step of the normal access shall not be more than 400 mm from normal ground level.

#### **3.1.3 Walkways and Handrails**

The following requirements apply:

- a) Handrails should be in a continuous length without sudden changes of direction to facilitate evacuation with minimal visibility.
- b) Walkway surfaces should be self cleaning and non slip.
- c) Openings in guardrails for the purpose of access to steps, stairways or ladders shall be fitted with a hinged or sliding guardrail structure where practicable. Chains are not considered suitable.

#### **3.1.4 Egress**

Two means of egress shall be provided from the Operator's cab to the ground including;

- a) At least 1 means of easy egress (normal access) and
- b) At least 1 means of emergency egress. This may be achieved by a second door or a push out window, panel, ladder or emergency escape chute, which shall be suitably marked.

At least 1 of these means of egress shall not be in the vicinity of a potential fire source.

## **3.2 BRAKES**

### **3.2.1 General**

- a) Brakes shall comply with the relevant Australian, ISO or SAE Standards refer Appendix A.
- b) Brakes on wheeled machines shall comply with AS 2958.1.
- c) All mechanical braking systems shall be fail safe.
- d) Consideration should be given to eliminate, or minimise so far as practicable, locking of the wheels.
- e) An effective interlock shall be provided to protect against the equipment being driven with any brake applied. This interlock can be overridden for maintenance which is being carried out in accordance with the Manufacturers' instructions.
- f) Brake lining material shall not contain asbestos.

### **3.2.2 Park Brake System**

All equipment shall be equipped with a park brake system capable of being applied and released from the Operator's position.

The park brake system should have the capability of holding the equipment stationary on a 15% grade as described in AS 2958 in both forward and reverse directions.

This shall apply with the equipment at its maximum gross mass as specified by the Manufacturer.

Safety chocks should also be available in the event of the equipment being immobilised.

Once applied the park brake system shall not rely on any exhaustible energy source.

### **3.2.3 Brake Pressures**

A warning light easily visible from the Operators' seat and/or an audible alarm should be used to monitor the state of all pressurised braking systems.(Refer AS 2958.1)

#### **3.2.3.1 Line Pressures**

Suitable connecting points for checking pressures of all braking systems shall be provided.

#### **3.2.3.2 Brake Drag Indication**

A suitable brake warning device should be provided to monitor brake drag where required. e.g. residual brake pressure.

### **3.2.4 Brake Wear Indication**

A clearly identifiable means of monitoring brake wear and the required adjustment range shall be supplied by the Manufacturer .

### **3.2.5 Energy Storage**

Air or hydraulic energy storage for service brake applications should be independent from the requirements of other consuming systems.

### **3.2.6 Multiple Circuit Braking Systems**

Braking systems shall be designed as a minimum as dual circuit systems.

Note: The use of single circuit brake systems should only be considered if all risk scenarios have been considered and measures taken to effectively eliminate or minimise risk.

All split brake systems should be supplied with a means of readily identifying when excessive differential pressure between the two sections occurs.

This may be achieved by use of an indicator light readily visible to the driver.

### **3.2.7 Oil Immersed Braking Systems**

Oil immersed braking systems shall be so designed that the temperature never reaches the flash point for the oil. The oil used in braking systems shall be as specified by the equipment Manufacturer.

The use of fire resistant brake fluid should be considered for all non-oil immersed hydraulic brake systems.

#### **3.2.7.1 Monitoring**

- a) The temperature of any oil immersed braking system should be monitored.
- b) Monitoring should be visible from the Operator's seated position.

### **3.2.8 Brake Testing**

A means of using measurement for maintenance checking (or at least indication) of vehicle deceleration shall be provided where practical for rubber tyred equipment.

Part of the maintenance plan shall include onboard brake and electrical retard brake tests carried out in accordance with AS 2958 and the results recorded in the Mine's maintenance records.

The Manufacturer shall provide to the Owner the accepted deceleration limits for all braking systems (electrical retard and mechanical) as designed for the equipment.

A portable means of recording brake application frequency and length of application is considered satisfactory. This should be suitable for easy installation on the equipment when required for checking purposes.

Note: This is particularly useful for:-

- (i) Operator training.
- (ii) Identifying effectiveness/ deterioration of the braking system rather than relying on "Operator feel".
- (iii) Could give pre-warning of possible brake failure.
- (iv) Complementing periodic inspections.

### **3.2.9 Automatic Operation of Brakes**

Automatic operation of brakes may in some circumstances correct for operator error and prevent serious accidents. Hence consideration be given to the following controls: -

- a) If service brake system fails then the emergency brakes shall be automatically applied.
- b) The automatic rate of application of the brakes should not exceed the safe application rate.
- c) A warning device that effectively indicates to the Operator that the braking system is about to apply automatically shall be provided (ref. SAE J1152, SAE J1472, SAE J1473).

## **3.3 CONVEYORS**

Conveyors on mobile and transportable equipment shall comply with AS 1755.

### **3.4 CONTROL FUNCTIONS**

#### **3.4.1 General**

Instrumentation and Operators controls shall comply with AS 2956 or other appropriate International Standards.

The operating controls shall be clearly marked to show their function and mode of operation in accordance with AS 2956.4 or ISO 6405.2.

#### **3.4.2 Warning Device**

An audible warning device (eg. horn) shall be provided for use as a manually initiated warning device.

##### **3.4.2.1 Air Device**

If an audible warning device is air operated then a secondary warning device shall be provided (eg. for electric start trucks where air is not available until the engine is operating, then an electric horn is required.)

##### **3.4.2.2 Pre-Start Warning**

An automatically initiated pre-start warning device shall be provided where a hazard exists if people are near the equipment and it is started or moved. This applies particularly to draglines, large shovels, reclaimers, loaders and other large equipment where it is difficult for the Operator to ensure that no one is exposed to a hazard if the equipment is started.

##### **3.4.2.3 Reversing**

An automatic reversing warning system shall be provided on all equipment such as all trucks, loaders, graders, scrapers and other plant where reversing a short distance with limited visibility is normal practice.

#### **3.4.3 Emergency Stop**

Emergency stop facilities should be provided in accordance with AS 4024.1.

### **3.5 ENGINE COMPARTMENT**

#### **3.5.1 Location of Services**

- a) The location of services including fuel, hydraulic oil and electric power within the engine compartment shall be avoided wherever possible.
- b) Any services required to be in the engine compartment shall be effectively shielded from hot spots and suitably protected from wear and tear.
- c) The potential for physical damage to services during maintenance work shall be considered

#### **3.5.2 Fuel and Hydraulic Circuits**

All fuel and hydraulic circuits within the engine compartment should comply with the following:

- a) Where possible hydraulic components should not be located where main ventilating air will cause leaking oil to be spread over the engine compartment.
- b) Hydraulically driven fans should not be used where potential exists for an oil leak from the fan hydraulics to contact hot surfaces (e.g. resistor bank cooling). If there is no alternative

to using hydraulic driven fans then the fan hydraulics shall be suitably guarded to ensure that oil does not come in contact with ignition sources.

- c) All fuel tanks be fitted with non leaking caps which are effective irrespective of the attitude of the equipment.
- d) All fuel filters be of metal or glass construction or alternatively installed within a metal container.

#### **3.5.2.1 Pipes & Hoses**

- a) All pressurised fuel lines shall be metal or metal braided.
- b) All non-pressurised fuel lines should be metal or metal braided.
- c) All pipes/hoses shall be constructed of fire resistant material and shall be routed away from hot engine surfaces. Appendix A lists standards that will act as a guide.
- d) Should the requirements of a) above prove to be impractical then an effective shield is required between the pipe/hose and any adjacent components, etc. which have operating surface temperatures in excess of 150 degrees Celsius.
- e) All pipes/hoses shall be routed in a manner which will give them maximum mechanical protection against wear and damage
- f) All connections shall be fit for purpose and suitably rated.

#### **3.5.3 Firewalls**

Firewalls shall suitable rated in accordance with the risk and should be in accordance with the following:

- a) Installed for all diesel powered equipment.
- b) Considered for all electric powered equipment,
- c) Separate the engine (heat source) from the hydraulics (fuel source).
- d) So designed that engine ventilation is not interfered with.

#### **3.5.4 Radiator Caps**

Radiator caps for cooling systems shall be fitted with a means of safely relieving pressure to prevent burning personnel and shall be able to be accessed safely.

A means to check coolant level without the removal of the radiator cap shall be provided.

A means of filling the radiator without removing the radiator cap should be provided.

### **3.6 ERGONOMICS**

All relevant ergonomic aspects of the equipment should be addressed by the Manufacturer in the design and manufacture of the equipment.

A suitably qualified person should review the ergonomic aspects of the equipment to ensure compliance with good practice. A report should be prepared by this person and supplied to the Operator before delivery.

#### **3.6.1 Controls**

The controls shall be located within the "zones of comfort and reach" as detailed in AS 2956.5 or ISO 6682.

### 3.6.2 Visibility

- a) Operator visibility shall be maximised e.g. auxiliary equipment should be located where it will not interfere with visibility.
- b) The Manufacturer shall provide a drawing identifying the Operators field of vision and a suitable diagram shall be displayed in the Operators cabin.
- c) Reference shall be made to ISO 5006 in the review of visibility.

### 3.6.3 Vibration

Adequate preventative measures shall be taken to prevent excessive vibration being transmitted to the Operator during the operation of any equipment. The transmitted vibration during operations shall not exceed the levels specified by AS 2670.1, 'Evaluation of human exposure to whole-body vibration - General requirements'.

## 3.7 FIRE CONTROL SYSTEMS

Fire control systems shall be designed, installed and maintained in accordance with the appropriate standards.

(Note: An Australian standard titled 'Mobile and transportable equipment – Risk based fire system' will be available shortly.)

The manufacture shall identify all potential fuel sources and provide a full assessment of fire risk associated with the equipment being supplied.

### 3.7.1 Fire Extinguisher(s)

As a minimum fire extinguisher(s) of a suitable type and capacity shall be installed on equipment. The extinguisher should be fitted at a location on the equipment that is least likely to catch fire, be easily detached by a person from ground level and have gauges that are easily readable.

All fire extinguishers should be maintained in accordance with AS 1851.

The following minimum size of fire extinguishers should be used based on engine rating:

- Less than 100 kW 30B(E): 2 kg - 3 kg
- Between 101 kW to 200 kW 80B(E): 4.5 kg - 9 kg
- Greater than 200 kW and large equipment 80B(E): 40 kg – 60 kg Trolley mounted (e.g. draglines, shovels, fuel farms, etc.)

### 3.7.2 Fire Suppression

A fire suppression system should be provided on all equipment. This fire suppression system should be in accordance with the outcomes of a fire risk assessment.

All fire suppression systems should comply with the appropriate standard.

Risk management techniques should be used to determine the method of operation of the fire suppression system, (manually operated fire suppression system as against an automatically operated fire suppression system).

A fail safe shut off valve system shall be fitted to the fuel supply line where the equipment is fitted to an internal combustion engine.

#### 3.7.2.1 Design

The fire fighting system should be designed to provide personnel protection from fires that may be initiated from all heat sources and result in injury to if the fire is not suppressed.

The items to be considered in the design of a fire suppression system should include but be not limited to:

- a) The volume of the area to be covered.
- b) The ventilation of the area to be covered.
- c) The quantity of fuel, including diesel fuel, oil or other combustible material that may be available to feed the fire.
- d) The areas where ignition is more easily initiated (eg. Turbo charger of a diesel engine).
- e) The storage, type and application of the extinguishing agent shall be shown to be non-injurious to all personnel likely to come into contact with the system in either the stored or discharged condition.
- f) Pressurised carbon dioxide systems are not preferred (because of the danger of asphyxiating personnel).
- g) A system for the charging / filling of fire fighting systems shall be provided.
- h) Fire fighting system extinguishants shall comply with the requirements of the Ozone Protection Act, 1989 and any Regulations pertaining to this Act.
- i) All pressurised systems shall be protected by a relief system to prevent over pressurisation.

#### **3.7.2.2 Activation of System**

Clear indication of the selected mode of operation should be visible from the driver's normal driving position.

Manually operated controls to trigger the system shall be provided:

- a) Within the Operator's cabin and located within reach of the driver's normal operating position and
- b) Adjacent to the bottom of the normal access ladder, walkway etc., to the Operator's compartment, readily accessible from ground level.

Control lines should be so arranged that failure of any one line would not prevent the system operating when initiated from another activation point.

Visual indication shall be provided for the equipment Operator to show whether the system is ready for operation or has been discharged.

For some systems it may be useful to switch an automatic system to manual operation. If this feature is provided then it shall only be possible to carry out the switching function from the driver's normal operating position.

#### **3.7.2.3 Electrical Control**

Each component of an electrical installation that supplies a fire protection system shall be separately controlled by a switch which is additional to the main switch used to control other components of the equipment.

This switch shall be clearly marked, "Fire Suppression System".

All electrical controls shall fail to safety unless a back up power supply system is provided.

Loss of electric power shall not prevent the operation of the fire extinguishing system by manual initiation.

Wiring systems on fire suppression equipment should have a 2 hour fire rating.

### **3.7.3 Automatic Fire Suppression**

If fitted, automatic fire suppression systems should where appropriate be interlocked to automatically shut down all power so that the equipment cannot be operated if the fire suppression system is disabled or faulty.

Where interlocking occurs, the system should allow for manual override to allow control by the Operator when required.

Where automatic fire suppression systems are fitted or installed a visible and audible warning must be given to the Operator when a fire is detected.

Note:- Many Operators forget to shut down equipment when abandoning plant with the result that damage to equipment and danger to other persons can be aggravated. A number of Operators have been more severely injured because a fire was still being fed by the power source whilst they evacuated the equipment as the power source was not shut down.

#### **3.7.3.1 Shutdown Delay**

For automatic fire suppression systems the shut off valve shall operate in the following sequence:

- a) A timer to delay engine shut down activates after a predetermined time. This time delay should vary depending on the equipment type and mine conditions.

Examples of typical times may include:

- (i) Rear dump trucks, water carts, rubber-tyred dozers and similar  
- 30 to 40 seconds delay.
  - (ii) Bulldozers, front-end loaders, graders, drill rigs and similar  
- 15 to 20 seconds delay.
- b) On expiry of the time delay, then the engine should be automatically shut down and the fire suppression system should be activated.

Note:

- (i) This time delay is to allow the Operator to become aware that the fire suppression system is about to activate.
- (ii) These delays may be reset by the Operator if required to bring the equipment to rest safely.
- (iii) Operator training for automatic fire systems must be carried out.

## **3.8 FLUID SYSTEMS**

### **3.8.1 General**

Hydraulic systems and components shall comply with AS 2671 and AS 4024.

### **3.8.2 Emergency Shutdown**

It shall be possible to relieve the pressure from hydraulic systems, steering systems, accumulators and pressurised fuel tanks from the vicinity of one of the emergency stop points at ground level. (To permit pressure which may be fuelling a fire to be relieved.)

### **3.8.3 Hoses**

- a) Hydraulic hose shall comply with the provisions of AS 3791.
- b) Flexible hoses and fittings shall be suitable for the fluid used and the maximum system pressure and temperature.

- c) The hose factor of safety shall be a minimum of 4 to 1 based on hose or fitting burst pressure to maximum working pressure for the maximum operating temperature. Refer AS 3791 and ISO 7751.
- d) Elastomeric (rubber type) hose shall not be used on a delivery line between an air compressor and air receiver. Fit for purpose Teflon with steel braid is satisfactory. All delivery hoses shall be heat resistant. All other hosing shall be suitable for the application.
- e) All air, hydraulic, fuel, refrigerant and fire suppression hoses shall be routed separately and suitably clamped (to prevent vibration and pulsation causing fretting between services leading to hose and cable failure.)
- f) Hoses should be labelled with information or identification to enable the following to be identified;
  - (i) Date of installation.
  - (ii) Working pressure.
  - (iii) Code of construction.
  - (iv) Length, end fittings and date of fitment.
  - (v) Fluid medium being transported.

#### **3.8.3.1 Fire Resistance Hose**

All hydraulic hose shall be fire resistant unless the hose is located in a low risk fire area.

The requirements for flame resistance should be in accordance with;

- a) Testing to AS 1180-10b and acceptance to AS 2660, or
- b) Satisfy the flame test requirements of the U.S.A. Code of Federal Regulations Title 30 Part 18 Section 18.65, or
- c) Comply with type 1 or 3 hose specifications as listed in ISO 6805, or
- d) An equivalent level of fire resistance provided.

#### **3.8.3.2 Fire Proof Hose**

All brake, turbo lube hoses and fire suppression system hoses should be fire proof but as a minimum shall be fire resistant.

The requirements for flame resistance should be in accordance with;

- a) SAE Aerospace standard AS1339-2000, Hose Assembly, Polytetrafluoroethylene, Metallic Reinforced, 3000 psi, 400 °F, Lightweight, Hydraulic and Pneumatic.  
The operating limit for this hose is -54<sup>0</sup> C to +232<sup>0</sup> C, or
- b) An equivalent level of fire resistance provided.

#### **3.8.4 Accumulators**

- a) All hydraulic accumulators shall be designed, manufactured, certified, installed, labelled, maintained and inspected in accordance with the relevant Australian Standard, refer clause 'Pressure vessels'.
- b) Accumulators shall be securely installed.
- c) Where a hydraulic system incorporates an accumulator the attachments to the accumulator shall be by means of a minimal length adapter and flexible hose.
- d) Fittings shall be located or otherwise guarded to provide mechanical protection against operational and maintenance damage eg. Rock damage or stepping onto components during maintenance etc.

- e) A manual bleed valve should be fitted to allow pressure relief for maintenance purposes. This should preferably be accessible from ground level and fluid should return to tank, as per clause 3.8.2 'Emergency Shutdown'.
- f) A safety relief should be included in the manual gas charging circuit when gas charging accumulators are installed.

#### **3.8.4.1 PVC Piping**

The use of nylon or PVC piping for pneumatic safety control systems shall not be used unless the loss of pressure within these systems cause the system to fail to safety. All such piping shall be adequately protected and shielded from contact with hot and/or sharp surfaces.

### **3.9 GUARDS AND SHIELDS**

When a hazard cannot be eliminated or avoided by design, then the provision of safeguards shall be considered.

Guards and shields shall comply with AS 4024.1 and AS 2958.2 or ISO 3457.

#### **3.9.1 Shields**

- a) Shields should be fitted where any hydraulic hoses may be damaged by impact. (e.g. in wheel arch areas, under body, etc.)
- b) Shields shall be fitted in the vicinity of the turbo charger to prevent hydraulic / engine oil spraying on hot surfaces, provided that they don't trap fuel or oil around the turbo charger.

#### **3.9.2 Guards**

Guards shall be fitted as follows:-

- a) On every fan to prevent contact.
- b) In the vicinity of every moving component that is readily accessible and can result in injury.
- c) In the vicinity of any access way where a person may contact moving equipment.
- d) Any other areas required to be guarded by regulations mentioned earlier.
- e) Any other areas as identified from accident statistics or risk assessments such as drivelines.

#### **3.9.3 Fire Resistant Guards**

Fire resistant guards are to be provided as follows:

- a) Any covers, shields or guards not constructed from steel shall be constructed from fire resistant material if the failure of the material is likely to place an operator at risk when a fire occurs.
- b) The degree of fire resistance should suit the size of the fire that may eventuate and should provide protection for at least 2 hours.
- c) Comparative fire resistance may be obtained by testing to ASTM 1354, ISO 5660 or AS 1530.
- d) This specifically applies to engine covers of large rear dump trucks as well as most other large equipment.
- e) The engine compartment should be effectively shielded from the Operator's compartment in the event of a fire.

- f) The means of egress shall be effectively shielded in the event of a fire to provide safe egress for the Operator.

### **3.10 MARKING, SIGNS AND IDENTIFICATION**

#### **3.10.1 General**

Where appropriate, permanent markings, signs and identification plates shall be in accordance with AS 1318 and AS 1319.

Where a hazard could exist from the misinterpretation of a symbol the meaning of the symbol shall be clarified in writing.

Green and red zones should mark minimum safe operating pressure on the pressure gauges of hydraulic and/or pneumatic systems.

##### **3.10.1.1 Construction & Location**

Markings, signs and labels shall be of durable construction and be permanently attached. It is preferable for signs and labels to be constructed of engraved brass, stainless steel, 'Traffolyte' or similar.

Markings, signs and labels shall be installed or positioned and maintained so that they are clearly visible.

#### **3.10.2 Labelling**

Labelling shall include individual labels displayed in a suitable position covering the following areas where applicable:-

##### **3.10.2.1 Compliance Plate**

Compliance plates where required by relevant Australian and International Standard shall be displayed in a prominent position.

As an example the compliance plate of a rubber tyred vehicle might show the following:-

- a) The date of manufacture and serial number.
- b) The tare and gross weight of the equipment.
- c) The axle loads, if applicable.
- d) The maximum number of personnel for which seating is provided.
- e) Other appropriate equipment details.

##### **3.10.2.2 Limits of Application**

In the Operator's cabin a label showing all limits of application of the equipment as identified in Clause 2.7, 'Limits of Application'.

On board indication of grade (cross and fore/aft) with the safe limits identified shall be provided where appropriate. This applies particularly to cranes, rubber tyred vehicles and overburden drills but should also be considered for other equipment.

##### **3.10.2.3 Warning and Danger Signs**

Labelling shall include as a minimum but be not limited to:

- a) A warning sign adjacent to all accessible rotating fans.
- b) A warning at all accumulators that pressure must be safely released before work commences.
- c) A warning on any spring applied brake chamber that it contains a spring under compression.

- d) A warning that "hearing protection must be worn" is to be placed on the equipment at relevant locations where the noise exceeds regulatory levels and personnel are required to carry out operational or maintenance activities.
- e) A warning that the park brake shall be applied and implements lowered before leaving the equipment.
- f) Minimum safe operating pressure on the pressure gauges of hydraulic and/or pneumatic systems, preferably by green and red zones.
- g) Any automatic/self starting equipment or equipment started remotely shall be identified as such.

Danger signs and other signs as considered necessary by the Manufacturer should be placed in appropriate positions on the equipment.

#### **3.10.2.4 Controls & Pre-Operational Checklist**

Labelling shall include as a minimum but be not limited to:

- a) Identification of all controls including direction of movement where applicable in accordance with AS 2956.4 or ISO 6405-2.
- b) Emergency stops.
- c) A pre-operational check list which is provided within the control compartment denoting the minimum Operators checks prior to operating the equipment. The check list will be constructed of suitable material.
- d) Location of isolation points.
- e) Location of emergency egress points.

#### **3.10.2.5 Action in Event of Fire**

The required Operator action in event of a fire occurring shall be provided within the Operator compartment, similar to the following;

## **IN CASE OF FIRE**

- 1. Safely Stop Machine**
- 2. Shut Down All Power and Apply Park Brake**
- 3. Activate Fire Suppression System (If fitted)**
- 4. Initiate Mine Emergency Response**

Do not endanger yourself by attempting to get down  
from moving equipment

Note:

It is important that Operators are trained in the actions required in the event of a fire for each type of equipment.

### **3.10.3 Towing, Jacking and Supporting**

The designated locations for towing, lifting, jacking and supporting the equipment shall be labelled.

## **3.11 LIGHTING AND ALARMS**

### **3.11.1 General**

- a) Suitable permanent or mobile lighting shall be provided for mobile and transportable equipment appropriate to their location in accordance with the appropriate standard.
- b) Lighting and marking shall comply with SAE J1029 unless otherwise specified.
- c) The main access shall be adequately lit without interfering with operator visibility.

#### **3.11.1.1 Emergency Lighting**

Emergency lighting shall be provided to allow for safe egress in the absence of normal power, unless the Operator can leave the equipment safely without exposure to hazards or risk of injury. (eg. smaller equipment that do not normally have their access way lit when operating at night or day)

#### **3.11.1.2 Reversing Lights**

Reversing lights shall be provided on all equipment.

The lights should provide the Operator with adequate visibility when reversing at night.

#### **3.11.1.3 Audible Reverse Alarm**

Audible alarms may be replaced by alternative methods provided they give an equivalent level of safety.

### **3.11.2 Brakes and Direction Indicators**

All equipment that exceeds 8 km/hr shall be provided with the following:-

- a) Dual globe direction indication blinker lights at the front and rear of equipment.
- b) Dual globe service brake indication lights readily visible from the rear of the equipment, (front location should be considered).
- c) Dual globe retard brake indication lights readily visible from the rear of the equipment, (front location should be considered). This is applicable for electrical and mechanical retarding systems.

Note: Multiple LED units are considered suitable for the purpose of dual globe lights.

### **3.11.3 Reflectors / Lights**

Adequate reflectors, reflective tape and/or lights shall be provided on all equipment to make it readily visible from any direction and hence reduce the likelihood of a collision. (e.g. broken down item of equipment) This includes but is not limited to :-

- a) Lights or reflectors visible from the side arranged in strips to assist in identifying the length of the equipment.

This applies in particular to diesel powered overburden drills and dump trucks but should also be considered for other equipment.

- b) The front head board or highest extremity of all trackless equipment to provide visibility in undulating terrain.

### 3.12 NOISE

#### 3.12.1 Noise Survey

The Manufacturer shall provide a full and comprehensive sound level analysis of the supplied equipment. This analysis shall be carried out in accordance with AS 2012.

#### 3.12.2 Operator Level Requirements

Noise levels within the Operator's cabin shall be such that the allowable exposure without hearing protection, as defined in AS 1269, is not exceeded during normal operation of the plant and with the air conditioner on the "high" setting.

The recorded measurement taken at the Operators ear, as described in AS 2012.2, must not exceed an Equivalent Continuous  $L_{eq}$  A-Weighted Sound pressure level, inside the cabin as defined by the regulatory body.

#### 3.12.3 Environmental Noise Assessment

Acoustical measurement of exterior noise emitted by earth moving equipment in stationary and dynamic test conditions may be necessary to meet environmental conditions of consent to mining.

Stationary testing should be in accordance with AS 2012 which is technically equivalent to ISO 6393. Dynamic testing shall be carried out in accordance with ISO 6395. Variations to these standards may be required to enable testing of large equipment in operating conditions. Site specific requirements intended to improve the control of tonal differences and the directivity of noise under varying load conditions may also be applicable.

### 3.13 OPERATOR'S CABIN AND PROTECTION

#### 3.13.1 ROPS, FOPS and TOPS

##### 3.13.1.1 General

'Roll Over Protective Structure' (ROPS) and 'Falling Object Protective Structure' (FOPS) shall be fitted to all earthmoving equipment in accordance with AS 2294 except for all small agricultural wheeled tractors which shall be in accordance with AS 1636.

'Tip Over Protective Structure' (TOPS) should be fitted to excavators in accordance with AS 4987 and AS 4988. Compliance with equivalent SAE or ISO standards is an acceptable alternative.

All equipment not covered under the ROPS, FOPS and TOPS standards shall be subject to a risk assessment to determine if the requirements of ROPS, FOPS or TOPS need to be adopted.

The head boards / spillboards of rear dump trucks are **NOT** considered as an effective ROPS.

At least one means of exit shall be useable in the event of a roll over of any type of equipment.

Where equipment is involved in an incident which has resulted to impact on either the ROPS or FOPS structure, then replacement and or repairs shall be carried out in accordance with AS 2294.1.

##### 3.13.1.2 ROPS

ROPS should be fitted to seated operator equipment such as:

- Wheeled prime-movers,
- Wheeled off-highway dump trucks,
- Rubber-tyred and crawler mounted dozers,

- Scrapers,
- Graders,
- Rollers,
- Loaders,
- Tractors (with or without attachments) used mainly on the surface working at any mine.

#### **3.13.1.3 FOPS**

FOPS should be fitted to seated operator equipment such as:

- Load-haul-dump (LHD) units,
- Loaders,
- Graders,
- Dump trucks,
- Rollers,
- Dozers,
- Rubber-tyred drilling rigs,
- Overburden drills on the surface of mines
- Personnel carriers

#### **3.13.2 Cabins**

- a) Cabs should be totally enclosed and soundproofed.
- b) Maximum visibility shall be provided to the Operator.
- c) All windows shall be fitted with safety glass or equivalent.
- d) Windscreen washing and wiping facilities should be provided.
- e) The Operator's working space, passenger carrying space, cabin or working platforms should be designed to minimise as far as practicable any protrudences or sharp edges which could cause injury in the event of an accident or sudden movement.

#### **3.13.3 Heating, Demisting and Fresh Air Supply**

Heating, demisting and fresh air supply should be provided as follows:-

- a) Be capable of adequately demisting the Operator's cabin window.
- b) Supply filtered external makeup air sufficient to maintain a positive pressure inside the Operator's cabin with windows and doors closed.  

The air supply system should make adequate allowance for deterioration of door and window seals.
- c) The heater should have isolating valves fitted to both supply and return lines adjacent to the engine to allow changing of heater hoses and/or core without disturbance to the engine cooling system.

#### **3.13.4 Seats and Seat Belt**

Seats and seat belts as a minimum shall be in accordance with the following:

- a) The Operator's seat should be a high backed type where suitable (may not be for dozers), fully suspended and adjustable and comply with AS 2955.6.

- b) Seats should be robust enough and anchored securely in order to provide adequate anchorage points for safety belts.
- c) Seat belts shall be provided for all seats on any rubber tyred plant.
- d) Seat belts should be installed on any equipment that travels at more than 8 km per hour.
- e) All seat belts and anchorages shall comply with AS 2664 or SAE J386 or ISO 6683.
- f) Personal restraining mechanisms should be designed and installed under the equipment Manufacturer's instructions and wherever possible factory fitted to the equipment.
- g) Passenger seats should be fitted with a restraining device to provide the same level of protection to any occupants within the machinery or vehicles.
- h) These seats and devices should be used exclusively for safely carrying and securing persons. On no account should these seats be used to carry goods or ancillary equipment.

### **3.13.5 Air Conditioning**

Air Conditioning should be provided and be in accordance with the following:

- a) The system shall comply with the requirements of the "Ozone Protection Act 1989" - No 208 and the "Ozone Protection Regulation 1991" No 134, NSW.
- b) The mounting of the air conditioner and accessories should not interfere with operator visibility or cabin headroom within the applicable ergonomics standard.
- c) The air conditioner's mountings shall not interfere with the structural integrity of ROPS or FOPS.
- d) The air conditioner intake location shall be located to avoid:-
  - (i) Exhaust emissions.
  - (ii) Areas where significant fuel and heat sources are present or where fumes from a fire may be expected to concentrate.
  - (iii) Dusty locations.

### **3.14 PRESSURE VESSELS**

All pressure vessels at a mine or plant shall be designed, inspected, maintained and operated in accordance with the following standards;

- a) AS 1200, 'Pressure Equipment'
- b) AS 1210, 'Pressure Vessels'
- c) AS 3788, 'Pressure Equipment - In Service Inspection'
- d) AS 3873, 'Pressure Equipment - Operation and Maintenance'
- e) AS 3892, 'Pressure Equipment – Installation'
- f) Any other relevant Australian Standard

The Manufacturer should provide a current 'Certificate of Inspection' with the delivery of equipment.

### **3.15 STEERING**

#### **3.15.1 Power Steering**

All equipment fitted with power steering, shall be capable of safe operation in the event of engine or power failure to enable the equipment to be brought safely to rest.

#### **3.15.2 Emergency Steering**

- a) Emergency steering shall be provided on all tractor scrapers, articulated trucks and dumpers as defined in SAE J116.
- b) If fitted, emergency steering should comply with SAE J53.

### **3.16 TOWING, JACKING & SUPPORTING**

#### **3.16.1 Towing of Equipment Which is Inoperable.**

Note: This is not intended to cover recovery of equipment. (e.g. bogged equipment)

A fit for purpose means of towing shall be recommended by the Manufacturer and provisions to be made should include the following:-

- a) Designed towing attachments and connectors shall be located at the front and rear of the vehicle, with the maximum design load and direction of load specified.
- b) The designed minimum factor of safety should be 2.5 times the maximum rated towable capacity of the towing equipment.
- c) The towing connectors be of rigid construction (not slings) and certified as fit for purpose.
- d) The maximum towable weight (gross load) for towed equipment be as per the towing equipment manufacturer's recommendation.
- e) A means of releasing fail safe brakes.
- f) A means of steering or guiding the towed equipment.
- g) A means of adequately braking the equipment system.
- h) Limitations and requirements of the towing system.

Note: If towing is impractical then this should be stated by the Manufacturer.

#### **3.16.2 Jacking and Supporting Equipment**

Designated positions for the independent jacking and supporting of the equipment shall be provided. Labelling and documentation shall be provided accordingly.

### **3.17 WHEELS AND RIMS**

The Manufacturer of wheels and rims shall recommend:-

- a) The maximum permissible duty cycle (TKPH) and tyre pressure.
- b) Procedures for servicing wheel rims, including in particular multi-piece wheel rims, refer AS 4457.

## SECTION 4 REQUIREMENTS FOR SPECIFIC TYPES OF EQUIPMENT

### 4.1 DUMP TRUCKS AND OTHER TIPPING VEHICLES

- a) New Dump trucks should be so designed that the tail from one vehicle is not able to enter the cab of another vehicle.

This shall not be achieved by any means which restricts the Operators visibility. e.g. moving the Operators cabin further back.

- b) Extended bumper bars should be considered for some vehicles where they are considered practical. (Can reduce impact injuries and reduce damage to vehicles.)

### 4.2 REAR DUMP VEHICLES ONLY

#### 4.2.1 Warning Devices

A warning device shall be provided in the Operators cabin, to indicate when the rear dump tray is elevated.

The device shall be visual and/or audible, and located such that it is readily noticed by the Operator.

#### 4.2.2 Interlocks

When the rear dump tray is elevated, propulsion in the FORWARD and REVERSE direction shall be inhibited unless:-

##### 4.2.2.1 Mechanical Defeat

The rear dump vehicle is a mechanical drive vehicle that contains the following features which are mechanically linked to the body being raised;

- (i) Drive is limited to FORWARD direction only, and
- (ii) Drive is limited to first gear only.

##### 4.2.2.2 Defeat Switch

A defeat switch is provided to override the propulsion inhibit in the FORWARD direction only.

If installed the defeat switch shall contain the following features;

- (i) When operated and held in position, forward propulsion is possible at low speed only.
- (ii) When released the defeat switch shall automatically return to a position where ALL propulsion is inhibited with the rear dump tray raised.
- (iii) The defeat switch shall not effect the operation of the rear dump tray raised warning device.

The defeat switch shall be located within the ZONE OF COMFORT, as defined in AS 2956.5.

#### 4.2.3 Dump Body Restraint

- a) Rear dump truck shall be provided with a “means” of restraining the dump body when in the raised position for inspection or maintenance.
- b) Power down controls shall be isolated.

- c) This “means” should consist of pins or slings or similar and shall have a minimum safety factor of 2 to 1 when applied to the maximum possible down load (which includes ‘hangup’) which can be exerted on the dump body when the dump body is in the raised position.

#### **4.3 ELECTRICAL REQUIREMENTS**

Refer section 5.4 for electrical requirements for specific types of equipment.

#### **4.4 PERSONNEL VEHICLES**

Personnel vehicles used underground should be fitted with disc brakes. Oil immersed disk brakes are preferable to reduce fire risk.

## SECTION 5 ELECTRICAL REQUIREMENTS

### 5.1 GENERAL

The electrical wiring of all Mobile and Transportable Equipment shall comply with the requirement of this section.

All electrical wiring shall comply with the requirements of AS 3000 and AS 3007.

#### 5.1.1 Safe and Sound Practice.

Equipment shall be installed in accordance with the appropriate requirements of this document and the generally accepted principles of safe, sound and good electrical engineering practice.

#### 5.1.2 Fixing and Supports.

All fixings, fastenings and supports shall be of adequate strength and arranged to protect the wiring and associated electrical equipment from mechanical damage and failure.

#### 5.1.3 General Protection Against Damage

All electrical parts of equipment shall be protected against damage due to:

- mechanical failure,
- rock damage,
- stepping onto components during maintenance,
- exposure to weather,
- water,
- excessive dampness,
- corrosive fumes,
- accumulation of dust/debris,
- steam,
- oil, grease & fuel,
- high temperature,
- or any other circumstances which may damage electrical

#### 5.1.4 Protection of Live Parts.

All live parts shall be arranged so that a short circuit or arcing, either between other live parts or between live parts and other conductive materials, will not take place under the normal conditions of service.

All connections shall be made so that they can not loosen or overheat under normal conditions of service.

#### 5.1.5 Extra Low Voltage

All extra-low voltage wiring shall comply with AS 4242, "Earth-moving machinery and ancillary equipment for use in mines - Electrical wiring systems at extra-low voltage".

### **5.1.6 Trailing Cable Supplied Equipment**

Trailing cable supplied equipment (eg. draglines, drills and electric shovels) shall be wired in accordance with AS 3000 and AS 3007 where there is no conflict with the regulations.

Electrical components on such equipment shall comply with the relevant Australian Standards.

Trailing Cables should be constructed in accordance with AS 1802 or AS 2802.

### **5.1.7 Lithium Batteries**

Lithium battery packs shall be adequately protected against vibration and fretting which may result in a short circuit occurring.

Note: They can explode if a short circuit occurs.

## **5.2 MECHANICAL PROTECTION OF CABLES, CONDUCTORS AND WIRING LOOMS**

### **5.2.1 Wiring - General**

All wiring reticulated about the equipment shall be;

- a) Enclosed in suitable mechanical protection (ie flexible conduit, rigid conduit, or any other suitable substance), and
- b) Arranged and located so as to facilitate regular visual inspections, and
- c) Arranged so it is not in contact with any hot surfaces or harnessed with, fuel lines, brake lines, oil lines, pneumatic lines, hydraulic lines, etc.

Refer appendix B for typical diagrams showing examples of compliance and non-compliance with this clause.

#### **5.2.1.1 Materials In Contact With Wiring**

All materials in contact with or adjacent to any cable, conductor, or its covering shall be shaped so that it will not cause abrasion of the cable, conductor or its covering that could lead to its failure.

#### **5.2.1.2 Maintenance**

Electrical wiring should not be located where it can be damaged during maintenance or repair. (e.g. being struck by falling objects, being walked upon, etc.)

#### **5.2.1.3 Enclosed Wiring**

Wiring enclosed within cabinets, components, junction boxes etc., shall be suitably loomed, harnessed and supported.

#### **5.2.1.4 Wiring Through Walls**

Where wiring is to be threaded through conduits, partition walls, etc., the wiring shall be adequately glanded or bushed, and where wiring protective covering terminates at a partition wall (ie. electrical cabinet etc.) it shall be adequately fixed to the point of termination.

Refer appendix B for typical diagrams showing examples of compliance and non-compliance with this clause.

### **5.2.2 Segregation of Wiring Systems**

Segregation of wiring shall be as follows:

- a) Wiring of fire protection systems shall not be enclosed with wiring of any other system, except for the purpose of termination at the point of supply.

- b) Circuits that are not provided with electrical protection shall be segregated from all other circuits by barriers, conduits etc.

### **5.2.3 Prohibited Connections.**

Unserviceable equipment which is in an unsafe condition shall be isolated and shall not remain connected to the point of supply.

### **5.2.4 Unused Equipment and Cables.**

All redundant parts of electrical equipment and cables shall be completely disconnected from the source of supply and marked, stating the location of the opposite end of the circuit and the status of the interconnecting cable (ie. open circuit, healthy, short circuit etc.).

Disconnected wiring which remains in association with wiring that is in use shall be terminated or insulated and means taken at both ends to prevent inadvertent reconnection.

### **5.2.5 Circuit Diagrams and Manuals.**

Each equipment shall be supplied with an accurate electrical schematic diagram, showing all components and conductor markings. Where plug and socket arrangements are used their location shall be noted on the schematic diagram. Diagrams should include aftermarket components fitted by the Local Supplier.

Manuals shall be supplied with each equipment. The manuals should include the relevant electrical diagrams, parts list, cable schedule, component ratings and a section on recommended maintenance periods and procedures, including safety precautions to be taken.

When any circuit alterations are made the electrical schematic and wiring diagrams shall be updated immediately including unused equipment and cables. (refer clause 5.2.4)

### **5.2.6 Labelling**

#### **5.2.6.1 Circuit Identification.**

At each protective device there shall be placed a label of durable material, securely fastened, indicating the circuit or sub circuit being supplied by that protective device and the rating of that device.

Where this is not practicable each protective device may be identified by a code. A legend plate relating the code to the relevant circuit and the rating of the device shall be placed in a conspicuous position and be made of a durable material. Any such coding system shall be clearly shown on the electrical schematic and wiring diagrams.

It is recommended labels, legend plates etc. are suitably fastened by reliable methods (eg, screws, pop rivets, etc).

#### **5.2.6.2 Cable Marking**

Each conductor shall be marked at every point of termination in accordance with the equipment electrical schematic diagram. The marking shall be of a durable material that is easily cleaned.

## **5.3 EMERGENCY STOP DEVICE**

### **5.3.1 General**

Emergency stop controls shall be provided and shall include the following features:

- a) An emergency stop shall be initiated by pushing a large red button.
- b) Be of the manually operated, automatic lock-off manual reset type.

- c) On activating the emergency stop device, the device shall latch either electrically or mechanically, such that the actuation can only be reversed by a deliberate action, the equipment shall not restart automatically.
- d) The circuit shall be designed fail safe (i.e. not need power to shut down the engine), and otherwise protected from faults that may defeat the operation of the facility.
- e) Be capable of being operated with minimal effort without danger to the Operator
- f) Be designed such that the operation of the emergency stop is a deliberate action.

### **5.3.2 Identification**

Identification of emergency stop devices shall be in accordance with AS 2956.4 or in accordance with the principles of AS 1318 and AS 1319.

They shall be clearly marked "EMERGENCY STOP" and in accordance with AS 1319.

### **5.3.3 Location**

Emergency stops shall be located as follows:

- a) In the Operators cabin, and located within the ZONE OF REACH, as defined in AS 2956.5 and located so as to minimise the risk of inadvertent operation.
- b) In the vicinity of the normal boarding point onto the equipment, and located such that both large and small Operators can reach the device from a position on the ground at the boarding point.

These stops shall not be located in front of outblowing fans or airflows. (may direct fire to control point).

### **5.3.4 Emergency Circuits**

Circuits installed to supply devices that are to be used in an emergency shall be dedicated for that purpose. Electrical protection devices such as fuses, circuit breakers etc. may be undesirable in such circuits.

If no electrical protection is provided then alternative precautions to minimise the risk of a fault occurring in the circuit shall be taken. Such alternatives should include but be not limited to:

- Total segregation,
- Additional physical protection,
- Oversizing of cables and components,
- Increased creepage and clearance distances,
- Increased thermal withstand, etc.

## **5.4 GENERAL ARRANGEMENT, CONTROL & PROTECTION**

### **5.4.1 General**

The general arrangement, control and protection of circuits and equipment shall be such that the installation safely operates with regard to the following:-

- a) Selection of cables.
- b) Arrangement and functionality of circuits.
- c) Control of circuits by suitable switching arrangements.

- d) Protection of circuits from overload and short circuit conditions.
- e) Selection, design and location of switches and ancillary equipment normally used on equipment.
- f) Operation and arrangement of switches, push buttons or other devices shall be such that their inadvertent operation shall not cause any danger to equipment operators or equipment.
- g) Where electrical protective devices or circuits are required not to disconnect the electrical supply in order to prevent loss of control of the equipment, a warning device shall be located in the Operator's cabin to warn the Operator of a malfunction.

#### **5.4.2 Circuit Protection**

It is not always practicable or desirable to protect certain circuits with electrical protective devices. Where this is the case, additional precautions shall be taken to minimise the risk of the circuit failing.

These additional precautions shall include but be not limited to:

- a) Additional mechanical protection.
- b) Suitable location.
- c) Adequate harnessing and support.
- d) Segregation from other circuits, energy sources, fuels, etc.
- e) Oversizing of cables and components.

In summary use the increased safety philosophy.

#### **5.4.3 Size & Type of Cables & Conductors**

##### **5.4.3.1 General**

Cables shall be selected having due regard to the following criteria.

- a) The current-carrying capacity as determined from the cable insulant, and installation methods.
- b) Voltage drop.
- c) Short circuit performance as determined from the characteristics of the protective device .
- d) Mechanical strength.

All cables that reticulate about the equipment shall be enclosed in conduit or other protective measures of adequate strength which is oil, water and fuel resistant.

##### **5.4.3.2 Current Carrying Capacity**

Every cable shall have a current carrying capacity not less than the maximum load current to be carried by it, and shall be capable of carrying the expected currents under both normal and abnormal conditions. Normal conditions may include increased ambient temperature. (eg. Inside engine bays cables may need to be derated.)

#### **5.4.4 Current Rating of Control Devices**

Every switch, fuse, push button, circuit breaker etc., shall have a current rating not less than the maximum demand of the circuit it controls.

#### **5.4.5 Voltage Rating of Components**

Every switch, fuse, push button, circuit breaker etc., shall have a voltage rating not less than the maximum voltage of the circuit.

#### **5.4.6 Current Rating of Protective Devices**

Protective devices shall be arranged so as to automatically disconnect the active conductors of a circuit in the event of an overload or a short circuit or both. These devices shall be provided to interrupt any over-current flowing in the circuit before any damage is caused by thermal effects. Circuit breakers shall not be automatic reset devices.

Current rating of the protective device shall be not more than current carrying capacity of connected cable.

#### **5.4.7 Requirements for Specific Types of Equipment**

Rear Dump Trucks only shall in addition to the above comply with the following :

- a) SAE J1317 - 'Electric Propulsion Rotating Equipment - Off Road Dumpers'
- b) SAE J1299 - 'Electric Propulsion Control - Off Road Dumpers'
- c) Enclosures containing electrical components, and electrical components shall comply with the relevant Australian Standards.
- d) The minimum degree of protection against access to live parts shall be IP2X as defined in AS 1939, 'Degree of Protection Provided by Enclosures for Electrical Equipment (IP Code)'.

It should be realised that for maintainability and ease of cleaning, enclosures and devices may need to be rated as high as IP57. The customer/user should take this into consideration when specifying their requirements.

#### **5.4.8 Warnings / Indications in the Operators Cabin.**

Indication shall be provided to the Operator of any malfunction on the equipment that may cause loss of control or serious damage to the equipment, so as to allow the equipment to be brought safely to rest. i.e. Ground fault alarm, overspeed etc.

#### **5.4.9 Electric Drive Loaders Only – Propulsion Systems**

The system shall provide adequate control and safety features to ensure that, when operated as designed, the risk of malfunction is minimised and that the risk of injury to Operators or damage to the equipment is minimised.

## SECTION 6 APPENDICES

### 6.1 APPENDIX A – ASSOCIATED STANDARDS

#### 6.1.1 Appendix A1 – Australian Standards

The following is a list of Australian Standards and their ISO equivalents as of 11 January 2001.

Australian Standard (AS)	Title	Equivalent	ISO No. and Year	Current ISO edition
1101.1	Graphic symbols for general engineering - Hydraulic and pneumatic systems		ISO 1219.1	
1180	Methods of test for hose made from elastomeric materials		1817 1818 1400	
1200 – 2000	Pressure equipment			
1210 - 1997	Pressure Vessels			
1269.0 - 1998	Occupational noise management – Overview			
1269.1 - 1998	Occupational noise management - Measurement and assessment of noise immission and exposure			
1269.2 - 1998	Occupational noise management - Noise control management			
1269.3 - 1998	Occupational noise management – Hearing protector program			
1269.4 - 1998	1998 Occupational noise management - Auditory assessment			
1318 -1985	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) (incorporating Amdt 1)			
1319 -1994	Safety signs for the occupational environment			
1418.1-1994	Cranes (including hoists and winches) - General requirements			
1530	Methods for fire tests on building materials, components and structures		5657	

Australian Standard (AS)	Title	Equivalent	ISO No. and Year	Current ISO edition
1636	Tractors, roll over protective structures – Criteria and tests		3463: 1989 5700: 1989	Amd.1 1998
1636.1 – 1996	Conventional tractors			
1636.2 – 1996	Rear mounted tractors			
1636.3 – 1996	Mid-mounted for narrow track tractors			
1657 - 1992	Fixed, platforms, walkways, stairways and ladders			
1755 - 2000	Conveyors – Safety requirements			
1851	Maintenance of fire protection equipment			
1939 -1990	Degrees of protection provided by enclosures for electrical equipment (IP Code)			
2012	Acoustics—Measurement of airborne noise emitted by earth-moving machinery and agricultural tractors—Stationary test condition			
2012.1—1990	Determination of compliance with limits for exterior noise	identical	6393:1990	1998
2012.2—1990	Operators Position	identical	6394:1990	1998
2294	Earth-moving machinery—Protective structures		NA	
2294.1—1997	General		NA	
2294.2—1997	Laboratory tests and performance requirements for roll-over protective structures	identical	3471:1994	1994 Amd. 1:1997 Cor. 1:2000
2294.3—1997	Laboratory tests and performance requirements for falling-object protective structures	identical	3449:1992	
2294.4—1997	Specifications for deflection-limiting volume	identical	3164:1995	
2359.1 - 1995	Powered industrial trucks – General requirements			
2359.2 - 1985	Industrial trucks (known as the SAA Industrial Truck Code) - Operation			
2359.3-1995	Powered industrial trucks - Counterbalanced fork-lift trucks - Stability tests		1074	
2359.4-1995	Powered industrial trucks - Reach and straddle fork-		3184	1998

Australian Standard (AS)	Title	Equivalent	ISO No. and Year	Current ISO edition
	lift trucks - Stability tests			
2359.5-1995	Powered industrial trucks - Control symbols		3287	1999
2359.6-1995	Powered industrial trucks - Safety code		3691	1980
2359.7-1995/Amdt 1-1997	Powered industrial trucks - Terminology			
2359.8-1995	Powered industrial trucks - Pallet stackers and high-lift platform trucks - Stability tests		5766	1990
2359.9-1995	Powered industrial trucks - High-lift rider trucks - Overhead guards - Specification and testing		6055	1997
2359.10-1995	Powered industrial trucks - Fork-lift trucks - Hook-on type fork arms - Vocabulary			
2359.11-1995	Powered industrial trucks - Fork-lift trucks - Hook-on type fork arms and fork carriers - Mounting dimensions		2328	1993
2359.12-1996	Powered industrial trucks - Hazardous areas			
2550.1-1993	Cranes - Safe use - General requirements			
2660-1991	Hose and hose assemblies - Air/water - For underground coal mines			
2664—1983	Earth-moving machinery—Seat belts and seat belt anchorage's	based on	6683:1981	1981 Amd.1:1998
2670.1 - 2001	Evaluation of human exposure to whole-body vibration - General requirements		2631-1	1997
2671 - 1983	Fluid power, hydraulic systems and components		4413	1998
2868—1986	Classification of machinery for earth-moving, construction, surface mining and agricultural purposes		NA	
2951	Earth-moving machinery—Nomenclature		NA	
2951.0—1988	General introduction and listing		NA	
2951.1—1988	Basic types	identical	6165:1987	1997
2951.2	Dimensions and symbols		NA	
2951.2.1—1988	Base machine	identical	6746-1:1987	
2951.2.2—	Equipment	identical	6746-2:1987	

Australian Standard (AS)	Title	Equivalent	ISO No. and Year	Current ISO edition
1988				
2951.3—1988	Tractors	identical	6747:1982	1998
2951.4—1988	Loaders—Terminology and commercial specifications	identical	7131:1984	1997
2951.5—1988	Dumpers—Terminology and commercial specifications	identical	7132:1984	1990
2951.6—1988	Tractor-scrapers—Terminology and commercial specifications	identical	7133:1985	1994
2951.7—1988	Graders—Terminology and commercial specifications	identical	7134:1985	1993 Amd. 1:1996

2952	Earth-moving machinery—Basic shapes and dimensions		NA	
2952.0—1988	General listing and introduction		NA	
2952.1—1988	Dimensions of fuel filler opening	identical	3541:1985	Withdrawn
2952.2—1988	Drain, fill and level plugs	identical	6302:1986	1993
2952.3—1988	Lubrication fittings—Nipple type	identical	6392:1980	6392-1:1996
2952.4—1988	Tractors with dozer, graders, tractor-scrapers—Cutting edges	identical	7129:1982	1997
2952.5—1988	Plough bolt heads	identical	7852:1983	
2952.6—1988	Dozer end-bits—Hole specification	identical	7891:1984	Withdrawn

2953	Earth-moving machinery—Human dimensions		NA	
2953.0—1988	General introduction and listing		NA	
2953.1—1988	Minimum access	identical	2860:1983	1992
2953.2—1988	Physical dimensions of operators and minimum operator space envelope	identical	3411:1982	1995
2953.3—1988	Seat index point	identical	5353:1978	1995

2954	Earth-moving machinery—rated loads and volumetric ratings		NA	
2954.0:1988	General introduction and listing		NA	
2954.1—1988	Rated operating loads for crawler and wheel loaders	identical	5998:1986	
2954.2—1988	Dumper bodies—volumetric rating	identical	6483:1980	
2954.3—1988	Elevating scrapers—Volumetric ratings	identical	6484:1986	
2954.4—1988	Tractor scraper—volumetric rating	identical	6485:1980	
2954.5—1988	Loader and front loading excavator buckets—volumetric rating	identical	7546:1983	
2954.6—1988	Hydraulic excavators—Hoe type buckets—	identical	7451:1983	1997

Australian Standard (AS)	Title	Equivalent	ISO No. and Year	Current ISO edition
	volumetric ratings			Cor.1:1998

2955	Earth-moving machinery—Tests and measurements		NA	
2955.0—1988	General introduction and listing		NA	
2955.1—1988	Measurement of tool movement time	identical	5004:1981	Withdrawn
2955.2—1988	Method for locating the centre of gravity	identical	5005:1977	
2955.3—1988	Determination of ground speed	identical	6014:1986	
2955.4—1988	Hydraulic excavators—measurement of tool forces	identical	6015:1986	6015:1989
2955.5—1988	Measurement of the masses of whole machines, their equipment and components	identical	6016:1982	1998
2955.6—1988	Operators seat—Transmitted vibration	identical	7096:1982	2000
2955.7—1988	Measurement of the dimensions of whole machines with their equipment	identical	7128:1983	Withdrawn
2955.8—1988	Measurement of turning dimensions of wheeled machines	identical	7457:1983	1997
2955.9—1988	Measurement of drawbar pull	identical	7464:1983	
2955.10—1988	Loaders—Measurement of tool forces and tipping loads	identical	8313:1986	1989

2956	Earth-moving machinery—instrumentation and operators controls			
2956.0—1988	General introduction and listing		NA	
2956.1—1988	Excavators—Operator's controls	identical	4557:1982	Withdrawn
2956.2—1988	Operating instrumentation	identical	6011:1987	
2956.3—1988	Service instrumentation	identical	6012:1982	1997
2956.4—1988	Symbols	identical	6405:1982	6405-1:1991 Amd. 1:1997 Amd. 2:1999 6405-2:1993 Amd 1:
2956.5—1988	Zones of comfort and reach for controls	identical	6682:1986	Amd. 1:1989
2956.6—1988	Crawler tractors and crawler loaders—Operator's controls	identical	7095:1982	Withdrawn

2957	Earth-moving machinery—Operation and maintenance			
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Australian Standard (AS)	Title	Equivalent	ISO No. and Year	Current ISO edition
2957.0—1988	General introduction and listing		NA	
2957.1—1988	Common maintenance and adjustment tools	identical	4510-1:1987	
2957.2—1988	Common repair tools—Mechanical pullers and pushers	identical	4510-2:1986	1996
2957.3—1988	Preservation and storage	identical	6749:1984	
2957.4—1984	Format and content of manuals	identical	6750:1984	
2957.5—1988	Guide to procedure for operator training	identical	7130:1981	
2957.6—1988	Training of mechanics	identical	8152:1984	
2958	Earth-moving machinery—safety			
2958.0—1988	General introduction and listing		NA	
2958.1—1995	Wheeled machines—Brakes	based on	3450:1985	1996
2958.2—1988	Guards and shields—Definitions and specifications	identical	3457:1986	
2958.3—1992	Roller compactors—Brake systems		NA	
3000 - 2000	Electrical installations (known as the Australian/New Zealand Wiring Rules)			
3007.1 -1987	Electrical installations - Surface mines and associated processing plant - Scope and definitions			
3007.2 -1987	Electrical installations - Surface mines and associated processing plant - General protection requirements			
3007.3 -1987	Electrical installations - Surface mines and associated processing plant - General requirements for equipment and ancillaries			
3007.4 -1987	Electrical installations - Surface mines and associated processing plant - Additional requirements for specific applications			
3007.5 -1987	Electrical installations - Surface mines and associated processing plant - Operating requirements			
3788 -2001	Pressure equipment - In-service inspection			
3791 - 1995	Hydraulic hose			
3868—1991	Earth-moving machinery—Design guide for access systems	based on	2867	1994
3873-2001	Pressure equipment - Operation and maintenance			

Australian Standard (AS)	Title	Equivalent	ISO No. and Year	Current ISO edition
3892-2001	Pressure equipment - Installation			
3931 - 1998	Risk analysis Risk analysis of technological systems - Application guide			
4024.1 - 1996	Safeguarding of machinery – General principals			
4024.2 - 1998	Safeguarding of machinery – Installation and commissioning requirements for electro-sensitive systems - Optoelectronic devices			
4343 - 1999	Pressure equipment - Hazard levels			
4242—1994	Earth-moving machinery and ancillary equipment for use in mines—Electrical wiring systems at extra-low voltage		NA	
4360 - 1999	Risk Management			
4457—1997	Earth-moving machinery—Off-highway rims and wheels—Maintenance and repair		NA	
4987 - 2002	Earth –moving machinery – Tip-over protective structure (TOPS) for compact excavators – Laboratory tests and performance requirements		ISO 12117:1997	
4988 - 2002	Earth –moving machinery – Hydraulic excavators – Laboratory tests and performance requirements for operator protective guards		ISO 10262:1998	
A176—1968 Reconfirmed 1989	Tynes for motor grader scarifiers		NA	
	Rubber hoses and hose assemblies for underground mining - Wire-reinforced hydraulic types for coal mining - Specification		ISO 6805:1994	

**Notes:**

- a) A blank space in the Current ISO edition column indicates that the edition upon which the Australian Standard was based, is still the CURRENT ISO Standard
- b) The letters NA in the ISO No and Year column indicate that there is no ISO Standard. ie the Australian Standard was developed here.

- c) A year eg 1998, in the Current ISO edition column indicates that the edition upon which the Australian Standard was based, has been SUPERSEDED by a later edition. The year indicates the year the most recent edition was published.
- d) An ISO Standard number and year, eg 6392-1:1996, indicates that both the ISO number and the edition have been superseded by the number and year shown. This occurs when it is felt that the content needed to be split into two or more Parts, or more Parts were needed

**6.1.2 Appendix A2 – ISO Standards With No Australian Equivalent**

ISO No.	Title
ISO 5006-1: 1991	Earth-moving machinery; operator's field of view; part 1: test method
ISO 5006-2: 1993	Earth-moving machinery; operator's field of view; part 2: evaluation method
ISO 5006-3: 1993	Earth-moving machinery; operator's field of view; part 3: criteria
ISO 5660-1: 1993	Fire tests; reaction to fire; part 1: rate of heat release from building products (cone calorimeter method)
ISO 6805:1994	Rubber hoses and hose assemblies for underground mining - Wire-reinforced hydraulic types for coal mining - Specification
ISO 7751:1991	Rubber and plastics hoses and hose assemblies; ratios of proof and burst pressure to design working pressure

Australian and ISO standards are available through Standards Australia, ([www.standards.com.au](http://www.standards.com.au))

**6.1.3 Appendix A3 – Department of Mineral Resources Publications**

- MDG 1 Guideline for Free Steered Vehicles – For Underground Use in Coal Mines
- MDG 1010 Risk Management Handbook for the Mining Industry – May 1997
- MDG 1013 System Safety Techniques: Job Steps, Conditions and Hazard Control Planning
- MDG 1014 Guide to Reviewing a Risk Assessment of Mine Equipment and Operations.

## 6.1.4 Appendix A4 - SAE Standards

### SAE Automotive Standards

SAE No.	Title
<b>Operator Protection</b>	
J1040	Performance Criteria For Roll-over Protection Structures (ROPS) For Construction, Earthmoving, Forestry and Mining Machinery.
J1164	Labelling of ROPS and FOPS.

### Brakes and Performance

J53	Minimum performance criteria for steering of wheeled earthmoving construction machines
J880	Brake system rating test code-commercial vehicles.
J897	Machine slope operation test code
J950	Gradeability test code.
J982	Test Code-truck, truck - tractor, and trailer air service brake system pneumatic pressure and time levels.
J992	Brake system performance requirements, truck, bus and combination of vehicles.
J1026	Braking performance - in service crawler tractors and crawler loaders(A)
J1029	Lighting and marking of Construction and Industrial Machinery.
J1136	Braking performance - roller compactors(A)
J1152	Braking performance - rubber-tired construction machines.
J1450	Air brake actuator diaphragm test procedure.
J1469	Air brake actuator test procedure - truck-tractor, bus and trailer.
J1472	Braking performance - roller compactors.
J1473	Braking performance - rubber-tired earthmoving machines.

### Electrical

J1317	Electrical Propulsion Rotating Equipment—Off-Road Dumper
J1299	Electrical Propulsion Control—Off-Road Dumpers

### SAE Aerospace Standards

SAE AS1339	Hose Assembly, Polytetrafluoroethylene, Metallic Reinforced, 3000 psi, 400 °F, Lightweight, Hydraulic and Pneumatic
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**Note:** SAE standards are available through Standards Australia, ([www.standards.com.au](http://www.standards.com.au)) or directly through Society of Automotive Engineers U.S.A. on ([www.sae.org](http://www.sae.org))

## 6.2 APPENDIX B – ELECTRICAL WIRING DIAGRAMS

### 6.2.1 Examples of Compliance – General Wiring

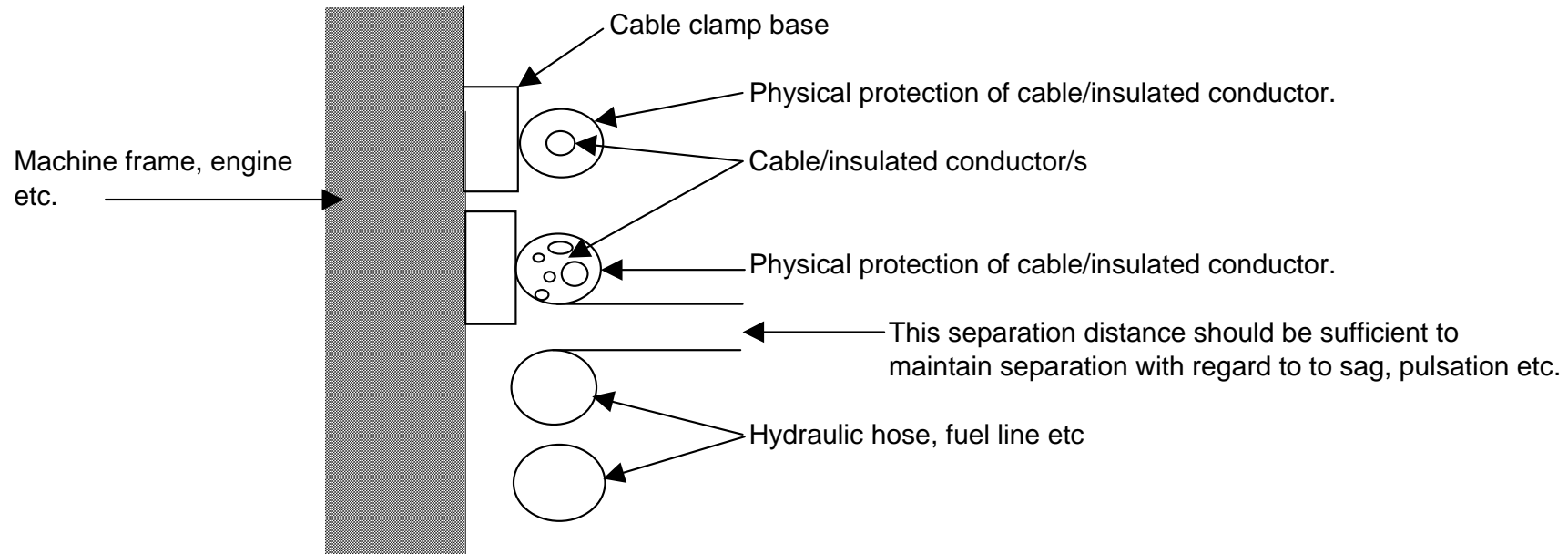


Figure 6.1 – Example of Compliance With 'Wiring – General'

6.2.2 Examples of Compliance (With Qualification) – General Wiring

With electrical wiring and hoses located in this position the inspections are more difficult to do and combustible materials may collect around wiring and hoses. Where there is intimate contact with hot surfaces, hoses, electrical wiring and its protection needs to have the appropriate thermal rating.

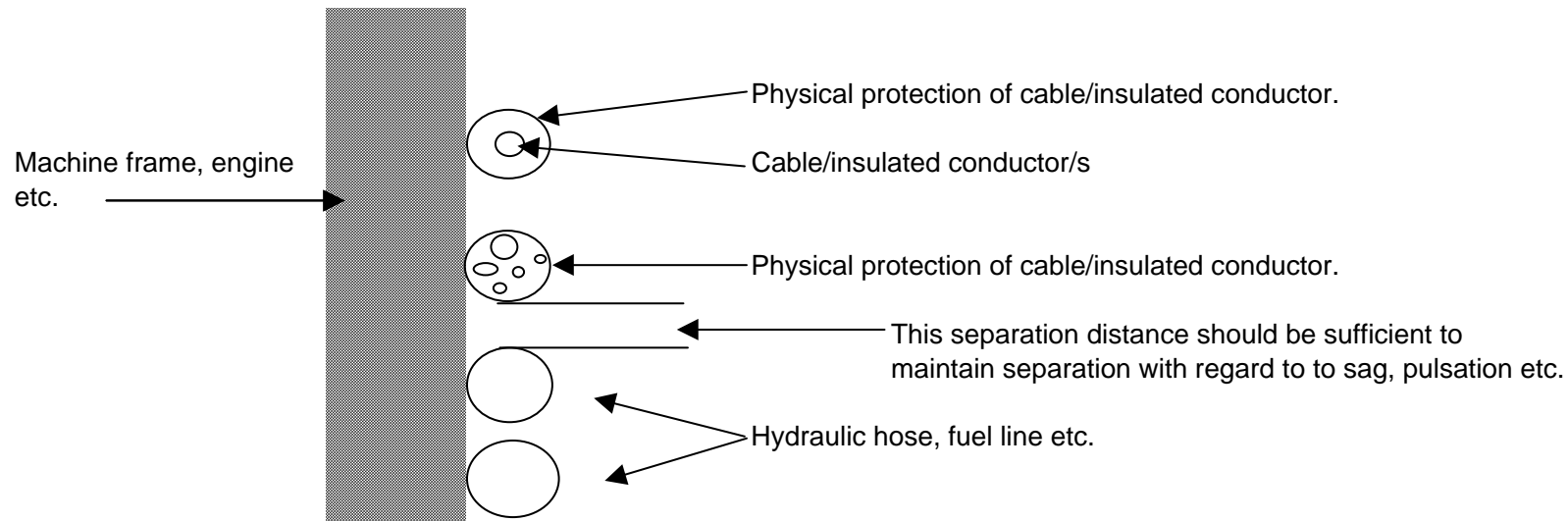


Figure 6.2 – Example of Compliance (With Qualification) With ‘Wiring – General’

With electrical wiring and hoses located in this position the inspections are more difficult to do and combustible materials may collect around wiring and hoses. Where there is intimate contact with hot surfaces, hoses, electrical wiring and its protection needs to have the appropriate thermal rating.

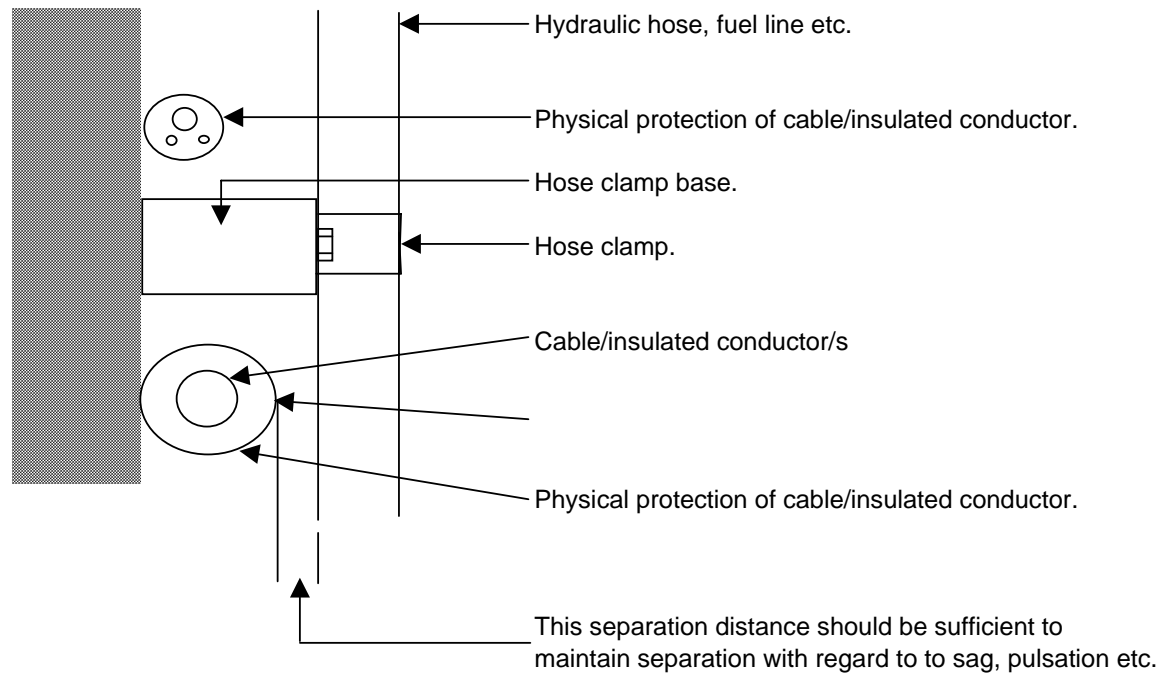


Figure 6.3 – Example of Compliance (With Qualification) With ‘Wiring – General’

### 6.2.3 Does Not Comply With General Wiring

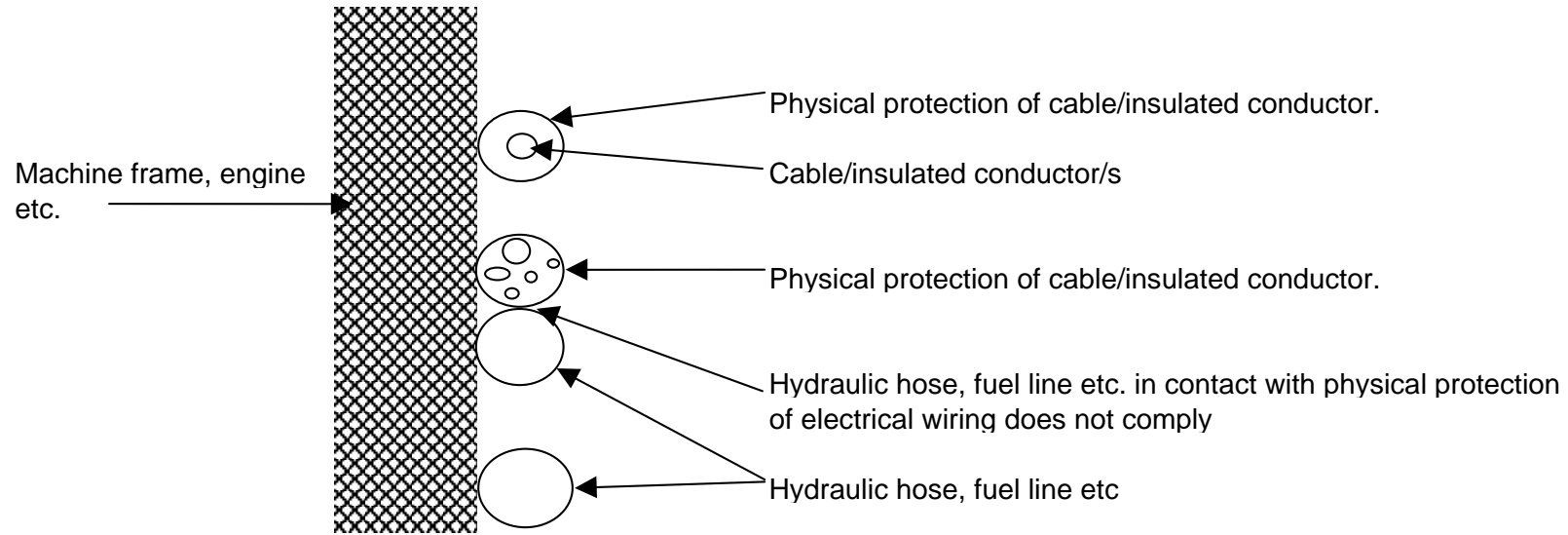


Figure 6.4 – Example of Does Not Comply With 'Wiring – General'

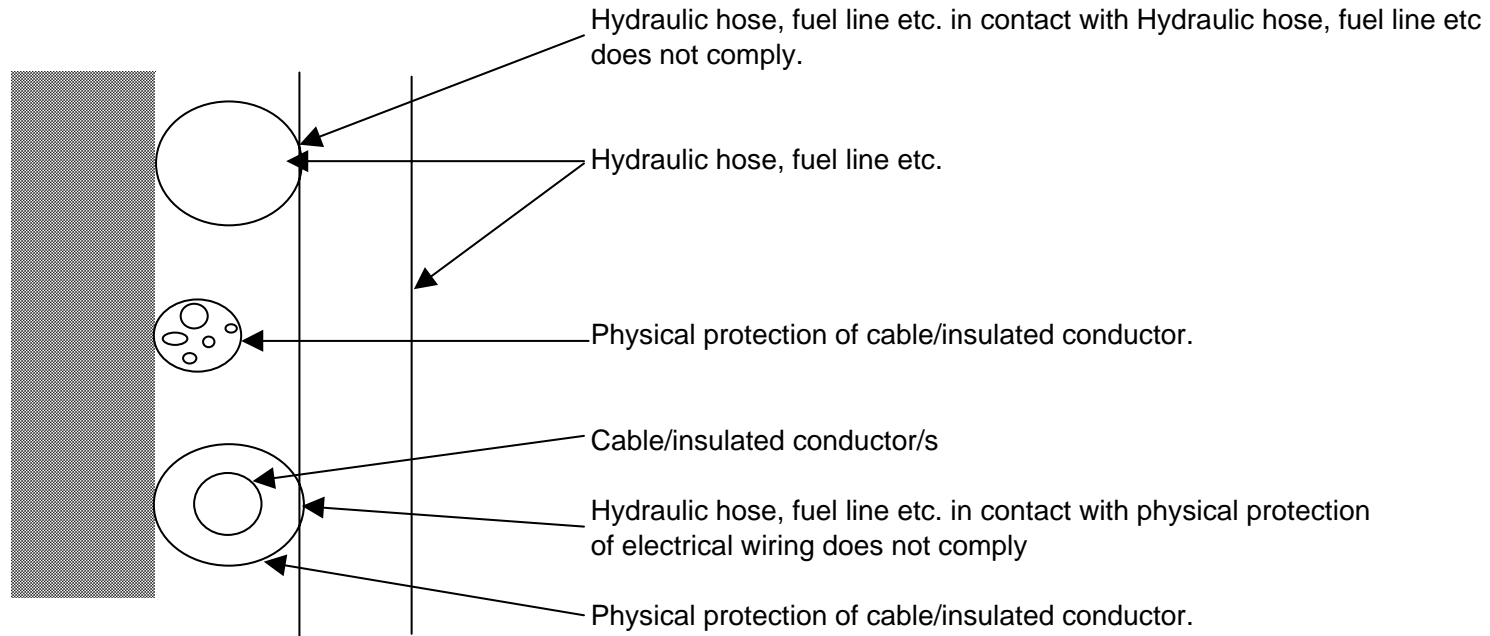


Figure 6.5 – Example of Does Not Comply With, 'Wiring – General'

### 6.2.4 Example of Compliance and Non-Compliance With 'Wiring Through Walls'

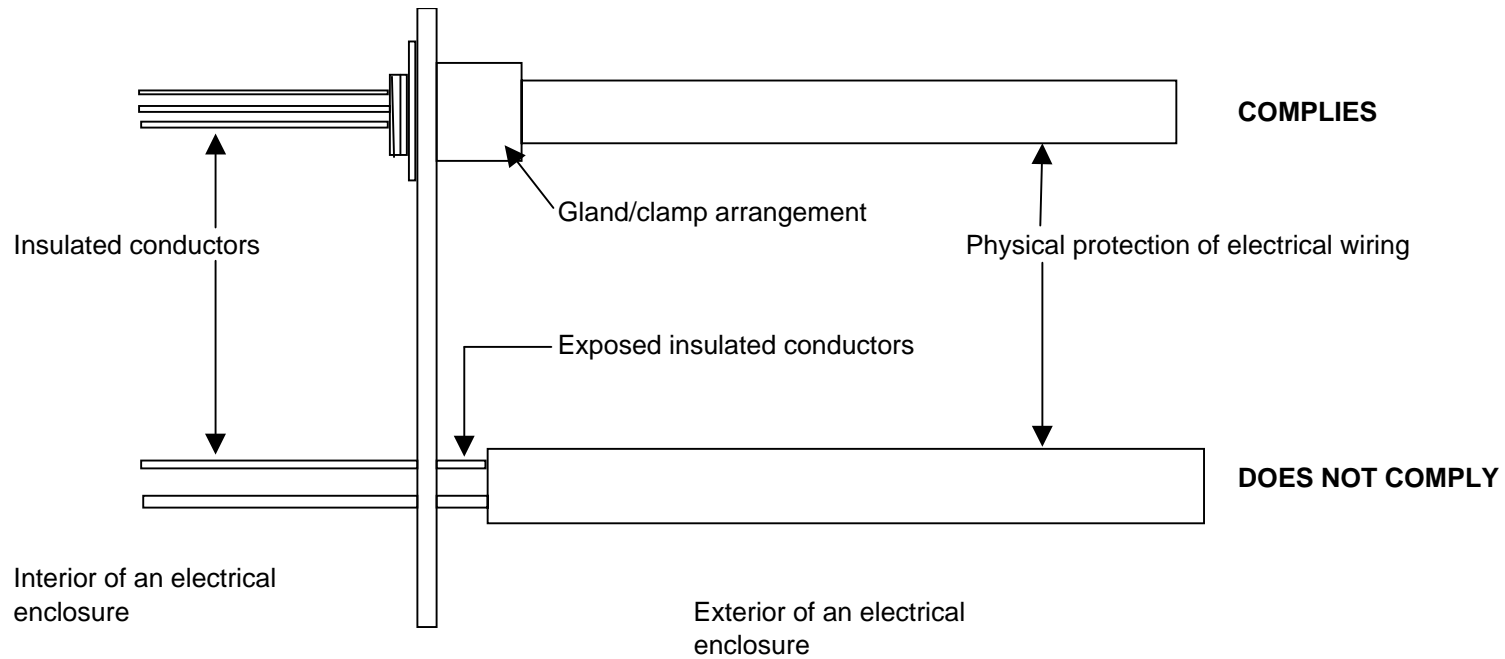


Figure 6.6 – Example of Compliance and Non-Compliance 'Wiring Through Walls'

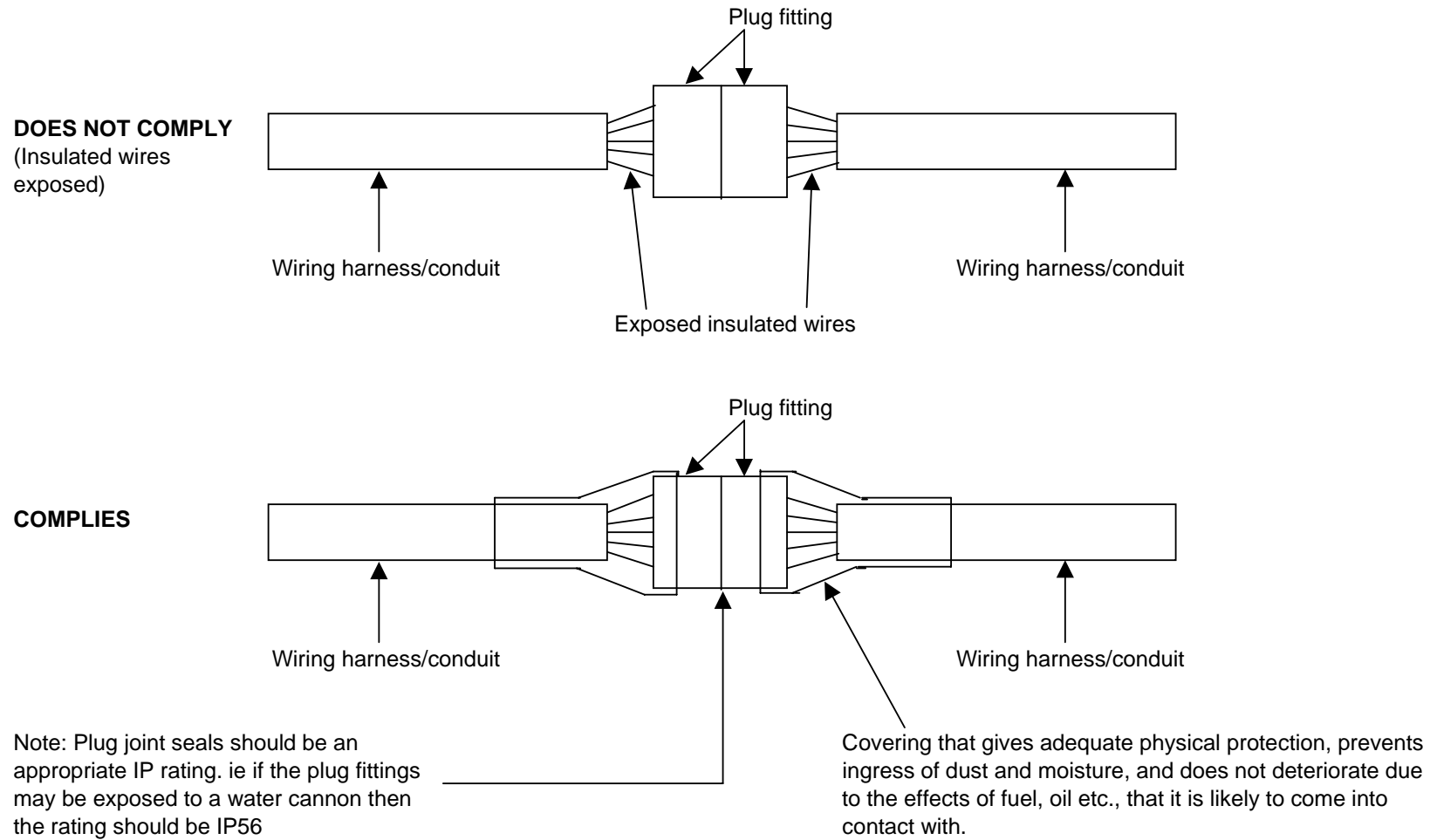


Figure 6.7 – Example of Compliance and Non-Compliance With ‘Wiring Through Walls’

### **6.3 APPENDIX C - LEGISLATION**

For N.S.W. mining the following legislation applies:

- a) Occupational Health and Safety Act, 2000,
- b) Coal Mines Regulations Act 1982,
- c) Mines Inspection Act 1901
- d) Coal Mines (General) Regulation 1999
- e) Coal Mines (Open Cut) Regulation 1999
- f) Mines Inspection General Rule 2000

All electrical and mechanical apparatus must comply with the requirements of these regulations.

Note: The Chief Inspector may from time to time vary the legislative requirements of the above regulations. These are published in the N.S.W. Government Gazette.

Manufacturers, Purchasers, Owners, Operators and Site Contractors should ensure Gazette Notices are complied with where applicable.

**6.4 APPENDIX D – FEEDBACK SHEET**

**FEEDBACK SHEET – MDG15 2001**

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:

Senior Inspector of Mechanical Engineering  
Mine Safety Operations  
NSW Department of Primary Industries  
PO Box 344  
Hunter Region Mail Centre NSW 2310  
Fax: (02) 4931 6790

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

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**What do you find most useful about the Guideline?**

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**What do you find least useful?**

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**Do you have any suggested changes to the Guideline?**

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Thank you for completing and returning this Feedback Sheet