

Australian/New Zealand Standard™

**Electrical equipment for mines and  
quarries**

**Part 4: Mains powered electrical mobile  
machines**



## **AS/NZS 4871.4:2010**

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee EL-023, Electrical Equipment in Mines and Quarries. It was approved on behalf of the Council of Standards Australia on 13 April 2010 and on behalf of the Council of Standards New Zealand on 23 April 2010.

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The following are represented on Committee EL-023:

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Australian Coal Association  
Australian Industry Group  
Aviation and Marine Engineers Association, New Zealand  
Department of Mines and Energy, Qld  
Department of Primary Industries, Mineral Resources, NSW  
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**Part 4: Mains powered electrical mobile  
machines**

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## PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-023, Electrical Equipment in Mines and Quarries, to supersede AS/NZS 4871.4:2002, *Main powered electrical mobile machines*.

The objective is to set out requirements for the design, construction and testing of electrical powered mobile machines for use in mines and quarries.

This Standard is Part 4 of the series AS/NZS 4871, *Electrical equipment for mines and quarries*.

The AS/NZS 4871 series comprises the following parts:

Part 1: General requirements

Part 2: Distribution, control and auxiliary equipment

Part 3: Substations

Part 4: Main powered electrical mobile machines (this Part)

Part 5: Battery powered electrical mobile machines

Part 6: Diesel powered machinery and ancillary equipment

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**Australian/New Zealand Standard**  
**Electrical equipment for mines and quarries**

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## Part 4: Mains powered electrical mobile machines

## SECTION 1 SCOPE AND GENERAL

**1.1 SCOPE**

This Standard specifies requirements for the design, construction and testing of electrical powered mobile machines used in association with mining and quarrying activities.

**1.2 APPLICATION**

All mains powered mobile machines shall comply with the requirements of AS/NZS 4871.1 and the requirements of this Standard.

**1.3 REFERENCED DOCUMENTS**

The following documents are referred to in this Standard:

AS/NZS	
4240	Remote control systems for mining equipment (series)
4871	Electrical equipment for coal mines, for use underground
4871.1	Part 1: General requirements

**1.4 DEFINITIONS**

For the purpose of this Standard the definitions in AS/NZS 4871.1 apply.

**1.5 EXISTING EQUIPMENT**

In recognition of changes made to this edition of this Standard, existing equipment should be assessed for risk and interim control measures should be implemented where necessary.

Compliance improvements should be made within a time frame that takes into consideration the associated risk levels.

## SECTION 2 COMMON REQUIREMENTS

### 2.1 GENERAL

Machines and accessories shall be of rugged construction and be designed in a manner that will facilitate inspection and maintenance. They shall be well constructed, based on sound engineering principles and suitable for their intended use.

### 2.2 ELECTRICAL ISOLATION

Every machine shall be provided with an isolating facility by means of which all power to the machine can be isolated for the purpose of carrying out electrical work.

The main switching device shall be manually operated and capable of being locked in the isolated position.

The isolator shall be either in a separate compartment or remote from the machine to isolate the supply cable.

The main isolating device shall isolate all electrical circuits within the confines of the machine unless such circuits are ELV or for equipment operating in hazardous areas, all circuits are classified as intrinsically safe.

### 2.3 ISOLATION FOR MECHANICAL MAINTENANCE

Every machine shall be equipped with an isolating device by means of which all power to the machine can be isolated for the purposes of carrying out non-electrical work on the machine. The main isolating device shall isolate all electrical power circuits that may effect movement.

On the load side of the isolating device, functional switching devices may be used for individual drives or groups of drives.

### 2.4 LIGHTING SYSTEMS

Machines shall be provided with a lighting system that is appropriate for the machines operation.

### 2.5 AUTOMATIC GAS MONITORING SYSTEM

Where an explosive gas monitoring system is provided, the following requirements and recommendations apply:

- (a) The trip mechanism should isolate the power supply to the machine.
- (b) The monitor should give a visual warning that a predetermined concentration of explosive gas has been reached.
- (c) The monitor should be configured to cease operation of parts of the machine when the explosive gas concentration setpoint has been reached.
- (d) A lockout mechanism that will prevent the restoration of power to a machine until the trip mechanism is reset should be fitted. Following an explosive gas trip it should not be possible to apply power to the machine until the explosive gas concentration has fallen to safe levels.
- (e) There should be a visual indication of the gas level.

- (f) A system to override the trip mechanism may be provided to allow the safe withdrawal of the machine for repair and maintenance. Only functions necessary for the safe withdrawal shall be enabled.
- (g) Access to the override or reset mechanism should be restricted to authorised personnel.

NOTES:

- 1 The relevant regulatory authority may require gas monitoring systems to be fitted to the machine.
- 2 Some regulatory authorities may require audible and visual warning when a predetermined gas level is reached.

## **2.6 MACHINE CONTROLS**

### **2.6.1 General**

Controls on all machines shall be located so they are within easy reach of the operator.

Consideration should be given to sound ergonomic principles for location and means of operation.

Where dual-driving cabs are fitted to machines, a control direction device shall be fitted and set to give control to one driving cab and to immobilize the controls in the second driving cab.

Where two or more machines are connected together to operate in tandem—

- (a) one machine shall be the master from which all controls (for all machines) are to be centralized—other controls not required for safety shall be neutralized;
- (b) the control system shall be designed to fail-to-safety; and
- (c) the emergency braking in each machine shall operate all machines connected in tandem.

Where more than one control station is fitted to a machine, or where multiple machines are connected together, the operating logic between each of the control stations shall be subject to a risk management process.

### **2.6.2 Emergency stop device**

Machines shall have an accessible emergency stop device(s) located for easy access during all modes of operation.

Emergency stop devices shall comply with the requirements of AS/NZS 4871.1.

### **2.6.3 Dead man control**

Where 'dead man control' is required its operation shall stop travel movement and bring the machine safely to rest. The dead man system shall be subject to functional safety analysis, refer to AS/NZS 4871.1.

### **2.6.4 Reversing alarm**

Reversing alarms are required, except for machines generally driven equally in both directions. Reversing alarms shall be audible and sound continuously while the vehicle is in reverse mode. In addition, visual alarms may be required, based on a risk management process.

### **2.6.5 Pre-start alarms**

A pre-start alarm shall be fitted and operate prior to machine starting. The alarm shall be audible and sound for a time determined by a risk management process before any movement occurs. Other audible alarms may be required to indicate hazardous movement subject to risk management process. In addition visual alarms may be required based on a risk management process.

Pre-start warning alarms shall be operational regardless of what form of control has been selected.

## **2.7 MACHINE SAFETY INTERLOCKS**

### **2.7.1 General**

The following interlocks are not all required on all machines, but the information provides a guide to what may be required on individual machines. The need for any particular safety interlock shall be determined by risk management process.

### **2.7.2 Doors**

Where driver compartments are fitted with hinged access doors, an interlocking device shall be fitted to stop the machine movement while the doors are open, and apply the brakes to prevent machine 'run away'.

### **2.7.3 Water flow**

Where a flow of water is required, e.g. dust suppression, pick ignition and cooling, a flow monitoring device shall be fitted to prevent machine operation unless a predetermined flow of water is available on the machine.

NOTE: Some machines may require a pressure switching device in addition to the above.

### **2.7.4 Roof bolting**

Where a machine is fitted with roof bolting equipment, an interlocking device shall be fitted to stop all hazardous movements of the machine before the roof bolting can commence or to stop the roof bolting when machine movement is required. This switching device shall be within easy reach of the bolter operator.

### **2.7.5 Control-mode**

Where control-mode is selectable, the selected mode of control shall be visible and clearly marked. Emergency stops shall shut down all control functions irrespective of the control mode selected. Other safety stops shall shut down all associated control functions.

### **2.7.6 Remote control**

Remote control modes shall comply with AS/NZS 4240.

### **2.7.7 Pendant control (umbilical cord)**

Pendant control shall comply with AS/NZS 4240.

### **2.7.8 Traction control systems**

Traction control systems shall be designed in accordance with the principles in the risk management requirements of AS/NZS 4871.1.

## **2.8 MACHINE MOTORS**

Motors manufactured for use on machines should take into consideration the following features:

- (a) Accessible connections to motor leads or terminals, including earth connection.

- (b) Locking device for screw type inspection covers.
- (c) Lifting lugs or eye bolt locations to facilitate handling on and off the machine.
- (d) Adequate mounting fixings or supports, with reasonable access to all fasteners, which is required for routine inspection and maintenance.
- (e) Avoidance of entries that will allow water to enter the motor enclosure during normal operating conditions.

NOTE: It may be necessary to consider protection in the machine design to prevent a direct fall of water on the motor.

## **2.9 MACHINE CABLING**

### **2.9.1 Cable arrangements**

All external cables installed on a mobile machine shall be—

- (a) arranged clear of moving parts;
- (b) provided with short-circuit protection that will adequately protect the smallest CSA cable that it is protecting;
- (c) protected from hot surfaces that may adversely affect the insulation of cables and moving parts;
- (d) arranged so as to prevent excessive bending or twisting;
- (e) clamped in place to prevent undue movement;
- (f) protected from mechanical damage by being correctly positioned within the body of the machine;
- (g) protected from hydraulic lines and abrasions; and
- (h) of the same temperature rating as the environment in which they are installed.

### **2.9.2 Cable construction**

All non-IS cables shall comply with AS/NZS 4871.1.

## **2.10 CABLE REELS**

### **2.10.1 General**

Where cable reels are fitted to machines, the driven reel shall maintain positive tension of the trailing cable during reeling and unreeling operations, within the cable manufacturers' specified operating tensions for the cables under all operating conditions.

### **2.10.2 Cable reel bearings**

Cable reel bearings shall not be an integral part of a circuit for transmitting electrical energy nor form part of the earthing circuit.

### **2.10.3 Cable reel dimensions**

Cable reel drums should be designed to prevent undue bending of cables outside the cable manufacturers' specified operating bending radius for continuous reeling and sheathing duty.

### **2.10.4 Cable reel interlock limit**

Cable reels shall be fitted with a protective device to stop the machine travel. The functionality of the protection device shall be determined by the risk management process.

The protective devices shall operate in the event of the following—

- (a) the cable exceeds the maximum safe limit of cable on the reel (over fill limit); or

- (b) the machine exceeds the minimum safe limit of cable on the reel (run out limit).

The above mentioned device shall—

- (i) automatically cause the machine to stop and apply the brakes; and
- (ii) be part of a control circuit so arranged that resetting of the device does not automatically restart the machine.

#### **2.10.5 Cable reel motion detection**

Consideration should be given to the inclusion of cable reel motion detection and indication.

### **2.11 MACHINE INTERLOCK CONTROLS**

#### **2.11.1 Conveyor reversing**

The reversing of a machine conveyor shall be controlled by a switching device so the reverse operation will not occur inadvertently.

#### **2.11.2 Cable interlock**

For applications where the trailing cable machine anchor point may not be directly supervised by an operator or has a risk of overtension (such as with shearers on longwall applications), the supply cable shall be prevented from being over tensioned by a system that automatically stops any dangerous motion associated with the over tension.

#### **2.11.3 Trailing cable attachments**

Attachments should be provided for anchoring trailing cables where the cable attaches to the machine.

The design should allow for all machine movements to minimize the risk of cable damage.

Where the cable is secured to allow reeling of the cable, means should be provided to reduce shock loading on the cable in excess of the safe working load of the cable.

#### **2.11.4 Pilot control**

Where pilot control switching is fitted on a machine, the switch device shall be spring return from the 'start' position to the 'run' position. Trip functions may be connected in the pilot circuit. The pilot circuit should not allow restoration of power unless it is in a healthy state. For example, if there is no power on a machine and the switch is stuck in RUN, then the pilot relay should not operate.

Refer to Clause 3.2.1.4 of AS/NZS 4871.1 for hazardous zone applications.

#### **2.11.5 Electrical braking**

Electrical dynamic braking, where fitted, shall not be used for safety or parking brake applications.

#### **2.11.6 Over-speed protection**

Where it is possible for the operator of the machine to inadvertently over-speed a mobile machine, an over-speed protection device shall be provided.

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