

Australian/New Zealand Standard™

**Electrical equipment for coal mines—
Introduction, inspection and
maintenance**

Part 1: For hazardous areas



AS/NZS 2290.1:2014

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Australian/New Zealand Standard™

Electrical equipment for coal mines— Introduction, inspection and maintenance

Part 1: For hazardous areas

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-023, *Electrical Equipment for Mines and Quarries*, to supersede AS/NZS 2290.1:2005, *Electrical equipment for coal mines—Introduction and maintenance*, Part 1: *For hazardous areas*.

The objective of this Standard is to facilitate the safe, efficient and productive use of electrical explosion-protected equipment and cables in underground coal mine hazardous areas, by specifying requirements and recommendations for the inspection and maintenance of such equipment.

This Standard is part of a series of standards on the maintenance and overhaul of electrical equipment used in association with underground mining machines. The series is as follows:

- (a) AS/NZS 2290.1, *Electrical equipment for coal mines—Introduction and maintenance*, Part 1: *For hazardous areas* (this Standard).
- (b) AS 2290.3, *Electrical equipment for coal mines—Maintenance and overhaul*, Part 3: *Maintenance of gas detecting and monitoring equipment*.

In addition, this Standard aligns with AS/NZS 3800:2012, *Electrical equipment for explosive atmospheres—Repair and overhaul*.

The principal differences between this edition and the 2005 edition are as follows:

- (i) Life-cycle management of explosion-protected equipment has been embraced.
- (ii) The range of inspections has been expanded to include initial and periodic inspections.
- (iii) A risk-based process is required for the identification of ‘readily accessible components’ and the determination of ‘inspection frequency’; however, recommended inspection schedules for individual explosion-protection techniques have been retained.
- (iv) An electrical engineering manager has been specified as the process owner and responsible decision maker.
- (v) General inspection requirements that are applicable to all explosion-protection techniques have been included.
- (vi) The range of explosion-protection techniques has been expanded to address currently installed equipment.
- (vii) This Standard has been aligned with the AS/NZS 60079 series, where compatible with Group I requirements.
- (viii) An alternate risk assessment method encompassing equipment protection levels (EPLs) for Ex equipment is discussed in an informative appendix.

NOTE: See Appendix M.

The term ‘informative’ has been used in this Standard to define the application of the appendix to which it applies. An ‘informative’ appendix is only for information and guidance.

Statements expressed in mandatory terms in footnotes to tables are deemed to be requirements of this Standard.

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FOREWORD

Electrical installations in hazardous areas have features specially designed to make them suitable for operation in such areas. For safety reasons, it is essential that the integrity of those special features is maintained throughout the life of the installations. Therefore they require an initial inspection and regular periodic inspections by competent persons in accordance with this Standard.

NOTE: Correct functional operation of hazardous area installations does not mean, and should not be interpreted as meaning, that the integrity of the special features referred to above is preserved.

The use of this Standard and safe electrical engineering practice will assist in the management of electrical hazards.

The implementation of this Standard will contribute significantly to the—

- (a) prevention of ignition of explosive gases or dusts;
- (b) prevention of electric shock and burns;
- (c) prevention of arcing faults that have sufficient energy to invalidate the type of explosion-protection as a result of damage to the enclosure or generation of an excessive pressure rise beyond that for which the electrical enclosure was designed; and
- (d) prevention of fires caused by the malfunction of electrical equipment.

The risk management process should be utilized to identify relevant controls. There are a number of controls associated with using electricity in hazardous areas, including the following:

- (i) Fit-for-purpose electrical explosion-protected equipment.
- (ii) Fit-for-purpose cables for hazardous areas in a mining environment.
- (iii) Fit-for-purpose electrical protection.
- (iv) Fit-for-purpose earthing systems.
- (v) Reduction of the potential for phase-to-phase arcing faults.
- (vi) Fit-for-purpose lightning protection.
- (vii) Fit-for-purpose tools and test equipment.
- (viii) Isolation and electrical testing procedures.
- (ix) Removal/restoration of power procedures.
- (x) Proper classification of hazardous areas.
- (xi) Correct first aid treatment for persons who receive an electric shock and burns.

This Standard covers many of these particular aspects, but also takes a holistic approach to the electrical system and recognizes that many of the controls interact and that each of the life cycle stages interact. It is up to the user of this Standard to make judgements and decisions with all of this in mind.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard**Electrical equipment for coal mines—Introduction, inspection and maintenance****Part 1: For hazardous areas**

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out requirements for the inspection and maintenance of electrical equipment designed for use in hazardous areas in and around underground coal mines.

Section 2 provides general requirements that are fundamental to the safe use of electrical equipment in hazardous areas. Section 3 provides specific requirements for each type of explosion-protection technique.

This Standard is intended to be applied where there is a potential risk due to the presence of explosive gas, dust mixtures and combustible dust layers. It does not apply to—

- (a) surface infrastructure, typically Group II or Group III classified areas, other than gas drainage and borehole dewatering areas that could negatively impact on an underground mine workings;
- (b) areas where a risk can arise due to the presence of hybrid mixtures;
- (c) areas where small quantities of flammable materials are introduced for maintenance purposes; or
- (d) shotfiring activities and associated equipment.

This Standard does not include—

- (i) electrical installation and inspection requirements not directly associated with an explosion-protection technique;
- (ii) the regulatory compliance assessment of electrical equipment; or
- (iii) the permanent repair, reclamation and overhaul of explosion protected equipment.

1.2 NORMATIVE REFERENCES

The following are the normative documents referenced in this Standard. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE: Documents for informative purposes are listed in the Bibliography.

AS/NZS

3000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
3800	Electrical equipment for explosive atmospheres—Repair and overhaul
4761	Competencies for working with electrical equipment for hazardous areas (EEHA) (series)
4801	Occupational health and safety management systems—Specification with guidance for use

AS/NZS

4871 Electrical equipment for mines and quarries (series)

60079 Explosive atmospheres

60079.2 Part 2: Equipment protection by pressurized enclosures 'p'

1.3 DEFINITIONS

For the purposes of this document, the terms and definitions given in AS/NZS 60079.0 and the following apply.

NOTE: Additional definitions applicable to explosive atmospheres can be found in IEC 60050-426.

1.3.1 Certificate

The document issued by a test authority ascertaining the conformity of a piece of equipment to a particular standard.

NOTE: Referred to as a Certificate of Conformity and replaces the use of 'Certification'

1.3.2 Competent person

A person who can demonstrate a combination of knowledge, skills and experience, to effectively, efficiently and safely carry out activities in hazardous areas as covered by this Standard. Competency in some cases may be limited to one or more specific types of protection technique (e.g. Ex 'd', Ex 'i') or activity (e.g. design, selection, installation, maintenance, testing and inspection).

1.3.3 Defect management scheme

Scheme used to document and track identified deficiencies in explosion-protected plant and their installations so that the deficiency can be appropriately scheduled for rectification by a competent person.

1.3.4 Electrical engineering manager

A competent person who is also authorized for the management of other competent persons, who has knowledge in the field of explosion protection, local conditions, the site installation, and the responsibility of defining the technical specifications and frequency of inspection and maintenance of electrical equipment within hazardous areas.

NOTE: Legislation may require a statutory appointed person to manage this responsibility.

1.3.5 Fixed plant/equipment

Typically installed for a lengthy period (e.g. conveyor starter, pump starter).

1.3.6 Hazardous area (explosion risk zone)

Area in which an explosive atmosphere is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of equipment.

NOTES:

- 1 For the purposes of this Standard, an area is a three-dimensional region or space.
- 2 Some legislation uses the terminology 'hazardous zone' or 'explosion risk zone' to define geographical limits of the hazardous area.

1.3.7 Inspection

Action comprising careful scrutiny of an item carried out either without dismantling, or with the addition of partial dismantling as required, supplemented by means such as measurement, in order to arrive at a reliable conclusion as to the condition of an item.

The inspection is to verify the explosion-protected integrity of enclosures, fixtures, fittings and cables for hazardous area installations.

1.3.8 Inspection, external

Inspection which identifies those defects, such as loose bolts, which will be apparent only by examination and, where necessary, the use of tools.

NOTE: External inspections do not normally require the enclosure to be opened, or the equipment to be de-energized.

1.3.9 Inspection, initial

Inspection of all electrical equipment, systems and installations before they are brought into service.

1.3.10 Inspection, internal

Inspection, which requires the opening of an enclosure to identify defects, such as loose terminations or the application of test equipment, or both. This inspection includes an external inspection.

1.3.11 Inspection, pre-overhaul

An audit to assess the condition of equipment that includes those aspects covered by an internal inspection and, in addition, requires the dismantling, review and dimensional checks of flameproof flanges, and a sample of threaded entries, operators and other components against compliance documentation. The findings are used to assess the requirement for overhaul.

1.3.12 Inspection, periodic

Inspection of all electrical equipment, systems and installations carried out on a routine basis.

1.3.13 Inspection report

Report or record that details the location, equipment and installation inspected, competent persons involved, inspection activities completed and the results of the inspection findings, including defects located and rectified, and defects that could not be immediately resolved. It may also include dimensional checks.

1.3.14 Inspection, sample

Inspection of a proportion of the electrical equipment, systems and installations.

1.3.15 Life cycle

The period of time covering the complete history of an item of equipment commencing with design, then including construction introduction, commissioning, operation, maintenance, modification, repair overhaul, and then concluding with final removal from service and disposal.

1.3.16 Maintenance

Combination of any actions carried out to retain an item in, or restore it to, conditions in which it is able to meet the requirements of the relevant certificate or specification and perform its required functions.

1.3.17 Mobile plant/equipment

Capable of being readily moved about under its own power whilst in operation (e.g. continuous miner, shuttle car, load haul dump machine and longwall face equipment).

1.3.18 Modification

Work to be performed on equipment which involves the fitting of additional facilities or alterations.

1.3.19 Non-hazardous area (negligible explosion risk zone)

Area in which an explosive atmosphere is not expected to be present in quantities such as to require special precautions for the construction, installation and use of equipment.

1.3.20 Portable equipment

Capable of being carried by a person while in operation, or which can easily be moved from one place to another while connected to the supply (e.g. gas detector, test instrument, work light).

1.3.21 Readily accessible component

A component nominated as accessible as identified by risk assessment, refer to Clause 2.4.2.

1.3.22 Transportable plant/equipment

Can be relocated and not carried by personnel [e.g. section transformer, distribution control box (DCB), pump pod].

1.3.23 Verification dossier

A set of documents showing the compliance history of electrical equipment and installations; refer to Clause 2.2.2.

SECTION 2 GENERAL REQUIREMENTS

2.1 LIFE CYCLE MANAGEMENT

The environment in which Group I equipment operates can vary from good (clean and dry) to poor (wet with high sulphur content coal). It can also include high vibration operating conditions. The conditions will vary depending on the mine, the equipment type and the equipment's operating location within the mine, with the most arduous duty expected for face mining machinery.

Any electrical system should be specified, designed, installed, commissioned, operated, maintained (including servicing and repairs) and disposed of in a manner that manages the electrical hazards in the mine. This can be done throughout the life cycle by—

- (a) ensuring equipment is fit for purpose;
- (b) employing and training competent people;
- (c) developing safe working procedures;
- (d) ensuring competent supervision; and
- (e) managing the work environment.

Generally equipment is not fixed, but rather portable, mobile or transportable. Associated with the movement of equipment is an increased likelihood for mechanical impact and damage. The compact design and location of electrical equipment on mining equipment makes in-service inspection difficult. The increasing power and functional complexity of modern mining equipment add to this difficulty. Therefore prior to equipment placement underground, it is important to conduct a thorough initial inspection.

At the initial inspection, the scope of periodic inspections shall be determined, in particular which components are readily accessible for external and internal inspections and which inspections are necessary to verify the explosion-protection characteristics of the equipment. An in-service inspection regime can then be formulated to compliment the equipment design, to ensure its ongoing verification of, or early detection of a failure of, explosion protection properties. A failure modes and effects study may be warranted to identify the critical aspects of the explosion protection design. From this study the required inspections and their frequency can be made.

So as to track the placement of explosion-protected equipment a register and identification tagging system shall be used. The system used to track the replacement and repaired equipment shall take into account the verification dossier and work order scheduling so that the correct register and status of explosion protected equipment are readily available to the electrical engineering manager. The system shall track make, model, certificate and serial numbers of equipment.

The following shall be compiled for the whole installation and for each item of explosion-protected equipment—

- (i) a site acceptance examination checklist;
- (ii) an in-service external/internal inspection checklist;
- (iii) report forms; and
- (iv) a defect management scheme.

Whilst in service the equipment shall be periodically inspected to verify the explosion protection characteristics are retained and identify any changes in the environment around the installation that may affect these explosion protection characteristics. Periodic inspections and maintenance activities in accordance with this Standard shall continue throughout the service life of the equipment.

Because of the arduous conditions to which mining face equipment is subjected, this equipment shall be scheduled for periodic removal from service, at which time its compliance with the appropriate certificates shall be verified. This process shall be conducted in accordance with AS/NZS 3800. Recommended service intervals are provided in Tables 1 to 4.

Retirement strategies are beyond the scope of this Standard due to the broad range of explosion-protected equipment utilized in coal mining; however, it is recommended that the equipment owner periodically evaluate service life expectation based on, for example, parts availability and condition of equipment.

2.2 DOCUMENTATION

2.2.1 General

For effective life cycle management of equipment, it is important that all appropriate documentation needed to comply with this Standard is in place at the time of introduction and prior to commissioning. Documentation shall be maintained and updated throughout the life of the equipment.

This Clause (2.2.) lists expected documentation that should be obtained for all items of equipment upon arrival on site, including second-hand and hire equipment.

NOTES:

- 1 This may be in hard copy or electronic format.
- 2 A typical documentation check sheet is provided in Appendix D.

The user shall maintain a verification dossier and other appropriate documentation. Verification dossiers are used to retain information covering the complete life-cycle of hazardous area installations and equipment. The location of all parts of the dossier and who is responsible for its currency should be nominated in the documentation.

2.2.2 Verification dossier

The verification dossier shall include the following documentation, where applicable:

- (a) A statement of the identity of the person(s) having ownership of the installation or parts thereof.
- (b) Classification of hazardous areas, nomination of the relevant hazardous area classification standard and, if included, the equipment protection level (EPL) required for each location.

NOTE: Refer to Appendix M and AS/NZS 60079.26 for information relating to EPLs.

- (c) Documentation relating to the suitability of the equipment for the area and environment to which it will be exposed, for example, equipment group, temperature rating, type of protection, IP rating, corrosion resistance.
- (d) Documentation/certificate for electrical equipment, including those items with special conditions, for example, equipment with certificate numbers that have the suffix 'X'.
- (e) Installation instructions.
- (f) Drawings and schedules relating to circuit identification.
- (g) Records of selection criteria for cable entry systems for compliance with the requirements for the particular explosion-protection technique.

- (h) Descriptive system document for the intrinsically safe system, including summation of entity parameter, where appropriate.
- (i) Documentation certifying that the equipment is rated for the voltages and frequency applied during normal operation.
- (j) Records sufficient to enable the explosion-protected equipment to be maintained in accordance with its type of protection, for example, list and location of equipment, spares, technical information.
- (k) As a minimum, records covering overhaul and repair of equipment by a registered/recognized facility.
- (l) Manufacturer's instructions, in particular inspection and maintenance guidance instructions and schedules.
- (m) Statutory limitation, certificate or approval requirements, or a combination thereof.
- (n) Circuit design, installation specifications and other records sufficient to enable the explosion protected installations and equipment to be maintained in accordance with their type of protection.

NOTE: Examples include circuit drawings, protection settings, list and location of equipment, spares, certificates, technical information and drawings identifying the explosion-protection properties. See AS/NZS 60079.14.

- (o) Copies of previous inspection records.

NOTE: Other documentation may be necessary in addition to that specified above. See AS/NZS 60079.14, AS/NZS 3800, AS/NZS 4871 (series) and AS/NZS 60079.10, and/or AS/NZS 4801.

2.2.3 Additional documentation

In addition to the verification dossier, the following documentation shall be retained:

- (a) Records of site introduction of equipment.
- (b) Commissioning instructions and records.
- (c) Operating manuals.
- (d) Maintenance and inspection procedures and records.
- (e) Training documents to enable the life-cycle management of the equipment.
- (f) Record of disposal.

2.3 COMPETENCY

2.3.1 Competent persons

The inspection and maintenance of hazardous area equipment and installations shall only be carried out by competent persons. A competent person should be familiar with the various types of protection and installation practices, the requirements of this Standard, the relevant regulations/company rules applicable to the installation, and the general principles of area classification. The competency of the person shall be relevant to the type of work undertaken.

Appropriate continuing education or training shall be undertaken by personnel on a regular basis.

NOTES:

- 1 The endorsed competency to the relevant group and explosion protection technique, for inspection, maintenance and attending breakdowns, etc., may be demonstrated in accordance with the AS/NZS 4761 series, or an equivalent training and assessment framework.

- 2 Regulation may require a licence or special competency(ies) to carry out work to this Standard.
- 3 It is not a requirement that competent persons are members of an external independent organization.
- 4 It is recommended that competent persons who conduct inspections become conversant with equipment protection levels (EPL) requirements; refer to Appendix M and AS/NZS 60079.26.

2.3.2 Electrical engineering manager

The electrical engineering manager, with assistance from the plant manufacturer/supplier, shall define the competencies required for maintenance of the equipment. The defined competencies should include isolation procedures, safe working practices and specific inspection activities for the type of explosion-protection and plant design. Evidence of the relevant competency shall be available.

Electrical engineering managers shall maintain a working knowledge of contemporary legislation and standards relevant to hazardous areas. Electrical engineering managers shall be proficient in—

- (a) maintenance planning for hazardous areas;
- (b) inspection strategies;
- (c) auditing inspection activities and reports in accordance with AS/NZS 4801 or an equivalent Standard;
- (d) investigating in-service failures of explosion-protection techniques; and
- (e) developing corrective actions to prevent known failure modes of explosion-protected equipment from eventuating.

2.4 INSPECTIONS

2.4.1 General

A risk assessment shall be carried out and documented, to identify particular controls for the initial and ongoing safe use of electrical equipment installed in each hazardous area. The risk assessment should be in accordance with AS/NZS ISO 31000 or a similar Standard.

NOTE: A simplified inspection flowchart is provided in Appendix A.

To ensure that equipment is installed and maintained in a satisfactory condition for continued use within a hazardous area, a combination of the following shall be used:

- (a) Site acceptance examination (initial inspection).
- (b) Regular periodic inspections (internal and external).
- (c) Event triggered inspections (safety notification, in-service failure or relocation/re-installation).
- (d) Pre-overhaul audits.

Refer to Clause 2.4.3 for further information on inspection types.

If at any time there is a change in the installation environment or if any equipment is moved from one location to another, a check shall be made to ensure that the type of protection, surface temperature, IP rating, through fault current and arc fault containment, where appropriate, are suitable for the revised conditions.

If plant or equipment is dismantled during the course of an inspection, precautions shall be taken during reassembly to ensure that the integrity of the type of protection is not impaired. This shall include removing any residual dust and moisture, and replacing gaskets correctly.

NOTE: The major factors effecting the deterioration of equipment include susceptibility to corrosion, exposure to chemicals or solvents, accumulation of dust or dirt, water ingress, exposure to excessive ambient temperature, mechanical damage and exposure to undue vibration. Other service factors include training and experience of personnel, unauthorized modifications or adjustments and inappropriate maintenance, for example, that which is not in accordance with the manufacturer's recommendation.

The competent person shall look for any factor, whether covered by checklists or not, which is likely to impair the safety and functionality of equipment. Any defects found shall be rectified as part of the check, notified to an appropriate supervisor and recorded on the inspection report form. If defects are found that invalidate the explosion protection of the equipment, these defects shall be rectified immediately. If the defects cannot be rectified immediately, the equipment shall be taken out of service.

The level of inspection selected for equipment using more than one type of protection (e.g. mixed techniques) shall be a combination of the relevant requirements for each of the individual types of protection. Careful consideration should be given to protection techniques that rely on each other for the explosion protection integrity.

2.4.2 Determining accessibility for inspection of components

Components on equipment may be considered to be not readily accessible. Alternate strategies may need to be used to inspect components that are more difficult to access. Such strategies may include an alternate inspection timetable for external inspections or a more frequent internal inspection timetable, or both.

To determine the accessibility of components of a machine/plant, a risk assessment shall be conducted. This risk assessment shall detail the hazards associated with the failure of readily accessible and non-readily accessible components. This may form part of the risk assessment nominated in Clause 2.4.1.

The risk assessment should include participation of the OEM and be based on sound hazardous area maintenance principles and historical information.

The results of this risk assessment shall form the basis of the equipment maintenance system and shall be documented and communicated to all personnel conducting maintenance on the equipment.

2.4.3 Types of inspection

2.4.3.1 General

The results of all initial, periodic and pre-overhaul inspections, including what was inspected and the type of inspection, shall be recorded and retained for traceability.

2.4.3.2 Initial inspection

Initial inspections are typically internal inspections used to check that the selected type of protection and its installation are appropriate. Requirements for initial inspections are given in Clause 2.5. Specific requirements for each type of explosion-protection technique are given in Section 3.

2.4.3.3 Periodic inspections

Periodic inspections may be internal or external. Refer to the requirements given in Clause 2.6. Recommended periodic inspection frequencies are given in Tables 1 to 4. Specific requirements for each type of explosion-protection technique are given in Section 3.

An external or internal periodic inspection may indicate the need for further internal or pre-overhaul inspection, maintenance or repair.

2.4.3.4 *Pre-overhaul audit*

Pre-overhaul audits are external and detailed internal inspections. Requirements for pre-overhaul audits are given in Clause 2.7. Specific requirements for each type of explosion-protection technique are given in Section 3.

2.5 INITIAL INSPECTION REQUIREMENTS

A new installation of plant or equipment shall have an initial inspection. The initial inspection shall determine that the installation is complete and suitable for initial energization within the hazardous area.

NOTE: A full initial inspection may not be required if an equivalent inspection has been performed by the manufacturer, and the transport and installation processes are not likely to have affected those items inspected by the manufacturer. For example, inspection of endshield spigot flamepaths of a flameproof motor are not required; however, the motor terminal housing cover, which would have been removed to facilitate connection of the field wiring, should be inspected afterwards as part of the installation process.

The initial inspection shall verify that the equipment is explosion-protected prior to being put into operation and determine the periodic inspection requirements for individual equipment items.

The initial inspection shall include a review of equipment and documentation to confirm that the explosion-protected characteristics, certificate requirements and manufacturer's recommendations are met. The initial inspection should occur under the guidance of a person competent to inspect hazardous area equipment, in accordance with the AS/NZS 4761 series, from the relevant manufacturer or service facility. The initial inspection may occur at the premises of the relevant manufacturer or service provider, or at the surface workshop of the mine.

The initial inspection shall extend to verification of equipment condition and ensure that the explosion protection characteristics have been retained during transportation, installation and commissioning activities.

NOTE: Attachments and sub-assemblies may have been damaged or vibrated loose during transport and installation. In particular, checks should be made that blanking elements that are suitable for the explosion protection technique are fitted to unused cable entries.

The initial inspection shall evaluate the integrity, robustness and vulnerability of the explosion-protection characteristics.

During the initial inspection, all non-compliance shall be recorded and rectification scheduled prior to the plant or equipment being brought into service.

NOTE: Identified non-compliance should be reported to the relevant original equipment manufacturer, overhaul service provider or their certifying body, or a combination thereof.

Commissioning of explosion-protected equipment should include sufficient checks to confirm that the equipment aligns to certificate documents and, where applicable, an overhaul compliance statement.

Where equipment may have been in storage prior to installation, its current condition shall be assessed, and storage and maintenance records verified to assess the suitability of the equipment for installation. The overhaul requirements for this equipment should be established at this time.

NOTE: Consideration may be given to adjusting the overhaul date beyond the name plate date for equipment that has been appropriately maintained whilst in clean storage.

New installations with identified non-compliances—

- (a) shall not be brought into service until the non-compliances are addressed; or

- (b) a risk based examination of the non-compliances shall be completed to determine that the plant is safe to operate.

Where the explosion-protection properties are compromised, or the conditions of certification are not met, the item shall not be put into service in a hazardous area under any circumstance.

2.6 PERIODIC INSPECTION REQUIREMENTS

2.6.1 General

To ensure that in-service installations are maintained in a satisfactory condition for continued use within a hazardous area, regular periodic inspections shall be carried out. Where necessary, maintenance or repairs shall be undertaken to restore the explosion-protection characteristics of the installation and equipment.

NOTE: In the case of dusts, housekeeping may influence the inspection and maintenance requirements.

Following any adjustment, maintenance, repair, reclamation, modification or replacement, the equipment or relevant parts of equipment concerned should be subjected to an internal inspection.

NOTE: Modifications that impact on the explosion-protection characteristics may invalidate the certificate and need to be referred to a certificate holder or original equipment manufacturer.

Enclosures which are opened for breakdown repair or internal inspection should be subject to independent follow-up external inspection at the earliest possible opportunity, for example, an inspection work order issued to the oncoming shift.

2.6.2 Frequency of inspection

The frequency of periodic inspections shall be determined by risk assessment.

NOTE: Recommended periodic inspection frequencies are detailed in Section 3.

The risk assessment shall address exposure to explosive atmospheres, potential for mechanical damage, and overheating and other environmental conditions, as per Clause 2.9. Further, this risk assessment shall include a review of the manufacturer's documentation, sound engineering practices, maintenance records for similar plant and in service records.

Where self-monitoring systems for the explosion protection techniques are incorporated, the inspection frequency can be modified according to the risk, for example, the safety devices monitoring a pressurization system that indicate a failure of the technique. The design of these monitoring systems should use a functional safety approach.

The frequency of periodic inspections should also be matched to the type of equipment. To assist in defining inspection strategies, four broad types of mining electrical explosion-protection equipment have been defined in Clause 1.3, that is mobile, portable, transportable and fixed. These equipment types should be used as a basis for scheduling periodic inspection activities and frequencies.

Ongoing review of the results of inspections shall be undertaken and used to justify the inspection intervals and type.

NOTES:

- 1 Risk evaluations for inspection frequencies should be retained in the site records or equipment verification dossier.
- 2 A simplified inspection flowchart is provided in Appendix A.

2.6.3 Portable equipment

Portable explosion-protected equipment, typically caplights, gas detectors, radios and similar devices are designed for arduous duty. They are subjected to impact tests to verify suitability prior to a certificate being issued. Although rigorously tested, portable equipment is subject to vibration, impact, moisture, dust and other contaminants. Cases and seals are subject to damage, which may result in contaminants affecting the integrity of the explosion protection technique.

Portable explosion-protected equipment shall be subject to periodic external and internal inspections. This should be in accordance with the recommended inspection schedule for the type of protection technique; see Tables 1 to 4. In addition, hand-held and portable equipment shall be visually checked before use to ensure that it is not damaged.

On occasion, non-incendive, portable, non-explosion-protected equipment may be required for use in a hazardous area when explosion-protected equipment is not available, such as an insulation tester and vibration analysis equipment. The equipment shall be subjected to comprehensive inspection, prior to and during use. Battery charging or replacement shall not occur in a hazardous zone.

NOTE: For this equipment to be used in a designated hazardous area, the area should be determined as safe in accordance with mine procedures. This should include continuous gas detection.

2.6.4 Fixed installations

For fixed installations, both the level of inspection and the interval between periodic inspections shall be determined by risk assessment, taking into account the type of equipment, manufacturer's guidance, factors governing its deterioration, the area classification, the EPL requirements and the results of previous inspections. Where inspection levels and intervals have been established for similar equipment, plant and environments, this knowledge shall be used in determining the inspection strategy. It may also be necessary to consider the safety risk level and increase inspection frequencies for high risk installations.

NOTE: When large numbers of similar items such as luminaires, junction boxes, etc. are installed in a similar environment, it might be feasible to carry out periodical inspections on a sample basis provided that the number of samples in addition to the inspection frequency is subjected to review. It is, however, recommended that all items be subjected to at least 'external inspection' as appropriate.

2.6.5 Transportable and mobile equipment

Transportable and mobile equipment, including development and longwall panel equipment, is particularly prone to damage and misuse, and therefore the interval between periodic inspections may need to be reduced. These inspections should be in accordance with the table giving the recommended inspection schedule for the type of protection (see Tables 1 to 4).

2.7 PRE-OVERHAUL AUDIT REQUIREMENTS

2.7.1 General

Pre-overhaul audits are used to determine and report on the condition of electrical explosion-protected equipment and associated cables. The components to be audited shall be determined in consultation with the electrical engineering manager.

NOTE: Pre-overhaul audits should not be expected to reveal faults of a random nature, such as loose connections, but should be used to monitor the effects of environmental conditions, vibration, inherent design weakness, etc.

The reported equipment condition shall be used by the electrical engineering manager to determine when an overhaul should be carried out.

Pre-overhaul reports submitted to the electrical engineering manager shall be specific about components inspected and actual measurements obtained.

NOTE: A typical pre-overhaul audit report sheet is provided in Appendix L.

Pre-overhaul audits shall not be used to indefinitely postpone the overhaul of explosion-protected equipment. Recommended audit check lists are detailed in Clause 3.2.4. The results of an audit may assist with establishing the interval between overhauls for individual items of explosion protected equipment. These audit results should be used as a guide to continue safe use of the equipment in a hazardous area. The pre-overhaul audit does not include general issues, for example reliability.

The overhaul interval will depend on the working environment, the duty of the equipment, time based deterioration and the quality of maintenance. The number of pre-overhaul audits, of any individual piece of plant equipment, should not extend the scheduled overhaul date by more than two years. Any variation to this recommendation shall be supported by data in inspection records and generally by information within the verification dossier.

The initial pre-overhaul audit shall be carried out 12 months before the overhaul is due. A second pre-overhaul audit should then be carried out at the time of the recommended overhaul. The results of these two pre-overhaul audits can then be compared to determine if the condition of explosion-protected features has deteriorated. Subject to the above results, a decision to overhaul or extend service life of the equipment can be made. The period between pre-overhaul audits shall not be more than 12 months. So as to get a true comparison between pre-overhaul audits, the same components shall be inspected at each audit.

Some explosion-protected components of mobile and transportable equipment are difficult to access and critical flamepaths cannot be inspected without dismantling (e.g. motor end shields, motor shafts, cable glands at the rear of large enclosures). Many of these flamepaths are subject to an extremely arduous operating environment (excessive vibration, duty cycles, corrosive substances, etc.). Because of this, the explosion-protected properties can be easily compromised. Therefore—

- (a) an engineering review and a risk management exercise shall be conducted to determine which components on mobile and transportable equipment require special consideration because of the duty and environment; and
- (b) the overhaul periods of motors shall not exceed the periods specified in the site maintenance scheme.

2.7.2 Examination

Pre-overhaul audit frequencies shall be determined by the electrical engineering manager. The pre-overhaul audit shall be carried out by a competent person. The competent person shall operate within the requirements of a national recognized service facility scheme, as defined in AS/NZS 3800 or an equivalent standard, and utilize traceable measuring and test equipment. All measurements and methods used shall follow procedures documented by the recognized facility.

NOTE: A nationally recognized service facility' generally refers to the service facilities recognized within the ANZEx Scheme, in accordance with MP 87.2.

A competent person shall have the competencies to conduct detailed inspections of hazardous areas, installations and the overhaul and repair of explosion-protected equipment, in accordance with the AS/NZS 4761 series.

Prior to the examination, the competent person shall review all original, overhaul, pre-overhaul audit and repair history examination reports. This review shall be utilized to determine the rate of deterioration of the explosion-protected equipment, service factors, etc. that may influence the life cycle of the equipment. A check should be made to ensure that all previously identified faults have been rectified and have not reoccurred.