NEW ZEALAND

EDICT OF GOVERNMENT

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AS-NZS 60079-14 (2009) (English): Explosive atmospheres - Electrical installations design, selection and erection [By Authority of New Zealand Electricity (Safety) Regulations 2010 (SR 2010/36)]

We will sell to no man,
we will not deny or defer to any man either justice or right.
Magna Carta—Tūtohinga Nui
Kore rawa e hoko ki te tangata, e kore e whakakāhoretia,
e tautuku rānei te tangata ki te ture, tika ranei.

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AS/NZS 60079.14:2009
A1-2009 Appended

STANDARDS
NEW ZEALAND
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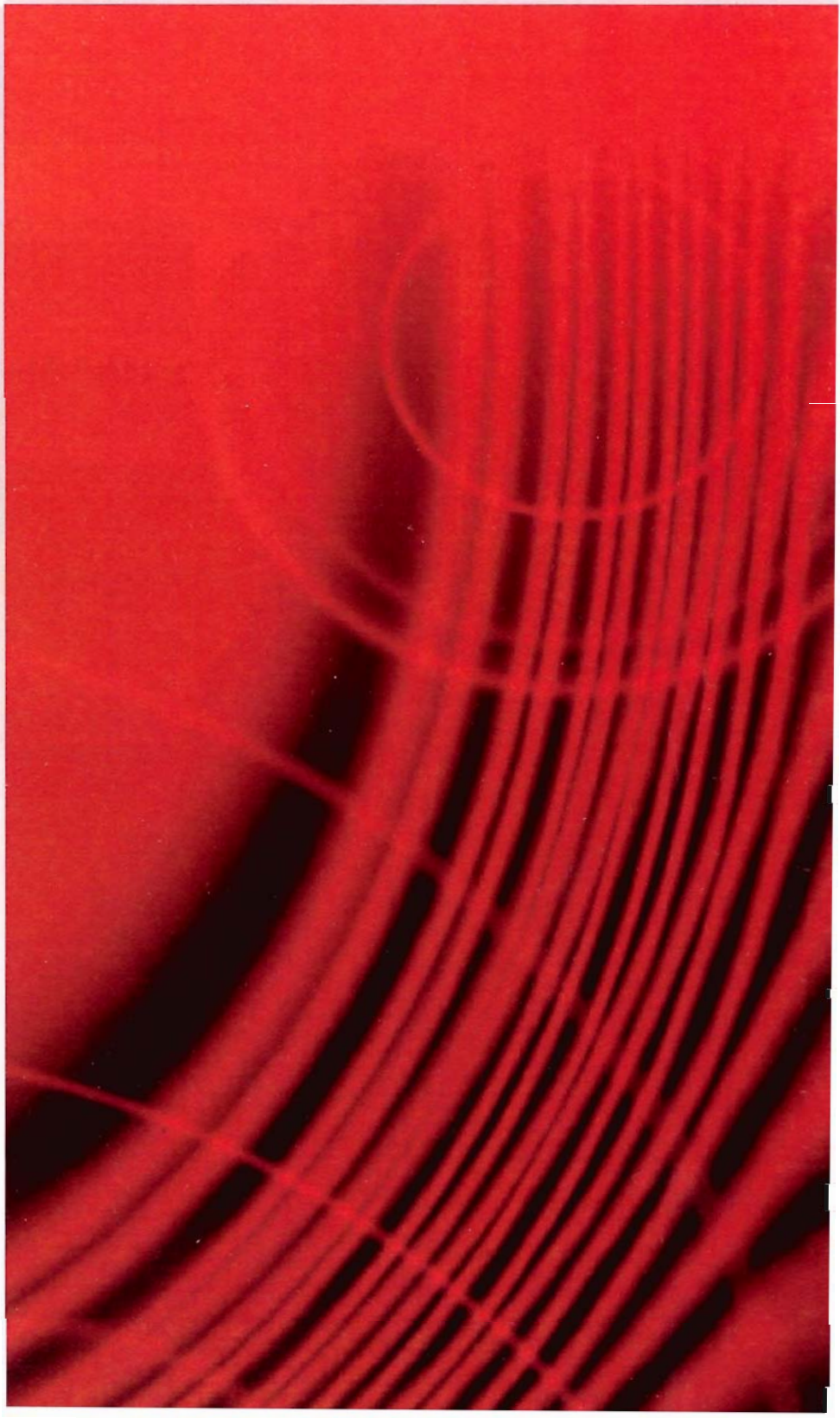
Australian/New Zealand Standard™

Explosive atmospheres

Part 14: Electrical installations design, selection and erection (IEC 60079-14, Ed. 4.0(2007) MOD)



STANDARDS
Australia

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee EL-014, Equipment for Explosive Atmospheres. It was approved on behalf of the Council of Standards Australia on 13 August 2009 and on behalf of the Council of Standards New Zealand on 11 September 2009.
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The following are represented on Committee EL-014:

Auckland Regional Chamber of Commerce
Australian Chamber of Commerce and Industry
Australian Industry Group
Australian Institute of Petroleum Ltd
Australian Petroleum Production and Exploration Association
Department of Mines and Energy, Qld
Electrical Compliance Testing Association
Energy Networks Association
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This Standard was issued in draft form for comment as DR 08193.

Australian/New Zealand Standard™

Explosive atmospheres

Part 14: Electrical installations design, selection and erection (IEC 60079-14, Ed. 4.0(2007) MOD)

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-014, Equipment for Explosive Atmospheres. In conjunction with AS/NZS 60079-17, it will replace the AS/NZS 2381, AS 2381 and AS 1076 series, two years after publication. After this time the AS/NZS 2381, AS 2381 and AS 1076 series will be withdrawn. This Standard, in conjunction with AS/NZS 60079.17, will also replace AS/NZS 61241.14, two years after publication. After this time AS/NZS 61241.14 will be withdrawn.

The objective of this Standard is to set out the requirements for the design, selection and erection of electrical installations in hazardous areas associated with explosive atmospheres; these requirements are in addition to the requirements for electrical installations in non-hazardous areas.

This Standard is an adoption with national modifications and has been reproduced from IEC 60079-14, Ed.4.0(2007), *Explosive atmospheres - Part 14: Electrical installations design, selection and erection.* It has been varied as indicated to take account of Australian/New Zealand conditions and for the protection of human health and safety, a legitimate reason under the WTO Agreement on Technical Barriers to Trade (TBT).

Variations to IEC 60079-14, Ed. 4.0(2007)) are indicated at the appropriate places throughout this Standard. Strikethrough (~~example~~) identifies IEC text, tables and figures, that for the purposes of this Australian/New Zealand Standard, are deleted. Where text, tables or figures are added, each is set in its proper place and identified by shading (example). Added figures are not themselves shaded, but are identified by a shaded border.

The adoption of this Standard forms part of the strategic objective established by Standards Australia and Standards New Zealand for adoption of all of the IEC 60079 series.

The change to the IEC based Standard introduces changes in both technical content and presentation. However many of the technical changes are also introduced as a result of changes within the IEC as part of the fourth edition of IEC 60079-14.

Included in this Standard are selected details and informative annexes from AS/NZS 2381.1:2005 that are considered appropriate to retain.

Significant technical changes included in this Standard, with respect to the previous IEC edition are as follows:

(a) Equipment Protection Levels (EPLs) have been introduced and are explained in Annex I.

(b) Dust requirements included from AS/NZS 61241.14.

NOTE: Dust requirements are included as an interim presentation for the purpose of this edition and will be refined in a next edition with other required technical changes.

As this Standard is reproduced from an International Standard, the following applies:

(i) Its number does not appear on each page of text and its identity is shown only on the cover and title page.

(ii) A full point should be substituted for a comma when referring to a decimal marker.

The terms 'normative' and 'informative' are used to define the application of the annex to which they apply. A normative annex is an integral part of a Standard, whereas an informative annex is only for information and guidance.

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INTRODUCTION

Preventive measures to reduce the explosion risk from flammable materials are based on three principles, which shall be applied in the following order:

1. Substitution
2. Control
3. Mitigation

Substitution involves, for example, replacing a flammable material by one which is either not flammable or less flammable.

Control involves, for example:

a) reducing the quantity of flammables;

b) avoiding or minimising releases;

c) controlling the release;

d) preventing the formation of an explosive atmosphere;

e) collecting and containing releases; and

f) avoiding ignition sources.

NOTE 1 With the exception of item f), all of the above are part of the process of hazardous area classification.

Mitigation involves, for example:

a) reducing the number of people exposed;

b) providing measures to avoid the propagation of an explosion;

c) providing explosion pressure relief;

d) providing explosion pressure suppression; and

e) providing suitable personal protective equipment.

NOTE 2 The above items are part of consequence management when considering risk.

Once the principles of substitution and control (items a) to e)) have been applied, the remaining hazardous areas should be classified into zones according to the likelihood of an explosive atmosphere being present (see AS/NZS 60079.10.1~~IEC 60079-10~~ or AS/NZS 61241.10~~IEC 61241-10~~/IEC 60079-10-2). Such classification, which may be used in conjunction with an assessment of the consequences of an ignition, allows equipment protection levels to be determined and hence appropriate types of protection to be specified for each location.

For an explosion to occur, an explosive atmosphere and a source of ignition need to co-exist. Protective measures aim to reduce, to an acceptable level, the likelihood that the electrical installation could become a source of ignition.

By careful design of the electrical installation, it is frequently possible to locate much of the electrical equipment in less hazardous or non-hazardous areas.

When electrical equipment is to be installed in areas where dangerous concentrations and quantities of flammable gases, vapours, mists or dusts may be present in the atmosphere, protective measures are applied to reduce the likelihood of explosion due to ignition by arcs, sparks or hot surfaces, produced either in normal operation or under specified fault conditions.

Many types of dust that are generated, processed, handled and stored, are combustible. When ignited they can burn rapidly and with considerable explosive force if mixed with air in the appropriate proportions. It is often necessary to use electrical equipment~~apparatus~~ in locations where such combustible materials are present, and suitable precautions must therefore be taken to ensure that all such equipment~~apparatus~~ is adequately protected so as to reduce the likelihood of ignition of the external explosive atmosphere. In electrical equipment~~apparatus~~, potential ignition sources include electrical arcs and sparks, hot surfaces and frictional sparks.

Areas where dust, flyings and fibres in air occur in dangerous quantities are classified as hazardous and are divided into three zones according to the level of risk.

Combustible dust can be ignited by equipment in several ways:

- by surfaces of the equipment~~apparatus~~ that are above the minimum ignition temperature of the dust concerned. The temperature at which a type of dust ignites is a function of the properties of the dust, whether the dust is in a cloud or layer, the thickness of the layer and the geometry of the heat source;
- by arcing or sparking of electrical parts such as switches, contacts, commutators, brushes, or the like;
- by discharge of an accumulated electrostatic charge;
- by radiated energy (e.g. electromagnetic radiation);
- by mechanical sparking or frictional sparking associated with the equipment~~apparatus~~.

In order to avoid dust ignition hazards it is necessary that:

- the temperature of surfaces on which dust can be deposited, or which would be in contact with a dust cloud, is kept below the temperature limitation specified in this Standard;
- any electrical sparking parts, or parts having a temperature above the temperature limit specified in this Standard:
    - are contained in an enclosure which adequately prevents the ingress of dust, or
    - the energy of electrical circuits is limited so as to avoid arcs, sparks or temperatures capable of igniting combustible dust;
- any other ignition sources are avoided.

Several types of protection are available for electrical equipment in hazardous areas (see AS/NZS 60079.0~~IEC 60079-0~~), and this Standard gives the specific requirements for design, selection and erection of electrical installations in explosive atmospheres.

This part of AS/NZS~~IEC~~ 60079 is supplementary to other relevant AS/NZS~~IEC~~ standards, ~~for example~~ and AS/NZS 3000~~IEC 60364 series~~ as regards electrical installation requirements. This part also refers to AS/NZS 60079.0~~IEC 60079-0~~ and its associated standards for the construction, testing and marking requirements of suitable electrical equipment.

NOTE 3 It is not always the case that Australian/New Zealand Standards are mandated for use. Therefore when implementing Standards, practices and specifications including those published by International or National Standards Organizations it must be understood that the Regional, National, State and local statutes (acts and regulations, licences and lease conditions) will always take precedence. This would not preclude the use of the 60079 series.

Example 1: In Australia the Offshore Petroleum Act is the governing statute under which the respective state and territory regulations are implemented. The Offshore Petroleum Act provides an enforcement mechanism for offshore requirements within the Petroleum (Submerged Lands) Act and state/territory specific requirements.

Example 2: New Zealand Legislation applies to the fixed installations offshore but as the legislation is performance based it does not mandate AS/NZS 3000. In most cases, it allows for other solutions such as the API codes.

Example 3: Individual companies operating within an approved Safety Management System/Risk Management Plan which is accepted by the applicable regulator having jurisdiction, may opt for use of alternate specifications or Standards.

This Standard is based on the assumption that electrical equipment is correctly installed, tested, maintained and used in accordance with its specified characteristics.

Inspection, maintenance and repair aspects play an important role in control of hazardous area installations and the user's attention is drawn to AS/NZS 60079.17~~IEC 60079-17~~ and IEC 60079-19 for further information concerning these aspects.

In any industrial installation, irrespective of size, there may be numerous sources of ignition apart from those associated with electrical equipment. Precautions may be necessary to ensure safety from other possible ignition sources, but guidance on this aspect is outside the scope of this Standard.

Where equipment is verified for compliance with~~In~~ AS/NZS 61241.1~~IEC 61241-1~~, for protection by enclosure 'tD', two different types of practice, A and B, are specified and are intended to provide an equivalent level of protection.

Both of these practices are in common use and the requirements of each should be followed without mixing either the apparatus requirements or selection/installation requirements of the two practices. They adopt different methodology with the primary differences being:

Practice A	Practice B
Written principally as performance based requirements	Written as both performance and prescriptive based requirements
Maximum surface temperature is determined with 5 mm layer of dust and installation rules require 75 °C margin between the surface temperature and ignition temperature of the particular dust	Maximum surface temperature is determined with 12,5 mm layer of dust and installation rules require 25 °C margin between the surface temperature and ignition temperature of the particular dust
A method of achieving the required dust ingress protection by the use of resilient seals on joints and rubbing seals on rotating or moving shafts or spindles and determining dust ingress according to AS/NZS 60529~~IEC 60529~~ -IP Code	A method of achieving the required dust ingress protection by specified widths and clearances between joint faces and, in the case of shafts and spindles, specified lengths and diametrical clearances between moving and stationary parts and determining dust ingress according to the heat cycling test

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Australian/New Zealand Standard

Explosive atmospheres
Part 14: Electrical installations design, selection and erection
(IEC 60079-14, Ed. 4.0(2007) MOD)

1 Scope

This part of AS/NZS 60079~~IEC 60079~~ contains the specific requirements for the design, selection and erection of electrical installations in hazardous areas associated with explosive atmospheres.

Where the equipment is required to meet other environmental conditions, for example, protection against ingress of water and resistance to corrosion, additional methods of protection may be necessary. The method used shall~~should~~ not adversely affect the integrity of the enclosure.

The requirements of this Standard apply only to the use of equipment under normal or near normal atmospheric conditions. For other conditions, additional precautions may be necessary. For example, most flammable materials and many materials which are normally regarded as non-flammable might burn vigorously under conditions of oxygen enrichment. Other precautions might also be necessary in the use of equipment under conditions of extreme temperature and pressure. Such precautions are beyond the scope of this Standard.

The requirements specified in this Standard are supplementary to and not alternative to any requirements given in AS/NZS 3000. Any alterations or modifications to AS/NZS 3000 in this document are specifically stated. ~~These requirements are in addition to the requirements for installations in non-hazardous areas~~.

This Standard applies to all electrical equipment including fixed, portable, transportable and personal, and installations, permanent or temporary.

It applies to installations at all voltages.

This Standard does not apply to

~~– electrical installations in mines susceptible to firedamp;~~

~~NOTE This Standard may apply to electrical installations in mines where explosive gas atmospheres other than firedamp may be formed and to electrical installations in the surface installation of mines.~~

- inherently explosive situations and dust from explosives or pyrophoric substances (for example explosives manufacturing and processing);
- rooms used for medical purposes;
- other than group I, electrical installations in areas where the hazard is due to hybrid mixtures of combustible dust and explosive gas, vapour or mist.

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No account is taken in this Standard of the toxic risks that are associated with most flammable gasses and liquids in concentrations that are usually very much less than the lower explosive limit. In locations where personnel may be exposed to potentially toxic concentrations of flammable material, appropriate precautions should be taken. Such precautions are outside the scope of this Standard. This Standard also does not take into account of any risk due to an emission of flammable or toxic gas from ~~the~~ dusts.

NOTE For further information, refer to the relevant departments/authorities in New Zealand or in each Australian State.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

References to international standards that are struck through in this clause are replaced by references to Australian or Australian/New Zealand Standards that are listed immediately thereafter.

AS 1299, *Electrical equipment for coal mines—Flameproof restrained plugs and receptacles*

AS 1300, *Electrical equipment for coal mines—Bolted flame-proof cable coupling devices*

AS 1482, *Electrical equipment for explosive atmospheres—Protection by ventilation—Type of protection v*

AS 1681, *Safety requirements for electrically heated Type 1 ovens in which flammable volatiles can occur*

AS 1828, *Electrical equipment for explosive atmospheres—Cable glands*

AS 2290.1, *Electrical equipment for coal mines—Maintenance and overhaul*, Part 1: *Maintenance of electrical equipment for hazardous areas*

AS 2380.2, *Electrical equipment for explosive atmospheres—Explosion-protection techniques* Part 2: *Flameproof enclosure d*

AS 2380.4, *Electrical equipment for explosive atmospheres—Explosion-protection techniques* Part 4: *Pressurized rooms or pressurized enclosures*

AS 2380.6, *Electrical equipment for explosive atmospheres—Explosion-protection techniques Part 6: Increased safety*

AS 2380.7, *Electrical equipment for explosive atmospheres—Explosion-protection techniques* Part 7: *Intrinsic safety i*

AS 2380.9, *Electrical equipment for explosive atmospheres—Explosion-protection techniques* Part 9: *Type of protection n—Non-sparking*

AS 2676.1, *Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings*, Part 1: *Vented cells*

AS 2676.2, *Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings*, Part 2: *Sealed cells*

AS 2832, *Cathodic protection of metals (all Parts)*

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AS 3011.1, *Electrical installations—Secondary batteries installed in buildings*, Part 1: *Vented cells*

AS 3011.2, *Electrical installations—Secondary batteries installed in buildings*, Part 2: *Sealed cells*

AS/NZS 1020, *The control of undesirable static electricity*

AS/NZS 1768, *Lightning protection*

AS/NZS 1802, *Electric cables—Reeling and trailing—For underground coal mining purposes*

AS/NZS 1826, *Electrical equipment for explosive gas atmospheres—Special protection—Type of protection 's'*

AS/NZS 1972, *Electric cables—Underground coal mines—Other than reeling and trailing*

AS/NZS 2053.1, *Conduits and fittings for electrical installations*, Part 1: *General requirements*

AS/NZS 2053.2, *Conduits and fittings for electrical installations*, Part 2: *Rigid plain conduits and fittings of insulating material*

AS/NZS 2053.5, *Conduits and fittings for electrical installations*, Part 5: *Corrugated conduits and fittings of insulating material*

AS/NZS 2053.7, *Conduits and fittings for electrical installations*, Part 7: *Rigid metal conduits and fittings*

AS/NZS 2053.8, *Conduits and fittings for electrical installations*, Part 8: *Flexible conduits and fittings of metal or composite material*

AS/NZS 2229, *Fuel dispensing equipment for explosive atmospheres*

AS/NZS 2243.8, *Safety in laboratories*, Part 8: *Fume cupboards*

AS/NZS 3000, *Electrical installations (known as the Australian/New Zealand Wiring Rules)*

AS/NZS 3191, *Electric flexible cords*

AS/NZS 3800, *Electrical equipment for explosive atmospheres—Repair and overhaul*

AS/NZS 4114.1, *Spray painting booths, designated spray painting areas and paint mixing rooms*, Part 1: *Design, construction and testing*

AS/NZS 4114.2, *Spray painting booths, designated spray painting areas and paint mixing rooms*, Part 2: *Installation and maintenance*

AS/NZS 4761.1, *Competencies for working with electrical equipment for hazardous areas (EEHA)—Competency Standards*

AS/NZS 4871, *Electrical equipment for underground coal mines*

AS/NZS 4871.1, *Electrical equipment for underground coal mines*, Part 1: *General requirements*

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~~IEC 60034-1, *Rotating electrical machines – Part 1: Rating and performance*~~

AS 60034.1, *Rotating electrical machines*, Part 101: *Rating and performance* (IEC 60034.1 MOD)

~~IEC 60034-5, *Rotating electrical machines – Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification*~~

AS 60034.5, *Rotating electrical machines*, Part 5: *Degrees of protection provided by the integral design of rotating electrical machines (IP code)—Classification*

~~IEC 60050-826, *International Electrotechnical Vocabulary – Part 826: Electrical installations*~~

AS 1852.826, *International Electrotechnical Vocabulary*, Part 826: *Electrical installations of buildings*

~~IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*~~

AS 1931.1, *High-voltage test techniques*. Part 1: *General definitions and test requirements*

IEC 60079 (all parts), *Explosive atmospheres*

~~IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*~~

AS/NZS 60079.0, *Explosive atmospheres*, Part 0: *Equipment—General requirements*

~~IEC 60079-1, *Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d"*~~

AS/NZS 60079.1, *Explosive atmospheres*, Part 1: *Equipment protection by flameproof enclosures 'd'*

~~IEC 60079-2, *Explosive atmospheres – Part 2: Equipment protection by pressurized enclosure "p"*~~

AS/NZ 60079.2, *Explosive atmospheres*, Part 2: *Equipment protection by pressurized enclosure 'p'*

~~IEC 60079-5, *Explosive atmospheres – Part 5: Equipment protection by powder filling "q"*~~

AS/NZS 60079.5, *Explosive atmospheres*, Part 5: *Equipment protection by powder filling 'q'*

~~IEC 60079-6, *Explosive atmospheres – Part 6: Equipment protection by oil immersion "o"*~~

AS/NZS 60079.6, *Explosive atmospheres*, Part 6: *Equipment protection by oil immersion 'o'*

~~IEC 60079-7, *Explosive atmospheres – Part 7: Equipment protection by increased safety "e"*~~

AS/NZS 60079.7, *Explosive atmospheres*, Part 7: *Equipment protection by increased safety 'e'*

~~IEC 60079.10, *Electrical apparatus for explosive gas atmospheres - Part 10: Classification of hazardous areas*~~

AS/NZS 60079.10.1, *Explosive atmospheres*, Part 10.1: *Classification of areas—Explosive gas atmospheres* (IEC 60079-1 Ed.1.0(2008) MOD)

~~IEC 60079-11, Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i"~~

AS/NZS 60079.11, *Explosive atmospheres*, Part 11: *Equipment protection by intrinsic safety 'i'*

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IEC/TR 60079-13, *Electrical apparatus for explosive gas atmospheres – Part 13: Construction and use of rooms or buildings protected by pressurization*

~~IEC 60079-14, *Electrical* apparatus *for explosive gas atmospheres – Part 14:Electrical installations in hazardous areas (other than mines)*~~

~~IEC 60079-15, *Electrical* apparatus *for explosive gas atmospheres – Part 15: Construction, test and marking of type of protection "n" electrical* apparatus~~

AS/NZS 60079.15, *Electrical apparatus for explosive gas atmospheres*, Part 15: *Construction, test and marking of type of protection 'n' electrical apparatus*

IEC 60079-16, *Electrical apparatus for explosive gas atmospheres – Part 16:Artificial ventilation for the protection of analyzer(s) houses*

~~IEC 60079-18, *Electrical* apparatus *for explosive gas atmospheres – Part 18:Construction, test and marking of type of protection encapsulation "m" electrical* apparatus~~

AS/NZS 60079.18, *Electrical apparatus for explosive gas atmospheres*, Part 18: *Construction, test and marking of type of protection encapsulation 'm' electrical apparatus*

IEC 60079-19, *Explosive atmospheres – Part 19: Equipment repair, overhaul and reclamation*

~~IEC 60079-25, *Electrical* apparatus *for explosive gas atmospheres – Part 25: Intrinsically safe systems*~~

AS/NZS 60079.25, *Electrical apparatus for explosive gas atmospheres*, Part 25: *Intrinsically safe systems*

~~IEC 60079-26, *Explosive atmospheres – Part 26: Equipment with equipment protection level (EPL) Ga*~~

AS/NZS 60079.26, *Explosive atmospheres*, Part 26: *Equipment with equipment protection level (EPL) Ga*

~~IEC 60079-27, *Electrical* apparatus *for explosive gas atmospheres – Part 27: Fieldbus intrinsically safe concept (FISCO) and Fieldbus non-incendive concept (FNICO)*~~

AS/NZS 60079.27, *Electrical apparatus for explosive gas atmospheres*, Part 27: *Fieldbus intrinsically safe concept (FISCO)*

~~IEC 60079-28, *Explosive atmospheres – Part 28: Protection of equipment and transmission systems using optical radiation*~~

AS/NZS 60079.28, *Explosive atmospheres*, Part 28: *Protection of equipment and transmission systems using optical radiation*

~~IEC 60079-29-1, *Explosive atmospheres – Part 29-1: Gas detectors – Performance requirements of detectors for flammable gases*~~

AS/NZS 60079.29.1, *Explosive atmospheres*, Part 29.1: *Gas detectors—Performance requirements of detectors for flammable gases*

~~IEC 60079-29-2, *Explosive atmospheres – Part 29-2: Gas detectors – Selection, installation, use and maintenance of detectors for flammable gases and oxygen*~~

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AS/NZS 60079.29.2, *Explosive atmospheres,* Part 29.2: *Gas detectors—Selection, installation, use and maintenance of detectors for flammable gases and oxygen*

IEC 60079-31, *Explosive atmospheres – Part 31: Equipment dust ignition protection by enclosure "tD"*[1]

IEC 60243-1, *Electrical strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

IEC 60332-1-2, *Tests on electric and optical cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable-Procedure for 1KW pre-mixed flame*

~~IEC 60364 (all parts) *Low-voltage electrical installations*~~

~~IEC 60364-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*~~

~~IEC 60529, *Degrees of protection provided by enclosure (IP code)*~~

AS 60529, *Degrees of protection provided by enclosures (IP code)*

IEC 60950 (all parts), *Information technology equipment – Safety*

IEC 61010-1, *Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements*

IEC 61241 (all parts), *Electrical apparatus for use in the presence of combustible dust*

~~IEC 61241-0, *Electrical* apparatus *for use in the presence of combustible dust – Part 0: General requirements*~~

AS/NZS 61241.0, *Electrical apparatus for use in the presence of combustible dust,* Part 0: *General requirements*

~~IEC 61241-1, *Electrical* apparatus *for use in the presence of combustible dust – Part 1: Protection by enclosures "tD"*~~

AS/NZS 61241.1, *Electrical apparatus for use in the presence of combustible dust,* Part 1: *Protection by enclosures 'tD'*

~~IEC 61241-2-1, *Electrical* apparatus *for use in the presence of combustible dust – Part 2: Test methods – Section 1: Methods for determining the minimum ignition temperatures of dust*~~

AS/NZS 61241.2.1, *Electrical apparatus for use in the presence of combustible dust,* Part 2.1: *Test methods—Methods for determining the minimum ignition temperatures of dust*

~~IEC 61241-4, *Electrical apparatus for use in the presence of combustible dust – Part 4:Type of protection "pD"*~~

AS/NZS 61241.4, *Electrical apparatus for use in the presence of combustible dust,* Part 4: *Type of protection 'pD'*

~~IEC 61241-10, *Electrical* apparatus *for use in the presence of combustible dust – Part 10: Classification of areas where combustible dusts are or may be present*~~

~~[1] To be published~~

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AS/NZS 61241.10, *Electrical apparatus for use in the presence of combustible dust*, Part 10: *Classification of areas where combustible dusts are or may be present*

~~IEC 61241-11, *Electrical* apparatus *for use in the presence of combustible dust – Part 11: Protection by intrinsic safety 'iD'*~~

AS/NZS 61241.11, *Electrical apparatus for use in the presence of combustible dust*, Part 11: *Protection by intrinsic safety 'iD'*

AS/NZS 61241-18, *Electrical apparatus for use in the presence of combustible dust – Part 18: Protection by encapsulation 'mD'*

IEC 61285, *Industrial process control – Safety of analyser houses*

IEC 61558-2-6, *Safety of power transformers, power supply units and similar – Part 2-6: Particular requirements for safety isolating transformers for general use*

~~IEC 62305-3, *Protection against lightning – Part 3 Physical damage to structures and life hazard*~~

ISO 10807, *Pipework – Corrugated flexible metallic hose assemblies for the protection of electric cables in explosive atmospheres*

BS 7361, *Cathodic protection (all Parts)*

CENELEC/TR 50427, *Assessment of inadvertent ignition of flammable atmospheres by radio-frequency radiation—Guide*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in AS/NZS 60079.0~~IEC 60079-0~~ and the following apply.

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

3.1 General

3.1.1
competent body
individual or organization which can demonstrate appropriate technical knowledge and relevant skills to make the necessary assessments of the safety aspect under consideration

3.1.2
verification dossier
set of documents showing the compliance of electrical equipment and installations

3.2 Hazardous areas

3.2.1
hazardous area
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

NOTE For the purposes of this Standard, an area is a three-dimensional region or space.

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3.2.2
non-hazardous area
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

3.2.3
group (of an electrical equipment for explosive atmospheres)
classification of electrical equipment related to the explosive atmosphere for which it is to be used

NOTE Electrical equipment for use in explosive atmospheres is divided into three groups:

- group I: electrical equipment for mines susceptible to firedamp;
- group II (which can be divided into subgroups): electrical equipment for places with an explosive gas atmosphere, other than mines susceptible to firedamp (see 5.5);
- group III (which can be divided into subgroups): electrical equipment for places with an explosive dust atmosphere (see 5.5).

3.2.4
maximum permissible surface temperature
highest temperature that a surface of electrical ~~apparatus~~ equipment is allowed to reach in practical service to avoid ignition

NOTE This definition does not apply to gases. The maximum permissible surface temperature will depend upon the type of dust, whether as a cloud or layer, if a layer, its thickness and the application of a safety factor. For details see 5.6.3.

3.2.5
zones
hazardous areas classified into zones based upon the frequency of the occurrence and duration of an explosive atmosphere

3.2.6
Zone 0
place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously or for long periods or frequently

3.2.7
Zone 1
place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally

3.2.8
Zone 2
place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only

3.2.9
Zone 20
area in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently

3.2.10
Zone 21
area in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur, occasionally, in normal operation

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3.2.11
Zone 22
area in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only

3.3 Flameproof enclosure

3.3.1
flameproof enclosure 'd'
type of protection in which the parts capable of igniting an explosive gas atmosphere are provided with an enclosure which can withstand the pressure developed during an internal explosion of an explosive mixture and which prevents the transmission of the explosion to the explosive gas atmosphere surrounding the enclosure

3.3.2
pressure-piling
increased pressure resulting from an ignition, in a compartment or subdivision of an enclosure due to a gas mixture being pre-compressed, e.g. due to a primary ignition in another compartment or subdivision

NOTE This may lead to a higher maximum pressure than would otherwise be expected.

3.4 Increased safety

3.4.1
increased safety 'e'
type of protection applied to electrical equipment in which additional measures are applied so as to give increased security against the possibility of excessive temperatures and of the occurrence of arcs and sparks in normal service or under specified abnormal conditions

3.4.2
initial starting current
I_A
highest r.m.s. value of current absorbed by an a.c. motor at rest or by an a.c. magnet with its armature clamped in the position of maximum air gap, when supplied at the rated voltage and rated frequency

3.4.3
starting current ratio
I_A/I_N
ratio between initial starting current I_A and rated current I_N

3.4.4
time
t_E
time taken for an a.c. rotor or stator winding, when carrying the initial starting current I_A, to be heated up to the limiting temperature from the temperature reached in rated service at the maximum ambient temperature

3.5 Intrinsic safety – General

3.5.1
intrinsic safety 'i'
type of protection based upon the restriction of electrical energy within equipment and of interconnecting wiring exposed to an explosive atmosphere to a level below that which can cause ignition by either sparking or heating effects

NOTE Because of the method by which intrinsic safety is achieved, it is necessary to ensure that not only the electrical equipment exposed to the explosive atmosphere but also other electrical equipment with which it is interconnected is suitably constructed.

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3.5.2
intrinsically safe apparatus
electrical apparatus in which all the circuits are intrinsically safe

NOTE Intrinsically safe apparatus should conform to AS/NZS 60079.11~~IEC 60079-11~~, level of protection 'ia', 'ib' or 'ic'.

3.5.3
galvanic isolation
arrangement within an item of intrinsically safe apparatus or associated apparatus which permits the transfer of signals or power between two circuits without any direct electrical connection between the two

NOTE Galvanic isolation frequently utilizes either magnetic (transformer or relay) or opto-coupled elements.

3.5.4
simple apparatus
electrical component or combination of components of simple construction with well-defined electrical parameters which is compatible with the intrinsic safety or energy-limited safety of the circuit in which it is used

~~NOTE The following apparatus is considered to be simple apparatus:~~

~~a) passive components, e.g. switches, junction boxes, resistors and simple semi-conductor devices;~~

~~b) sources of stored energy with well-defined parameters, e.g. capacitors or inductors, whose values are considered when determining the overall safety of the system;~~

~~c) sources of generated energy, e.g. thermocouples and photocells, which do not generate more than 1,5 V, 100 mA and 25 mW. Any inductance or capacitance present in these sources of energy are considered as in b) above.~~

3.5.5
intrinsically safe circuit
circuit in which all the equipment is either intrinsically safe apparatus or simple apparatus

NOTE The circuit may also contain associated apparatus.

3.5.6
intrinsically safe electrical system
assembly of interconnected items of electrical equipment, described in a descriptive system document, in which the circuits or parts of circuits intended to be used in an explosive atmosphere are intrinsically safe

3.5.7
intrinsically safe sub-circuit
part of an intrinsically safe circuit which is galvanically isolated from another part or other parts of the same intrinsically safe circuit

3.6 Intrinsic safety parameters

3.6.1
maximum external inductance to resistance ratio
(L_o/R_o)
ratio of inductance (L_o) to resistance (R_o) of any external circuit connected to the connection facilities of the electrical equipment without invalidating intrinsic safety

3.7 Pressurization

3.7.1
pressurization 'p'
technique of guarding against the ingress of the external atmosphere into an enclosure by maintaining a protective gas therein at a pressure above that of the external atmosphere.

NOTE Pressurization should conform to AS/NZS 60079.2~~IEC 60079-2~~ 'px', 'py' or 'pz'.

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3.7.2
continuous dilution (flow)
continuous supply of a protective gas, after purging, at such a rate that the concentration of a flammable substance inside the pressurized enclosure is maintained at a value outside the explosive limits at any potential ignition source (that is, outside the dilution area)

NOTE The dilution area is an area in the vicinity of an internal source of release where the concentration of a flammable substance is not diluted to a safe concentration.

3.7.3
leakage compensation
flow of protective gas sufficient to compensate for any leakage from the pressurized enclosure and its ducts

3.7.4
static pressurization
maintenance of an overpressure within a pressurized enclosure without the addition of protective gas in the hazardous area

3.8 Type of protection 'n'

3.8.1
type of protection 'n'
type of protection applied to electrical equipment such that, in normal operation and in certain specified abnormal conditions, it is not capable of igniting a surrounding explosive atmosphere

NOTE 1 Type of protection should conform to AS/NZS 60079.15~~IEC 60079-15~~ 'nA', 'nC', 'nL' or 'nR'.

NOTE 2 Additionally, the requirements of the equipment standard are intended to ensure that a fault capable of causing ignition is not likely to occur.

NOTE 3 An example of a specified abnormal condition is a luminaire with a failed lamp.

3.8.2
energy-limited apparatus
electrical equipment in which the circuits and components are constructed according to the concept of energy limitation

3.8.3
associated energy-limited apparatus
electrical equipment which contains both energy-limited and non-energy-limited circuits and is constructed so that the non-energy-limited circuits cannot adversely affect the energy-limited circuits

3.9

oil-immersion 'o'
type of protection in which the electrical equipment or parts of the electrical equipment are immersed in a protective liquid in such a way that an explosive gas atmosphere which may be above the liquid or outside the enclosure cannot be ignited

3.10

powder filling 'q'
type of protection in which the parts capable of igniting an explosive gas atmosphere are fixed in position and completely surrounded by filling material to prevent the ignition of an external explosive atmosphere

NOTE The type of protection may not prevent the surrounding explosive gas atmosphere from penetrating into the equipment and components and being ignited by the circuits. However, due to the small free volumes in the filling material and due to the quenching of a flame which may propagate through the paths in the filling material,an external explosion is prevented.

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3.11

encapsulation 'm'
type of protection whereby parts that are capable of igniting an explosive atmosphere by either sparking or heating are enclosed in a compound in such a way that the explosive atmosphere cannot be ignited under operating or installation conditions

NOTE Encapsulation should conform to AS/NZS 60079.18~~IEC 60079-18~~ 'ma', 'mb' or 'mc'.

3.12 dust ignition protection

3.12.1 ~~3.12~~
dust ignition protection type 'tD'
type of protection whereby all electrical apparatus is protected by an enclosure to avoid ignition of a dust layer or cloud

NOTE This definition is used in AS/NZS 61241.1.

3.12.2
dust ignition protection by enclosure 't'
type of protection for explosive dust atmospheres where electrical equipment is provided with an enclosure providing dust ingress protection and a means to limit surface temperatures

NOTE This definition will be used in the future AS/NZS 60079.31.

3.13 Electrical supply systems

3.13.1
protective extra-low voltage
(PELV)
electric system in which the voltage cannot exceed the value of extra-low voltage:

- under normal conditions, and
- under single fault conditions, except earth faults in other electric circuits

[IEV 826-12-32]

3.13.2
safety extra-low voltage
(SELV)
electric system in which the voltage cannot exceed the value of extra-low voltage:

- under normal conditions and
- under single fault conditions, including earth faults in other electric circuits

[IEV 826-12-31]

3.14 Equipment

3.14.1
fixed
equipment fastened to a support, or otherwise secured in a specific location

[IEV 826-07-07]

3.14.2
transportable
equipment not intended to be carried by a person nor intended for fixed installation

NOTE For Group I applications, AS/NZS 4871 defines transportable and mobile machines. For the purposes of this Standard, Group I applications should read transportable as being equivalent to the definition of transportable in AS/NZS 4871 and include mobile machines.

3.14.3
portable
equipment intended to be carried by a person

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3.14.4
personal
equipment intended to be supported by a person's body during normal use

4 General

4.1 General requirements

Hazardous areas are classified into Groups I, II and III. Groups II and III are further classified into zones 0, 1 and 2 for gases vapours and mists according to AS/NZS 60079.10.1~~IEC 60079-10~~ , and into zones 20, 21 and 22 for combustible dusts according to AS/NZS 61241.10~~IEC 61241-10~~/IEC 60079-10-2, in order to facilitate the selection of appropriate electrical equipment and the design of suitable electrical installations.

Electrical equipment should, as far as is reasonably practicable, be located in non-hazardous areas. Where it is not possible to do this, it should be located in an area with the lowest requirements.

~~Electrical installations in hazardous areas shall also comply with the appropriate requirements for installations in non-hazardous areas. However the requirements for non-hazardous areas are insufficient for installations in hazardous areas.~~

Electrical equipment and materials shall be installed and used within their electrical ratings for power, voltage, current, frequency, duty and such other characteristics where non-conformity might jeopardize the safety of the installation. In particular, care shall be taken to ensure that the voltage and frequency are appropriate to the supply system with which the equipment is used and that the temperature classification has been established for the correct voltage, frequency and other parameters.

All electrical equipment and wiring in hazardous areas shall be selected and installed in accordance with ~~Clauses~~ 5 to 9 inclusive and the additional requirements for the particular type of protection (~~Clauses~~ 10 to 18).

Equipment shall be installed in accordance with its documentation. It shall be ensured that replaceable items are of the correct type and rating. On completion of the erection, initial inspection of the equipment and installation shall be carried out in accordance with AS/NZS 60079.17~~IEC 60079-17~~ or for Group I, AS/NZS 2290.1.

Installations should be designed and equipment and materials installed with a view to providing ease of access for inspection and maintenance (AS/NZS 60079.17~~IEC 60079-17~~ or for Group I, AS/NZS 2290.1).

In certain cases it is only by the application of methods or conditions of control that the required degree of safety can be obtained. Such methods may include the use of procedures and/or the use of monitoring devices, such as gas detectors, or pressure, temperature or flow devices. Depending on the degree and type of hazard involved, the associated conditions of control initiated by the monitoring device may include one of the following:

(a) Automatic disconnection of the power supply.

(b) Automatic initiation of an alarm followed by an associated manual procedure to restore the integrity of the system.

(c) A manual procedure, whereby one or other of the parameters necessary for an explosive condition is retained under continuous control.

NOTE Conditions of control would apply where it is not practicable to comply with other requirements of this Standard.

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~~Equipment and systems used in exceptional circumstances, for example research, development, pilot plant where explosion protected equipment is not available, need not meet the requirements of this Standard, provided that the installation is under the supervision of a competent body and one or more of the following conditions, as appropriate, are met:~~

- ~~measures are taken to ensure that an explosive atmosphere does not occur; or~~
- ~~measures are taken to ensure that this equipment is disconnected on the occurrence of an explosive atmosphere, in which case ignition after disconnection, e.g. due to heated parts, shall be prevented also; or~~
- ~~measures are taken to ensure that persons and the environment are not endangered by fires or explosions.~~

In addition, the measures or conditions of control to be taken shall be documented by ~~to be taken are laid down in writing by~~ a competent body who:

- is familiar with the requirements for this, and any other relevant standards and code of practice concerning the use of electrical equipment and systems for use in hazardous areas,
- has~~have~~ access to all information necessary to carry out the assessment.

Examples of specific applications are provided in Annex ZA. Such applications may be treated from first principles to meet the requirements of this Standard or may follow the requirements identified in Annex ZA. Specific applications include:

- Ovens in which flammable volatiles occur
- Fuel dispensers
- Fixed electrostatic equipment
- Electrostatic hand spray guns
- Powder coatings
- Laboratory fume cupboards, and
- Secondary batteries in buildings.

4.2 Documentation

It is necessary to ensure that any installation complies with the appropriate certificates as well as with this Standard and any other requirements specific to the plant on which the installation takes place. To achieve this result, a verification dossier shall be prepared for every installation and shall be either kept on the premises or stored in another location. In the latter case, a document shall be left on the premises indicating who the owner or owners are and where that information is kept, so that when required, copies may be obtained.

In order to correctly install or extend an existing installation, the following information, additional to that required for non-hazardous areas, is required, where applicable:

- area classification documents (see AS/NZS 60079.10.1~~IEC 60079-10~~ and AS/NZS 61241.10~~IEC 61241-10~~/IEC 60079-10-2) with plans showing the classification and extent of the hazardous areas including the zoning (and maximum permissible dust layer thickness if the hazard is due to combustible dust);
- optional assessment of consequences of ignition (see 5.3);
- instructions for erection and connection;
- documents for electrical equipment with conditions of use, e.g. for equipment with certificate numbers which have the suffix 'X';
- descriptive system document for the intrinsically safe system (see 12.2.5);
- ~~manufacturer's/qualified person's declaration;~~

~~NOTE The manufacturer's/qualified person's declaration is applicable to situations where uncertified equipment (other than simple~~ apparatus ~~in intrinsically safe or energy limited circuits) is used.~~

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- necessary information to ensure correct installation of the equipment provided in a form which is suitable to the personnel responsible for this activity (see AS/NZS 60079.0~~IEC 60079-0~~ Instructions);
- information necessary for inspection, e.g. list and location of equipment, spares, technical information (see AS/NZS 60079.17~~IEC 60079-17~~ or for Group I, AS/NZS 2290.1);
- details of any relevant calculation, e.g. for purging rates for instruments or analyser houses;
- if repairs are to be carried out by the user or a repairer, information necessary for the repair of the electrical equipment (see IEC 60079-19);
- where applicable, gas or vapour classification in relation to the group or subgroup of the electrical equipment;
- temperature class or ignition temperature of the gas or vapour involved;
- external influences and ambient temperature;
- records of selection criteria for cable entry systems for compliance with the requirements for the particular type of protection;
- drawings and schedules relating to circuit identification;
- In New Zealand, the Hazardous Area Statement of Periodic Verification on completion of a periodic inspection. (refer to Annex ZB).

Additional requirements in the case of dust:

- documentation relating to the suitability of the equipment for the area and environment to which it will be exposed, e.g. temperature ratings, type of protection, IP rating, corrosion resistance
- material characteristics including electrical resistivity, the minimum ignition temperature of the combustible dust cloud, minimum ignition temperature of the combustible dust layer and minimum ignition energy of the combustible dust cloud shall be recorded;
- ~~the plans showing types and details of wiring systems;~~
- ~~records of selection criteria for cable entry systems for compliance with the requirements for the particular type of protection;~~
- ~~drawings and schedules relating to circuit identification.~~

NOTE The verification dossier may be kept as hard copy or in electronic form. Methods accepted by legislation ~~in each country~~ may vary the form in which the documentation will be legally accepted.

It shall be the responsibility of the person(s) in control of the installation or parts thereof to ensure that the relevant information is produced but the preparation of the documentation may be delegated to expert bodies or organizations.

4.3 Assurance of conformity of equipment

4.3.1 Equipment with certificates according to IEC standards or AS/NZS Standards

~~Equipment with certificate according to IEC 60079 series, IEC 60079-29-1 and IEC 60079-29-2 or IEC 61241 series, meets the requirements for hazardous areas, when selected and installed in accordance with this Standard.~~

Equipment with acceptable certification according to hazardous areas Standards published as AS/NZS Standards, IEC Standards or AS Standards as listed in Tables 2.1 for gases and vapours or Table 2.2 for combustible dusts as appropriate, is acceptable when selected and installed in accordance with this Standard.

Acceptable certification of equipment shall be covered by a Certificate of Conformity which—

(a) is issued in accordance with a Type 5 Scheme complying with ISO/IEC Guide 67; and

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(b) is issued by a body operating within the IECEx Scheme or the ANZEx Scheme or by a certification body with accreditation by JAS-ANZ or an organization that has a Mutual Recognition Agreement (MRA) with JAS-ANZ covering Product Certification of Explosion Protected Equipment; and

(c) certification shall be issued by a Certification Body or agency with current accreditation or acceptance by way of independent assessment complying with ISO/IEC Guide 65. The accreditation or acceptance shall show Ex certification for an ISO Type 5 system in the Ex field, as part of their capability; and

(d) the certification system shall also require—

(i) testing of samples for compliance with relevant IEC Standards or Australian Standards;

(ii) assessment and audit of manufacturers by the Certification body, for compliance of their quality system according to ANZEx or IECEx requirements or equivalent; and

(iii) on-going surveillance audits of manufacturers, in accordance with ANZEx or IECEx quality requirements or equivalent, by the Certification body, responsible for issuing the Certificate. This does not preclude the Certification Body arranging to have surveillance audits conducted by another body operating as their agent.

Equipment certified under the IECEx Scheme and registered on the IECEx database (www.iecex.com) or the ANZEx Scheme registered on the ANZEx database (www.anzex.com.au) meets these criteria. Equipment certified under the AUSEx Scheme is acceptable when manufactured within the certificate validity period.

NOTE For Ex 'v' installations and where Ex 'p' is applied to buildings, and the like, that are assembled and/or installed on site, certification may not be appropriate. In such cases a statement of assessment by a competent person may be accepted.

4.3.2 Equipment without certificates according to acceptable~~IEC S~~standards

~~Apart from simple~~ apparatus ~~used within an intrinsically safe circuit, the selection of equipment for use in a hazardous area, which either has no certificate at all or it has a certificate but not in accordance with one of the standards listed in 4.3.1, shall be restricted to circumstances where suitable equipment with certificate is not obtainable. The justification for the use of such equipment, along with the installation and marking requirements, shall be made by the user, manufacturer or third party and be recorded in the verification dossier. The following requirements of this Standard, under these conditions, may not be applicable.~~

Apart from simple apparatus used within an intrinsically safe circuit, the selection of equipment for use in a hazardous area, which has a certificate but not in accordance with one of the Standards listed in 4.3.1, shall be restricted to circumstances where suitable equipment with acceptable certification is not obtainable.

The justification for the use of such equipment certified to an alternative Standard to those referenced in 4.3.1, along with the selection, installation, marking, inspection, maintenance, repair and overhaul requirements, shall be made by the person(s) in control of the installation using a competent body.

The justification shall be included as part of the verification dossier. This may take the form of a Conformity Assessment Document. Guidance for the preparation of a Conformity Assessment Document can be found in Annex ZD.

4.3.2.1 For use in Australia

For Group I installations, equipment certified to an alternative Standard is not accepted.

NOTE Regulatory authorities may specify additional requirements for acceptance of equipment certified to alternative Standards.

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4.3.2.2 For New Zealand

Proof of compliance can be demonstrated with one of the following regimes of compliance (including any marking requirements):

(a) European Council Directive 94/9/EC (ATEX) on Hazardous Area Equipment.

(b) For battery powered equipment without integrated chargers—

(i) approvals issued by FM Approvals of the United States of America; or

(ii) certified by Underwriters Laboratories Inc (UL) of the United States of America to ANSI/UL 60079 series of Standards.

All the requirements applying to the supplier/sponsor/manufacturer under these regimes or systems, shall be met by a person or organization located in New Zealand who is responsible for the supply of product in New Zealand. The person or organization in New Zealand may at times be a company importing the product directly for their own use.

4.3.3 Selection of repaired, second hand or existing equipment

When ~~it is intended that~~ existing, second hand or repaired equipment is to be installed in a new installation, it shall only be reused if:

a) it can be verified that the equipment is unmodified and is in a condition that meets the content of the original certificate (including any repair or overhaul) and

b) any changes to equipment Standards relevant to the item considered do not require additional safety precautions.

In addition, the procedure set out in Figure 4.1 shall be followed.

NOTE 1 The act of introducing equipment where specifications are not identical to an existing installation may cause that installation to be deemed 'new'.

NOTE 2 In the situation where equipment is dual certified (e.g. as intrinsically safe apparatus and independently as flameproof equipment~~apparatus~~) care should be taken that the type of protection used for its new intended location has not been compromised by the way in which it was originally installed and subsequently maintained. Different protection concepts have different maintenance requirements. In the above example: equipment~~apparatus~~ originally installed as flameproof should only be used as flameproof unless it can be verified that there has been no damage to the safety components within the intrinsically safe circuit on which safety depends by, for example, an over-voltage at the supply terminals or if it was originally installed as intrinsically safe then a check is required to ensure that there has been no damage to the flamepaths before it can be used as flameproof.

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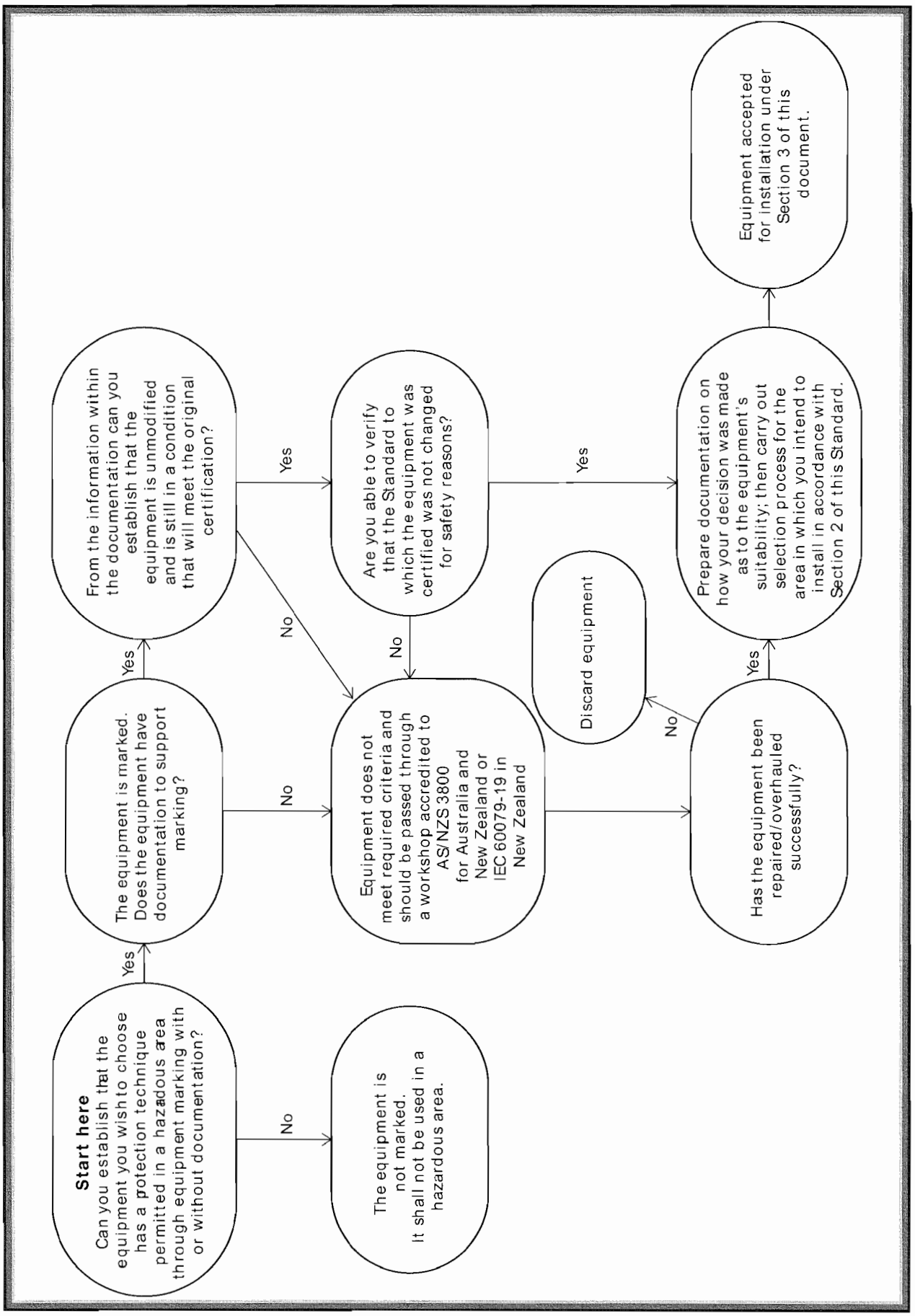

Figure 4.1 – Flow chart procedure for selection of repaired or existing equipment

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4.4 CompetencyQualifications of personnel

The design of the installation, the selection of equipment and the erection covered by this Standard shall be carried out only by persons whose training has included instruction on the various types of protection and installation practices, relevant rules and regulations and on the general principles of area classification. The competency of the person shall be relevant to the type of work to be undertaken (see Annex F).

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

Competency may be demonstrated in accordance with AS/NZS 4761, *Competencies for working with electrical equipment for hazardous areas (EEHA)*, or equivalent training and assessment framework.

NOTE Competency may be demonstrated in accordance with a training and assessment framework relevant to national regulations or standards or user requirements.

5 Selection of equipment (excluding cables and conduits)

5.1 Information requirements

In order to select the appropriate electrical equipment for hazardous areas, the following information is required:

- classification of the hazardous area including the equipment protection level requirements where applicable;
- where applicable, gas, vapour or dust classification in relation to the group or subgroup of the electrical equipment;
- temperature class or ignition temperature of the gas or vapour involved;
- minimum ignition temperature of the combustible dust cloud, minimum ignition temperature of the combustible dust layer and minimum ignition energy of the combustible dust cloud;
- external influences and ambient temperature.

NOTE It is recommended that the equipment protection levels (EPL) requirements are recorded on the area classification drawing (See AS/NZS 60079.10.1 and AS/NZS 61241.10). This should also apply even if consequences have not been subjected to risk assessment, (see 5.3 and Annex I). The assignment of EPLs will make the future allocation of equipment types and installation requirements easier as EPL allocations become consolidated into equipment marking and common practice.

It is recommended that the equipment protection levels (EPL) requirements are recorded on the area classification drawing. This should also apply even if consequences have not been subjected to risk assessment (see 5.3 and Annex I).

5.2 Zones

Hazardous areas are classified into zones. Zoning does not take account of the potential consequences of an explosion.

NOTE The previous editions of this Standard allocated protection concepts to zones, on the statistical basis that the more frequent the occurrence of an explosive atmosphere, the greater the level of safety required against the possibility of an ignition source.

5.3 Relationship between Equipment protection levels (EPLs) and zones

Where only the zones are indentified in the area classification documentation, then the relationship between EPLs and zones from Table 1 shall be followed.

NOTE EPLs are introduced in this Standard for the first time. EPLs need not be assigned to existing installations where hazardous area classifications have previously been applied. Throughout the remainder of this Standard EPLs are used but these references can be interpreted as zones, according to Table 1, where only zones are assigned.

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Table 1 – Equipment protection levels (EPLs) where only zones are assigned

Zone	Equipment protection levels (EPLs)
0	'Ga'
1	'Ga' or 'Gb'
2	'Ga', 'Gb' or 'Gc'
20	'Da'
21	'Da' or 'Db'
22	'Da', 'Db' or 'Dc'

Where the EPLs are identified in the area classification documentation, those requirements for selection of the equipment shall be followed.

NOTE As an alternative to the relationship given in Table 1 between EPLs and zones, EPLs may be determined on the basis of risk, i.e. taking into account the consequences of an ignition. This may, under certain circumstances, require a higher EPL or permit a lower EPL than the defined in Table 1.

5.4 Selection of equipment according to EPLs

5.4.1 Relationship between EPLs and types of protection

The recognised types of protection according to IEC standards have been allocated EPLs according to ~~Table 2~~Tables 2.1 and 2.2.

Table 2.1 – Gases and vapours—Relationship between EPLs and types of protection and applicable Standards

EPL	Type of protection	Code	Group	According to	Comments
'Ma'	Intrinsically safe	'ia'	I	AS/NZS 60079.11 AS 2380.7	
	Encapsulation	'ma'	I	AS/NZS 60079.18	
	Special protection	's'	I	AS/NZS 1826	Where certified for use in Zone 0
	Two independent types of protection each meeting EPL 'Mb'		I	AS/NZS 60079	In accordance with 5.4.2
'Mb'	Intrinsically safe	'ib'	I	AS/NZS 60079.11 AS 2380.7	
	Flameproof	'd'	I	AS/NZS 60079.1 AS 2380.2	
	Increased safety	'e'	I	AS/NZS 60079.7 AS 2380.6	
	Pressurized enclosures	'p' 'px'	I	AS/NZS 60079.2 AS 2380.4	
	Encapsulation	'm' 'mb'	I	AS/NZS 60079.18	
	Powder filling	'q'	I	AS/NZS 60079.5	
	Special protection	's'	I	AS/NZS 1826	Where certified for use in Zone 1
'Ga'	Intrinsically safe	'ia'	II	AS/NZS 60079.11 AS 2380.7 IEC 60079-11	
	Encapsulation	'ma'	II	AS/NZS 60079.18 IEC 60079-18	
	Two independent types of protection each meeting EPL 'Gb'		II	AS/NZS 60079.26 IEC 60079-26	
	Protection of equipment and transmission systems using optical radiation		II	AS/NZS 60079.28	Where certified for use in Zone 0.
				IEC 60079-28	Where certified for use in Zone 0.
	Special Protection	's'	II	AS/NZS 1826	Where certified for use in Zone 0.

(continued)

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EPL	Type of protection	Code	Group	According to	Comments
'Gb'	Flameproof enclosures	'd'	II	AS/NZS 60079.1	
				AS 2380.2	
				IEC 60079-1	
	Increased safety	'e'	II	AS/NZS 60079.7	
				AS 2380.6	
				IEC 60079-7	
	Intrinsically safe	'ib'	II	AS/NZS 60079.11	
				AS 2380.7	
				IEC 60079-11	
	Encapsulation	'm' 'mb'	II	AS/NZS 60079.18	
				AS 2431	
				IEC 60079-18	
	Oil immersion	'o'	II	AS/NZS 60079.6	
				IEC 60079-6	
	Pressurized enclosures	'p' 'px' 'py'	II	AS/NZS 60079.2	
				AS 2380.4	According to Zone 1 requirements
				IEC 60079-2	
	Powder filling	'q'	II	AS/NZS 60079.5	
				IEC 60079-5	
	Fieldbus intrinsically safe concept (FISCO)		II	AS/NZS 60079.27	AS/NZS 60079.27, Ed. 2.0:2008 only
				IEC 60079-27	
	Protection of equipment and transmission systems using optical radiation		II	AS/NZS 60079.28	Where certified for use in Zone 1.
				IEC 60079-28	Where certified for use in Zone 1.
	Special protection	's'	II	AS/NZS 1826	Where certified for use in Zone 1.
'Gc'	Intrinsically safe	'ic'	II	AS/NZS 60079.11	
				IEC 60079-11	
	Encapsulation	'mc'	II	AS/NZS 60079.18	
				IEC 60079-18	
	Non-sparking	'n' 'nA'	II	AS/NZS 60079.15	
				AS 2380.9	
				IEC 60079-15	2nd edition (2001) of IEC60079-15 not accepted unless reviewed according to 4.3.2
	Restricted breathing	'nR'	II	AS/NZS 60079.15	
				AS 2380.9	
				IEC 60079-15	2nd edition (2001) of IEC60079-15 not accepted unless reviewed according to 4.3.2
	Energy limitation	'nL'	II	AS/NZS 60079.15	
				AS 2380.9	
				IEC 60079-15	2nd edition (2001) of IEC60079-15 not accepted unless reviewed according to 4.3.2
	Sparking equipment	'nC'	II	AS/NZS 60079.15	
				AS 2380.9	
				IEC 60079-15	2nd edition (2001) of IEC60079-15 not accepted unless reviewed according to 4.3.2
	Pressurized enclosures	'p' 'pz'	II	AS/NZS 60079.2	
				AS 2380.4	According to Zone 2 requirements
				IEC 60079-2	
	Fieldbus non-incendive concept (FNICO)		II	AS/NZS 60079.27	AS/NZS 60079.27, Ed. 1.0:2006, applies for FNICO
				IEC 60079-27	
	Protection of equipment and transmission systems using optical radiation		II	AS/NZS 60079.28	Where certified for use in Zone 2.
				IEC 60079-28	Where certified for use in Zone 2.
	Special protection	's'	II	AS/NZS 1826	Where certified for use in Zone 2.
NOTE For protection by ventilation, Ex 'v' in accordance with AS 1482, refer to 19.					

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Table 2.2 – Combustible dusts—Relationship between EPLs and types of protection and applicable Standards

EPL	Type of protection	Code	Group	According to	Comments
'Da'	Intrinsically safe	'ia'	III	AS/NZS 60079.11 [1)]	
				AS/NZS 61241.11	Equipment identified as Ex iaD
				AS 2380.7 [1)]	
				IEC 60079-11 [1)]	
	Encapsulation	'ma'	III	AS/NZS 60079.18	
				IEC 60079-18	
	Protection by enclosure	'ta'	III	AS/NZS 61241.1	Equipment identified as Ex tD A20
				AS/NZS 61241.1.1	Equipment identified as DIP A20
				AS/NZS 60079.31	
				IEC 60079-31	
'Db'	Intrinsically safe	'ib'	III	AS/NZS 60079.11 [1)]	
				AS/NZS 61241.11	Equipment identified as Ex ibD
				AS 2380.7 [1)]	
				IEC 60079-11 [1)]	
	Encapsulation	'mb'	III	AS/NZS 60079.18	Equipment identified as Ex m and Ex mb
				AS 2431	Equipment identified as Ex m
				IEC 60079-18	Equipment identified as Ex m and Ex mb
				AS/NZS 61241.18	Equipment identified as Ex mD
				IEC 61241-18	Equipment identified as Ex mD
	Protection by enclosure	'tb'	III	AS/NZS 61241.1	Equipment identified as Ex tD A21
				AS/NZS 61241.1.1	Equipment identified as DIP A21
				AS 2236	Equipment identified as DIP
				AS/NZS 60079.31	
				IEC 60079-31	
	Pressurized enclosures	'p'	III	AS 2380.4	
				AS/NZS 61241.4	Equipment identified as Ex pD
				IEC 61241-4	Equipment identified as Ex pD
'Dc'	Intrinsically safe	'ic'	III	AS/NZS 60079-11	
				IEC 60079-11	
	Protection by enclosure	'tc'	III	AS/NZS 60079.31	
				IEC 60079-31	
	Pressurized enclosures	'pD'	III	IEC 61241-4	

[1)] – Additional installation requirements apply – see 5.4.5

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Table 2 – Relationship between types of protection and EPLs

EPL	Type of protection	Code	According to
'Ga'	Intrinsically safe	'ia'	IEC 60079-11
	Encapsulation	'ma'	IEC 60079-18
	Two independent types of protection each meeting EPL 'Gb'		IEC 60079-26
	Protection of equipment and transmission systems using optical radiation		IEC 60079-28
'Gb'	Flameproof enclosures	'd'	IEC 60079-1
	Increased safety	'e'	IEC 60079-7
	Intrinsically safe	'ib'	IEC 60079-11
	Encapsulation	'm' 'mb'	IEC 60079-18
	Oil immersion	'o'	IEC 60079-6
	Pressurized enclosures	'p', 'px' or 'py'	IEC 60079-2
	Powder filling	'q'	IEC 60079-5
	Fieldbus intrinsically safe concept (FISCO)		IEC 60079-27
	Protection of equipment and transmission systems using optical radiation		IEC 60079-28
'Gc'	Intrinsically safe	'ic'	IEC 60079-11
	Encapsulation	'mc'	IEC 60079-18
	Non-sparking	'n' or 'nA'	IEC 60079-15
	Restricted breathing	'nR'	IEC 60079-15
	Energy limitation	'nL'	IEC 60079-15
	Sparking equipment	'nC'	IEC 60079-15
	Pressurized enclosures	'pz'	IEC 60079-2
	Fieldbus non-incendive concept (FNICO)		IEC 60079-27
	Protection of equipment and transmission systems using optical radiation		IEC 60079-28
'Da'	Intrinsically safe	'iD'	IEC 60079-11
	Encapsulation	'mD'	IEC 60079-18
	Protection by enclosure	'tD'	IEC 60079-31
'Db'	Intrinsically safe	'iD'	IEC 60079-11
	Encapsulation	'mD'	IEC 60079-18
	Protection by enclosure	'tD'	IEC 60079-31
	Pressurized enclosures	'pD'	IEC 61241-4
'Dc'	Intrinsically safe	'iD'	IEC 60079-11
	Encapsulation	'mD'	IEC 60079-18
	Protection by enclosure	'tD'	IEC 60079-31
	Pressurized enclosures	'pD'	IEC 61241-4

5.4.2 Equipment for use in locations requiring EPL 'Ma', 'Ga' or 'Da'

NOTE: For Group I, equipment marked as EPL 'Ma' is the only equipment allowed to be kept energized when the gas concentration in the general body of air exceeds 25% of the LEL.

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Electrical equipment and circuits can be used in locations requiring EPL 'Ga' ~~or 'Da'~~ if the equipment is either marked as EPL 'Ga' ~~or 'Da' respectively~~ or uses a type of protection listed in Table 2.1 as meeting the requirements of EPL 'Ga' ~~or 'Da' respectively~~. Electrical equipment and circuits can be used in locations requiring EPL 'Da' if the equipment is either marked as EPL 'Da' or uses a type of protection listed in Table 2.2 as meeting the requirements of EPL 'Da'. The installation shall comply with the requirements of this Standard as appropriate to the type of protection employed. When 'Ga' is marked in accordance with 60079-26 for combined types of protection, or AS/NZS 1826, the installation shall simultaneously comply with the requirements of this Standard as appropriate to the types of protection employed.

Electrical equipment and circuits can be used in locations requiring EPL 'Ma' if the equipment is either marked as EPL 'Ma' or uses a type of protection listed in Table 2.1 as meeting the requirements of EPL 'Ma'. The combination of two independent types of protection each meeting EPL 'Mb", may also be used to achieve EPL 'Ma" as defined in Table 2.1. In this case the combination shall, in conjunction with associated cables, have a safety performance (explosion protection) availability of at least 0.999 or an ignition risk reduction factor of at least 1000.

NOTE In determining the safety availability or risk reduction factor one of the following Standards should be used: AS 61508, AS 61511 or AS 62061. This does not preclude the use of equivalent methods.

5.4.3 Equipment for use in locations requiring EPL 'Mb' 'Gb' or 'Db'

Electrical equipment can be used in locations requiring EPL 'Gb' ~~or 'Db'~~ if the equipment is either marked as EPL 'Ga' or 'Gb' ~~and 'Da' or 'Db' respectively~~ or uses a type of protection listed in Table 2.1 as meeting the requirements of EPL 'Ga' or 'Gb' ~~and 'Da' or 'Db' respectively~~. Electrical equipment can be used in locations requiring EPL 'Db' if the equipment is either marked as EPL 'Da' or 'Db' or uses a type of protection listed in Table 2.2 as meeting the requirements of EPL 'Da' or 'Db' The installation shall comply with the requirements of this Standard as appropriate to the type of protection employed. For Group I, equipment marked as EPL 'Mb' is only allowed to be kept energized when the gas concentration in the general body of air does not exceed 25% of the LEL.

Where equipment meeting the requirements of EPL 'Ga' or 'Da' is installed in a location which only requires equipment to EPL 'Gb' or 'Db' respectively, it shall be installed in full accordance with the requirements of all the types of protection employed except as varied by the additional requirements for the individual protection techniques.

5.4.4 Equipment for use in locations requiring EPL 'Gc' or 'Dc'

Electrical equipment can be used in locations requiring EPL 'Gc' ~~or 'Dc' respectively~~ if the equipment is either marked as EPL 'Ga' or 'Gb'or, 'Gc' ~~and 'Da'or 'Db' or 'Dc' respectively~~ or uses any type of protection listed in Table 2.1 as meeting the requirements of EPL 'Ga' or Gb' or 'Gc'. Electrical equipment can be used in locations requiring EPL 'Dc' if the equipment is either marked as EPL 'Da' or 'Db' or 'Dc' or uses any type of protection listed in Table 2.2 as meeting the requirements of EPL 'Da' or Db' or 'Dc'. The installation shall comply with the requirements of this Standard as appropriate to the type of protection employed.

Where equipment meeting the requirements of EPL 'Ga',or 'Gb' and 'Da' or 'Db' respectively is installed in a location which only requires equipment to EPL 'Gc' or 'Dc' it shall be installed in full accordance with the requirements of all the types of protection employed except as varied by the additional requirements for the individual protection techniques.

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5.4.5 Additional installation requirements for using intrinsic safety with dusts

Intrinsically safe apparatus complying with AS/NZS 60079.11, IEC 60079-11 and AS 2380.7 are permitted, provided that the following conditions are satisfied:

The apparatus is—

a) Group IIA, IIB or IIC and the minimum dust cloud ignition energy to which the equipment will be exposed is higher than 15 mJ; or

b) Group IIB or IIC, and the minimum dust cloud ignition energy to which the equipment will be exposed is higher than 1 mJ; or

c) Group I, and coal dust is the only hazard present.

d) The equipment is either encapsulated or protected by an enclosure complying with at least the degree of protection IP5X given in AS 60529.

5.5 Selection according to equipment grouping

Electrical equipment shall be selected in accordance with Table 3.

Table 3 – Relationship between gas/vapour or dust subdivision and equipment group

Location gas/vapour or dust subdivision	Permitted equipment group
I	I
IIA	II, IIA, IIB or IIC
IIB	II, IIB or IIC
IIC	II or IIC
IIIA	IIIA, IIIB or IIIC
IIIB	IIIB or IIIC
IIIC	IIIC

Where electrical equipment is marked indicating suitability with a particular gas or vapour, it shall not be used with other gases or vapours without a thorough assessment being carried out by a competent body and the assessment results showing that it is suitable for such use.

NOTE: Group II associated apparatus can be used in Group I applications, provided the Group II associated apparatus is located in a non-hazardous area or a suitable Group I Ex enclosure suitable for the associated apparatus.

5.6 Selection according to the ignition temperature of the gas, vapour or dust and ambient temperature

5.6.1 General

The electrical equipment shall be so selected that its maximum surface temperature will not reach the ignition temperature of any gas, vapour or dust which may be present.

If the marking of the electrical equipment does not include an ambient temperature range, the equipment is designed to be used within the temperature range –20 °C to +40 °C. If the marking of the electrical equipment includes an ambient temperature range, the equipment is designed to be used within this range.

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If the ambient temperature is outside the temperature range, or if there is a temperature influence from other factors, e.g. the process temperature or exposure to solar radiation, the effect on the equipment shall be considered and measures taken documented.

NOTE Cable glands normally do not have a temperature class or ambient operating temperature range marking. They do have a rated service temperature and unless marked, the service temperature is by default in a range of –20°C to +80°C. If different service temperatures are required, care should be taken, that the cable gland and the associated parts are suitable for such applications.

5.6.2 Gas or vapour

Symbols for the temperature classes marked on the electrical equipment have the meaning indicated in Table 4.

Table 4 – Relationship between gas or vapour ignition temperature and temperature class of equipment

Temperature class required by the area classification	Ignition temperature of gas or vapour in °C	Allowable temperature classes of equipment
T1	>450	T1 – T6
T2	>300	T2 – T6
T3	>200	T3 – T6
T4	>135	T4 – T6
T5	>100	T5 – T6
T6	>85	T6

5.6.3 Dust

Dust layers exhibit two properties as layer thickness increases: a reduction in minimum ignition temperature and an increase in thermal insulation.

The maximum permissible surface temperature for equipment~~apparatus~~ is determined by the deduction of a safety margin from the minimum ignition temperature of the dust concerned, when tested in accordance with the methods specified in AS/NZS 61241.2.1~~IEC 61241-2-1~~ for both dust clouds and layer thickness of up to 5 mm for type of protection "tD", practice A and all other types of protection, and 12,5 mm for type of protection "tD" practice B. For group I applications, the surface temperature shall be limited to 150°C.

For installations where the layer thickness is greater than the values given above, the maximum surface temperature shall be determined with particular reference to the layer thickness and all the characteristics of the material(s) being used. Examples of excessively thick dust layers can be found in Annex G.

5.6.3.1 Temperature limitations because of the presence of dust clouds

The maximum surface temperature of the equipment~~apparatus~~ shall not exceed two-thirds of the minimum ignition temperature in degrees Celsius of the dust/air mixture concerned:

$$T_{max} = 2/3\ T_{CL}$$

where T_{CL} is the minimum ignition temperature of the cloud of dust.

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5.6.3.2 Temperature limitation because of presence of dust layers

5.6.3.2.1 Enclosures for practice A and all other equipmentapparatus for dust layers

– Up to 5 mm thickness:

The maximum surface temperature of the equipmentapparatus when tested in the dust-free test method in 23.4.4.1 of AS/NZS 61241.0IEC 61241-0 shall not exceed a value of 75 °C below the minimum ignition temperature for the 5 mm layer thickness of the dust concerned:

$$T_{max} = T_{5\ mm} - 75\ °C$$

where $T_{5\ mm}$ is the minimum ignition temperature of 5 mm layer of dust.

– Above 5 mm up to 50 mm thickness:

Where there is a possibility that dust layers in excess of 5 mm may be formed on practice A equipmentapparatus, the maximum permissible surface temperature shall be reduced. For guidance, examples of the reduction in maximum permissible surface temperature of equipmentapparatus used in the presence of dust having minimum ignition temperatures in excess of 250 °C for a 5 mm layer are shown in the graph below (Figure 1) for increasing depth of layers.

– For dust layers above 50 mm, see 5.6.3.3

NOTE Before applying the information in this graph, reference should be made to IEC 61241-2-1.

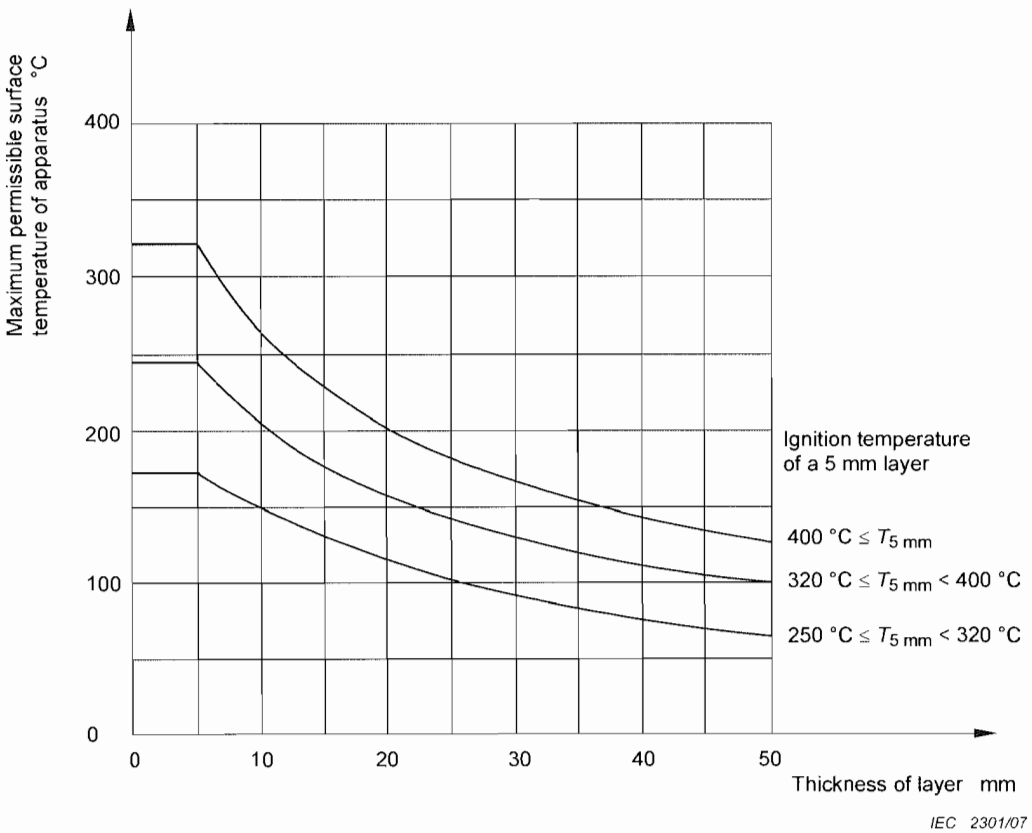

Figure 1 – Correlation between the maximum permissible surface temperature and depth of dust layers

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Laboratory verification shall be carried out for equipmentapparatus where the ignition temperature of a 5 mm layer is below 250 °C, or where there is any doubt concerning the application of the graph. See 5.6.3.3.

5.6.3.2.2 Enclosures for practice B only equipmentapparatus for dust layers up to 12,5 mm thickness

The maximum surface temperature of the equipmentapparatus shall not exceed a value of 25 °C below the minimum ignition temperature for the 12,5 mm layer thickness of the dust concerned when the equipmentapparatus is tested according to the dust layer test method in 8.2.2.2 of AS/NZS 61241.1IEC 61241-1 :

$$T_{max} = T_{12,5\ mm} - 25\ °C$$

where $T_{12,5\ mm}$ is the ignition temperature of the 12,5 mm layer of dust.

NOTE T_{max} obtained from this subclause and T_{max} from 5.6.3.2.1 are considered to offer equivalent safety.

5.6.3.3 Unavoidable dust layers

Where it cannot be avoided that a dust layer forms around the sides and bottom of an equipmentapparatus, or where the equipmentapparatus is totally submerged in dust, because of the insulation effect a much lower surface temperature may be necessary. This special requirement can be met by a system of power limitation, with or without inherent temperature control, which shall be determined in accordance with AS/NZS 61241.0IEC 61241-0.

For installations where the layer depth is greater than 50 mm for enclosures subject to practice A and all other equipmentapparatus, or 12,5 mm for enclosures subject to practice B only, the maximum surface temperature of the equipmentapparatus may be marked with the maximum surface temperature T_L as reference to the permitted layer depth. Where the equipmentapparatus is marked T_L for a layer depth, the ignition temperature of the combustible dust, at layer depth L, shall be applied in place of $T_{5\ mm}$. The maximum surface temperature of the equipmentapparatus T_L shall be at least 75 °C lower than the ignition temperature of the combustible dust, at layer depth L. Examples of excessively thick dust layers can be found in Annex G.

5.6.3.4 Maximum permissible surface temperature

The lowest of the values obtained in 5.6.3.2 and 5.6.3.2.1 for practice A and in 5.6.3.2 and 5.6.3.2.2 for practice B, will determine the maximum surface temperature of the equipmentapparatus to be used.

If the equipmentapparatus is to be used in conditions covered by 5.6.3.3, then these lower values shall be applied.

5.7 Selection of radiating equipment for dust

For equipment radiating in the optical spectral range that is to be installed in the hazardous area, all relevant requirements of this Standard, including this clause, shall be applied.

For equipment installed outside, but radiating into the hazardous area, only the requirements of this subclause shall be applied.

5.7.1 Ignition process

Radiation in the optical spectral range, especially in the case of focusing, can become a source of ignition for dust clouds or dust layers.

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Sunlight, for example, may initiate an ignition if objects concentrate the radiation (for example, concave mirror, lenses, etc.).

The radiation from high intensity light sources, e.g. photo flash lamps is, in certain circumstances, so greatly absorbed by dust particles, that these particles become an ignition source for dust clouds or for dust layers.

In the case of laser radiation (for example, signalling, telemeters, surveying, range-finders) the energy or power density even of the unfocused beam at long distances may be so great that ignition is possible. Here, too, the heating is mainly caused by the effect of the laser beam on dust layers or by absorption on dust particles in the atmosphere. Particularly intense focusing may cause temperatures far in excess of 1 000 °C at the focal point.

Consideration shall be given to the possibility that the equipment itself producing the radiation (for example, lamps, electric arcs, lasers, etc.) may be an ignition source.

5.7.2 Safety measures in Zone 20 or 21

Radiation-generating electrical equipment, if tested and certified in accordance with the requirements for Zone 20 or 21, may be used. Independently of this fact, it shall be ensured that irradiation power or irradiation that may penetrate into or occur in Zone 20 or 21, even in the case of rare disturbances in the entire part of the radiation process proceeding in Zone 20 or 21, and at any point in the radiation cross-section, shall not exceed the following values:

- 5 mW/mm^2 or 35 mW for continuous wave lasers and other continuous wave sources; and
- 0,1 mJ/mm^2 for pulse lasers or pulse light sources with pulse intervals of at least 5 s.

Radiation sources with pulse intervals of less than 5 s are regarded as continuous light sources in this respect.

NOTE Zones are used here and not EPLs as the ignition process is dependant on the dust density. The likelihood of dust of sufficient density is higher in zones 20 and 21.

5.7.3 Safety measures in Zone 22

Equipment generating radiation may be used. The irradiation intensity or irradiation shall not exceed 10 mW/mm^2 or 35 mW continuous and 0,5 mJ/mm^2 for pulse in normal operation.

5.8 Selection of ultrasonic equipment for dust

For equipment installed outside, but radiating into, the hazardous area, only the requirements of this subclause shall be applied.

For ultrasonic transmitting equipment that is to be installed in the hazardous area, all relevant requirements of this Standard, including those of this subclause, shall be applied.

5.8.1 Ignition process

When ultrasonics are applied, large proportions of the energy released by the sound transducer are absorbed by solid or liquid materials. Heating can occur in the material affected and, in extreme cases, may heat the material beyond the minimum ignition temperature.

5.8.2 Safety measures

The following remarks refer solely to the ignition hazard produced by sonic power. In terms of safety, it shall be considered, amongst other things, that electric charges shall have been safely eliminated from the piezo-ceramics (frequently used as transducers in ultrasonic equipment) by means of suitable circuit elements.

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5.8.2.1 Safety measures in Zone 20 or 21

In Zone 20 or 21, ultrasonics may be used only when the working method is recognized as perfectly suitable for use in this Zone by reason of the low sonic power available, which shall not exceed a power density in the sound field of 0,1 W/cm^2 and a frequency of 10 MHz for continuous sources and 2 mJ/cm^2 for pulse sources. The average power density shall not exceed 0,1 W/cm^2.

NOTE Zones are used here and not EPLs as the ignition process is dependant on the dust density. The likelihood of dust of sufficient density is higher in zones 20 and 21.

5.8.2.2 Safety measures in Zone 22

In Zone 22, in the case of working processes using the usual ultrasonic devices (for example, ultrasonic therapy appliances, diagnostic appliances and impulse chip testing devices), no special safety measures against ignition hazards due to the use of ultrasonics themselves are necessary, provided the power density in the sound field generated does not exceed 0,1 W/cm^2 and an installed frequency of 10 MHz.

5.9 External influences

Electrical equipment shall be selected and/or installed so that it is protected against external influences which could adversely affect the explosion protection (e.g. pressure conditions, chemical, mechanical, vibrational, thermal, electrical, humidity, corrosion). External influences shall be identified as part of the installation design and selection of equipment for the installation and measures applied for control shall be documented and included in the verification dossier.

NOTE 1 Attention is drawn to the risks that can arise when equipment is subject to prolonged humidity and wide temperature variations. Under such conditions, the equipment should be provided with suitable devices to ensure satisfactory prevention or draining of condensate.

NOTE 2 Where the manufacturer has tested the enclosure to a higher degree of ingress protection (IP) than required by the type of protection (perhaps to make it suitable for an adverse environment), the IP rating of the enclosure should be maintained to the IP rating requirement of the location or that required by the type of protection, whichever is the higher. Where the IP rating assigned to the equipment is not maintained, this should be identified in the verification dossier.

Precautions shall be taken, without affecting designed ventilation conditions, to prevent foreign bodies falling vertically into the ventilation openings of vertical rotating electrical machines.

The integrity of electrical equipment may be affected if it is operated under temperature or pressure conditions outside those for which the equipment has been constructed. In these circumstances, further advice shall be sought (see also 5.6).

Where canned pumps, process connections for flow, pressure or analysis measurements, equipment using flammable gas in lieu of instrument air, or the like depend upon a single seal diaphragm or tube to prevent process fluids from entering the wiring system, an additional seal or barrier shall be provided in the wiring system with an adequate drain between the seals or barriers so that the occurrence of any leaks will become apparent.

NOTE 32 Attention is drawn to the risks that can arise when process fluids become introduced into equipment, (e.g. pressure switches or canned electric motor pumps). Under fault conditions, (e.g. a diaphragm or can failure), the fluid may be released inside the equipment under considerable pressure which may cause any or all of the following to occur:

- rupture of the equipment enclosure;
- risk of immediate ignition;
- transmission of the fluid along the inside of the cable or conduit.

Such equipment should be selected so that process fluid containment is reliably separated from the electrical equipment (e.g. by use of a primary seal for the main process interface and a secondary seal internal to the equipment in case of primary seal failure). Where this is not achieved, the equipment could~~should~~ be vented (via a suitably explosion protected vent, drain or breather) and/or the wiring system should~~shall~~ be sealed to prevent the transmission of any fluid. Failure of the primary seal should also be annunciated e.g. by visible leak, self-revealing failure of the equipment, audible sound or electronic detection.

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Potential wiring system sealing methods include; the use of a special sealing joint or, a cable gland incorporating a seal around the individual conductors or, a length of mineral-insulated metal-sheathed (MIMS) cable or an 'epoxy' joint should be introduced into the cable run. It should be noted that the application of a cable sealing device may only mitigate the rate of vapour transmission and additional attenuation measures may be necessary. Venting systems should be arranged so that the occurrence of any leaks will become apparent.

In the absence of IEC standards on process sealing for electrical equipment, national or other applicable standards such as IEC 61010-1 should be followed. IEC 61010-1 includes some information relative to process connections.

~~NOTE 3 Where the manufacturer has tested the enclosure to a higher degree of ingress protection (IP) than required by the type of protection (perhaps to make it suitable for an adverse environment), the IP rating of the enclosure should be maintained to the IP rating requirement of the location or that required by the type of protection whichever is the higher. Where the IP rating assigned to the equipment is not maintained, this should be identified in the verification dossier.~~

5.10 Light metals as construction materials

Particular consideration shall be given to the location of items that incorporate light metals in the external construction as it has been well established that such materials give rise to sparking that is incendive under conditions of frictional contact.

5.10.1 Gas or vapour

Installation materials (e.g. cable trays, mounting plates, weather protection) shall not contain by mass more than:

- for locations requiring EPL 'Ga' or Group I

  10 % in total of aluminium, magnesium, titanium and zirconium, or

  7,5 % in total of magnesium, titanium and zirconium;

- for locations requiring EPL 'Gb'

  7,5 % magnesium and titanium;

- for locations requiring EPL 'Gc'

  no requirements

NOTE The above requirements are compatible with those required by AS/NZS 60079.0~~IEC 60079-0~~ for equipment.

5.10.2 Dust

See Annex G~~Annex H~~.

5.11 Transportable, portable and personal equipment

5.11.1 General

Due to the demand of the application and enhanced flexibility for use, transportable, portable or personal equipment may be required to be used in differing areas. Equipment of a lower EPL shall not be taken into an area requiring a higher EPL, unless it is otherwise protected. In practice, however, such a limitation may be difficult to enforce - particularly with portable equipment. It is recommended, therefore, that all equipment meet the requirements of the location to which the equipment will be exposed which requires the highest EPL. Similarly, the equipment group and temperature classification should be appropriate for all the gases, vapours and dusts in which the equipment may be used. Unless suitable precautions are taken, spare batteries shall not be taken into the hazardous area.

5.11.2 Transportable and portable equipment - Gas

Unlike equipment which is permanently installed, transportable or portable equipment may occupy the hazardous area on a temporary basis. Such equipment may include, for example, emergency generators, electrical arc welders, industrial lift (fork) trucks, air compressors, powered ventilation fans or blowers, portable electrically powered hand-tools, certain types of test and inspection equipment. Group I equipment shall comply with AS/NZS 4871.

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Equipment that may be transported or carried into a hazardous area shall be to the appropriate equipment protection level. Where there is a need to use transportable or portable equipment in a hazardous area for which the normally required EPL is not obtainable, a documented program for risk management shall be implemented. This program shall include appropriate training, procedures and controls. A safe work permit shall be issued appropriate to the potential ignition risk created by the use of the equipment (see Annex D).

If plugs and sockets are present in a hazardous area, they shall be to the required EPL for the area. Alternately, they shall only be energized or connections made under a safe work procedure (see Annex D).

5.11.3 Personal Equipment - Gas

Items of personal equipment which are battery or solar operated are sometimes carried by personnel and inadvertently taken into a hazardous area.

A basic electronic wrist watch is an example of a low voltage, electronic device which has been independently evaluated and found to be acceptable for use in a hazardous area under both historic and current EPL requirements.

NOTE For Group I applications digital wrist watches are required to be certified as Ex.

All other personal battery or solar operated equipment (including electronic wrist watches incorporating a calculator) shall:

a) conform to a recognised type of protection appropriate to EPL, gas group and temperature class requirements, or

b) be subjected to risk assessment, or

c) be taken into the hazardous area under a safe work procedure.

NOTE An increased risk is associated with lithium batteries which may be used to power personal electronic equipment and their use should be assessed as described in this clause.

5.11.4 Dust

Ordinary industrial portable equipment~~apparatus~~ should not be used in a hazardous area unless the specific location has been assessed to ensure that potentially combustible dust is absent during the period of use ("dust-free" situation). If plugs and sockets are present in a hazardous area, they should be suitable for ~~use in~~ the particular EPL~~Zone~~ and have mechanical and/or electrical inter-locking to prevent an ignition source occurring during insertion or removal of the plug. Alternatively, they should only be energized in a "dust-free" situation.

5.12 Selection of rotating electrical machines

5.12.1 General

~~Rotating electrical machines are classified in accordance with IEC 60034-1 for duty cycles S1 to S10.~~

In selecting rotating electrical machines, as a minimum, the following shall be considered:

- duty cycle
- supply voltage and frequency range
- heat transfer from driven equipment (e.g. pump)
- bearing and lubricant life
- insulation class
- type of starting

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5.12.2 Motors fed from a converter supply

Selection and installation of motors supplied at varying frequency and voltage by a converter shall take into account items that may reduce the voltage at the motor terminals. Also other hazards shall be taken into account.

NOTE 1 A filter at the output of the converter can cause a voltage drop at the terminals of the machine. The reduced voltage increases the motor current, and slip and therewith increases the temperature of the motor in the stator and rotor. Such temperature rise may be most notable at constant rated load conditions.

NOTE 2 Additional information on the application of motors with a converter supply can be found in IEC/TS 60034-17 and IEC/TS 60034-25. Major concerns include frequency spectrums of the voltage and current plus their additional losses, over-voltage effects, bearing currents and high frequency earthing.

5.13 Luminaires

Selection of luminaires shall take into account ~~the EPLs, the Equipment Group and~~ the possibility of changes of the temperature class~~,~~ if lamps with different wattages can be used.

NOTE Low-pressure sodium lamps should not be transported through a hazardous area ~~or installed above a hazardous area~~ owing to the risk of ignition due to free sodium from a broken lamp.

5.14 Plugs and socket outlets for dust

Plugs and socket outlets are not permitted in locations requiring EPL "Da".

In locations requiring EPL "Db" and EPL "Dc" they shall comply with AS/NZS 61241.0~~IEC 61241-0~~ and the following requirements apply.

For Group I installations in Australia, flameproof restrained plugs and receptables shall comply with AS 1299 and couplers shall comply with AS 1300.

NOTE Connectors used for "Ex iD" protection are not classified as plugs and socket outlets.

5.14.1 General

Plugs and socket outlets shall be used in combination with a suitable form of flexible connection, as set out in 0.

5.14.2 Mounting

Socket outlets shall be installed so that dust will not enter the socket outlet with or without a plug in place. For Group III, to minimize the ingress of dust in the event of a dust cap being accidentally left off, socket outlets shall be positioned at an angle, which is not more than 60 degree to the vertical, and the opening facing downwards.

5.14.3 Location

Socket outlets shall be installed in locations so that the flexible cord required shall be as short as possible.

6 Protection from dangerous (incendive) sparking

6.1 Danger from live parts

In order to avoid the formation of sparks liable to ignite the explosive atmosphere, the possible inadvertent contact with bare live parts other than intrinsically safe or energy-limited parts shall be prevented.

6.2 Danger from exposed and extraneous conductive parts

The limitation of earth-fault currents (magnitude and/or duration) in frameworks or enclosures and the prevention of elevated potentials on equipotential bonding conductors are essential for safety.

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Although it is impracticable to cover all possible systems, the following applies to electrical systems, other than intrinsically safe or energy-limited circuits with voltages up to 1 000 V a.c. r.m.s./ 1 500 V d.c.

6.2.1 TN type of system earthing

If a type of system earthing TN is used, it shall be type TN-S (with separate neutral N and protective conductor PE) in the hazardous area, i.e. the neutral and the protective conductor shall not be connected together, or combined in a single conductor, in the hazardous area. At any point of transition from TN-C to TN-S, the protective conductor shall be connected to the equipotential bonding system in the non-hazardous area.

NOTE The MEN system commonly used in Australia and New Zealand is a TN-S system.

6.2.2 TT type of system earthing

If a type of system earthing TT (separate earths for power system and exposed conductive parts) is used, then it shall be protected by a residual current device.

NOTE Where the earth resistivity is high, such a system may not be acceptable.

6.2.3 IT type of system earthing

If a type system earthing IT (neutral isolated from earth or earthed through an sufficiently high impedance) is used, an insulation monitoring device shall be provided to indicate the first earth fault.

NOTE 1 If the first fault is not removed, a subsequent fault on the same phase will not be detected, possibly leading to a dangerous situation.

NOTE 2 Local bonding, known as supplementary equipotential bonding, may be necessary (see IEC 60364-4-41).

6.2.4 SELV and PELV systems

~~Safety extra-low voltage systems (SELV) shall be in accordance with 414 of IEC 60364-4-41.~~ Live parts of safety extra low voltage (SELV) system circuits shall not be connected to earth, or to live parts or to protective conductors forming part of other circuits. Any exposed conductive parts may be unearthed or earthed (for example for electro-magnetic compatibility).

~~Protective extra-low voltages systems (PELV) shall be in accordance with 414 of IEC 60364-4-41.~~ Protective extra low voltage (PELV) system circuits are earthed. Any exposed conductive parts of PELV systems shall be connected to a common earthing (and potential equalization) system.

~~Safety isolating transformers for SELV and PELV shall be in accordance with IEC 61558-2-6.~~

6.2.5 Electrical separation

Electrical separation shall be in accordance with AS/NZS 3000.~~413 of IEC 60364-4-41 for the supply of only one item of equipment.~~

6.2.6 Above hazardous areas

Equipment that may produce hot particles or hot surfaces located less than 3,5 m above a hazardous area shall be either totally enclosed or provided with suitable guards or screens, to prevent any ignition sources falling into the hazardous area.

NOTE Such items may include:

- fuses that may produce arcs, sparks or hot particles;
- switches that may produce arcs, sparks or hot particles;
- motors or generators that have sliding contacts or brushes;
- heaters, heating elements or other equipment that may produce arcs, sparks or hot particles;

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- auxiliary equipment such as ballasts, capacitors and starting switches for all types of discharge luminaires.
- all lamps.

Low pressure sodium vapour discharge lamps shall not be installed above a hazardous area.

6.3 Potential equalization

6.3.1 General

Potential equalization is required for installations in hazardous areas. For TN, TT and IT systems, all exposed and extraneous conductive parts shall be connected to the equipotential bonding system. The bonding system may include protective conductors, metal conduits, metal cable sheaths, steel wire armouring and metallic parts of structures, but shall not include neutral conductors. Connections shall be secure against self loosening and shall minimise the risk of corrosion which may reduce the effectiveness of connection.

For Group I, AS/NZS 4871.1 shall apply.

If the armour or screens of cables are only earthed outside the hazardous area (e.g. in the control room) then this point of earthing shall be included in the potential equalization system of the hazardous area.

NOTE If the armour is earthed only outside of the hazardous area in TN system there is a possibility, that dangerous sparks may be created at the ending of the armour in hazardous area, therefore this armour or screen should be treated like unused cores (see 9.6.3).

Exposed conductive parts need not be separately connected to the equipotential bonding system if they are firmly secured to and are in conductive contact with structural parts or piping which are connected to the equipotential bonding system. Extraneous conductive parts which are not part of the structure or of the electrical installation, for example frames of doors or windows, need not be connected to the equipotential bonding system, if there is no danger of voltage displacement.

~~Cable glands which incorporate clamping devices which clamp the braiding or armour of the cable can be used to provide equipotential bonding.~~

~~For additional information see 411.3 of IEC 60364-4-41.~~

Metallic enclosures of intrinsically safe or energy-limited equipment~~apparatus~~ need not be connected to the equipotential bonding system, unless required by the equipment~~apparatus~~ documentation or to prevent accumulation of static charge.

Installations with cathodic protection shall not be connected to the equipotential bonding system unless the system is specifically designed for this purpose. Insulated or galvanically isolated facilities such as corrosion protected pipelines are susceptible to induced high voltage charging, which shall be managed without direct earthing using approved electrolytic switches, polarising cells or other suitable means. Where equipment connected to protected structures may also be connected to the equipotential bonding or other earthing systems by the wiring system, electrical isolation between the protected structure and other bonding or earthing systems shall be provided.

NOTE 1 Isolation of electrical equipment may be achieved by the use of insulating adaptors, non-conductive gland plates, non-metallic cable glands, insulating joints or other suitable fittings or use of approved polarising cells.

NOTE 2 Potential equalization between vehicles and fixed installations may require special arrangements, for example where insulated flanges are used to connect pipelines.

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6.3.2 Temporary bonding

Temporary bonding includes earth connections that are made to moveable items such as drums, vehicles and portable equipment for control of static electricity~~ or potential equalisation~~.

It is recommended that the final connection of a temporary bonding connection should be made either:

a) in a non-hazardous area; or

b) using a connection that meets the EPL requirements of the location; or

c) using a documented procedure which reduces the risk of sparking to an acceptable level.

~~6.3.2.1 Gas~~

For temporary bonding the resistance between metallic parts shall be less than 1 MΩ. Conductors and connections shall be durable, flexible and of sufficient mechanical strength to withstand in-service movement.

~~NOTE In the absence of IEC standards national or other standards should be followed.~~

~~6.3.2.2 Dust~~

~~For temporary bonding, the resistance between metallic parts can be greater than that corresponding to a cross-sectional area of 10 mm^2 of copper.~~

NOTE Examples of temporary bonding include that made to a portable drum or a vehicle.

6.4 Static electricity

Static electrical charges may accumulate to levels, that could be incendive. Static charges may be caused by such mechanisms as friction, or movement of non conducting materials (such as plastics or paper) or gases or liquids flowing through pipelines. Measures shall be taken to control static electricity and various approaches may be adopted according to the particular conditions under consideration. Detailed recommendations for the control of risks due to static electricity are given in AS/NZS 1020.

6.4.1 Gas

In the design of electrical installations, steps shall be taken to reduce to a safe level the effects of static electricity.

NOTE Detailed information dealing with diameter or width of long parts and limitation of thickness of non-metallic layers can be found in 7.4 of AS/NZS 60079.0~~IEC 60079-0~~ .

Cables are exempted from this clause.

The risk of incendive sparking from non-metallic installation materials (e.g. plastic covered cable trays, plastic mounting plates, plastic weather protection) shall be controlled by:

a) suitable selection of the material so that the insulation resistance of the item does not exceed 1 GΩ; or

b) limitation of the surface area of non-metallic parts as shown in Table 5. The surface area is defined as follows:

   – for sheet materials, the area exposed (chargeable);

   – for curved objects, the area shall be the projection of the object giving the maximum area;

   – for individual non-metallic parts, the area shall be evaluated independently if they are separated by conductive earthed frames.

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Table 5 – Limitations of areas

Maximum surface area, mm^2			
EPL requirement of location	Group IIA location	Group IIB location	Group IIC location
'Ga'	5 000	2 500	400
'Gb'	10 000	10 000	2 000
'Gc'	10 000	10 000	2 000

NOTE The values for surface area can be increased by a factor of four if the exposed area of non-metallic material is surrounded by conductive earthed frames.

6.4.2 Dust

Equipment of plastic material shall be so designed that under normal conditions of use, danger of ignition due to propagating brush discharges is avoided. This can be achieved by not using plastic, which is covering a conductive material. If however the plastic is covering a conductive material the plastic shall have one or more of the following characteristics:

a) surface resistance $\leq 10^9$ tested according to AS/NZS 60079.0~~IEC 60079-0~~;

b) a breakdown voltage ≤ 4 kV (measured across the thickness of the insulating material according to the method described in IEC 60243-1);

c) a thickness ≥ 8 mm of the external insulation on metal parts.

NOTE External insulation of 8 mm and greater on metal parts such as measurement probes or similar components make propagating brush discharges unlikely to occur. When evaluating the minimum thickness of the insulation to be used or specified it is necessary to allow for any expected wear under normal usage.

d) by limitation of the transferred charge using the test method described in AS/NZS 60079.0~~IEC 60079-0~~;

e) by the inability to store a dangerous charge by measurement of capacitance when tested in accordance with the test method in AS/NZS 60079.0~~IEC 60079-0~~.

6.5 Lightning protection

In the design of electrical installations, steps shall be taken to reduce to a safe level the effects of lightning ~~(see IEC 62305-3, Annex D)~~. Precautions to take against lightning are described in AS/NZS 1768.

~~Subclause~~ 12.3 gives details of lightning protection requirements for Ex 'ia' apparatus installed in locations requiring EPL 'Ga'.

6.6 Electromagnetic radiation

In the design of electrical installations, steps shall be taken to reduce to a safe level the effects of electromagnetic radiation (see AS/NZS 60079.0~~IEC 60079-0~~).

It may be necessary to take special precautions for installations in the vicinity of sources of electromagnetic radiation, such as high-frequency radio and radar transmitters in which case reference should be made to CENELEC/TR 50427.

6.7 Cathodically protected metallic parts

Cathodically protected metallic parts located in hazardous areas are live extraneous conductive parts which shall be considered potentially dangerous (especially if equipped with an impressed current system) despite their low negative potential. No cathodic protection shall be provided for metallic parts in locations requiring EPL 'Ga' or 'Da' unless it is specially designed for this application.

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The insulating elements required for the cathodic protection, for example insulating elements in pipes and tracks, should if possible be located outside the hazardous area.

NOTE Detailed guidelines for the cathodic protection of metals are described in the various parts of AS 2832 and in BS 7361. When re-inspecting cathodic protection systems BS 7361 should be used.

~~NOTE In the absence of IEC standards on cathodic protection, national or other standards should be followed.~~

6.8 Ignition by optical radiation

In the design of optical installations, steps shall be taken to reduce to a safe level the effects of radiation in accordance with AS/NZS 60079.28~~IEC 60079-28~~. For required safety measures concerning combustible dusts, see 5.7.

NOTE Optical equipment in the form of lamps, lasers, LEDs, optical fibers etc. is increasingly used for communications, surveying, sensing and measurement. In material processing optical radiation of high irradiance is used. Often the installation is inside or close to explosive atmospheres and radiation from such equipment may pass through these atmospheres. Depending on the characteristics of the radiation it might then be able to ignite a surrounding explosive atmosphere. The presence or absence of an additional absorber significantly influences the ignition.

7 Electrical protection

The requirements of this clause are not applicable to intrinsically safe and energy-limited circuits.

7.1 General

Wiring shall be protected against overload and from the harmful effects of short-circuits and earth faults.

All electrical equipment shall be protected against the harmful effects of short-circuits and earth faults.

Short-circuit and earth-fault protection devices shall be such that auto-reclosing under fault conditions is prevented.

Precautions shall be taken to prevent operation of multi-phase electrical equipment (e.g. three-phase motors) where the loss of one or more phases can cause overheating to occur. In circumstances where automatic disconnection of the electrical equipment may introduce a safety risk which is more dangerous than that arising from the risk of ignition alone, a warning device (or devices) may be used as an alternative to automatic disconnection provided that operation of the warning device (or devices) is immediately apparent so that prompt remedial action will be taken.

7.2 Rotating electrical machines

Rotating electrical machinery shall additionally be protected against overload unless it can withstand continuously the starting current at rated voltage and frequency or, in the case of generators, the short-circuit current, without inadmissible heating. The overload protective device shall be:

a) a current-dependent, time lag protective device monitoring all three phases, set at not more than the rated current of the machine, which will operate in 2 h or less at 1,20 times the set current and will not operate within 2 h at 1,05 times the set current, or

b) a device for direct temperature control by embedded temperature sensors, or

c) another equivalent device.

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7.3 Transformers

Transformers shall additionally be protected against overload unless they can withstand continuously the short-circuited secondary current at rated primary voltage and frequency without inadmissible heating or where no overload is to be expected as a result of the connected loads.

7.4 Resistance heating devices

In addition to overcurrent protection, and in order to limit the heating effect due to abnormal earth-fault and earth-leakage currents, the following protection additional shall be installed:

a) in a TT or TN type system, a residual current device (RCD) with a rated residual operating current not exceeding 100 mA shall be used. Preference should be given to RCDs with a rated residual operating current of 30 mA.

~~NOTE 1 Additional information on RCDs is given in IEC 61008-1.~~

b) in an IT system, an insulation monitoring device shall be used to disconnect the supply whenever the insulation resistance is not greater than 50 Ω per volt of rated voltage.

NOTE ~~1~~2 The above additional protection is not required if the resistance-heating device (for example an anti-condensation heater in an electric motor) is intended to be protected by the manner in which it is installed in the electrical equipment.

Resistance-heating devices shall be protected against excessive surface temperature, where required. Where specified, protective measures shall be applied in accordance with the requirements of the manufacturer and relevant documentation. Where protection is achieved by sensing it shall be either:

- the temperature of the resistance heating device or, if appropriate, of its immediate surroundings; or
- the surrounding temperature and one or more other parameters; or
- two or more parameters other than the temperature.

NOTE ~~2~~3 Examples of the parameters include: the level, flow, current, power consumption.

Any temperature protective device, if required, shall be independent from any operating temperature control device and de-energize the resistance-heating device either directly or indirectly. Protective devices shall be manually reset only.

8 Emergency switch-off and electrical isolation

The requirements of this clause are not applicable to intrinsically safe and energy-limited circuits.

8.1 Emergency switch-off

For emergency purposes, at a suitable point or points outside the hazardous area, there shall be convenient means of switching off electrical supplies to the hazardous area.

Electrical equipment which must continue to operate to prevent additional danger shall not be included in the emergency switch-off and shall be on a separate circuit(s).

NOTE 1 The switching devices installed in the general switchgear are normally adequate with respect to emergency switch-off facilities.

NOTE 2 Emergency switch off should consider isolation of all circuit power supply conductors including the neutral.

NOTE 3 Suitable points for emergency switch off should be assessed relevant to the site distribution, personnel on site and the nature of site operations.

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8.2 Electrical isolation

To allow work to be carried out safely, suitable means of isolation (for example isolators, fuses and links) shall be provided for each circuit or group of circuits, to include all circuit conductors including neutral.

Labelling shall be provided immediately adjacent to each means of isolation to permit rapid identification of the circuit or group of circuits thereby controlled.

NOTE There should be effective measures or procedures to prevent the restoration of supply to the equipment whilst the risk of exposing unprotected live conductors to an explosive gas atmosphere continues.

9 Wiring systems

9.1 General

Wiring systems shall comply fully with the relevant requirements of this clause except that intrinsically safe and energy-limited installations need not comply with 9.3.3 to 9.3.8 ~~9.3.1 to 9.3.6~~ inclusive.

9.2 Aluminium conductors

Where aluminium is used as the conductor material, it shall be used only with suitable connections and, with the exceptions of intrinsically safe and energy-limited installations, shall have a cross-sectional area of at least 16 mm^2.

Connections shall ensure that the required creepage and clearance distances will not be reduced by the additional means which are required for connecting aluminium conductors.

NOTE 1 Minimum creepage and clearance distances may be determined by the voltage level and/or the requirements of the type of protection.

NOTE 2 Precautions against electrolytic corrosion should be considered.

9.3 Cables

~~Cables with low tensile strength sheaths (commonly known as 'easy tear' cables) shall not be used in hazardous areas unless installed in conduit.~~

~~9.3.1 Cables for fixed wiring~~

~~Cables used for fixed wiring in hazardous areas shall be appropriate for the ambient conditions in service. Cables shall be:~~

~~a) sheathed with thermoplastic, thermosetting, or elastomeric material. They shall be circular, compact, have extruded bedding and fillers, if any, shall be non hygroscopic, or~~

~~b) mineral insulated metal sheathed, or~~

~~c) special, e.g. flat cables with appropriate cable glands.~~

9.3.1 Specific methods not permitted

9.3.1.1 In hazardous areas

The following wiring systems shall not be installed in hazardous areas:

a) Bare conductors.

b) Open wiring.

c) Earth sheath return (ESR) wiring systems not insulated to the equivalent of double insulation.

d) Busway systems.

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e) Aerial wiring systems.

f) Single wire earth return systems.

g) Low and extra-low voltage track systems.

h) Cables, except when installed in conduit according to Table 6, with sheaths of a tensile strength lower than—

i) thermoplastic

- polyvinyl chloride (PVC) ..... 2.5 N/mm^2
- polyethylene..... 10.0 N/mm^2

ii) elastomeric

- polychloroprene, chlorosulfonated polyethyle or similar polymers..... 10.0 N/mm^2

NOTE These cables are commonly known as 'easy tear' cables.

9.3.1.2 Above hazardous areas

The following wiring systems shall not be installed above hazardous areas unless they are enclosed or provided with suitable guards or screens, to prevent any ignition sources falling into the hazardous area:

a) Bare conductors.

b) Open wiring.

c) Aerial wiring systems.

d) Low and extra-low voltage track systems.

NOTE Specialized wiring systems, such as on gantry cranes, which by their design require the use of track systems, bare conductors, aerial wiring or open wiring may be acceptable subject to an assessment of the ignition avoidance measures being completed by a competent person.

9.3.2 Cables for fixed wiring

Cables used for fixed wiring in hazardous areas shall be appropriate for the ambient conditions in service.

9.3.2.1 Group I

Fixed wiring, feeder and machine cables shall comply with AS/NZS 1802 AS/NZS 1972.

9.3.2.2 Group II

Wiring systems for non intrinsically safe and non energy limited circuits shall be selected in accordance with Table 6. For cables for use in intrinsically safe or energy limited systems refer to 12.

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Table 6 - Non-intrinsically safe and non energy limited wiring systems in hazardous areas

Type of wiring system	EPL Ga	EPL Gb	EPL Gc
Cables in metallic conduit and fittings complying with AS/NZS 2053.1 and AS/NZS 2053.7 and the appropriate protection technique for the area in which they are to be installed.	P	P	P
Served MIMS.	*	P	P
Thermoplastic, thermosetting or elastomeric sheathed unarmoured.			P
Thermoplastic, thermosetting or elastomeric sheathed with armouring or braiding designed for mechanical protection.	*	P	P
Cables in rigid and corrugated, non-metallic conduit, minimum light duty, complying with AS/NZS 2053.1, AS/NZS 2053.2 and AS/NZS 2053.5.			P
Metal sheathed, served and armoured.	*	P	P
Flexible cords and cables in accordance with 9.3.5.	*	P	P
Metal sheathed, served and unarmoured.			P
Flexible steel conduit with non-metallic serving to AS/NZS 2053.1 and AS/NZS 2053.8.			P
Trunking, ducts, pipes or trenches installed to meet the requirements of 9.6.8.		P	P
Flexible conduit assemblies complying with the relevant requirements of AS/NZS 60079.1		P	P
P denotes permitted use. * This wiring system may be installed in a location requiring EPL Ga, if provided with additional protection to counter the harmful environmental effects detailed in 9.5.1.			
For additional requirements for conduit refer to 9.4.			

NOTE 1 - Where enclosures are likely to be subjected to large variations in ambient and/or service temperature conditions, a 'pumping' action can transfer the fluids from the hazardous atmosphere through cables which are not substantially compact. Similarly cables with non filled interstices or with hygroscopic fillers (eg. fibre fillers), may transmit flammable fluids through the interstitial spaces of the cable under capillary or hygroscopic action with sufficient partial pressure to exit the cable termination at the extremities of the cable. Particular caution is drawn to the use of electro-pneumatic transducers and the like which employ natural gas as their pneumatic medium. When such cables link between a hazardous and non-hazardous area this may result in a flammable atmosphere being transported to the inside of, for example, control room equipment. The situation is likely to be most acute with equipment installed in a Zone 0 or Zone 1 location (where the presence of a hazardous atmosphere has a greater likelihood and duration). If these conditions are likely to apply, a cable sealing device (which seals between the inner sheath and the individual conductors) should be used. The application of a cable sealing device may only mitigate the rate of vapour transmission and additional attenuation measures may be necessary.

NOTE 2 Telecommunication circuits shall comply with the requirements of this Standard in addition to any requirements of the relevant telecommunications Standards.

9.3.2.3 Group III

For cables for use in intrinsically safe systems refer to applicable clauses of 9.6 and 12.

For locations requiring EPL 'Da' cables in metallic conduits and fittings for the appropriate protection technique shall be used in accordance with 9.4.

Fixed wiring for locations requiring EPL 'Db' or 'Dc' shall be one of the following:

a) Mineral insulated metal sheathed cables.

b) Served metal sheathed cables.

c) Thermoplastic sheathed cables.

d) Thermosetting sheathed cables.

e) Elastomeric sheathed cables.

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~~9.3.3~~9.3.2 Cables supplying transportable and portable equipment

Transportable and portable electrical equipment shall have cables with a heavy polychloroprene or other equivalent synthetic elastomeric sheath, cables with a heavy tough rubber sheath, or cables having an equally robust construction. The conductors shall be stranded and shall have a minimum cross-sectional area of 1,0 mm^2. If a protective earthing (PE) conductor is necessary, it shall be separately insulated in a manner similar to the other conductors and shall be incorporated within the supply cable sheath.

If, for transportable and portable electrical equipment, a metallic flexible armour or screen is incorporated in the cable, this shall not be used as the only protective conductor. The cable shall be suitable for the circuit protective arrangements, e.g. where earth monitoring is used, the necessary number of conductors shall be included. Where the equipment needs to be earthed, the cable may include an earthed flexible metallic screen in addition to the PE conductor.

Portable electrical equipment with rated voltage not exceeding 250 V to earth and with rated current not exceeding 6 A may have cables

- with an ordinary polychloroprene or other equivalent synthetic elastomeric sheath,
- with an ordinary tough rubber sheath, or
- with an equally robust construction.

These cables are not admissible for portable electrical equipment exposed to heavy mechanical stresses, for example hand-lamps, foot-switches, barrel pumps, etc.

For Group I cables for reeling and trailing applications shall comply with AS/NZS 1802.

~~9.3.4~~9.3.3 Flexible connections ~~for dust~~

For terminal connections to fixed equipment that may be required from time to time to be moved a small distance (e.g. motors on slide rails), cables should be arranged to permit the necessary movement without detriment to the cable. Either this, or one of the types of cables suitable for use with transportable equipment may be used. Suitably protected terminal boxes for the junction with the fixed wiring and the wiring to the equipment shall be provided where the fixed wiring is not itself of a type suitable to permit the necessary movement. If flexible metallic tubing is used, it and its fittings shall be so constructed that damage to the cable consequent upon its use is avoided. Adequate earthing or bonding should be maintained; the flexible tubing should not be the sole means of earthing. The flexible tubing ~~shall be impervious to dust and its use~~ shall not impair the integrity of the enclosure of the equipment to which it is joined. For Group III, the flexible tubing shall be impervious to dust.

~~9.3.5~~9.3.4 Flexible cables

Flexible cables in hazardous areas shall be selected from the following:

- ordinary tough rubber sheathed;
- ordinary polychloroprene sheathed;
- heavy tough rubber sheathed;
- heavy polychloroprene sheathed;
- plastic insulated and of equally robust construction to heavy tough rubber sheathed flexible cables.

~~NOTE In the absence of IEC cable standards, reference should be made to national or other standards.~~

Flexible cables shall not be installed in locations requiring EPL 'Ga' or 'Da', unless certified as part of the equipment.

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9.3.6 Additional requirements for locations requiring EPL 'Gb'

Flexible cabling shall be one of the types specified in Table 7, as appropriate, except for flexible cords or cables that are an integral part of electrical equipment, provided such equipment, including the cable, complies with the appropriate Standard for the type of explosion-protection concerned.

Table 7 - Flexible cabling in locations requiring EPL 'Gb'

Type			Application
Ordinary duty-sheathed	Heavy-duty sheathed	Sheathed, metallic and screened overall	
	P	P[1]	Handheld or portable appliances and luminaires[2, 3]
P	P	P[1]	Fixed equipment
	P	P	Other equipment[2, 4]

P denotes permitted use.

[1] Where a screened flexible cable is subject to continuous flexing, a composite type screen should be used.

[2] Restricted to flexible cables having a conductor cross-sectional area of not less than 1.5 mm^2.

[3] Where the flexible cable is subjected to mechanical injury, further protection shall be provided.

[4] Additional cable protection is required. Refer to 9.3.9.

Where a flexible cable is provided for fixed equipment such as control and monitoring devices, the following conditions shall also be met:

a) The flexible cable shall be a sheathed flexible cable or cord with functional and protective insulation not inferior to ordinary duty sheathed flexible cord complying with AS/NZS 3191.

b) The current-carrying capacity of the flexible cable or cord shall be not less than the rating of the circuit protective device at the origin of the final subcircuit and in any case the nominal cross-sectional area shall be not less than 1 mm^2.

c) The length of the flexible cable or cord, installed without further mechanical protection, shall be not greater than 600 mm, unless the flexible cable has been designed and certified as an integral part of a piece of equipment.

d) The flexible cable or cord shall not be installed in a position where it is subject to mechanical damage.

e) Terminations of the flexible cable or cord shall be appropriate to the hazardous area in which the equipment is located.

9.3.7~~9.3.5~~ Non-sheathed single cores

Non-sheathed single cores shall not be used for live conductors, unless they are installed inside switchboards, enclosures or conduit systems.

9.3.8~~9.3.6~~ Overhead lines

Where overhead wiring with uninsulated conductors provides power or communications services to equipment in a hazardous area, it shall be terminated in a non-hazardous area and the service continued into the hazardous area with cable or conduit.

~~NOTE Uninsulated conductors should not be installed above hazardous areas. Uninsulated conductors include items such as partially insulated crane conductor rail systems and low and extra-low voltage track systems.~~

9.3.9~~9.3.7~~ Avoidance of damage

Cable systems and accessories should be installed, so far as is practicable, in positions that will prevent them being exposed to mechanical damage, to corrosion or chemical influences (for example solvents), to the effects of heat and to the effects of UV radiation (but see also 12.2.2.5 for intrinsically safe circuits).

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Where exposure of this nature is unavoidable, protective measures, such as installation in conduit, shall be taken or appropriate cables selected (for example, to minimize the risk of mechanical damage, armoured, screened, seamless aluminium sheathed, mineral-insulated metal sheathed or semi-rigid sheathed cables could be used).

Where cables are subject to vibration, they shall be designed to withstand that vibration without damage.

NOTE 1 Precautions should be taken to prevent damage to the sheathing or insulating materials of cables when they are to be installed at temperatures below –5 °C.

NOTE 2 Where cables are secured to equipment or cable trays the bend radius on the cable should be in compliance with the cable manufacturers data or be at least 8 times the cable diameter to prevent damage to the cable. The bend radius of the cable should start at least 25 mm from the end of the cable gland.

9.3.10~~9.3.8~~ Cable surface temperature

The surface temperature of cables shall not exceed the temperature class for the installation.

NOTE Where cables are identified as having a high operating temperature (for example 105 °C), this temperature relates to the copper temperature of the cable and not the cable sheath. Due to heat losses, it is unlikely that cable temperature will exceed T6. When high temperature cables are required, this information will be included in the certificate for the equipment or in the manufacturer's recommendations.

9.3.11~~9.3.9~~ Flame propagation

Cables for fixed wiring external to equipment shall have flame propagation characteristics which enable them to withstand the tests according to IEC 60332-1-2, unless they are laid in earth, in sand-filled trenches/ducts or are otherwise protected against flame propagation.

NOTE 1 IEC 60332-1-2 specifies the use of a 1 kW pre-mixed flame and is for general use, except that the procedure specified may not be suitable for the testing of small single insulated conductors or cables of less than 0,5 mm² total cross-section because the conductor melts before the test is completed, or for the testing of small optical fibre cables because the cable is broken before the test is completed. In these cases, the procedure given in IEC 60332-2-2 is recommended.

NOTE 2 Since the use of insulated conductor or cable which retards flame propagation and complies with the recommended requirements of IEC 60332-1-2 is not sufficient by itself to prevent propagation of fire under all conditions of installation, it is recommended that wherever the risk of propagation is high, for example in long vertical runs of bunches of cables, special installation precautions should also be taken. It cannot be assumed that because the sample of cable complies with the performance requirements recommended in IEC 60332-1-2, that a bunch of cables will behave in a similar manner. In such situations verification is possible by testing for vertical flame spread of vertically-mounted bunched wires or cables in accordance with IEC 60332-3 series.

9.3.12~~9.3.10~~ Connections of cables to equipment

The connection of cables to the electrical equipment shall be effected by means of cable glands appropriate to the type of cable used and shall maintain the explosion protection integrity of the relevant type of protection. The glands shall comply with Table 8.

Where the threaded entry or hole size is different to that of the cable gland, a threaded adapter complying with Table 8 shall be fitted.

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Table 8 - Selection of glands, adapters and blanking elements type of protection according to the enclosure type of protection.

Protection technique for the equipment	Glands, adapters and blanking element protection technique			
	Ex 'd'	Ex 'e'	Ex 'n'	Ex 't' and 'DIP'
Ex 'd' (Note 3)	P			
Ex 'e'	P	P	P	P
Ex 'i' and Ex 'nL'	No stated requirements			
Ex 'm'	Ex'm' would not normally be applied to wiring connections. The protection technique for connections shall suit the wiring system used.			
Ex 'n' except Ex 'nL' (Note 4)	P	P	P	P
Ex 'o'	Ex'o' would not normally be applied to wiring connections. The protection technique for connections shall suit the wiring system used.			
Ex 'p'	P	P	P	P
Ex 'q'	Ex'q' would not normally be applied to wiring connections. The protection technique for connections shall suit the wiring system used.			
Ex 's'	Only as allowed by the conditions of the certificate.			
Ex 't' and 'DIP'	P	P	P	P
Ex 'v'	Type of protection does not apply to the equipment connections			

P denotes permitted use.

Note 1 The gland, adapter or blanking elements are further subjected to selection criteria for IP rating.

Note 2 Requirements for the application of all glands, adapters or blanking elements are given in 5.9 and 9 to 18.

Note 3 Requirements for Ex'd' applications are given in 10.4.2

Note 4 Requirements for Ex'nR' applications are given in 14.3.2.2

Note 5 Glands complying with AS1828 are accepted.

~~Where the certificate for the cable gland has an 'X' marking, this cable gland shall be only used for fixed installations. If an additional clamping is required to prevent pulling and twisting of the cable transmitting the forces to the conductor terminations inside the enclosure, a clamp shall be provided and placed within 300 mm of the end of the cable gland.~~

~~Where the equipment is portable only glands without 'X' marking shall be used.~~

Cable glands and/or cables shall be selected to reduce the effects of 'coldflow characteristic' of the cable.

NOTE 1 Cables employ materials which may exhibit 'coldflow' characteristics. 'Coldflow' in cables can be described as the movement of the cable sheath under the compressive forces created by the displacement of seals in cable glands where the compressive force applied by the seal is greater than the resistance of the cable sheath to deformation. Low smoke and/or fire resistant cables usually exhibit significant cold flow characteristics. Cold flow could give rise to a reduction in the insulation resistance of the cable and, where reasonably practical, efforts should be made to prevent this by selection of suitable cable glands.

Cable glands, blanking elements and adapters with tapered threads shall not be used in enclosures having gland plates with unthreaded entries.

~~Cable glands with tapered threads shall not be used in enclosures having gland plates with unthreaded entries.~~

NOTE 2 Tapered threads include NPT threads.

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9.3.13 Non electrical entries

For any non electrical entry (e.g. air lines or fibre optic cable) the integrity of the enclosure shall be maintained.

For Ex 'd' enclosures, certified compound filled glands are deemed to be acceptable.

9.4 Conduit systems

Any conduit system shall comply with the Standards listed in Table 6. ~~National or other standards should be followed for conduit systems.~~

~~NOTE IEC standards for conduit systems are currently under consideration.~~

Conduit shall be provided with a conduit sealing device where it enters or leaves a hazardous area, to prevent the transmission of gases or liquids from the hazardous areas to non-hazardous areas. There shall be no union, coupling or other fittings between the sealing device and the hazardous areas boundary.

Conduit sealing devices shall seal around the outer sheath of the cable where the cable is effectively filled or around the individual conductors inside the conduit. The sealing mechanism shall be such that it does not shrink on setting and sealing mechanisms shall be impervious to, and unaffected by, chemicals found in the hazardous area.

If required to maintain the appropriate degree of ingress protection (e.g. IP54) of the enclosure, conduit shall be provided with a conduit sealing device adjacent to the enclosure.

The conduit shall be wrenchtight at all of the threaded connections.

Where the conduit system is used as the protective earthing conductor, the threaded junction shall be suitable to carry the fault current which would flow when the circuit is appropriately protected by fuses or circuit-breakers.

In the event that the conduit is installed in a corrosive area, the conduit material shall either be corrosion resistant or the conduit shall be adequately protected against corrosion.

Combinations of metals that can lead to galvanic corrosion shall be avoided.

Non-sheathed insulated single or multicore cables may be used in the conduits. However, when the conduit contains three or more cables, the total cross-sectional area of the cables, including insulation, shall be not more than 40 % of the cross-sectional area of the conduit.

Long runs of wiring enclosures shall be provided with suitable draining devices to ensure satisfactory draining of condensate. In addition, cable insulation shall have suitable water resistance.

To meet the degree of protection required by the enclosure, in addition to the use of conduit sealing devices, it may be necessary to seal between the conduit and the enclosure (for example by means of a sealing washer or non-setting grease).

NOTE Where the conduit is the sole means of earth continuity, this sealing should not reduce the effectiveness of the earth path.

Conduit used for mechanical protection only (commonly referred as 'Open' conduit systems) does not need to meet the requirements of this clause. However, precaution measures shall be applied to prevent the transfer of~~or~~ potentially explosive atmosphere through the conduit ~~with suitable conduit sealing devices~~ where the conduit enters or leaves a hazardous area.

Where the thread form of the equipment entry differs from the thread form of the conduit, an adapter complying with Table 8 shall be fitted.

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9.5 Cable and conduit systems

9.5.1 EPL 'Ga'

Additional requirements for cables in an 'ia' type of protection installation are defined in ~~Clause~~ 12. Additional requirements for cables and conduits used with other types of protection according to AS/NZS 60079.26~~IEC 60079-26~~ shall comply with the relevant protection concepts identified in the documentation.

9.5.2 EPL 'Da'

The requirements for cables for use in intrinsically safe systems are defined in AS/NZS 61241.11~~IEC 61241-11~~ .

NOTE Cables in metallic conduits, and fittings for the appropriate protection technique for the area in which they are to be installed, are subject to approval at national level.

9.5.3 Cable and conduit systems for EPL 'Gb', 'Gc', 'Db' and ''Dc'

Additional requirements for cable and conduit systems are given in ~~clauses~~ 10 to 18 for the appropriate type of protection.

9.6 Installation requirements

9.6.1 Circuits traversing a hazardous area

Where circuits traverse a hazardous area in passing from one non-hazardous area to another, the wiring system in the hazardous area shall be appropriate to the EPL requirements for the route.

9.6.2 Protection of stranded ends

If multi-stranded and, in particular, fine-stranded conductors are employed, the ends shall be protected against separation of the strands, for example by means of cable lugs or core end sleeves, or by the type of terminal, but not by soldering alone.

The creepage distances and clearances, in accordance with the type of protection of the equipment, shall not be reduced by the method in which the conductors are connected to the terminals.

9.6.3 Unused cores

The requirements of this clause do not apply to intrinsic safety and energy-limited circuits (see 12.2.2.5.3).

The hazardous area end of each unused ~~core in multi-core cables~~conductor shall either be ~~connected~~terminated to earth or be adequately insulated by means of terminations suitable for the type of protection. Insulation by tape alone is not permitted.

Where one end of unused conductors are insulated in the hazardous area, they shall be earthed at the other end.

9.6.4 Unused openings

Unused openings for cable glands or conduit entries in electrical equipment shall be closed with blanking elements suitable for the relevant type of protection. Blanking elements shall comply with Table 8~~IEC 60079-0~~, and be of a type that can only be removed with the aid of tools.

~~NOTE For blanking element used in intrinsic safety circuits, see IEC 60079-11~~

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9.6.5 Fortuitous contact

Except for trace-heating, fortuitous contact between the metallic armouring/sheathing of cables and pipework or equipment containing flammable gases, vapours or liquids shall be avoided. The insulation provided by a non-metallic outer sheath on a cable will usually be sufficient to avoid this.

9.6.6 Jointing

Cable runs in hazardous areas should, where practicable, be uninterrupted. Where discontinuities cannot be avoided, the joint, in addition to being mechanically, electrically and environmentally suitable for the situation, shall be

- made in an enclosure with a type of protection appropriate to the EPL requirements for the location, or
- providing the joint is not subject to mechanical stress, be 'epoxy' filled, compound-filled or sleeved with heat-shrunk tubing or cold-shrunk tubing, in accordance with the manufacturer's instructions.

Conductor connections, with the exception of those in flameproof conduit systems, intrinsically safe circuits and energy-limited circuits, shall be made only by means of compression connectors, secured screw connectors, welding or brazing. Soldering is permissible if the conductors being connected are held together by suitable mechanical means and then soldered, so there is no stress on the connection.

NOTE 9.6.6 does not apply to Group I installations.

9.6.7 Openings in walls

Openings in walls for cables and conduits between different hazardous areas and between hazardous and non-hazardous areas shall be adequately sealed, for example by means of sand seals or mortar sealing to maintain the area classification where relevant.

9.6.8 Passage and collection of flammables

Where trunking, ducts, pipes or trenches are used to accommodate cables, precautions shall be taken to prevent the passage of flammable gases, vapours or liquids from one area to another and to prevent the collection of flammable gases, vapours or liquids in trenches.

Such precautions may involve the sealing of trunking, ducts or pipes. For trenches, adequate venting or sand-filling may be used. Conduits and, in special cases, cables (e.g. where there is a pressure differential) shall be sealed, if necessary, so as to prevent the passage of liquids or gases.

9.6.9 Static build-up for dust

Cable routing should be arranged so that the cables are not exposed to the friction effects and static build-up due to the passage of dust. Precautions shall be taken to prevent the build-up of static on surfaces of cables.

9.6.10 Accumulation of combustible dust

Cable routing should be arranged in such a way that the cables accumulate the minimum amount of dust layers whilst remaining accessible for cleaning. Where trunking, ducts or pipes or trenches are used to accommodate cables, precautions should be taken to prevent the passage or collection of combustible dusts in such places. Where layers of dust are liable to form on cables and impair the free circulation of air, consideration shall be given to derating the current-carrying capacity of the cables, especially if low minimum ignition temperature dusts are present. Any wiring system subject to dust layers shall comply with the temperature requirements of 5.6.3.4.

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10 Additional requirements for type of protection 'd' – Flameproof enclosures

10.1 General

Flameproof enclosures, with only an Ex component enclosure certificate (marked with a 'U'), shall not be installed. They shall always have an equipment certificate for the complete assembly.

Alteration of the internal components of the equipment is not permitted without re-evaluation of the equipment because conditions may be created inadvertently which lead to pressure-piling, change in temperature class, or other such issues that may invalidate the certificate.

Equipment marked for a specific gas, or marked for ~~an apparatus~~ a group plus a specific gas, and used in that specific gas atmosphere shall be installed in accordance with the requirements for the ~~apparatus~~ group to which the specific gas belongs. For example, equipment marked 'IIB + H_2' and used in a hydrogen atmosphere shall be installed as IIC equipment.

10.2 Solid obstacles

When installing equipment, care shall be exercised to prevent the flameproof flange joint approaching nearer than the distance specified in Table ~~9~~6 to any solid obstacle which is not part of the equipment, such as steelwork, walls, weather guards, mounting brackets, pipes or other electrical equipment, unless the equipment has been tested at a smaller distance of separation and has been documented.

Table ~~9~~6 – Minimum distance of obstruction from the flameproof flange joints related to the gas group of the hazardous area

Gas group	Minimum distance mm
IIA	10
IIB	30
IIC	40

10.3 Protection of flameproof joints

Protection against corrosion of flameproof joints shall be maintained in accordance with manufacturer's documentation. The use of gaskets is only permissible when specified in manufacturer's documentation.

Flameproof joints shall not be painted.

Painting (by the user) of the enclosure after complete assembly is permitted. The application of grease to the flameproof joint faces will reduce, but not eliminate, the quantity of paint penetrating the gap. Where the manufacturer's documentation does not address joint protection, then only non-setting grease or anti-corrosive agents without evaporating solvents shall be used.

NOTE 1 Silicone based greases are often suitable for this purpose but care needs to be taken concerning use with gas detectors. It cannot be too strongly emphasized that extreme care should be exercised in the selection and application of these substances to ensure the retention of the non-setting characteristics and to allow subsequent separation of the joint surfaces.

NOTE 2 Non-hardening grease-bearing textile tape may be employed outside of a straight flanged joint with the following conditions:

– where the enclosure is used in conjunction with gases allocated to group IIA, the tape should be restricted to one layer surrounding all parts of the flange joint with a short overlap, new tape should be applied whenever existing tape is disturbed;

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- where the enclosure is used in conjunction with gases allocated to group IIB, the gap between the joint surfaces should not exceed 0,1 mm, irrespective of the flange width. The tape should be restricted to one layer surrounding all parts of the flange joint with a short overlap. New tape should be applied whenever existing tape is disturbed;

- where the enclosure is used in conjunction with gases allocated to group IIC, the tape should not be applied.

10.4 Cable entry systems

10.4.1 General

~~It is essential that cable entry systems comply with all the requirements referred to in the equipment standard and documentation. Cable glands shall:~~

- ~~be appropriate to the type of cable employed;~~
- ~~maintain the type of protection; and~~
- ~~be in accordance with 0~~

Where cables enter into flameproof equipment via flameproof bushings through the wall of the enclosure which are part of the equipment (indirect entry), the parts of the bushings outside the flameproof enclosure shall be protected in accordance with one of the types of protection listed in AS/NZS 60079.0~~IEC 60079-0~~. For example, the exposed part of the bushings are within a terminal compartment which may either be another flameproof enclosure or will be protected by type of protection 'e'. Where the terminal compartment is Ex 'd', then the cable system shall comply with 10.4.2 Where the terminal compartment is Ex 'e', then the cable system shall comply with 11.2.

Where cables enter into flameproof equipment directly, the cable system shall comply with 10.4.2.

NOTE 1 The use of aluminium conductors in Ex 'd' flameproof enclosures should be avoided in those cases where a fault leading to potentially severe arcing involving the conductors may occur in the vicinity of a plain flanged joint. Adequate protection may be afforded by conductor and terminal insulation that prevents the occurrence of faults or by using enclosures with spigot or threaded joints.

Thread engagement for cable glands, adapters or blanking elements shall be at least five full threads.Flameproof cable glands, adapters or blanking elements, having parallel threads may be fitted with a sealing washer between the entry device and the flameproof enclosure providing that after the washer has been fitted, the applicable thread engagement is still achieved. ~~Thread engagement shall be at least five full threads.~~ Suitable grease may be used provided it is non-setting, non-metallic and non-combustible and any earthing between the two is maintained.

Where taper threads are used, the connection shall be made wrench tight.

Additional holes shall not be made into flameproof enclosures.

Only addition of holes or alteration to thread form permitted by the certification documents and completed by the manufacturer or certified workshops shall be permitted.

Where the thread form of the equipment entry is different to the thread form of the cable gland or blanking element, only one adapter shall be used per entry.

~~Where the threaded entry or hole size is different to that of the cable gland, a flameproof threaded adapter complying with IEC 60079-1 shall be fitted which complies with thread engagement requirements detailed above. Unused cable entries shall be sealed with a flameproof blanking element complying with IEC 60079-1.~~

NOTE 2 Gas or vapour migration and propagation of flame may occur through the interstices between the strands of standard stranded conductors, or between individual cores of a cable. Special cable construction can be employed as means of reducing migration and preventing the propagation of flame. Examples include compacted strands, sealing of the individual strands, and extruded bedding.

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10.4.2 Selection of cable glands

The cable entry system shall comply with one of the following:

a) cable glands in compliance with AS/NZS 60079.1~~IEC 60079-1~~ and certified as part of the equipment when tested with a sample of the particular type of cable;

b) where a cable has thermoplastic, thermosetting or elastomeric insulation and is substantially compact and circular with extruded bedding and fillers that are non-hydroscopic, a flameproof cable gland, in compliance with AS/NZS 60079.1, may be utilized, providing this incorporates a sealing ring and is selected in accordance with Figure 2

~~b) where a cable, in compliance with 0(a) is substantially compact, a flameproof cable gland, in compliance with IEC 60079-1, may be utilized, providing this incorporates a sealing ring and is selected in accordance with Figure 2.~~

NOTE When there is any doubt as to the compactness of the cable, to prevent flame propagation apply 10.4.2 d) or e).

Compliance with Figure 2~~1~~ is not necessary if the cable gland complies with AS/NZS 60079.1~~IEC 60079-1~~ and has been tested with a sample of specific cable to repeated ignitions of the flammable gas inside an enclosure and shows no ignition outside the enclosure.

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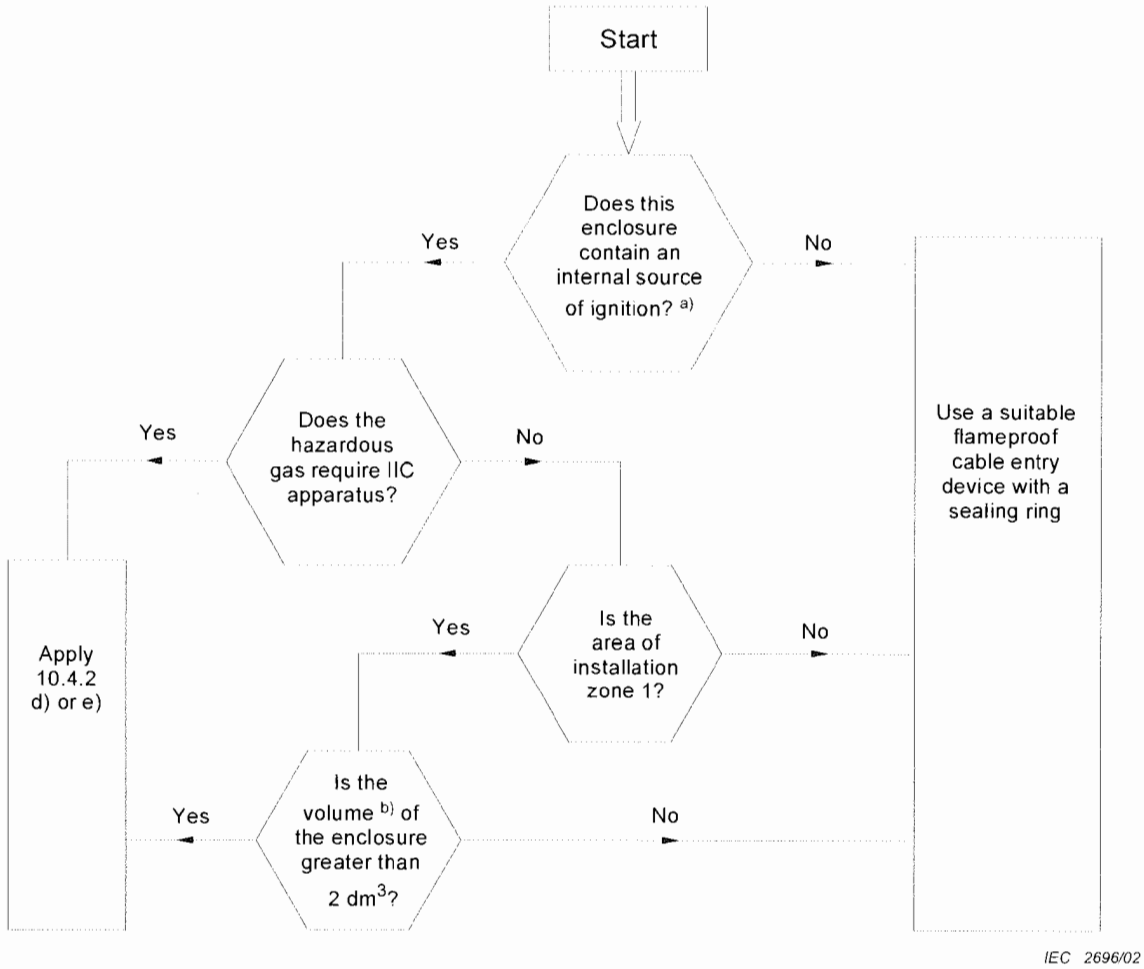

[a] Internal sources of ignition include sparks or equipment temperatures occurring in normal operation which can cause ignition. An enclosure containing terminals only or an indirect entry enclosure (see 10.4.1) is considered not to constitute an internal source of ignition.

[b] The term 'volume' is defined in AS/NZS 60079.1~~IEC 60079-1~~.

Figure 2 – Selection chart for cable entry devices into flameproof enclosures for cables complying with item b) of 10.4.2

c) mineral-insulated metal-sheathed cable with or without plastic outer covering with appropriate flameproof cable gland complying with AS/NZS 60079.1~~IEC 60079-1~~;

d) flameproof sealing device (for example a sealing chamber) specified in the equipment documentation or complying with AS/NZS 60079.1~~IEC 60079-1~~ and employing a cable gland appropriate to the cables used. The sealing device shall incorporate compound or other appropriate seals which permit stopping around individual cores. The sealing device shall be fitted at the point of entry of cables to the equipment;

e) flameproof cable gland, specified in the equipment documentation or complying with AS/NZS 60079.1~~IEC 60079-1~~ , incorporating compound filled seals or elastomeric seals that seal around the individual cores or other equivalent sealing arrangements;

10.5 Conduit systems

Flameproof sealing devices for conduit shall be:

a) provided with the equipment and detailed in the equipment documentation; or

b) as specified in the equipment documentation; or

c) compliant with AS/NZS 60079.1~~IEC 60079-1~~.

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Conduit sealing devices shall be provided, either as part of the flameproof enclosure or immediately or as close as practical to the entry to the flameproof enclosure using a minimum number of fittings.

Conduit sealing devices, having parallel threads may be fitted with a sealing washer between the device and the flameproof enclosure providing that after the washer has been fitted, the applicable thread engagement is still achieved. Thread engagement shall be at least five full threads. Suitable grease may be used provided it is non-setting and any earthing between the two is maintained.

NOTE 1 A conduit sealing device is considered as fitted immediately at the entry of the flameproof enclosure when the device is fixed to the enclosure either directly or through an accessory necessary for coupling according to the manufacturer's instructions.

NOTE 2 Gas or vapour leakage and propagation of flames may occur through the interstices between the strands of standard stranded conductors, or between individual cores of a cable. Special constructions can be employed as means of reducing leakage and preventing the propagation of flames. Examples include compacted strands, sealing of the individual strands, and extruded bedding.

10.6 Motors

10.6.1 Motors with a converter supply

Motors supplied at varying frequency and voltage by a converter supply require that either:

a) the motor has been type-tested for this duty as a unit in association with the converter specified in the descriptive documents according to AS/NZS 60079.0~~IEC 60079-0~~ and with the protective device provided, or

b) the motor has not been type-tested for this duty as a unit in association with the converter. In this case, means (or equipment) for direct temperature control by embedded temperature sensors specified in the motor documentation or other effective measures for limiting the surface temperature of the motor housing shall be provided. The effectiveness of the temperature control shall take into account power, speed range, torque and frequency for the duty required and shall be verified and documented. The action of the protective device shall be to cause the motor to be electrically disconnected.

NOTE 1 In some cases, the highest surface temperature occurs on the motor shaft.

NOTE 2 A current-dependent time lag protective device (in accordance with 7.2 a)) is not to be regarded as an 'other effective measure'.

NOTE 3 For motors with type of protection 'e' terminal boxes, when using converters with high-frequency pulses in the output, care should be taken to ensure that any overvoltage spikes and higher temperatures which may be produced in the terminal box are taken into consideration.

10.6.2 Reduced-voltage starting (soft starting)

Motors with a soft start supply require that either:

a) the motor has been type tested as a unit in association with the soft start device specified in the descriptive documents and with the protective device provided, or

b) the motor has not been type tested as a unit in association with the soft start device. In this case, means (or equipment) for direct temperature control by embedded temperature sensors specified in the motor documentation, other effective measures for limiting the surface temperature of the motor housing shall be provided or the speed control device ensures that the motor run up is such that the surface temperature is not exceeded. The effectiveness of the temperature control or proper run up shall be verified and documented. The action of the protective device shall be to cause the motor to be disconnected.

NOTE 1 It is considered that soft starting is used for a short time period

NOTE 2 For motors with type of protection 'e' terminal boxes, when using a soft start device with high-frequency pulses in the output, care should be taken to ensure that any overvoltage spikes and higher temperatures which may be produced in the terminal box are taken into consideration.

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11 Additional requirements for type of protection 'e' – Increased safety

Increased safety enclosures, with only an Ex component enclosure certificate (marked with a 'U'), shall not be installed. They shall always have an equipment certificate for the complete assembly.

11.1 Degree of ingress protection of enclosures (IEC 60034-5 and IEC 60529)

Enclosures containing bare live parts shall have a degree of ingress protection of at least IP54, whereas enclosures containing insulated parts shall only have a degree of ingress protection of at least IP44. Rotating electrical machinery (except for terminal boxes and bare conducting parts) installed in clean environments and regularly supervised by trained personnel shall be protected by an enclosure with a degree of ingress protection of at least IP20. The restriction of application shall be marked on the machine.

11.2 Wiring systems

11.2.1 General

Cables and conduits shall be installed in accordance with ~~Clause~~ 9 and the following additional requirements concerning cable entries and conductor terminations.

Additional cable entry holes may be made into the enclosure providing this is permitted by the manufacturers documentation.

NOTE 1 Threaded holes in ~~plastic~~ enclosures should be at right angles to the face of the enclosure (due to the possible moulding methods for plastic enclosures, the wall of the enclosure may have draw angles). Surfaces with angles do not allow the gland and associated fittings inserted in the hole to fit square to the face, resulting in ineffective sealing.

NOTE 2 Taper threaded holes in plastic enclosures are not recommended because the high stresses created during sealing of these threads may fracture the enclosure wall.

11.2.2 Enclosure entries

Cable glands, adapters, blanking elements and other fittings connected to increased safety equipment shall maintain the degree of ingress protection IP54 or that required by the location, whichever is the higher and maintain the mechanical integrity of the enclosure.

NOTE 1 To meet the ingress protection requirement it may also be necessary to seal between the cable gland, adapter or blanking element, including between each item, and the enclosure (for example by means of a sealing washer or thread sealant). A separate entry boss may be required on enclosures with low mechanical strength to avoid excess stress on the enclosure.

NOTE 2 In order to meet the minimum requirement of IP54, when threaded cable glands are secured into a threaded entry and a thread engagement of 6 mm or greater is maintained, no additional sealing is required.

Where mineral-insulated metal sheathed cables are used, the requirement to achieve creepage distances shall be maintained by using an Ex 'e' mineral insulated cable sealing device.

~~**11.2.2 Cable glands**~~

~~The connection of cables to increased safety equipment shall be effected by means of cable glands appropriate to the type of cable used. They shall comply with the requirements of IEC 60079-0.~~

~~NOTE 1 To meet the ingress protection requirement it may also be necessary to seal between the cable glands and the enclosure (for example by means of a sealing washer or thread sealant).~~

~~NOTE 2 In order to meet the minimum requirement of IP54, threaded cable entry devices into threaded cable entry plates or enclosures of 6 mm or greater thickness need no additional sealing between the cable entry device and the entry plate or enclosure providing the axis of the cable entry device is perpendicular to the external surface of the cable entry plate or enclosure.~~

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~~Where mineral-insulated metal sheathed cables are used, the requirement to achieve creepage distances shall be maintained by using an Ex 'e' mineral insulated cable sealing device.~~

~~Threaded adapters complying with IEC 60079-0 may be fitted into the cable entry holes to allow connection of the device or cable gland.~~

~~Unused entries in the enclosure shall be sealed by blanking elements, which comply with IEC 60079-0 and maintain the degree of ingress protection IP 54 or that required by the location, whichever is the higher.~~

11.2.3 Conductor terminations

Some terminals (e.g. slot types) may permit the entry of more than one conductor. Where more than one conductor is connected to the same terminal, care shall be taken to ensure that each conductor is adequately clamped.

Unless permitted by the manufacturer's documentation, two conductors of different cross-sectional area shall not be connected into one terminal unless they are first secured with a single compression type ferrule or other method specified by the manufacturer.

To avoid the risk of short-circuits between adjacent conductors in terminal blocks, the insulation of each conductor shall be maintained up to the metal of the terminal.

NOTE Where single screw saddle clamps are used with a single conductor, the latter should be shaped around the screw in the form of a 'U' unless clamping of single conductors without 'U' is permitted in the documentation supplied with the equipment.

11.2.4 Combinations of terminals and conductors for general connection and junction boxes

Care shall be taken to ensure that the heat dissipated within the enclosure does not result in temperatures in excess of the required equipment temperature class. This can be achieved by:

a) following the guidance given by the manufacturer relating to the permissible number of terminals, the conductor size and the maximum current, or

b) checking that the calculated dissipated power, using parameters specified by the manufacturer, is less than the rated maximum dissipated power.

NOTE 1 The length of the conductors inside the enclosure should not exceed the diagonal length of the enclosure as this is the basis of calculations and type tests. Additional lengths of the conductors inside the enclosure running at maximum permitted current may give rise to increased internal temperature that may exceed the temperature class.

NOTE 2 Bunching of more than 6 conductors may also give rise to high temperatures that may exceed T6 and/or damage to the insulation and should be avoided.

11.3 Cage induction motors

11.3.1 Mains-operated

In order to meet the requirements of ~~item a) of~~ 7.2 a), inverse-time delay overload protective devices shall be such that not only is the motor current monitored, but the stalled motor will also be disconnected within the time t_E stated on the marking plate. The current-time characteristic curves giving the delay time of the overload relay or release as a function of the ratio of the starting current to the rated current shall be held by the user.

The curves will indicate the value of the delay time from the cold state related to an ambient temperature of 20 °C and for a range of starting current ratios (I_A/I_N) of at least 3 to 8. The tripping time of the protective devices shall be equal to these values of delay ±20 %.

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The properties of delta wound machines in the case of the loss of one phase should be specifically addressed. Unlike star wound machines, the loss of one phase may not be detected, particularly if it occurs during operation. The effect will be current imbalance in the lines feeding the machine and increased heating of the motor. A delta wound motor with a low torque load during start-up might also be able to start under this winding failure condition and therefore the fault may exist undetected for long periods. Therefore, for delta wound machines, phase imbalance protection shall be provided which will detect machine imbalances before they can give rise to excessive heating effects.

In general, motors designed for continuous operation, involving easy and infrequent starts which do not produce appreciable additional heating, are acceptable with inverse-time delay overload protection. Motors designed for arduous starting conditions or which are to be started frequently are acceptable only when suitable protective devices ensure that the limiting temperature is not exceeded.

Arduous starting conditions are considered to exist if an inverse-time delay overload protective device, correctly selected as above, disconnects the motor before it reaches its rated speed. Generally, this will happen if the total starting time exceeds 1,7 t_E.

NOTE 1 Operation

Where the duty of the motor is not S1 (continuous operation at constant load), the user should obtain the appropriate parameters for the determination of suitability given a definition of operation.

NOTE 2 Starting

It is preferred that the direct on-line starting time for the motor is less than the t_E time so that the motor protection device does not trip the motor during start-up. Where the starting time exceeds 80 % of the t_E time, the limitations associated with starting whilst maintaining operation within the machine instruction manual should be ascertained from the motor manufacturer.

As the voltage dips during a direct on-line start, the starting current decreases and the run-up time increases. Although these effects may tend to cancel out for small voltage dips, for voltages less than 85 % of U_N during start-up, the motor manufacturer should declare the associated limitations on start-up.

Motors may be limited by the manufacturer to a fixed number of start attempts.

NOTE 3 Protection relay

The protection relay for machines in accordance with type of protection 'e' should, in addition to the requirements of ~~Clause~~ 7:

a) monitor the current in each phase;

b) provide close overload protection to the fully loaded condition of the motor.

Inverse-time delay overload protection relays may be acceptable for machines of duty type S1 which have easy and infrequent starts. Where the starting duty is arduous or starting is required frequently, the protection device should be selected so that it ensures limiting temperatures are not exceeded under the declared operational parameters of the machine. Where the starting time exceeds 1,7t_E, an inverse-time relay would be expected to trip the machine during start-up.

Under some circumstances, e.g. for duty types other than S1, the motor may be certified with the temperature detection and protection. If this is the case, the t_E time may not be identified.

11.3.2 Winding temperature sensors

In order to meet the requirements of 7.2 b), winding temperature sensors associated with protective devices shall be adequate for the thermal protection of the machine even when the machine is stalled. The use of embedded temperature sensors to control the limiting temperature of the machine is only permitted if such use is specified in the machine documentation.

NOTE The type of built-in temperature sensors and associated protective device will be identified on the machine.

11.3.3 Machines with rated voltage greater than 1 kV

Machines with a rated voltage exceeding 1 kV shall be selected taking into account the 'Potential stator winding discharge risk assessment – Ignition risk factors' (see Annex E). If the total sum of the risk factors is greater than 6, then anti-condensation space heaters shall be employed, and special measures shall be applied to ensure that the enclosure does not contain an explosive gas atmosphere at the time of starting.

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NOTE 1 If the machine is intended to operate under 'special measures', the certificate will have the symbol 'X' in accordance with AS/NZS 60079.0~~IEC 60079-0~~.

NOTE 2 Special measures may include pre-start ventilation, the application of fixed gas detection inside the machine or other methods specified in manufacturer's instructions.

NOTE 3 In the table in Annex E, the reference to 'Time between detailed inspections' is intended to reflect the interval between cleaning of the stator windings. It should read 'Time between major overhauls (disassembly and cleaning where necessary)' as a detailed inspection in accordance with AS/NZS 60079.17~~IEC 60079-17~~ would not normally require the stator winding to be examined.

11.3.4 Motors with converter supply

Motors supplied at varying frequency and voltage by a converter shall have been type tested for this duty as a unit in association with the converter and the protective device.

11.3.5 Reduced-voltage starting (soft starting)

Motors with a soft start supply require either:

a) the motor has been type tested as a unit in association with the soft start device specified in the descriptive documents and with the protective device provided, or

b) the motor has not been type tested as a unit in association with the soft start device. In this case, means (or equipment) for direct temperature control by embedded temperature sensors specified in the motor documentation, other effective measures for limiting the temperature of the motor shall be provided or the speed control device ensures that the motor run up is such that the temperature is not exceeded. The effectiveness of the temperature control or proper run up shall be verified and documented. The action of the protective device shall be to cause the motor to be disconnected.

NOTE 1 It is considered that soft starting is used for a short time period

NOTE 2 When using a soft start device with high-frequency pulses in the output, care should be taken to ensure that any overvoltage spikes and higher temperatures which may be produced in the terminal box are taken into consideration.

11.4 Luminaires

Luminaires with fluorescent lamps and electronic ballasts shall not be used where temperature class T5 or T6 is required or where the ambient temperature exceeds 60 °C.

NOTE This restriction minimizes the risk of End of Life (EOL) effects of the lamp.

Lamps (e.g. bi-pins, screw connections on tungsten lamps) using non-conductive materials with a conductive coating shall not be used unless tested with the equipment.

NOTE This requirement is intended to apply to recently designed lamps where the pins or end caps may be plastic or ceramic with a conductive film coating.

12 Additional requirements for types of protection 'i' – Intrinsic safety

Additional requirements for 'iD' are under consideration.

12.1 Introductory remark

A fundamentally different type of protection philosophy has to be recognized in the installation of intrinsically safe circuits. In comparison with all other types of installations, where care is taken to confine electrical energy to the installed system as designed so that a hazardous environment cannot be ignited, the integrity of an intrinsically safe circuit has to be protected from the intrusion of energy from other electrical sources so that the safe energy limitation in the circuit is not exceeded, even when breaking, shorting or earthing of the circuit occurs.

As a consequence of this principle, the aim of the installation rules for intrinsically safe circuits is to maintain separation from other circuits. Unless otherwise stated, requirements for intrinsically safe circuits shall apply to all levels of protection ('ia', 'ib' and 'ic').

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Energy-limited circuits 'nL' shall comply with all the requirements for intrinsically safe circuits 'ic'.

12.2 Installations to meet the requirements of EPL 'Gb' or 'Gc'

12.2.1 Equipment

In installations to meet the requirements of EPL 'Gb', the intrinsically safe apparatus and the intrinsically safe parts of associated apparatus shall comply with AS/NZS 60079.11~~IEC 60079-11~~, at least to level of protection 'ib'.

In installations to meet the requirements of EPL 'Gc', the intrinsically safe apparatus and the intrinsically safe parts of associated apparatus shall comply with AS/NZS 60079.11~~IEC 60079-11~~, at least to level of protection 'ic'.

Simple apparatus need not be marked, but shall comply with the requirements of AS/NZS 60079.11~~IEC 60079-11~~ and AS/NZS 60079.0~~IEC 60079-0~~, in so far as intrinsic safety is dependent on them.

Associated apparatus should preferably be located outside the hazardous area or, if installed inside a hazardous area, shall be provided with another appropriate type of protection in accordance with ~~Clause~~ 5 which is suitable for the ignition sources which the associated apparatus may present.

Electrical equipment connected to the non-intrinsically safe terminals of an associated apparatus shall not be fed with a voltage supply greater than U_m shown on the label of the associated apparatus. The prospective short-circuit current of the supply shall not be greater than 1 500 A.

Limitation of the prospective short circuit current, where higher fault levels exist, may be achieved by appropriate upstream fusing or protection

Where U_m marked on the associated apparatus is less than 250 V it shall be installed in accordance with one of the following:

a) Where U_m does not exceed 50 V a.c. or 120 V d.c., in an SELV or PELV system or,

b) via a safety isolating transformer complying with the requirements of IEC 61558-2-6 or technically equivalent standard, or

c) directly connected to apparatus complying with IEC 60950, IEC 61010-1, or a technically equivalent standard, or

d) fed directly from cells or batteries.

In order to protect against unauthorized interference and damage, the components and wiring of intrinsically safe apparatus and associated apparatus (e.g. barriers) shall be mounted in enclosures offering a degree of ingress protection of at least IP20 unless a higher degree of ingress protection is required by the apparatus documentation. Alternative methods of mounting may be used if they offer similar integrity against interference and damage (e.g. mounted in racks in a normally locked switch-room).

All apparatus forming part of an intrinsically safe system should, where reasonably practicable, be identifiable as being part of an intrinsically safe system. This recommendation may be met by conformity with 12.2.2.6.

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12.2.2 Cables

12.2.2.1 General

Only insulated cables whose conductor-earth, conductor-screen and screen-earth test voltages are at least 500 V a.c. or 750 V d.c. shall be used in intrinsically safe circuits.

The diameter of individual conductors within the hazardous area shall be not less than 0,1 mm. This applies also to the individual strands of a finely stranded conductor.

12.2.2.2 Electrical parameters of cables

The electrical parameters (C_c and L_c) or (C_c and L_c/R_c) for all cables used (see 12.2.5) shall be determined according to a), b) or c):

a) the most onerous electrical parameters provided by the cable manufacturer;

b) electrical parameters determined by measurement of a sample;

NOTE Annex C details a satisfactory method of determining the relevant parameters.

c) 200 pF/m and either 1 μH/m or 30 μH/Ω where the interconnection comprises two or three cores of a conventionally constructed cable (with or without screen).

Where a FISCO or FNICO system is used, the requirements for cable parameters shall comply with AS/NZS 60079.27~~IEC 60079-27~~.

12.2.2.3 Earthing of conducting screens

Where a screen is required, except as in a) through c) below, the screen shall be electrically connected to earth at one point only, normally at the non-hazardous area end of the circuit loop. This requirement is to avoid the possibility of the screen carrying a possibly incendive level of circulating current in the event that there are local differences in earth potential between one end of the circuit and the other.

If an earthed intrinsically safe circuit is run in a screened cable, the screen for that circuit shall be earthed at the same point as the intrinsically safe circuit which it is screening.

If an intrinsically safe circuit or sub-circuit which is isolated from earth is run in a screened cable, the screen shall be connected to the equipotential bonding system at one point.

Special cases:

a) If there are special reasons (for example when the screen has high resistance, or where screening against inductive interference is additionally required) for the screen to have multiple electrical connections throughout its length, the arrangement of Figure 3 may be used, provided that
   - the insulated earth conductor is of robust construction (normally at least 4 mm2 but 16 mm2 may be more appropriate for clamp type connections);
   - the arrangement of the insulated earth conductor plus the screen is insulated to withstand a 500 V insulation test from all other conductors in the cable and any cable armour;
   - the insulated earth conductor and the screen are only connected to earth at one point which shall be the same point for both the insulated earth conductor and the screen, and would normally be at the non-hazardous end of the cable;
   - the insulated earth conductor complies with 0;
   - the inductance/resistance ratio (L/R) of the cable, installed together with the insulated earth conductor, shall be established and shown to conform to the requirements of 12.2.5.

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b) If the installation is effected and maintained in such a manner that there is a high level of assurance that potential equalization exists between each end of the circuit (i.e. between the hazardous area and the non-hazardous area), then, if desired, cable screens may be connected to earth at both ends of the cable and, if required, at any interposing points.

c) Multiple earthing through small capacitors (for example 1 nF, 1 500 V ceramic) is acceptable provided that the total capacitance does not exceed 10 nF.

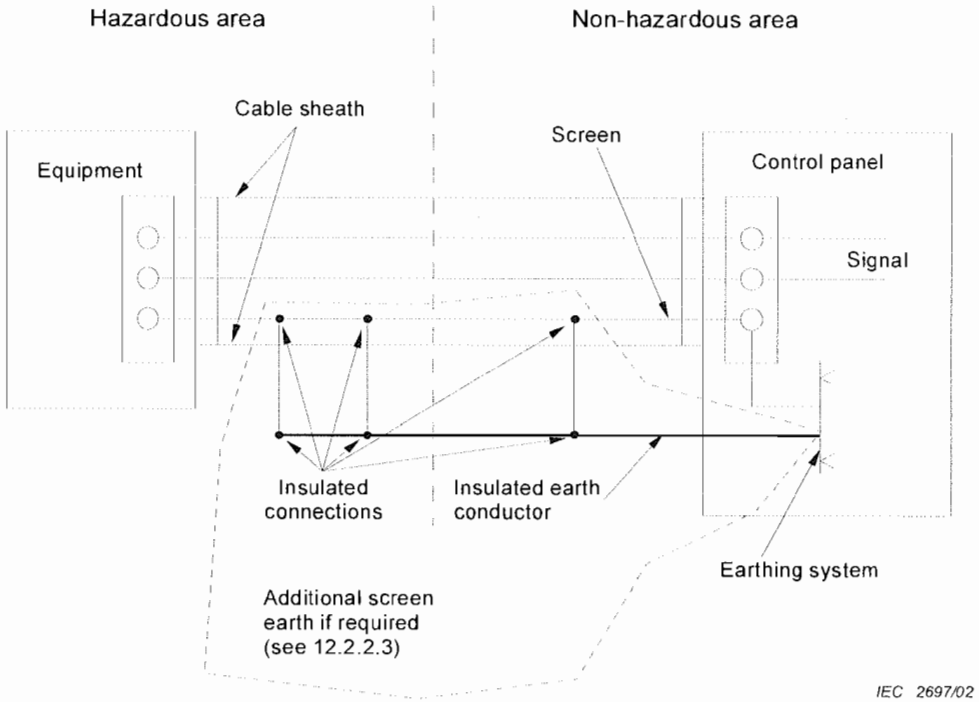

Figure 3 – Earthing of conducting screens

12.2.2.4 Cable armour bonding

Armour shall be bonded to the equipotential bonding system via the cable entry devices or equivalent, at each end of the cable run. Where there are interposing junction boxes or other equipment, the armour will normally be similarly bonded to the equipotential bonding system at these points. In the event that armour is required not to be bonded to the equipotential bonding system at any interposing point, care shall be taken to ensure that the electrical continuity of the armour from end to end of the complete cable run is maintained.

Where bonding of the armour at a cable entry point is not practical, or where design requirements make this not permissible, care shall be taken to avoid any potential difference which may arise between the armour and the equipotential bonding system giving rise to an incendive spark. In any event, there shall be at least one electrical bonding connection of the armour to the equipotential bonding system. The cable entry device for isolating the armour from earth shall be installed in the non-hazardous area or locations requiring EPL 'Gc'.

12.2.2.5 Installation of cables and wiring

12.2.2.5.1 General

Installations with intrinsically safe circuits shall be erected in such a way that their intrinsic safety is not adversely affected by external electric or magnetic fields such as from nearby overhead power lines or heavy current-carrying single core cables. This can be achieved, for example, by the use of screens and/or twisted cores or by maintaining an adequate distance from the source of the electric or magnetic field.

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In addition to the cable requirements of 9.3.99~~.3.7~~, cables in both hazardous and non-hazardous areas shall be installed so as to ensure that intrinsically safe circuit cables cannot be inadvertently connected to circuit cables which are not intrinsically safe. This may be achieved by:

a) separating the different types of circuit cables, or

b) placing the cables so as to protect against the risk of mechanical damage; or

c) using cables which are armoured, metal sheathed or screened for specific types of circuits (e.g. all circuits which are not intrinsically safe are run in armoured cable or all intrinsically safe circuits are armoured).

NOTE Cables installed with protected conditions, e.g. control rooms or like situations, where they are not likely to be damaged are considered to meet b).

12.2.2.5.2 Conductors

Conductors of intrinsically safe circuits shall not be carried in the same cable as conductors of circuits which are not intrinsically safe except as permitted 12.4.

Conductors of intrinsically safe circuits, except as permitted in 12.2.2.7, shall not be in the same bundle or duct as conductors of circuits which are not intrinsically safe unless separated by an intermediate layer of insulating material or by an earthed metal partition. No separation is required if metal sheaths or screens are used for the intrinsically safe circuits or the circuits which are not intrinsically safe.

12.2.2.5.3 Unused cores in multi-core cables

Each unused core in a multi-core cable shall either

a) be adequately insulated from earth and from each other at both ends by the use of suitable terminations, or

b) if other circuits in the multicore have an earth connection (e.g. via the associated apparatus), be connected to the earth point used to earth any intrinsically safe circuits in the same cable, but shall be adequately insulated from earth and from each other by the use of suitable terminations at the other end.

12.2.2.6 Marking of cables

Cables containing intrinsically safe circuits shall be marked (except as below) to identify them as being a part of an intrinsically safe circuit. If sheaths or coverings are marked by a colour, the colour used for cables containing intrinsically safe circuits shall be light blue. Where intrinsically safe circuits have been identified by the use of light blue covered cable, then light blue covered cable shall not be used for other purposes in a manner or location which could lead to confusion or detract from the effectiveness of the identification of intrinsically safe circuits.

If all intrinsically safe circuit cables or all cables of circuits which are not intrinsically safe are armoured, metal sheathed or screened, then marking of intrinsically safe circuit cables is not required.

Alternative marking measures shall be taken inside measuring and control cabinets, switchgear, distribution equipment, etc. where there is a risk of confusion between cables of intrinsically safe and non-intrinsically safe circuits, in the presence of a blue neutral conductor. Such measures include:

- combining the cores in a common light blue harness;
- labelling;
- clear arrangement and spatial separation.

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12.2.2.7 Multi-core cables containing more than one intrinsically safe circuit

The requirements of this subclause are in addition to those of 12.2.2.1 to 12.2.2.6.

Multi-core cables may contain more than one intrinsically safe circuit. Circuits which are not intrinsically safe shall not be carried in the same multi-core as intrinsically safe circuits except as noted in 12.4.

The radial thickness of the conductor insulation shall be appropriate to the conductor diameter and the nature of the insulation. The minimum radial thickness shall be 0,2 mm.

The conductor insulation shall be such that it will be capable of withstanding an r.m.s. a.c. test voltage of twice the nominal voltage of the intrinsically safe circuit with a minimum of 500 V.

Multi-core cables shall be of a type capable of withstanding a dielectric test of at least

- 500 V r.m.s. a.c. or 750 V d.c. applied between any armouring and/or screen(s) joined together and all the cores joined together;
- 1 000 V r.m.s. a.c. or 1 500 V d.c. applied between a bundle comprising one half of the cable cores joined together and a bundle comprising the other half of the cores joined together. This test is not applicable to multi-core cables with conducting screens for individual circuits.

The voltage tests shall be carried out by a method specified in an appropriate cable standard. Where no such method is available, the tests shall be carried out in accordance with Clause 10 of AS/NZS 60079.11~~IEC 60079-11~~.

12.2.2.8 Fault considerations in multi-core cables

The faults, if any, which shall be taken into consideration in multi-core cables used in intrinsically safe electrical systems depend upon the type of cable used.

- Type A

  For cables complying with the requirements of 12.2.2.7 and, in addition, with conducting screens providing individual protection for intrinsically safe circuits in order to prevent such circuits becoming connected to one another, coverage of such screens shall be at least 60 % of the surface area. No faults between circuits are taken into consideration.

- Type B

  Cable which is fixed, effectively protected against damage, complying with the requirements of 12.2.2.7 and, in addition, no circuit contained within the cable has a maximum voltage U_0 exceeding 60 V. No faults between circuits are taken into consideration.

- Others

  For cables complying with the requirements of 12.2.2.7 but not the additional requirements of Type A or Type B, it is necessary for 'ia' or 'ib' to take into consideration up to two short-circuits between conductors and, simultaneously, up to four open circuits of conductors. In the case of identical circuits, failures need not be taken into consideration provided that each circuit passing through the cable has a safety factor for spark ignition parameters of four times that required for level of protection 'ia' or 'ib'.

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12.2.3 Termination of intrinsically safe circuits

Terminals for intrinsically safe circuits shall be separated from terminals of circuits which are not intrinsically safe by one of the methods, a) or b), given below:

a) When separation is accomplished by distance, then the clearance between terminals shall be at least 50 mm. Care shall be exercised in the layout of terminals and in the wiring method used so that contact between circuits is unlikely if a wire becomes dislodged.

b) When separation is accomplished by use of an insulating partition or earthed metal partition, the partitions used shall extend to within 1,5 mm of the walls of the enclosure, or alternatively provide a minimum measurement of 50 mm between the terminals when taken in any direction around the partition.

The minimum clearances between the bare conducting parts of external conductors connected to terminals and earthed metal or other conducting parts shall be 3 mm.

The clearance between the bare conducting parts of field wiring terminals of separate intrinsically safe circuits shall be such that there is at least 6 mm between the bare conducting parts of connected external conductors.

Where there is a risk of confusion between terminals of intrinsically safe and non intrinsically safe circuits, the terminals of the intrinsically safe circuits shall be marked as such.

NOTE 1 This marking may be by the use of colour, in which case it shall be light blue.

Plugs and sockets used for connection of external intrinsically safe circuits shall be separate from, and non-interchangeable with, those of circuits which are not intrinsically safe. Where the equipment is fitted with more than one plug and socket for external connections and interchange could adversely affect the type of protection, such plugs and sockets shall either be arranged so that interchange is not possible, e.g. by keying, or mating plugs and sockets shall be identified, e.g. by marking or colour coding, to make interchange obvious (see 12.4).

NOTE 2 Where a connector carries earthed circuits and the type of protection depends on the earth connection, then the connector should be constructed in accordance with the requirements given in AS/NZS 60079.11~~IEC 60079-11~~ relating to earth conductors, connections and terminals.

12.2.4 Earthing of intrinsically safe circuits

Intrinsically safe circuits shall be either

a) isolated from earth, or

b) connected at one point to the equipotential bonding system if this exists over the whole area in which the intrinsically safe circuits are installed.

The installation method shall be chosen with regard to the functional requirements of the circuits and in accordance with the manufacturer's instructions.

More than one earth connection is permitted on a circuit, provided that the circuit is galvanically separated into subcircuits, each of which has only one earth point.

In intrinsically safe circuits which are isolated from earth, attention shall be paid to the danger of electrostatic charging. A connection to earth across a resistance greater than 0,2 MΩ for example for the dissipation of electrostatic charges, is not deemed to be earthing.

Intrinsically safe circuits shall be earthed if this is necessary for safety reasons, for example in installations with safety barriers without galvanic isolation. They may be earthed if necessary for functional reasons, for example with welded thermocouples. If the intrinsically safe apparatus does not withstand the electrical strength test with at least 500 V a.c. r.m.s. to earth according to AS/NZS 60079.11~~IEC 60079-11~~, a connection to earth for the equipment is to be assumed.

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Where the equipment is earthed (e.g. by the method of mounting) and a bonding conductor is used between the equipment and the point of earth connection of the associated apparatus, conformity with a) or b) is not required. Such situations should receive careful consideration by a competent person and in any case should not be used for circuits without galvanic isolation entering an locations requiring EPL 'Ga'. If bonding conductors are employed, they should be adequate for the situation, have a copper cross-sectional area of no less than 4 mm^2, be permanently installed without the use of plugs and sockets, adequately mechanically protected, and have terminations which, with the exception of the IP rating, conform to the requirements of type of protection 'e'.

In intrinsically safe circuits, the earthing terminals of safety barriers without galvanic isolation (for example Zener barriers) shall be:

1) connected to the equipotential bonding system by the shortest practicable route, or
2) for TN-S systems only, connected to a high-integrity earth point in such a way as to ensure that the impedance from the point of connection to the main power system earth point is less than 1 Ω. This may be achieved by connection to a switch-room earth bar or by the use of separate earth rods.

The conductor used shall be insulated to prevent invasion of the earth by fault currents which might flow in metallic parts with which the conductor could come into contact (for example control panel frames). Mechanical protection shall also be provided in places where the risk of damage is high.

The cross-section of the earth connection shall consist of

- at least two separate conductors each rated to carry the maximum possible current, which can continuously flow, each with a minimum of 1,5 mm^2 copper, or
- at least one conductor with a minimum of 4 mm^2 copper.

NOTE The provision of two earthing conductors should be considered to facilitate testing.

If the prospective short-circuit current of the supply system connected to the barrier input terminals is such that the earth connection is not capable of carrying such current, then the cross-sectional area shall be increased accordingly or additional conductors used.

If the earth connection is achieved via junction boxes, special care should be taken to ensure the continued integrity of the connection.

12.2.5 Verification of intrinsically safe circuits

Unless a system certificate is available defining the parameters for the complete intrinsically safe circuit, then the whole of this subclause applies.

12.2.5.1 General

A descriptive system document shall be prepared by the system designer in which the items of electrical equipment and the electrical parameters of the system, including those of inter-connecting wiring, are specified.

NOTE The form in which information in the descriptive system document necessary to ensure safety should be kept is not stated precisely and may be covered by a number of sources such as drawings, schedules, maintenance manuals or similar documents. The documents should be prepared and maintained such that all the information relevant to a particular installation can be easily accessed.

When installing intrinsically safe circuits, including cables, the maximum permissible inductance, capacitance or L/R ratio and surface temperature shall not be exceeded. The permissible values shall be taken from the associated apparatus documentation or the marking plate.

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12.2.5.2 Intrinsically safe circuits with only one associated apparatus

Where a circuit contains significant amounts of energy stored in both capacitance and inductance the capacitive stored energy may reinforce the effect of the power source feeding the inductor. The distributed inductance and capacitance of cables is known to be less incendive than that of an inductive or capacitive component. The following method of assessment of cable parameters, which is only applicable to linear (resistive current limited) circuits, takes these factors into account.

Determine the ~~output voltage [U_o], output current [I_o],~~ maximum external capacitance [C_o], maximum external inductance [L_o], and the maximum external inductance to resistance ratio [L_o/R_o] of the power source from the label or documentation of that source.

Determine the effective total inductance and capacitance of all the apparatus connected in the circuit by adding together the input capacitances [C_i] and input inductances [L_i] of the connected apparatus plus the total capacitance and inductance of any simple apparatus included in the system.

Where either or both the effective total inductance and capacitance is not greater than 1% of L_o and C_o respectively then the permitted inductance or capacitance of the interconnected cable is determined by subtracting these effective values from the C_o and L_o of the source of power. The use of the L_o/R_o ratio as a cable parameter is permitted, provided that the effective total capacitance is greater than or equal to 1% of C_o. If the effective total inductance is greater than 1% of Lo then the permitted *L/R* ratio of the cable must be recalculated in accordance with AS/NZS 60079.25~~IEC 60079-25~~. Where the use of the L_o/R_o ratio is permitted, then if the cable has an *L/R* ratio less than, or equal to the permitted value, it is not necessary to satisfy the Lo requirement.

Where both the total inductance and capacitance are greater than 1% of L_o and C_o respectively then the values of C_o and L_o should be divided by two. The cable inductance and capacitance should then be calculated by subtracting the effective total inductance and capacitance from these reduced values. The use of the L_o/R_o parameter for the cable is not permitted in these circumstances.

Guidance on the determination of cable parameters is given in 12.2.2.2.

NOTE Where the intrinsically safe apparatus contains effective inductance and the associated apparatus is marked with an inductance/resistance *L/R*-value, reference should be made to AS/NZS 60079.25~~IEC 60079-25~~, intrinsically safe systems, Annex D: Verification of inductive parameter

The values of permissible input voltage U_i, input current I_i and input power P_i of each intrinsically safe apparatus shall be greater than or equal to the values U_o, I_o and P_o respectively of the associated apparatus.

For simple apparatus the maximum temperature can be determined from the values of P_o of the associated apparatus to obtain the temperature class. The temperature class can be determined by

a) reference to Table 10~~7~~, or

b) calculation using the formula:

$$T = P_o R_{th} + T_{amb}$$

where

T is the surface temperature;

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P_o is the power marked on the associated apparatus;

R_{th} is the thermal resistance (K/W) (as specified by the component manufacturer for the applicable mounting conditions);

T_{amb} is the ambient temperature (normally 40 °C);

and reference to Table 4.

In addition, components with a surface area smaller than 1 000 mm^2 (excluding lead wires) may be classified as T5 if their surface temperature does not exceed 150 °C.

The equipment~~apparatus~~ group of the intrinsically safe circuit is the same as the lowest gas grouping of any of the items of electrical equipment forming that circuit (for example a circuit with IIB and IIC equipment will have a circuit grouping of IIB).

Table 10~~7~~ – Assessment for T4 classification according to component size and ambient temperature

Total surface area excluding lead wires	Requirement for T4 classification (based on 40 °C ambient temperature)
<20 mm^2	Surface temperature ≤275 °C
≥20 mm^2 ≤1000 mm^2	Surface temperature ≤200 °C
≥20 mm^2	Power not exceeding 1,3 W *
* Reduced to 1,2 W with 60 °C ambient temperature or 1,0 W with 80 °C ambient temperature.	

Junction boxes and switches in intrinsically safe circuits can be assumed to have a temperature classification of T6.

12.2.5.3 Intrinsically safe circuits with more than one associated apparatus

If the intrinsically safe circuit contains more than one associated apparatus or if two or more intrinsically safe circuits are interconnected, the intrinsic safety of the whole system shall be checked by means of theoretical calculations or a spark ignition test in accordance with AS/NZS 60079.11~~IEC 60079-11~~ and AS/NZS 60079.25~~IEC 60079-25~~. The equipment ~~apparatus~~ group, temperature class and the level of protection shall be determined.

Account shall be taken of the risk of feeding back voltages and currents into associated apparatus from the rest of the circuit. The rating of voltage and current-limiting elements within each associated apparatus shall not be exceeded by the appropriate combination of U_o and I_o of the other associated apparatus.

NOTE 1 For associated apparatus with linear current/voltage characteristics, the basis of calculation is given in annex A. For associated apparatus with non-linear current/voltage characteristics, the guidance in Annex C of AS/NZS 60079.25~~IEC 60079-25~~ can be used and/or expert advice should be sought.

NOTE 2 If the internal resistances $R_i = U_o/I_o$ of the associated apparatus are known for intrinsically safe circuits under consideration (output characteristic according to Figure C.1a of the standard AS/NZS 60079.25~~IEC 60079-25~~: Intrinsically safe systems), then the method given in Annex B of AS/NZS 60079.25~~IEC 60079-25~~ can be used as an alternative.

12.3 Installations to meet the requirements of EPL 'Ga'

Intrinsically safe circuits shall be installed in accordance with 12.2 except where modified by the following special requirements.

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In installations with intrinsically safe circuits for locations requiring EPL 'Ga', the intrinsically safe apparatus and the associated apparatus shall comply with AS/NZS 60079.11~~IEC 60079-11~~, level of protection 'ia'. The circuit (including all simple ~~components, simple electrical~~ apparatus, intrinsically safe apparatus, associated apparatus and the maximum allowable electrical parameters of inter-connecting cables) shall be of level of protection 'ia'.

Associated apparatus with galvanic isolation between the intrinsically safe and non-intrinsically safe circuits is preferred.

Since only one fault in the equipotential bonding system, in some cases, could cause an ignition hazard, associated apparatus without galvanic isolation shall be used only if the earthing arrangements are in accordance with item 2) of 12.2.4 and any mains-powered equipment connected to the safe area terminals are isolated from the mains by a double wound transformer, the primary winding of the transformer shall be protected by an appropriately rated fuse of adequate breaking capacity.

NOTE 1 If the intrinsically safe circuit is divided into sub-circuits, the locations requiring EPL 'Ga' sub-circuit(s) including the galvanically isolating elements should be level of protection 'ia' but sub-circuits not in locations requiring EPL 'Ga' need only be level of protection 'ib' or 'ic'.

NOTE 2 Galvanic isolation may be achieved via the associated apparatus or via galvanically isolating apparatus within an intrinsically safe circuit in EPL 'Gb', 'Gc' or non-hazardous locations.

Simple apparatus even if installed outside the locations requiring EPL 'Ga' shall be referred to in the system documentation and shall comply with the requirements of AS/NZS 60079.11~~IEC 60079-11 , level of protection 'ia'~~.

If earthing of the circuit is required for functional reasons, the earth connection shall be made outside the locations requiring EPL 'Ga', but as close as is reasonably practicable to the EPL 'Ga' equipment.

NOTE 3 If earthing of the circuit is inherent in the circuit operation, as for example with a grounded tip thermocouple or a conductivity probe, this should be the only connection to earth, unless it can be demonstrated that no fault condition can arise as a result of the presence of more than one earth connection.

If part of an intrinsically safe circuit is installed in locations requiring EPL 'Ga' such that the equipment and the associated equipment are at risk of developing hazardous potential differences within the locations requiring EPL 'Ga', e.g. through the presence of atmospheric electricity, a surge protection device shall be installed between each non-earth bonded core of the cable and the local structure as near as is reasonably practicable, preferably within 1 m, to the entrance to the locations requiring EPL 'Ga'. Examples of such locations are flammable liquid storage tanks, effluent treatment plants and distillation columns in petrochemical works. A high risk of potential difference is generally associated with a distributed plant and/or exposed equipment location, and the risk is not alleviated simply by using underground cables or tank installation.

The surge protection device shall be capable of diverting a minimum peak discharge current of 10 kA (8/20 µs impulse according to IEC 60060-1, ten operations). The connection between the protection device and the local structure shall have a minimum cross-sectional area equivalent to 4 mm² copper.

The spark-over voltage of the surge protection device shall be determined by the user and an expert for the specific installation.

NOTE 4 The use of one or more low voltage surge protection devices in an intrinsically safe modifies the way in which that circuit is considered to be earthed. This must be taken into account in the design of the intrinsically safe system. Further guidance on the use of surge protection devices is given in AS/NZS 60079.25~~IEC 60079-25~~.

The cable between the intrinsically safe apparatus in the locations requiring EPL 'Ga' and the surge protection device shall be installed such that it is protected from lightning.

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12.4 Special applications

For some special applications, such as the monitoring of power cables, circuits using the principles of intrinsic safety are included in the same cable as power circuits. Such installations require a specific analysis of the risks involved.

For special applications, intrinsically safe circuits are permitted in the same plug and socket assembly as circuits which are not intrinsically safe, provided that it meets the requirements of AS/NZS 60079.11~~IEC 60079-11~~ and the part of AS/NZS 60079~~IEC 60079~~ appropriate to the type of protection used to protect the non-intrinsically safe circuits and that intrinsic safety is not required when the other circuits are energized.

13 Additional requirements for pressurized enclosures

Pressurized enclosures, or pressurization control systems, with only an Ex component ~~enclosure~~ certificate (marked with a 'U'), shall not be installed. They shall always have an equipment certificate for the complete assembly.

The fitting of a pressurization control system with certificate onto a pressurized enclosure without certificate does not confer the certificate on the pressurized enclosure or its contents.

13.1 Type of protection 'p'

13.1.1 General

Unless it has been assessed as a whole, the complete installation shall be checked for compliance with the requirements of the documentation and this Standard.

The required level of protection 'x', 'y' or 'z' is determined by the EPL requirement for the location and whether the enclosure contains ~~an ignition-capable source of ignition~~equipment not meeting 'Gc' in accordance with Table 118.

Table 118 – Determination of type of protection (with no flammable release within the enclosure)

EPL	Enclosure contains equipment not meeting EPL 'Gc' requirements without pressurization~~ignition-capable equipment~~	Enclosure contains equipment meeting EPL 'Gc' requirements without pressurization~~does not contain ignition-capable equipment~~
'Gb'	Type px	Type py
'Gc'	Type px or pz	No pressurization required
NOTE AS/NZS 60079.2~~IEC 60079-2~~ requires that type 'py' equipment will only contain equipment to type of protection 'd', 'e', 'i', 'm', 'nA', 'nC', 'o' or 'q'.		

~~The fitting of a pressurization control system with certificate onto a pressurized enclosure without certificate does not confer the certificate on the pressurized enclosure or its contents.~~

13.1.2 Ducting

All ducts and their connecting parts shall be able to withstand a pressure equal to

- 1,5 times the maximum overpressure, specified by the manufacturer of the pressurized equipment, for normal operation, or
- the maximum overpressure that the pressurizing source can achieve with all the outlets closed where the pressurizing source (for example a fan) is specified by the manufacturer of the pressurized equipment,

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with a minimum of 200 Pa (2 mbar).

The materials used for the ducts and connecting parts shall not be adversely affected by the specified protective gas nor by the flammable gas or vapours in which they are to be used.

The points at which the protective gas enters the supply duct(s) shall be situated in a non-hazardous area, except for cylinder supplied protective gas.

Ducting should be located in a non-hazardous area as far as is reasonably practicable. If ducting passes through a hazardous area and the protective gas is at a pressure below atmospheric then the ducting shall be free from leaks.

Ducts for exhausting the protective gas should preferably have their outlets in a non-hazardous area. When ducts exhaust to a hazardous area, ~~Consideration shall otherwise be given to the fitting of~~ spark and particle barriers (i.e. devices to guard against the ejection of ignition-capable sparks or particles) shall be fitted as shown in Table 12~~9~~.

NOTE During the purge period a small hazardous area may exist at the duct outlet.

Table 12~~9~~ – Use of spark and particle barriers

EPL requirements for the location of exhaust duct outlet	Equipment	
	A	B
'Gb'	Required[a]	Required[a]
'Gc'	Required	Not required
A: Equipment which may produce ignition-capable sparks or particles in normal operation. B: Equipment which does not produce ignition-capable sparks or particles in normal operation.		
[a] If the temperature of the enclosed equipment constitutes a hazard upon failure of pressurization, a suitable device shall be fitted to prevent the rapid entry of the surrounding atmosphere into the pressurized enclosure.		

Pressurizing equipment, such as an inlet fan or compressor, that is used to supply protective gas should preferably be installed in a non-hazardous area. Where the drive motor and/or its control equipment are located within the supply ducting, or where the installation in a hazardous area cannot be avoided, the pressurizing equipment shall be suitably protected.

13.1.3 Action to be taken on failure of pressurization

13.1.3.1 General

Pressurization control systems are sometimes fitted with override devices or 'maintenance switches' which are intended to allow the pressurized enclosure to remain energized in the absence of pressurization, e.g. when the enclosure door has been opened.

Such devices shall be used in a hazardous area only if the specific location has been assessed to ensure that potentially flammable gas or vapour is absent during the period of use ('gas-free' situation). The enclosure should be de-energized at once if flammable gases are detected while operating under these conditions and re-purged before it is put back into service.

NOTE It is only necessary to re-purge the enclosure after pressurization has been re-established if flammable gas was detected in the area while the manual override was in operation.

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13.1.3.2 Equipment without an internal source of release

An installation comprising electrical equipment without an internal source of release shall comply with Table 1310 whenthen the pressurization with the protective gas fails.

NOTE Pressurized enclosures protected by static pressurization should be moved to a non-hazardous area for refilling if pressurization is lost.

If static pressurization is applied, the pressure monitoring devices shall lock out if pressure is lost and shall only be reset after pressure has been restored following refilling.

Table 1310 – Action to be taken when the pressurization with the protective gas fails for electrical equipment without an internal source of release

EPL requirement	Enclosure contains equipment not meeting EPL 'Gc' requirements without pressurization	Enclosure contains equipment meeting EPL 'Gc' requirements without pressurization
'Gb'	Apply 13.1.3.2.1Alarm and switch-off [a]	Apply 13.1.3.2.2Alarm [b]
'Gc'	Apply 13.1.3.2.2Alarm [b]	'p' not requiredNo action

NOTE Restoration of pressurization should be completed as soon as possible, but in any case within 24 h. During the time that the pressurization is inoperative, action should be taken to avoid the entry of flammable material into the enclosure.

Provided that pressurized equipment is switched off automatically upon pressurization failure, an additional alarm may not be necessary for safety, even in locations requiring EPL 'Gb'. If power is not switched off automatically, e.g. in an locations requiring EPL 'Gc', an alarm is the minimum action that is recommended if combined with immediate action by the operator to restore the pressurization or switch off the equipment.

Equipment within the pressurized enclosure suitable for the EPL requirements of the external location need not be switched off when pressure fails. However, care should be taken to ensure that there is no trapped flammable material inside the enclosed equipment which may leak out into the larger pressurized enclosure where work involving the creation of ignition capable sparks may occur.

[a] If automatic switch-off would introduce a more dangerous condition, other precautionary measures should be taken, for example duplication of protective gas supply.

[b] If the alarm operates, immediate action should be taken, for example to restore the integrity of the system.

13.1.3.2.1 Automatic switch-off

An automatic device shall be provided to switch off the electrical supply to the equipment when the overpressure and/or protective gas flow falls below the minimum prescribed value. In addition, an audible or visible alarm may be necessary. When such switching off might jeopardize the safety of the installation and safety is otherwise ensured, a continuous audible or visible alarm shall be provided until pressurization is restored or other appropriate measures are taken, including switching off with a known delay.

NOTE 1 If automatic switch-off would introduce a more dangerous condition, other precautionary measures should be taken, for example duplication of protective gas supply.

NOTE 2 Equipment within the pressurized enclosure suitable for the EPL requirements of the external location need not be switched off when pressure fails. However, care should be taken to ensure that there is no trapped flammable material inside the enclosed equipment, which may leak out into the larger pressurized enclosure where work involving the creation of ignition capable sparks may occur.

13.1.3.2.2 Alarm

If the internal pressure or flow of protective gas falls below the minimum prescribed value, a signal that is immediately apparent to the operator shall indicate the loss of pressure. The pressurization system shall be restored as soon as possible, or else the electrical supply shall be switched off manually.

13.1.3.3 Equipment with an internal source of release

Equipment with an internal source of release shall be installed in accordance with the manufacturer's instructions.

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In particular, any containment system safety devices that are required for safety but which were not actually supplied with the equipment, e.g. sample flow limiters, pressure regulators or in-line flame arrestors, should be fitted by the user.

Where the pressurized enclosure has an internal containment system that allows process fluids or gases to be taken into the enclosure, the likelihood and effect of the pressurizing gas leaking into the process system should be considered. For example, if a low-pressure process gas in a containment system is at a lower pressure than the pressurizing air, any leakage path into the containment system will allow air into the process and produce a potentially adverse or dangerous effect on the process.

In the event of failure of the protective gas, an alarm shall be given and corrective action taken to maintain the safety of the system.

The action to be taken on pressure or flow failure should be decided by the user, taking into account at least the following considerations:

- the manufacturer's recommendations;
- the nature of the release from the containment system (e.g. 'none', 'limited' or 'unlimited');
- the constituents of the internal release, e.g. liquid or gas, and their flammability limits;
- whether or not the flammable substance supply is automatically shut off upon pressure/flow failure;
- the nature of the equipment inside the enclosure, e.g. incendive, suitable for locations requiring EPL 'Gb' or 'Gc', and its proximity to the source of release;
- the external EPL requirements, e.g. 'Gb' or 'Gc';
- the type of protective gas used, e.g. air or inert gas. In the latter case, the enclosure should always be re-purged after pressure has been lost to restore the high concentration of inert gas (and low concentration of oxygen) required to provide adequate protection;
- the consequences of unannounced automatic shutdown of the equipment.

Where the sample gas has a high upper explosive limit (UEL) e.g. >80 %, or where the gas is capable of reacting exothermically even in the absence of air, e.g. ethylene oxide, it is not possible to protect the enclosure with inert gas using 'leakage compensation' techniques. The use of the 'continuous flow' technique with air or inert gas is suitable if the flow rate is high enough to dilute the release to a concentration below 25 % of the lower explosive limit (LEL), or to a level below which decomposition cannot take place.

13.1.4 Multiple pressurized enclosures with a common safety device

Requirements for the use of a common safety device with more than one pressurized enclosure are given in AS/NZS 60079.2~~IEC 60079-2~~.

13.1.5 Purging

The minimum purge time, specified by the manufacturer, for the pressurized enclosure shall be increased by the minimum additional purging duration per unit volume of ducting, specified by the manufacturer, multiplied by the volume of the ducting.

If the concentration in the atmosphere within the enclosure and the associated ducting, for locations requiring EPL 'Gc', is well below the lower flammable limit (for example 25 % LEL) purging may be omitted. Additionally, gas detectors may be used to check whether the gas in the pressurized enclosure is flammable.

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13.1.6 Protective gas

The protective gas used for purging, pressurization and continuous dilution shall be non-combustible and non-toxic. It shall also be substantially free from moisture, oil, dust, fibres, chemicals, combustibles and other contaminating material that may be dangerous or affect the satisfactory operation and integrity of the equipment. It will usually be air, although an inert gas may be used, particularly when there is an internal source of release of flammable material. The protective gas shall not contain more oxygen by volume than that normally present in air.

Where air is used as the protective gas, the source shall be located in a non-hazardous area and usually in such a position as to reduce the risk of contamination. Consideration shall be given to the effect of nearby structures on air movement and of changes in the prevailing wind direction and velocity.

Care should be taken to keep the temperature of the protective gas below 40 °C at the inlet of the enclosure. In special circumstances, a higher temperature may be permitted or a lower temperature may be required, in which case the temperature shall be marked on the pressurized enclosure.

Where inert gas is used, particularly in large enclosures, measures shall be taken to prevent the danger of suffocation. Pressurized enclosures using inert gas as the protective gas should be marked to indicate the hazards, for example:

'WARNING – THIS ENCLOSURE CONTAINS INERT GAS AND MAY BE A DANGER OF SUFFOCATION. THIS ENCLOSURE ALSO CONTAINS A FLAMMABLE SUBSTANCE THAT MAY BE WITHIN THE FLAMMABLE LIMITS WHEN EXPOSED TO AIR'

13.1.7 Wiring systems

Where necessary, to prevent the ingress of combustible gas or vapour by diffusion, or to prevent leakage of protective gas, wiring systems shall be sealed.

NOTE 1 This does not preclude a cable duct or a conduit being purged with the equipment.

Cabling and cable glands shall comply with the requirements of ~~Clause~~ 9 and be in accordance with the manufacturer's equipment documentation.

NOTE 2 Compact cables, barrier glands and/or conduit seals should be considered as sealing methods.

13.2 Motors

13.2.1 Motors with a converter supply

Motors supplied at varying frequency and voltage by a converter supply require that either:

a) the motor has been type-tested for this duty as a unit in association with the converter specified in the descriptive documents according to AS/NZS 60079.0~~IEC 60079-0~~ and with the protective device provided, or

b) the motor has not been type-tested for this duty as a unit in association with the converter. In this case, means (or equipment) for direct temperature control by embedded temperature sensors specified in the motor documentation or other effective measures for limiting the surface temperature of the motor housing shall be provided. The effectiveness of the temperature control taking into account power, speed range, torque and frequency for the duty required shall be verified and documented. The action of the protective device shall be to cause the motor to be disconnected.

NOTE 1 In some cases, the highest surface temperature occurs on the motor shaft.

NOTE 2 A current-dependent time lag protective device (in accordance with 7.2 a) is not to be regarded as an 'other effective measure'.

NOTE 3 For motors with type of protection 'e' or 'n' terminal boxes, when using convertors with high-frequency pulses in the output, care should be taken to ensure that any overvoltage spikes and higher temperatures which may be produced in the terminal box are taken into consideration.

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13.2.2 Reduced-voltage starting (soft starting)

Motors with a soft start supply require that either:

a) the motor has been type tested as a unit in association with the soft start device specified in the descriptive documents and with the protective device provided, or

b) the motor has not been type tested as a unit in association with the soft start device. In this case, means (or equipment) for direct temperature control by embedded temperature sensors specified in the motor documentation, other effective measures for limiting the surface temperature of the motor housing shall be provided or the speed control device ensures that the motor run up is such that the surface temperature is not exceeded. The effectiveness of the temperature control or proper run up shall be verified and documented. The action of the protective device shall be to cause the motor to be disconnected.

NOTE 1 It is considered that soft starting is used for a short time period

NOTE 2 When using a soft start device with high-frequency pulses in the output, care should be taken to ensure that any overvoltage spikes and higher temperatures which may be produced in the terminal box are taken into consideration.

13.3 Type of protection 'pD'

13.3.1 Sources of protective gas

In certain circumstances, such as where it is necessary to maintain operation of equipment, it may be advisable to provide two sources of protective gas so that the alternative source may take over in the event of failure of the primary source. Each source shall be capable of maintaining, independently, the required level of pressure or rate of supply of protective gas.

Upon loss of pressure, the requirements of Table 1411 shall be implemented.

Table 14 – Action to be taken when the pressurization with the protective gas fails

EPL Requirement	Type of equipment in the enclosure	
	Enclosure contains equipment NOT meeting EPL 'Dc' requirements without pressurization	Enclosure contains equipment meeting EPL 'Dc' requirements without pressurization
'Db'	Apply 13.3.2	Apply 13.3.3
'Dc'	Apply 13.3.3	'pD' not required

~~**Table 11 – Summary of protection requirements for enclosures**~~

~~Area classification~~	~~Type of equipment in the enclosure~~	
	~~Ignition capable equipment~~	~~Equipment with no sources of ignition in normal operation~~
~~Zone 20~~	~~"pD" not applicable~~	~~"pD" not applicable~~
~~Zone 21~~	~~Apply 13.3.2~~	~~Apply 13.3.3~~
~~Zone 22~~	~~Apply 13.3.3~~	~~"pD" not required~~

~~If any of the equipment inside the enclosure is not suitable for a combustible dust atmosphere, upon loss of pressure, the requirements of Table 1411 shall be implemented.~~

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13.3.2 Automatic switch-off

An automatic device shall be provided to switch off the electrical supply to the equipment ~~and initiate an audible or visible alarm~~ when the overpressure and/or protective gas flow falls below the minimum prescribed value. In addition, an audible or visible alarm may be necessary. When such switching off might jeopardize the safety of the installation and safety is otherwise ensured, a continuous audible or visible alarm shall be provided until pressurization is restored or other appropriate measures are taken, including switching off with a known delay.

NOTE If automatic switch-off would introduce a more dangerous condition, other precautionary measures should be taken, for example duplication of protective gas supply.

13.3.3 Alarm

If the internal pressure or flow of protective gas falls below the minimum prescribed value, a signal which is immediately apparent to the operator shall indicate the loss of pressure. The pressurization system shall be restored as soon as possible, or else the electrical supply shall be switched off manually.

13.3.4 Common source of protective gas

When a source of protective gas is common to separate enclosures, the protective measures may be common to several, provided that the resulting protection takes account of the most unfavourable conditions in the whole assembly.

If the protective devices are common, the opening of a door or cover need not switch off the electrical supply to the whole assembly or initiate the alarm provided that

- the said opening is preceded by switching off the electrical supply to that particular equipment, except to such parts as are protected by a suitable type of protection,
- the common protective device continues to monitor the pressure in all the other enclosures of the group, and
- the subsequent switching on of the electrical supply to that particular equipment is preceded by the applicable cleaning procedure

13.3.5 Switching on electrical supply

1) Before switching on the electrical supply to the equipment on start-up or after shutdown, it is the responsibility of the operator to be satisfied that dust has not penetrated the enclosure or associated ducts in such a concentration that is likely to create a potential dust hazard. The operator shall take into account in making such an assessment
   - i) the need for a substantial safety margin, and
   - ii) the level of concentration in air of the applicable explosive dust required for a hazard to exist, and, if applicable,
   - iii) the thickness of dust layers where there is a potential for combustion to occur due to heating.
2) Doors and covers which can be opened without the use of tools shall be interlocked so that automatically on opening the electrical supply is switched off from all parts not otherwise protected. The supply shall be prevented from being switched on again until the doors and covers have been re-closed.

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13.3.6 Motors with a converter supply

Ex pD motors supplied at varying frequency and voltages shall meet the requirements of either item a) or item b), as follows:

a) There shall be means (or equipment) for direct temperature control by embedded temperature sensors specified in the motor manufacturer's documentation or other effective measures for limiting the surface temperature of the motor housing. The action of the protective device shall be to cause the motor to be disconnected. The motor and convertor combined need not be tested together.

b) The motor shall be type-tested for this duty as a unit in association with the convertor specified in the descriptive documents and with the protective device provided.

13.4 Rooms for explosive gas atmosphere

13.4.1 Pressurized rooms and analyser houses

13.4.1.1 Pressurized rooms

Requirements for electrical installations in pressurized rooms are given in IEC 60079-13.

13.4.1.2 Analyser houses

Requirements for electrical installations in analyser houses are given in IEC 60079-16 and IEC 61285.

14 Additional requirements for type of protection 'n'

14.1 General

Type of protection 'n' enclosures, with only an Ex component enclosure certificate (marked with a 'U'), shall not be installed. They shall always have an equipment certificate for the complete assembly.

Type of protection 'n' is divided into 4 sub-types:

'nA' non-sparking equipment;

'nC' sparking equipment in which the contacts are suitably protected other than by a restricted-breathing enclosure or energy limitation;

'nR' restricted breathing enclosures;

'nL' energy limited apparatus (see ~~Clause~~ 12).

The energy-limited apparatus 'nL' and the energy-limited parts of associated energy-limited apparatus, shall comply with AS/NZS 60079.15~~IEC 60079-15~~.

Equipment for connection into energy-limited (nL) circuits should be installed in accordance with the requirements of equipment to type of protection 'ic', as specified in ~~Clause~~ 12.

Equipment to type of protection 'nL' may be used in an intrinsically safe 'ic' circuit in accordance with ~~Clause~~ 12.

Equipment which contains energy-limited circuits shall be terminated in accordance with the requirements of the type of protection of the terminal enclosure (e.g. Ex 'nA', Ex 'd', Ex 'e').'

14.2 Degree of ingress protection of enclosures (IEC 60034-5 and IEC 60529)

Enclosures containing bare live parts and enclosures containing only insulated parts require a degree of ingress protection of at least IP54 and IP44, respectively.

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When used in locations providing adequate protection against the entry of solid foreign bodies or liquids capable of impairing safety (for example indoors), enclosures containing bare live parts and enclosures containing only insulated parts require a degree of ingress protection of IP4X and IP2X, respectively.

Equipment which would not be impaired by contact with solid foreign bodies or liquids (for example strain gauges, resistance thermometers, thermocouples, energy-limited apparatus, etc.) need not comply with the above requirements.

14.3 Wiring systems

14.3.1 General

Cables and conduits shall be installed in accordance with ~~Clause~~ 9, with the following additional requirements concerning cable entries and conductor terminations.

Additional cable entry holes may be made into the enclosure providing this is permitted by the manufacturer's documentation.

NOTE 1 Threaded holes in ~~plastic~~ enclosures should be at right angles to the face of the enclosure (due to the possible moulding methods for ~~plastic~~ enclosures, the wall of the enclosure may have draw angles). Faces with angles do not allow the gland and associated fittings inserted in the hole to fit square to the face, resulting in ineffective sealing.

NOTE 2 Taper threaded holes in plastic enclosures are not recommended because the high stresses created during sealing of these threads may fracture the enclosure wall.

14.3.2 Enclosure entries~~Cable glands~~

14.3.2.1 General

Cable glands, adapters, blanking elements and other fittings connected to non-sparking equipment shall maintain the degree of ingress protection IP54 or that required by the location, whichever is the higher and maintain the mechanical integrity of the enclosure.

NOTE 1 To meet the ingress protection requirement it may also be necessary to seal between the cable gland adapter or blanking element, including between each item, and the enclosure (for example by means of a sealing washer or thread sealant). A separate entry boss may be required on enclosures with low mechanical strength to avoid excess stress on the enclosure.

NOTE 2 In order to meet the minimum requirement of IP54, when threaded cable glands are secured into a threaded entry and a thread engagement of 6 mm or greater is maintained, no additional sealing is required.

Where mineral-insulated metal sheathed cables are used, the requirement to achieve creepage distances shall be maintained by using an Ex 'e' or Ex 'n' mineral insulated cable sealing device.

~~The connection of cables to equipment with type of protection 'n' shall be effected by means of cable glands appropriate to the type of cable used. They shall comply with the requirements of IEC 60079-0.~~

~~NOTE 1 To meet the ingress protection requirement it may also be necessary to seal between the cable glands and the enclosure (for example by means of a sealing washer or thread sealant).~~

~~NOTE 2 In order to meet the minimum requirement of IP54, threaded cable entry devices into threaded cable entry plates or enclosures of 6 mm or greater thickness need no additional sealing between the cable entry device and the entry plate or enclosure providing the axis of the cable entry device is perpendicular to the external surface of the cable entry plate or enclosure.~~

~~Where mineral-insulated metal sheathed cables are used, the requirement to achieve creepage distances shall be maintained by using an mineral insulated cable sealing device complying with IEC 60079-0.~~

~~Threaded adapters complying with IEC 60079-0 may be fitted into the cable entry holes to allow connection of the device or cable gland.~~

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~~Unused entries in the enclosure shall be sealed by blanking elements, which comply with IEC 60079-0 and maintain the degree of ingress protection IP54 or that required by the location, whichever is the higher.~~

14.3.2.2 Cable glands for 'nR' equipment

The sealing of restricted-breathing enclosures shall be such as to maintain the restricted-breathing properties of the enclosure.

NOTE ~~1~~ Where the cable used is not part of the certificate and/or instruction manual and is not effectively filled, it may be necessary to use a cable gland or other method (e.g. epoxy joint, shrinking tube) which seals around the individual conductors of the cable to prevent leakage from the enclosure.

~~NOTE 2~~ A suitable sealing washer shall be fitted between the cable gland and the enclosure. Conduit or tapered threads will require the use of a thread sealant (see ~~Clause~~ 9).

14.3.3 Conductor terminations

Some terminals e.g. slot types, may permit the entry of more than one conductor. Where more than one conductor is connected to the same terminal, care shall be taken to ensure that each conductor is adequately clamped.

Unless permitted by the manufacturer's documentation, two conductors of different cross-sections shall not be connected into one terminal unless they are first secured with a single compression type ferrule or other method specified by the manufacturer.

To avoid the risk of short-circuits between adjacent conductors in terminal blocks, the insulation of each conductor shall be maintained up to the metal of the terminal.

NOTE Where single screw saddle clamps are used with a single conductor, the latter should be shaped around the screw in the form of a 'U' unless clamping of single conductors without 'U' is permitted in the documentation supplied with the equipment.

14.4 Motors

14.4.1 Machines with rated voltage greater than 1 kV

Machines with a rated voltage exceeding 1 kV and duties other than S1 or S2 shall be selected taking into account the 'Potential stator winding discharge risk assessment – Ignition risk factors' (see Annex E). If the total sum of the risk factors is greater than 6, then anti-condensation space heaters shall be employed, and special measures shall be applied to ensure that the enclosure does not contain an explosive gas atmosphere at the time of starting.

NOTE 1 If the machine is intended to operate under 'special measures', the certificate with have the symbol 'X' in accordance with AS/NZS 60079.0~~IEC 60079-0~~.

NOTE 2 Special measures may include pre-start ventilation, the application of fixed gas detection inside the machine or other methods specified in manufacturer's instructions.

14.4.2 Motors with converter supply

Motors supplied at varying frequency and voltage by a converter requires that either:

a) the motor has been type tested, in accordance with AS/NZS 60079.15~~IEC 60079-15~~, with the specific converter or with a comparable converter in reference to the output voltage and current specifications, or

b) the motor has not been type-tested for this duty as a unit in association with the converter. In this case, means (or equipment) for direct temperature control by embedded temperature sensors specified in the motor documentation or other effective measures for limiting the temperature of the motor shall be provided. The effectiveness of the temperature control taking into account power, speed range, torque and frequency for the duty required shall be verified and documented. The action of the protective device shall be to cause the motor to be disconnected. Alternatively the motor has had its temperature class determined by calculation in accordance with AS/NZS 60079.15~~IEC 60079-15~~.

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14.4.3 Reduced-voltage starting (soft starting)

Motors with a soft start supply require either:

a) the motor has been type tested as a unit in association with the soft start device specified in the descriptive documents and with the protective device provided, or

b) the motor has not been type tested as a unit in association with the soft start device. In this case, means (or equipment) for direct temperature control by embedded temperature sensors specified in the motor documentation, other effective measures for limiting the surface temperature of the motor shall be provided or the speed control device ensures that the motor run up is such that the surface temperature is not exceeded. The effectiveness of the temperature control or proper run up shall be verified and documented. The action of the protective device shall be to cause the motor to be disconnected.

NOTE – It is considered that soft starting is used for a short time period.

14.5 Luminaires

Luminaires with fluorescent lamps and electronic ballasts shall not be used where temperature class T5 or T6 is required or where the ambient temperature exceeds 60 °C.

NOTE 1 This restriction minimizes the risk of End of Life (EOL) effects of the lamp.

Lamps (e.g. bi-pins, screw connections on tungsten lamps) using non-conductive materials with a conductive coating shall not be used unless tested with the equipment.

NOTE 2 This requirement is intended to apply to recently designed lamps where the pins or end caps may be plastic or ceramic with a conductive film coating.

15 Additional requirements for type of protection 'o'– Oil immersion

Oil immersed equipment shall be installed in accordance with manufacturer's documentation.

16 Additional requirements for type of protection 'q' – Powder filling

Powder filled equipment shall be installed in accordance with manufacturer's documentation.

17 Additional requirements for type of protection 'm' – Encapsulation

Encapsulated equipment shall be installed in accordance with manufacturer's documentation.

18 Additional requirements for type of protection 'tD' – Protection by enclosure

18.1 Practices A and B

Two different types of practice for protection by enclosure are specified in this Standard, both intended to provide an equivalent level of protection against ignition.

18.2 Practice A

In addition to the requirements of 5.6.3.2.1, the following design details and test methods apply.

- the construction of the enclosure shall meet the general requirements as specified in AS/NZS 61241.1~~IEC 61241-1~~:

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Table 15 – Dust tightness practice A	
EPL 'Da' EPL 'Db' EPL 'Dc' with conductive dust	EPL 'Dc' with non-conductive dust
IP 6X	IP 5X

~~Table 12 – Dust tightness practice A~~

~~Zone 20~~ ~~Zone 21~~ ~~Zone 22 with conductive dust~~	~~Zone 22~~ ~~with non-conductive dust~~
~~IP 6X~~	~~IP 5X~~

18.3 Practice B

In addition to the requirements of 5.6.3.2.2, the following design details and test methods apply.

- the construction of the enclosure shall meet the general requirements as specified in AS/NZS 61241.1~~IEC 61241-1~~:

Table 16 – Dust tightness practice B		
EPL 'Da'	EPL 'Db' EPL 'Dc' with conductive dust	EPL 'Dc' with non-conductive dust
Dust-tight as specified in 8.2.1.4 of AS/NZS 61241.1 Additional requirements as specified in Clause 7 of AS/NZS 61241-1	Dust-tight as specified in 8.2.1.4 of AS/NZS 61241.1 Additional requirements as specified in Clause 7 of AS/NZS 61241.1	Dust protected as specified in 8.2.1.5 of AS/NZS 61241.1. Clause 7 of AS/NZS 61241.1 is not applicable

~~Table 13 – Dust tightness practice B~~

~~Zone 20~~	~~Zone 21~~ ~~Zone 22 with conductive dust~~	~~Zone 22~~ ~~with non-conductive dust~~
~~Dust-tight as specified in 8.2.1.4 of IEC 61241-1~~ ~~Additional requirements as specified in Clause 7 of IEC 61241-1~~	~~Dust-tight as specified in 8.2.1.4 of IEC 61241-1~~ ~~Additional requirements as specified in Clause 7 of IEC 61241-1~~	~~Dust protected as specified in 8.2.1.5 of IEC 61241-1.~~ ~~Clause 7 of IEC 61241-1 is not applicable~~

18.4 Motors supplied at varying frequency and voltages

Ex tD motors supplied at varying frequency and voltages shall meet the requirements of either item a) or item b), as follows:

a) There shall be means (or equipment) for direct temperature control by embedded temperature sensors specified in the motor manufacturer's documentation or other effective measures for limiting the surface temperature of the motor housing. The action of the protective device shall be to cause the motor to be disconnected. The motor and converter combined need not be tested together.

b) The motor shall be type-tested for this duty as a unit in association with the converter specified in the descriptive documents and with the protective device provided.

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19 Protection by ventilation Ex 'v'

Protection by ventilation Ex 'v' shall be in accordance with AS 1482.

Ventilation of buildings and rooms can be by gas or vapour dilution ventilation and point extraction ventilation.

Dilution and ventilation of electrical power equipment can introduce heat dissipation through the design, construction and testing of ventilating systems, which are required to reduce the temperature of electrical power equipment to a safe level for use in hazardous locations in which explosive gases or vapours may be present.

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Annex A
(normative)

Verification of intrinsically safe circuits with more than one associated apparatus with linear current/voltage characteristics

A.1 General

The capacitance and inductance parameters for the system of intrinsically safe circuits shall be determined from the ignition curves of AS/NZS 60079.11~~IEC 60079-11~~ using the system values of U_o and I_o under fault conditions and at each point in the system. The faults in accordance with AS/NZS 60079.11~~IEC 60079-11~~ shall be applied to the electrical system as an entity and not to each item of electrical equipment.

The above requirements can be met by using the following calculation procedures.

A.2 Intrinsic safety with level of protection 'ib'

The level of protection shall be deemed to be 'ib' even if all the associated apparatus is level of protection 'ia'.

NOTE This level of protection reduction takes account of the fact that the assessment is by calculation only without any test.

a) Determine the highest voltage and current in the system using the U_o and I_o values stated on the associated apparatus (see Annex B).

b) Check that the highest system current (I_o) multiplied by a safety factor of 1,5 does not exceed the current obtained from the ignition curves for resistive circuits, for the appropriate equipment~~apparatus~~ group in AS/NZS 60079.11~~IEC 60079-11~~ for the maximum system voltage (U_o).

c) The maximum permissible inductance (L_o) is obtained from the ignition curves for inductive circuits, for the appropriate equipment~~apparatus~~ group in AS/NZS 60079.11~~IEC 60079-11~~, using the highest system current (I_o) multiplied by a safety factor of 1,5.

d) The maximum permissible capacitance (C_o) is obtained from the appropriate ignition curve for capacitive circuits in AS/NZS 60079.11~~IEC 60079-11~~, using the highest system voltage (U_o) multiplied by a safety factor of 1,5.

e) Check that the maximum permissible values of C_o and L_o conform to the requirements of 12.2.5.2.

f) Check that U_o, I_o and P_o (where $P_o = I_o U_o/4$) conform to the requirements of 12.2.5.2.

g) Determine the equipment~~apparatus~~ group of the system, in accordance with 12.2.5.2, taking into account the equipment~~apparatus~~ group of the ignition curves used.

h) Determine the temperature class of the system in accordance with 12.2.5.2 (where $P_o = I_o U_o/4$).

A.3 Intrinsic safety with level of protection 'ic'

A similar calculation method may be used for 'ic' circuits. The safety factor used shall be unity.

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Annex B
(informative)

Methods of determining the maximum system voltages and currents in intrinsically safe circuits with more than one associated apparatus with linear current/voltage characteristics (as required by Annex A)

B.1 Intrinsically safe circuits

In the case of two or more associated apparatus in an intrinsically safe circuit (see 12.2.5.3), the following practical method can be used to determine the new maximum system voltages and currents under fault conditions in the intrinsically safe circuit using the values U_o, I_o of each item of associated apparatus taken from the documentation or from the marking plate.

Dependent on the interconnection of the intrinsically safe terminals of the associated apparatus, the values of U_o and I_o should be determined, in the case of normal operation and also under fault conditions, taking into account

- the summation of voltages only,
- the summation of currents only, or
- the summation of both voltages and currents.

In the case of series connection of the associated apparatus with galvanic isolation between intrinsically safe and non-intrinsically safe circuits (see Figure B.1) only the summation of voltages is possible, irrespective of the polarity of the circuits.

In the case of parallel connection of both poles of the sources (see Figure B.2) only the summation of currents is necessary.

In all other cases, where any interconnection of the poles of the sources is possible (see Figure B.3) series or parallel connections have to be taken into account, dependent on the fault under consideration. In this situation, both the summation of voltages and the summation of currents have to be considered separately.

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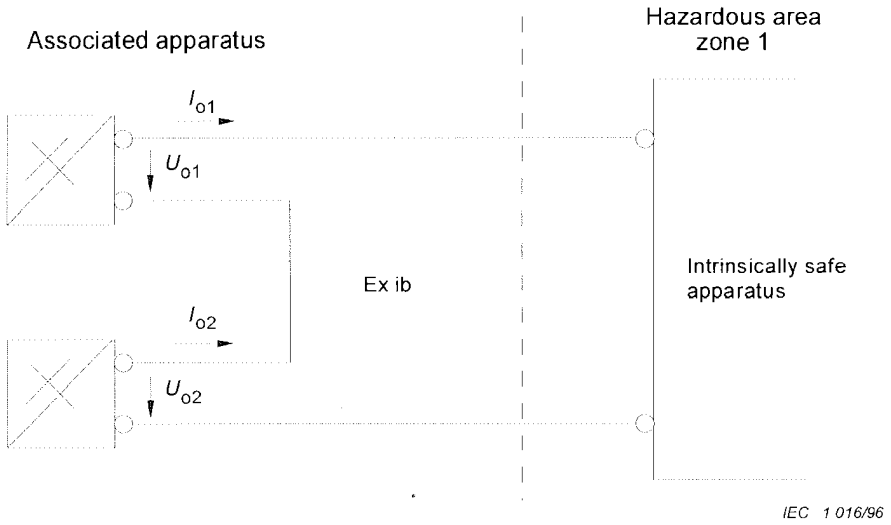
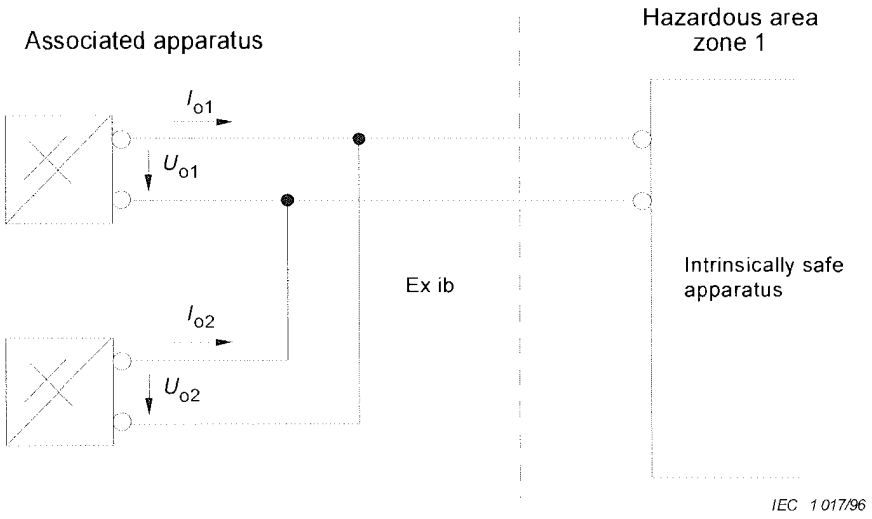


New maximum system values: $U_o = \Sigma\ U_{oi} = U_{o1} + U_{o2}$

$I_o = \text{max. } (I_{oi})$

Figure B.1 – Series connection – Summation of voltage



New maximum system values: $U_o = \text{max. } (U_{oi})$

$I_o = \Sigma\ I_{oi} = I_{o1} + I_{o2}$

Figure B.2 – Parallel connection – Summation of currents

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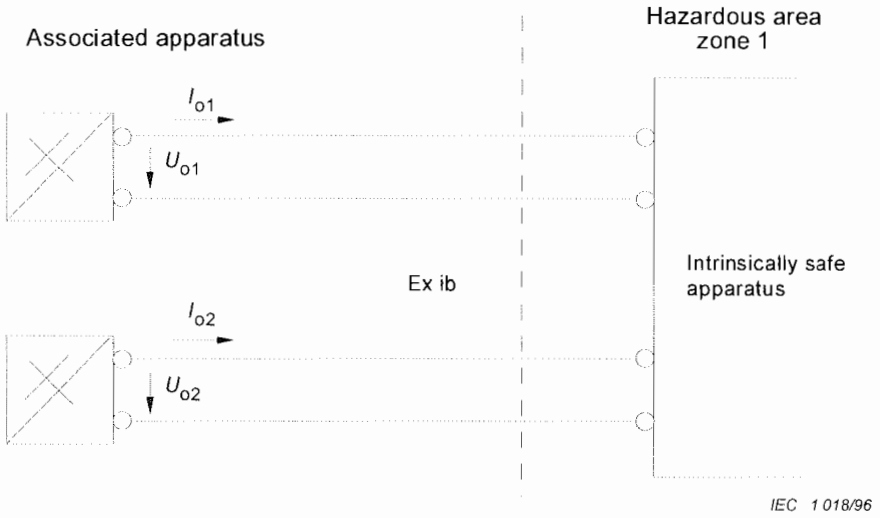

New maximum system values: $U_o = \Sigma\, U_{oi} = U_{o1} + U_{o2}$ $U_o = \text{max.}\ (U_{oi})$

or

$I_o = \text{max.}\ (I_{oi})$ $I_o = \Sigma\, I_{oi} = I_{o1} + I_{o2}$

Figure B.3 – Series and parallel connections – Summations of voltages and summations of currents

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Annex C
(informative)

Determination of cable parameters

C.1 Measurements

The inductance and capacitance of a cable should be measured using equipment operating at a frequency of 1 kHz ± 0,1 kHz and an accuracy of ±1 %. The resistance of the cable should be measured using d.c. equipment with an accuracy of ±1 %. Results taken from a representative sample of cable with a minimum length of 10 m are acceptable. Measurements should be taken at an ambient temperature of 20 °C to 30 °C.

NOTE The equipment for the measurement of inductance should be able to operate satisfactorily when measuring low inductance in the presence of significant resistance.

Where practicable, measurements of all the possible combinations of the cores which can result from open-circuiting and short-circuiting the separate ends of the cables should be made. The maximum measured values of capacitance, inductance and the *L/R* ratio should be used as the cable parameters. Where there are a large number of cores, measurements should only be made utilizing a representative sample of the combination of cores which will create the largest values of inductance and capacitance.

The maximum capacitance of the cable should be determined by open-circuiting the remote end of the cable and measuring the capacitance of the combinations of the wires and screens which give the maximum value. For example, if a twin-pair screened cable is being measured, then the highest value will probably be measured between one core connected to the screen and the other core. That this is the highest value of capacitance should be confirmed by measuring the other combination of cores and screen.

The maximum inductance should be measured by connecting together the remote ends of the two cores which are spaced furthest from one another. The D.C. resistance of this path is the resistance used in calculating the *L/R* ratio of the cable.

Where the cable is loosely constructed, bending and twisting the cable a minimum of ten times should not cause the cable parameters to vary by more than 2 %.

For the purpose of these measurements, the combination of faults which could connect separate conductors in series to effectively increase the length of cables should not be considered. When measuring capacitance, any screens or unused cores should be joined together and connected to one side of the circuit being measured.

C.2 Multi-core cables

Where the conductors utilized by a particular intrinsically safe or energy-limited circuit are readily identifiable within a multi-core, only the cable parameters related to those specific conductors should be considered.

C.2.1 Type A multi-core cables

When all the conductors utilized in a circuit are within one screen, only the interconnections of the conductors within that screen and to that screen should be considered. Where the conductors are within more than one screen, measurement should be made utilizing all the relevant conductors within the relevant screens.

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C.2.2 Type B multi-core cables

When the conductors utilized for a particular circuit can be clearly identified, measurement should be made only on those conductors. Where a clear identification cannot be made, all the possible combinations of the conductors used in that particular intrinsically safe circuit should be considered.

C.2.3 Other multi-core cables

Measurement should be made on all conductors and any screens associated with the intrinsically safe systems which can be interconnected by the two short-circuit faults which have to be considered.

Where relevant conductors are not clearly identifiable, the testing should be extended to the possible combinations of the total number of conductors and screens associated with the three interconnected circuits.

C.3 FISCO

The effective capacitance of the bus cable results from the capacitance per meter C' for the capacitance between the two conductors and. if the cable contains a screen an additional capacitance per meter needs to be considered.

The calculation of the capacitance depends on the electrical connection of bus cable and screen. If the bus circuit is isolated from the earthed screen or if the screen is arranged symmetrically between the plus and minus of the supply unit (Fieldbus balanced about ground), not only the capacitance conductor/conductor but also the series capacitance from the conductor/screen and screen/conductor is to be allowed for. The following is obtained

$C' = C'conductor/conductor + 0,5C'conductor/screen$

If the screen is connected with one pole of the supply unit, the following relation will result:

$C' = C'conductor/conductor + C'conductor/screen$

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Annex D
(informative)

Safe work procedure guidelines for explosive gas atmospheres

A safe work procedure can be implemented to permit ignition sources to be used in a hazardous area under prescribed conditions.

A safe work permit can be issued when a specific location has been assessed to ensure that gas or vapour is not present and is not expected to be present, in quantities which may give rise to flammable concentrations, during a specified period. The permit may prescribe continuous or periodic gas monitoring and/or detailed actions to be taken in the event of a release.

Considerations for the issue of a safe work permit may include:

a) specifying the start date/time of the permit,

b) defining the location of the activity,

c) specifying the nature of the permitted activity (e.g. Diesel generator, drilling),

d) taking and possible recording measurements to confirm the absence of an ignitable concentration of any flammable gas or vapour,

e) specifying sampling requirements to confirm the continued absence of a flammable gas or vapour,

f) control of possible flammable gas or liquid sources,

g) specifying contingency plans for emergencies,

h) specifying the expiry date/time of the permit.

NOTE Important aspects associated with documentation, training, controls, and use required for an effective application of a safe work permit are beyond the scope of this Standard. In the absence of relevant IEC standards, national codes should be referenced.

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Annex E
(normative)
Potential stator winding discharge risk assessment – Ignition risk factors

Characteristics	Value	Factor
Rated voltage	> 11 kV	6
	> 6,6 kV to 11 kV	4
	> 3,3 kV to 6,6 kV	2
	> 1 kV to 3,3 kV	0
Average starting frequency in service	> 1 / hour	3
	> 1 / day	2
	> 1 / week	1
	≤1 / week	0
Time between disassembly, cleaning and examination of windings	> 10 years	3
	> 5 to 10 years	2
	> 2 to 5 years	1
	< 2 years	0
Degree of protection (IP Code)	< IP44 [a]	3
	IP44 and IP54	2
	IP55	1
	> IP55	0
Environmental conditions	Very dirty and wet [b]	4
	Coastal outdoor [c]	3
	Outdoor	1
	Clean and dry indoor	0

[a] Only in clean environments and regularly serviced by trained personnel

[b] 'Very dirty and wet' locations include those that may be subjected to deluge systems or comprise open deck on offshore locations.

[c] Exposed to atmospheres containing salt.

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Annex F
(normative)

Knowledge, skills and competencies of responsible persons, operatives and designers

F.1 Scope

This annex specifies the knowledge, skills and competencies of persons referred to in this Standard.

F.2 Knowledge and skills

F.2.1 Responsible persons

Responsible persons who are responsible for the processes involved in the design, selection and erection of explosion protected equipment shall possess, at least, the following:

a) general understanding of relevant electrical engineering;

b) understanding and ability to read and assess engineering drawings;

c) practical understanding of explosion protection principles and techniques;

d) working knowledge and understanding of relevant standards in explosion protection;

e) basic knowledge of quality assurance, including the principles of auditing, documentation, traceability of measurement and instrument calibration.

Such persons shall confine their involvement to the management of competent Operatives conducting selection and erection duties and not engage themselves directly in the work without ensuring their practical skills at least meet the requirements given in F.2.2 below.

F.2.2 Operatives (selection and erection)

Operatives shall possess, to the extent necessary to perform their tasks, the following:

a) understanding of the general principles of explosion protection;

b) understanding of the general principles of types of protection and marking;

c) understanding of those aspects of equipment design which affect the protection concept;

d) understanding of content of certificates and relevant parts of this Standard;

e) general understanding of inspection and maintenance requirements of IEC 60079-17;

f) familiarity with the particular techniques to be employed in the selection and erection of equipment referred to in this Standard;

g) understanding of the additional importance of permit to work systems and safe isolation in relation to explosion protection.

F.2.3 Designers (design and selection)

Designers shall possess, to the extent necessary to perform their tasks, the following:

a) detailed knowledge of the general principles of explosion protection;

b) detailed knowledge of the general principles of types of protection and marking;

c) detailed knowledge of those aspects of equipment design which affect the protection concept;

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d) detailed knowledge of content of certificates and relevant parts of this Standard;

e) understanding of practical skills for the preparation and installation of relevant concepts of protection;

f) detailed knowledge of the additional importance of Permit to Work systems and safe isolation in relation to Explosion Protection;

g) detailed knowledge of the particular techniques to be employed in the selection and erection of equipment referred to in this Standard;

h) general understanding of Inspection and Maintenance requirements of IEC 60079-17.

F.3 Competencies

F.3.1 General

Competencies shall apply to each of the explosion protection techniques for which the person is involved. For example: it is possible for a person to be competent in the field of selection and erection of Ex'i' equipment only and not be fully competent in the selection and erection of Ex'd' switchgear or Ex'e' motors. In such cases, the person's management shall define this in their documentation system.

F.3.2 Responsible persons

Responsible Persons shall be able to demonstrate their competency and provide evidence of attaining the knowledge and skill requirements specified in F.2.1 relevant to the types of protection and/or types of equipment involved.

F.3.3 Operatives

Operatives shall be able to demonstrate their competency and provide evidence of attaining the knowledge and skill requirements specified in F.2.2 relevant to the types of protection and/or types of equipment involved.

They shall also be able to demonstrate their competency with documentary evidence in the:

- use and availability of documentation specified in 4.2;
- production of job reports to the user as specified in 4.2;
- practical skills necessary for the preparation and installation of relevant concepts of protection;
- use and production of installation records as specified in 4.2.

F.3.4 Designers

Designers shall be able to demonstrate their competency and provide evidence of attaining the knowledge and skill requirements specified in F.2.3 relevant to the types of protection and/or types of equipment involved.

They shall also be able to demonstrate their competency with documentary evidence in the:

- production of documentation specified in 4.2;
- production of Designers certificates to the user as specified in 4.2;
- practical skills necessary for the preparation and compilation of relevant design details for the concepts of protection and systems involved;
- updated and production of installation records as specified in 4.2.

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~~F.4 Assessment~~

~~The competency of Responsible Persons, Operatives and Designers shall be verified and attributed, at intervals relevant to national regulations or standards or user requirements, on the basis of sufficient evidence that the person:~~

~~a) has the necessary skills required for the scope of work;~~

~~b) can act competently across the specified range of activities; and~~

~~c) has the relevant knowledge and understanding underpinning competency.~~

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Annex G
(informative)

Examples of dust layers of excessive thickness

This annex provides four examples of excessively thick dust layers (see Figures G.1a to G.1d).

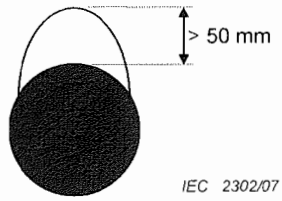

Figure G.1a – Excessive layer on top of equipment

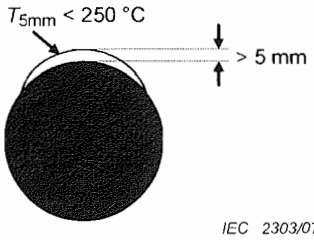

Figure G.1b – Excessive layer on top of equipment due to low ignition temperature of the dust

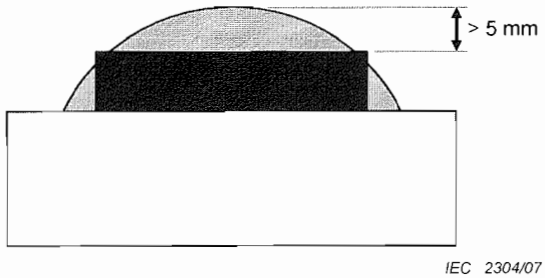

Figure G.1c – Excessive layer at the sides of equipment

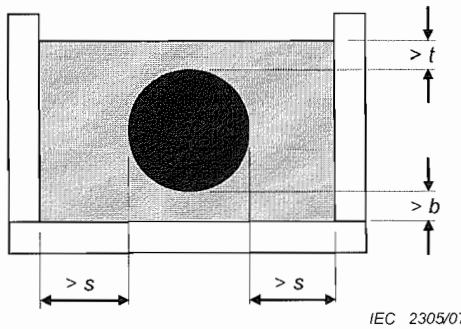

Figure G.1d – Completely submerged equipment

Dimensions *b*, *s* and *t* to be limited by laboratory investigation

Figure G.1 – Examples for dust layers of excessive thickness with the requirement of laboratory investigation

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Annex H
(normative)

Frictional sparking risks with light metals and their alloys

H.1 General

Incendive frictional sparking can occur in circumstances where light metals or their alloys are brought into suitable contact with other materials, particularly when the other material is an oxygen carrier such as rust. Suitable safeguards shall therefore be taken to prevent the occurrence of such frictional contact in circumstances where an explosive atmosphere may be present, because the simultaneous occurrence of the two sets of circumstances could lead to ignition.

Explosive atmospheres shall be avoided and the equipment, whenever practicable, shall be sited in locations where such atmospheres are not likely to occur.

NOTE Coal mining legislation may restrict the use of light metal alloys in Group I applications.

H.2 Rigidly mounted equipment

For rigidly mounted electrical equipment with light metal enclosures, and also for aluminium armoured or sheathed cable sited in areas requiring EPL 'Gc' or 'Dc'~~Zone 22 areas~~, the frictional sparking risk may be disregarded except in those particular circumstances where heavy impact might also initiate the release of flammable material. This also applies in areas requiring EPL 'Gb' or 'Db'~~Zone 21 areas~~, unless the impact risk is high, in which case the use of light metal enclosures or aluminium protected cables shall be avoided. Such equipment and cables shall not be used in areas requiring EPL 'Ga' or 'Da'~~Zone 20 areas~~.

H.3 Portable and transportable equipment

Portable and transportable equipment with light metal or light alloy enclosures, which are otherwise unprotected against frictional contact, shall not be taken into hazardous areas unless special precautions are taken to ensure safety. Such precautions may include a special permit to work in the assured absence of an explosive atmosphere, though more satisfactory safeguards may be taken, e.g. coating the equipment with a suitable abrasion-resistant material.

Where coatings are used, they shall be subject to regular and careful inspection. Use of the equipment shall not be permitted if inspection reveals that the protective material has become damaged to the extent that the underlying protected metal is visible.

Precautions shall be adopted even for equipment intended for use in areas requiring EPL 'Gc' or 'Dc'~~Zone 22 areas~~ only, since it might be difficult in practice to prevent the transfer of unprotected portable equipment to an area of greater risk.

H.4 Fans

Provided that the protective cowls for light metal fans, e.g. on motors, are designed so that they are not readily deformed, such fans may be used in areas requiring EPL 'Gb', 'Db', 'Gc' and 'Dc' ~~Zone 21 and Zone 22 areas~~ since other modes of failure, e.g. bearing failure, are more likely to create a source of ignition. If plastic fans or cowls are used as alternatives, they shall be of anti-static material.

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Annex I
(informative)

Introduction of an alternative risk assessment method encompassing "equipment protection levels" for Ex equipment

I.1 Introduction

This annex provides an explanation of the concept of a risk assessment method encompassing equipment protection levels (EPLs). These EPLs are introduced to enable an alternative approach to current methods of selecting Ex equipment.

I.2 Historical background

Historically, it has been acknowledged that not all types of protection provide the same level of assurance against the possibility of an incendive condition occurring. The Installation Standard, IEC 60079-14, allocates specific types of protection to specific zones, on the statistical basis that the more likely or frequent the occurrence of an explosive atmosphere, the greater the level of security required against the possibility of an ignition source being active.

Hazardous areas (with the normal exception of coal mining) are divided into zones, according to the degree of hazard. The degree of hazard is defined according to the probability of the occurrence of explosive atmospheres. Generally, no account is taken of the potential consequences of an explosion, nor of other factors such as the toxicity of materials. A true risk assessment would consider all factors.

Acceptance of equipment into each Zone is historically based on the type of protection. In some cases the type of protection may be divided into different levels of protection which again historically correlate to zones. For example, intrinsic safety is divided into levels of protection ia and ib. The encapsulation 'm' standard includes two levels of protection 'ma' and 'mb'.

In the past, the equipment selection standard has provided a solid link between the type of protection for the equipment and the Zone in which the equipment can be used. As noted earlier, nowhere in the IEC system of explosion protection is there any account taken of the potential consequences of an explosion, should it occur.

However, plant operators often make intuitive decisions on extending (or restricting) their zones in order to compensate for this omission. A typical example is the installation of 'Zone 1 type' navigation equipment in Zone 2 areas of offshore oil production platforms, so that the navigation equipment can remain functional even in the presence of a totally unexpected prolonged gas release. In the other direction, it is reasonable for the owner of a remote, well secured, small pumping station to drive the pump with a 'Zone 2 type' motor, even in Zone 1, if the total amount of gas available to explode is small and the risk to life and property from such an explosion can be discounted.

The situation became more complex with the introduction of the first edition of IEC 60079-26 which introduced additional requirements to be applied for equipment intended to be used in Zone 0. Prior to this, Ex ia was considered to be the only technique acceptable in Zone 0.

It has been recognized that it is beneficial to identify and mark all products according to their inherent ignition risk. This would make equipment selection easier and provide the ability to better apply a risk assessment approach, where appropriate.

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I.3 General

A risk assessment approach for the acceptance of Ex equipment has been introduced as an alternative method to the current prescriptive and relatively inflexible approach linking equipment to zones. To facilitate this, a system of equipment protection levels has been introduced to clearly indicate the inherent ignition risk of equipment, no matter what type of protection is used.

The system of designating these equipment protection levels is as follows.

I.3.1 Mines susceptible to firedamp (Group I)

I.3.1.1 EPL Ma

Equipment for installation in a mine susceptible to firedamp, having a 'very high' level of protection, which has sufficient security that it is unlikely to become an ignition source, even when left energised in the presence of an outbreak of gas.

NOTE Typically communications circuits and gas detection equipment will be constructed to meet the Ma requirements, for example an Ex ia telephone circuit.

I.3.1.2 EPL Mb

Equipment for installation in a mine susceptible to firedamp, having a 'high' level of protection, which has sufficient security that it is unlikely to become a source of ignition in the time span between there being an outbreak of gas and the equipment being de-energised.

NOTE Typically Group I equipment will be constructed to meet the Mb requirements, for example Ex d motors and switchgear.

I.3.2 Gases (Group II)

I.3.2.1 EPL Ga

Equipment for explosive gas atmospheres, having a 'very high' level of protection, which is not a source of ignition in normal operation, expected faults or when subject to rare faults.

I.3.2.2 EPL Gb

Equipment for explosive gas atmospheres, having a 'high' level of protection, which is not a source of ignition in normal operation or when subject to faults that may be expected, though not necessarily on a regular basis.

NOTE The majority of the standard protection concepts bring equipment within this equipment protection level.

I.3.2.3 EPL Gc

Equipment for explosive gas atmospheres, having a 'enhanced' level of protection, which is not a source of ignition in normal operation and which may have some additional protection to ensure that it remains inactive as an ignition source in the case of regular expected occurrences (for example failure of a lamp).

NOTE Typically this will be Ex n equipment.

I.3.3 Dusts (Group III)

I.3.3.1 EPL Da

Equipment for combustible dust atmospheres, having a 'very high' level of protection, which is not a source of ignition in normal operation or when subject to rare faults.

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I.3.3.2 EPL Db

Equipment for combustible dust atmospheres, having a 'high' level of protection, which is not a source of ignition in normal operation or when subject to faults that may be expected, though not necessarily on a regular basis.

I.3.3.3 EPL Dc

Equipment for combustible dust atmospheres, having an 'enhanced' level of protection, which is not a source of ignition in normal operation and which may have some additional protection to ensure that it remains inactive as an ignition source in the case of regular expected occurrences.

For the majority of situations, with typical potential consequences from a resultant explosion, it is intended that the following would apply for use of the equipment in zones (this is not directly applicable for coal mining, as the Zone concept does not generally apply). See Table I.1.

Table I.1 – Traditional relationship of EPLs to zones (no additional risk assessment)

Equipment protection level	Zone
Ga	0
Gb	1
Gc	2
Da	20
Db	21
Dc	22

I.4 Risk of ignition protection afforded

The various levels of protection of equipment must be capable of functioning in conformity with the operational parameters established by the manufacturer to that level of protection. See Table I.2.

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Table I.2 – Description of risk of ignition protection provided

Protection afforded	Equipment protection level Group	Performance of protection	Conditions of operation
Very high	Ma Group I	Two independent means of protection or safe even when two faults occur independently of each other	Equipment remains functioning when explosive atmosphere present
Very high	Ga Group II	Two independent means of protection or safe even when two faults occur independently of each other	Equipment remains functioning in zones 0, 1 and 2
Very high	Da Group III	Two independent means of protection or safe even when two faults occur independently of each other	Equipment remains functioning in zones 20, 21 and 22
High	Mb Group I	Suitable for normal operation and severe operating conditions	Equipment de-energized when explosive atmosphere present
High	Gb Group II	Suitable for normal operation and frequently occurring disturbances or equipment where faults are normally taken into account	Equipment remains functioning in zones 1 and 2
High	Db Group III	Suitable for normal operation and frequently occurring disturbances or equipment where faults are normally taken into account	Equipment remains functioning in zones 21 and 22
Enhanced	Gc Group II	Suitable for normal operation	Equipment remains functioning in Zone 2
Enhanced	Dc Group III	Suitable for normal operation	Equipment remains functioning in Zone 22

I.5 Implementation

The 4th edition of IEC 60079-14 (encompassing the former requirements of IEC 61241-14) will introduce the EPLs to allow a system of 'risk assessment' as an alternative method for the selection of equipment. Reference will also be included in the classification standards IEC 60079-10 and IEC 61241-10.

The additional marking and the correlation of the existing types of protection are being introduced into the revisions to the following IEC standards:

- IEC 60079-0 (encompassing the former requirements of IEC 61241-0)
- IEC 60079-1
- IEC 60079-2 (encompassing the former requirements of IEC 61241-4)
- IEC 60079-5
- IEC 60079-6
- IEC 60079-7
- IEC 60079-11 (encompassing the former requirements of IEC 61241-11)
- IEC 60079-15

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- IEC 60079-18 (encompassing the former requirements of IEC 61241-18)
- IEC 60079-26
- IEC 60079-28

For the types of protection for explosive gas atmospheres the EPLs require additional marking. For explosive dust atmospheres the present system of marking the zones on equipment is being replaced by marking the EPLs.

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Annex ZA
(normative)

Specific occupancies

ZA.1 General

Guidance on the classification of areas relating to several specific occupancies is given in AS/NZS 60079.10.1.

The applications listed may be treated from first principles to meet the general requirements of this Standard, refer 4.1, or may follow the specific requirements identified in this annex.

ZA.2 Ovens

Electrically heated Type 1 ovens in which flammable volatiles occur may be verified as complying with and installed in accordance with AS 1681.

ZA.3 Fuel dispensing

Fuel dispensers may be manufactured and verified as complying with AS/NZS 2229.

ZA.4 Finishing processes

ZA.4.1 Spray and spray/bake booths

ZA.4.1.1 General

Spray painting booths may comply with the design, construction and testing requirements of AS/NZS 4114.1 and the installation requirements of AS/NZS 4114.2.

ZA.4.1.2 Compliance

Where compliance with AS/NZS 4114 is claimed, proof of compliance may be demonstrated by a certificate of conformity issued by a national certification body accredited by JAS-ANZ for product certification in accordance with AS/NZS 4114.1, or by other means acceptable to the Authority.

ZA.4.1.3 Installation and maintenance

Spray painting booths may be installed and maintained in accordance with AS/NZS 4114.2. The manner in which this work is undertaken shall not reduce the electrical safety or explosion protection afforded by the equipment design or associated equipment such as motors, light fittings, control boxes and sensing devices.

NOTE The method of installation should pay particular attention to the explosion protection properties of explosion-protected electrical equipment (termed Ex equipment) including certification conditions that may be included on the Ex certification.

ZA.4.1.4 Associated rooms

Associated rooms such as paint mixing and paint preparation rooms shall be correctly installed and maintained in accordance with this Standard.

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ZA.4.1.5 Fixed electrostatic equipment

Where fixed electrostatic spraying and deterring equipment is installed, such equipment should comply with the following requirements:

a) High voltage grids or electrodes shall be—

i) located in suitable non-combustible booths or enclosures provided with adequate interlocked mechanical ventilation;

ii) rigidly supported and of substantial construction; and

iii) effectively insulated from earth by means of suitable insulators.

b) High voltage leads shall be—

i) effectively and permanently supported on suitable insulators;

ii) effectively guarded against accidental contact or earthing; and

iii) provided with automatic means for discharging any residual charge to earth when the supply voltage is interrupted.

c) Goods being processed shall be supported on conveyors so that the minimum clearance between goods and high voltage grids or conductors cannot be less than twice the sparking distance. A visible and legible sign indicating the sparking distance shall be permanently located near the equipment.

d) Suitable automatic controls shall operate without time delay to disconnect the power supply and to signal the operator in the event of any of the following occurrences:

i) Stoppage of ventilating fans or failure of ventilating equipment from any cause.

ii) Stoppage of the conveyor carrying goods through the high voltage field.

iii) Occurrence of an earth or of an imminent earth at any point on the high voltage system.

iv) Reduction of clearance below that specified in Item (c).

e) Adequate fencing, railings or guards that are electrically conducting and earthed shall be provided for safe isolation of the process.

f) Signs shall be permanently mounted designating the process zone as dangerous because of high voltage.

ZA.4.1.6 Electrostatic hand spray guns

Electrostatic hand spray guns should be used only within a spray booth or approved spray area. Electrostatic hand spray guns and equipment, and devices used in connection with paint spraying operations shall be of a suitable type and shall comply with the following requirements:

a) The equipment shall be designed so that the maximum surface temperature of the equipment in the spraying area cannot exceed 65°C under any condition.

b) The electrostatically charged exposed elements of the spray gun shall be capable of being energized only by a switch that also controls the paint supply.

c) Transformers, power packs, control equipment, and all other electrical portions of the equipment, with the exception of the spray gun itself and its connections to the power supply, shall be located outside the hazardous area.

d) The handle of the spray gun shall be electrically connected to earth by a metallic connection.

NOTE This requirement is to prevent build-up of a static charge on the operator's body.

e) All electrically conductive objects in the spraying area shall be effectively earthed, including paint containers, wash cans and any other objects or devices in the area.

The equipment shall carry a prominent and permanently installed warning, explaining the necessity of such earthing.

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f) Objects being painted shall be maintained in metallic contact with the conveyor or other earthed support. To ensure an effective and continuous contact—

i) hooks shall be regularly cleaned;

ii) areas of contact shall be sharp points or knife edges where possible;

iii) points of support of the object shall be concealed from random spray where feasible; and

iv) where objects are being sprayed and supported from a conveyor, the point of attachment to the conveyor shall be located so as not to collect spray material during normal operation.

g) The spraying operation shall take place within a spray area that is adequately ventilated to remove solvent vapours released from the operation. The electrical equipment shall be interlocked with the ventilation of spraying areas so that the equipment cannot be operated unless the ventilation fans are in operation.

ZA.4.2 Powder coatings

ZA.4.2.1 General

The hazard rating associated with the application of finely ground particles of protective finishing material in dry powder form is dependent upon the chemical composition of the material, particle size, shape and distribution. Hazards associated with both combustible dusts and vapours are inherent in this process and electrical equipment shall—

a) be of a type suitable for EPL 'Ga' and EPL 'Gb' use; and

b) comply with ZA.4.1.6 e).

ZA.4.2.2 Application

Coating powders shall be applied by means of—

a) fluidized bed;

b) electrostatic fluidized bed;

c) powder spraygun; or

d) electrostatic powder spraygun.

ZA.4.2.3 Fixed and hand electrostatic spraying equipment

Fixed and hand electrostatic spraying equipment for the application of powder coatings shall comply with ZA.4.1.5 and ZA.4.1.6.

ZA.4.2.4 Electrostatic fluidized beds

Electrostatic fluidized beds shall satisfy the following requirements:

a) Electrostatic fluidized beds and associated equipment shall be of an approved type.

b) The maximum surface temperature of such equipment in the coating area shall not exceed 65°C.

c) The high voltage circuits and exposed electrodes shall not produce a spark sufficient to ignite any powder mixture or create an appreciable shock hazard upon coming in contact with an earthed object under normal operating conditions.

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The following additional requirements shall be satisfied when powder coating is carried out with electrostatic fluidized beds:

i) Transformers, power packs, control equipment and other electrical portions of the equipment, except for charging electrodes and their connections to the power supply, shall be located outside the powder coating area or shall otherwise conform to the requirements of ZA.4.2.1.

ii) All electrically conductive objects in the charging influence of the electrodes shall be adequately earthed. The powder coating equipment shall carry a prominent, permanently installed warning explaining the necessity for earthing these objects.

iii) Objects being coated shall be maintained in contact with the conveyor or other support in order to ensure proper earthing. To ensure effective contact, hangers shall be regularly cleaned and areas of contact shall be sharp points or knife edges where possible.

iv) The electrical equipment shall be interlocked with a ventilation system so that the equipment cannot be operated unless the ventilation fans are in operation.

ZA.4.2.5 Use of metal floor ducts to enclose wiring

Metal floor ducts may be used only for supplying ceiling outlets for extensions to the area below the floor of the hazardous area, but such ducts shall have no connections leading into or through the hazardous area above the floor, unless sealed using glands meeting the requirements of 9.3.12 for Ex 'e' application.

ZA.5 Laboratory fume cupboards

The criteria for the installation of fume cupboards in laboratories are set out in AS/NZS 2243.8.

ZA.6 Secondary batteries in buildings

Secondary batteries in buildings may be installed, tested, maintained and replaced in accordance with AS 2676.1, AS 2676.2, AS 3011.1 and AS 3011.2.

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Annex ZB
(normative)

Statement of periodic verification (New Zealand only)

Sample form of record or statement for confirming the completion of periodic inspections.

HAZARDOUS AREA STATEMENT OF PERIODIC VERIFICATION

(Please print)

Identification of installation: .....

.....

.....

Location of installation: .....

.....

.....

Name of person carrying out the inspection:

.....

Date of examination: .....

Results:

Further sheets may be attached if required.

Signed: ..... Date: .....

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Annex ZC
(Informative)

Information relating to AUSEx, ANZEx and IECEx Certification Schemes

ZC.1 The AUSEx Scheme

While its origins date back to the early 1960s, as a regulatory approval scheme, the AUSEx Scheme evolved to provide industry with an ISO Type 1 or commonly called 'Type Test' Certification Scheme requiring independent testing and assessment of samples representative of production and the signed undertaking by the certificate holder that they would monitor and maintain control over production, to ensure that all items produced were manufactured to be the same as the sample submitted that past testing.

AUSEx Certificates were numbered using the AUSEx or AUS letters followed by a 4-digit certificate number.

With the worldwide introduction of documented Quality Management Systems and ISO 9000, in the late 1980s to mid 1990s, there has been a shift from Type Test or Approval Type Certification Schemes to 'Quality Based' Certification Schemes, such as the new ANZEx and IECEx Schemes, mentioned below. This shift has resulted in the phasing out of the AUSEx Scheme.

This Scheme has now been replaced by the ANZEx Scheme and from 1 January 2004 it is no longer possible to lodge applications for new AUSEx Certificates.

Previously issued AUSEx Certificates are valid until the end of their expiry period (10 years). It is important to understand that the expiry date of an AUSEx Certificate only relates to the manufacturing date of the product and does not affect products previously purchased and installed.

For details about AUSEx Certificates visit the Administering Body website (www.anzex.com.au).

Further details on the AUSEx Scheme are available from Standards Australia Publication MP 69.

ZC.2 The ANZEx Scheme

As mentioned above, the introduction, worldwide, of Documented Quality Management Systems, has resulted in product certification schemes moving to 'Quality Based Certification Systems'. While ANZEx maintains the same requirements for testing and assessment of samples, as has been the practice with the AUSEx Scheme, the expiry date has now been replaced with initial assessment of manufacturer's quality system supported by ongoing surveillance by the Certification Body issuing the ANZEx Certificate.

The quality system requirements for manufacturers is based on ISO 9001:2000, with additional requirements, specific to the manufacturing of Ex products, specified in Standards Australia Publication MP 87.1. ANZEx is modelled on the widely used ISO Type 5 system.

The ANZEx Scheme also caters for 'one-offs' or limited production through the mechanism of an ANZEx 'Restricted Type Test Certificate' for which assessment/auditing or surveillance of the manufacturers quality system is not necessary as each Restricted Type Test Certificate identifies by serial number or other means, the exact item(s) covered.

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While further details are available from MP 87.1, additional information concerning Certification and Testing Bodies along with a database of issued certificates are available by visiting the Administering Body website (www.anzex.com.au).

ZC.3 The IECEx Scheme

The global harmonization of Ex Standards, via the International Electrotechnical Commission (IEC) Technical Committee TC 31, has provided the foundation for a global approach to Ex certification via the formation of a single international certification scheme, known as the IECEx Scheme.

Similar to the ANZEx Scheme, IECEx is modelled on the well known ISO Type 5 System, requiring—

a) testing, evaluation of samples;

b) initial assessment and audit of manufacturers quality system; and

c) on-going surveillance of the manufacturer's quality system.

The object of the IECEx Scheme is the worldwide acceptance of a single International Certificate of Conformity. In addition, IECEx provides for the issuing and acceptance of International IECEx Test Reports and Quality Reports as a means of 'fast-tracking' local certification or approval.

Certificates issued under the IECEx Scheme are in electronic format with the master copy freely accessible from the IECEx 'On-Line Certificate of Conformity System' via the official IECEx Website, enabling industry, government and stakeholders instant access to the full certificate and its details along with a range of search and data export functions.

Further information regarding the IECEx Scheme, including a list of all accepted IECEx Certification Bodies, is available by visiting the Official IECEx Website: www.iecex.com.

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Annex ZD
(informative)

Conformity assessment documents

ZD.1 Background

The proof of compliance requirements given in 4.3 requires proof of compliance with the ANZ Ex or IEC Ex Certificates of Conformity. Both of these Certification Schemes adopt the ISO/IEC Guide 67-System 5 for their procedure.

ZD.2 System 5

This system includes type testing of the equipment and manufacturing within a quality management system. Surveillance of the quality system is conducted and samples of the equipment may be taken from either the market or the point of production or both and may be assessed for ongoing conformity. The extent to which the three elements of ongoing surveillance are conducted can be adjusted for a given situation. As a result, this system provides significant flexibility for ongoing surveillance.

This certification system includes the following:

a) samples on request by the certification body;

b) testing;

c) evaluation of the test report;

d) initial conformity assessment of the quality system;

e) decision;

f) licence; (Certificate of Conformity)

g) surveillance of the quality management system of the organization;

h) surveillance on equipment from the market.

In determining the requirements for an 'Assessment Statement' to establish an 'equivalent level of safety', these elements are considered, therefore, to be the recommended minimum requirements, within the assessment statement.

ZD.3 Contents of the conformity assessment document

The following items should be provided in all 'Conformity Assessment Documents' before they are considered for acceptance by the Owner/Occupier.

ZD.3.1 Scope

The assessment statement should nominate the extent of work undertaken including a list of considerations that are included in the report and any considerations, which may reasonably have been expected, that have been excluded.

ZD.3.2 The equipment and application

All details of the equipment and application that fully define the actual equipment, its function and application, should be included.

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ZD.3.3 Description

The description should adequately define the equipment by type and model, including any special variations or additions that establish the unique identity of the item being assessed. It may include characteristics relating to appearance, materials etc., such as by description and/or photographs.

ZD.3.4 Function of the product including proposed location

Information relevant to the function and location of the equipment should be included, such as—:

a) the purpose and use of the product and full details of the hazardous area parameters;

b) a unique or generic reference to location. This may include fixed plant and equipment, relocatable plant and equipment and items, that are common to many locations; and

c) the manufacturer's electrical performance specification and hazardous area specification for the equipment. These are preferably appended to the report rather than supplied separately thus ensuring a complete record is maintained for the equipment.

ZD.3.5 Standards compliance

All assessments should be to either AS/NZS or IEC standards. If evidence in the form of a test report to a standard other than these is presented, the assessor should undertake and document ALL variations. These variations can then be checked to ensure that requirements of the AS/NZS or IEC standards have been met and that the assessor is able to demonstrate, and document, that they provide an equivalent level of safety.

In all cases a reference list of standards to which the item has been assessed and cross referenced should be included in the Conformity Assessment Document.

Where a Conformity Assessment Document is prepared using a Certificate of Conformity based on Standards other than AS/NZS or IEC Standards, then the Conformity Assessment Document should contain full information of any applicable variation to the requirements of the AS/NZS or IEC Standards, relating to the installation and use of the equipment including any inspection, maintenance, overhaul or repair variations. In support of this, full manufacturer's documentation according to AS/NZS 60079.0:2005 should be provided.

ZD.3.6 Documents

The documents provided by the manufacturer, and being the evidence used for the assessment, should be listed and appended to the Conformity Assessment Document.

As a minimum they should include a Test Report, a Certificate of Conformity from a Certification Body, and Certificate or audit report of the Manufacturers Quality System. Each document is verified as authentic either direct from the organization that has issued it or from a reliable independent means. In addition, each organization should have accreditation that is acceptable for a MRA/MOU or equivalent with NATA (Test Laboratories) or JAZANZ (Certification Bodies) including auditing of Management Systems and Quality Programs that are equivalent to those detailed in MP87.1 and IEC Ex OD005.

ZD.3.7 Equipment sample

Should the assessor determine it is desirable to assess a sample of the equipment due to any doubt as to the documentation being applicable, or for any other reason, the manufacturer should provide a production sample having the specific configuration required by the application.

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ZD.3.8 Training of installation and maintenance personnel

In the case where equipment to be used is not to AS/NZS or IEC Standards, the requirements for all training of personnel should be included in the Assessment Statement. This should take into account the safe use of the equipment including requirements for operating conditions, installation, inspection and maintenance including spare parts, overhaul and repair. The information should be made available for the purposes of delivering the training to the identified personnel.

ZD.3.9 Elements of the report

ZD.3.9.1 General

In addition to the items above each Conformity Assessment Document should include the following items.

ZD.3.9.2 Executive summary

A summary normally given at the beginning of the report that provides an overview of the overall assessment sufficient for guidance on whether a full review for acceptance is warranted.

ZD.3.9.3 Conformity assessment

A formal Conformity Assessment by the assessor as to their opinion on compliance and detailing any special requirements that may need to be observed.

ZD.3.9.4 Authorization of report

A statement given by the assessor to indicate they have sighted all the documentation, if necessary a sample of the equipment and that they have personally undertaken the review.

ZD.3.9.5 Conclusion

A clear summary of the evidence presented and whether or not it is sufficient, authentic/valid, recent and satisfactory in order that a positive or negative conclusion can be reached.

ZD.4 Assessor requirements

All assessors should have qualifications/training credentials of assessment to verify competency. As a minimum it is expected that competency to the Unit 'Conduct a Conformity Assessment of Explosion Protected Equipment', in accordance with AS/NZS 4761.1 or equivalent, will be attained.

ZD.5 ATEX documentation

ZD.5.1 Purpose

This clause provides details regarding the necessary documentation required under the ATEX 94/9/EC Directive associated with the preparation of Conformity Assessment Documents. Listed are the individual documents normally issued in accordance with the ATEX directive that provide the necessary 'objective evidence' that satisfies the requirements of the Directive. It is usually the responsibility of the applicant for a Conformity Assessment Document to provide this information.

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ZD.5.2 Requirements for documents

All documents should be provided in English. Where the original of an issued document was in a language other than English an authorised translation into English normally provided by the issuing body is acceptable.

Copies should be of good quality and easy to read such that they do NOT give rise to confusion or incorrect information being used.

ZD.5.2.1 EC-Type Examination Certificate

The certificate should be supplied in full with all pages included and any supplementary information in the way of Annexes or referred documentation included. If variations have been issued that are relevant to the equipment whose documentation is being assessed, then all variations should also be included.

The Certificate will include the Registration number of the Notified Body [ExNB] and any certificate NOT containing this should be considered as invalid.

Only Certificates from ExNBs that have National Accreditation, provided the respective National Accreditation Bodies have a Mutual Recognition Agreement with the Joint Accreditation System of Australia and New Zealand [JASANZ http://www.jas-anz.com.au/showpage.php], are acceptable. For this reason the Certificate should show this accreditation information and, if not, evidence of the accreditation is required to be provided separately. Participation in the IEC Ex Scheme is considered to satisfy this requirement.

ZD.5.2.2 Test Report

Each EC-Type Examination Certificate is based on the results of testing and assessment and will commonly list a 'Test Report', 'Assessment and Test Report', 'Confidential Report' or similar, as the basis for issuing the Certificate. For the purpose of a Conformity Assessment Document these are collectively referred to as the 'Test Report'

Similar to the Certificate, the Test Report should also be issued under the terms of accreditation of a National Accreditation Body. In this case, the National Accreditation Body will need to have a MRA with the National Association of Testing Authorities [NATA http://www.nata.asn.au/] for the Test Report to be acceptable. The Test Report should provide this information and, if not, evidence of accreditation will be required separately.

As the ATEX directive does not mandate compliance with Standards, as the only mechanism for the issue of a certificate, it is vital that this evidence clearly demonstrates the third party involvement in order to satisfy the equivalence requirements to Australian and New Zealand standards. Therefore, the Test Report should demonstrate that ALL assessment and tests have been conducted by the ExNB.

There are occasions when a Test Report cannot reasonably be obtained. This may be due to confidentiality issues or that the document is not readily available in English. Under these circumstances, it is possible to accept a statement from the Test Laboratory that clearly states '..... the assessment and testing, covering ALL requirements given in standards EN [insert all the standards referred to on the certificate] has been conducted by [name of organization] entirely under the terms of accreditation with [name of the National Accrediting Body] Registration Number [insert registration number]. This has resulted in the issue of Test Report No. [this SHOULD match the reference given on the Certificate].....

It is preferable that such a statement is signed by the same person responsible for the issue of the original report but at least by a signatory accepted under the terms of accreditation of the test laboratory.

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ZD.5.2.3 Quality Management System Certificate

A Quality Management System Certificate to ISO 9001 issued to the manufacturer by an accredited body and specifically covering the site or location where the equipment was manufactured, is to be provided.

ZD.5.2.4 EC Quality Production Notification

In addition to the Quality Management System Certificate the ATEX directive requires that a manufacturer has the production of Ex products under surveillance by an ExNB and this is demonstrated by an EC Quality Production Notification (this title may vary slightly from country to country). It is not necessary for the ExNB that issues the Quality Production Notification to be the same as the ExNB that issued the certificate. The production Quality Notification should clearly show that it covers the production of the specific product whose documentation is being assessed.

ZD.5.2.5 EC Manufacturers Declaration of Conformity

This document is to be provided by the manufacturer to legally market equipment within the European Union (EU). Whilst not essential for the assessment to prepare a Conformity Assessment Document, it does provide support in as much as it is an undertaking by the manufacturer to supply conforming equipment.

This declaration of conformity needs to specifically include the equipment whose documentation is being assessed and the requirements of the EU Directive 94/9/EC. It is normal that other directives, for example the EMC directive or Low Voltage directive, are also shown on this declaration of conformity.

ZD.6 North American documentation

ZD.6.1 UL documentation

The UL Listing/Certification program involves all the items for System 5 Certification including third party type test and quality requirements through the compulsory factory surveillance program. This means that the evidence of a listing (or occasionally a certificate) will enable the Standards used to be determined, allowing a Conformity Assessment Document to be prepared. In all cases the testing will be conducted by UL. As there is no relaxation of the factory surveillance permitted, it is accepted that this is integral and current, for the Listing to remain valid. It is important that variations in installation, inspection, maintenance and repair are identified and highlighted in the Conformity Assessment Document.

ZD.6.2 FM documentation

The FM Certification program involves all the items for System 5 Certification including third party type test and quality requirements through the compulsory factory surveillance program. This means that the evidence of a Certificate of Approval or Certificate of Conformity/Compliance will identify the Standards and allow a Conformity Assessment Document to be prepared. In all cases the testing will have been conducted by FM. As there is no relaxation of the factory surveillance permitted, it is accepted that this is integral and current, for the Certificate to remain valid. It is important that variations in installation, inspection, maintenance and repair are identified and highlighted in the Conformity Assessment Document.

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ZD.6.3 CSA documentation

The CSA Certification program involves all the items for System 5 Certification, except it may be necessary to verify if CSA has conducted all the testing or can accept the test report used under the terms of their accreditation. The North American compulsory factory surveillance program is also applied in Canada. This means that the evidence of a Certificate of Conformity/Compliance will identify the Standards used and allow a Conformity Assessment Document to be prepared. As there is no relaxation of the factory surveillance permitted, it is accepted that this is integral and current, for the Certificate to remain valid. It is important that variations in installation, inspection, maintenance and repair are identified and highlighted in the Conformity Assessment Document.

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Annex ZE
(normative)

Risk assessment for EPLs

ZE.1 Introduction

In accordance with AS/NZS 60079.10.1 Clause 4.2 for gas/vapour hazard classifications, and the future AS/NZS 60079.10.2 for dust hazard classifications, Equipment Protection Levels (EPLs) may be used as a basis for equipment selection and installation. The use of EPLs is an option for selection and installation of equipment based on traditional zone criteria.

NOTE 1 AS/NZS 60079.10.2 will replace AS/NZS 61241.10 for dust hazard classifications at the next edition. The application of EPLs will be similarly expressed in AS/NZS 60079.10.1.

This annex provides requirements that apply in Australia and New Zealand when the option of the EPL assignment is used.

NOTE 2 The application of risk assessment for EPLs is outside the scope of IEC TC31 and is therefore the responsibility of national standards. The requirements of this annex may not apply in other countries.

Risk adjustments for EPL are intended only to be applied by organizations where a formal risk management and operational frameworks have previously been established, e.g. the organization already operates under a safety case management regime or has a national or international management framework covering Standards and processes to be applied.

ZE.2 Hazardous area classification and EPLs

In all cases, a zone based hazardous area classification shall be assessed in accordance with AS/NZS 60079.10.1 or AS/NZS 61241.10 as appropriate.

Table 1 shows the relationship between zones and EPLs where no further assessment is carried out.

Subsequent to the completion of the area classification, a risk assessment may be carried out to assess whether the consequences of ignition of an explosive atmosphere require the use of equipment of a higher equipment protection level (EPL) or may justify the use of equipment with a lower equipment protection level than normally required. In this case the assessment criteria and processes provided in this annex shall apply.

Where a risk assessment is carried out to assess consequences the acceptable range of adjustments to the EPLs is given in Table ZE.2

Acceptable EPL will be further identified as either 'G' for gas/vapour hazards, zones 0, 1 and 2, or 'D' for dust hazards, zones 20, 21 and 22.

Table ZE.2 - Acceptable adjustment range for EPLs

Zone	Acceptable EPL Range
0, 20	a, b
1, 21	a, b, c
2, 22	a, b, c
Non Hazardous	a, b, c or none

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ZE.3 Requirements for risk based EPL assessments

Extending hazardous area classifications for risk assessment and assigning EPLs is not intended to be carried out without thorough and careful consideration. Accordingly, for risk based EPL assessments to be accepted, the following elements and processes shall be applied:

a) Hazardous area classification shall be included in the assessment.

b) The assessment shall be made with input from person/s with the appropriate competencies and experience in the areas of—

i) Hazardous area classification.

ii) Risk assessment.

iii) Process and plant design.

iv) Plant operations.

NOTE 1 – It is desirable that these persons are from multi-discipline teams. Other members may also need to be considered e.g. legal, OH&S and general management.

Where departing from established assignment of EPLs they shall be developed based on a formal risk assessment process appropriate to the plant and organization (e.g. risk assessment workshop using a facilitator or leader).

NOTE 2 – Commonly used risk assessment methodologies that may be appropriate include, but are not limited to—

i) Use of AS/NZS 4360.

ii) Use of AS/NZS 61511.

iii) Layers of Protection Model (LOPA).

iv) Threat/Barrier diagrams.

v) As Low As Reasonably Practicable assessments (ALARP).

NOTE 3 – This does not preclude assignment of EPLs following a corporate standard or guide where such a standard is first developed in a formal process.

c) EPLs, other than default assignment as shown in Table 1, shall not be assigned solely by installation and/or maintenance contractors/personnel.

d) The risk assessment processes followed and EPLs assigned shall be formally documented and managed, including retention of records.

e) The EPLs assigned shall be recorded as part of the hazardous area classification drawings and charts. References to assessments and any corporate guides for EPLs shall be included in this documentation. Refer also to 4.2.

NOTE 4 – Users may choose a suitable format to suit their need for presentation of EPLs. However, it is suggested that a graphical representation is most efficient.

ZE.4 Other than risk based EPL assessments

EPLs may be assigned on factors other than risk assessment. Such factors may include, for example—

a) Standardization of equipment for installation and maintenance issues.

b) Preference or requirement for an IP rating or impact rating afforded by the protection technique of a particular EPL.

NOTE An example where enhanced IP or impact ratings may be required is a coal handling plant where EPL b equipment offers improvements in both ratings over what would otherwise be accepted for a zone 22 classification.

Where other than risk based EPL assessment is applied, the EPL assigned shall be not less than that shown in Table 1 (i.e. where no EPL is assigned).

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Where factors such as those identified above are considered the decisions may be accepted by the relevant responsible person(s) in the owner or operators organization. Such decisions shall be recorded in relevant documentation and noted on hazardous area/EPL drawings.

ZE.5 Relationships of EPLs to other Acts and Regulations

The application of EPLs is intended to allow for variances in equipment selection and installation based on factors other than release and dispersion conditions. However, where other risk factors are taken into account to determine EPLs, these should be carefully considered. Adjustments will also need to consider the application of relevant Acts and Regulations.

NOTE 1 – Examples of other factors that might be considered include environmental, personal injury, company reputation, production losses etc. Cost may not be a valid factor.

NOTE 2 – Justification for reducing EPLs from the base classification should always consider personal injury risk and OH&S legislation, particularly with respect to practicability and risk minimization.

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Bibliography

AS 61508, *Functional safety of electrical/electronic/programmable electronic safety-related systems*

AS IEC 61511, *Functional safety—Safety instrumented systems for the process industry sector*

AS 62061, *Safety of machinery—Functional safety of safety-related electrical, electronic and programmable electronic control systems*

MP 87.1, *Australian/New Zealand Certification Scheme for explosion-protected electrical equipment (ANZEx Scheme)—Product Certification Program—Basic rules and procedures*

IEC/TS 60034-17, *Rotating electrical machines – Part 17: Cage induction motors when fed from converters – Application guide*

IEC/TS 60034-25, *Rotating electrical machines – Part 25: Guide for design and performance of a.c. motors specifically designed for convertor supply*

IEC 60050(426), *International Electrotechnical Vocabulary – Chapter 426: Electrical equipment for explosive atmospheres*

IEC 60332-2-2, *Tests on electric and optical fibre cables under fire conditions – Part 2-2: Test for vertical flame propagation for a single small insulated wire or cable – Procedure for diffusion flame*

IEC 60332-3 (all parts), *Tests on electric cables under fire conditions*

IEC 60614-2-1, *Specification for conduits for electrical installations – Part 2-1: Particular specifications for conduits – Metal conduits*

IEC 60614-2-5, *Specification for conduits for electrical installations – Part 2-5: Particular specifications for conduits – Flexible conduits*

IEC 60742, *Isolating transformers and safety isolating transformers – Requirements*

IEC 60755, *General requirements for residual current operated protective devices*

IEC 61008-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

IEC 61010-1, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61024-1, *Protection of structures against lightning – Part 1: General principles*

CENELEC/TR 50427, *Assessment of inadvertent ignition of flammable atmospheres by radio-frequency radiation – Guide*

CENELEC/TR 50404, *Electrostatics – Code of practice for the avoidance of hazards due to static electricity*

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Amendment No. 1
to
AS/NZS 60079.14:2009
Explosive atmospheres
Part 14: Electrical installations design, selection and erection
(IEC 60079-14, Ed 4.0 (2007) MOD)

CORRECTION

The 2009 edition of AS/NZS 60079.14 is amended as follows; the amendment(s) should be inserted in the appropriate place(s).

SUMMARY: This Amendment applies to Clauses 4.3.1, 4.3.2 and 4.3.2.1 and Table 2.2.

Published on 15 August 2011.
Approved for publication in New Zealand on behalf of the Standards Council of New Zealand on 1 July 2011.

AMDT No. 1 AUG 2011

Preface

Delete the first paragraph and *replace* with:

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-014, Equipment for Explosive Atmospheres. In conjunction with AS/NZS 60079-17, it is intended to replace the AS/NZS 2381, AS 2381 and AS 1076 series, in September 2012. After this time it is intended that the AS/NZS 2381, AS 2381 and AS 1076 series will be withdrawn. It is also intended that this Standard, in conjunction with AS/NZS 60079.17, will replace AS/NZS 61241.14, in September 2012. After this time it is intended that AS/NZS 61241.14 will also be withdrawn.

AMDT No. 1 AUG 2011

Clause 4.3.1, 4.3.2 and 4.3.2.1

Delete Clauses 4.3.1, 4.3.2 and 4.3.2.1 and *replace* with:

4.3.1 Equipment with certificates according to IEC standards or AS/NZS Standards

~~Equipment with certificate according to IEC 60079 series, IEC 60079-29-1 and IEC 60079-29-2 or IEC 61241 series, meets the requirements for hazardous areas, when selected and installed in accordance with this Standard.~~

Equipment with acceptable certification according to hazardous areas Standards published as AS/NZS Standards, IEC Standards or AS Standards in accordance with ~~as listed in~~ Table 2.1 or ~~for gases and vapours or Table~~ 2.2 ~~for combustible dusts as appropriate~~ as applicable, is acceptable when selected and installed in accordance with this Standard.

Acceptable certification of equipment shall be covered by a Certificate of Conformity which—

(a) is issued in accordance with a Type 5 Scheme complying with ISO/IEC Guide 67; and

(b) is issued by a body operating within the IECEx Scheme or the ANZEx Scheme or by a certification body with accreditation by JAS-ANZ or an organization that has a Mutual Recognition Agreement (MRA) with JAS-ANZ covering Product Certification of Explosion Protected Equipment; and

(c) certification shall be issued by a Certification Body or agency with current accreditation or acceptance by way of independent assessment complying with ISO/IEC Guide 65. The accreditation or acceptance shall show Ex certification for an ISO Type 5 system in the Ex field, as part of their capability; and

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(d) the certification system shall also require—

(i) testing of samples for compliance with relevant IEC Standards or Australian Standards;

(ii) assessment and audit of manufacturers by the Certification body, for compliance of their quality system according to ANZEx or IECEx requirements or equivalent; and

(iii) on-going surveillance audits of manufacturers, in accordance with ANZEx or IECEx quality requirements or equivalent, by the Certification body, responsible for issuing the Certificate. This does not preclude the Certification Body arranging to have surveillance audits conducted by another body operating as their agent.

Equipment certified under the IECEx Scheme and registered on the IECEx database (www.iecex.com) or the ANZEx Scheme registered on the ANZEx database (www.anzex.com.au) meets these criteria. Equipment certified under the AUSEx Scheme is acceptable when manufactured within the certificate validity period.

NOTE: For Ex 'v' installations and where Ex 'p' is applied to buildings, and the like, that are assembled and/or installed on site, certification may not be appropriate. In such cases a statement of assessment by a competent person may be accepted.

4.3.2 Equipment without certificates according to ~~acceptable~~ IEC S~~s~~tandards or AS/NZS Standards

~~Apart from simple apparatus used within an intrinsically safe circuit, the selection of equipment for use in a hazardous area, which either has no certificate at all or it has a certificate but not in accordance with one of the standards listed in 0, shall be restricted to circumstances where suitable equipment with certificate is not obtainable. The justification for the use of such equipment, along with the installation and marking requirements, shall be made by the user, manufacturer or third party and be recorded in the verification dossier. The following requirements of this Standard, under these conditions, may not be applicable.~~

Apart from simple apparatus used within an intrinsically safe circuit, the selection of equipment for use in a hazardous area, which has a certification that ~~e but~~ is not in accordance with ~~one of the Standards listed in~~ 4.3.1, shall be restricted to circumstances where suitable equipment with ~~acceptable~~ certification in accordance with 4.3.1 is not practically obtainable.

The justification for the use of such equipment along with the selection, installation, and marking, inspection, maintenance and repair and overhaul requirements ~~certified to an alternative Standard to those referenced in 4.3.1, along with the selection, installation, marking, inspection, maintenance, repair and overhaul requirements,~~ shall be made by the person(s) in control of the installation using a competent body.

The justification shall be included as part of the verification dossier. Justification may be demonstrated in ~~This may take~~ the form of a Conformity Assessment Document. Guidance for the preparation of a Conformity Assessment Document can be found in Annex ZD.

4.3.2.1 For use in Australia

For Group I installations, equipment with alternative certification ~~certified to an alternative Standard~~ is not accepted.

NOTE: Regulatory authorities may specify additional requirements for acceptance of equipment with alternative certification certified to alternative Standards.

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No. 1
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2011

Clause 5.4.1, Table 2.2

Delete Table 2.2 and *replace* with:

EPL	Type of protection	Code	Group	According to	Comments
'Da'	Intrinsically safe	'ia'	III	AS/NZS 60079.11 [1)]	
				AS/NZS 61241.11	Equipment identified as Ex iaD
				AS 2380.7 [1)]	
				IEC 60079-11 [1)]	
	Encapsulation	'ma'	III	AS/NZS 60079.18	
				IEC 60079-18	
	Protection by enclosure	'ta'	III	AS/NZS 61241.1	Equipment identified as Ex tD A20
				AS/NZS 61241.1.1	Equipment identified as DIP A20
				AS/NZS 60079.31	
				IEC 60079-31	
'Db'	Intrinsically safe	'ib'	III	AS/NZS 60079.11 [1)]	
				AS/NZS 61241.11	Equipment identified as Ex ibD
				AS 2380.7 [1)]	
				IEC 60079-11 [1)]	
	Encapsulation	'mb'	III	AS/NZS 60079.18	Equipment identified as Ex m or Ex mb
				AS 2431	Equipment identified as Ex m
				IEC 60079-18	Equipment identified as Ex m or Ex mb
				AS/NZS 61241.18	Equipment identified as Ex mD
				IEC 61241-18	Equipment identified as Ex mD
	Protection by enclosure	'tb'	III	AS/NZS 61241.1	Equipment identified as Ex tD A21 or Ex tD B21
				AS/NZS 61241.1.1	Equipment identified as DIP A21 or DIP B21
				AS 2236	Equipment identified as DIP
				AS/NZS 60079.31	
				IEC 60079-31	
	Pressurized enclosures	'p'	III	AS 2380.4	
				AS/NZS 61241.4	Equipment identified as Ex pD
				IEC 61241-4	Equipment identified as Ex pD
'Dc'	Intrinsically safe	'ic'	III	AS/NZS 60079-11	
				IEC 60079-11	
	Protection by enclosure	'tc'	III	AS/NZS 61241.1	Equipment identified as Ex tD A22 or Ex tD B22
				AS/NZS 61241.1.1	Equipment identified as Ex tD A22 or Ex tD B22
				AS/NZS 60079.31	
				IEC 60079-31	
	Pressurized enclosures	'pD'	III	IEC 61241-4	

[1)] – Additional installation requirements apply – see 5.4.5.