Title	**Demonstrate introductory underpinning knowledge of electrical equipment in explosive atmospheres**		
Level	**4**	**Credits**	**5**

Purpose	This unit standard is intended for use in the training and assessment of people who work with explosion-protected equipment in explosive atmospheres. People credited with this unit standard are able to demonstrate knowledge of: – explosive atmospheres and explosion-protection principles – the principles of explosion-protection techniques – the characteristics and application of the flameproof Ex d explosion-protection technique – the characteristics and application of the increased safety Ex e explosion-protection technique – the characteristics and application of intrinsic safety Ex i and Ex iD explosion-protection techniques – the characteristics and application of the non-sparking Ex n explosion-protection technique – the characteristics and application of less common explosion-protection techniques – the characteristics and application of the pressurisation enclosure Ex p technique – the characteristics and application of the enclosures for dusts Ex t explosion-protection technique – the common characteristics of explosion-protection techniques, and – Ex certification schemes.

Classification	Explosive Atmospheres > Electrical Apparatus in Explosive Atmospheres - Operations

Available grade	Achieved

Guidance Information

1 This unit standard has been designed for training and assessment on-job or off-job in a simulated environment, which includes explosion-protected equipment and wiring systems similar to those encountered in a real workplace. It is recommended candidates achieve Unit 30068, *Enter classified explosive atmosphere areas to undertake work*, or demonstrate equivalent knowledge and skills, prior to enrolment in this unit standard.

2 This unit standard covers the theoretical component for *Determine the explosion-protection requirements specified for a classified hazardous area*, in the Australian/New Zealand Standard AS/NZS 4761.1 (version as cited in the Electricity (Safety) Regulations) *Competencies for working with electrical equipment in hazardous areas* (*EEHA*). Refer to unit standard 30069, *Determine the explosion-protection requirements specified for classified explosive atmospheres*, for the practice component.

3 Achievement of this unit standard alone does not entitle trainees to legally perform prescribed electrical work without supervision. Until registered and licensed under the Electricity Act 1992, trainees are assisting, and must work under supervision when carrying out prescribed electrical work.

4 References

- AS/NZS 1768:2007, *Lightning protection*
- AS/NZS 3000 (version as cited in the Electricity (Safety) Regulations), *Electrical installations (known as the Australian/New Zealand Wiring Rules)*
- AS/NZS 4761.1 (version as cited in the Electricity (Safety) Regulations) *Competencies for working with electrical equipment in hazardous areas* (*EEHA*) – *Competency Standards*
- AS/NZS 60079.14 (version as cited in the Electricity (Safety) Regulations), *Explosive atmospheres – Part 14: Electrical installations design, selection and erection*
- AS/NZS 60079.17 (version as cited in the Electricity (Safety) Regulations), *Explosive atmospheres – Part 17: Electrical installations inspection and maintenance*
- Electricity Act 1992
- Electricity (Safety) Regulations 2010
- Health and Safety at Work Act 2015, and associated regulations

and their subsequent amendments and replacements.

5 Definitions

ANZEx – Australian/New Zealand Certification Scheme for explosion-protected electrical apparatus (ANZEx Scheme).

ATEX – Appareils destinés à être utilisés en Atmosphères Explosibles, comprises two European Union directives (Directive 94/9/EC) that describe what apparatus, protective systems, and work that is permitted in potentially explosive atmospheres.

Certification documentation – document(s) that assure(s) the conformity of a product, process, system, person, or organisation with specified requirements.

EPL – equipment protection levels.

Equipment group – Group I is for equipment for underground mines. Group II is for gases and vapours in surface industries, and is divided into Groups IIA, IIB and IIC for substances with increasing ease of ignition. Group III is for dusts in surface industries, and is similarly divided into Groups IIIA, IIIB and IIIC. These are added as roman number suffixes to explosion-protection technique markings on equipment and on Certificates of Compliance.

Explosion-protected equipment – electrical equipment to which one or more explosion-protection techniques are applied to avoid ignition of a surrounding explosive atmosphere.

Explosion-protection techniques – techniques applied to the design of electrical equipment, components, and systems to prevent electrical energy from becoming an ignition source in the presence of a surrounding explosive atmosphere, as follows:
For Gas and Vapour Atmospheres
Ex d – flameproof
Ex e – increased safety
Ex i – intrinsic safety; with levels of protection Ex ia, Ex ib, and Ex ic
Ex n – non sparking with levels of protection Ex nA, Ex nC, Ex nL, Ex nR, and Ex nZ
For dust
Ex iD – intrinsic safety (dusts)
Ex tD – enclosed
Others, less common
Ex p – Pressurisation, with levels of protection Ex pX, Ex pY, and Ex pZ, Ex pD (dust)
Ex m – encapsulation, with levels of protection Ex ma, Ex mb, Ex mc (gases and vapours), and Ex mD (dusts)
Ex s – special protection; categorised by zone of application; for example; Ex s (Zone 0)
Ex o – oil immersion
Ex op – optical radiation
Ex q – sand filled
Ex v – ventilation.
Explosive atmosphere – mixture with air, under atmospheric conditions, of flammable substances in the form of gas, vapour, dust, fibres, or flyings which, after ignition, permits self-sustaining propagation.
Hazardous area – a three-dimensional region or space 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.
Integrity of explosion-protected equipment – the condition of being unified, complete or sound in construction of the equipment design and use that ensures explosion-protection, e.g. the structural integrity of the equipment.
LEL – lower explosive limit – the concentration of flammable gas, vapour, or dust in air below which, an explosive atmosphere will not be formed.
Mixed explosion-protection – equipment that comprises several components, each with its own explosion-protection technique, contained within the one enclosure.
Safe and sound practice – as it relates to the installation of electrical equipment is defined in AS/NZS 3000.
Temperature class – classification system of electrical equipment, based on its maximum surface temperature, related to the specific explosive atmosphere for which it is intended to be used.
UEL – upper explosive limit – the concentration of flammable gas, vapour, or dust in air above which, an explosive atmosphere will not be formed.

6 Assessment is to take account of variations between the industry sectors and enterprises. For example, equipment used in underground mining will be different in some respects from that used in a petrochemical plant.

7 Range
- a Candidates must refer to current legislation and Standards during assessment.
- b Demonstration of safe working practices and installation in accordance with *safe and sound practice* are essential components of assessment of this unit standard.
- c All activities and evidence presented for all outcomes and performance criteria in this unit standard must be in accordance with:
  - i legislation
  - ii workplace policies and procedures
  - iii Standards – may include but are not limited to those listed in Schedule 2 of the Electricity (Safety) Regulations 2010
  - iv applicable site, enterprise, and industry practice
  - v manufacturers' instructions, specifications, and data sheets.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of explosive atmospheres and explosion-protection principles.

Performance criteria

1.1 Explain the properties of combustible substances and their potential to create an explosive hazard.

Range conditions that will lead to an explosion, explosive range of substances including LEL and UEL, flashpoint.

1.2 Explain the terms combustion, ignition, and propagation.

1.3 Describe explosive parameters of substances, as given in tables of substance characteristics, in terms of the properties of combustible materials.

Range materials include – gases, vapours from liquids, dusts, fibres, flyings;
properties include – flash points of liquids, LEL and UEL of gases.

1.4 Describe the toxic nature of gases, vapours, and dusts and their potential harmful consequences.

1.5 Describe the nature of explosive atmospheres.

Range definitions of explosive atmospheres found in Standards, explosive atmospheres, equipment groups, temperature classes and their relationship to the substances present;
the concept of zones in terms of likelihood or frequency and duration of the presence of an explosive atmosphere in that location;
the need for zone classification by specialists using Standards in conjunction with people who understand the most about the operation and control of the plant, equipment, and environment.

1.6 Describe methods of achieving explosion-protection in terms of energy limitation, exclusion, containment, dilution, ventilation, and elimination of ignition source.

1.7 Describe workplace health and safety responsibilities related to explosive atmospheres.

Range the main features and purpose of a clearance-to-work system including work permit systems, safety procedures to be followed before entering a hazardous area.

1.8 Describe the roles and responsibilities of the parties involved in the safety of explosive atmospheres.

Range Acts and regulations related to the safety of explosive atmospheres and the authorities responsible for their implementation;
where assistance and further information can be obtained to help persons with explosive atmospheres responsibilities;
the explosive atmospheres responsibilities of the owner of premises, and of the occupier of premises;
enterprises and personnel engaged in classification, installation, maintenance, design, overhaul and/or modification, assessment, and inspection of explosion-protection systems and/or installations;
manufacturers of explosion-protected equipment;
designated authorities, insurers.

Outcome 2

Demonstrate knowledge of the principles of explosion-protection techniques.

Range includes but is not limited to – Ex d, Ex e, Ex i, Ex ia, Ex ib, Ex ic;Ex iD, Ex m, Ex ma, Ex mb, Ex mc, Ex mD, Ex n, Ex nA, Ex nC, Ex nL, Ex nR, Ex nZ, Ex o, Ex op, Ex p, Ex pD, Ex pX, Ex pY, Ex pZ, Ex q, Ex s, Ex tD, Ex v.

Performance criteria

2.1 Explain the principles of each explosion-protection technique, the methods used to achieve the protection, and how each technique works.

2.2 Explain visible conditions or actions that would void the explosion-protection provided by each technique.

Outcome 3

Demonstrate knowledge of the characteristics and application of the flameproof Ex d explosion-protection technique.

Performance criteria

3.1 Explain how flameproof type enclosure works to provide explosion protection.

3.2 Describe the features and functions of flameproof enclosures.

Range enclosure materials, flame paths, fasteners, enclosure entries, breathing and drain devices, gaskets.

3.3 Describe the attributes of flame proof enclosures.

Range integrity under pressure, suitability for power switching equipment, situations where it can be used, situations where it cannot be used.

3.4 Describe actions or conditions that would void the protection provided by the flameproof technique.

Range installed location, cable/conduit entries, flame paths, gaskets, fasteners, pressure piling.

3.5 Explain the use of Standards to determine the requirements with which the installation of the flameproof explosion-protected equipment must comply.

Outcome 4

Demonstrate knowledge of the characteristics and application of the increased safety Ex e explosion-protection technique.

Performance criteria

4.1 Explain how the increased safety explosion-protection technique works to provide explosion protection.

4.2 Describe the features and functions of increased safety explosion-protection technique.

Range electrical connections, length of conductors within an enclosure, clearances between bare conductive parts, creepage distances, enclosure entries, IP rating of enclosures, temperature limitation, certified components.

4.3 Describe the attributes of the increased safety explosion-protection technique.

Range includes but is not limited to – temperature rise, maximum power dissipation, protection devices, certified components, creepage, clearance distances, absence of sparking contacts, enclosure entries, situations where it can be used, situations where it cannot be used.

4.4 Describe actions or conditions that would void the protection provided by the increased safety technique.

Range installed location, electrical connections, clearances, preservation of temperature limits, components.

4.5 Explain the use of Standards to determine the requirements to which the installation of the increased safety explosion-protected equipment is to comply.

Outcome 5

Demonstrate knowledge of the characteristics and application of intrinsic safety Ex i and Ex iD explosion-protection techniques.

Performance criteria

5.1 Explain how the intrinsic safety explosion-protection technique works to provide explosion protection.

5.2 Describe the features and functions of intrinsic safety explosion-protection.

Range associated equipment, simple devices, dependant components, infallible components, assemblies and connections, external wiring, safety barrier.

5.3 Describe the attributes of the intrinsic safety explosion-protection.

Range levels of protection, ignition energy limiting, entity versus integrated system concept, situations where it can be used, situations where it cannot be used.

5.4 Describe actions or conditions that would void the protection provided by the intrinsic safety explosion-protection technique due to poor installation or maintenance.

Range installed location, stored energy sources, insulation ratings, external wiring, earthing bonding.

5.5 Explain the use of Standards to determine the requirements to which the installation of intrinsic safety technique explosion-protected equipment is to comply.

Outcome 6

Demonstrate knowledge of the characteristics and application of the non-sparking Ex n explosion-protection technique.

Performance criteria

6.1 Explain how the non-sparking explosion-protection technique works to provide explosion protection.

6.2 Describe the features and function of the non-sparking explosion-protection technique.

6.3 Describe the attributes of the non-sparking explosion-protection technique.

Range levels of protection, situations where it can be used, situations where it cannot be used.

6.4 Describe actions or conditions that would void the protection provided by the non-sparking explosion-protection technique due to poor installation or maintenance.

Range installed location, enclosures, cable/conduit entries, external connections.

6.5 Explain the use of Standards to determine the requirements to which the installation of the non-sparking explosion-protected equipment is to comply.

Outcome 7

Demonstrate knowledge of the characteristics and application of less common explosion-protection techniques.

Range Ex m, Ex o, Ex q, Ex v.

Performance criteria

7.1 Explain how the less common explosion-protection techniques work to provide explosion protection.

7.2 Describe the features and functions of the explosion-protection techniques.

7.3 Describe the attributes of the explosion-protection technique.

7.4 Identify typical situations where the explosion-protection techniques can be used and cannot be used.

7.5 Describe actions or conditions that would void the protection provided by the techniques.

7.6 Explain the use of Standards to determine the requirements to which the installation and maintenance of the techniques are to comply.

Outcome 8

Demonstrate knowledge of the characteristics and application of the pressurisation enclosure Ex p technique.

Performance criteria

8.1 Explain how the pressurisation explosion-protection technique works to provide explosion protection.

8.2 Describe the features and functions of pressurisation explosion-protection.

Range types of pressurisation, pressurisation system, purging, temperature limitation, safety devices, containment systems, protection types, situations where it can be used, situations where it cannot be used.

8.3 Describe actions or conditions that would void the protection provided by the pressurisation safety explosion-protection technique due to poor installation or maintenance.

Range inadequate cable/conduit entries, poorly secured doors and covers, failed safety devices, negating purging requirements after maintenance.

8.4 Explain the use of Standards to determine the requirements to which the installation of pressurisation enclosure explosion-protected technique equipment is to comply.

Outcome 9

Demonstrate knowledge of the characteristics and application of enclosures for dusts Ex t explosion-protection technique.

Performance criteria

9.1 Explain how the dust enclosure explosion-protection technique works to provide explosion protection.

9.2 Describe the features and functions of dust explosion-protection techniques.

Range level of protection, protective devices, gaskets, situations where it can be used, situations where it cannot be used, dust enclosures in legacy systems.

9.3 Describe actions or conditions that would void the protection provided by dust explosion-protection technique.

Range cable/conduit entries, sealing, dust layer accumulation.

9.4 Explain the use of Standards to determine the requirements to which the installation of dust explosion-protected equipment is to comply.

Outcome 10

Demonstrate knowledge of the common characteristics of explosion-protection techniques.

Performance criteria

10.1 Explain the criteria on which EPLs are assigned.

10.2 Describe the purposes of temperature classification, equipment grouping, cloud and layer temperature, and ingress protection.

10.3 Explain equipment (nameplate) markings.

10.4 Describe the limitations of non-metallic or specific alloy enclosures.

10.5 Explain the purpose and use of conformity and certification/approval for equipment used in explosive atmospheres.

10.6 Describe environmental conditions that may impact on explosion-protection techniques.

10.7 Explain the principles and applications of other and mixed explosion-protection techniques.

10.8 Describe features and purpose of conduit seals and cable termination devices.

Range conduit seals and barrier and compression glands for cables with or without armouring, screening and/or drain wires.

Outcome 11

Demonstrate knowledge of Ex certification schemes.

Performance criteria

11.1 Explain the purpose and scope of certification schemes.

11.2 Identify the schemes accepted in Australia and New Zealand.

11.3 Identify schemes commonly used in countries other than Australia and New Zealand.

11.4 Describe processes for having equipment certified under the accepted Australia and New Zealand Ex schemes.

Range scheme procedures, quality management requirements, conformance testing and assessment, on-going certification requirements.

11.5 Describe the purpose and use of conformity and on-going certification for equipment used in explosive atmospheres.

Range ATEX, ANZEx, IECEx.

Planned review date	31 December 2027

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	20 May 2011	31 December 2021
Review	2	16 March 2017	31 December 2025
Review	3	2 March 2023	N/A

Consent and Moderation Requirements (CMR) reference	0003

This CMR can be accessed at http://www.nzqa.govt.nz/framework/search/index.do.

Comments on this unit standard

Please contact Waihanga Ara Rau Construction and Infrastructure Workforce Development Council qualifications@WaihangaAraRau.nz if you wish to suggest changes to the content of this unit standard.