

<b>Title</b>	<b>Demonstrate underpinning knowledge of gas detection equipment in explosive atmospheres</b>		
<b>Level</b>	<b>4</b>	<b>Credits</b>	<b>5</b>

<b>Purpose</b>	<p>This unit standard is intended for use in the training and assessment of people who work with electrical equipment in explosive atmospheres.</p> <p>People credited with this unit standard are able to demonstrate:</p> <ul style="list-style-type: none"> <li>– knowledge of explosive atmospheres and explosion-protection principles</li> <li>– and apply knowledge of the principles of gas detection and the use and care of portable gas detection devices</li> <li>– knowledge of the factors to consider in the evaluation and selection of portable gas detection equipment</li> <li>– knowledge of basic properties, behaviour, and detection of gases and vapours</li> <li>– knowledge of fixed gas detection equipment, and</li> <li>– knowledge of the instructions to be given to non-technical people in the use of portable gas detection devices in specific applications or environments.</li> </ul>
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<b>Classification</b>	Explosive Atmospheres > Electrical Apparatus in Explosive Atmospheres - Operations
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<b>Available grade</b>	Achieved
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### 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 30069, *Determine the explosion-protection requirements specified for classified explosive atmospheres*, or demonstrate equivalent knowledge and skills, prior to enrolment in this unit standard.
- 2 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.
- 3 References
  - AS/NZS 1768:2007, *Lightning protection*
  - AS/NZS 1826:2008, *Electrical equipment for explosive gas atmospheres – Special protection – Type of protection 's'*

- AS/NZS 3000 (version as cited in the Electricity (Safety) Regulations), Electrical installations (known as the Australian/New Zealand Wiring Rules)
- AS/NZS 4641:2018, Electrical apparatus for detection of oxygen and other gases and vapours at toxic levels – General requirements and test methods
- AS/NZS 4761.1 (version as cited in the Electricity (Safety) Regulations), Competencies for working with electrical equipment for 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
- AS/NZS 60079.29.1:2017, Explosive atmospheres – Part 29.1: Gas detectors - Performance requirements of detectors for flammable gases
- AS/NZS 60079.29.2 (version as cited in the Electricity (Safety) Regulations), Explosive atmospheres – Gas detectors - Selection, installation, use and *maintenance of detectors for flammable gases and oxygen*
- Electricity Act 1992
- Electricity (Safety) Regulations 2010
- *Workplace Exposure Standards and Biological Exposure Indices Edition 13*, available from WorkSafe New Zealand [www.worksafe.govt.nz](http://www.worksafe.govt.nz), and associated regulations

and their subsequent amendments and replacements.

- 4 It is necessary for users of fixed gas detection apparatus to be competent with portable gas detectors as well. Additional underpinning knowledge for people working with, or intending to work with, fixed gas detection apparatus is covered in unit standard 26742, *Demonstrate underpinning knowledge of permanently-installed gas detection apparatus in explosive atmospheres*.
- 5 Definitions
- Catalytic sensor* – a widely used type of sensor for detection of flammable (explosive) gases and vapours up to their LEL.
- 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.
- Electrochemical sensor* – a type of sensor containing electrodes and an electrolyte. Different varieties can detect oxygen deficiency and a range of toxic gases.
- 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.
- Ex i* – intrinsic safety; with levels of protection Ex ia, Ex ib, and Ex ic.

*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.

*Explosive range* – the range of concentrations in air of a gas or vapour, between its LEL and UEL, where an explosive atmosphere occurs.

*Infrared sensor (IR, NDIR)* – a general purpose sensor that can be made highly selective; e.g to CO<sub>2</sub>.

*Integrity of explosion-protected apparatus* – the condition of being unified, complete or sound in construction of the apparatus design and use that ensures explosion-protection, for example, the structural integrity of the apparatus.

*LEL* – lower explosive limit – the concentration of flammable gas, vapour, or dust in air below which, an explosive atmosphere will not be formed.

*PID* – photo ionisation detector – a high sensitivity detection device.

*Safe and sound practice* – as it relates to the installation of electrical equipment is defined in AS/NZS 3000.

*Electrical Installations* (known as the Australian/New Zealand Wiring Rules).

*Semi-conductor sensor* – a simple sensor suitable for detecting changes in the atmosphere, such as location of gas leaks.

*Temperature class* – classification system of electrical apparatus, 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.

*Zone* – classification of explosive atmosphere areas based on the likelihood (duration and/or frequency) of an explosive atmosphere. For gases and vapours Zone 0 is the most severe with Zones 1 and 2 progressively less severe. Similarly there are Zones 20, 21 and 22 for dusts. Different explosion-protection techniques are applicable to different zones.

- 6 Assessment is to take account of variations between the industry sectors and enterprises. For example, equipment used in dust-explosive atmospheres 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.

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## Outcomes and performance criteria

### Outcome 1

Demonstrate knowledge of explosive atmospheres and explosion-protection principles.

#### Performance criteria

- 1.1 Explain 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 and relate them to activities and the environment.
- 1.3 Describe explosive parameters of substances, as given in tables of substance characteristics, in terms of the properties of combustible materials.
- Range materials – gases, vapours from liquids, dusts;  
properties – 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 standard definitions of explosive atmospheres, explosive atmosphere, 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.
- 1.6 Describe methods of achieving explosion-protection in terms of energy limitation, exclusion, containment, dilution, and elimination of ignition source.
- Range Ex i, other principal methods.
- 1.7 Describe the behaviour of gas and vapour releases.
- Range mechanism and rate of release; gas and vapour density; effects of temperature, pressure, and dilution.

### Outcome 2

Demonstrate and apply knowledge of the principles of gas detection and the use and care of portable gas detection devices.

**Performance criteria**

- 2.1 Explain fundamental principles for the use of gas and vapour detection instruments.
- 2.2 Describe the use of manufacturers' instruction manuals.
- Range operating instructions, adjustment procedures, operational limitations, accessories, storage.
- 2.3 Explain calibration and response checking of gas and vapour detection instruments.
- 2.4 Describe and demonstrate sampling and/or testing techniques with respect to environmental variables.
- Range differences between gas and vapour sampling, density effects, temperature effects, frequency and validity of testing, likely release sites, propagation.
- 2.5 Explain the likelihood of toxic substances being present, the possible effects of toxic substances on the testing personnel, and measures to follow to prevent harm or injury.

**Outcome 3**

Demonstrate knowledge of the factors to consider in the evaluation and selection of portable gas detection equipment.

**Performance criteria**

- 3.1 Describe the requirements for gas detection for a given situation in terms of sources for obtaining data on physical chemistry of the gas to be detected and the conditions under which the gas may be present.
- 3.2 Describe the principle of the processes used to assess the specifications of gas detection equipment against established requirements with respect to a typical manufacturers' specification or data sheet.
- Range sensor technology in terms of expected compounds; required sensitivity, possible technology limitations in terms of expected compound concentration; required integrity of explosion-protected equipment in terms of expected compounds, equipment group, and temperature class; required integrity of explosion-protected equipment in terms of zone of operation.

**Outcome 4**

Demonstrate knowledge of basic properties, behaviour, and detection of gases and vapours.

**Performance criteria**

- 4.1 Describe the detection of gases and vapours in terms of equipment capability.
- Range gases to be detected, gases not to be detected, intended application, environmental effects.
- 4.2 Describe safety requirements that must be observed for personnel who could be present when flammable gases are being monitored.
- 4.3 Describe gas propagation characteristics.
- Range release of gas and vapours, ventilation, density, temperature, location.
- 4.4 Describe the common properties of gases and vapours.
- Range density of gases, vapours and their mixtures; effect of temperature on density; toxicity, LEL, and UEL of combustible compounds.
- 4.5 Describe the differences between the detection of gases and the detection vapours.
- Range behaviour of gases compared with evaporation of liquids and condensation of vapours at different temperatures and pressures, and the effects of these on propagation, calibration, sampling and validity of readings.
- 4.6 Describe oxygen deficiency and its impact on safety to personnel.
- Range chemical reaction of oxygen with a substance, resulting in a solid product; chemical reaction of oxygen with a substance, resulting in gaseous products; dilution of the air by displacement, by some other gas or vapour.
- 4.7 Describe measuring principles used by catalytic sensors, electrochemical sensors, infrared sensors, PID, and semi-conductor sensors in accordance with AS/NZS 60079.29.1 and AS/NZS 60079.29.2.
- Range common applications, limitations and safety interferences of other gases with the measurement, sensor poisoning.

**Outcome 5**

Demonstrate knowledge of fixed gas detection equipment.

**Performance criteria**

- 5.1 Explain the positioning of fixed sample points or sensors in terms of the ideal locations and most practical locations.
- Range compromise between gas/vapour propagation, coverage of site, speed of response, access for maintenance and calibration, protection against environment and mechanical damage, purpose of alarms.
- 5.2 Describe the use of manufacturers' instruction manuals.
- Range operating instructions, adjustment procedures, operational limitations, storage.
- 5.3 Identify common problems associated with fixed gas detection equipment.
- Range includes but is not limited to – contamination, poisoning, saturation, inadequate maintenance.
- 5.4 Outline the need and procedures for maintenance and calibration of fixed gas detection equipment.
- 5.5 Describe the need and procedures for integrity and response checking of fixed gas detection equipment.
- 5.6 Outline requirements for gas detection for a given situation in terms of sources for obtaining data on the physical chemistry of the gas or vapour to be detected and the conditions under which the gas or vapour may be present.
- 5.7 Describe the integrity and safety of gas and vapour sampling equipment.
- Range redundancy, integrity of power supply, planned maintenance.

**Outcome 6**

Demonstrate knowledge of the instructions to be given to non-technical people in the use of portable gas detection devices in specific applications or environments.

**Performance criteria**

- 6.1 Describe the instructions to be given to non-technical people relating to the limitations of flammable gas detection equipment.
- Range their ability to detect gases and vapours that are present in the vicinity of the detector or in the line of sight of portable open path equipment, and their inability to detect combustible liquids, combustible mists, dusts, or fibres.

6.2 Describe the instructions to be given to non-technical people relating to interpretation of gas detection instrument readings or behaviour.

Range upscale reading in the presence of a gas for which an instrument is not calibrated, causes of erratic indications, reading of low concentrations of gas of interest, off-scale readings, the 'read and run' technique.

6.3 Describe the instructions to be given to non-technical people relating to toxicity level of flammable gases and vapours and their potential for occurring in a given situation.

6.4 Describe the instructions to be given to non-technical people relating to issues with gas and vapour detection in confined spaces.

6.5 Describe the instructions to be given to non-technical people relating to use of manufacturers' instruction manual.

Range operating instructions, adjustment procedures, operational limitations, storage.

<b>Planned review date</b>	31 December 2027
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#### Status information and last date for assessment for superseded versions

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

<b>Consent and Moderation Requirements (CMR) reference</b>	0003
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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](mailto:qualifications@WaihangaAraRau.nz) if you wish to suggest changes to the content of this unit standard.