IECEx OD 504

Edition 1.0 2009-09

IECEx OPERATIONAL DOCUMENT

IEC System for Certification to Standards relating to Equipment for use in Explosive Atmospheres (IECEx System)

IECEx Scheme for Certification of Personnel Competencies for Explosive Atmospheres –

Specification for Units of Competency Assessment Outcomes

IECEx OD 504:2009(E)

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

IECEx OD 504

Edition 1.0 2009-09

IECEx OPERATIONAL DOCUMENT

IEC System for Certification to Standards relating to Equipment for use in Explosive Atmospheres (IECEx System)

IECEx Scheme for Certification of Personnel Competencies for Explosive Atmospheres –

Specification for Units of Competency Assessment Outcomes

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

IECEx Operational Document 504 –

IECEx Scheme for Certification of Personnel Competencies for Explosive Atmospheres –

Specification for Units of Competency Assessment Outcomes

This Operational Document, OD 504 sets out the requirements for Competencies for working with electrical equipment for explosive atmospheres according to IEC Standards. It's purpose is to support certification where competency is required, e.g. Repair and Overhaul Service Facilities, and may be considered for Certification of Persons undertaking the work in various aspects of explosive atmospheres where it may be advantageous to be certified.

Document History

Date	Summary
October 2009	Original issue (Edition 1.0)

Address:

IECEx Secretariat
286 Sussex Street
Sydney NSW 2000
Australia

Contact Details:

Tel: +61 2 8206 6940
Fax: +61 2 8206 6272
e-mail: chris.agius@iecex.com
http://www.iecex.com

INTRODUCTION

The objective of this IECEx Operational Document is to set out the generic cross-industry competencies needed for work associated with electrical equipment for hazardous areas; these competencies are intended for use by any industry sector or enterprise with regards to explosion-protection related to the relevant functional areas.

The procedures, systems and methods of assessment as set out in this document are to be followed in assessing an application for competencies for carrying out work associated with Explosive Atmospheres and of Ex equipment.

Competency of personnel working in explosive atmospheres is necessary; the potential for accidents in Ex areas is increased if personnel are not adequately trained. The need for competency is included in many legal documents (legislation), but is often not clearly defined. Competency includes the ability to carry out specific tasks versus prescribed general requirements specified in regulations and installation procedures.

Competence depends on knowledge, skill, experience and training. Measurement of competency is a difficult task and requires specific assessment methods. Competency evolves with years and may deteriorate, so continued training and assessment is necessary.

This document sets out the specification for the IECEx Units of Competency, according to the application of IEC Standards and includes the content of the required knowledge in relationship with the tasks carried out in explosive atmospheres. Also included are requirements for competency evaluation.

FOREWORD

The development of Competency Standards for electrical equipment for explosive atmospheres is necessary due to the concern with the variability in skills of electrical workers and others dealing with this equipment. Although training has been available, it was usually confined to the technical aspects and there is generally no strategy to provide this specific assessment of competency.

The concern over competence is heightened by the trend away from prescriptive regulations towards performance-based regulations. The performance-based approach places the ‘duty of care’ responsibilities on enterprises and individuals, which, in turn, is said to promote self-monitored quality assurance. This results in greater compliance with requirements than is the case with the inspectoral methods that accompany prescriptive regulations.

Since the early 1990s industries have expressed the need for an internationally structured qualification system for identification of Competency to be used by any industry sector or enterprise, with regards to explosion-protected equipment for explosive atmospheres.

Specification for Units of Competency Assessment Outcomes

1 Scope and general

This document specifies the competencies required for work associated with electrical equipment for explosive atmospheres (commonly termed 'Ex' equipment) and the standards to which competency is to be assessed and attributed. It provides guidance to assessing competency based on the knowledge and skills that define the Units of Competency.

The competencies specified in this specification are intended as additional competencies to those previously acquired for the specific type of work in non-explosive atmospheres.

NOTE Annex A summarizes the specific prerequisite Units and recommended general competencies to achieve Units of Competency in this specification.

The principal application of this specification is to personnel dealing with explosion-protected and associated equipment for explosive atmospheres, covering the following work functions:

a) Classification of Hazardous Areas.

b) Producing, processing or servicing functions in a hazardous area and not directly involved in installing, maintaining or repairing explosion-protected equipment and systems.

c) Installing and maintaining explosion-protected equipment and systems in the hazardous area.

d) Overhauling, repairing and modifying explosion-protected equipment.

e) Developing/designing and maintaining explosion-protection strategies.

f) Inspecting hazardous area equipment, systems and installations.

The specification sets the minimum requirements for Certifying Bodies who issue certificates for the competencies described in this specification. However, this specification may also be referenced by:

i) bodies certifying overhaul and repair workshops; and

ii) enterprises in establishing the competency of their personnel.

NOTE A single unit of competency is not to be confused with a job description, which will invariably comprise a number of units.

2 Normative references

The following publications contain provisions, which, through reference in this text, constitute provisions of this Operational Document. At the time of publication, the editions indicated were valid. The Ex Management Committee shall decide the timetable for the introduction of revised editions of the publications..

IEC 60079 Series, *Equipment for explosive atmospheres*

IEC 60050-426, *International Electrotechnical Vocabulary – Part 426: Equipment for explosive atmospheres*

IEC 61241, *Electrical apparatus for use in the presence of combustible dust*

ISO/IEC 17024, *Conformity Assessment – General requirements for bodies operating certification of persons*

3 Terms and definitions

For the purposes of this document, the definitions from 3.1 to 3.48 and explanatory information applies.

For the definitions of any other terms, particularly those of a more general nature, reference should be made to IEC 60050(426) or other appropriate parts of the IEV (International Electrotechnical Vocabulary).

3.1
Actions to limit risk of an explosion
organizational arrangements for rectifying defects, shutting down plant or machinery under emergency conditions, evacuating a hazardous area, reporting defects and conditions of plant and machinery, monitoring the hazardous area for presence of an explosive atmosphere and meeting Occupational Health & Safety (OH&S) obligations

3.2
Appropriate personnel
the person who is the recipient of the output provided by a Competent person

NOTE Examples of appropriate personnel are Site Managers, Project Managers, Line Managers, Maintenance managers, Supervisors and Team Leaders etc..

3.3
Approved, approval
with the approval of, acceptable to the authority having jurisdiction

3.4
Assessment of competence
the process of checking and confirming the ability to carry out specific work activities and/or functions based on evidence that shows a person can carry out such work safely and to stated requirements

3.5
Authority, regulatory
a government agency responsible for relevant legislation and its application

3.6
Certification
procedure by which a third party gives written assurance that a product, process or service conforms to specified requirements

3.7
Classification of explosive atmospheres
a method of analysing and classifying the environment where an explosive atmosphere may occur to allow the proper selection of equipment, particularly electrical equipment, to be installed and used safely in that environment

3.8
Competency
the acquired specific knowledge and skills and the application of that knowledge and skill to the standards of performance required in the workplace

NOTE The concept of competency focuses on what is expected of an employee in the workplace rather than on the learning process, and embodies the ability to transfer and apply skills and knowledge to new situations and environments.

3.9
Competent person
a person who can demonstrate a combination of knowledge and skills to effectively, efficiently and safely carry out activities in explosive atmospheres, covered by this specification

NOTE Competency in some cases may be limited according to scope limitations.

3.10
Competency, Unit of
a Unit of Competency is the competency required for a useful work function and which resides with an individual

3.11
Defects
visual damage or corrosion of the explosion-protection aspect of the installation or apparatus

3.12
Equipment marking
information with regards to certification that is required to be marked on each item of equipment incorporating an explosion-protection technique

3.13
Established procedures
formal arrangements of an organization, enterprise or statutory authority of how work is to be done and by whom

NOTE Examples of established procedures are documented in quality management systems, safety management systems, work clearance systems, work instructions, reporting systems and arrangements for dealing with emergencies.

3.14
Explosion properties of hazardous materials
there are two sets of properties:
a) for gases, vapours, flammable liquids and mists: vapour pressure; boiling point; flashpoint; ignition temperature; explosive limits; relative vapour density; minimum ignition energy
b) for dusts: layer ignition temperature; cloud ignition temperature; minimum ignition energy

NOTE 1 Explosive limits (lower/LEL and upper/UEL) and flammability limits (lower/LFL and upper/UFL) are deemed to be synonymous. It should be recognized that some particular authorities having jurisdiction may have overriding requirements that dictate the use of one of these sets of terms and not the other.

NOTE 2 Explosion severity is another relevant property for dusts.

3.15
Explosion-protected equipment
equipment to which specific measures are applied to avoid ignition of a surrounding explosive atmosphere

NOTE The word ‘equipment’ includes ‘apparatus‘, as mentioned in many relevant Standards.

3.16
Explosion-protection techniques
techniques applied to the design of electrical equipment, components and systems to prevent the electrical energy from becoming an ignition source in the presence of flammable vapours and gases or combustible dusts in explosive atmospheres

NOTE Some of these techniques and also alternative techniques may be applied to the design of non-electrical equipment for the avoidance of non-electrical ignition sources. These techniques are not yet standardised at international level and are currently outside the scope of this document.

3.17
Group (of equipment for explosive atmospheres)
classification of electrical equipment related to the explosive atmosphere for which it is to be used

NOTE 1 Equipment for use in explosive gas atmospheres is divided into two groups:
– Group I: Equipment for mines susceptible to firedamp; and
– Group II (which can be divided into subgroups IIA, IIB, IIC): Equipment for places with an explosive gas atmosphere, other than mines susceptible to firedamp.

NOTE 2 This has also been known as ‘gas grouping’.

NOTE 3 Explosive dusts atmospheres will be designated as Group III in the future .

3.18
Hazard and risk assessment
any recognized methodology of identifying hazards and assessing risks such as ‘hazard and operability study’ (HAZOP) and ‘fault tree analysis’ (HAZAN)

3.19
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 electrical equipment

NOTE Explosive atmospheres may include a variety of adverse environmental conditions such as those encountered in coal mines, shipping, oil/gas platforms and the like, which commonly require further specifications stated in legislation or regulatory requirements.

3.20
Hazardous materials
in the context of this specification hazardous materials are flammable gases and vapours and combustible dusts

NOTE All vapours of flammable liquids are flammable vapours.

3.21
Inspection, close
an inspection which encompasses those aspects covered by a visual inspection and, in addition, identifies those defects, such as loose bolts, which will be apparent only by the use of access equipment, such as steps (where necessary) and tools. Close inspections do not normally require the enclosure to be opened or the equipment to be de-energized

3.22
Inspection, detailed
an inspection which encompasses those aspects covered by a close inspection and, in addition, identifies those defects, such as loose terminations, which will only be apparent by opening the enclosure, and using (where necessary) tools and test equipment

3.23
Inspection, initial
an inspection of all electrical equipment, systems and installations before they are brought into service

3.24
Inspection, periodic
an inspection of all electrical equipment, systems and installations carried out on routine basis

3.25
Inspection, sample
an inspection of a proportion of the electrical equipment, systems and installations

3.26
Inspection, schedule
a formal arrangement for conducting inspections which details the extent, grade and frequency of the inspections and the explosion-protected characteristics and compliances to be checked

3.27
Inspection, visual
an inspection which identifies, without the use of access equipment or tools, those defects, such as missing bolts, which will be apparent to the eye

3.28
Inspector, actions taken by an
actions taken by an inspector in relation to defects, non-conformities, faults in a hazardous area installation

NOTE Examples of such actions are: disconnection or non-connection of supply until a defect or fault or non-conformity is rectified, notice of period in which it has to be rectified, other actions within the scope of statutory regulations.

3.29
Installation
in the context of this specification an installation includes explosion-protected equipment, wiring and other required items as they are fixed in place and connected as necessary, to operate as intended

3.30
Integrity (of explosion-protected equipment)
aspects of the equipment design and use that afford explosion-protection

3.31
Non-conformance
equipment that does not satisfy the applicable Standards or requirements

3.32
OH&S (Occupational Health and Safety) policies and procedures
arrangements of an organization or enterprise to meet its legal and ethical obligations of ensuring the workplace is safe and without risk to health

NOTE Ensuring a workplace is safe will include hazard identification and risk assessment mechanisms, implementation of safety regulations, safety training, safety systems incorporating work clearance procedures, isolation procedures, use of protective equipment and clothing and use of codes of practice.

3.33
Other items
items that are not in themselves explosion-protected but have an influence on the integrity of the explosion-protection technique used. For example, an overload device for a motor or associated equipment in the case of the increased safety technique Ex ‘e’

3.34
Pre-commission testing
tests specified, such as, performance and setting of protection devices and systems, earth loop impedance, insulation resistance, and earth continuity equipment connection and operation tests at no load

3.35
Process specialist personnel
responsible persons with expertise in the technical aspects that relate to explosive hazards and include chemical engineers, process engineers, mining engineers, safety managers, and the like

3.36
Re-certification/ Supplementary approval
submission of previously certified/approved equipment to accredited certifying body or authority, to determine whether the equipment complies with the relevant Standards after modification or where original certification/approval is not fully known

3.37
Requirements
those to which equipment and procedures and their outcomes shall conform and include statutory obligations and regulations and Standards called-up by legislation or regulations

NOTE Requirements may include codes of practice, job specifications, Standards called up in specifications, procedures and work instructions and quality management systems.

3.38
Scope Limitation
where an individual demonstrates competence relevant to a Unit of Competency for specific aspect that may relate to the Type of Protection, Product Types, Groups, Voltages etc. A scope limitation of a Unit of Competency is shown in the scope of the certificate

NOTE The available scope limitations are given in OD 502.

3.39
Servicing
maintaining, fault finding and repair of equipment, plant machinery and installations

3.40
Special tools, equipment and testing devices
tools for the removal of enclosure covers and connecting conductors, measuring devices such as feeler gauges and micrometer, gas and vapour sensors, electrical testing devices approved for use in a particular hazardous area

3.41
Specifications
all those attributes that define accurately the nature of the involved hazards, materials/products, processes, equipment and installation design

NOTE Examples of specifications are design and manufacturer's specifications defining all the necessary parameters and tolerances, process flow diagrams, explosive characteristics and technical data sheets for hazardous materials and products, and the like.

3.42
Standards
technical documents which set out specifications and other criteria for equipment, materials and methods, to ensure they consistently perform as intended. The Standards referred to in this specification are those published by International Electrotechnical Commission

3.43
Temperature classification
system of classification by which electrical equipment is allocated one of six temperature classes according to its maximum surface temperature

3.44
Verification dossier
a set of documents showing the compliance of electrical equipment and installations

NOTE The information in a ‘Verification Dossier’ is subject to audit under a formal inspection process.

3.45
Wiring system
permitted wiring and accessories for power, measurement, control or communications purposes

3.46
Zones, hazardous
the zones into which explosive atmospheres are classified based upon the frequency of the appearance and duration of an explosive atmosphere

3.47
Zones in explosive gas atmospheres
see IEC 60079-10-1 for the definitions of Zones 0, 1 and 2

3.48
Zones in explosive dusts atmospheres
see IEC 61241-10 for the definitions of Zones 20, 21 and 22

4 Units of competency

4.1 Scope

This Section describes the Units of Competency for working with electrical equipment for explosive atmospheres and to ensure the risk of any explosion hazard in such areas has been minimized. The specific Units of Competency are described in detail in Clauses 4.2 to 4.11 and a list of such Units is shown in Table 4.1.

Table 4.1 – List of units of competency

Reference Title	Scope limitation [a)]
Unit Ex 001 – Apply basic principles of protection in explosive atmospheres	Not applicable
Unit Ex 002 – Perform classification of hazardous areas	3
Unit Ex 003 – Install explosion-protected equipment and wiring systems	1, 2, 3, 4
Unit Ex 004 – Maintain equipment in explosive atmospheres	1, 2, 4
Unit Ex 005 – Overhaul and repair of explosion-protected equipment	1, 2, 4
Unit Ex 006 – Test electrical installations in or associated with explosive atmospheres	3, 4
Unit Ex 007– Perform visual & close inspection of electrical installations in or associated with explosive atmospheres	3, 4
Unit Ex 008 – Perform detailed inspection of electrical installations in or associated with explosive atmospheres	3, 4
Unit Ex 009 – Design electrical installations in or associated with explosive atmospheres	3, 4
Unit Ex 010 – Perform audit inspection of electrical installations in or associated with explosive atmospheres	3, 4

[a)] Limitation by:
1. Explosion-protection technique or
2. Product Type
3. Group
4. Voltage

4.2 Unit Ex 001 – Apply basic principles of protection in explosive atmospheres

4.2.1 Scope

This Unit of Competency covers the explosion-protection aspects of plant and machinery operation or maintenance. It requires the ability to visually identify any damage or deterioration of explosion-protected equipment, monitor equipment and plant in relation to changes in the explosion hazard and to follow procedures to limit the risk of an explosion.

This unit of competency is based on various parts of IEC 60079 series and any other relevant ISO/IEC standards that apply to this Unit of Competency.

4.2.2 Prerequisites

There is no minimum level of technical education applicable for this unit of Competency.

Competence in this unit shall be assessed in combination with, or after the gaining of, other competencies required by a given industry or enterprise for plant or machinery operation or installations, maintenance or service functions. (see Annex A).

NOTE Annex A sets out the specific prerequisite Units and the recommended general competencies and level assumed to be held by a person before undertaking training/assessment to achieve a Unit of Competency.

4.2.3 Elements and performance criteria

Elements		Performance criteria		Critical aspects of evidence
1.1	Prepare to work in hazardous area	1.1.1	Nature of the explosion hazard in the area and risks are known and the status of the explosion hazard is ascertained through established procedures.	Following work permits and clearance procedures.
		1.1.2	Operation and condition of plant and machinery, with regards to explosion-protection, is ascertained through established procedures.	Following work permits and clearance procedure. Correctly operating plant and machinery.
		1.1.3	Established procedures for use of the plant and machinery, with regards to explosion-protection techniques used in the area, are followed.	Correctly operating plant and machinery.
1.2	Observe condition of explosion-protection system area	1.2.1	OH&S policies and procedures, with regards to explosion-protection, are followed.	Following work permits and clearance procedures.
		1.2.2	Performance of plant and machinery is monitored to identify faults that may affect the integrity of the explosion-protected equipment and wiring system.	Monitoring hazards and following evacuation procedures.
		1.2.3	Observations of explosion-protected equipment and wiring are made during normal operations and visual and audible non-conformances that may affect the integrity of the explosion-protection technique are identified.	Identifying visual damage or deterioration of explosion-protected equipment.
		1.2.4	Explosion hazard monitoring equipment is observed and a dangerous state of the hazard is identified (e.g. by using gas detectors).	Monitoring hazards and following evacuation procedures.
1.3	Take actions to limit risk of an explosion	1.3.1	Variations outside normal operating conditions are reported and documented in accordance with established procedures.	
		1.3.2	Established procedures are followed in the event of a potential or immediate hazardous condition arising from any non-conformance identified in equipment/wiring or changes in the explosion hazard to a dangerous state.	Following plant and electrical isolation procedures.

4.2.4 Scope Limitations

Competency shall be demonstrated in relation to any classified hazardous area. Any scope limitations shall be included in the application according to OD 502.

4.2.5 Evidence guide – Critical aspects of evidence

Evidence of competency in this unit shall show:

a) proficient performance associated with each element of competence by employing the techniques, procedures, information and resources available in the workplace according to Table in 4.2.3.

b) an understanding of the knowledge and associated skills essential to performance as given in 4.2.5.1 to 4.2.5.4.

c) practical application of the knowledge and skills essential to performance as given in 4.2.5.5 to 4.2.5.6.

4.2.5.1 Explosive atmospheres and explosion-protection principles

Evidence shall show an understanding of explosive atmospheres and explosion-protection principles to an extent indicated by:

a) Properties of combustible substances and their potential to create an explosive hazard encompassing:
   i) condition in the workplace that will lead to an explosion;
   ii) the terms ‘combustion’, ‘ignition’ and ‘propagation’;
   iii) explosive range of substances encountered in the workplace i.e. LEL/UEL;
   iv) explosive parameters of substances as given in tables of substance characteristics, i.e., properties of combustible materials – gases, vapours (from liquids), and Dusts; such as flash point;
   v) the difference between gases and vapours; and
   vi) the toxic nature of gases and vapours and potential harmful consequences.

b) The nature of explosive atmospheres encompassing:
   i) the Standards definition of a ‘hazardous area’;
   ii) the recommended methods for classifying the type and degree of explosion hazard in an area;
   iii) hazardous area classifications as defined by Standards; and
   iv) factors that are considered when a hazardous area is classified.

c) The basics of how explosion-protection is achieved by the methods of exclusion, containment, energy limitation, dilution, avoidance of ignition source.

d) Occupational Health and Safety responsibilities related to explosive atmospheres encompassing:
   i) the main features and purpose of a ‘clearance to work’ system (includes hot work permit system);
   ii) typical safety procedures that should be followed before entering a hazardous area;
   iii) the purpose of gas detectors and their limitations;
   iv) effects of temperature on gas and vapour detection;
   v) frequency of monitoring for presence of gas or vapours, i.e. effects of temperature rise;
   vi) factors affecting the accuracy of gas detectors, for example, contamination, condensation, temperature;
   vii) safety in use of gas detectors, for example, ‘read and run concept’; and
   viii) the safety precautions to be taken when working in a hazardous area.

e) The roles of the parties involved in the safety of explosive atmospheres encompassing:
   i) Regulations related to the safety of explosive atmospheres and the Authorities responsible for their implementation;
   ii) where assistance and further information can be obtained to assist persons with hazardous area responsibilities, for example, Standard bodies, experienced consultants; and

iii) the hazardous area responsibilities of:
   a) the owner of premises in which a hazardous area exists;
   b) the occupier of premises in which a hazardous area exists;
   c) enterprises and personnel engaged in installation and/or maintenance of explosion-protection systems;
   d) enterprises and personnel engaged in the classification of explosive atmospheres and/or design of explosion-protection systems;
   e) enterprises and personnel engaged in the overhaul, modification and/or assessment of explosion-protected equipment;
   f) enterprises and personnel engaged in the inspection of explosion-protection installations;
   g) manufacturers of explosion-protected equipment;
   h) designated authorities;
   i) insurers.

4.2.5.2 Explosion-protected equipment – Ex certification schemes

Evidence shall show an understanding of Ex certification schemes to accepted standards to an extent indicated by:

a) Purpose and scope of certification schemes.
b) Certification Schemes commonly used internationally.
c) Processes for having equipment certified under the acceptable Ex schemes encompassing:
   i) scheme procedures;
   ii) quality management requirements;
   iii) conformance testing and assessment; and
   iv) requirements for ongoing certification.

4.2.5.3 Explosion-protected equipment – Principles

Evidence shall show an understanding of the principles of the following explosion-protection techniques: Flameproof (Ex ‘d’); Increased safety (Ex ‘e’); type of protection ‘n’ (Ex ‘n’); Intrinsic safety (Ex ‘i’); Encapsulation (Ex ‘m’); Oil immersion (Ex ‘o’); Pressurization (Ex ‘p’); Powder filled (Ex ‘q’) for gas atmospheres and Protection by enclosures-Dusts (Ex ‘tD’ or Ex ‘t’); Pressurization-Dusts (Ex ‘pD’); Encapsulation-Dusts (Ex ‘mD’); and Intrinsic safety-Dusts (Ex ‘iD’). The following aspects indicate the extent of understanding required:

a) The principles of each explosion-protection technique, the methods used and how each technique works.
b) How explosion-protected equipment is identified by the ‘Ex’ symbol marked on the equipment, including old equipment and equipment certified in another country.
c) Visible conditions or actions that would void the explosion-protection provided by a particular technique.

4.2.5.4 Explosion-protection visual checks

Evidence shall show an understanding of visible conditions of explosion-protection equipment that indicate the protection is void and changes in the nature of the explosion hazard that may render the explosion-protection unsafe. The following aspects indicate the extent of understanding required.

a) Occupational, health and safety procedures encompassing:
   i) occupational, health and safety procedures to be followed before entering explosive atmospheres; and
   ii) occupational, health and safety procedures to be followed while conducting close inspection.

b) Visible defects in explosion-protected equipment and wiring.

c) Conditions that may indicate a change in a given explosion hazard.

d) Reporting defects in explosion-protected equipment and wiring encompassing:

   i) the purpose of a verification dossier; and

   ii) various ways for reporting defects in explosion-protected equipment and wiring.

e) Procedures to be followed in the event of a change in the explosion hazard.

4.2.5.5 Hazardous area management work performance

In assessing competent hazardous area management work performance evidence regarding the following aspects of competency shall be considered:

a) Application of relevant statutory requirements.

b) Establishing or understanding procedures for engaging competent persons.

c) Establishing or understanding and maintaining procedures for identifying potentially explosive hazards.

d) Establishing procedures for implementing and maintaining explosion-protection strategies.

4.2.5.6 Hazardous area operations reporting work performance

In assessing competent hazardous area operations reporting work performance evidence regarding the following aspects of competency shall be considered:

a) Permits and clearance.

b) Hazard monitoring and evacuation procedures.

c) Operation of plant and machinery.

d) Plant and electrical isolation.

e) Identifying visual damage and corrosion of equipment and wiring systems.

f) Reporting defects.

4.3 Unit Ex 002 – Perform classification of hazardous areas

4.3.1 Scope

This Unit of Competency covers knowledge and skills to classify areas where explosive materials may exist. It requires the ability to gather and analyse data relative to explosion hazards, determine the extent of risk and establish and document zones.

This unit of competency is based on IEC 60079-10-1 and IEC 61241-10 and any other relevant standard that apply to this Unit of Competency.

4.3.2 Prerequisites

Competency in this unit is likely to require a degree or diploma or equivalent.

The area classification should be carried out by those who understand the relevance and significance of properties of flammable materials and those who are familiar with the process and the equipment along with safety, electrical, mechanical and other qualified engineering personnel.

Competencies in gathering and analysing technical data and using this data for risk assessment. (see Annex A).

4.3.3 Elements and performance criteria

Elements		Performance criteria		Critical aspects of evidence
2.1	Determine the type and extent of explosion hazard	2.1.1	Functions and process equipment in the area are determined and hazardous materials identified from specifications, hazard and risk and/or written consultation with process specialist personnel.	Accessing necessary information and identifying hazardous products involved in a given process, explosive properties of materials involved in a given process, and potential sources and characteristics of release of hazardous products.
		2.1.2	Explosion and physical properties of hazardous materials are listed, together with the title of the authority from which the data is obtained.	
		2.1.3	Gas groupings and temperature class of flammable gases, vapours and/or dusts that may be present in the area are established from collected data.	
		2.1.4	Potential sources of release and/or dusts layering are identified from specifications, and/or written consultation with process specialist personnel.	Analysing data in the context of explosion risk.
2.2	Establish the type and extent of zones	2.2.1	Zones are determined by similarity to examples in Standards or from first principles.	Determining area delineation and documenting area classifications.
		2.2.2	Where first principles are used, grades, sources and magnitude of release and dusts layering are established from specifications and diagrams and reviewed with process specialist personnel.	
2.3	Document classification and delineation of zones	2.3.1	Area classification documentation is completed in accordance with requirements and submitted to appropriate personnel.	
		2.3.2	Classification documentation records are filed for future reference and for incorporation in the verification dossier.	

4.3.4 Scope Limitations

Competency shall be demonstrated in relation to any hazardous areas in which the classification cannot be directly identified by common situations or specific examples. Any scope limitations shall be included in the application according to OD 502.

4.3.5 Evidence guide – Critical aspects of evidence

Evidence of competency in this unit shall show:

a) Competent performance associated with each element of competence by employing the techniques, procedures, information and resources available in the workplace and encompassing the aspects for which competency is sought according to Table in 4.3.3.

b) An understanding of the knowledge and associated skills essential to performance as given in 4.3.5.1 to 4.3.5.2.

c) A practical application of the knowledge and skills essential to performance as given in 4.3.5.3.

4.3.5.1 Explosive atmospheres and explosion-protection principles

Evidence shall show an understanding of explosive atmospheres and explosion-protection principles to an extent indicated by:

a) Properties of combustible substances and their potential to create an explosive hazard encompassing:
   i) condition in the workplace that will lead to an explosion;
   ii) the terms ‘combustion’, ‘ignition’ and ‘propagation’;
   iii) explosive range of substances encountered in the workplace i.e. LEL/UEL;
   iv) explosive parameters of substances as given in tables of substance characteristics, i.e., properties of combustible materials – gases, vapours (from liquids), and dusts; such as flash point;
   v) the difference between gases and vapours; and
   vi) the toxic nature of gases and vapours and potential harmful consequences.
b) The nature of explosive atmospheres encompassing:
   i) the Standards definition of a ‘hazardous area’;
   ii) the recommended methods for classifying the type and degree of explosion hazard in an area;
   iii) hazardous area classifications as defined by Standards; and
   iv) factors that are considered when a hazardous area is classified.
c) The basics of how explosion-protection is achieved by the methods of exclusion, containment, energy limitation, dilution, avoidance of ignition source.
d) Occupational Health and Safety responsibilities related to explosive atmospheres encompassing:
   i) the main features and purpose of a ‘clearance to work’ system (includes hot work permit system);
   ii) typical safety procedures that should be followed before entering a hazardous area;
   iii) the purpose of gas detectors and their limitations;
   iv) effects of temperature on gas and vapour detection;
   v) frequency of monitoring for presence of gas or vapours, i.e. effects of temperature rise;
   vi) factors affecting the accuracy of gas detectors, for example, contamination, condensation, temperature;
   vii) safety in use of gas detectors, for example, ‘read and run concept’;
   viii) the safety precautions to be taken when working in a hazardous area.
e) The roles of the parties involved in the safety of explosive atmospheres encompassing:
   i) Regulations related to the safety of explosive atmospheres and the Authorities responsible for their implementation;
   ii) where assistance and further information can be obtained to assist persons with hazardous area responsibilities, for example, Standard bodies, experienced consultants; and
   iii) the hazardous area responsibilities of the owner of premises in which a hazardous area exists; the occupier of premises in which a hazardous area exists; enterprises and personnel engaged in installation and/or maintenance of explosion-protection systems; enterprises and personnel engaged in the classification of explosive atmospheres and/or design of explosion-protection systems; enterprises and personnel engaged in the overhaul, modification and/or assessment of explosion-protected equipment; enterprises and personnel engaged in the inspection of explosion-protection installations; manufacturers of explosion-protected equipment; designated authorities; insurers.

4.3.5.2 Explosive atmospheres classification techniques

Evidence shall show an understanding of processes involved in gathering and analysing technical data to classify non-specific explosive atmospheres. The following aspects indicate the extent of understanding required:

a) The process of classifying explosive atmospheres encompassing:
   i) methods by which an area can be classified;
   ii) the characteristics/attributes of an area that should be considered in the classification process, for example, type of process, nature of plant, source and nature of release;
   iii) the requirements and Standards for classifying a hazardous area; and
   iv) the responsibilities of the owner/occupiers for classification of a hazardous area.
b) The likelihood (zoning) or risk assessment method of an explosive hazard encompassing:
   i) ignition properties of materials relevant to determining the risk and extent of an explosive hazard;
   ii) sources for obtaining data on ignition properties of materials under the conditions in which they could be present in a given process;
   iii) methods for determining the risk related to explosive atmospheres and the circumstances appropriate to their use, for example, ‘hazard and operability study’ (hazop); ‘fault tree analyses’ (hazan); and
   iv) means for reducing hazard risk.
c) The extent of an explosive hazard and classifying an area accordingly encompassing:
   i) the extent of zones for an area, given data on the explosive hazard risks for that area;
   ii) requirements for documenting the classification of a hazardous area; and
   iii) the extent of the zones, temperature classes and gas groups on site drawings in a hazardous area.

4.3.5.3 Hazardous area classification work performance

In assessing competent hazardous area classification work performance evidence regarding the following aspects of competency shall be considered:

a) Accessing necessary information and identifying hazardous products involved in a given process, explosive properties of materials involved in a given process, and potential sources and characteristics of release of hazardous products.
b) Analysing data in the context of explosion risk.
c) Determining area delineation and documenting area classifications.

4.4 Unit Ex 003 – Install explosion-protected equipment and wiring systems

4.4.1 Scope

This Unit of Competency covers the explosion-protection aspects for installing explosion-protected and associated equipment and wiring systems. It requires the ability to match equipment with that specified for a given location, work safely, and to installation Standards and complete the necessary installation documentation.

This unit of competency is based on IEC 60079-14 and any other relevant standard that apply to this Unit of Competency.

For installation all types of protection must be understood.

4.4.2 Prerequisites

The applicant shall have the level of technical education (or equivalent) attained, relevant to the application, through documents such as College Certificates and Vocational qualifications etc.

A minimum 3 years experience in industrial electrical installation practice is required.

Competence in this unit shall be assessed either concurrently with or after Unit Ex 001 – Apply basic principles of protection in explosive atmospheres.

NOTE This experience can include time spent under general supervision.

4.4.3 Elements and performance criteria

Elements		Performance criteria		Critical aspects of evidence
3.1	Prepare for installation of equipment and wiring	3.1.1	OH&S policies and procedures for preparing to work in a hazardous area are followed.	Working safely in a hazardous area including, the use of work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.
		3.1.2	Types of explosion-protected equipment and wiring systems to be installed are verified from design documents.	Checking equipment against certification documents including conditions of certification relating to the safe use.
		3.1.3	Location in which specific items of equipment and circuits are to be installed is determined from design documents.	Checking equipment against certification documents including conditions of certification relating to the safe use.
		3.1.4	Explosion-protected equipment markings are checked to ensure they conform to design specifications and certification documents.	Checking equipment against certification documents including conditions of certification relating to the safe use.
		3.1.5	Certification document supplied with each item of equipment is collected for forwarding to appropriate personnel.	Documenting installation completion.
		3.1.6	Special tools, equipment and testing devices needed to carry out the installation work are obtained and checked for correct operation and safety.	Working safely in a hazardous area including, the use of work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.
3.2	Install the equipment and wiring systems	3.2.1	OH&S policies and procedures for working in a hazardous area are followed.	Working safely in a hazardous area including, the use of work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.
		3.2.2	Equipment is installed to conform with design specifications, Standards and within the limits specified by the equipment certification.	Handling and installing equipment and wiring in a manner that does not reduce the type of protection afforded by the equipment design. Checking equipment against certification documents including conditions of certification relating to the safe use.

Elements		Performance criteria		Critical aspects of evidence
		3.2.3	Equipment and wiring system components are dismantled where necessary and parts stored to protect them against loss or damage.	Handling and installing equipment and wiring in a manner that does not reduce the type of protection afforded by the equipment design.
		3.2.4	Equipment and wiring are installed in a manner that does not reduce the type of protection afforded by the equipment design.	Handling and installing equipment and wiring in a manner that does not reduce the type of protection afforded by the equipment design.
		3.2.5	Circuits are tested prior to connection to devices to ensure resistance of earthing is sufficiently low, installation resistance is safe, polarity and connections are correct and each circuit complies with requirements.	Testing installed cables/circuits to ensure they are safe.
3.3	Confirm that the installation is completed	3.3.1	Arrangements are made, in accordance with requirements, for an initial inspection to be carried out on the installation.	Documenting installation completion.
		3.3.2	Appropriate action is taken to rectify non-conformances found during the initial inspection to ensure the installation complies with requirements.	Verifying equipment has been installed according to installation design specifications.
		3.3.3	The completed installation is documented in accordance with requirements and forwarded to personnel responsible for compiling the verification dossier.	Documenting installation completion.

4.4.4 Scope Limitations

Competency shall be demonstrated in relation to any classified hazardous area and explosion-protection technique. Any scope limitations shall be included in the application according to OD 502.

4.4.5 Evidence guide – Critical aspects of evidence

In addition to the requirements of 4.2.5 evidence of competency in this unit shall show:

a) Competent performance associated with each element of competence by employing the techniques, procedures, information and resources available in the workplace and encompassing the following aspects for which competency is sought according to Table in 4.4.3.

b) An understanding of the knowledge and associated skills essential to performance as given in 4.4.5.1 to 4.4.5.12.

c) A practical application of the knowledge and skills essential to performance as given in 4.4.5.13.

4.4.5.1 Flameproof (Ex ‘d’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Flameproof (Ex ‘d’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the flameproof (Ex ‘d’) technique.

NOTE Examples of characteristics and design features are flame paths, integrity under pressure, pressure piling, and enclosure entries.

b) Typical situations where the flameproof explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Flameproof technique.

d) The use of Standards in determining the requirements to which the design of the flameproof explosion-protected apparatus shall comply.

4.4.5.2 Increased safety (Ex 'e') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Increased safety (Ex 'e') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Increased safety (Ex 'e') technique.

NOTE Examples of characteristics and design features are temperature rise, maximum power dissipation, protection devices, certified components, creepage and clearance distances, absence of sparking contacts and enclosure entries.

b) Typical situations where the Increased safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Increased safety technique.

d) The use of Standards in determining the requirements to which the design of the Increased safety explosion-protected apparatus shall comply.

4.4.5.3 Non-sparking (Ex 'n') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Non-sparking (Ex 'n') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Non-sparking (Ex 'n') technique.

NOTE Examples of characteristics and design features are creepage and clearance distances and restricted breathing.

b) Typical situations where the Non-sparking explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Non-sparking technique.

d) The use of Standards in determining the requirements to which the design of the Non-sparking explosion-protected apparatus shall comply.

4.4.5.4 Encapsulation (Ex 'm') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Encapsulation (Ex 'm') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Encapsulation (Ex 'm') technique.

NOTE An example of characteristics and design features is solenoid valve.

b) Typical situations where the Encapsulation explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Encapsulation technique.

d) The use of Standards in determining the requirements to which the design of the Encapsulation explosion-protected apparatus shall comply.

4.4.5.5 Oil immersion (Ex 'o') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Oil Immersion (Ex 'o') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Oil Immersion (Ex ‘o’) technique.

NOTE An example of characteristics and design features are transformers.

b) Typical situations where the Oil Immersion explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Oil Immersion technique.

d) The use of Standards in determining the requirements to which the design of the Oil Immersion explosion-protected apparatus shall comply.

4.4.5.6 Powder filled (Ex ‘q’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Powder Filled (Ex ‘q’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Powder Filled (Ex ‘q’) technique.

NOTE An example of characteristics and design features is a capacitor used with a luminaire.

b) Typical situations where the Powder filled explosion-protection technique are used.

c) Actions or conditions that would void the protection provided by the Powder Filled technique.

d) The use of Standards in determining the requirements to which the design of the Powder Filled explosion-protected apparatus shall comply.

4.4.5.7 Intrinsic safety (Ex ‘i’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Intrinsic safety (Ex ‘i’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Intrinsic safety (Ex ‘i’) technique.

NOTE Examples of characteristics and design features are field devices, cables, safe area devices, earthing, entity versus integrated system concept, simple devices and interface devices and their parameters, segregation, infallible components, current and voltage limiting, creepage and clearance distances.

b) Typical situations where the Intrinsic safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by Intrinsic safety.

d) The use of Standards in determining the requirements to which the design of the Intrinsic safety explosion-protected apparatus shall comply.

4.4.5.8 Pressurization (Ex ‘p’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Pressurization (Ex ‘p’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Pressurization (Ex ‘p’) technique.

NOTE Examples of characteristics and design features are exclusion and dilution, purge periods, controlled shut down, monitoring and sources of internal release.

b) Typical situations where the pressurization explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the pressurization technique.

d) The use of Standards in determining the requirements to which the design of the pressurization explosion-protected apparatus shall comply.

4.4.5.9 Dust protection by enclosures (Ex 't') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Enclosures (Ex 't') for Dusts explosion-protection technique. The following aspects indicate the extent of understanding required:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the techniques for dusts.

b) Typical situations where dust explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by protection by enclosure technique.

d) The use of Standards in determining the requirements to which the design of the dust explosion-protected enclosure shall comply.

4.4.5.10 Common characteristics of explosion-protection techniques

Evidence shall show an understanding of the common characteristics of explosion-protection techniques to an extent indicated by:

a) The purposes of 'temperature classification' and 'gas grouping/apparatus grouping'.

b) Equipment markings (nameplate).

c) Limitations of non-metallic or specific alloy enclosures.

d) The purpose and use of conformity and certification/approval for equipment used in explosive atmospheres.

e) Environmental conditions that may impact on explosion-protection techniques.

f) The principles and applications of other and mixed explosion-protection techniques.

NOTE Other techniques include encapsulation Ex 'm'; oil-immersion Ex 'o'; powder-filling Ex 'q' and special protection Ex 's'.

4.4.5.11 Explosive atmospheres installation requirements

Evidence shall show an understanding of hazardous area installation principles and maintenance techniques to an extent indicated by:

a) Preparation to install and maintain explosion-protected equipment in explosive atmospheres encompassing:
   i) OH&S procedures to be followed when working in a hazardous area;
   ii) the significance of information provided on the certification documentation and schedules for a given item of explosion-protected equipment;
   iii) the typical contents of a verification dossier and its purpose; and
   iv) limitations in the use of tools and testing devices in explosive atmospheres.

b) The relationship between explosion-protected equipment, their certification documents and required locations given in specifications and layout drawings and/or written instructions encompassing:
   i) the purpose of markings on the equipment and on the certification documents for a given item of explosion-protected equipment;
   ii) matching explosion-protected equipment with certification documents and the equipment specified for an installation; and
   iii) the location of the items of explosion-protected equipment for an installation from specifications and layout drawings and/or instructions.

c) Installation Standards and requirements applicable to hazardous encompassing:
   i) the wiring systems permitted and not permitted in or above explosive atmospheres;
   ii) equipment not permitted in or above explosive atmospheres;
   iii) the regulations and Standards to which explosion-protected equipment and wiring must be installed in a hazardous area and how these are applied;

iv) cable penetrations through walls; and
v) the documentation required as a record of the installation process, including certification documentation.

4.4.5.12 Explosive atmospheres cable termination techniques

Evidence shall show knowledge and skills in terminating cables suitable for use in explosive atmospheres to an extent indicated by:

a) Selecting compliant cable termination devices.
b) Installing conduit systems, where applicable, including seals to meet hazardous area requirements. Gases only.
c) Terminating a cable with a barrier gland. Gases only.
d) Terminating all types of cables into an enclosure.
e) Testing termination/connections of installed cables/circuits.

NOTE Tests include earth continuity, insulation resistance and polarity.

4.4.5.13 Hazardous area installation work performance

In assessing competent hazardous area installation work performance evidence regarding the following aspects of competency shall be considered:

a) Working safely in a potentially hazardous area in relation to work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.
b) Handling and installing equipment and wiring in a manner that does not adversely affect the type of protection afforded by the equipment design.
c) Checking equipment against certification documents and design specifications.
d) Documenting installation completion.

4.5 Unit Ex 004 – Maintain equipment in explosive atmospheres

4.5.1 Scope

This Unit of Competency covers the explosion-protection aspects for maintaining explosion-protected and associated equipment and wiring systems including plant maintenance schemes. It requires the ability to develop and manage maintenance programs incorporating strategies for inspections, repair/overhaul/replacement of components and recording of maintenance outcomes. This includes the ability to follow a maintenance program, work safely, carry out maintenance to Standards and manufacturer's instructions and complete the necessary maintenance documentation.

This unit of competency is based on IEC 60079-17 and any other relevant standards that apply to this Unit of Competency.

4.5.2 Prerequisites

The applicant shall have the level of technical education (or equivalent) attained, relevant to the application, through documents such as College Certificates and Trade Credentials etc.

A minimum 3 years experience in industrial maintenance practice is required.

NOTE 1 This experience can include time spent under general supervision.

Competence in this unit shall be assessed either concurrently with or after Unit Ex 001 – Apply basic principles of protection in explosive atmospheres and competencies in maintenance of general plant and equipment, have been achieved (see Annex A). In addition, if the scope limitation requires, the achievement of competencies in developing and managing general electrical/instrumentation maintenance programs will satisfy the prerequisite (see Annex A).

NOTE 2 For work on wiring and equipment operating above 1000 V a.c. or 1500 V d.c. competency in high voltage switching and safe isolation should be held

4.5.3 Elements and performance criteria

Elements		Performance criteria		Critical aspects of evidence
4.1	Prepare to carry out maintenance	4.1.1	OH&S policies and procedures for preparing to work in a hazardous area are followed.	Working safely in a hazardous area in relation to, work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation. Following established maintenance procedures. Applying relevant contingency management skills.
		4.1.2	Area classification and details of explosion-protected equipment and wiring are ascertained from hazardous area layout drawings and equipment certification documents held in the verification dossier.	Following established maintenance procedures. Applying relevant contingency management skills.
		4.1.3	Extent of maintenance to be conducted is established from the maintenance schedule and reports held in the verification dossier.	Following established maintenance procedures. Applying relevant contingency management skills.
		4.1.4	Special tools, equipment and testing devices needed to carry out the maintenance work are obtained and checked for correct operation and safety.	Following established maintenance procedures. Applying relevant contingency management skills.
4.2	Carry out maintenance	4.2.1	OH&S policies and procedures for working in a hazardous area are followed.	Working safely in a hazardous area in relation to, work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation. Following established maintenance procedures. Applying relevant contingency management skills.
		4.2.2	Work is carried out to planned schedule to ensure all items are correctly maintained.	Following established maintenance procedures. Applying relevant contingency management skills.
		4.2.3	Equipment is checked and tested in accordance with established procedures to determine whether it functions correctly, complies with approval documentation and is not subject to deterioration or damage.	Identifying defects and faults. Following established maintenance procedures. Applying relevant contingency management skills.
		4.2.4	Equipment is adjusted or repaired within the limits permitted by the equipment certification and in accordance with manufacturers' instructions.	Identifying defects and faults. Following established maintenance procedures. Applying relevant contingency management skills.
		4.2.5	Certification documentation for replacement equipment is sighted to ensure that it is identical to the equipment it replaces and is in accordance with the explosion-protection system design.	Following established maintenance procedures. Applying relevant contingency management skills.
		4.2.6	Circuits of equipment being withdrawn from service are terminated or isolated safely and in the manner approved for the classification of the area.	Documenting maintenance details. Applying relevant contingency management skills.
		4.2.7	Flexible cables and cords are examined and removed from service if they are not in immediate use or are found to be defective or damaged.	Following established maintenance procedures. Applying relevant contingency management skills.

Elements		Performance criteria		Critical aspects of evidence
		4.2.8	Spare equipment, flexible cables and cords are maintained and suitably stored where they are not likely to suffer deterioration or damage.	Following established maintenance procedures. Applying relevant contingency management skills.
4.3	Complete maintenance work inspections and documentation	4.3.1	Detailed inspection of explosion-protected equipment and systems subject to the maintenance work is arranged in accordance with established procedures and requirements.	Following established maintenance procedures. Applying relevant contingency management skills.
		4.3.2	Results of inspections and maintenance activities are recorded in accordance with established procedures and requirements.	Following established maintenance procedures. Applying relevant contingency management skills.
		4.3.3	Appropriate personnel are notified of the completion of maintenance and details are documented in accordance with established procedures and requirements.	Following established maintenance procedures. Applying relevant contingency management skills.
4.4	Establish maintenance requirements	4.4.1	Policies and procedures are developed to include OH&S practices, skills required and frequency and level of maintenance work.	Following established maintenance procedures. Applying relevant contingency management skills.
		4.4.2	Systems are established to manage and record maintenance work and up-to-date verification dossier, in accordance with requirements.	Following established maintenance procedures. Applying relevant contingency management skills.
		4.4.3	Level of repair to be done under maintenance work is established in accordance with requirements.	Following established maintenance procedures. Applying relevant contingency management skills.
		4.4.4	Arrangements are made to check that the hazardous area, explosion-protected equipment and installation comply with the verification dossier.	Following established maintenance procedures. Applying relevant contingency management skills.
		4.4.5	Discrepancies between the explosion-protected equipment and installation and the verification dossier are documented and arrangements made to ensure that the explosion-protection systems are adequate for the area classification.	Following established maintenance procedures. Applying relevant contingency management skills.
4.5	Develop and implement maintenance schedule	4.5.1	Maintenance schedules are developed from recommendations of Standards and equipment manufacturers and in accordance with requirements.	Following established maintenance procedures. Applying relevant contingency management skills.
		4.5.2	Procedures are developed and implemented to ensure the maintenance program is followed in accordance with the planned schedule and site requirements.	Following established maintenance procedures. Applying relevant contingency management skills.
		4.5.3	Procedures are developed and implemented to ensure the verification dossier is maintained in accordance with planned schedule and site requirements.	Following established maintenance procedures. Applying relevant contingency management skills.
4.6	Evaluate maintenance program	4.6.1	Periodic and sample inspection reports are used to ascertain maintenance quality and the need for revision of maintenance schedule and frequency.	Following established maintenance procedures. Applying relevant contingency management skills.

Elements		Performance criteria		Critical aspects of evidence
		4.6.2	Maintenance schedule is periodically reviewed and revised to maintain the integrity of the explosion-protection system.	Following established maintenance procedures. Applying relevant contingency management skills.

4.5.4 Scope Limitations

Competency shall be demonstrated in relation to any classified hazardous area and explosion-protection technique. Any scope limitations shall be included in the application according to OD 502.

4.5.5 Evidence guide – Critical aspects of evidence

In addition to the requirements of 4.2.5 evidence of competency in this unit shall show:

a) Competent performance associated with each element of competence by employing the techniques, procedures, information and resources available in the workplace and encompassing the following aspects for which competency is sought according to Table in 4.5.3.

b) An understanding of the knowledge and associated skills essential to performance as given in 4.5.5.1 to 4.5.5.13.

c) A practical application of the knowledge and skills essential to performance as given in 4.5.5.14.

4.5.5.1 Flameproof (Ex ‘d’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Flameproof (Ex ‘d’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the flameproof (Ex ‘d’) technique.

NOTE Examples of characteristics and design features are flame paths, integrity under pressure, pressure piling, and enclosure entries.

b) Typical situations where the flameproof explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Flameproof technique.

d) The use of Standards in determining the requirements to which the design of the flameproof explosion-protected apparatus shall comply.

4.5.5.2 Increased safety (Ex ‘e’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Increased safety (Ex ‘e’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Increased safety (Ex ‘e’) technique.

NOTE Examples of characteristics and design features are temperature rise, maximum power dissipation, protection devices, certified components, creepage and clearance distances, absence of sparking contacts and enclosure entries.

b) Typical situations where the Increased safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Increased safety technique.

d) The use of Standards in determining the requirements to which the design of the Increased safety explosion-protected apparatus shall comply.

4.5.5.3 Non-sparking (Ex ‘n’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Non-sparking (Ex ‘n’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Non-sparking (Ex ‘n’) technique.

NOTE Examples of characteristics and design features are creepage and clearance distances and restricted breathing.

b) Typical situations where the Non-sparking explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Non-sparking technique.

d) The use of Standards in determining the requirements to which the design of the Non-sparking explosion-protected apparatus shall comply.

4.5.5.4 Encapsulation (Ex ‘m’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Encapsulation (Ex ‘m’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Encapsulation (Ex ‘m’) technique.

NOTE An example of characteristics and design features is solenoid valve.

b) Typical situations where the Encapsulation explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Encapsulation technique.

d) The use of Standards in determining the requirements to which the design of the Encapsulation explosion-protected apparatus shall comply.

4.5.5.5 Oil immersion (Ex ‘o’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Oil Immersion (Ex ‘o’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Oil Immersion (Ex ‘o’) technique.

NOTE Examples of characteristics and design features are transformers.

b) Typical situations where the Oil Immersion explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Oil Immersion technique.

d) The use of Standards in determining the requirements to which the design of the Oil Immersion explosion-protected apparatus shall comply.

4.5.5.6 Powder filled (Ex ‘q’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Powder Filled (Ex ‘q’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Powder Filled (Ex ‘q’) technique.

NOTE An example of characteristics and design features is a capacitor used with a luminaire.

b) Typical situations where the Powder filled explosion-protection technique are used.

c) Actions or conditions that would void the protection provided by the Powder Filled technique.

d) The use of Standards in determining the requirements to which the design of the Powder Filled explosion-protected apparatus shall comply.

4.5.5.7 Intrinsic safety (Ex 'i') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Intrinsic safety (Ex 'i') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Intrinsic safety (Ex 'i') technique.

NOTE Examples of characteristics and design features are field devices, cables, safe area devices, earthing, entity versus integrated system concept, simple devices and interface devices and their parameters, segregation, infallible components, current and voltage limiting, creepage and clearance distances.

b) Typical situations where the Intrinsic safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by Intrinsic safety.

d) The use of Standards in determining the requirements to which the design of the Intrinsic safety explosion-protected apparatus shall comply.

4.5.5.8 Pressurization (Ex 'p') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Pressurization (Ex 'p') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Pressurization (Ex 'p') technique.

NOTE Examples of characteristics and design features are exclusion and dilution, purge periods, controlled shut down, monitoring and sources of internal release.

b) Typical situations where the pressurization explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the pressurization technique.

d) The use of Standards in determining the requirements to which the design of the pressurization explosion-protected apparatus shall comply.

4.5.5.9 Dust protection by enclosures (Ex 't') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Enclosures (Ex 't') for Dusts explosion-protection technique. The following aspects indicate the extent of understanding required:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the techniques for dusts.

b) Typical situations where dust explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by protection by enclosure technique.

d) The use of Standards in determining the requirements to which the design of the dust explosion-protected enclosure shall comply.

4.5.5.10 Common characteristics of explosion-protection techniques

Evidence shall show an understanding of the common characteristics of explosion-protection techniques to an extent indicated by:

a) The purposes of 'temperature classification' and 'gas grouping/apparatus grouping'.

b) Equipment markings (nameplate).

c) Limitations of non-metallic or specific alloy enclosures.

d) The purpose and use of conformity and certification/approval for equipment used in explosive atmospheres.

e) Environmental conditions that may impact on explosion-protection techniques.

f) The principles and applications of other and mixed explosion-protection techniques.

NOTE Other techniques include encapsulation Ex 'm'; oil-immersion Ex 'o'; powder-filling Ex 'q', and special protection Ex 's'.

4.5.5.11 Explosive atmospheres maintenance requirements

Evidence shall show an understanding of maintenance procedures in hazardous area that will ensure the integrity of the explosion-protection technique to an extent indicated by:

a) The purpose of a maintenance schedule.

b) The purpose and extent of 'visual', 'close', 'sample' and 'periodic' inspections.

c) The features of each explosion-protection technique that should be included in a maintenance schedule.

d) The impact of environmental conditions on explosion-protected equipment, including corrosion and frequency of maintenance.

e) The documentation requirements for recording the maintenance process and results.

4.5.5.12 Explosive atmospheres cable termination techniques

Evidence shall show knowledge and skills in terminating cables suitable for use in explosive atmospheres to an extent indicated by:

a) Selecting compliant cable termination devices.

b) Installing conduit systems, where applicable, including seals to meet hazardous area requirements. Gases only.

c) Terminating a cable with a barrier gland. Gases only.

d) Terminating a multipair, SWA, overall screened, individual screened cable into an enclosure.

e) Testing termination/connections of installed cables/circuits.

NOTE Tests include earth continuity, insulation resistance and polarity.

4.5.5.13 Explosive atmospheres management

Evidence shall show an understanding of the management responsibilities related to explosive atmospheres, the strategies used to maintain the safety of explosive atmospheres and the maintenance requirements. The following aspects indicate the extent of understanding required:

a) The responsibilities of a person managing activities or a site related to a hazardous area, encompassing:
   i) OH&S procedures that are to be established;
   ii) responsibilities for ensuring that a hazardous area has been made safe prior to commencement of work; and
   iii) responsibilities and processes for establishing and maintaining a verification dossier.

b) Explosion-protection strategies in relation to a hazardous area, encompassing:
   i) the process of classifying a hazardous area;
   ii) various ways in which electrical systems /apparatus can be treated to prevent them from becoming an ignition source; and
   iii) the cost of the different ways of treating electrical systems/apparatus associated with explosive atmospheres.

c) Requirements for the maintenance of electrical systems associated with explosive atmospheres, encompassing:
   i) the type and grades of inspection of explosive atmospheres;

ii) maintenance programs for electrical explosion-protected systems/apparatus; and
iii) documentation requirements associated with maintenance procedures.

4.5.5.14 Hazardous area maintenance work performance

In assessing competent hazardous area maintenance work performance evidence regarding the following aspects of competency shall be considered:

a) Establishing maintenance policies and procedures that encompass OH&S responsibilities.
b) Establishing maintenance management systems that address the special requirements for explosion-protected equipment and installations.
c) Ensuring a hazardous area is appropriately classified and explosion-protection strategies are adequate.
d) Developing and implementing maintenance programs and schedules in relation to explosion-protected equipment and installations.
e) Evaluating maintenance programs in relation to explosion-protected equipment and installations.
f) Working safely in a potentially hazardous area in relation to work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.
g) Identifying defects and faults.
h) Interpreting certification documentation in relation to maintenance, repair and replacement.
i) Following established maintenance procedures.
j) Documenting maintenance details.

4.6 Unit Ex 005 – Overhaul and repair of explosion-protected equipment

4.6.1 Scope

This Unit of Competency covers the explosion-protection aspects of overhauling and repairing explosion-protected equipment both at a craftsperson (operative) level and as the responsible person for verifying compliance after such overhaul and/or repair. For the operative it requires the ability to identify and select authorized components, follow repair specifications to effect the overhaul/repair of equipment and complete repair documentation. For the Responsible Person it requires the ability to establish and document the level of work required, arranging for the overhaul/repair to be carried out, verify compliance of overhauled/repaired equipment and complete the necessary documentation.

This unit of competency is based on IEC 60079-19 and any other relevant standards that may apply.

4.6.2 Prerequisites

The applicant shall have the level of technical education (or equivalent) attained, relevant to the application, through documents such as College Certificates and Trade Credentials etc.

For an operative a minimum 3 years experience in the overhaul and repair of general electrical, electronic and/or mechanical equipment relevant to the scope of the unit of competency being applied for taking into account the scope limitations.

For a responsible person a minimum 3 years experience in the servicing of Ex electrical, electronic and/or mechanical equipment relevant to the scope of the unit of competency being applied for taking into account the scope limitations.

Competence in this unit shall be assessed either concurrently with or after Unit Ex 001 – Apply basic principles of protection in explosive atmospheres and competencies in the overhaul and repair of general electrical, electronic and/or mechanical equipment have been achieved. (see Annex A).

4.6.3 Elements and performance criteria

4.6.3.1 Criteria for an operative

Elements		Performance criteria		Critical aspects of evidence
5.1	Prepare for overhaul/repair of equipment	5.1.1	Equipment to be overhauled or repaired is identified by its markings and certification documentation.	Identifying equipment from its marking and certification documentation.
		5.1.2	Specifications and instructions for the overhaul/repair work are received and expected outcomes of the work confirmed with the responsible person*.	Confirming the expected outcomes of the overhaul/repair work.
		5.1.3	Special tools, equipment and testing devices needed to carry out the overhaul or repair work are obtained and checked for correct operation, safety and currency of calibration certification.	Checked for correct operation, safety and currency of calibration certification.
5.2	Carry out the overhaul or repair work	5.2.1	Specifications and instructions for the overhaul/repair work are followed in accordance with established procedures.	Following overhaul/repair specifications and instructions.
		5.2.2	Replacement parts and components used in the overhaul or repair are identified as being authorized by the equipment manufacturer.	Identifying replacement parts and components as being authorized by the equipment manufacturer.
		5.2.3	Overhaul/repair of equipment is done in a manner that does not reduce the type of protection afforded by the equipment design.	Following overhaul/repair specifications and instructions.
		5.2.4	Quality checks are made to ensure that the overhaul/repair of the equipment complies with the overhaul/repair specifications and instruction.	Using quality systems.
5.3	Document overhaul/repair work	5.3.1	Overhaul/repair work carried out is documented in accordance with established quality procedures.	Documenting overhaul/repair work.
		5.3.2	The responsible person is notified of the completion of the work in accordance with established quality procedures.	Documenting overhaul/repair work.

4.6.3.2 Criteria for a Responsible Person

In addition to the requirements detailed in 4.6.3.1 the responsible person shall demonstrate the following:

Elements		Performance criteria		Critical aspects of evidence
5.4	Prepare for overhaul/repair of equipment	5.4.1	Instructions on overhaul and/or repair are received and expected outcomes of the work confirmed with appropriate personnel.	Establishing contract requirements with owner or operator of the equipment. Using quality systems.
		5.4.2	Certification documents for the equipment are sought and received in order to check that the equipment complies with the certification.	Interpreting certification documentation and Standards. Measuring, testing and inspecting equipment for compliance with certification and Standards using quality systems.

Elements		Performance criteria		Critical aspects of evidence
5.5	Establish the level of overhaul required	5.5.1	The extent of work to be done is determined from measurement, test and inspection results and their correspondence with original certification and the requirements of Standards. Results of measurements, tests & inspection passed to the Responsible Person.	Measuring, testing and inspecting equipment for compliance with certification and Standards. Using quality systems.
		5.5.2	Specifications and instructions for the overhaul/repair work are documented in accordance with requirements.	Specifying overhaul/repair work. Using quality systems.
5.6	Arrange overhaul/repair work	5.6.1	Arrangements are made for the overhaul/repair work to be done in accordance with established procedures.	Specifying overhaul/repair work. Using quality systems.
		5.6.2	A copy of overhaul/repair specifications and instructions is provided to personnel responsible for carrying out the work.	Specifying overhaul/repair work. Using quality systems.
5.7	Verify that equipment complies with original certification	5.7.1	Level of testing required to verify that overhauled/repaired equipment complies with original certification specifications is determined in accordance with requirements.	Measuring, testing and inspecting equipment for compliance with certification and Standards. Using quality systems.
		5.7.2	Verification tests are conducted in accordance with established procedures.	Measuring, testing and inspecting equipment for compliance with certification and Standards. Using quality systems.
5.8	Document overhaul/repair work	5.8.1	Equipment marking is checked and marked where applicable, in accordance with original certification.	Using quality systems.
		5.8.2	Overhaul/repair work is documented in accordance with requirements stating that the equipment complies with the original certification or type of protection standard.	Documenting overhaul/repair work. Using quality systems.
		5.8.3	Documentation of the repair work is retained, and a copy is issued with the equipment for inclusion in the Repair Facility Records (see 4.4.1.5.3 of IEC 60079-19	Documenting overhaul/repair work. Using quality systems.

4.6.4 Scope Limitations

Competency shall be demonstrated in relation to any classified hazardous area and explosion-protection techniques. The scope limitations will clearly state the Unit of Competency applies for either an Operative or a Responsible person. Any other scope limitations shall be included in the application according to OD 502.

4.6.5 Critical aspects of evidence for both operative and responsible person

In addition to the requirements of 4.2.5 evidence of competency in this unit shall show:

a) Competent performance associated with each element by employing the techniques, procedures, information and resources available in the workplace and encompassing the following aspects for which competency is sought according to Table in 4.6.3.

b) An understanding of the knowledge and associated skills essential to performance as given in 4.6.5.1 to 4.6.6.2.

c) A practical application of the knowledge and skills essential to performance as given in 4.6.6.3 to 4.6.6.4.

4.6.5.1 Common characteristics of explosion-protection techniques

Evidence shall show an understanding of the common characteristics of explosion-protection techniques to an extent indicated by:

a) The purposes of ‘temperature classification’ and ‘gas grouping/apparatus grouping’.

b) Equipment markings (nameplate).

c) Limitations of non-metallic or specific alloy enclosures.

d) The purpose and use of conformity and certification/approval for equipment used in explosive atmospheres.

e) Environmental conditions that may impact on explosion-protection techniques.

f) The principles and applications of other and mixed explosion-protection techniques.

NOTE Other techniques include encapsulation Ex ‘m’; oil-immersion Ex ‘o’; powder-filling Ex ‘q’, and special protection Ex ‘s’.

4.6.5.2 Flameproof (Ex ‘d’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Flameproof (Ex ‘d’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the flameproof (Ex ‘d’) technique.

NOTE Examples of characteristics and design features are flame paths, integrity under pressure, pressure piling, and enclosure entries.

b) Typical situations where the flameproof explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Flameproof technique.

d) The use of Standards in determining the requirements to which the design of the flameproof explosion-protected apparatus shall comply.

4.6.5.3 Increased safety (Ex ‘e’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Increased safety (Ex ‘e’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Increased safety (Ex ‘e’) technique.

NOTE Examples of characteristics and design features are temperature rise, maximum power dissipation, protection devices, certified components, creepage and clearance distances, absence of sparking contacts and enclosure entries.

b) Typical situations where the Increased safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Increased safety technique.

d) The use of Standards in determining the requirements to which the design of the Increased safety explosion-protected apparatus shall comply.

4.6.5.4 Non-sparking (Ex ‘n’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Non-sparking (Ex ‘n’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Non-sparking (Ex ‘n’) technique.

NOTE Examples of characteristics and design features are creepage and clearance distances and restricted breathing.

b) Typical situations where the Non-sparking explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Non-sparking technique.

d) The use of Standards in determining the requirements to which the design of the Non-sparking explosion-protected apparatus shall comply.

4.6.5.5 Encapsulation (Ex 'm') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Encapsulation (Ex 'm') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Encapsulation (Ex 'm') technique.

NOTE An example of characteristics and design features is solenoid valve.

b) Typical situations where the Encapsulation explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Encapsulation technique.

d) The use of Standards in determining the requirements to which the design of the Encapsulation explosion-protected apparatus shall comply.

4.6.5.6 Oil immersion (Ex 'o') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Oil Immersion (Ex 'o') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Oil Immersion (Ex 'o') technique.

NOTE Examples of characteristics and design features are transformers.

b) Typical situations where the Oil Immersion explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Oil Immersion technique.

d) The use of Standards in determining the requirements to which the design of the Oil Immersion explosion-protected apparatus shall comply.

4.6.5.7 Powder filled (Ex 'q') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Powder Filled (Ex 'q') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Powder Filled (Ex 'q') technique.

NOTE An example of characteristics and design features is a capacitor used with a luminaire.

b) Typical situations where the Powder filled explosion-protection technique are used.

c) Actions or conditions that would void the protection provided by the Powder Filled technique.

d) The use of Standards in determining the requirements to which the design of the Powder Filled explosion-protected apparatus shall comply.

4.6.5.8 Intrinsic safety (Ex 'i') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Intrinsic safety (Ex 'i') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Intrinsic safety (Ex 'i') technique.

NOTE Examples of characteristics and design features are field devices, cables, safe area devices, earthing, entity versus integrated system concept, simple devices and interface devices and their parameters, segregation, infallible components, current and voltage limiting, creepage and clearance distances.

b) Typical situations where the intrinsic safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by intrinsic safety.

d) The use of Standards in determining the requirements to which the design of the intrinsic safety explosion-protected apparatus shall comply.

4.6.5.9 Pressurization (Ex 'p') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Pressurization (Ex 'p') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Pressurization (Ex 'p') technique.

NOTE Examples of characteristics and design features are exclusion and dilution, purge periods, controlled shut down, monitoring and sources of internal release.

b) Typical situations where the pressurization explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the pressurization technique.

d) The use of Standards in determining the requirements to which the design of the pressurization explosion-protected apparatus shall comply.

4.6.5.10 Dust protection by enclosures (Ex 't') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Enclosures (Ex 't') for Dusts explosion-protection technique. The following aspects indicate the extent of understanding required:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the techniques for dusts.

b) Typical situations where dust explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by protection by enclosure technique.

d) The use of Standards in determining the requirements to which the design of the dust explosion-protected enclosure shall comply.

4.6.5.11 Common characteristics of explosion-protection techniques

Evidence shall show an understanding of the common characteristics of explosion-protection techniques to an extent indicated by:

a) The purposes of 'temperature classification' and 'gas grouping/apparatus grouping'.

b) Equipment markings (nameplate).

c) Limitations of non-metallic or specific alloy enclosures.

d) The purpose and use of conformity and certification/approval for equipment used in explosive atmospheres.

e) Environmental conditions that may impact on explosion-protection techniques.

f) The principles and applications of other and mixed explosion-protection techniques.

NOTE Other techniques include encapsulation Ex 'm'; oil-immersion Ex 'o'; powder-filling Ex 'q', and special protection Ex 's'.

4.6.6 Critical aspects of evidence for the Responsible Person

The Responsible Person requires an understanding of the knowledge and associated skills essential to performance as follows:

4.6.6.1 Explosion-protected equipment overhaul and repair – General requirements

Evidence shall show an understanding of overhaul and repair procedures of explosion-protected equipment to an extent indicated by:

a) The scope and limitations for overhaul and repair of explosion-protected equipment encompassing:
   i) the requirements for compliance of a workshop;
   ii) the requirements of a 'competent person' for a registered workshop engaged in the overhaul/repair of explosion-protected equipment; and
   iii) the scope and limitations of work permitted under workshop registration.
b) Overhaul and repair (technical) Standard encompassing:
   i) the documentation/information required to enable overhauls/repairs to be undertaken;
   ii) categories of work, for example, overhaul; no repair; overhaul-repair;
   iii) modifications that are, and are not, permitted within the equipment certification; and
   iv) the requirements for overhaul/repair processes relevant to the type of protection and equipment.
c) Requirements for documentation and identification of overhauled/repaired explosion-protected encompassing:
   i) overhaul/repair report document; and
   ii) requirements for distribution of overhaul/repair reports.
d) Quality management systems as covered by international Standards encompassing:
   i) documentation regime of a quality management system;
   ii) principle of document and data control covering both internally and externally generated documents and data; and
   iii) principles of process control as applied to the overhaul and repair of explosion-protected equipment.

4.6.6.2 Explosion-protected equipment overhaul and repair specific to each technique

Evidence shall show an understanding of overhaul and repair for specific explosion-protection techniques to an extent indicated by:

a) The use of Standards in determining the requirements to which the design of explosion-protected apparatus shall comply.
b) The level of overhaul/repair required encompassing:
   i) Standards and their use for determining the requirement for a specific explosion-protection technique;
   ii) measurement/tests and equipment required to determine whether an item of equipment meets the certification requirements;
   iii) requirements for maintaining the accuracy/calibration of measuring/test equipment;
   iv) measurement/test procedures for determining whether an item of equipment meets the certification requirements;
   v) level of overhaul/repair required from comparisons of test results and requirements specified in the original certification; and
   vi) specifying overhaul/repair work required to restore an item of explosion-protected equipment to conform to the original certification.
c) Measurement/tests procedures to verify that an item of equipment meets the original certification requirements.

4.6.6.3 Explosion-protected equipment overhaul and repair work performance – operative

In assessing competent hazardous area overhaul and repair work performance – operative evidence regarding the following aspects of competency shall be considered:

a) Interpretation of nameplate data, correct identification of equipment classification & standards to which it was manufactured.

b) Identification of faulty or worn components correct identification of component & competent use of documentation.

c) Verification of surface finish compliance with standard against roughness gauge.

d) Dimensional checks on components with identification of flame path gap compliance with certification document or standard with competent use of record documentation.

e) Checking internal threads for wear or damage with competent use of record documentation.

f) Induction motor core flux test calculations with competent use of record documentation.

g) Induction motor stator winding dimensional measurements with competent use of record documentation.

h) Induction motor stator winding wire conversion with competent use of record documentation.

i) Correct interpretation of certification drawings (Optional).

4.6.6.4 Explosion-protected equipment overhaul and repair work performance – Responsible Person

In assessing competent hazardous area overhaul and repair work performance – Responsible Person evidence regarding the following aspects of competency shall be considered:

All requirements of operative given in 4.6.6.3 plus:

a) Following OH&S procedures.

b) Correct interpretation of certification documentation, including drawings, and standards.

c) Identification of appropriate reclamation procedures for defective component based on fault and equipment classification type.

d) Measuring, testing and inspecting equipment for compliance with certification and Standards.

e) Specifying overhaul/repair work.

f) Documenting overhaul/repair work.

4.7 Unit Ex 006 – Test electrical installations in or associated with explosive atmospheres

4.7.1 Scope

This Unit of Competency covers testing electrical installations for explosive atmospheres. It requires the ability to select, prepare and use appropriate testing devices, work safely and to Standards and to interpret and record test results.

This unit of competency is based on IEC 60079-14 and any other relevant standards that may apply.

4.7.2 Prerequisites

The applicant shall have the level of technical education (or equivalent) attained, relevant to the application, through documents such as College Certificates and Trade Credentials etc.

A minimum 3 years experience in industrial electrical installation practice is required.

Competence in this unit shall be assessed either concurrently with or after Unit Ex 001 – Apply basic principles of protection in explosive atmospheres and conducting testing of general electrical, electronic, instrumentation and/or data communication installations have been achieved (see Annex A).

NOTES For work on wiring and equipment operating above 1000 V a.c. or 1500 V d.c. competency in high voltage switching and safe isolation should be held.

4.7.3 Elements and performance criteria

Elements		Performance criteria		Critical aspects of evidence
6.1	Prepare to conduct testing	6.1.1	OH&S policies and procedures for preparing to work in an area where an explosive atmosphere may be present are followed.	Working safely in a hazardous area in relation to work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.
		6.1.2	Area classification is ascertained from the hazardous area layout drawings or other classification documents.	Identifying the nature of the hazardous area and location of equipment and circuits to be tested.
		6.1.3	Location of each item of equipment and of circuits subject to testing are determined from design drawings and documentation.	
		6.1.4	Special tools, equipment and testing devices needed for the testing work are obtained and checked for correct operation and safety.	Selecting appropriately certified testing devices and approved tools.
6.2	Conduct testing	6.2.1	OH&S policies and procedures for working in a hazardous area are followed.	Working safely in a hazardous area in relation to work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.
		6.2.2	Parts of equipment that are dismantled in order to conduct testing are stored to protect them against loss or damage.	Reassembling/reconnecting equipment at the completion of testing that ensures the integrity of the explosion-protection system is maintained.
		6.2.3	Certified and approved low energy testing devices are selected and used to test into areas where explosive hazard may be present.	Selecting appropriately certified testing devices and approved tools.
		6.2.4	Sensitive circuit components required to be tested, which are likely to be damaged by high test voltages, are tested by an appropriate testing method.	Conducting required tests correctly and without damaging circuits or equipment.
		6.2.5	Tests necessary to determine whether the installation complies with requirements for the explosion-protection techniques to be used and for electrical safety are conducted in accordance with established procedures.	Conducting required tests correctly and without damaging circuits or equipment.
		6.2.6	When testing has been completed, equipment parts and circuit connections are replaced in a manner that ensures the integrity of the explosion-protection system.	Reassembling/reconnecting equipment at the completion of testing that ensures the integrity of the explosion-protection system is maintained.
6.3	Confirm and document test results	6.3.1	Non-conformances and faults revealed by the testing and the resulting recommended actions are documented and reported to appropriate personnel.	Identifying non-conformances and faults from test results. Documenting testing outcomes.

Elements		Performance criteria		Critical aspects of evidence
		6.3.2	Completion of testing is verified and a copy of the testing documentation submitted to the appropriate personnel for inclusion in the verification dossier in accordance with established procedures.	Documenting testing outcomes.

4.7.4 Scope Limitations

Competency shall be demonstrated in relation to any classified hazardous area and explosion-protection technique. Any scope limitations shall be included in the application according to OD 502.

4.7.5 Critical aspects of evidence

In addition to the requirements of 4.2.5 evidence of competency in this unit shall show:

a) Competent performance associated with each element of competence by employing the techniques, procedures, information and resources available in the workplace and encompassing the following aspects for which competency is sought according to Table in 4.7.3.

b) An understanding of the knowledge and associated skills essential to performance as given in 4.7.5.1 to 4.7.5.13.

c) A practical application of the knowledge and skills essential to performance as given in 4.7.5.14.

4.7.5.1 Flameproof (Ex ‘d’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Flameproof (Ex ‘d’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the flameproof (Ex ‘d’) technique.

NOTE Examples of characteristics and design features are flame paths, integrity under pressure, pressure piling, and enclosure entries.

b) Typical situations where the flameproof explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Flameproof technique.

d) The use of Standards in determining the requirements to which the design of the flameproof explosion-protected apparatus shall comply.

4.7.5.2 Increased safety (Ex ‘e’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Increased safety (Ex ‘e’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Increased safety (Ex ‘e’) technique.

NOTE Examples of characteristics and design features are temperature rise, maximum power dissipation, protection devices, certified components, creepage and clearance distances, absence of sparking contacts and enclosure entries.

b) Typical situations where the Increased Safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Increased safety technique.

d) The use of Standards in determining the requirements to which the design of the Increased Safety explosion-protected apparatus shall comply.

4.7.5.3 Non-sparking (Ex ‘n’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Non-sparking (Ex ‘n’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Non-sparking (Ex ‘n’) technique.

NOTE Examples of characteristics and design features are creepage and clearance distances and restricted breathing.

b) Typical situations where the Non-sparking explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Non-sparking technique.

d) The use of Standards in determining the requirements to which the design of the Non-sparking explosion-protected apparatus shall comply.

4.7.5.4 Encapsulation (Ex ‘m’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Encapsulation (Ex ‘m’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Encapsulation (Ex ‘m’) technique.

NOTE An example of characteristics and design features is solenoid valve.

b) Typical situations where the Encapsulation explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Encapsulation technique.

d) The use of Standards in determining the requirements to which the design of the Encapsulation explosion-protected apparatus shall comply.

4.7.5.5 Oil immersion (Ex ‘o’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Oil Immersion (Ex ‘o’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Oil Immersion (Ex ‘o’) technique.

NOTE Examples of characteristics and design features are transformers .

b) Typical situations where the Oil Immersion explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Oil Immersion technique.

d) The use of Standards in determining the requirements to which the design of the Oil Immersion explosion-protected apparatus shall comply.

4.7.5.6 Powder filled (Ex ‘q’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Powder Filled (Ex ‘q’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Powder Filled (Ex ‘q’) technique.

NOTE An example of characteristics and design features is a capacitor used with a luminaire.

b) Typical situations where the Powder filled explosion-protection technique are used.

c) Actions or conditions that would void the protection provided by the Powder Filled technique.

d) The use of Standards in determining the requirements to which the design of the Powder Filled explosion-protected apparatus shall comply.

4.7.5.7 Intrinsic safety (Ex 'i') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Intrinsic safety (Ex 'i') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Intrinsic safety (Ex 'i') technique.

NOTE Examples of characteristics and design features are field devices, cables, safe area devices, earthing, entity versus integrated system concept, simple devices and interface devices and their parameters, segregation, infallible components, current and voltage limiting, creepage and clearance distances.

b) Typical situations where the Intrinsic Safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by Intrinsic Safety.

d) The use of Standards in determining the requirements to which the design of the Intrinsic Safety explosion-protected apparatus shall comply.

4.7.5.8 Pressurization (Ex 'p') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Pressurization (Ex 'p') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Pressurization (Ex 'p') technique.

NOTE Examples of characteristics and design features are exclusion and dilution, purge periods, controlled shut down, monitoring and sources of internal release.

b) Typical situations where the pressurization explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the pressurization technique.

d) The use of Standards in determining the requirements to which the design of the pressurization explosion-protected apparatus shall comply.

4.7.5.9 Dust protection by enclosures (Ex 't') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Enclosures (Ex 't') for Dusts explosion-protection technique. The following aspects indicate the extent of understanding required:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the techniques for dusts.

b) Typical situations where dust explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by protection by enclosure technique.

d) The use of Standards in determining the requirements to which the design of the dust explosion-protected enclosure shall comply.

4.7.5.10 Common characteristics of explosion-protection techniques

Evidence shall show an understanding of the common characteristics of explosion-protection techniques to an extent indicated by:

a) The purposes of 'temperature classification' and 'gas grouping/apparatus grouping'.

b) Equipment markings (nameplate).

c) Limitations of non-metallic or specific alloy enclosures.

d) The purpose and use of conformity and certification/approval for equipment used in explosive atmospheres.

e) Environmental conditions that may impact on explosion-protection techniques.

f) The principles and applications of other and mixed explosion-protection techniques.

NOTE Other techniques include encapsulation Ex 'm'; oil-immersion Ex 'o'; powder-filling Ex 'q', and special protection Ex 's'.

4.7.5.11 Explosive atmospheres installation requirements

Evidence shall show an understanding of hazardous area installation principles and maintenance techniques to an extent indicated by:

a) Preparation to install and maintain explosion-protected equipment in explosive atmospheres encompassing:
   i) OH&S procedures to be followed when working in a hazardous area;
   ii) the significance of information provided on the certification documentation and schedules for a given item of explosion-protected equipment;
   iii) the typical contents of a verification dossier and its purpose; and
   iv) limitations in the use of tools and testing devices in explosive atmospheres.
b) The relationship between explosion-protected equipment, their certification documents and required locations given in specifications and layout drawings and/or written instructions encompassing:
   i) the purpose of markings on the compliance plate and certification documents for a given item of explosion-protected equipment;
   ii) matching explosion-protected equipment with certification documents and the equipment specified for an installation; and
   iii) the location of the items of explosion-protected equipment for an installation from specifications and layout drawings and/or instructions.
c) Installation Standards and requirements applicable to hazardous encompassing:
   i) the wiring systems permitted and not permitted in or above explosive atmospheres;
   ii) equipment not permitted in or above explosive atmospheres;
   iii) the regulations and Standards to which explosion-protected equipment and wiring must be installed in a hazardous area and how these are applied; and
   iv) the documentation required as a record of the installation process, including certification documentation.

4.7.5.12 Explosive atmospheres cable termination techniques

Evidence shall show knowledge and skills in terminating cables suitable for use in explosive atmospheres to an extent indicated by:

a) Selecting compliant cable termination devices.
b) Installing conduit systems, where applicable, including seals to meet hazardous area requirements. Gases only.
c) Terminating a cable with a barrier gland. Gases only
d) Terminating a multipair, SWA, overall screened, individual screened cable into an enclosure
e) Testing termination/connections of installed cables/circuits.

NOTE Tests include earth continuity, insulation resistance and polarity.

4.7.5.13 Explosive atmospheres installation testing

Evidence shall show an understanding of testing installations of explosion-protected equipment, wiring and circuits associated with explosive atmospheres. The following aspects indicate the extent of understanding required:

a) Preparation for conducting installation testing in a hazardous area encompassing:
   i) OH&S procedures to be followed for working in a hazardous area; and
   ii) procedures for determining whether a given hazardous area is safe to conduct electrical testing.
b) Characteristics and limitations of testing equipment used to test installation in explosive atmospheres encompassing:
   i) testing devices required to test an installation in a hazardous area; and
   ii) the suitability of testing device for use in a hazardous area.
c) Documentation of results of hazardous area installation tests encompassing:
   i) test results that should be recorded in a verification dossier; and
   ii) procedures and options for dealing with test results that show non-conformance.

4.7.5.14 Hazardous area installation testing work performance

In assessing competent hazardous area installation testing work performance evidence regarding the following aspects of competency shall be considered:

a) Working safely in a potentially hazardous area in relation to work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.
b) Handling and installing equipment and wiring in a manner that does not adversely affect the type of protection afforded by the equipment design.
c) Conducting tests.
d) Documenting testing outcomes.

4.8 Unit Ex 007– Perform visual & close inspection of electrical installations in or associated with explosive atmospheres

4.8.1 Scope

This Unit of Competency covers evaluating the completeness of a hazardous area verification dossier and compliance of the explosion-protected aspects of the electrical installations within the constraints of a visual inspection. It requires the ability to work safely in a hazardous area, evaluate a verification dossier, identify explosion-protected equipment with their certification and specified location, visually inspect an installation for compliance and report and act on inspection results.

This unit of competency is based on IEC 60079-14 & IEC 60079-17 and any other relevant standards that may apply.

4.8.2 Prerequisites

The applicant shall have the level of technical education (or equivalent) attained, relevant to the application, through documents such as College Certificates and Trade Credentials etc

A minimum 3 years experience in industrial electrical installation practice.

Competence in this unit shall be assessed either concurrently with or after units Unit Ex 003 – Install explosion-protected equipment and wiring systems or Unit Ex 004 – Maintain equipment in explosive atmospheres have been achieved. Alternatively, competencies in general electrical inspection will satisfy the prerequisite (see Annex A).

NOTE For work on wiring and equipment operating above 1000 V a.c. or 1500 V d.c. competency in high voltage switching and safe isolation should be held

4.8.3 Elements and performance criteria

Elements		Performance criteria		Critical aspects of evidence
7.1	Evaluate records system	7.1.1	Records system is reviewed to verify that essential hazardous area documentation is retained and procedures for maintaining records are established.	Recognizing the completeness of a verification dossier.
		7.1.2	Hazardous area classification and design drawings and documentation are checked to verify that appropriate procedures have been followed in assuring the area is safe.	Recognizing the completeness of a verification dossier.
7.2	Prepare for inspection	7.2.1	Type and intended location of each item of equipment and circuits subject to inspection are determined from design drawings and documentation.	Identifying components of an installation and their location from documentation retained in the verification dossier.
		7.2.2	OH&S policies and procedures for preparing to work in a hazardous area are followed.	Working safely in a hazardous area in relation to, work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation
		7.2.3	Special tools, equipment and devices needed for the inspection are obtained and checked for correct operation and safety.	Working safely in a hazardous area in relation to, work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation
7.3	Conduct inspection	7.3.1	OH&S policies and procedure for working in a hazardous area are followed.	
		7.3.2	Where necessary, access equipment is used to identify equipment against their certification documentation and specified location.	Working safely in a hazardous area in relation to, work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation
		7.3.3	Equipment, systems and installation are inspected within the scope of the regulatory requirements for compliance with the design specifications retained in the verification dossier and in accordance with requirements.	Identifying components of an installation and their location from documentation retained in the verification dossier.
7.4	Report inspection results	7.4.1	Any non-conformances, faults or unauthorized modifications identified by the visual inspection are documented in accordance with established procedures.	Identifying compliant and non-compliant explosion-protected aspects of an electrical installation.
		7.4.2	Where applicable, a non-conformance report, including the actions taken and a statement on whether circuits have been re-energized, is made and forwarded to the appropriate personnel.	Documenting inspection outcomes.
		7.4.3	Where applicable, documentation in relation to all aspects of the inspection forwarded to the appropriate personnel for inclusion in the verification dossier in accordance with requirements.	Documenting inspection outcomes.

4.8.4 Scope Limitations

Competency shall be demonstrated in relation to any classified hazardous area and explosion-protection technique. Any scope limitations shall be included in the application according to OD 502.

4.8.5 Critical aspects of evidence

In addition to the requirements of 4.2.5 evidence of competency in this unit shall show:

a) Competent performance associated with each element of competence by employing the techniques, procedures, information and resources available in the workplace and encompassing the following aspects for which competency is sought according to Table in 4.8.3.

b) An understanding of the knowledge and associated skills essential to performance as given in 4.8.5.1 to 4.8.5.12.

c) A practical application of the knowledge and skills essential to performance as given in 4.8.5.13.

4.8.5.1 Flameproof (Ex 'd') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Flameproof (Ex 'd') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the flameproof (Ex 'd') technique.

NOTE Examples of characteristics and design features are flame paths, integrity under pressure, pressure piling, and enclosure entries.

b) Typical situations where the flameproof explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Flameproof technique.

d) The use of Standards in determining the requirements to which the design of the flameproof explosion-protected apparatus shall comply.

4.8.5.2 Increased safety (Ex 'e') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Increased safety (Ex 'e') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Increased safety (Ex 'e') technique.

NOTE Examples of characteristics and design features are temperature rise, maximum power dissipation, protection devices, certified components, creepage and clearance distances, absence of sparking contacts and enclosure entries.

b) Typical situations where the Increased safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Increased safety technique.

d) The use of Standards in determining the requirements to which the design of the Increased safety explosion-protected apparatus shall comply.

4.8.5.3 Encapsulation (Ex 'm') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Encapsulation (Ex 'm') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Encapsulation (Ex 'm') technique.

NOTE An example of characteristics and design features is solenoid valve.

b) Typical situations where the Encapsulation explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Encapsulation technique.

d) The use of Standards in determining the requirements to which the design of the Encapsulation explosion-protected apparatus shall comply.

4.8.5.4 Oil immersion (Ex 'o') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Oil Immersion (Ex 'o') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Oil Immersion (Ex 'o') technique.

NOTE Examples of characteristics and design features are transformers.

b) Typical situations where the Oil Immersion explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Oil Immersion technique.

d) The use of Standards in determining the requirements to which the design of the Oil Immersion explosion-protected apparatus shall comply.

4.8.5.5 Powder filled (Ex 'q') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Powder Filled (Ex 'q') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Powder Filled (Ex 'q') technique.

NOTE An example of characteristics and design features is a capacitor used with a luminaire.

b) Typical situations where the Powder filled explosion-protection technique are used.

c) Actions or conditions that would void the protection provided by the Powder Filled technique.

d) The use of Standards in determining the requirements to which the design of the Powder Filled explosion-protected apparatus shall comply.

4.8.5.6 Non-sparking (Ex 'n') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Non-sparking (Ex 'n') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Non-sparking (Ex 'n') technique.

NOTE Examples of characteristics and design features are creepage and clearance distances and restricted breathing.

b) Typical situations where the Non-sparking explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Non-sparking technique.

d) The use of Standards in determining the requirements to which the design of the Non-sparking explosion-protected apparatus shall comply.

4.8.5.7 Intrinsic safety (Ex 'i') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Intrinsic safety (Ex 'i') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Intrinsic safety (Ex 'i') technique.

NOTE Examples of characteristics and design features are field devices, cables, safe area devices, earthing, entity versus integrated system concept, simple devices and interface devices and their parameters, segregation, infallible components, current and voltage limiting, creepage and clearance distances.

b) Typical situations where the Intrinsic safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by Intrinsic safety.

d) The use of Standards in determining the requirements to which the design of the Intrinsic safety explosion-protected apparatus shall comply.

4.8.5.8 Pressurization (Ex 'p') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Pressurization (Ex 'p') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Pressurization (Ex 'p') technique.

NOTE Examples of characteristics and design features are exclusion and dilution, purge periods, controlled shut down, monitoring and sources of internal release.

b) Typical situations where the pressurization explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the pressurization technique.

d) The use of Standards in determining the requirements to which the design of the pressurization explosion-protected apparatus shall comply.

4.8.5.9 Dust protection by enclosures (Ex 't') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Enclosures (Ex 't') for Dusts explosion-protection technique. The following aspects indicate the extent of understanding required:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the techniques for dusts.

b) Typical situations where dust explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by protection by enclosure technique.

d) The use of Standards in determining the requirements to which the design of the dust explosion-protected enclosure shall comply.

4.8.5.10 Common characteristics of explosion-protection techniques

Evidence shall show an understanding of the common characteristics of explosion-protection techniques to an extent indicated by:

a) The purposes of 'temperature classification' and 'gas grouping/apparatus grouping'.

b) Equipment markings (nameplate).

c) Limitations of non-metallic or specific alloy enclosures.

d) The purpose and use of conformity and certification/approval for equipment used in explosive atmospheres.

e) Environmental conditions that may impact on explosion-protection techniques.

f) The principles and applications of other and mixed explosion-protection techniques.

NOTE Other techniques include encapsulation Ex 'm'; oil-immersion Ex 'o'; powder-filling Ex 'q', and special protection Ex 's'.

4.8.5.11 Explosive atmospheres installation requirements

Evidence shall show an understanding of hazardous area installation principles and maintenance techniques to an extent indicated by:

a) Preparation to install and maintain explosion-protected equipment in explosive atmospheres encompassing:

   i) OH&S procedures to be followed when working in a hazardous area;

ii) the significance of information provided on the certification documentation and schedules for a given item of explosion-protected equipment;
iii) the typical contents of a verification dossier and its purpose; and
iv) limitations in the use of tools and testing devices in explosive atmospheres.

b) The relationship between explosion-protected equipment, their certification documents and required locations given in specifications and layout drawings and/or written instructions encompassing:
   i) the purpose of markings on the compliance plate and certification documents for a given item of explosion-protected equipment;
   ii) matching explosion-protected equipment with certification documents and the equipment specified for an installation; and
   iii) the location of the items of explosion-protected equipment for an installation from specifications and layout drawings and/or instructions.

c) Installation Standards and requirements applicable to hazardous encompassing:
   i) the wiring systems permitted and not permitted in or above explosive atmospheres;
   ii) equipment not permitted in or above explosive atmospheres;
   iii) the regulations and Standards to which explosion-protected equipment and wiring must be installed in a hazardous area and how these are applied; and
   iv) the documentation required as a record of the installation process, including certification documentation.

4.8.5.12 Explosive atmospheres visual & close inspection requirements

Evidence shall show an understanding of the purpose and process of visual & close inspections to an extent indicated by:

a) Occupational, health and safety procedures encompassing:
   i) occupational, health and safety procedures to be followed before entering explosive atmospheres; and
   ii) occupational, health and safety procedures to be followed while conducting close inspection.

b) Requirements for a verification dossier and relationship to as-built electrical installation.

c) Purpose, scope and limitations of close inspections.

d) Documentation requirements resulting from a visual or close inspection.

4.8.5.13 Hazardous area visual & close inspection work performance

In assessing competent hazardous area visual & close inspection work performance evidence regarding the following aspects of competency shall be considered:

a) Working safely in a potentially hazardous area in relation to work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.

b) Inspecting equipment and wiring in a manner that does not adversely affect the type of protection afforded by the equipment design.

c) Conducting visual inspections.

d) Documenting inspection outcomes.

4.9 Unit Ex 008 – Perform detailed inspection of electrical installations in or associated with explosive atmospheres

4.9.1 Scope

This Unit of Competency covers the explosion-protection aspects of conducting initial, periodic and sample audit inspections of explosion-protected equipment and installations. It requires the ability to audit a verification dossier, work safely in a hazardous area, inspect against Standards and report and act on inspection results.

This unit of competency is based on IEC 60079-14 & IEC 60079-17 and any other relevant standards that may apply.

4.9.2 Prerequisites

The applicant shall have the level of technical education (or equivalent) attained, relevant to the application, through documents such as College Certificates and Trade Credentials etc.

A minimum 3 years experience in general electrical installation practice and a minimum of 2 years experience in Hazardous Area electrical installation practice.

Competence in this unit shall be assessed either concurrently with or after competencies in Unit Ex 003 – Install explosion-protected equipment and wiring systems or Unit Ex 004 – Maintain equipment in explosive atmospheres have been achieved. Alternatively, competencies in general electrical inspection will satisfy the prerequisite (see Annex A).

NOTE For work on wiring and equipment operating above 1000 V a.c. or 1500 V d.c. competency in high voltage switching and safe isolation should be held

4.9.3 Elements and performance criteria

Elements		Performance criteria		Critical aspects of evidence
8.1	Prepare for inspection	8.1.1	Type of inspection is ascertained from the inspection schedule retained in the verification dossier.	Determining the extent of the inspection and location of equipment.
		8.1.2	Areas classification is ascertained from hazardous area layout drawings retained in the verification dossier.	Working safely in a hazardous area in relation to, work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.
		8.1.3	Type and intended location of each item of equipment and circuits subject to inspection are determined from design drawings and documentation.	Working safely in a hazardous area in relation to, work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.
		8.1.4	OH&S policies and procedures for preparing to work in a hazardous area are followed.	
		8.1.5	Special tools, equipment and devices needed for the inspection are obtained and checked for correct operation and safety.	
8.2	Conduct inspection	8.2.1	OH&S policies and procedure for working in a hazardous area are followed.	Working safely in a hazardous area in relation to, work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.
		8.2.2	Parts of equipment that are dismantled in order to conduct inspection are stored to protect them against loss or damage.	Handling dismantled parts of equipment appropriately.
		8.2.3	Equipment, systems and installation are inspected for compliance with the design specifications retained in the verification dossier and in accordance with requirements.	Conducting detailed inspections in accordance with requirements and procedures.
		8.2.4	Where applicable, after the inspection of each item, equipment parts and circuit connections are replaced in a manner that ensures the integrity of the explosion-protection system.	Replacing equipment parts and connections at the completion of the inspection of each item that ensures the integrity of the explosion-

Elements		Performance criteria		Critical aspects of evidence
				protection system.
8.3	Report inspection results	8.3.1	Any non-conformances, faults or unauthorized modifications are documented in accordance with established procedures.	Documenting inspection outcomes.
		8.3.2	Where applicable, a non-conformance report, including the actions taken and a statement on whether circuits have been re-energized, is made and forwarded to the appropriate personnel.	Documenting inspection outcomes.
		8.3.3	Documentation in relation to all aspects of the inspection forwarded to the appropriate personnel for inclusion in the verification dossier in accordance with requirements.	Documenting inspection outcomes.

4.9.4 Scope Limitations

Competency shall be demonstrated in relation to any classified hazardous area and explosion-protection technique. Any scope limitations shall be included in the application according to OD 502.

4.9.5 Critical aspects of evidence

In addition to the requirements of 4.2.5 evidence of competency in this unit shall show:

a) Competent performance associated with each element of competence by employing the techniques, procedures, information and resources available in the workplace and encompassing the following aspects for which competency is sought according to Table in 4.9.3.

b) An understanding of the knowledge and associated skills essential to performance as given in 4.9.5.1 to 4.9.5.15.

c) A practical application of the knowledge and skills essential to performance as given in 4.9.5.16.

4.9.5.1 Flameproof (Ex ‘d’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Flameproof (Ex ‘d’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the flameproof (Ex ‘d’) technique.

NOTE Examples of characteristics and design features are flame paths, integrity under pressure, pressure piling, and enclosure entries.

b) Typical situations where the flameproof explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Flameproof technique.

d) The use of Standards in determining the requirements to which the design of the flameproof explosion-protected apparatus shall comply.

4.9.5.2 Increased safety (Ex ‘e’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Increased safety (Ex ‘e’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Increased safety (Ex ‘e’) technique.

NOTE Examples of characteristics and design features are temperature rise, maximum power dissipation, protection devices, certified components, creepage and clearance distances, absence of sparking contacts and enclosure entries.

b) Typical situations where the Increased safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Increased safety technique.

d) The use of Standards in determining the requirements to which the design of the Increased safety explosion-protected apparatus shall comply.

4.9.5.3 Non-sparking (Ex 'n') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Non-sparking (Ex 'n') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Non-sparking (Ex 'n') technique.

NOTE Examples of characteristics and design features are creepage and clearance distances and restricted breathing.

b) Typical situations where the Non-sparking explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Non-sparking technique.

d) The use of Standards in determining the requirements to which the design of the Non-sparking explosion-protected apparatus shall comply.

4.9.5.4 Encapsulation (Ex 'm') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Encapsulation (Ex 'm') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Encapsulation (Ex 'm') technique.

NOTE An example of characteristics and design features is solenoid valve.

b) Typical situations where the Encapsulation explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Encapsulation technique.

d) The use of Standards in determining the requirements to which the design of the Encapsulation explosion-protected apparatus shall comply.

4.9.5.5 Oil immersion (Ex 'o') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Oil Immersion (Ex 'o') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Oil Immersion (Ex 'o') technique.

NOTE Examples of characteristics and design features are transformers.

b) Typical situations where the Oil Immersion explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Oil Immersion technique.

d) The use of Standards in determining the requirements to which the design of the Oil Immersion explosion-protected apparatus shall comply.

4.9.5.6 Powder filled (Ex 'q') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Powder Filled (Ex 'q') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Powder Filled (Ex 'q') technique.

NOTE An example of characteristics and design features is a capacitor used with a luminaire.

b) Typical situations where the Powder filled explosion-protection technique are used.

c) Actions or conditions that would void the protection provided by the Powder Filled technique.

d) The use of Standards in determining the requirements to which the design of the Powder Filled explosion-protected apparatus shall comply.

4.9.5.7 Intrinsic safety (Ex 'i') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Intrinsic safety (Ex 'i') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Intrinsic safety (Ex 'i') technique.

NOTE Examples of characteristics and design features are field devices, cables, safe area devices, earthing, entity versus integrated system concept, simple devices and interface devices and their parameters, segregation, infallible components, current and voltage limiting, creepage and clearance distances.

b) Typical situations where the Intrinsic safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by Intrinsic safety.

d) The use of Standards in determining the requirements to which the design of the Intrinsic safety explosion-protected apparatus shall comply.

4.9.5.8 Pressurization (Ex 'p') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Pressurization (Ex 'p') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Pressurization (Ex 'p') technique.

NOTE Examples of characteristics and design features are exclusion and dilution, purge periods, controlled shut down, monitoring and sources of internal release.

b) Typical situations where the pressurization explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the pressurization technique.

d) The use of Standards in determining the requirements to which the design of the pressurization explosion-protected apparatus shall comply.

4.9.5.9 Dust protection by enclosures (Ex 't') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Enclosures (Ex 't') for Dusts explosion-protection technique. The following aspects indicate the extent of understanding required:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the techniques for dusts.

b) Typical situations where dust explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by protection by enclosure technique.

d) The use of Standards in determining the requirements to which the design of the dust explosion-protected enclosure shall comply.

4.9.5.10 Common characteristics of explosion-protection techniques

Evidence shall show an understanding of the common characteristics of explosion-protection techniques to an extent indicated by:

a) The purposes of ‘temperature classification’ and ‘gas grouping/apparatus grouping’.

b) Equipment markings (nameplate).

c) Limitations of non-metallic or specific alloy enclosures.

d) The purpose and use of conformity and certification/approval for equipment used in explosive atmospheres.

e) Environmental conditions that may impact on explosion-protection techniques.

f) The principles and applications of other and mixed explosion-protection techniques.

NOTE Other techniques include encapsulation Ex ‘m’; oil-immersion Ex ‘o’; powder-filling Ex ‘q’, and special protection Ex ‘s’.

4.9.5.11 Explosive atmospheres installation requirements

Evidence shall show an understanding of hazardous area installation principles and maintenance techniques to an extent indicated by:

a) Preparation to install and maintain explosion-protected equipment in explosive atmospheres encompassing:
   i) OH&S procedures to be followed when working in a hazardous area;
   ii) the significance of information provided on the certification documentation and schedules for a given item of explosion-protected equipment;
   iii) the typical contents of a verification dossier and its purpose; and
   iv) limitations in the use of tools and testing devices in explosive atmospheres.
b) The relationship between explosion-protected equipment, their certification documents and required locations given in specifications and layout drawings and/or written instructions encompassing:
   i) the purpose of markings on the compliance plate and certification documents for a given item of explosion-protected equipment;
   ii) matching explosion-protected equipment with certification documents and the equipment specified for an installation; and
   iii) the location of the items of explosion-protected equipment for an installation from specifications and layout drawings and/or instructions.
c) Installation Standards and requirements applicable to hazardous encompassing:
   i) the wiring systems permitted and not permitted in or above explosive atmospheres;
   ii) equipment not permitted in or above explosive atmospheres;
   iii) the regulations and Standards to which explosion-protected equipment and wiring must be installed in a hazardous area and how these are applied; and
   iv) the documentation required as a record of the installation process, including certification documentation.

4.9.5.12 Explosive atmospheres maintenance requirements

Evidence shall show an understanding of maintenance procedures in hazardous area that will ensure the integrity of the explosion-protection technique to an extent indicated by:

a) The purpose of a maintenance schedule.

b) The purpose and extent of ‘visual’, ‘close’, ‘sample’ and ‘periodic’ inspections.

c) The features of each explosion-protection technique that should be included in a maintenance schedule.

d) The impact of environmental conditions on explosion-protected equipment, including corrosion and frequency of maintenance.

e) The documentation requirements for recording the maintenance process and results.

4.9.5.13 Explosive atmospheres cable termination techniques

Evidence shall show knowledge and skills in terminating cables suitable for use in explosive atmospheres to an extent indicated by:

a) Selecting compliant cable termination devices.

b) Installing conduit systems, where applicable, including seals to meet hazardous area requirements. Gases only.

c) Terminating a cable with a barrier gland. Gases only

d) Terminating a multipair, SWA, overall screened, individual screened cable into an enclosure.

e) Testing termination/connections of installed cables/circuits.

NOTE Tests include earth continuity, insulation resistance and polarity.

4.9.5.14 Explosive atmospheres detailed inspection techniques

Evidence shall show an understanding of techniques used in inspecting installations of explosion-protected and associated apparatus and hazardous area wiring. The following aspects indicate the extent of understanding required:

a) The relationship between the documentation held in a verification dossier and the installed equipment encompassing:
   i) consistency between the location and type of equipment with the area classification details in the verification dossier; and
   ii) equipment certification and any attached conditions that relate to the equipment as it is installed.
b) Inspecting a hazardous area installation encompassing:
   i) typical processes for undertaking the inspection of a hazardous area installation;
   ii) requirements applicable to a given installation; and
   iii) reporting of an inspection of a hazardous area installation.

4.9.5.15 Explosive atmospheres visual & close inspection requirements

Evidence shall show an understanding of the purpose and process of visual & close inspections to an extent indicated by:

a) Occupational, health and safety procedures encompassing:
   i) occupational, health and safety procedures to be followed before entering explosive atmospheres; and
   ii) occupational, health and safety procedures to be followed while conducting close inspection.
b) Requirements for a verification dossier and relationship to as-built electrical installation.

c) Purpose, scope and limitations of visual & close inspections.

d) Documentation requirements resulting from a visual or close inspection.

4.9.5.16 Hazardous area detail inspection work performance

In assessing competent hazardous area detail inspection work performance evidence regarding the following aspects of competency shall be considered:

a) Working safely in a potentially hazardous area in relation to work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.

b) Handling and installing equipment and wiring in a manner that does not adversely affect the type of protection afforded by the equipment design.

c) Conducting inspections.

d) Documenting inspection outcomes.

4.10 Unit Ex 009 – Design electrical installations in or associated with explosive atmospheres

4.10.1 Scope

This Unit of Competency covers the explosion-protection aspects of designing electrical power, control and instrumentation systems and installations. It requires the ability to establish design briefs and to pursue economical and effective explosion-protection design solutions.

This unit of competency is based on IEC 60079-14 and any other relevant standards that may apply.

4.10.2 Prerequisites

The applicant shall have the level of technical education (or equivalent) attained, relevant to the application, through documents such as Degree, Diploma and College Certificates etc

A minimum 3 years experience in general electrical installation design or supervised Hazardous Area installation design.

Competence in this unit shall be assessed either concurrently with or after Unit Ex 001 – Apply basic principles of protection in explosive atmospheres and competencies have been achieved in designing electrical systems and installations (see Annex A).

4.10.3 Elements and performance criteria

Elements		Performance criteria		Critical aspects of evidence
9.1	Establish design brief	9.1.1	Site and plant specifications are obtained and reviewed to establish the system requirements.	Accessing and interpreting relevant information
		9.1.2	Classification of the area is obtained from the hazardous area layout drawings or other classification documents.	Accessing and interpreting relevant information
		9.1.3	Organizational policies and specifications for hazardous area electrical systems are obtained or established with the appropriate personnel.	Accessing and interpreting relevant information
9.2	Design system and installation	9.2.1	Safety, functional and economic considerations are incorporated in system design.	Providing design options and justifications including hazard risk, functionality and economic considerations.
		9.2.2	Design complies with all hazardous area requirements and includes specifications and all other necessary documentation for explosion-protected equipment, accessories and wiring systems.	Providing design options and justifications including hazard risk, functionality and economic considerations.
9.3	Check and finalise design	9.3.1	Design is checked under established procedures for compliance with all relevant requirements.	Following checking and documentation procedures.
		9.3.2	Design is submitted for appropriate organizational approval and, where	Following checking and

Elements		Performance criteria		Critical aspects of evidence
			applicable, statutory or regulatory approval.	documentation procedures.
		9.3.3	Approved copies of design documents are issued for retention in the verification dossier, in accordance with established procedures and requirements.	Following checking and documentation procedures.

4.10.4 Scope Limitations

Competency shall be demonstrated in relation to any classified hazardous area and explosion-protection technique. Any scope limitations shall be included in the application according to OD 502.

4.10.5 Evidence guide – Critical aspects of evidence

In addition to the requirements of 4.2.5 evidence of competency in this unit shall show:

a) Competent performance associated with each element of competence by employing the techniques, procedures, information and resources available in the workplace and encompassing the following aspects for which competency is sought according to Table in 4.10.3.

b) An understanding of the knowledge and associated skills essential to performance as given in 4.10.5.1 to 4.10.5.14.

c) A practical application of the knowledge and skills essential to performance as given in 4.10.5.15 to 4.10.5.16.

4.10.5.1 Flameproof (Ex ‘d’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Flameproof (Ex ‘d’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the flameproof (Ex ‘d’) technique.

NOTE Examples of characteristics and design features are flame paths, integrity under pressure, pressure piling, and enclosure entries.

b) Typical situations where the flameproof explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Flameproof technique.

d) The use of Standards in determining the requirements to which the design of the flameproof explosion-protected apparatus shall comply.

4.10.5.2 Increased safety (Ex ‘e’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Increased safety (Ex ‘e’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Increased safety (Ex ‘e’) technique.

NOTE Examples of characteristics and design features are temperature rise, maximum power dissipation, protection devices, certified components, creepage and clearance distances, absence of sparking contacts and enclosure entries.

b) Typical situations where the Increased safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Increased safety technique.

d) The use of Standards in determining the requirements to which the design of the Increased safety explosion-protected apparatus shall comply.

4.10.5.3 Non-sparking (Ex 'n') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Non-sparking (Ex 'n') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Non-sparking (Ex 'n') technique.

NOTE Examples of characteristics and design features are creepage and clearance distances and restricted breathing.

b) Typical situations where the Non-sparking explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Non-sparking technique.

d) The use of Standards in determining the requirements to which the design of the Non-sparking explosion-protected apparatus shall comply.

4.10.5.4 Encapsulation (Ex 'm') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Encapsulation (Ex 'm') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Encapsulation (Ex 'm') technique.

NOTE An example of characteristics and design features is solenoid valve.

b) Typical situations where the Encapsulation explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Encapsulation technique.

d) The use of Standards in determining the requirements to which the design of the Encapsulation explosion-protected apparatus shall comply.

4.10.5.5 Oil immersion (Ex 'o') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Oil Immersion (Ex 'o') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Oil Immersion (Ex 'o') technique.

NOTE Examples of characteristics and design features are transformers.

b) Typical situations where the Oil Immersion explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Oil Immersion technique.

d) The use of Standards in determining the requirements to which the design of the Oil Immersion explosion-protected apparatus shall comply.

4.10.5.6 Powder filled (Ex 'q') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Powder Filled (Ex 'q') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Powder Filled (Ex 'q') technique.

NOTE An example of characteristics and design features is a capacitor used with a luminaire.

b) Typical situations where the Powder filled explosion-protection technique are used.

c) Actions or conditions that would void the protection provided by the Powder Filled technique.

d) The use of Standards in determining the requirements to which the design of the Powder Filled explosion-protected apparatus shall comply.

4.10.5.7 Intrinsic safety (Ex 'i') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Intrinsic safety (Ex 'i') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Intrinsic safety (Ex 'i') technique.

NOTE Examples of characteristics and design features are field devices, cables, safe area devices, earthing, entity versus integrated system concept, simple devices and interface devices and their parameters, segregation, infallible components, current and voltage limiting, creepage and clearance distances.

b) Typical situations where the Intrinsic safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by Intrinsic safety.

d) The use of Standards in determining the requirements to which the design of the Intrinsic safety explosion-protected apparatus shall comply.

4.10.5.8 Pressurization (Ex 'p') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Pressurization (Ex 'p') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Pressurization (Ex 'p') technique.

NOTE Examples of characteristics and design features are exclusion and dilution, purge periods, controlled shut down, monitoring and sources of internal release.

b) Typical situations where the pressurization explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the pressurization technique.

d) The use of Standards in determining the requirements to which the design of the pressurization explosion-protected apparatus shall comply.

4.10.5.9 Dust protection by enclosures (Ex 't') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Enclosures (Ex 't') for Dusts explosion-protection technique. The following aspects indicate the extent of understanding required:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the techniques for dusts.

b) Typical situations where dust explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by protection by enclosure technique.

d) The use of Standards in determining the requirements to which the design of the dust explosion-protected enclosure shall comply.

4.10.5.10 Common characteristics of explosion-protection techniques

Evidence shall show an understanding of the common characteristics of explosion-protection techniques to an extent indicated by:

a) The purposes of 'temperature classification' and 'gas grouping/apparatus grouping'.

b) Equipment markings (nameplate).

c) Limitations of non-metallic or specific alloy enclosures.

d) The purpose and use of conformity and certification/approval for equipment used in explosive atmospheres.

e) Environmental conditions that may impact on explosion-protection techniques.

f) The principles and applications of other and mixed explosion-protection techniques.

NOTE Other techniques include encapsulation Ex ‘m’; oil-immersion Ex ‘o’; powder-filling Ex ‘q’, and special protection Ex ‘s’.

4.10.5.11 Explosive atmospheres installation requirements

Evidence shall show an understanding of hazardous area installation principles and maintenance techniques to an extent indicated by:

a) Preparation to install and maintain explosion-protected equipment in explosive atmospheres encompassing:
   i) OH&S procedures to be followed when working in a hazardous area;
   ii) the significance of information provided on the certification documentation and schedules for a given item of explosion-protected equipment;
   iii) the typical contents of a verification dossier and its purpose; and
   iv) limitations in the use of tools and testing devices in explosive atmospheres.
b) The relationship between explosion-protected equipment, their certification documents and required locations given in specifications and layout drawings and/or written instructions encompassing:
   i) the purpose of markings on the compliance plate and certification documents for a given item of explosion-protected equipment;
   ii) matching explosion-protected equipment with certification documents and the equipment specified for an installation; and
   iii) the location of the items of explosion-protected equipment for an installation from specifications and layout drawings and/or instructions.
c) Installation Standards and requirements applicable to hazardous encompassing:
   i) the wiring systems permitted and not permitted in or above explosive atmospheres;
   ii) equipment not permitted in or above explosive atmospheres;
   iii) the regulations and Standards to which explosion-protected equipment and wiring must be installed in a hazardous area and how these are applied; and
   iv) the documentation required as a record of the installation process, including certification documentation.

4.10.5.12 Explosive atmospheres installation planning

Evidence shall show an understanding of hazardous area electrical installations planning and the selection of appropriate explosion-protected equipment and wiring. The following aspects indicate the extent of understanding required:

a) Interpretation of documents showing the classification of a hazardous area encompassing:
   i) the methods used for classifying explosive atmospheres;
   ii) the delineation of zones, temperature classes and gas groups of a given hazardous area from classification documents;
   iii) the delineation of zones, temperature classes and gas groups of a given hazardous area from similar situations previously classified, such as those given in Standards; and
   iv) situations where classification needs to be undertaken by a person competent in non-specific area classification i.e. a person who has attained Unit Ex 002 – Perform classification of hazardous areas.
b) Selecting and checking equipment, wiring and accessories encompassing:
   i) the impact of environmental conditions, such as corrosion and maintenance requirements, on explosion-protected equipment and accessories;
   ii) explosion-protected equipment and accessories to suit the requirements of given explosive atmospheres;

iii) wiring systems to suit the requirements of a hazardous area, load and duty requirements and consideration of capacitive/inductive effects and inductance/ resistance ratio where applicable;
iv) earthing and equipotential bonding requirements for a hazardous area installation;
v) procedures used to check the compliance certification of equipment used in a hazardous area; and
vi) electrical protection systems and devices, for example, overloads, earth fault protection) appropriate to an explosion-protection technique.
vii) Compliant cable termination devices including glands.

c) Documentation of hazardous area installation design encompassing:
   i) the items that should be included in the documentation for the design of a hazardous area installation;
   ii) installation layout, specification, work schedule and other documentation required for inclusion in a verification dossier; and
   iii) the essential documentation that needs to be specified/requested from manufacturers when purchasing explosion-protected equipment/accessories.

4.10.5.13 Common classified explosive atmospheres

Evidence shall show an understanding of common and specific explosive atmospheres for which classification examples are given in Standards. The following aspects indicate the extent of understanding required:

a) The example classifications given in Standards.
b) Applying the classifications given in Standards to similar situations for the purpose of planning of electrical installations.

4.10.5.14 Explosion-protected electrical systems design

Evidence shall show an understanding of explosion-protected electrical system design to an extent indicated by:

a) Process for establishing a design brief for an explosion-protected electrical system encompassing:
   i) consultation processes for establishing client requirements and preparing a design brief; and
   ii) system requirements using site and plant specifications, hazardous area classifications and organization requirements.
b) System design encompassing:
   i) major considerations influencing explosion-protected electrical system designs;
   ii) requirements in Standards and regulations that affect the electrical system design; and
   iii) typical design process incorporating explosion-protection in an electrical system.
c) Design documentation required for a hazardous area encompassing:
   i) procedures for checking and approval of explosion-protected system design; and
   ii) requirements for documenting a final design including documents to be included in a verification dossier.

4.10.5.15 Hazardous area installation design work performance

In assessing competent hazardous area installation design work performance evidence regarding the following aspects of competency shall be considered:

a) Interpreting area classification documentation.
b) Classifying area from Standards.
c) Documenting area classification.

d) Selecting equipment for a given classified area.

e) Selecting wiring systems for a given classified area.

f) Checking equipment certification for suitability for a given classified area.

4.10.5.16 Explosion-protected electrical system design work performance

In assessing competent hazardous area electrical system design work performance evidence regarding the following aspects of competency shall be considered:

a) Accessing and interpreting relevant information.

b) Providing design options and justifications including hazard risk, functionality and economic considerations.

c) Following checking and documentation procedures.

4.11 Unit Ex 010 – Perform audit inspection of electrical installations in or associated with explosive atmospheres

4.11.1 Scope

This Unit of Competency covers the explosion-protection aspects of conducting an audit of an electrical installation. It requires the ability to verify whether an installation complies with the relevant hazardous area Standards for that installation and includes the verification of design and certification documentation (verification dossier), maintenance, overhaul and repair, work safety, inspection against Standards and reporting of audit results.

This unit of competency is based on IEC 60079-14 & IEC 60079-17 and any other relevant standards that may apply.

4.11.2 Prerequisites

The applicant shall have the level of technical education (or equivalent) attained, relevant to the application, through documents such as Degree, Diploma, College Certificates, Trade Credentials etc

A minimum 3 years experience in general electrical installation or inspection practice, a minimum of 2 years experience in Hazardous Area electrical installation inspection practice.

Competence in this unit shall be assessed either concurrently with or after Unit Ex 001 – Apply basic principles of protection in explosive atmospheres and after competencies in engineering auditing or equivalent have been achieved (see Annex A).

4.11.3 Elements and performance criteria

Elements		Performance criteria		Critical aspects of evidence
10.1	Audit hazardous area documentation (verification dossier) and prepare to audit as-built installation	10.1.1	Records system (verification dossier) is reviewed to verify that essential hazardous area documentation is retained and procedures for maintaining records are established.	Reviewing hazardous area documentation and identifying the extent of the audit. Handling and installing equipment and wiring in a manner that does not reduce the type of protection afforded by the equipment design.
		10.1.2	Hazardous area classification and design drawings and documentation are checked to verify that appropriate procedures have been followed and are checked for traceability and	Reviewing hazardous area documentation and identifying the extent of the audit.

Elements		Performance criteria		Critical aspects of evidence
			authentication.	Handling and installing equipment and wiring in a manner that does not reduce the type of protection afforded by the equipment design.
		10.1.3	Type and intended location of each item of equipment and circuits subject to audit are determined from design drawings and documentation.	
		10.1.4	OH&S policies and procedures for preparing to work in a hazardous area are followed.	Working safely in a hazardous area in relation to work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.
		10.1.5	Appropriately qualified persons are engaged to assist in aspects of the audit process.	Engaging and directing appropriately qualified persons as required.
		10.1.6	Special tools, equipment and devices needed for the inspection are obtained and checked for correct operation and safety.	
10.2	Conduct audit	10.2.1	OH&S policies and procedures for working in a hazardous area are followed.	Working safely in a hazardous area in relation to work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.
		10.2.2	Parts of equipment that are dismantled in order to conduct inspection are protected against loss or damage.	Conducting audit to industry Standards.
		10.2.3	Appropriate qualified persons are directed to access components of the installation as required to audit the installation.	Conducting audit to industry Standards.
		10.2.4	Equipment, systems and installations are inspected for compliance with the design specifications retained in the hazardous areas documentation (verification dossier) and in accordance with requirements of the applicable Standards.	
10.3	Report audit results	10.3.1	Differences between the hazardous areas documentation (verification dossier) including the design specifications and installation are recorded.	Reporting non-conformance features aspects of the installation affecting safety.
		10.3.2	Any non-conformance, faults or unauthorized modifications are documented in accordance with established procedures.	Identifying any non-conformance aspects of the installation. Reporting non-conformance features aspects of the installation affecting safety.
		10.3.3	Where applicable, a non-conformance report regarding the safety of the installation is made and forwarded to the appropriate personnel.	Reporting non-conformance features aspects of the installation affecting safety.
		10.3.4	Documentation in relation to all aspects of the audit is forwarded to the appropriate personnel for any actions identified and for inclusion in the hazardous areas documentation	Documenting inspection audit outcomes.

Elements		Performance criteria		Critical aspects of evidence
			(verification dossier). This includes any conformity assessment and fitness-for-purpose assessment.	

4.11.4 Scope Limitations

Competency shall be demonstrated in relation to any classified hazardous area. Any scope limitations shall be included in the application according to OD 502.

4.11.5 Evidence guide – Critical aspects of evidence

In addition to the requirements of 4.2.5 evidence of competency in this unit shall show:

a) Competent performance associated with each element by employing the techniques, procedures, information and resources available in the workplace and encompassing the following aspects for which competency is sought according to Table in 4.11.3.

b) An understanding of the knowledge and associated skills essential to performance as given in 4.11.5.1 to 4.11.5.12.

c) A practical application of the knowledge and skills essential to performance as given in 4.2.5.5 to 4.2.5.6.

4.11.5.1 Flameproof (Ex ‘d’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Flameproof (Ex ‘d’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the flameproof (Ex ‘d’) technique.

NOTE Examples of characteristics and design features are flame paths, integrity under pressure, pressure piling, and enclosure entries.

b) Typical situations where the flameproof explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Flameproof technique.

d) The use of Standards in determining the requirements to which the design of the flameproof explosion-protected apparatus shall comply.

4.11.5.2 Increased safety (Ex ‘e’) explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Increased safety (Ex ‘e’) explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Increased safety (Ex ‘e’) technique.

NOTE Examples of characteristics and design features are temperature rise, maximum power dissipation, protection devices, certified components, creepage and clearance distances, absence of sparking contacts and enclosure entries.

b) Typical situations where the Increased safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Increased safety technique.

d) The use of Standards in determining the requirements to which the design of the Increased safety explosion-protected apparatus shall comply.

4.11.5.3 Non-sparking (Ex 'n') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Non-sparking (Ex 'n') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Non-sparking (Ex 'n') technique.

NOTE Examples of characteristics and design features are creepage and clearance distances and restricted breathing.

b) Typical situations where the Non-sparking explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Non-sparking technique.

d) The use of Standards in determining the requirements to which the design of the Non-sparking explosion-protected apparatus shall comply.

4.11.5.4 Encapsulation (Ex 'm') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Encapsulation (Ex 'm') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Encapsulation (Ex 'm') technique.

NOTE An example of characteristics and design features is solenoid valve.

b) Typical situations where the Encapsulation explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Encapsulation technique.

d) The use of Standards in determining the requirements to which the design of the Encapsulation explosion-protected apparatus shall comply.

4.11.5.5 Oil immersion (Ex 'o') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Oil Immersion (Ex 'o') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Oil Immersion (Ex 'o') technique.

NOTE Examples of characteristics and design features are transformers.

b) Typical situations where the Oil Immersion explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the Oil Immersion technique.

d) The use of Standards in determining the requirements to which the design of the Oil Immersion explosion-protected apparatus shall comply.

4.11.5.6 Powder filled (Ex 'q') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Powder Filled (Ex 'q') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Powder Filled (Ex 'q') technique.

NOTE An example of characteristics and design features is a capacitor used with a luminaire.

b) Typical situations where the Powder filled explosion-protection technique are used.

c) Actions or conditions that would void the protection provided by the Powder Filled technique.

d) The use of Standards in determining the requirements to which the design of the Powder Filled explosion-protected apparatus shall comply.

4.11.5.7 Intrinsic safety (Ex 'i') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Intrinsic safety (Ex 'i') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Intrinsic safety (Ex 'i') technique.

NOTE Examples of characteristics and design features are field devices, cables, safe area devices, earthing, entity versus integrated system concept, simple devices and interface devices and their parameters, segregation, infallible components, current and voltage limiting, creepage and clearance distances.

b) Typical situations where the Intrinsic safety explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by Intrinsic safety.

d) The use of Standards in determining the requirements to which the design of the Intrinsic safety explosion-protected apparatus shall comply.

4.11.5.8 Pressurization (Ex 'p') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Pressurization (Ex 'p') explosion-protection technique to an extent indicated by:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the Pressurization (Ex 'p') technique.

NOTE Examples of characteristics and design features are exclusion and dilution, purge periods, controlled shut down, monitoring and sources of internal release.

b) Typical situations where the pressurization explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by the pressurization technique.

d) The use of Standards in determining the requirements to which the design of the pressurization explosion-protected apparatus shall comply.

4.11.5.9 Dust protection by enclosures (Ex 't') explosion-protection technique

Evidence shall show an understanding of the characteristics and application of Enclosures (Ex 't') for Dusts explosion-protection technique. The following aspects indicate the extent of understanding required:

a) The purpose and characteristics of the design features of apparatus and circuits protected by the techniques for dusts.

b) Typical situations where dust explosion-protection technique is used.

c) Actions or conditions that would void the protection provided by protection by enclosure technique.

d) The use of Standards in determining the requirements to which the design of the dust explosion-protected enclosure shall comply.

4.11.5.10 Common characteristics of explosion-protection techniques

Evidence shall show an understanding of the common characteristics of explosion-protection techniques to an extent indicated by:

a) The purposes of 'temperature classification' and 'gas grouping/apparatus grouping'.

b) Equipment markings (nameplate).

c) Limitations of non-metallic or specific alloy enclosures.

d) The purpose and use of conformity and certification/approval for equipment used in explosive atmospheres.

e) Environmental conditions that may impact on explosion-protection techniques.

f) The principles and applications of other and mixed explosion-protection techniques.

NOTE Other techniques include encapsulation Ex ‘m’; oil-immersion Ex ‘o’; powder-filling Ex ‘q’, and special protection Ex ‘s’.

4.11.5.11 Explosive atmospheres installation requirements

Evidence shall show an understanding of hazardous area installation principles and maintenance techniques to an extent indicated by:

a) Preparation to install and maintain explosion-protected equipment in explosive atmospheres encompassing:
   i) OH&S procedures to be followed when working in a hazardous area;
   ii) the significance of information provided on the certification documentation and schedules for a given item of explosion-protected equipment;
   iii) the typical contents of a verification dossier and its purpose; and
   iv) limitations in the use of tools and testing devices in explosive atmospheres.
b) The relationship between explosion-protected equipment, their certification documents and required locations given in specifications and layout drawings and/or written instructions encompassing:
   i) the purpose of markings on the compliance plate and certification documents for a given item of explosion-protected equipment;
   ii) matching explosion-protected equipment with certification documents and the equipment specified for an installation; and
   iii) the location of the items of explosion-protected equipment for an installation from specifications and layout drawings and/or instructions.
c) Installation Standards and requirements applicable to hazardous encompassing:
   i) the wiring systems permitted and not permitted in or above explosive atmospheres;
   ii) equipment not permitted in or above explosive atmospheres;
   iii) the regulations and Standards to which explosion-protected equipment and wiring must be installed in a hazardous area and how these are applied; and
   iv) the documentation required as a record of the installation process, including certification documentation.

4.11.5.12 Hazardous area auditing processes

Evidence shall show an understanding of processes used in auditing hazardous areas to an extent indicated by:

a) Requirements to retain hazardous area documentation on site.
b) Components of an audit encompassing :
   i) authenticity of documentation;
   ii) hazardous area delineations shown in site diagrams;
   iii) location and operating parameters of equipment shown in certification documents;
   iv) compliance of equipment location;
   v) compliance of wiring systems; and
   vi) alignment of hazardous area documentation to as- built installation.
c) Reporting non-conformance of an installation.

4.11.5.13 Hazardous area audit inspection work performance

In assessing competent hazardous area detail inspection work performance evidence regarding the following aspects of competency shall be considered:

a) Working safely in a potentially hazardous area in relation to work permits and clearances, hazard monitoring and evacuation procedures, and plant and electrical isolation.

b) Accessing and interpreting relevant information.

c) Handling and installing equipment and wiring in a manner that does not adversely affect the type of protection afforded by the equipment design.

d) Conducting inspections.

e) Documenting inspection outcomes.

f) Interpreting area classification documentation.

g) Documenting area classification.

h) Selecting equipment for a given classified area.

i) Selecting wiring systems for a given classified area.

j) Checking equipment certification for suitability for a given classified area.

k) Following checking and documentation procedures.

4.12 Summary of essential knowledge and associated skills for each Unit of Competency

Essential knowledge and associated skills		Unit Ex 001 – Apply basic principles of protection in explosive atmospheres	Unit Ex 002 – Perform classification of hazardous areas	Unit Ex 003 – Install explosion-protected equipment and wiring systems	Unit Ex 004 – Maintain equipment in explosive atmospheres	Unit Ex 005 – Overhaul and repair of explosion-protected equipment	Unit Ex 006 – Test electrical installations in or associated with explosive atmospheres	Unit Ex 007 – Perform visual & close inspection of electrical installations in or associated with explosive atmospheres	Unit Ex 008 – Perform detailed inspection of electrical installations in or associated with explosive atmospheres	Unit Ex 009 – Design electrical installations in or associated with explosive atmospheres	Unit Ex 010 – Perform audit inspection of electrical installations in or associated with explosive atmospheres
1	Explosive atmospheres and explosion-protection principles	4.2.5.1	4.2.5.1	4.2.5.1	4.2.5.1	4.2.5.1	4.2.5.1	4.2.5.1	4.2.5.1	4.2.5.1	4.2.5.1
2	Explosion-protected equipment – Principles	4.2.5.3		4.2.5.3	4.2.5.3	4.2.5.3	4.2.5.3	4.2.5.3	4.2.5.3	4.2.5.3	4.2.5.3
3	Explosion-protected equipment – Ex certification schemes	4.2.5.2		4.2.5.2	4.2.5.2	4.2.5.2	4.2.5.2	4.2.5.2	4.2.5.2	4.2.5.2	4.2.5.2
4	Flameproof (Ex ‘d’) explosion-protection technique			4.4.5.1	4.5.5.1	4.6.5.1	4.7.5.1	4.8.5.1	4.9.5.1	4.10.5.1	4.11.5.1
5	Increased safety (Ex ‘e’) explosion-protection technique			4.4.5.2	4.5.5.2	4.6.5.3	4.7.5.2	4.8.5.2	4.9.5.2	4.10.5.2	4.11.5.2
6	Non-sparking (Ex ‘n’) explosion-protection technique			4.4.5.3	4.5.5.3	4.6.5.4	4.7.5.3	4.8.5.6	4.9.5.3	4.10.5.3	4.11.5.3
7	Encapsulation (Ex ‘m’) explosion-protection technique			4.4.5.4	4.5.5.4	4.6.5.5	4.7.5.4	4.8.5.3	4.9.5.4	4.10.5.4	4.11.5.4
8	Oil immersion (Ex ‘o’) explosion-protection technique			4.4.5.5	4.5.5.5	4.6.5.6	4.7.5.5	4.8.5.4	4.9.5.5	4.10.5.5	4.11.5.5
9	Powder filled (Ex ‘q’) explosion-protection technique			4.4.5.6	4.5.5.6	4.6.5.7	4.7.5.6	4.8.5.5	4.9.5.6	4.10.5.6	4.11.5.6

Essential knowledge and associated skills		Unit Ex 001 – Apply basic principles of protection in explosive atmospheres	Unit Ex 002 – Perform classification of hazardous areas	Unit Ex 003 – Install explosion-protected equipment and wiring systems	Unit Ex 004 – Maintain equipment in explosive atmospheres	Unit Ex 005 – Overhaul and repair of explosion-protected equipment	Unit Ex 006 – Test electrical installations in or associated with explosive atmospheres	Unit Ex 007 – Perform visual & close inspection of electrical installations in or associated with explosive atmospheres	Unit Ex 008 – Perform detailed inspection of electrical installations in or associated with explosive atmospheres	Unit Ex 009 – Design electrical installations in or associated with explosive atmospheres	Unit Ex 010 – Perform audit inspection of electrical installations in or associated with explosive atmospheres
10	Intrinsic safety (Ex 'i') explosion-protection technique			4.4.5.7	4.5.5.7	4.6.5.8	4.7.5.7	4.8.5.7	4.9.5.7	4.10.5.7	4.11.5.7
11	Pressurization (Ex 'p') explosion-protection technique			4.4.5.8	4.5.5.8	4.6.5.9	4.7.5.8	4.8.5.8	4.9.5.8	4.10.5.8	4.11.5.8
12	Dust protection by enclosures (Ex 't') explosion-protection technique			4.4.5.9	4.5.5.9	4.6.5.10	4.7.5.9	4.8.5.9	4.9.5.9	4.10.5.9	4.11.5.9
13	Common characteristics of explosion-protection techniques			4.4.5.10	4.5.5.10	4.6.5.11	4.7.5.10	4.8.5.10	4.9.5.10	4.10.5.10	4.11.5.10
14	Explosive atmospheres installation requirements			4.4.5.11			4.7.5.11	4.8.5.11	4.9.5.11	4.10.5.11	4.11.5.11
15	Explosive atmospheres maintenance requirements				4.5.5.11				4.9.5.12		
16	Explosive atmospheres cable termination techniques			4.4.5.12	4.5.5.12		4.7.5.12		4.9.5.13		
17	Explosive atmospheres detailed inspection techniques								4.9.5.14		
18	Explosion-protected equipment overhaul and repair – General requirements					4.6.6.1					

Essential knowledge and associated skills		Unit Ex 001 – Apply basic principles of protection in explosive atmospheres	Unit Ex 002 – Perform classification of hazardous areas	Unit Ex 003 – Install explosion-protected equipment and wiring systems	Unit Ex 004 – Maintain equipment in explosive atmospheres	Unit Ex 005 – Overhaul and repair of explosion-protected equipment	Unit Ex 006 – Test electrical installations in or associated with explosive atmospheres	Unit Ex 007 – Perform visual & close inspection of electrical installations in or associated with explosive atmospheres	Unit Ex 008 – Perform detailed inspection of electrical installations in or associated with explosive atmospheres	Unit Ex 009 – Design electrical installations in or associated with explosive atmospheres	Unit Ex 010 – Perform audit inspection of electrical installations in or associated with explosive atmospheres
19	Explosion-protected equipment overhaul and repair specific to each technique					4.6.6.2					
20	Explosive atmospheres installation planning									4.10.5.12	
21	Common classified explosive atmospheres									4.10.5.13	
22	Explosive atmospheres classification techniques		4.3.5.2								
23	Explosive atmospheres visual inspection requirements							4.8.5.12	4.9.5.15		
24	Explosive atmospheres management				4.5.5.13						
25	Explosion-protected electrical systems design									4.10.5.14	
26	Explosive atmospheres installation testing						4.7.5.13				
27	Explosion-protection visual checks	4.2.5.4									
28	Hazardous area auditing processes										4.11.5.12

Annex A
(informative)

Specific prerequisite units and recommended general competencies for achievement of each Unit of Competency

The Units of Competency in this specification have been developed to complement competencies/qualifications in the general functions of production, installation, maintenance, overhaul/repair, design, inspection and/or related management that have been previously acquired.

Table A1 shows the specific prerequisite units and the recommended general competencies and level assumed to be held by a person before undertaking training/assessment to achieve Units of Competency in this specification.

Table A1 – Summary of prerequisite units and recommended general competencies

Unit of Competency	Specific prerequisite Units	Previously attained competency
		Description
Unit Ex 001 – Apply basic principles of protection in explosive atmospheres		Competencies in plant or machinery operation or installations, maintenance or service functions.
Unit Ex 002 – Perform classification of hazardous areas		Competencies in gathering and analysing technical data and using this data for risk assessment.
Unit Ex 003 – Install explosion-protected equipment and wiring systems	Unit Ex 001	Competencies in installation of electrical, electronic, instrumentation and/or data communication equipment and wiring systems.
Unit Ex 004 – Maintain equipment in explosive atmospheres	Unit Ex 001	Competencies in maintenance of general low-voltage or extra-low voltage electrical, electronic, instrumentation and/or data communication equipment and wiring systems.
Unit Ex 005 – Overhaul and repair of explosion-protected equipment		Competencies in overhaul and repair of general low-voltage or extra-low voltage electrical/electronic equipment.
Unit Ex 006 – Test electrical installations in or associated with explosive atmospheres	Unit Ex 001	Competencies in conducting testing of general electrical, electronic, instrumentation and/or data communication installations.
Unit Ex 007– Perform visual & close inspection of electrical installations in or associated with explosive atmospheres	Unit Ex 003 or Unit Ex 004	Competencies in general electrical installation inspection are an alternative to the specific units listed in Column 2.
Unit Ex 008 – Perform detailed inspection of electrical installations in or associated with explosive atmospheres	Unit Ex 003 or Unit Ex 004	Competencies in general electrical installation inspection are an alternative to the specific units listed in Column 2.
Unit Ex 009 – Design electrical installations in or associated with explosive atmospheres		Competencies in designing electrical systems and installations.
Unit Ex 010 – Perform audit inspection of electrical installations in or associated with explosive atmospheres	Unit Ex 003 or Unit Ex 004 or Unit Ex 009	Competencies in general electrical installation inspection are an alternative to the specific units listed in Column 2.

Bibliography

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

IEC 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'*

IEC 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'*

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

IEC 60079-10-1, *Explosive gas atmospheres – Part 10-1: Classification of areas*

IEC 60079-10-2, *Explosive atmospheres – Part 10-2: Classification of areas – Combustible dust atmospheres*

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

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 apparatu*s

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

IEC 60079-17, *Electrical apparatus for explosive gas atmospheres – Part 17: Electrical installations inspection and maintenance*

IEC 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 60079-20-1, *Electrical apparatus for explosive gas atmospheres – Part 20-1: Data for flammable gases and vapours, relating to the use of electrical apparatus*

IEC 60079-20-2, *Electrical apparatus for explosive gas atmospheres – Part 20-2: Test methods and data – Classification of combustible dust materials*

IEC 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*

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

IEC 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*

IEC 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'*

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)*

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 61241-2-1, *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*

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 61892-7, *Mobile and fixed offshore units – Electrical installations – Part 7: hazardous ares*

IEC 60092-502, *Electrical installations in ships – Part 502: Tankers*

IEC 60092-506, *Electrical installations in ships – Part 506: Special Features – Ships carrying specific dangerous goods and materials hazardous only in bulk*

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*

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
Fax: + 41 22 919 03 00
info@iec.ch
www.iec.ch