

Explosion Protection: Regulations, Standards and Requirement for Electrical Installation, Inspection, Maintenance and Repair

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**Safety Case
Symposium 2019**
Singapore
Mar 26 - 27, 2019

Topics

- Hazardous Area and Explosion
- Regulations and Safety Case Relevant to Explosive Atmospheres
- International Standards for Electrical Installation, Inspection, Maintenance and Repair
- Knowledge, Skills and Competence of Personnel

Hazardous Area and Explosion

- **Hazardous area**

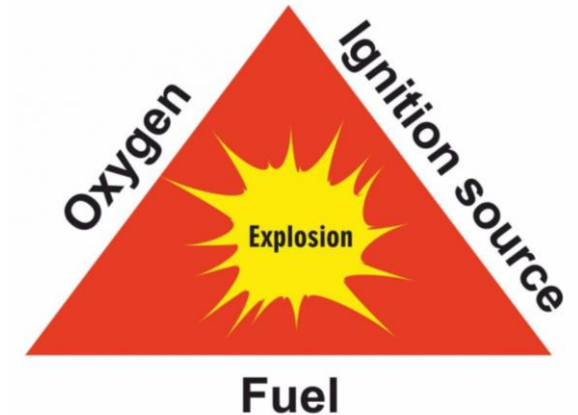
Area in which an explosive atmosphere is present or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of equipment

- **Explosive atmosphere**

Mixture with air, under atmospheric conditions, of flammable substances in the form of gas, vapour, dust, fibres, or flyings, which, after ignition, permits self-sustaining flame propagation

- **Explosion (in process industry)**

An explosion is defined as the process in which combustion occurs and spreads so rapidly as to create a high pressure, it forms a blast wave which travels outwards from the source, the blast wave has flame and high temperatures.



Fire/ Explosion
Triangle

Hazardous Area and Explosion

Typical industries with hazardous area

- Oil refineries, rigs – onshore / offshore
- Drilling ships and FPSOs
- Chemical processing plants
- Printing industries, paper and textiles
- Aircraft refueling and hangars
- Sewerage treatment plants
- Surface coating industries
- Grain handling
- Woodworking areas
- Sugar refineries
- Light metal working
- Underground coalmines



Ignition Sources (ref. EN 1127-1)

- Hot surfaces
- Flames and hot gases / particles
- Mechanically generated sparks
- **Electrical apparatus (equipment)**
- Static electricity
- Stray electric currents, cathodic corrosion protection
- Lightning
- RF Electromagnetic waves
- Electromagnetic radiation
- Ionising radiation
- Ultrasonics
- Adiabatic compression and shock waves
- Chemical / exothermic reactions



Regulations and Safety Case Relevant to Explosive Atmospheres

ATEX 137 (Directive 1999/92/EC) – Europe

8. 1. 2000

EN

Official Journal of the European Communities

L 23/57

DIRECTIVE 1999/92/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 1999

on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres (15th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

having regard to the Treaty establishing the European Community, and in particular Article 137 thereof,

having regard to the proposal from the Commission ⁽¹⁾, submitted after consultation with the Advisory Committee on Safety, Hygiene and Health Protection at Work and the Safety and Health Commission for the Mining and Other Extractive Industries,

having regard to the opinion of the Economic and Social Committee ⁽²⁾,

of workers at work ⁽⁴⁾; therefore, the provisions of the said Directive, in particular those relating to worker information, to the consultation and participation of workers and to the training of workers, are also fully applicable to cases in which workers are potentially at risk from explosive atmospheres, without prejudice to more restrictive or specific provisions contained in this Directive;

- (6) This Directive constitutes a practical step towards the achievement of the social dimension of the internal market;

- Within EU, the ATEX Directive 1999/92/EC sets out the minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres
- This directive is known as **‘ATEX 137’** or **‘ATEX Workplace Directive’**

ATEX 137 (Directive 1999/92/EC) – Europe

Obligations of the Employer

- Prevention of and protection against explosions
- Assessment of explosion risks
- General obligations, measures to ensure the safety and health of workers
 - Working environment for such that work can be preformed safely
 - Appropriate supervision during present of workers
- Duty of coordination
 - Measures and procedures where workers from several undertakings are present at the same workplace
- Places where explosive atmospheres may occur, employer shall
 - Classify areas into zones
 - Ensure minimum requirement in Annex II are applied (organization & explosion protection measures)
 - Mark with signs at the points of entry of explosive areas
- Provide the Explosion Protection Document
- Requirements for work equipment (ATEX equip.) and workplaces



Process Safety Management (PSM) – USA

- U.S. Occupational Safety and Health Administration (**OSHA**) has issued the Process Safety Management of Highly Hazardous Chemicals Standard, **29 CFR 1910.119**
- The standard emphasizes the management of hazards associated with highly hazardous chemicals.
- It contains requirement for preventing or minimizing the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals.
- Application for
 - A process which involves a chemical at or above the specified threshold quantities (listed in Appendix A of the standard)
 - A process which involves flammable liquid or gas (as defined in 1910.1200(c)) on site in one location, in a quantity of 10,000 pounds (4,535.9kg) or more, except for...

Process Safety Management (PSM) – USA

OSHA CFR 1910.119 (14 elements)

Process Safety Management



U.S. Department of Labor
Alexis M. Herman, Secretary

Occupational Safety and Health Administration
Charles N. Jeffress, Assistant Secretary

OSHA 3132
2000 (Reprinted)

- Employee Participation
- Process Safety Information
- Process Hazard Analysis
- Operating Procedures
- Training
- Contractors Safety Management
- Pre-startup Safety Review
- Mechanical Integrity of Equipment
- Hot Work Permit
- Management of Change
- Incident Investigation
- Emergency Planning and Response
- Compliance Audits
- Trade Secrets

Safety Case – Singapore

Technical Guide: Adequate Safety and Reliability in Design

- Design key issue 10: systems for identifying locations where flammable substances could be present

- 199 MHIs shall explain how potentially hazardous (flammable and explosive atmosphere) areas have been identified and classified. This may have been through an area classification study in which those areas where a risk exists, owing to the normal, occasional or accidental release of process materials to atmosphere, have been designated in accordance with recognised standards.
- 200 Sources of ignition for flammable atmospheres may include electrical equipment, naked flames or hot surfaces, and static electrical discharge. MHIs shall indicate how the likely sources of ignition have been considered in the design, for example:
- a) electrical equipment selection for defined hazardous areas;
 - b) avoidance of hot surfaces or naked flames, or sparks associated with equipment, such as through the use of spark arrestors; and
- 202 Equipment selected for use in hazardous areas shall be suitable for use in these areas under all foreseeable operating conditions, including normal operation, start-up, shutdown, emergency, cleaning, or any other expected condition throughout the life of the installation.



Safety Case – Singapore

Assessment Guide: for Electrical, Control & Instrumentation

- The General Approach to EC & I Assessment

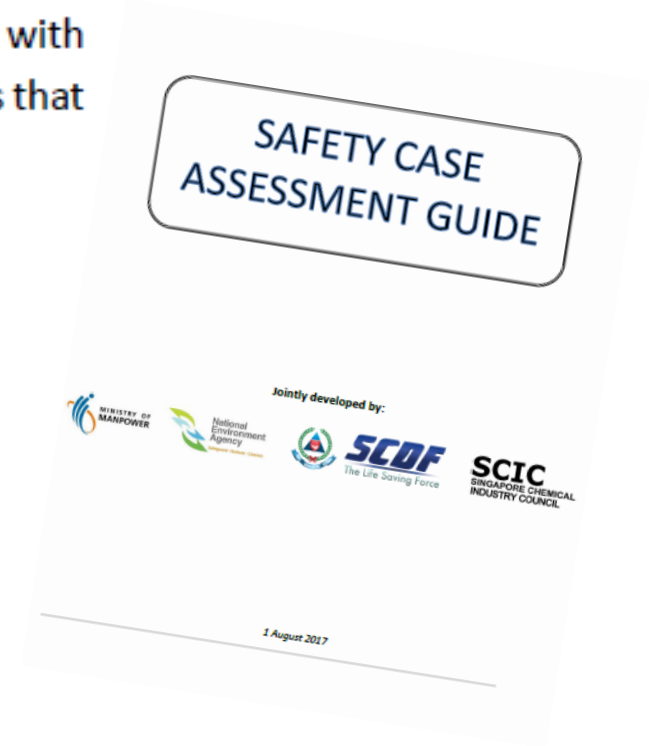
Explosive and/or Flammable Atmospheres

2.4. In the context of EC&I inspection, explosive and/or flammable atmospheres are concerned with the management, design, installation, operation, maintenance and modification of systems that reduce the risk of electrical sources of ignition arising from:

- electrical and instrumentation equipment;
- lightning;
- static;

and the mitigation of releases using:

- flammable gas detection;
- fire detection.



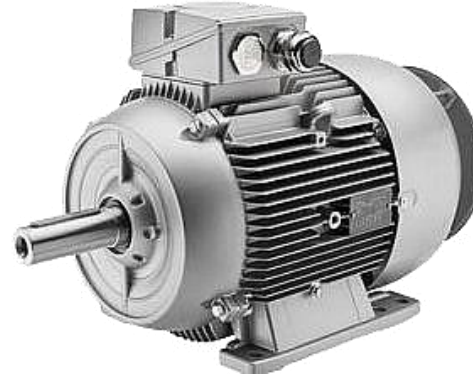
Electrical and Instrument Equipment (samples)



Ex d
Flameproof



Ex e
Increased Safety



Ex n
Non-sparking



Ex p
Pressurized enclosure

Electrical and Instrument Equipment (samples)



Ex i
Intrinsic Safety

Ex m
Encapsulation

Ex o
Oil Immersion

Ex t/ tD
Dust protection

Electrical and Instrument Equipment: Certified Ex equipment

Ex equipment: apparatus, fittings, devices, components, and the like used as a part of, or in connection with, an electrical installation in an explosive atmosphere



IECEx Certificate of Conformity

INTERNATIONAL ELECTROTECHNICAL COMMISSION
IEC Certification Scheme for Explosive Atmospheres
for rules and details of the IECEx Scheme visit www.iecex.com

Certificate No.:	IECEx TUR 16.0025X	Issue No: 0	Certificate history: Issue No. 0 (2016-07-06)
Status:	Current	Page 1 of 3	
Date of issue:	2016-07-06		
Applicant:	SAMCON Pro Schillerstraße D-35102 Lohr Germany		
Equipment:	ExConnection		
Optional accessory:			
Type of Protection:	d, I, b, Ia, Ib, op		
Marking:	Basic marking Ex d IIC T5 Gb Ex t IIIC T55 Optional and:		
Approved for issue on behalf of the IECEx Certification Body:			
Position:			
Signature: (for notified version)			

(1) TYPE-EXAMINATION CERTIFICATE

(2) Equipment and Protective Systems intended for use in Potentially Explosive Atmosphere - Directive 94/9/EC

(3) Type-Examination Certificate Number

TÜV 15 ATEX 7687 X

(4) Equipment: Michell Controller pz Purge System (Ex pz system)

(5) Manufacturer: ABB Pte Ltd



International Standards for Electrical Installation, Inspection, Maintenance and Repair

Safety Case – Singapore

Assessment Guide: for Electrical, Control & Instrumentation

To meet requirement:

- Application of **E&I design standard**: Singapore Standard, **Commonly used international standards** (e.g. EN, BS, API, ISO, IEC), Other national standards, Industry standards, ...
 - applied to the **design and selection of explosion protection (Ex) equipment**
 - applied to the **construction verification of explosion protected (Ex) equipment**
 - applied to the **maintenance and inspection of equipment** in explosive and / or flammable atmospheres, including fixed and mobile equipment e.g. periodic Ex inspection records for Ex d, e, n, i, tD from IEC 60079 / 61241.
- How it has been assured that **competent persons are involved in the selection and installation** of equipment and protective systems designed to be safe in explosive and / or flammable atmosphere.
- How the **maintenance and inspection of equipment** in explosive and / or flammable atmospheres, including fixed and mobile equipment is managed, and also record of **competence of the persons who carried out the inspection**.

International Standards: Application for E & I in explosive areas



IEC 60079-10-1

INTERNATIONAL
STANDARD



IEC 60079-14

INTERNATIONAL
STANDARD



IEC 60079-17

Edition 4.0 2007-09

INTERNATIONAL
STANDARD



IEC 60079-19

Edition 3.0 2010-11

NORME
INTERNATIONALE

INTERNATIONAL
STANDARD

NORME
INTERNATIONALE

Explosive atmospheres –
Part 10-1: Classification of areas – Explosive

Explosive atmospheres –
Part 14: Electrical installations design, s

Atmosphères explosives –
Partie 14: Conception, sélection et const

Explosive atmospheres –
Part 17: Electrical installations inspection

Atmosphères explosives –
Partie 17: Inspection et entretien des inst

Explosive atmospheres –
Part 19: Equipment repair, overhaul and reclamation

Source: <https://webstore.iec.ch/>



Webstore

International Electrotechnical Commission



International Standards: Application for E & I in explosive areas

International Standards (IEC & EN, identical as)	Constructional Standards (for Users)	Gas G Dust D
IEC 60079-10-1	Explosive atmospheres, Classification of areas – explosive gas	G
IEC 60079-10-2	Explosive atmospheres, Classification of areas – explosive dust	D
IEC 60079-14	Explosive atmospheres, Electrical installations design, selection and erection	G & D
IEC 60079-17	Explosive atmospheres, Elec. installations inspection and maintenance	G & D
IEC 60079-19	Explosive atmospheres, Equipment repair, overhaul and reclamation	G & D
ISO/IEC 80079-20-1	Material Characteristics for Gas/Vapour Classification - Test methods and data	G
ISO/IEC 80079-20-2	Material Characteristics - Combustible dust test methods	D

Source: <https://webstore.iec.ch/>



Knowledge, Skills and Competence of Personnel

Knowledge, Skills and Competence of Personnel

IEC 60079-14:2013

- The **design of the installation**, the **selection of equipment** and the **erection** covered by this standard shall be carried out only by persons whose training has included instruction on the **various types of protection and installation practices**, relevant rules and regulations and on the **general principles of area classification**.
- The **competency of the person shall be relevant to the type of work to be undertaken** (see Annex A).
- Appropriate continuing education or training shall be undertaken by personnel on a regular basis.

IEC 60079-17:2013

- The **inspection and maintenance of installations** shall be carried out only by **experienced personnel**, whose training has included instruction on the **various types of protection and installation practices**, the requirements of this standard, the relevant national regulations / company rules applicable to the installation and on the **general principles of area classification** (see Annex B).
- Appropriate continuing education or training shall be undertaken by personnel on a regular basis.
- Evidence of the relevant experience and training claimed shall be available.

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

Knowledge, Skills and Competence of Personnel

- Why Personnel Competence is important?



... to avoid these mistakes

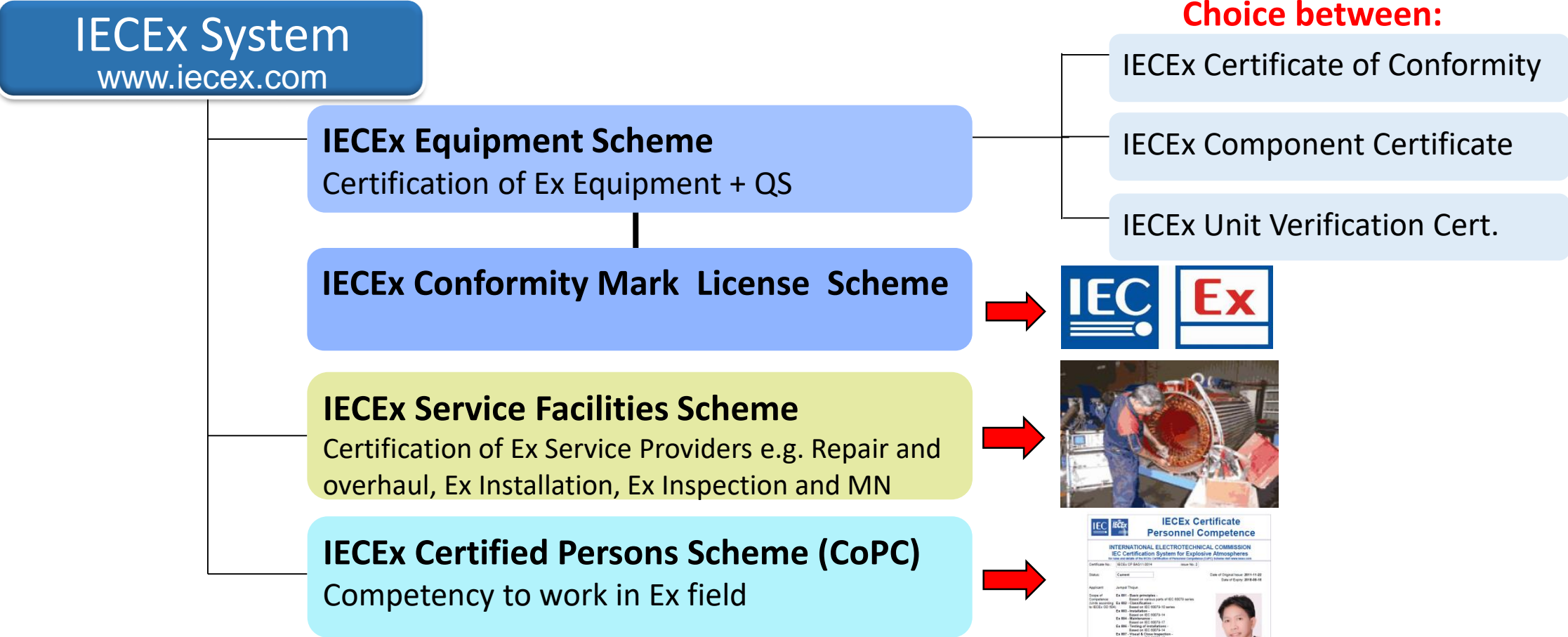
Knowledge, Skills and Competence of Personnel

- **Why Personnel Competence is important?**



... to avoid these mistakes

Schemes within IECEx System



IECEx Certified Person Scheme (CoPC)

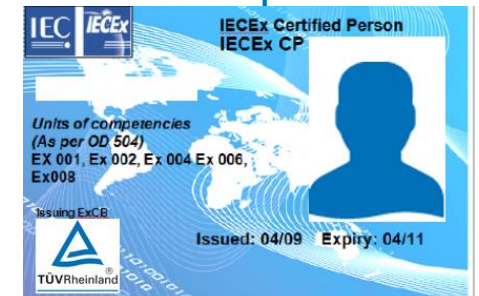
Units of Competence for CoPC

TUV Rheinland – RTP and Certification Body acc. to IECEx system



Training and certification of personnel competence CoPC (accredited under IECEx 05 scheme)


- Unit Ex 000 – Basic knowledge and awareness to enter a site that includes a classified hazardous area
- 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



The suggested units of competence for the job functions

Position/Job Function	Suggested Unit of Competence
None-Technical	Ex 000 Basic knowledge and awareness to enter a site
Plant Manager	Ex 001 Apply basic principles of protection in explosive atmospheres
Safety Manager	Ex 001 Apply basic principles of protection in explosive atmospheres Ex 002 Perform classification of hazardous areas
Site Supervisor and Inspector	Ex 001 Apply basic principles of protection in explosive atmospheres Ex 003 Install explosion-protected equipment and wiring systems Ex 004 Maintain equipment in explosive atmosphere Ex 006 Test electrical installations in or associated explosive atmospheres Ex 008 Perform detailed inspection of electrical installations
Technician (Installer, Inspector)	Ex 001 Apply basic principles of protection in explosive atmospheres Ex 003 Install explosion-protected equipment and wiring systems Ex 004 Maintain equipment in explosive atmosphere Ex 007 Perform visual and close inspection of electrical installations
Engineer Designers	Ex 002 Perform classification of hazardous areas Ex 009 Design electrical installations in or associated explosive atmospheres
Ex-Auditors	Ex 010 Perform audit inspection of electrical installations

IECEx CoPC: Online Certificate and ID Card (sample)



International Electrotechnical Commission System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres (IECEx System)

CERTIFIED EQUIPMENT

CONFORMITY MARK LICENSES

CERTIFIED SERVICE FACILITIES

CERTIFIED PERSONS

TOOLS

Information

IEC System for Certification to Standards relating to Equipment for use in Explosive Atmospheres (IECEx System)
IECEx Certificates of Personnel Competence Scheme enables:
IECEx Certification Bodies to issue new IECEx Certificates of Personnel Competence On-line.
Full Public access to consult, view and print issued IECEx Personnel Competence Certificates.
[Click here for a link to the INSTRUCTIONS FOR USE.](#)
For any questions, please contact Mr. Chris Agius, IECEx Secretary.

Available on the App Store

ANDROID APP ON Google play

Personnel Competence Certificates (CoPC)

Assessment Reports (PCAR)

Ex Facility Orientation Certificates (EFOC)

Certificate no.

Year

ExCB

Location

Competence

Applicant

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Total Certificates found : 96

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Certificate no.	Date	ExCB	Location	Competence	Applicant
IECEx CP BAS16.0015 Issue 0	2016-10-03	BAS	Singapore	Ex 001	Vimalasekaran Began
IECEx CP DEK16.0024 Issue 0	2016-08-11	DEK	Singapore	Ex 001	Kwan Kum Nyin
IECEx CP BAS16.0010 Issue 0	2016-06-22	BAS	Singapore	Ex 001	Chandiran Kumar
IECEx CP TUR16.0009 Issue 0	2016-05-25	TUR	Singapore	Ex 001	Yeo Kim Ann





IECEx Certificate
Personnel Competence

INTERNATIONAL ELECTROTECHNICAL COMMISSION
IEC Certification System for Explosive Atmospheres

for rules and details of the IECEx Certification of Personnel Competence (CoPC) Scheme visit www.iecex.com

Certificate No.: IECEx CP BAS11.0014


Issue No.: 2

Status: Current

Date of Original Issue: 2011-11-22

Date of Expiry: 2018-08-18

Applicant: Jumpol Thojun



Scope of Competence: (Units according to IECEx OD 504)

Ex 001 - Basic principles -
Based on various parts of IEC 60079 series

Ex 002 - Classification -
Based on IEC 60079-10 series

Ex 003 - Installation -
Based on IEC 60079-14

Ex 004 - Maintenance -
Based on IEC 60079-17

Ex 006 - Testing of installations -
Based on IEC 60079-14

Ex 007 - Visual & Close Inspection -
Based on IEC 60079-17

Ex 008 - Detailed Inspection -
Based on IEC 60079-17

Ex 009 - Design Electrical Installations -
Based on IEC 60079-14

Ex 010 - Audit Inspection -
Based on IEC 60079-17

For Detailed Information on Scope Application in accordance with IECEx OD 502 click on PCAR Number below:

PCAR Reference No.: [GB/BAS/PCAR11.0014/00](#)
[GB/BAS/PCAR11.0014/01](#)
[GB/BAS/PCAR11.0014/02](#)



This certificate is issued as verification that the Applicant was assessed and found to comply with the IECEx CoPC Scheme requirements, relating to the scope of Competence and referenced Standards listed above. This certificate is granted subject to the conditions as set out in IECEx CoPC Scheme Rules, IECEx 05 as amended.

Approved for issue on behalf of the IECEx Certification Body: R S Sinclair

Position: Technical Director


1. This certificate and schedule may only be reproduced in full.
2. This certificate is not transferable and remains the property of the issuing body.
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9RZ
United Kingdom



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Ex protection: Regulations and Application (by Jumpol Thojun)



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ExCBs for Certification of Personnel Competence (IECEX CoPC)

Country	Identifier
AUSTRALIA	SEEG
AUSTRALIA	TSI
BRAZIL	UL do Brasil
CANADA	QPS
FRANCE	INERIS
GERMANY	TUV Rheinland
GERMANY	TUV SUD PS
MALAYSIA	SIRIM
NETHERLANDS	DEKRA KEMA
NETHERLANDS	PBNA
NORWAY	Presafe/DNV
NORWAY/SOUTH	TRAINOR
KOREA/VIETNAM	
UNITED KINGDOM	SGS BASEEFA
UNITED KINGDOM	SIRA
UNITED STATES OF AMERICA	UL

Country: GERMANY

Name: TÜV Rheinland Industrie Service GmbH

Identifier: TUV Rheinland

Logo:



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Scope:

Ex 000: Basic knowledge and awareness

Ex 001: Apply basic principles of protection in explosive atmospheres

Ex 002: Perform classification of hazardous areas

Ex 003: Install explosion-protected equipment and wiring systems

Ex 004: Maintain equipment in explosive atmospheres

Ex 005: Overhaul and repair of explosion-protected equipment

Ex 006: Test electrical installations in or associated with explosive atmospheres

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

Ex 008: Perform detailed inspection of electrical installations in or associated with explosive atmospheres

Ex 009: Design electrical installations in or associated with explosive atmospheres

Ex 010: Perform audit inspection of electrical installations in or associated with explosive atmospheres

Scope is according to IECEx Operational Document OD 504

<http://www.iecex.com/information/excbs/certified-persons/>

Thanks for your attention

Jumpol Thojun

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