expo Technologies

Protection of electrical equipment in hazardous areas by purge & pressurization – overview of changes to IEC standard 60079-2

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Speaker / author introduction

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Steve joined Expo Technologies in 2016 after a lengthy career including spells in industrial gases, chemicals, vacuum systems & gas scrubbing technology.

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Martha joined Expo Technologies in 2005, becoming Certification Director in 2014. She is responsible for certification of both Expo products and customer projects.

Martha is on the EXL/31 committee, representing GAMBICA

Expo Technologies

We are a world leading company supplying premier engineered products and services to companies working in hazardous areas, including:

- Oil and gas extraction & refining
- Petrochemical production
- Chemical manufacture
- Pharmaceutical manufacturing
- Hydrogen energy infrastructure

We specialise in solutions using Purge & Pressurization

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ATEX ISO 9001

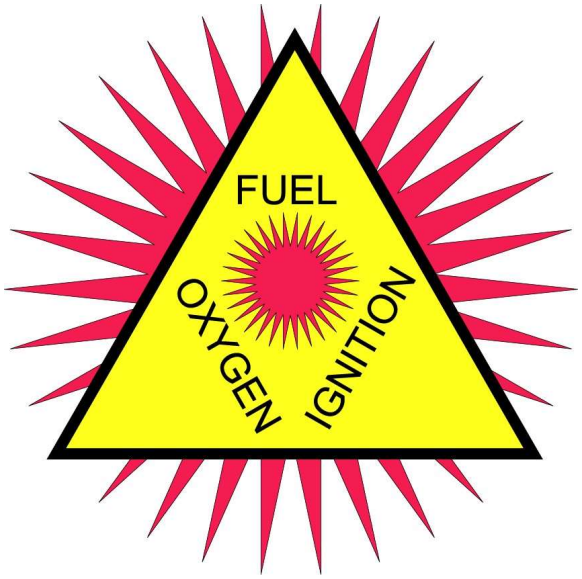
Purpose of this presentation

- Installation of electrical equipment in hazardous areas is heavily regulated
- Regulation is controlled through codes and standards, issued by many countries or economic blocks
- Codes & standards are regularly reviewed and updated by relevant committees
- This presentation discusses some areas of revision **proposed** for the 2023 edition 7 of IEC standard 60079-2 - Equipment protection by pressurized enclosure "p"

Note that this conference takes place before final standard is issued

Protection Method	Ex Code	Standard IEC / EN / BS / ANSI/ISA
Intrinsic Safety	ia ib ic	60079-11
Flameproof	da db dc	60079-1
Protection by Enclosure	ta tb tc	60079-31
Pressurisation	pxb pyb pzc	60079-2
Increased Safety	eb ec	60079-7
Encapsulation	ma mb mc	60079-18
Liquid Immersion	ob oc	60079-6
Powder Filling	q	60079-5
Hermetically Sealed / Non-Incendive Restricted Breathing	nC nR	60079-15
Pressurised Room	px py pz pv	60079-13
Optical Radiation	op sh op is op pr	60079-28
Special Protection	sa sb sc	60079-33
Non-electrical Equipment - Basic Method and Requirements	h	ISO 80079-36

Refresher – hazardous areas (1)

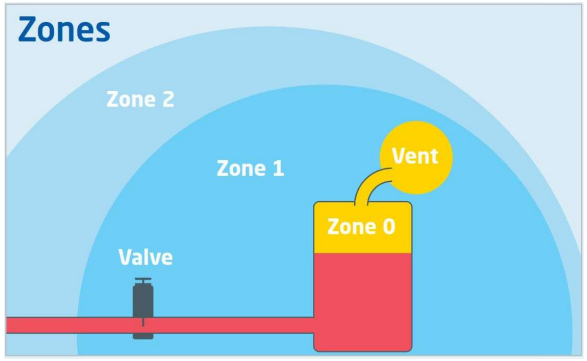


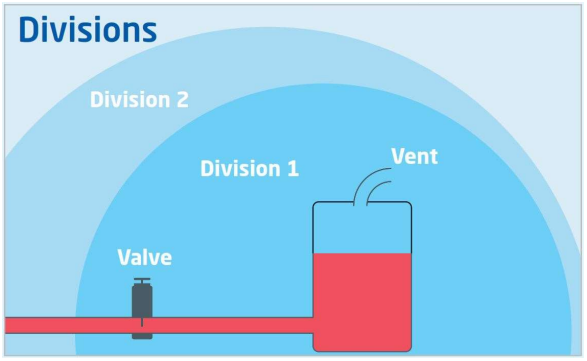
For an explosion to occur, 3 conditions must exist:

- Explosive material is present in a suitable concentration
- The presence of air or oxygen
- A source of ignition

Approved protection methods require the elimination of one of these 3 factors

Refresher – hazardous areas (2)





Zone system used with UKCA, ATEX, IECEx and many local standards

- Zone 0/20: > 1000 hours /year
- Zone 1/21: 10 to 1000 hours/year
- Zone 2/22: < 10 hours/year

Class & Division system primarily used in North America

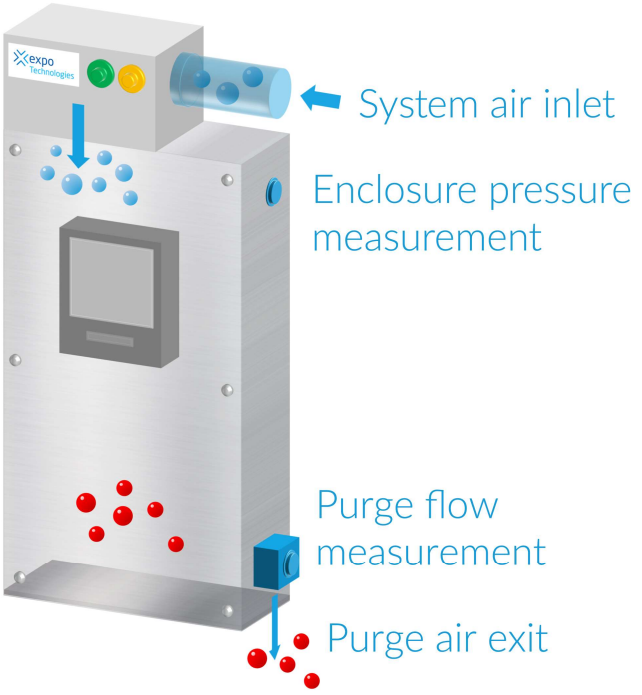
- Class I & II Div 1: > 10 hours /year
- Class I & II Div 2: < 10 hours/year

Refresher – most common protection methods

Containment	Prevention	Exclusion
Any flame or explosion is contained within the equipment and cannot ignite an explosive atmosphere outside	Elimination of sparks, limitation of electrical energy	Any potentially explosive atmosphere is prevented from coming into contact with the electrical equipment
Flameproof/ Explosion-proof Ex d	Increased safety Ex e Intrinsic safety Ex i	Encapsulation Ex m Pressurization Ex p
IEC 60079-1	IEC 60079-7 IEC 60079-11	IEC 60079-18 IEC 60079-2

Refresher – Purge & Pressurization

Step 1 - Purge



Action	The purge system supplies clean, dry instrument air to the enclosure at a high flow rate for a pre-set time, expelling any potentially flammable atmosphere remaining inside.
Monitoring	Enclosure pressure and purge flow
Equipment status	The enclosure contents are not energised

Refresher – Purge & Pressurization

Step 2 - Pressurization

Action	After purge is complete, the system supplies sufficient air to maintain a constant pressure inside the enclosure, compensating for any small leaks, preventing ingress of the outside atmosphere.
Monitoring	Enclosure pressure
Equipment status	The enclosure contents can be energised

Purge & Pressurization standard: IEC 60079-2

- The 6th edition was published in 2014. After the latest review process, we now have sight of the final draft of Edition 7 which is due to be published in May 2023.
- The introduction to the standard helpfully lists the various updates proposed and highlights 38 "Major Technical Changes. For simplicity, we have grouped some major changes into four broad areas:

1. Added clarity regarding the integral parts of pressurized equipment and its requirements.
2. Changes around the pressurization control system – for instance, clarification of the safety devices and safety control functions required, and how they should be verified before use.
3. Relaxation of some previous restrictions around low-powered cells & batteries used for computer backup
4. Introduction of gas leak detection as a possible mitigation method for some systems with an Internal Source of Release

Focus on key change #1 - Pressurized Equipment (1)

Pressurized Equipment

- Pressurization Control System
- Equipment contained in the enclosure
- Pressurized Enclosure

A pressurization control system with a separate certificate shall be marked as follows or equivalent:

ATTENTION - THE CERTIFICATE ON THIS PRESSURIZATION CONTROL SYSTEM IS ONLY FOR THE IDENTIFIED PARTS OF THE CONTROL SYSTEM. THE PRESSURIZED EQUIPMENT REQUIRES A SEPARATE CERTIFICATE

Focus on key change #1 - Pressurized equipment (2)

Edition 7 includes a whole new section on the constructional requirements for pressurized equipment, separated from the requirements for the pressurized enclosure or the pressurization control system

One addition refers to the "Bypass or Override function":

"If the pressurized equipment is provided with a bypass, override or 'maintenance switch' function that permits the equipment in the pressurized enclosure to be powered without the pressurization protection being active, then the control for this function shall be secure (e.g.: a key or a password) and the equipment shall provide a method to continuously indicate that it is in this mode."

Details of the function shall be provided in the user instructions.

There was no provision for a bypass or override function in Edition 6

Focus on key change #2 - Safety devices and safety control functions (1)

The "control functions" of the pressurization control system are now defined as the safety related parts that require evaluation:

Safety devices based upon Level of Protection (extract from Table 3, Edition 6)

Design criteria	Level of Protection "pxb"
Safety device to detect loss of minimum overpressure	Pressure sensor, see 7.11
Safety device(s) to verify purge period for Group I and Group II	Timing device, pressure sensor, and flow sensor at outlet; see 7.7

Control functions based upon Level of Protection (extract from Table 5, Edition 7)

Control Function Design criteria	Level of Protection "pxb"
method to detect loss of minimum pressurization overpressure	Pressure sensor or switch, see 8.8 Including expected malfunctions
method to verify purge period for Group I and Group II	see 8.4 and 8.5 Including expected malfunctions

For Level of Protection "pxb", every element associated with each control function shall be evaluated, by analysis, and if required by test, so that in normal operation and under expected malfunctions, the pressurization control system does not permit an unsafe condition.

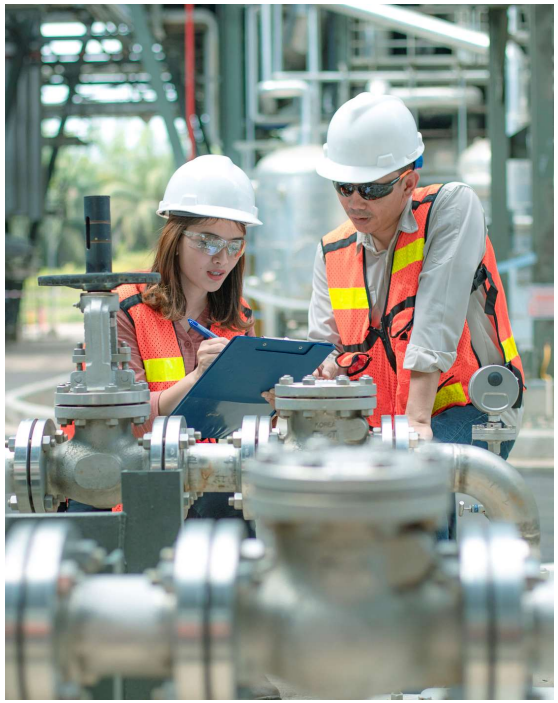
Focus on key change #2 - Safety devices and safety control functions (2)

Provider of safety devices

Edition 6: the required safety devices could be provided by the manufacturer or the user.

To align this standard with the installation requirements in IEC 60079-14, Edition 7 requires that the safety devices and control functions provided by the pressurization control system shall be provided by the manufacturer.

- Additionally, the user instructions shall include:
  - The method to verify the safety device /control function
  - The maximum interval between verifications
  - That the verifications shall be performed prior to commissioning.

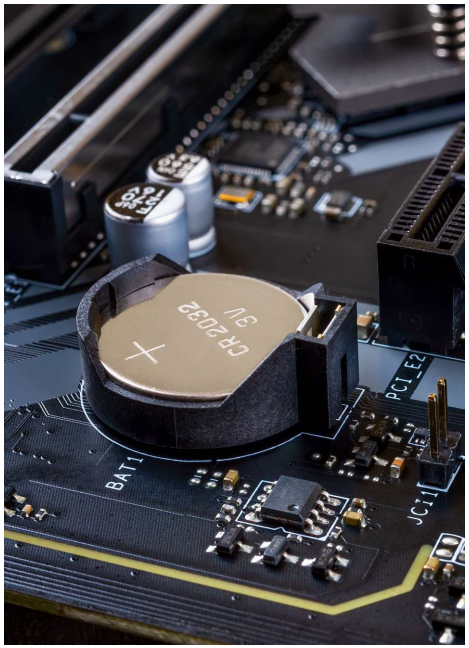


Focus on key change #3 - Cells & batteries (1)

For small cells or batteries used for local memory or BIOS power backup applications:

- Edition 6 required a full technical assessment, of the cell or battery and its circuitry, for safe use for EPL Gb and Db,
- Edition 7 enables faster assessment by permitting primary or secondary cells or batteries (voltage ≤ 5 V / total capacity ≤ 2,5Ah), installed within a pressurized enclosure solely do not require any further consideration if certain requirements are met.

- Must be a cell or battery type identified in IEC 60079-0 (fairly generic)
- Warning labels are required inside and outside of the enclosure



Focus on key change #3 - Cells & batteries (2)

The next crucial change is that IEC 60079-2 Edition 7 provides a method for the use of other cells and batteries (not used for memory backup applications), without the laborious technical assessment required on Edition 6, facilitating the installation of most types of cells and batteries within a pressurized enclosure - providing the general requirements above are complied with.

From Clause 12.3 Other cell and battery types:

For EPL Mb, Gb and Db, the cell or battery shall be removed from the pressurized enclosure if pressurization is lost for more than 12 h. The following warning is required:

WARNING – THIS PRESSURIZED ENCLOSURE CONTAINS A CELL OR BATTERY WHICH REMAINS CONNECTED AFTER THE EXTERNAL POWER HAS BEEN ISOLATED. REMOVAL OF THE CELL OR BATTERY IS REQUIRED IF THE ENCLOSURE IS TO REMAIN UNPROTECTED BY Ex "p" FOR LONGER THAN 12 HOURS. VERIFY THERE IS NO EXPLOSIVE ATMOSPHERE PRIOR TO REMOVING.

Focus on key change #4 - Leak detection in ISoR cases (1)

Internal Source of Release - point or location from which a flammable substance in the form of a flammable gas or vapour or liquid may be released into the pressurized enclosure such that in the presence of air an explosive gas atmosphere could be formed.

If sample is non-flammable (inert gas or liquid, or flammable gas in a concentration below its lower flammable limit) then any leak will generally not cause a dangerous situation if it comes into contact with live electrical equipment.

If sample is flammable (flammable gas in a concentration between its lower and upper flammable limits in air, or any flammable liquid) then any leak will potentially cause a dangerous situation if it comes into contact with live electrical equipment.

Focus on key change #4 - Leak detection in ISoR cases (2)

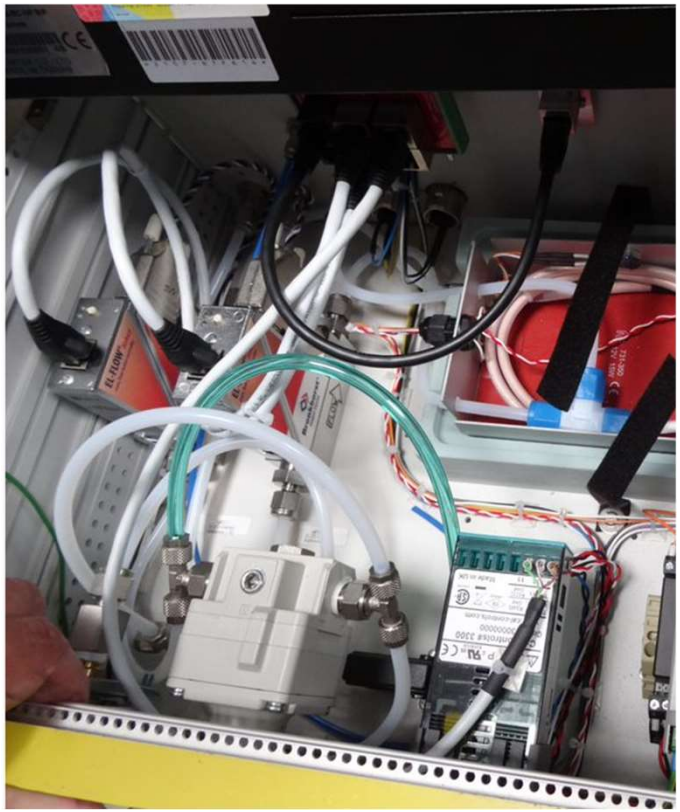
Further considerations around how the piping (containment system) is constructed – unless it is fully welded, then it would be considered to have potential to leak ("release")

Which is the case of most types of analysers bringing a gas sample into the pressurized enclosure

Existing possible mitigation includes:

- Partitioning to separate electrical equipment (ICE) from sample system
- Dilution by continuous flow to <25% of the LFL, with focus around ICE
- Maintaining the sample pressure below the enclosure pressure

Certification is possible, with Notified Bodies considering each system on a case-by-case basis



Focus on key change #4 - Leak detection in ISoR cases (3)

Edition 7, it is possible to add a leak detection device such as:

- Gas detector.
- Spill detector or liquid level detector
- Excess flow detection

This allows to classify the containment systems as “No normal release, with limited abnormal release” and may facilitate the application of Purge & Pressurization with Continuous Dilution with Air or Inert gas or Leakage compensation with inert gas.

Summary

- Multiple approved methods exist to protect electrical equipment in hazardous areas. Each method has advantages, disadvantages, and limitations
- While Purge & Pressurization is a very flexible method, the current standard naturally includes limitations, including
  - Use of cells and batteries
  - Applications where flammable gases and vapours may be present inside the enclosure
- Limitations have been changed or clarified in some key areas, potentially allowing manufacturers and users additional scope for certification, without compromising safety.
- Additional clarifications have been introduced around construction & use of "Pressurized Equipment"

IEC

31/1636/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: IEC 60079-2 ED7	
DATE OF CIRCULATION: 2022-09-02	CLOSING DATE FOR VOTING: 2022-11-25
SUPERSEDES DOCUMENTS: 31/1560/CD, 31/1565A/CC	

IEC TC 31 : EQUIPMENT FOR EXPLOSIVE ATMOSPHERES

SECRETARIAT: United Kingdom	SECRETARY: Mr Tom Stack
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.

FUNCTIONS CONCERNED:

☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☒ SAFETY

☒ SUBMITTED FOR CENELEC PARALLEL VOTING	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

Attention IEC-CENELEC parallel voting

The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting.

The CENELEC members are invited to vote through the CENELEC online voting system.

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Thank you for your attention.

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