

Advanced Solutions for Hazardous Area Process Analyzers

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ABSTRACT

Installing gas and liquid process analyzers in hazardous environments demands specialized protection solutions to ensure safety, reliability, and compliance with codes and standards.

The most applied protection methods focus on containment—using explosion-proof enclosures—and exclusion—through the application of purge and pressurization.

This paper discusses the pros and cons of both methods, with specific reference to their suitability for gas analyzers, before exploring purged and pressurized (Ex p) enclosure solutions. It will also explore the construction, certification requirements, and applications for hazardous areas and examine different purge system types (X, Y, and Z, leakage compensation, and continuous dilution). Additionally, it will review key considerations for designing custom enclosures capable of accommodating complex analyzer systems.

Specific attention is given to the challenges of working with flammable and non-flammable analytes and mitigation strategies such as continuous flow (dilution) and temperature control.

This paper illustrates the technical methods and best practices that enable safe analyzer operation in hazardous areas through real-world case studies, emphasizing certified approaches to address the diverse needs of process industries.

INTRODUCTION

Process analyzers are critical in industrial environments, providing real-time data to monitor and optimize production processes. However, specialized protection methods are necessary to ensure safety and regulatory compliance when these analyzers are installed in hazardous locations—where flammable gases, vapors, or liquids may be present.

Two primary protection approaches are commonly employed: containment, which utilizes explosion-proof enclosures, and exclusion, which relies on purge and pressurization (Ex p) techniques. While both methods are viable, their suitability varies depending on the application, regulatory requirements, and environmental conditions. This paper explores the advantages and limitations of these methods, with a particular emphasis on Ex p solutions for analyzer enclosures.

This paper examines the relevant hazardous area classification systems and certification standards—including NFPA, NEC, and IECEx—to provide insights into the regulatory landscape and the challenges of achieving compliance. Additionally, the discussion extends to key considerations in designing and implementing Ex p systems, including enclosure construction, purge methodologies (X, Y, Z), thermal management, and risk mitigation for flammable and non-flammable samples.

This paper illustrates best practices in hazardous area analyzer installations through real-world case studies, highlighting innovative solutions that address industry challenges while ensuring safety, reliability, and compliance.

1. UNDERSTANDING HAZARDOUS AREA CLASSIFICATIONS, CERTIFICATION REQUIREMENTS AND PROCESSES

DEFINING THE SCOPE OF THE HAZARD

While we are familiar with the terms used for classifying hazardous areas, such as zones, classes, and divisions, the process of defining why and how areas of a facility should be classified is less familiar. Hence, the following paragraphs briefly describe the process. Note that the discussion is confined to flammable liquids, vapors, and gases and does not consider combustible dusts.

There are 2 approaches to area classification - by direct analogy with typical installations that are described in established codes – for instance, the characteristics of a vehicle refueling station, the fuels, pumps, and tanks are well known - or by more quantitative methods that require specific knowledge of the plant in question.

The starting point is to identify sources of release. These may arise from constant activities, from time to time in normal operation, or as the result of some unplanned event. Catastrophic failures, such as vessel or line rupture are not typically considered by an area classification study.

For North America, the applicable standard is NFPA 497 Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas (2024)

Internationally, the standard is IEC 60079-10-1: 2020. Explosive atmospheres - Part 10-1: Classification of areas - Explosive gas atmospheres

Whatever process is followed, areas of the facility will be designated according to the risk of flammable substance release identified. Again, there are different systems for North America and internationally.

North America: Class & Division

Class I: A location made hazardous by the presence of flammable gases or vapors that may be present in the air in quantities sufficient to produce an explosive or ignitable mixture

Division 1	A location where a classified hazard exists or is likely to exist under normal conditions
Division 2	A location where a classified hazard does not normally exist but is possible to appear under abnormal conditions

International: Zones

Zone 0	An area in which an explosive gas atmosphere is continuously present for a long period of time
Zone 1	An area in which an explosive atmosphere is likely to occur in normal operation
Zone 2	An area in which an explosive gas atmosphere does not normally exist

Currently, there are efforts in North America to harmonize systems, and increase alignment between the Class & Division system and the Zone system. In the US, all

installations (both new and existing) can either continue using the Class & Division system or re-classify using the three- (3) Zone system. While in Canada, all new installations must use the three- (3) Zone system. Existing installations in Canada may continue to use the Class & Division system or opt to re-classify using the three- (3) Zone system. This is typically determined by the authority having jurisdiction over the area of installation, and in consultation with the end user, in some cases.

Further definition of the risk is required based on the specific properties of the material(s) that may be released. Materials are allocated to broad “Groups”, that again differ depending on the overall classification system.

Table 01 is a summary of these group classifications for common gases.

	USA (NEC500) / Canada (CEC)	IEC / ATEX
Acetylene	Group A	Group IIC
Hydrogen	Group B	
Ethylene	Group C	Group IIB
Methane	Group D	Group IIA
Propane	Group D	Group IIA

ENSURING ELECTRICAL EQUIPMENT IS SAFE TO USE

Once the hazard is defined, then the focus moves to ensuring that all electrical equipment to be used in the area is not capable of causing ignition.

While multiple approved methods exist to achieve this, the focus of this paper is on two methods – containment - through the use of explosion-proof enclosures (known as flameproof under the Zone system), and exclusion - through the application of purge & pressurization to the enclosure.

The requirements for safe use of either protection method are defined in a range of codes and standards:

USA (Class/Division): Explosion-proof NEC 500 / ANSI/UL 1203; Purge & Pressurization NEC 500 / NFPA496

International (Zone) : Flameproof IEC60079-1; Purge & Pressurization IEC60079-2

In the case of the International (Zone) system, there are region-level & country-level variants, such as ATEX in the European Union.

A brief comparison of these protection methods under the 2 different standard systems is given in the next section, with especial reference to their global acceptance.

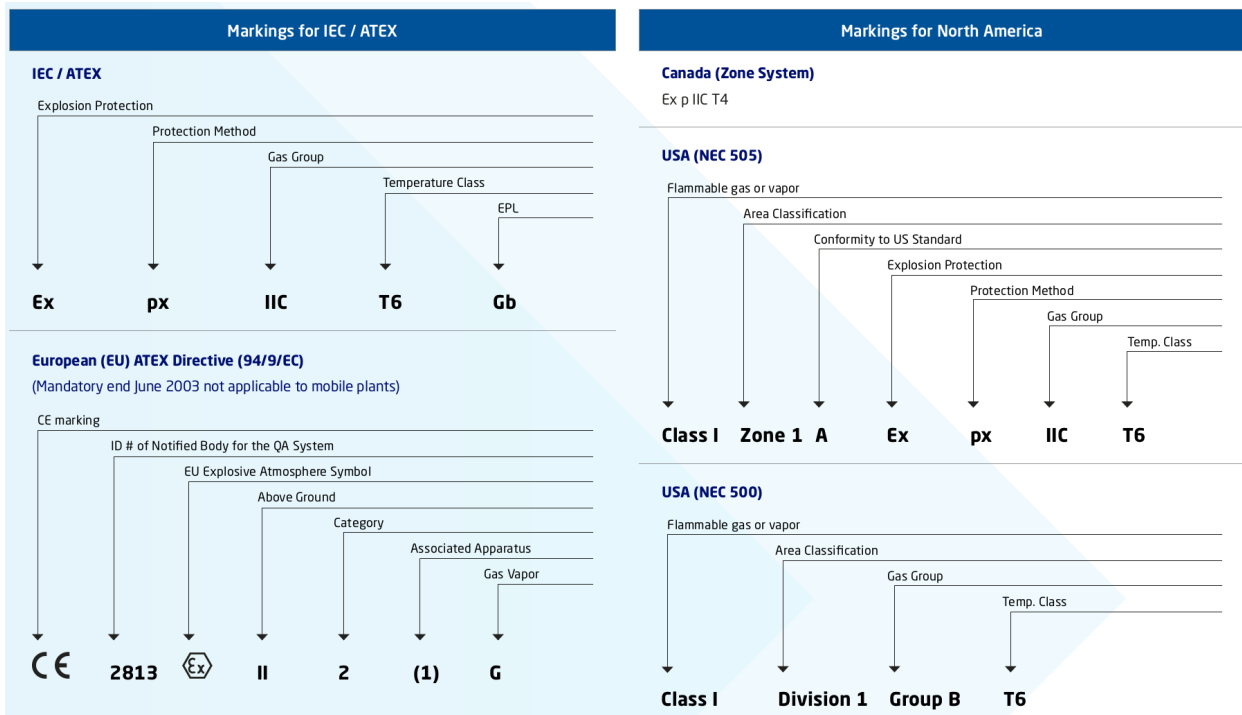
The process of evaluation, testing and certification of products must be carried out by a suitably authorized organization who will be familiar with the appropriate codes and standards for hazardous areas. The assessment will also consider the specifics of the hazardous area, including the zoning and gas group.

These organizations are known as Notified Bodies under the international system and are accredited by their national governments. In the US, the Occupational Safety and Health Administration (OSHA) oversee a program of Nationally Recognized Testing Laboratories (NRTLs).

Once the electrical equipment has successfully passed through the testing and assessment process, the certificate and marking labels are issued. The labels must be attached to the product to indicate to users that it is safe to use within the hazardous area.

Typically certification can be for a one-off product (unit verification) or for a product in production volumes (type approval)

Examples of Hazardous Area Markings:



HOW GLOBAL ARE PROTECTION METHODS?

Despite moves towards harmonization of the different systems, at the present time there are significant differences in Explosion proof/flameproof and purge & pressurization across the schemes that make it difficult for manufacturers to develop truly global products.

This table is a high-level summary of the key differences that manufacturers should be aware of.

Protection method	International system	US system
Containment	Flameproof: IEC 60079-1	Explosion-proof: NEC 500 / ANSI/UL 1203
Exclusion	Pressurized enclosure Ex p: IEC 60079-2	Purge & Pressurized: NFPA496

2. PURGE AND PRESSURIZATION SYSTEMS FOR ANALYZER ENCLOSURES

Different protection methodologies can make general-purpose or non-rated equipment, like analyzers, safe for use in hazardous areas. As stated previously, one of the main types of protection is purge and pressurization (Ex p), detailed in the codes and standards, NFPA496 (for North America) and EN 60079-2 (for ATEX and IEC Ex), as well as others.

WHAT IS PURGE AND PRESSURIZATION?

In the simplest terms, there are two- (2) main phases in the protection methodology of a purge and pressurization system.

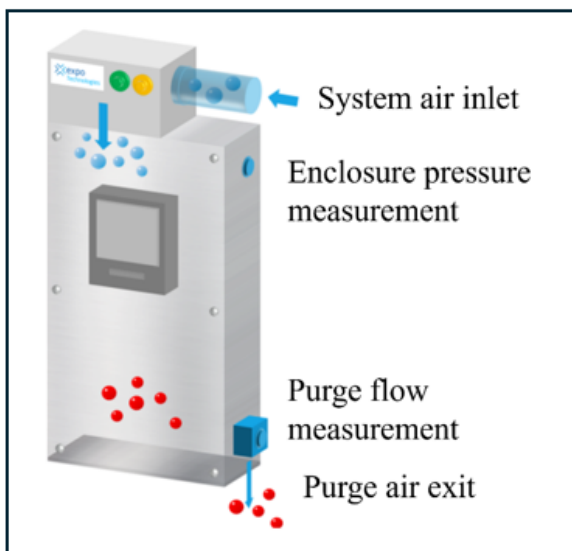


Figure 1



Figure 2

In the purge phase (Figure 1), the control unit of the purge and pressurization system supplies a clean, dry protective gas or media (typically air) to an enclosed volume. This supply is at a high flow rate for a pre-set time, expelling any potentially flammable atmosphere inside. The pressure in the enclosed volume and purge flow rate are monitored. The electrical equipment inside is not energized during the purging cycle.

Under North American codes and standards, four- (4) complete volume exchanges are required, while international (IEC) codes and standards require five- (5) volume exchanges prior to pressurization. Therefore, with a known enclosed volume and the purge flow rate of the protective system, the amount of time for the purge cycle can be calculated.

After the purge phase is complete, the purge and pressurization system provides a sufficient amount of protective gas or media to maintain a constant positive pressure inside the enclosed volume (Figure 2). This positive pressure is typically 1.0 inches of water column (2.49 mbar) or more, compensating for any small leaks and preventing ingress of the outside atmosphere. The pressure inside the enclosed volume is monitored, and the electrical equipment is energized.

The control unit of the purge and pressurization system contains sensors to monitor the pressure of the enclosed volume. If the pressure falls below a minimum level, the system can alarm and de-energize the electrical equipment until the system is reset. The level of action required upon loss or pressurization is determined by the codes and standards. For the more extreme hazardous area classifications, i.e. Class I, Div 1 and/or Zone 1, an alarm and de-energizing of power is required. For less extreme hazardous area classifications, i.e., Class I, Div 2, and/or Zone 2, alarming only is required, but the loss of pressurization must be rectified within 24 hours.

DETERMINING THE RIGHT PURGE AND PRESSURIZATION SYSTEM

For applications involving an analyzer, and depending upon the specifics of the application, several factors must be considered for applying and utilizing the right purge and pressurization system.

As defined in the applicable Ex codes and standards, there are three- (3) types of purge and pressurization systems:

Type X – Required for use in Class I, Division 1, or Zone 1 hazardous areas when the electrical equipment is general purpose or not rated. A type X system ensures that if a pressure loss occurs after the initial purge and pressurization cycles are complete, power to the protected equipment is de-energized.

Type Y – Required for use in Class I, Division 1, or Zone 1 hazardous areas when the electrical equipment is already Ex certified for Class I, Division 2, or Zone 2 at a minimum. With a type Y purge and pressurization system, the power control and interlock is optional,

but an audible alarm or visual indication must be used to notify upon loss of pressurization. The loss of pressurization must be rectified within a specified time.

Type Z – Required for use in Class I, Division 2, or Zone 2 hazardous areas when the electrical equipment is general purpose or not rated. With a type Z purge and pressurization, the power control and interlock is optional, but an audible alarm or visual indication must be used to notify upon loss of pressurization. The loss of pressurization must be rectified within a specified time.

With a clear definition and/or understanding of the hazardous area for the application, the type of purge and pressurization for protection of the analyzer and any other equipment can be easily selected.

Another consideration with purge and pressurization systems is the mode of operation. This protection methodology typically operates in one of two modes:

Continuous Flow – Once the purge phase is completed, an elevated flow rate continues to be supplied to the enclosed volume. This is typically used when the enclosed volume contains a gas analyzer with a flammable and/or hazardous sample. A continuous flow mode of operation will provide a level of dilution should there be an internal source of release. This requirement is often defined and/or necessary as part of the compliance with any final assembly or apparatus certification.

Leakage Compensation – After the purge phase is completed, the protective gas is supplied at a lower flow rate, sufficient to maintain a positive pressure in the enclosed volume while compensating for any leakage. While a common mode of operation for hazardous area applications, in most cases, a leakage compensation mode of operation does not have the capability to provide the dilution flow required with gas analyzers.

There are further factors, including the environmental integrity or rating required (i.e. type 4X or IP66), and the installation location's ambient temperature range that can influence the application and utilization of a purge and pressurization system. Long term reliability and maintenance considerations are also important.

3. ENCLOSURE DESIGN CONSIDERATIONS FOR HAZARDOUS LOCATIONS

Selecting the appropriate purge and pressurization system is just as crucial as choosing the right enclosure. Most hazardous area enclosures are designed to prevent potentially explosive atmospheres from entering but are not built to hold pressure. As a result, they are likely to leak when used for purge and pressurization. Such leakage can waste significant amounts of protective gas over time, and if the leak is substantial enough, it may prevent the purge process from functioning altogether. This situation could necessitate extensive modifications and rework, wasting time and money.

Several factors must be considered when evaluating analyzer applications, including material of construction, ventilation, thermal management, and ingress protection.

Stainless steel is commonly used in many applications due to its resistance to environmental elements and various chemicals found in industrial settings. Additionally, stainless steel offers the strength needed to support purge and pressurization processes. This strength helps with Ingress protection, which is critical aspect of enclosure design. One can broaden the range of applications by adhering to IP (Ingress Protection) or NEMA (National Electrical Manufacturers Association) standards. This enhancement allows analyzers typically used indoors to be safely employed outdoors, thanks to the added protection provided by the enclosure.

Other important construction features include door locks, gasket materials, and windows. When considering other items, such as door latches and gasket materials, careful selection is required to ensure a proper seal of the enclosure, preventing leaks. Additionally, consideration should be given to the gasket material itself, as in some cases, the environment in which the enclosure is in may degrade the seal's integrity.

Enclosure design should also consider ventilation and thermal management within the enclosure, which are vital for ensuring safe operation and system reliability. If cooling is necessary, it should be considered early in the project and certified for use in hazardous areas. Effective thermal management extends the useful life of the electronics and helps regulate the enclosure's maximum external surface temperature, which is critical in hazardous environments. One can ensure a successful application in hazardous areas by implementing thermal management and proper internal ventilation. Options to consider include certified vortex chillers or certified air conditioners which further mitigate hazardous location thermal issues.

4. RISK MITIGATION STRATEGIES FOR FLAMMABLE AND NON-FLAMMABLE SAMPLES

UNIQUE CERTIFICATION CHALLENGES WITH GAS ANALYZERS

Thus far the construction and certification process has been presented as straightforward, and in most cases of standard electrical equipment using explosion-proof or purge & pressurization methods, it is. However, there are unique challenges around gas analyzers which may complicate the process.

As previously mentioned the most important consideration for gas analyzers is the composition of the sample. If the sample is non-flammable, then the analyzer can be treated as normal safe area equipment, and subject to the standard requirements in the applicable code. While not impacting directly the hazardous area considerations, attention must still be given to ensure safe handling of the sample gas, piping system integrity, and,

potentially, leak detection to warn if the sample has leaked into the hazardous area containment.

In the case of purge & pressurization, the enclosure relief valve will provide some over-pressure protection, while in an explosion-proof enclosure, a breather/spark arrestor may be fitted to vent any escaping sample.

However, an escape of the sample gas into the external environment, say within an analyzer room, may be undesirable, and further mitigation may be required.

If the sample entering the pressurized enclosure is flammable, or contains a component above its Lower Flammable Limit (LFL) then additional mitigation is required. This condition is known as an internal source of release (ISOR).

This is a complex area and is covered in great depth in both NFPA & IECEx standards. This paper will not attempt to explain it in detail but rather highlight some of the key issues and potential mitigation.

Releases are categorised as “No release”, “Limited release” and “Unlimited release” – the first category is self-explanatory, the second category is valid in cases where a flow limiter is fitted, while the third is the worst case. The operating conditions are classified as “Normal” - the system is operating in a normal fashion, or “Abnormal” – a system failure has occurred resulting in a release of gas. The permitted pressurization method for each case depends on the resulting combination of the release and the operating conditions. This is summarised in table form in both ATEX/IECEx and NFPA.

MITIGATION METHODS

- a) The integrity of sample gas tubing – if the system is fully welded, then it can be considered fully leak-tight, hence “no release”. However, in the real world, this is hard to achieve, and metallic tubing with mechanical joints such as compression fittings are widely used. These fittings are considered to have the possibility of a release, so further mitigation is required.

- b) Flow limiting & dilution – in the event of a leak (release) inside the enclosure, an externally installed flow limiter provides additional mitigation. With a known maximum leak rate into the enclosure, the rate of purge gas dilution to keep the internal concentration below the LFL can be calculated. A simple example is shown below:

Sample gas hydrogen – LFL 4% in air

Sample limited to 1000 cm³/min / 61 in³/min (by an external flow limiter)

Required dilution in line with codes to 25% of LFL (ie 1%)

Thus the dilution air flow from the purge system is 100 times the sample limit ie 100 litres per minute (3.5 ft³/min).

- c) Enclosure partition – depending on the system design, separation of the system electronics (“Ignition capable equipment”) from the sample gas path can provide useful mitigation. The 2 compartments can then be purged in series, with the electronics section purged first.

- d) Positive differential pressure - maintaining a higher pressure in the enclosure than in the sample gas tubing – depending on the sample gas pressure, it may be possible to maintain an overall enclosure pressure that prevents or minimises a release. The IECEx code defines this pressure differential as a minimum of 50Pa (0.2in. water) and requires an automatic safety device to operate if the differential falls below this level.

- e) Gas detection – while this may seem an obvious mitigation method, it has not been officially recognized up to now but is mentioned in the upcoming revision of IEC 60079-2 due to be published soon, although we will have to wait to see how this is interpreted by certification bodies.

No single mitigation measure will guarantee that the analyzer system with an internal source of release will pass certification. A better approach to increase the chance of success is to apply a combination of the most appropriate for the overall system design.

TABLE 02 – ISOR PRESSURIZATION REQUIREMENTS (ATEX/IECEx upper table, NFPA lower table)

Internal release (see Annex E)				Continuous dilution		Leakage compensation	
Substance	Normal	Abnormal	Annex	UFL < 80 %	UFL > 80 %	UFL < 80 %	UFL > 80 %
Gas or liquid	None	None	E.2	Not applicable		Not applicable	
Gas	None	Limited	E.3	Air or inert	Air	Inert only	<no>
Gas	Limited	Limited	E.4	Air or inert	Air	<no>	<no>
Liquid	None	Limited	E.3	Inert only	<no>	Inert only	<no>
Liquid	Limited	Limited	E.4	<no>	<no>	<no>	<no>

<no> means pressurization technique not acceptable.

External Area Classification	Classified or Unclassified Location for which Internal Equipment is Suitable	Pressurizing Requirements for Limited Release Under Abnormal Conditions		Additional Requirements for Unlimited Release Under Abnormal Conditions
		No Release Under Normal Conditions	Limited Release Under Normal Conditions	
Class I Division 1 (Zone 1)	Class I Division 1 (Zone 1)	None	None	None
	Class I Division 2 (Zone 2)	Y	Y	None
	Unclassified	X	X	Inert*
Class I Division 2 (Zone 2)	Class I Division 1 (Zone 1)	None	None	None
	Class I Division 2 (Zone 2)	None	Z	None
	Unclassified	Z	X	Inert*
Class II	Class I Division 1 (Zone 1)	None	None	None
	Class I Division 2 (Zone 2)	None	Z	None
	Unclassified	Z	X	Inert*
None	Class I Division 1 (Zone 1)	None	None	None**
	Class I Division 2 (Zone 2)	None	Z	None**
	Unclassified	Z	X	Inert*

Certain key differences are worth highlighting:

1. Purge mode: IECEx generally specifies the continuous dilution method with air, it does permit leakage compensation with inert gas in the case of no normal release. NFPA specifies dilution only.
2. While IECEx does not permit unlimited releases under any circumstances, NFPA does under certain conditions.
3. Containment system: IECEx classifies a system with metallic joints (eg compression fittings) as having the potential for a normal release, NFPA considers such containment systems to have no normal release.

5. CASE STUDIES

The following are two- (2) examples of successful application and integration of analyzers into hazardous areas, with purge and pressurization as the protection methodology (Ex p).

TOTAL ORGANIC CARBON (TOC) ANALYZERS FOR ZONE 2 INSTALLATION

A Total Organic Carbon (TOC) analyzer is an analytical instrument that measures the total amount of organic carbon contained in water or liquid solutions. TOC analyzing and detection is necessary to account for chemical solvents and bacteria that can be contaminants and affect health and the environment.

A multi-national integrator, of gas and liquid analytical equipment, initiated a project to develop a custom hazardous area solution for the application and installation of TOC analyzers. The location of the project was a petrochemical facility in the Middle East. The resulting equipment was integrated into the water treatment part of the facility, meeting a Zone 2 hazardous area requirement / specification.



One of the challenges of the project that was immediately identified was the high ambient temperature environment, commonly seen in the Middle East. The TOC analyzers, being general purpose rated, did not have an operating temperature range compatible with the high temperatures so a means of thermal management was required, to ensure the analyzers remained within their standard operating temperature range. In addition, as sometimes seen with general purpose rated equipment, the analyzers needed modification to be compliant with the appropriate purge and pressurization (Ex p) codes and standards. Lastly, as sometimes required with industrial facilities, a specific paint finish was required on the protected enclosures housing the TOC analyzers.

The resulting enclosure/Ex p assembly incorporated a range of thermal management features, including insulation, a vortex type of cooler and anti-condensation heating to compensate for the high ambient temperatures of the location. In addition, the integrator was advised on the modifications to the TOC analyzer that were needed in order to comply with the Ex p requirements.

The TOC analyzer systems were installed, inspected and certified, meeting the Zone 2 hazardous area requirement / specification.

CONTINUOUS EMISSIONS MONITORING SYSTEM (CEMS) ANALYZER FOR ZONE 1 INSTALLATION

A Continuous Emissions Monitoring Systems (CEMS) analyzer is an important tool used to assess the concentration of gases emitted from industrial processes, often seen in power plants, refineries, manufacturing facilities and other industries dealing with emissions. This type of analyzer helps ensure compliance with environmental regulations and standards by providing real-time data on pollutants such as CO, CO₂ and other hazardous gases.

Large industrial complexes will often require a CEMS analyzer be installed, to measure and monitor the CO and CO₂ content in the effluent being vented to flares during and following the completion of various processes. A leading manufacturer of process analyzers had an application for placing this type of analytical equipment in a Zone 1 hazardous area rated environment, located within an industrial facility in the Asia-Pacific region.



The standard design of the CEMS analyzer made it initially unsuitable in an enclosure protected by purge and pressurization (Ex p) methodology. This was due to the internal enclosure ventilation requirements of the relevant codes and standards. In addition, the analyzer was strictly for general purpose / safe area use as standard, but needed to be installed, together with related electrical equipment in a cabinet to be located in an analyzer house which was classified as a Zone 1 hazardous area. Other protection concepts, such as Ex d and Ex e, had been investigated but were deemed impractical due to either the time scale of the project or cost constraints.

Working closely with engineering and other resources having a detailed understanding of analyzer applications, flow requirements for purge and pressurization protection, and trapped volume mitigation techniques enabled the production of an Ex p solution for the

application. Modifications to the analyzer were kept to a minimum, to the satisfaction of the customer, and created the necessary ventilation requirements but did not have any impact on the function of the instrument.

Thorough documentation of the solution allowed for customization of other application related equipment, enabling the customer / end user to pursue third-party apparatus certification for Zone 1.

CONCLUSION

The purge and pressurization protection methodology offers many benefits over other protection methods. With the capability to use general-purpose enclosures and electrical equipment, Ex p makes the design, assembly, and commissioning of an analyzer solution for hazardous areas a simpler process than other Ex protection methods.

Purge and pressurization systems also provide a solution that can be more reliable and have greater longevity since features not found in other protection methods can be utilized. Ex p allows for a larger installation footprint, covering a wide variety of requirements. Passive or active thermal management can be incorporated, giving design flexibility. Construction can include corrosion-resistant materials, providing a longer-lasting installation. Lastly, purge and pressurization solutions offer quicker and easier accessibility for maintenance, thereby increasing productivity.

By leveraging certified Ex p solutions and best practices in enclosure design, industrial operators can enhance safety, improve system reliability, and optimize the performance of analyzers in hazardous environments. The case studies presented in this paper demonstrate that with proper planning, innovative engineering, and adherence to regulatory standards, the challenges of hazardous area analyzer installations can be effectively addressed, ensuring both safety and operational efficiency.

REFERENCES

- (1) IEC 60079-2: An international standard - Explosive atmospheres. Part 2: Equipment protection by pressurized enclosure "p". ATEX 60079-2 is closely aligned with this standard. <https://webstore.iec.ch/publication/634>
- (2) NFPA496 – A North American Standard for purged & pressurized enclosures for electrical equipment. <https://www.nfpa.org/codes-and-standards/nfpa-496-standard-development/496>
- (3) IEC 60079-0: An international standard - Explosive atmospheres. Part 0: Equipment – General requirements. <https://webstore.iec.ch/publication/62232>

NOMENCLATURE

ATEX - The ATEX directives are two EU directives describing the minimum safety requirements for workplaces and equipment used in explosive atmospheres. The name is an initialization of the term ATmosphères EXplosibles

Class I Division 1 – A classification for a hazardous area used under North American certification programs. An area where ignitable concentrations of flammable gases, vapors or liquids can exist all of the time or some of the time under normal operating conditions. More onerous than Class I Division 2.

Class I Division 2 – A classification for a hazardous area used under North American certification programs. An area where ignitable concentrations of flammable gases, vapors or liquids are not likely to exist under normal operating conditions. In this area the gas, vapor or liquids would only be present under abnormal conditions. Less onerous than Class I Division 1

IECEx – Part of the International Electrical Commission (IEC), the IECEx provides a means for manufacturers, regulators and users of equipment used in hazardous areas to address the risk of fires or explosions from flammable gases or dusts.

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

Lower flammable limit (LFL) - expressed in volume per cent, the LFL is the lower end of the concentration range over which a flammable mixture of gas or vapour in air can be ignited at a given temperature and pressure.

NFPA - The National Fire Protection Association is a U.S.-based international nonprofit organization devoted to eliminating death, injury, property, and economic loss due to fire, electrical, and related hazards.

Type X purge system – A purge and pressurization system that meets the requirements in applicable codes and standards for electrical enclosures and other equipment installed in Zone 1 or Class I Div 1 hazardous environments

Type Z purge system – A purge and pressurization system that meets the requirements in applicable codes and standards for electrical enclosures and other equipment installed in Zone 2 or Class I Div 2 hazardous environments

Vortex cooler – An enclosure cooler driven by compressed air suitable for pressurized enclosures with heat loads of 7-800W.

Zone 1 – A classification for a hazardous area used under ATEX & IECEx certification programs. Defined as An area in which an explosive gas atmosphere is likely to occur in normal operation. More onerous than Zone 2.

Zone 2 - A classification for a hazardous area used under ATEX & IECEx certification programs. Defined as An area in which an explosive gas atmosphere is not likely to occur in normal operation and, if it occurs, will only exist for a short time. Less onerous than Zone 1.