expo Technologies

Engineering Safety at the Crossroads:

Evaluating Purge & Pressurization vs. Explosion-proof Protection Methods



This Whitepaper at a glance

Hazardous locations provide some of the greatest challenges to facility and electrical equipment safety. Fortunately, there are many protection concepts that can be utilized when placing electrical equipment into hazardous locations. The most widely used are Explosion-Proof or Purge & Pressurization.

This paper examines the pros and cons of both methods and uses customer case studies to demonstrate how, in many applications, Purge & Pressurization is the proper choice for many applications.

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Notes on Terminology & Scope

Flameproof or explosion-proof? While flameproof typically applies within ATEX & IECEx standards, and explosion-proof is more applicable in North America, and there are differences in test procedures, the protection concept is similar and this paper uses explosion-proof to cover both.

To avoid lengthy repetition, purge and pressurization and explosion-proof are abbreviated in this paper as Ex p and Ex d respectively.

Other than an initial mention of ignitable dusts and powders, this paper is focused on flammable gases and vapours.





1

Hazardous areas

Definition, classifications & risks

What is a **hazardous area?**

A hazardous area is a location where the potential for fire or explosion exists, due to the presence of ignitable gases, dusts, or powders in the atmosphere. Examples of these locations include oil & gas facilities, chemical processing plants, and pharmaceutical manufacturers. Detailed safety codes and global standards impose strict rules on how equipment, particularly electrical equipment, can be used and define acceptable protection methods. Systems are assessed against these codes and standards by recognised authorities to gain certification for use in the hazardous location.

The electrical equipment for controlling and operating plant – including control panels, analyzers, motors, generators, and a wide range of other equipment - must use approved explosion protection methods to protect people & property.

Hazardous area **standards & classification**

The objectives of explosion protection are common across the globe, but there are distinct regional differences in how hazardous areas are classified, as well as the standards that apply. This table summarises the main regional approaches:

Region / Standards	Classification	Hazard definition
North America / NFPA 496	**Class & Division system**	**Class I Div. 1:** An area where ignitable concentrations of flammable gases & vapours can exist all or some of the time under normal operating conditions. **Class I Div. 2**: An area where ignitable concentrations of flammable gases & vapours are only present under abnormal conditions.
International / IEC 60079 series	**Zone system**	**Zone 0:** An area in which an explosive gas atmosphere is present continuously or for long periods. (Typically>1,000 hrs/yr.) **Zone 1:** An area in which an explosive gas atmosphere is likely to occur in normal operation. (Typically10 to1,000 hrs/yr.) **Zone 2**: 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. (Typically< 10 hrs/yr.)

Individual countries & economic blocs may require equipment to be certified under local codes – for instance:

ATEX | INMETRO | KCs | PESO | CCC | cULus

Europe | Brazil | Korea | India | China | North America

In most cases these local codes are derived from international or North American NEC codes.

What are the **risks?**

Acquiring accurate data on explosions in hazardous environments is challenging. But to indicate the persistent risk of explosions in processing industries, examine the reporting of industrial explosions in respected trade media.

For example, HazardEx is a leading UK based publication that covers hazards, explosions and other risks to life across a range of global industrial sectors.

Their news feed for January through to October 2013 lists around 60 stories related to gas or chemical explosions or fires, across oil & gas, petrochemical, chemical and pharmaceutical industries. Around 75% of the reports were related to new incidents, while the remainder refer to historic cases where safety board reports have been issued, or negligent companies have been fined.

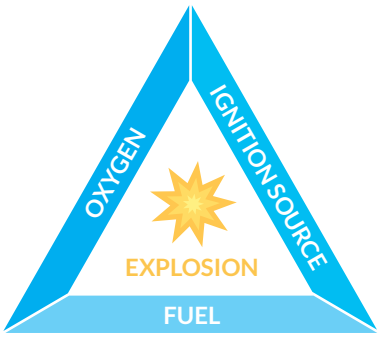
Explosions and fires in other industries such as pulp & paper, grain processing, and mining have not been included, as many are dust related, and not within the scope of this paper.



2

Explosion protection methods

2.1 What are **the options?**



The explosion triangle is an easily understandable explanation of the three elements needed for an explosion to occur: oxygen, fuel and an ignition source. Removing one element eliminates the explosion risk.
Thus any explosion protection solution should ideally limit or remove one of these components completely.

There are multiple methods of explosion protection, the most widely used concepts are:

Objective	Method	How it works
Eliminate Ignition source	**Intrinsic safety Ex i**	Elimination of sparks through the limitation of electrical energy to very low levels.
Eliminate Ignition source	**Increased safety Ex e**	Reducing the risk of sparking through component design. Components must be housed in enclosures with high integrity.
Exclusion	**Encapsulation Ex m**	Components are usually encased in a resin type material to exclude the atmosphere. Heat generation is limited.
Exclusion	**Purge and pressurization Ex p**	Equipment is first purged, then maintained at a positive pressure with air or an inert gas, thus the surrounding ignitable atmosphere cannot come in contact with energized parts of the apparatus. The overpressure is monitored, maintained and controlled.
Containment	**Flameproof / Explosion-proof Ex d**	Any flame or explosion is contained within the equipment and cannot ignite an explosive atmosphere outside

All of these protection methods have a role in explosion safety, but not all methods are suitable for every application. This paper will explore the two most widely employed across industrial applications – Flameproof/explosion proof (Ex d) and Purge & Pressurization (Ex p) and will also demonstrate that many applications are better suited for purge and pressurization solutions.

Key takeaways

- Each explosion system has its place in industrial environments
- All methods must comply with the appropriate national and international standards

2.2 Focus on Containment: **Explosion-Proof** and **Flameproof**

This method relies on containing any ignition within a robust containment system and preventing it propagating to the external environment.

Explosion proof boxes are generally thick walled cast boxes, typically in aluminium. For some applications stainless steel construction is required. Sizes typically range from 6" square (15cmx15cm) up to 36" square (90cmx90cm) Depending on the application, there is typically an economic limit on the size of these boxes.

Explosion proof boxes are designed to be sealed tight with multiple bolts and are designed to be "fit & forget". The flanged edges of these enclosures and their covers are machined to fit flush to allow a seamless join.

By design, if any explosive atmosphere inside the box ignites, the system prevents the explosion from propagating to the outside. Such boxes are designed with long bolt threads and any flame path passing into the thread would dissipate before it can exit the box. The same concept applies to cable glands and other threaded components that penetrate the enclosure walls.

Any explosion will at the very least severely damage, and often destroy, the electrical equipment inside the box. Simple contents like terminals and switches are typically low cost, while replacing more sophisticated equipment is very costly. The box itself will need to be replaced.

Two other key factors should be taken into account:

Fault indication
There is unlikely to be any sensor that would inform the control room if an explosion has happened or if the box has incurred damage.

Thermal management capacity
The thermal management capacity of explosion proof boxes is limited. Active cooling systems are not feasible, so the shedding of heat from internal components relies on emissivity alone. Unless the box has a large surface area, then this might be quite low, perhaps as low as 200 -300 W. In some cases, systems with higher heat outputs might need to be split across multiple boxes, adding cost and complexity.

Maintenance and user behavior

Explosion proof boxes must be sealed tight by multiple, individual bolts. Bolts may be partially tightened, come loose, or omitted altogether post-inspection – it is not unusual to see these boxes in safety-critical operations with bolts missing or loose.

Gaps formed by missing bolts can create a flame path. During the system lifetime, damage such as tool scratches and gouges on the flange surfaces can also create flame paths. Both situations can result in explosion.

Key takeaways

- Economic for simple fit and forget applications such as terminals & switchgear
- Any containment failure is likely to destroy the contents
- Limitations in how much heat can be dissipated
- Potential pitfalls in maintenance. Systematic approach is needed

2.3 Focus on Exclusion: **Purge and Pressurization**

By housing the electrical equipment inside a suitable enclosure, and maintaining a positive pressure, purge and pressurization prevents the entry of any combustible atmosphere into the enclosure.

Purge and pressurization is an extremely simple and versatile protection solution that is very well suited for the widest range of applications when compared to other methods. It is an active protection concept because it can notify operators either locally or remotely if any aspect of the system has failed or is offline. Ordinary, uncertified equipment, of almost any size or shape can be protected by this method.

As a general but not absolute rule, the bigger and more complex the application, the more suitable purge and pressurization becomes. It is more compatible with applications that use power controls, control modules and more costly electronics that may need more regular modification, rather than simple contactor electrics. Thermal management is easier as well.

The number and type of electronics that need protection can change over time, with new sensors and system upgrades. Purge and pressurization systems gives users more flexibility to fit more equipment in the enclosure over time.

Pressurized enclosures are typically constructed from sheet metal, and can vary greatly in size. In all cases they are lighter than comparable explosion-proof boxes.

Explosion proof enclosures, while highly suitable for protecting smaller and simple electrical equipment, are unsuitable for larger, complex protection applications owing to their weight and physical size.



Maintenance and user behavior

Most pressurized enclosures are constructed of stainless steel sheet and, generally, little maintenance is required other than periodic inspections of door and window seals. Doors giving access to the internal electrical components are typically opened with tool-operated quarter-turn latches. Upon loss of pressure the system must provide the user with an alarm and, in the case of Zone 1 / Class I Div.1, isolate power to the enclosure. If the enclosure door is not correctly closed after maintenance, the system will indicate to the user that pressurization has failed.

Key takeaway

Purge and pressurization prevents an explosion from taking place by expelling potentially combustible atmospheres from the space, where a positive pressure keeps this material expelled.

Maintenence is straightforward, and systems will alarm or shut down on loss of pressure.



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Purge and Pressurization

a deeper dive

There are two phases to a purge and pressurization system:

Purge phase

In the purge phase, the purge control 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. Enclosure pressure and purge flow are monitored. The electrical equipment inside the enclosure is not energized during purging.

Under North American NFPA requirements, four complete air exchanges are required, while IEC (International) rules requires five air exchanges prior to pressurization. Thus with a known volume of enclosure and purge air flow rate, the amount of time for the purge can be simply calculated.

Purge capacity and time

The time required for purging is a function of the enclosure volume, purge system flow rate, and the required number of air changes. The latter is defined in the international standard.

Purge time calculation example
Enclosure internal volume = 1,000 litres (35 cu.ft.)
No. of volume changes required by code:
ATEX = 5 (NFPA=4)

ATEX/IECEx case:
Total air required for purge = 5 x 1,000 l = 5,000 l
Time required for purge = 5,000 l / 225 Nlpm
= 22 minutes

North American case:
Total air required for purge = 4 x 35 cu.ft. = 140 cu.ft.
Time required for purge = 140 cu.ft. / 8 cu.ft./min.
= 17.5 minutes

Pressurization phase

After purging is complete, the system supplies sufficient air to maintain a small, constant positive pressure inside the enclosure, compensating for any small leaks, preventing ingress of the outside atmosphere. Enclosure pressure is monitored. The enclosure's contents can be energized.

The purge controller contains sensors to monitor the enclosure pressure; if it falls below a minimum level the system can alarm and de-energize the control panel until the system is reset. The level of action required on loss of pressure is determined by the standards. For the highest hazard classification (Class I Div 1, Zone 1) alarm and shutdown is required. For the lower classification (Class I Div 2, Zone 2) an alarm only is required, but the loss of pressure must be rectified within 24 hours.

Minimum overpressure levels

Different jurisdictions require different pressurization levels for compliance with standards.

	North America	International	
	Type X, Y & Z	px, py	pz
Min. pressure	25Pa	50pa	25pa

Purge systems are classified as follows:

North America	International	What it does
Type X	**px**	Reduces the classification within the enclosure from Div. 1 / Zone 1 to unclassified allowing uncertified equipment to be used.
Type Y	**py**	Reduces the classification within the enclosure from Div. 1 / Zone 1 to Div. 2 / Zone 2 allowing Div. 2 / Zone 2 certified equipment to be used.
Type Z	**pz**	Reduces the classification within the enclosure from Div. 2 / Zone 2 to unclassified allowing uncertified equipment to be used.

Compressed air consumption
Compressed instrument air is a utility found in almost all industrial plants. While the purge phase may use several cubic metres of air over 20-30 minutes (as in the case above), the ongoing pressurization phase will only need a few litres per minute, depending on the integrity of the enclosure and the application (see below). Thus the operational costs of the system are almost negligible.

Pressurization phase methods

Once the initial purge phase is complete, there are 2 different methods for the pressurization phase:

Leakage compensation
After purge, air is supplied at a flow rate sufficient to maintain overpressure, compensating for any enclosure leakage. For well-sealed enclosures, this flow rate is in the range of 0-5 Nlpm.

Continuous flow method
Once the purge is completed, the air flow rate is maintained into the enclosure. This is typically used when the enclosure contains a gas analyzer with a flammable sample. In this case dilution is required as part of compliance with certification requirements.
It is often stated that this method can provide cooling for the enclosure contents, however few if any detailed studies have been undertaken, and any impact is likely to be marginal. A rigorous approach should be taken to thermal management – see later for more details.

Key takeaway

Simply maintaining a positive pressure of a few Pa in the enclosure keeps hazardous atmospheres from re-entering, providing a very simple protection method





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So how does an engineer decide between **Purge & Pressurization** and Explosion-proof?

Installing electrical equipment in hazardous areas will always be significantly more expensive than locating the same equipment in a safe area, regardless of the chosen protection method.

Engineers may have questions and reservations about using purge and pressurization solutions for explosion protection if they are more familiar with other concepts. This section of the paper explores some of the most common areas.

What is the best solution for large systems?

For larger, more complex systems, a single pressurized enclosure can be designed and built to exactly suit the application and the contents, and purging larger enclosures is straightforward. The alternative with Ex d may involve spreading the system across multiple explosion-proof boxes, incurring both a weight and cost penalty, and the need for complex interconnections. Maintenance may also take longer (see Uptime box).

Uptime is critical, so how does access for maintenance compare?

When explosion-proof boxes are opened, the machined flange surfaces of both the cover and box must be inspected and cleaned. Surfaces must be smooth, and free of nicks, scratches, and dirt build-up that would prevent a proper seal. Cover bolts must be installed and tightened to the correct torque, ensuring that no cover bolts are omitted.

Opening an Ex p enclosure is a matter of isolating the air supply then unfastening the quarter-turn latches and opening the door. Door seals should be inspected for damage. Once the work is complete, the operator shuts the door, fastens the quarter-turn latches, and re-purges the enclosure. Provided a correctly sized purge controller has been used, the time taken to re-purge the enclosure is not generally a problem.

What about system upgrades?

With the growth of “edge computing” and plant internet infrastructure, computer processing is becoming more widespread and decentralized. System upgrades may therefore become more frequent. Within a pressurized enclosure, space is unlikely to be an issue, making changes to the internal components straightforward. The body that issued the original certificate can generally carry out the necessary amendments. Depending on the configuration of the Ex d box and the scope of the changes, upgrades may require full system replacement, incurring additional costs and project delays.

How can I ensure I maximise equipment life?

Provided the instrument air used to purge & pressurize the Ex p enclosure meets the required cleanliness and moisture standards, this will provide a perfect environment for electrical components. While Ex d provides a well sealed environment, which will also preserve the electrical equipment, there is always the risk that if an internal ignition occurs, damage may be done, requiring intervention and, potentially, component replacement. This may be acceptable for simple switchgear and wiring, but will be expensive for more sophisticated components.

How do I manage high heat loads?

Because purged enclosures are typically larger than explosion proof boxes, their greater surface area will shed more heat. If further cooling is needed, then there is generally sufficient space to install an active cooling system, such as a vortex cooler or certified air conditioning unit. Ex d boxes will have an upper limit of heat dissipation based on their dimensions – this is typically no more than 200W - and cannot practically accommodate additional cooling equipment.

I’m an OEM, what’s the best choice for product development?

For many of the areas discussed above, much will depend on the size and scope of the equipment. If designing from scratch the Ex d option may be feasible, but potentially expensive to develop. However, if high sales volumes are expected, these development costs can be spread across more units. The flexibility of Ex p makes it suitable for any stage of the product development cycle, and would have lower development costs.sold side-by-side. Ex p is one of the best protection methods for this development option.

Cost is always a consideration, how do they compare?

For small, simple applications, Ex d is undoubtedly the lowest-cost option. However, once the application requires larger enclosures and more complex components, the balance shifts. For instance, an application requiring 600 litres (21 cu.ft.) of internal volume would need the contents to be spread across 4 large Ex d boxes, with the need for costly interconnecting conduits or cables with barrier glands. Using Ex p on the other hand, the components could be contained within a single purged enclosure with dimensions 1800x800x600mm (72x31x24in.). In their unfitted, uncertified state, the 4 large Ex d boxes may have a total cost in excess of USD 40,000, while the Ex p solution, unfitted, but with certification and a purge system, would cost approximately 60% less.

Key takeaways

- The contents of pressurized enclosures are simple to maintain due to ease of access
- Pressurization with clean dry air systems protect expensive electrical systems and extend equipment life
- Thermal management is simpler to implement

Weighty matters

In the example already quoted, each of the 4 explosion-proof boxes would require internal dimensions of at least 900x600x250mm (36x24x10 in.) and would weigh around 180kg. (400 lb.). The Ex p enclosure would have a weight of 135kg. (300 lb.) including purge system.







Key takeaways

- Lighter purge and pressurization systems are more suitable for skid manufacturers than heavier explosion-proof alternatives.
- In most cases, for larger & complex projects, Ex p is the lowest cost solution.



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Typical purge and pressurization **applications**

Common engineering applications where a purged and pressurized solution is the most feasible include:

Gas analyzers

Introducing sample gases into Ex d enclosures adds a higher degree of complexity, so Ex p is the simplest option. This also applies where the sample gas is flammable (so called Internal Source of Release), although additional mitigation is generally required.

To read some analyzer case studies using Ex p, visit www.expoworldwide.com/case-studies and select "Gas and Liquid Analysis" under "Industry/Application"



Large / complex / high heat-load electrical control panels

such as variable speed and variable frequency drives. Ex p is especially applicable as thermal management systems are simpler to install.

To read some case studies on large and complex enclosures, visit www.expoworldwide.com/case-studies and select "Ex p enclosure" under Products



Hazardous area robotics

For multi-axis industrial robot arms, such as those used in automotive paint spraying, EX p is the only feasible and cost-effective solution.

To read some robotics case studies using Ex p, visit www.expoworldwide.com/case-studies and select "Robotics" under Industry/Application





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Customer **case studies**

Customer case study: **Exheat**

Norwich, UK-based Exheat is a leader in the design and manufacture of electric process heaters and associated thyristor control systems for both hazardous and non-hazardous area equipment.

Its products are used in many process industries, oil & gas being a primary market. For the control systems, about 80% of Exheat's output is located by end-users in safe areas, for the remaining 20%, Exheat commissions both Ex p and Ex d solutions – the decision is largely driven by the heater size and power.

The company manufactures and supplies process heaters across a very broad power range, from 10kW to 400kW and more, with most products at the larger end of this range. Technical director Robert Coss summarises the general pattern for selecting purge and explosion-proof protection solutions.

A process heater up to 20kW or 30kW typically requires a single explosion-proof box, and costs are typically lower than a purge and pressurisation system. As systems become larger, the Ex p option becomes more attractive and more suitable. Above 100kW, Ex p enclosures can be the favoured solution where the customer has a compressed air line, or where several Ex d boxes grouped together is unworkable.

Power of heater	Explosion protection method selected (typical)	Notes, cost
Up to 10kW	**Single Ex d box**	
20kW	**2x Ex d boxes**	Starts to get more complicated for wiring. Still could be cheaper than purge & pressurization
30kW	**Up to 3 Ex d boxes**	Purge & pressurization can be comparable on cost and simpler to build
50kW to 60kW	**Purge & pressurization system is preferred**	A single pressurized enclosure is lower cost and simpler than 5x Ex d boxes
>100kW	**Purge & pressurization is best solution**	As above

So, the break point for applications is around 30kW, where an Ex p solution becomes preferable due to cost, weight and the complication of connecting multiple boxes.

There are, of course, exceptions - In 2023, Exheat delivered a very large, 300kW heater and control system, assembled on a skid, for an overseas customer. Coss says, "Normally such a big product would necessitate a custom-made purge and pressurization system, but the customer had no compressed air and we supplied seven separate explosion proof boxes for the protection system to comply with all the safety and quality assurance requirements." Exheat estimates that, had air been available, an Ex p solution would have significantly reduced the project costs.

Thermal management and certification

Thermal management is important in industrial environments. The typical heat dissipation for a 10kW heater system is 200W, which can be distributed easily through an Ex p box if correctly sized. For higher ambient temperatures, either the application might need a bigger Ex d box simply to shed more heat, or split the system across multiple boxes, meaning higher cost. Here, a purge and pressurisation with vortex cooling or other cooling systems could be a lower cost, and better, solution.

EX HEAT INDUSTRIAL

Customer case study: **Servomex**
Ex p solutions for leading-edge gas analyzer OEM

For nearly a decade, Expo has worked with UK-based gas analyzer manufacturer Servomex to develop and supply purge & pressurization systems for its range of hazardous area analyzers. For example, the SERVOTOUGH FluegasExact 2700, widely used for combustion monitoring in power generation and process industries, uses a customized Expo MiniPurge unit to provide continuous flow through the sensor head, measuring purge gas flow at the outlet to ensure compliance with hazardous area codes and standards.



SERVOMEX
a spectris company





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Summary & Conclusions

Each of the approved explosion protection methods has applications that they are best suited to, typically depending on factors including the degree of hazard, plant location, power consumption, equipment complexity, cost, and maintenance requirements. This paper has looked in detail at Purge & Pressurization (Ex p) and Explosion Proof (Ex d) enclosures.

Ex d enclosures, while robust and built to contain very high forces, can be very heavy, and potentially inflexible when changes are required to the electronics inside for updates or repair. In containing any explosion that may occur, internal equipment may be damaged or destroyed. Smaller and standard-size boxes are often available in stock and typically quick to deliver. Ex d is a passive protection concept and does not notify the user any indication of failure or other non-conformity.

Ex p systems are flexible, communicative, and inherently safe, as loss of pressure will trigger an alarm and may automatically shut down power to the enclosure. Costs vary but they can be less expensive than larger, heavier Ex d-based solutions. Most Ex p enclosures are custom-made to order, so can match the project specification exactly.

Of increasing importance in plants with DCS and "edge computing" at the individual process level, purge and pressurization solutions can more easily allow equipment maintenance and upgrades within the enclosure, with simpler variations to the original certification without involving a Notified Body.

	Ex p	Ex d
Typical size	Totally flexible – small to very large	Typically fixed sizes - Small to medium
Equipment Inside	Simple to complex equipment	Simple electrical equipment
Thermal Management	Wide range of options up to kW	Limited by dissipation of box (possibly limited to a few hundred Watts)
Ease of Maintenance	Quick, easy access: post-maintenance integrity easy to verify	Multi-bolt access: post-maintenance integrity harder to verify
Ease of Upgrading	Simple, almost unlimited possibilities.	Not as simple, limited by form factor of box
Weight	Lower weight option for medium-large applications	Small Ex d boxes lower in weight, larger multi-box systems are heavier than Ex p
Flexibility	Can be made in virtually any dimensions.	Fixed standard sizes, custom sizes are typically costly
Cost comparison	Lowest cost option for medium-large applications	Single, small Ex d boxes are a low cost option, larger multi-box systems are more expensive than Ex p

For facilities with hazardous areas, significant investment must be made to ensure electrical equipment is compliant with relevant codes and standards. Facility engineers must therefore select the hazardous area protection method that gives the best balance of cost and performance while simplifying maintenance and upgrades to maximize equipment uptime.



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About **Expo Technologies**

Expo Technologies is the market leader in the supply of Purge and Pressurization systems into the global market. Drawing on our significant knowledge of safety standards around the world, we help deliver our clients' capabilities in hazardous and extreme environments.

Expo applies its experience in developing engineered solutions to our customers' needs –whether it's supplying a standard product from our extensive range or creating an innovative solution to a particular challenge.

Our purge and pressurization systems are certified and approved to national and international standards (ATEX, CCC, cFMus, cULus, EAC, IECEx, KOSHA, INMETRO, PESO) and protect more than 17,000 electrical systems and enclosures installed worldwide. Through its continued involvement with international standards committees, Expo is committed to remaining at the forefront of this safety-critical industry.

We service our customers through our principal operations in the UK, USA, and China, and via a worldwide network of authorized distributors and representatives.

https://www.linkedin.com/company/114087

https://twitter.com/Expo_Tech

https://www.facebook.com/people/Expo-Technologies/100057065276013/

Useful links for further information

NFPA – The leading information and knowledge resource on fire, electrical and related hazards
https://www.nfpa.org/

IEC Ex - The IEC system for certification to standards relating to equipment for use in explosive atmospheres
https://www.iecex.com/information/about-iecex/

ATEX - Equipment for potentially explosive atmospheres
https://single-market-economy.ec.europa.eu/sectors/mechanical-engineering/equipment-potentially-explosive-atmospheres-atex_en

Hazardex - provides the latest information relevant to those companies and individuals responsible for safe operations within hazardous area environments around the world.
https://www.hazardexonthenet.net/

Expo Technologies – A world leader in hazardous area protection by purge & pressurization
https://www.expoworldwide.com/


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