

Purge and Pressurization Systems – What are They?

Chuck Pitzen
Director of Marketing
AB-CO PURGE, LLC
www.ab-copurge.com
September 11, 2019

For someone unfamiliar with how to protect electrical enclosures used in very rigorous industrial environments, the terms “purge” and “pressurization” can conjure up all kinds of curious questions. The purpose of this paper is to help clarify for both the uninformed and for those who are partially informed and are considering the use of such a system, what a purge and pressurization system is.

The basic configuration of a purge and pressurization system consists of a network of pneumatic pressure regulators, valves, analog and/or digital indicators, differential pressure switches (mechanical or electronic) and tubing mounted on a common panel or housed in an enclosure. This assembled configuration is designed to be mounted to an electrical enclosure which is, or will be used in a very demanding industrial environment. Sizes of purge and pressurization system are dependent on the total volume of the electrical enclosure.

When supplied with a source of “protective gas” (clean instrument air or an inert gas) at a predetermined pressure, the primary function of the purge and pressurization system is to ensure a positive pressure exists within a powered-up electrical enclosure. Secondary functions include various indications that the positive pressure level within the enclosure has fallen below a specified value and powering off the electrical enclosure if the positive pressure is below this same specified value.

For most technical definitions associated with purge and pressurization systems, one can refer to NFPA (National Fire Protection Association) Standard 496. This standard is very specific as it is entitled Standard for Purged and Pressurized Enclosures for Electrical Equipment. Chapter 3 of this standard defines many of the specific terms used when researching purge and pressurization systems. For example:

Section 3.3.9.....defines *Pressurizing System* as “A grouping of components used to pressurize and monitor a protected enclosure.”

Section 3.3.12....defines *Protective Gas* as “The gas used to maintain pressurization or to dilute a flammable gas or vapor.”

Section 3.3.14 ...defines *Purging* as “The process of supplying an enclosure with a protective gas at a sufficient flow and positive pressure to reduce the concentration of any flammable gas or vapor initially present to an acceptable level.”

Purge and pressurization systems are normally designed to be used as a compliment to an electrical enclosure used in a defined “hazardous environment”. NEC (National Electrical Code) and CEC (Canadian Electrical Code) defines a hazardous location as:

“An area where a potential hazard (e.g., a fire, an explosion, etc.) may exist under normal or abnormal conditions because of the presence of flammable gases or vapors, combustible dusts, or ignitable fibers or fillings.”

As part of a system used in a hazardous environment, purge and pressurization systems must be certified and approved by one or more approval organizations: i.e., Factory Mutual, Underwriters Lab, the EU’s ATEX, International Electrotechnical Commission (IEC), to identify some of the more recognized. Therefore, manufacturers are required to have their systems tested by one or more of these approval organizations before they can be used in any hazardous locations. In addition, the various hazardous area location classifications need to be identified before a particular “Type” of purge and pressurization system is specified.

One of the first items to be addressed when considering what “Type” of purge and pressurization to specify is to determine the hazardous location classification in which the electrical enclosure is to be used. In order to determine this, we need to refer to the Class/Division System (used in the United States and Canada) or Zone System (used in the rest of the world).

A brief review of these classification systems will help one understand the various “Types” of purge and pressurization systems to be reviewed in latter paragraphs.

Class/Division/Group Classification Definitions:

Note: “Class” defines the nature and quantity of the hazardous material located in the surrounding environment.

Class I – Those locations where flammable gases/vapors may or may not exist in sufficient quantities to produce explosive or ignitable mixtures.

Class II – Those locations where combustible dusts may or may not be in sufficient quantities to produce explosive or ignitable mixtures.

Class III – Those locations where ignitable fibers may or may not be in sufficient quantities to produce explosive or ignitable mixtures.

Note: “Division” defines the probability of the hazardous material being able to produce an explosive or ignitable mixture based on the presence of the hazardous material.

Division 1 – The hazardous material is present continuously, intermittently, or periodically under normal operating conditions resulting in a high probability of producing an explosive or ignitable mixture.

Division 2 – The hazardous material has a low probability of producing an explosive or ignitable mixture and is present only during abnormal conditions and for a short period of time.

Note: "Group" defines the type of hazardous material in the surrounding atmosphere. Group

Group A – Atmospheres containing acetylene

Group B – Atmospheres containing a flammable gas, flammable liquid-produced vapor whose MESG* is less than 0.45 mm or MIC** ratio is less than 0.40. This would include hydrogen, acrolein, propylene oxide, butadiene, ethylene oxide.

Group C – Atmospheres containing a flammable gas, flammable liquid-produced vapor, or combustible liquid-produced vapor whose MESG* is greater than 0.45 mm but less than or equal to 0.75 mm or MIC** ratio is greater than 0.40 but less than or equal to 0.80. Gases in this class are ethylene, cyclopropane, acetaldehyde, and ethyl ether.

Group D – Atmospheres containing a flammable gas, flammable liquid-produced vapor, or combustible liquid-produced vapor whose MESG* is greater than 0.75 or MIC** ratio is greater than 0.80. Gases in this class are ammonia, acetone, methane, ethanol, propane, gasoline, naphtha, benzene, butane, and natural gas.

Group E – Atmospheres containing combustible metal dusts. These metals include magnesium, aluminum, and many commercial alloys of these two metals.

Group F – Atmospheres containing combustible carbon-type dusts with 8% or more trapped volatiles such as coal, carbon black, and coke dust.

Group G – Atmospheres containing combustible dusts not included in Groups E and F. These dusts include flour, grain, wood, starch, plastic, and chemicals.

*MESG..Maximum Experimental Safe Gap....is the standardized measurement of how easily a gas flame will pass through a narrow gap bordered by heat-absorbing metal. MESG is used to classify flammable gases for the design and/or selection of electrical equipment in hazardous areas.

**MIC ratio...Minimum Igniting Current ratio.....the ratio of the minimum current required from an inductive spark discharge to ignite the most easily ignitable mixture of a gas or vapor, divided by the minimum current required from an inductive spark discharge to ignite methane under the same test conditions.

(Note: Groups A, B, C, and D, are for gases and are Class I only; Groups E, F, and G are for dusts and flyings and are Class II or III.

Zone System:

International (outside the US and Canada) hazardous locations are classified by the Zone system. There are two zones; gas or dust. Electrical equipment for gas atmospheres is divided into Groups and Subgroups.

Note: The “Zone” identifies the probability of the gas or dust being present in enough quantity to produce explosive or ignitable mixtures.

Zone for GAS

Zone 0 – Ignitable mixtures of flammable gases or vapors are present continuously or for long periods of time

Zone 1 – Ignitable mixtures of flammable gases or vapors are likely to occur under normal operating conditions

Zone 2 – Ignitable mixtures of flammable gases or vapors are not likely to occur under normal operating conditions and if present are in the area for only a short period of time

Zone for DUST

Zone 20 – Combustible dusts or ignitable fibers or flyings are present continuously or for long periods of time

Zone 21 – Combustible dusts or ignitable fibers or flyings are likely to occur under normal operating conditions

Zone 22 – Combustible dusts or ignitable fibers or flyings are not likely to occur under normal operating conditions and if present are in the area for only a short period of time

Groups...The Zone system identifies three separate Groups for electrical equipment.

Group I – Equipment intended for use in mines susceptible to flammable mixtures of gases occurring naturally in the mine

Group II – *Equipment intended for use in places with an explosive gas atmosphere other than mines where flammable mixtures occur naturally. Group II is further divided into three subgroups:*

Group IIA – *Atmospheres containing propane, or gases and vapors of equivalent hazard*

Group IIB – *Atmospheres containing ethylene, or gases and vapors of equivalent hazard*

Group IIC – *Atmospheres containing hydrogen or acetylene, or gases and vapors of equivalent hazard.*

Group III – *Equipment intended for use in places with an explosive dust atmosphere. Group III is further divided into three subgroups:*

Group IIIA – *Atmospheres containing combustible flyings*

Group IIIB – *Atmospheres containing non-conductive dust*

Group IIIC – *Atmospheres containing conductive dust*

Types of Purge and Pressurization Systems

Once the hazardous location classification is known for the place in which the electrical enclosure is to be installed, the purge and pressurization system “Type” can be determined. There are three specific types of systems: Z-Type, Y-Type, and X-Type. Again, we can refer to NFPA Standard 496 for the definitions of each (following are the sections and definitions from the standard):

3.3.8.3 Type Z Pressurizing – *Enables use of equipment suitable for unclassified locations within the protected enclosure where the equipment would otherwise be required to be suitable for Division 2 or Zone 2 locations.*

3.3.8.2 Type Y Pressurizing – *Enables use of equipment suitable for Division 2 or Zone 2 locations within the protected enclosure where the equipment would otherwise be required to be suitable for Division 1 or Zone 1 locations.*

3.3.8.1 Type X Pressurizing -- *Enables use of equipment suitable for unclassified locations within the protected enclosure where the equipment would otherwise be required to be suitable for Division 1 or Zone 1 locations.*

Thus, ***the real value of the purge and pressurization system*** is that the user of the electrical enclosure can upgrade the hazardous location capability of the enclosure without having to upgrade any and/or all the components within the enclosure. It’s really a cost-saving advantage because you do not have to go thru the process of additional certifications and/or using a more expensive explosion proof enclosure. In

addition, the ease of entry into and exit out of the enclosure requires much less time than that of an explosion proof enclosure.

Up to this point we've focused on hazardous location applications (where elements of a fire or an explosion might exist) involving electrical enclosures. In addition to hazardous location applications, ***purge and pressurization systems can be used in various non-hazardous locations***. For example, if the enclosure is located in an application area in which the ambient air is very dusty or corrosive (but not explosive or ignitable), the use of a purge and pressurization system is an effective method of keeping the dusty and/or corrosive elements from entering the enclosure. These non-hazardous applications are not considered safety related but will help prolong the life and functionality of both the enclosure and the components within the enclosure—a definite cost savings.

The number of market sectors and applications within these sectors that use purge and pressurization systems is both broad and deep. Following is list of the more common sectors utilizing purge and pressurization systems:

- Upstream and midstream oil and gas (On-shore and Off-shore)
- Petro-chemical
- Bulk material handling
- Waste water treatment
- Land fills
- Grain storage
- Grain processing
- Pharmaceutical
- Cosmetics
- Coal mining
- Furniture manufacturing
- Transportation
- Aerospace
- Metering and dispensing

The demand for purge and pressurization systems continues to grow fueled by the increased emphasis on safety, both organic and regulatory, and the need for added functionality of systems requiring in-situ electrical enclosures.

AB-CO PURGE (www.ab-copurge.com) is a US company that manufactures purge and pressurization systems and is positioned to help fill the growing demand for these products.



Figure A – Front View of Purge and Pressurization System

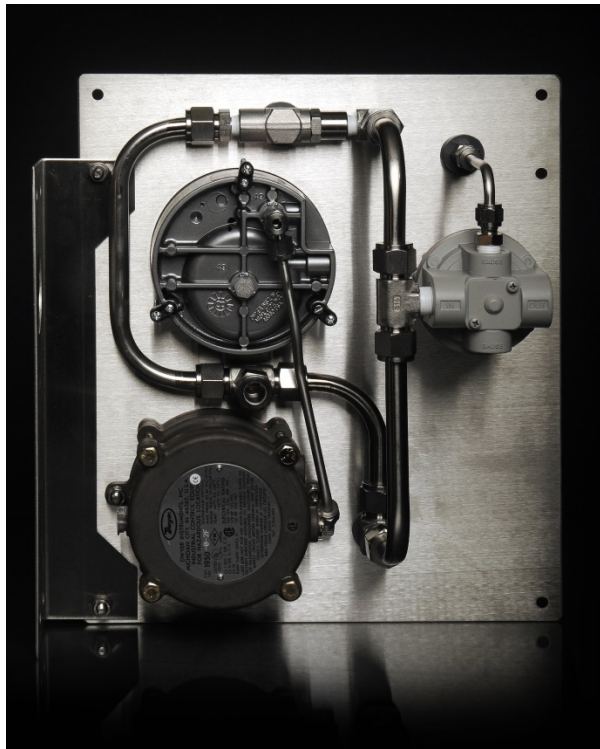


Figure B – Back View of Purge and Pressurization System