# Purge and Pressurization

## Terminology

Purging/pressurization systems permit the safe operation of electrical/electronic equipment under hazardous conditions when approved hazardous location equipment is not part of the application or the equipment is rated but to a lesser hazardous location than is present.

*Purging* is defined as a process of supplying a flow of clean air or an inert gas to the inside of an enclosure or motor to reduce hazardous internal airborne impurities to an acceptable safe level. The flow must provide the enclosure interior with a positive pressure greater than the ambient pressure to be sufficient to take the hazardous elements out of the enclosure or motor to this acceptable level. Standards require the internal air volume to be changed four times every for enclosures and ten times per hour for motors. During a purging process for an enclosure, a minimum positive pressure of 0.1" of $H_2O$ for Class I hazardous locations and 0.50" of $H_2O$ for Class II hazardous locations must be maintained.

*Pressurization* is defined as a process of supplying a flow of clean air or inert gas to the inside of an enclosure to increase the internal air pressure above external atmosphere pressure thus preventing the entrance of hazardous elements into the enclosure. Although very similar to purging, pressurization is not used to clean out impurities or hazardous gases that may exist inside an enclosure.

## The Concept of Purge/Pressurization

The concept of purge/pressurization allows the use of standard NEMA 4/12 enclosures in hazardous locations. Purge/pressurization equipment must be attached to the enclosure supplying a flow of clean air or an inert gas to maintain a positive pressure inside the enclosures and to reduce the internal concentration of hazardous material and gases to a safe level. This process starts by purging the interior of the enclosure of hazardous airborne impurities and gases to acceptable levels of concentration. Once these levels are met, the process changes to that of pressurization. This change does not lead to a break in the flow of air or inert gas because it would be then be possible for hazardous contaminants to enter/reenter the enclosure possibly leading to unacceptable levels. Pressurization now keeps the pressure inside the enclosure constant and above the ambient pressure so

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that the lower pressure external hazardous atmosphere cannot penetrate the enclosure.

**Standards**

There are a few standards regarding purge and pressurization. Within North America these are:

- *NFPA 70* – National Electrical Code, Article 500
- *NFPA 496* – Purged and Pressurized Enclosures for Electrical Equipment 1996 Edition
- *ISA 12.4-1996* -- Pressurized Enclosures
- *UL 698* – Industrial Control Equipment for use in Hazardous Locations, Class I, Gr. A, B, C, D and Class II, Gr. E, F, G
- *CSA C22.1 Part 1* – Canadian Electrical Code

In Europe the following standards are to be considered:

- *IEC 79-2*
- *EN 50016*

**Purge/Pressurization types**

Purging of enclosures is not required before pressurization in some cases. For Class I, purging is required to remove flammable gases and vapors from the enclosure interior. Purging is not required for Class II although combustible materials must be manually removed before starting pressurization.

The standards differ between three types of pressurization:

- Type X – Reduces classification within the enclosure from Class I or II, Division 1 to non-hazardous.
- Type Y – Reduces classification within the enclosure from Class I, Division 1 to Class I, Division 2.
- Type Z – Reduces classification within the enclosure from Class I, Division 2 to non-hazardous.

**Type X purge/pressurization**

This type of pressurization is defined to reduce classification within the enclosure from Class I or II, Division 1 to non-hazardous. The internal equipment can be rated for general-purpose, non-hazardous locations. The purge/pressurization system and the electrical power source must be interlocked since a power failure to the pressure system and not the internal equipment could result in an explosion due to the continuous presence of a

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hazardous atmosphere in Division I areas. The enclosure or motor must exchange 4 or 10 volumes respectively before power can be applied for Class I timing systems. The internal pressure must be maintained at 0.10" or 0.50" $H_2O$, depending on whether the external hazardous atmosphere is Class I or II.

**Type Y purge/pressurization**

This type is defined to reduce classification within the enclosure from Class I, Division 1 to Class I, Division 2. All internal protected equipment must be rated for Class I, Division 2 and an initial purge is required to ensure internal atmosphere is at a minimum, Division 2. The interlock between power system and the pressurization system is optional, but an audible alarm or visual indicators must be used to notify low pressure. The pressure must be maintained at 0.10"/0.50" $H_2O$ during the pressurization process.

**Type Z purge/pressurization**

Type Z is defined to reduce classification within the enclosure from Class I, Division 2 to non-hazardous. The internal equipment can be rated for general-purpose, non-hazardous locations. An initial purge is required to ensure internal atmosphere is non-hazardous. The interlock between power system and the pressurization is also optional, but an audible alarm or visual indicators must be used to notify low pressure. The pressure must be maintained at 0.10"/0.50" $H_2O$ during pressurization process.

**Differences between X, Y, Z**

For Type X and Z systems, the internal equipment can be rated as general-purpose equipment, but Type Y systems, Division 2 rated equipment is to be used. The purging time for Type Y and Z is based on a measured inlet airflow rate to the enclosure. Type X purging time is based on a measured airflow rate to the outlet. The removal of power to the enclosure is not required on loss of pressure for Type Y and Z systems. Since a Type X systems may have non-hazardous rated internal equipment in a Division 1 area, an interlock between the power and pressurization system is required to cut off power to this internal equipment in case of lost internal pressure. Type X systems also require electronic timers for full automatic control. In principle it can be said that Type X systems are more costly than Type Y and Z systems.

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## Enclosure Considerations

NEMA Type 4 enclosures are recommended for use with purge/pressurization systems. NEMA Type 12 enclosures can be used if the expected higher leak-rate is acceptable. Further, it is recommended to use single door enclosures to reduce the possible leak-rate arising from the typical door design of multi-door enclosures. The enclosures may have windows, but the window design should be considered while planning the pressurization system. Carbon or stainless steel is the preferred material for enclosures used with purge/pressurization systems. Lastly, the volume of the enclosure is to be considered when determining the length of time the purging will take and which pressurization system to use.

## Choosing a system

In choosing a purge/pressurization system, there are five primary factors. The first factor is the hazardous area classification (Class and Division) the enclosure and internal equipment are to be used in. For Division 1 areas, the hazardous rating of the internal equipment determines if a Type X or a Type Y system is to be used. Second factor is the equipment rating. The rating that is necessary for the equipment depends on the Class and Division of the ambient atmosphere and the desired hazardous environment inside the enclosure. A third criterion is the dimensions of the enclosure used to determine internal volume. The fourth factor is the enclosure configuration. For example, all cable entry must be sealed to NEMA Type 4 or 12 and any external wiring to the enclosure must be compliant for use in the particular hazardous environment present. In case of a Type X system, the power requirements, especially the demand of an interlock, is the fifth criterion to be considered.

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