

Z Purge Options for O₂ Analyzer Electronics In Hazardous Areas

THE PROBLEM

In some instances, electronic packages for an oxygen analyzer system must be installed in a location identified as a hazardous area. In these areas, the atmosphere contains flammable or ignitable concentrations of gases, vapors, dusts or fibers. There must be an understanding of how such areas are classified to ensure that electronics packages meet these classifications.

AREA CLASSIFICATION METHODS

The National Fire Protection Association (NFPA) classifies hazardous areas by three different factors: classes, groups and divisions. These factors each identify different elements of concern and combine to define the type of hazardous substance, an explosive rating of the substance and the degree of hazard created (Figure 1). An area rating of "Class I, Division 2", for example, defines a hazardous area which has gaseous vapors, such as propane, which could escape from containment to atmosphere, but only under abnormal operating conditions. Ratings can be combined to form broad coverage of both situations and hazardous substance mixtures, even across class barriers, such as rating of "Classes I and II, Groups, C, D and G, Division 2". Many conditions exist to determine area classification. Whether downwind, above or below your components, other devices can spread their hazard to your components. Gravity is a significant factor.

PURGING

"Purging" means to expel. The intent is to expel hazardous substances from a sealed enclosure. Purging, as defined in this generalized manner, is the technique of supplying a sealed enclosure with a clean, inert supply of gas to remove hazardous gases or vapors, or in order to prevent the accumulation of hazardous dusts within the sealed enclosure.

Purging can be accomplished with any inert gas including "instrument quality" air, nitrogen or argon which contains no more than trace amounts of a combustible vapor. Compressed air is the most common and practical purging medium. Bottled nitrogen is utilized most frequently in isolated places where no compressed air source is available.

Class Ratings

Classes define the type of hazardous substance in the surrounding atmosphere

- Class I** - contains flammable gases or vapors emitted by liquids
- Class II** - contains conductive, carbon-based and combustible dusts
- Class III** - contains ignitable fibrous materials

Group Ratings

Groups define the type of hazardous substance by its explosive rating based on other known substances in descending order from Class I, Group A to Class II, Group G

- Group A-D** - contains Class I gases, vapors and liquids
- Group E-G** - contains Class II conductive, carbon-based and combustible dusts

Division Ratings

Divisions define the degree of hazard by determining the hazardous substance's expected concentration in the surrounding atmosphere

- Division 1** - contains hazardous substances under normal operating conditions
- Division 2** - contains hazardous substances under abnormal operating conditions

Areas surrounding Division 1 areas must be rated as Division 2 areas

Class II, Group E areas containing any conductive dust must be rated as Division 1 areas

(See NFPA Code 70 (NEC) for complete area classification information and NFPA 497M for group ratings of common chemicals.)

Figure 1
NFPA Hazardous Area Classification Factors

PURGING (Continued)

Straight-forward purging and pressurization techniques require no more purging gas than is necessary to hold a "safe" 0.25 inch pressure in a sealed enclosure. Average consumption rates, using these techniques, should fall somewhere between 0.1 to 3.5 scfh per cubic foot of enclosure volume. Consumption is also dependent on the enclosure's integrity and the number of covers, doors and devices which penetrate the surface. However, different forms of protection may require as much as 80 to 100 scfm continuously to accomplish techniques such as cooling or dilution.

PRESSURIZATION/PURGING ENCLOSURE PROTECTION SYSTEMS FOR ROSEMOUNT O₂ ANALYZER ELECTRONICS

The IFT 3000 Intelligent Field Transmitter and the MPS 3000 Multiprobe Test Gas Sequencer from Rosemount can utilize a Z purge pressurization/purging enclosure protection system, which removes the hazardous substance. This method of protection is only slightly limited by the type, size, shape or location of the device and failure does not spell immediate disaster. A slow, continuous flow of protective gas is piped through the enclosure, which tends to eliminate problems such as heat, moisture, dust and corrosion.

NFPA CODE 496 PROTECTION METHODS

Pressurization - for general purpose equipment in Class II hazardous areas. These units are designed to prevent the entrance of combustible dust into a sealed enclosure containing general purpose electrical devices or instrumentation, excluding excessive heat output or hazardous substance analyzing or sampling devices.

Purging - for general purpose equipment in Class I hazardous areas. These units are designed to first remove and then prevent entry of flammable vapors into sealed enclosures containing general purpose electrical devices or instrumentation, excluding excessive heat output or hazardous substance analyzing devices.

NFPA CODE 496 SYSTEM TYPES

Type X - Division 1 to non-hazardous. For use of general purpose devices

Type Y - Division 1 to Division 2. For Division 2 rated devices.

Type Z - Division 2 to non-hazardous. For use of general purpose devices.

NFPA CODE RECOMMENDATIONS

The following are excerpts from NFPA Code 496 for electrical devices and instrumentation in Class I and II, Division 1 and 2 hazardous areas:

Class II Hazardous Area Pressurization

Division 2 Areas - where the enclosure is protected by a Type Z pressurization system and powered by a local disconnect switch.

With power to the protected enclosure de-energized, alarm systems activated and pressurization system air supply on...

Start-up Conditions:

1. Remove hazardous substance from the protected enclosure (preferably with a vacuum tool).
2. Check operation of over pressurization protection device (if utilized) and seal the protected enclosure.

System Start-up Procedures:

1. Pressurize the protected enclosure to a minimum of 0.10 or 0.50 inches of water (dependent on particle density) and maintain.
2. Energize protected enclosure power manually via a disconnect or breaker rated for the hazardous area.
3. Loss of pressurization requires immediate attention or manual de-energizing of protected enclosure power.

Division 1 Areas - where the enclosure is protected and powered by a Type X pressurization system.

Start-up Conditions and System Start-up Procedures - same as above except:

With power to the pressurization system energized, alarm systems activated and pressurization system air supply on...

1. System will apply power automatically when pressure is set and maintained at 0.10 or 0.50 inches of water.
2. Equipment that may overload, such as motors or transformers, may require protection of high temperature cut-off switches.

Class II, Division 1 and 2 Alarm System Recommendations:

Downstream constantly attended audible or visual alarms are recommended for all enclosures.

Class I Hazardous Area Purging

Division 2 Areas - where the enclosure is protected by a Type Z purging system and powered by a local disconnect switch.

Start-up Conditions:

1. Check operation of over pressurization protection device (if utilized) and seal the protected enclosure.

With power to the protected enclosure de-energized, alarm systems activated and purging system air supply on...

System Start-up Conditions:

1. Pressurize the protected enclosure to set and maintain a minimum of 0.10 inches of water pressure.
2. Exchange the recommended volumes of purging gas unless the area and enclosure are positively known to be non-hazardous.
3. Energize protected enclosure power manually via a disconnect or breaker rated for the hazardous area.
4. Loss of pressurization requires immediate attention or manual de-energizing of protected enclosure power.
5. Equipment that may overload, such as motors or transformers, may require internal isolation in a separate purged enclosure.

Division 1 Areas - where the enclosure is protected and powered by a Type X purging system.

Start-up Conditions and System Start-up Procedures - same as above except:

With power to the purging system energized, alarm systems activated and purging system air supply on...

1. Exchange is mandatory and system must deny power energizing automatically until exchange is completed.
2. Loss of pressurization must de-energize protected enclosure power or activate constantly attended audible and visual alarm systems.
3. Equipment that may overload, such as motors or transformers, may require protection of high temperature cut-off switches.

Class I, Division 1 and 2 Alarm System Recommendations.

Downstream constantly attended audible or visual alarms are recommended for all enclosures.

If protective gas supply does not have an alarm switch then purge panel must be ordered with pressure loss alarm switch (wps).

PRESSURE LOSS ALARM SWITCHES

The primary function of pressure loss alarm switches is limited to alarm system activation. These switches then detect failure of the protection gas supply, the pressurization/purging enclosure protection system, or the enclosure integrity. This all-around protection is accomplished because the switches are connected directly to the protected enclosure, essentially referencing downstream pressure on the complete assembly. All switches are differential pressure sensing devices, featuring a SPDT switch for normally open or closed operation and a calibration screw for field adjustment. Enclosure pressure is then compared to atmospheric pressure by porting the "high" side of the switch to the protected enclosure and the "low" out to atmosphere.

CONCLUSION

Oxygen analyzer electronics installed in a hazardous area must be designed specifically for these locations. The Rosemount IFT 3000 Intelligent Field Transmitter and the MPS 3000 Multiprobe Test Gas Sequencer can utilize a Z purge pressurization/purge enclosure which uses supply of clean, inert gas to remove hazardous gases or vapors from the electronics enclosure.

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