

Protection Methods for Gas Detectors Used in Hazardous Environments

By JIM TURNER

Introduction

Almost every industrial setting poses some potential safety risk to personnel working in such environments whether it is something that can be seen such as rotating machinery or unseen, such as possible lethal concentrations of flammable /combustible Gas.

Accordingly, there are several methods of personal protection employed specific to the threat posed. In the case of gas detection instrumentation employing electrical circuits/devices, identification of the working environment and the hazards faced in that environment is the first step in determining the method of protection required to ensure safety of personnel.

There are two systems used to define a hazardous environment, Division Classification and Zone Classification.

Division Classification

Division classification is the dominant method used to describe the hazardous environment in North America. A Division 1 area is defined as a place in which an explosive (or poisonous) atmosphere is continually present or intermittently present under normal operating conditions. Division 2 is said to be an environment where the threat of dangerous gas being present is not likely to occur in normal operation, however under abnormal conditions, gas may be present.

Zone Classification

Zone classification is ubiquitous throughout the world and is also being adopted in North America. Zone classification is divided into three parts. A Zone 0 area is defined as a place where the presence of a combustible/flammable gas is always present under normal operating conditions. Zone 1 is an environment in which there is an intermittent chance that combustible gas will be present under normal operating conditions and Zone 2 is where the presence of dangerous levels of combustible gas only occurs under abnormal operating conditions.

Ignition of a combustible/flammable gas may occur in several ways, but these can be generalized as either:

- Hot Surfaces (all flammable /combustible gases have an ignition temperature)
- Electrical Arcing or sparks
- Mechanical sparks

In North America, the following general protection concepts are employed.

No Arcs, Sparks or Hot Surfaces

Electrical equipment is designed in a way that ensures no hot surfaces or arcing/sparking can occur. In general terms, this means that there are no connectors or other potential sources of arcing or sparking and that the surface temperature of all components remains well below a defined threshold (determined by the particular gas that may be present in an installation, each gas has an ignition temperature)

Contain the Explosion

This concept is based on the assumption that an explosive gas penetrates the electrical equipment and is ignited by either temperature or spark. The enclosure hosting the electrical equipment prevents the explosion from spreading/igniting the atmosphere by keeping the explosion contained within the enclosure.

Keep Flammable Gas from Contacting Electrical Equipment

The electrical equipment is housed in an enclosure that prevents the threat from contacting the sources of ignition (hot surface, sparks or arcing). No gas can penetrate the enclosure and there is no risk of an explosion.

Limit the Energy of Sparks and Surface Temperatures

Flammable/combustible gas may enter an enclosure, however the electrical circuit is designed in such a way that high temperatures and/or arcing is tightly controlled. In this protection concept, electrical circuits are evaluated for the potential energy they can store and release (assuming that there can be connectors or other potential sources of arcing or sparking)

Once the classification of an area is understood then it is possible to select gas detection equipment best suited to the operating environment. There are many factors to be considered in choosing equipment for use in hazardous locations such as:

- Cost: both the cost of the protection equipment and supporting infrastructure may be prohibitive

North America

- Ease of installation and maintenance of protection equipment
- Power consumption

Each site has to be evaluated based on the inherent risk and other factors in order to determine the best solution for protection of personnel. The following charts describe the protection methods used to achieve the levels of safety protection required by particular hazardous location environments.

Concept of Protection	Protection Method	Area Classification	Identification of Equipment
No arcs, sparks or hot surfaces	Increased Safety	Zone 1	Ex e (Canada) / AEx e (USA)
	Non-incendive	Division 2	(NI) (Canada and USA)
	Non-sparking	Zone 2	Ex nA (Canada) AEx nA (USA)
Contain the explosion	Explosion Proof	Division 1	(XP) (Canada and USA)
	Flame Proof	Zone 1	Ex d (Canada) AEx d (USA)
	Powder Filled	Zone 1	Ex q (Canada) AEx q (USA)
	Enclosed Break	Zone 2	Ex nC (Canada) AEx nC (USA)
Limit the energy of sparks and surface temperatures	Intrinsic Safety	Division 1	(IS) (Canada and USA)
		Zone 1	Ex ib (Canada) AEx ib (USA)
	Zone 0	Ex ia (Canada) AEx ia (USA)	
Limited Energy	Zone 2	Ex nL (Canada) AEx nL (USA)	
Keep Flammable Gases from contacting electrical equipment	Pressurized	Division 1	Type X (Canada and USA)
		Division 1	Type Y (Canada and USA)
		Division 2	Type Z (Canada and USA)
		Zone 1	Ex px (Canada) AEx px (USA)
		Zone 1	Ex py (Canada) AEx py (USA)
		Zone 2	Ex pz (Canada) AEx pz (USA)
	Restricted Breathing	Zone 2	Ex nR (Canada) AEx nR (USA)
		Zone 0	AEx ma (USA)
Encapsulated	Zone 1	Ex m (Canada) AEx mb (USA)	
Oil Immersion	Zone 1	Ex o (Canada) AEx o (USA)	

In international markets, a similar approach is taken in defining protection methods. ATEX (Europe) and IECEx (International) protection methods and identification are captured in the chart to the right.

Europe/International

Concept of Protection	Protection Method	Area Classification	Identification of Equipment
Inherently Safe, protection by shutdown	Optical Radiation	Zone 1-2	Op pr
		Zone 0-2	Op sh
		Zone 0-2	Op is
Contain the explosion	Flame Proof	Zone 1-2	d
	Enclosed Break	Zone 2	nC
Limit the energy of sparks and surface temperatures	Intrinsic Safety	Zone 0-2	ia
		Zone 1-2	ib
		Zone 2	ic
Quench the flame	Quartz/Sand Filled	Zone 1-2	q
No arcs, sparks or hot surfaces	Increased Safety	Zone 1-2	e
Enclosure IP 54 or better	Non-sparking	Zone 2	nA
Keep Flammable Gases from contacting electrical equipment	Pressurized	Zone 1-2	px
		Zone 1-2	py
		Zone 2	pz
	Sealing (Hermetic)	Zone 2	nC
	Restricted Breathing	Zone 2	nR
	Encapsulation	Zone 0-2	ma
		Zone 1-2	mb
Zone 2		mc	
Oil Immersion	Zone 1	o	

Manufacturers offer an array of gas detection products to suit various environments and applications. Careful consideration of all factors

is required to select the proper equipment to ensure the safety of all personnel potentially affected by the presence of harmful gas.

JIM TURNER IS THE CERTIFICATION SPECIALIST FOR FLAME & GAS DETECTION SOLUTIONS WITHIN ROSEMOUNT ANALYTICAL – EMERSON PROCESS MANAGEMENT. FOR MORE INFORMATION PLEASE CONTACT JIM.D.TURNER@EMERSON.COM.