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Hazardous Area Classification Considerations

Wayne Perry, Senior Technical Director
Kaeser Compressors, Inc.

In the past, seeing the term “Hazardous Location” usually meant that the equipment being requested was destined for a chemical plant, refinery, or drilling platform. Today, we are seeing hazardous locations in sugar mills, grain storage facilities, and anywhere there may be flammable liquids, gasses, or dust present. Hazardous areas are defined as areas where the presence of flammable gases or liquids, combustible dusts, or easily ignited fibers exist in sufficient concentrations to cause a fire or explosion, provided a source of ignition. These areas range from portions of a room to whole plant sites.

Partly due to this expanded use of the classification system, specifiers are increasingly citing requirements for equipment suitable for use in classified areas. When properly used, the hazardous area classification system makes for a safer work environment. Too often, however, hazard classes are specified without concern for the significantly higher design and procurement costs they bring. In many cases, an open mind and a little ingenuity can avoid excessive costs for compressors and other equipment, without compromising safety.

Classification Systems

There are some differences between the classification system in North America and the system used in other parts of the world. In North America, the most common method for defining hazardous areas is by Class, Division, and Group. Classes are used to identify the type of material that may be found in the atmosphere:

Class I – Flammable gases and vapors in quantities sufficient to produce ignitable or explosive mixtures

Class II – Combustible or conductive dusts present in the atmosphere

Class III – Ignitable fibers or flyings are in the atmosphere, but not likely to be in sufficient quantities to produce ignitable mixtures.

Divisions are used to identify the probability that an ignitable substance will be in the atmosphere in concentrations that would support ignition:

Division 1 – The substance is present during normal operating conditions. This is further defined as being more than 10 hours per year.

Division 2 – The substance is not present during normal operating conditions and is present only when an abnormal condition exists. This is further defined as being between 1 hour and 10 hours per year.

Unclassified – In a facility with Class I or Class II areas, any area where concentrations of gases, vapors, or dust sufficient for ignition are present less than 1 hour per year are listed as Unclassified.

Groups are listed as A through G. Groups A through D identify gases and vapors and apply to Class I locations. Groups E through G identify combustible dusts and apply to Class II locations. The degree of flammability is alphabetical, with A being the most flammable and D being the least flammable gases and vapors, and E being the most flammable and G being the least flammable dusts.

These classifications can be found in National Fire Protection Association (NFPA) Section 500 and 505. Section 505 is a newer section that is structured to harmonize the NFPA codes with the Zone ratings used outside of North America.

In Europe and other parts of the world, a Zone rating is used. This is similar to the North American system with some slight differences.

Zone 0 – An atmosphere where a mixture of air and flammable gas, vapor, or mist is present frequently, continuously, or for long periods of time. This is further defined as 1000 hours per year or more.

Zone 1 – An atmosphere where a mixture of air and flammable gas, vapor, or mist is likely to occur during normal operations occasionally. This is further defined as more than 10 hours but less than 1000 hours per year.

Zone 2 – An atmosphere where a mixture of air and flammable gas, vapor, or mist is not likely to occur in normal operation but, if it does occur, will persist for only a short period of time. This is further defined as more than 1 hour but less than 10 hours per year.

Unclassified – Flammable mixture is present less than 1 hour per year.

Zones 0 and 1 would be roughly equal to Class I, Division 1. Zone 2 would be roughly equal to Class I, Division 2. Zones 20, 21, and 22 are for dusts with the second digit corresponding to Zones 0, 1, and 2 as far as likelihood of being present in the atmosphere.

Designations

When determining a hazardous area designation, the following things have to be considered:

A) Is the hazard a gas, vapor, mist, dust, or fiber?

B) What is the actual hazardous substance (gasoline, coal dust, sugar, etc.)?

C) How often will the hazardous substance be present?

D) How large of an area might it cover?

From that information, the classification can be determined using either the Class/Division or Zone methods. The degree of classification will determine the type of equipment that can be installed in that area.

There are a number of methods that are commonly used to protect equipment in classified areas. They are all designed to prevent the equipment from becoming a "source of ignition". Commonly used terms include:

Explosion-proof – This term does not mean that the equipment is built in a manner that it will prevent it from exploding. Explosion-proof equipment is built so that if a flammable mixture enters the equipment and there is a source of ignition (spark, internal heat, etc.) the equipment will contain the explosion without damage and be able to cool the hot gases that escape the equipment to the point where they cannot ignite the flammable mixture outside of the equipment. This equipment must also be designed so that the exterior does not get hot enough during normal or abnormal operation to ignite a flammable mixture that might surround the equipment.

Intrinsically Safe – Intrinsically safe equipment is equipment that does not contain enough energy to provide a source of ignition. Generally, this means that the equipment must be below 30 volts and have a current of less than 300 mA.

Encapsulation – Some electronic devices can be encapsulated in a resin to protect them from explosive mixtures. Care must be taken to make certain that the device will not generate sufficient heat to either damage the internal components or the resin.

Purged or Pressurized – An example of this would be a sealed electrical cabinet that maintains a positive internal pressure of inert gas, such as nitrogen, or clean air to prevent the ingress of a flammable mixture. Care must be taken with this type of system to ensure that the cabinet is purged prior to being energized.

Immersion – As the name implies, immersion involves placing the electrical equipment in a suitable liquid so that any flammable material in the atmosphere is not able to contact the equipment.

Hermetically Sealed – This commonly involves encapsulating an electrical device in glass, with its leads fused to the glass. Due to the possibility that the glass may break, this method cannot be used in Division 1 or Zones 0 or 1 locations.

Common Designations for Different Types of Hazardous Materials

Hazardous Material	Common NA System	Zone System
Gasses and/or vapors	Class I, Division 1 Class I, Division 2	Zone 0, Zone 1 Zone 2
Combustible Dusts	Class II, Division 1 Class II, Division 2	Zone 20, Zone 21 Zone 22
Fibers and/or Flyings	Class III, Division 1 Class III, Division 2	No Zone System Equivalent

Managing Costs and Risks

The goal of any facility that deals with hazardous materials should be to confine that hazard to as small an area as possible. This makes for a safer facility and minimizes the areas where equipment has to be modified at great expense to make it safe for operation. Modification of equipment to meet the requirements of classified areas can multiply the cost of that equipment two or three fold, and some equipment simply cannot be modified to meet those requirements.

In the case of air compressors, there are alternatives. In some cases, simply moving the proposed compressor installation location a short distance into a better ventilated area can change the classification from Class I, Division 2 to being Unclassified. The expense of 100 feet of piping will almost always be less than the modifications required to install the compressor in a classified area. In the case where the hazardous material is heavier than air, for example, siting the compressors up one floor may also change the location to Unclassified. Or conversely, if the hazardous material is lighter than air, locate the compressed air equipment down one floor. Here's another point to consider: having the compressor in an unclassified area improves the safety of the entire facility. A serious concern with compressors in classified areas is the possibility that they will pull in and transport flammable mixtures through the distribution piping into unclassified areas with other equipment not designed for classified areas.

In short, every effort should be made to locate compressors outside of classified areas. For both cost and safety, a little extra head work may reduce capital costs and improve safety.

About the Author

Wayne Perry is Senior Technical Director at Kaeser Compressors, Inc. An industry specialist with more than 35 years of experience in all aspects of the compressed air business, Perry is a Qualified AIRMaster+ Specialist for the U.S. Department of Energy and a former instructor for Compressed Air Challenge. He has provided extensive technical expertise in the development of international standards for compressed air system assessments and has also worked as a Compressed Air Expert for the United Nations Industrial Development Organization. Perry serves on various technical and standards committees of the Compressed Air and Gas Institute. He can be reached at wayne.perry@kaeser.com.

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Kaeser Compressors, Inc.
511 Sigma Drive
Fredericksburg, VA 22408 USA
Telephone: 540-898-5500
Toll Free: 800-777-7873
us.kaeser.com
info.usa@kaeser.com