The ability to safely heat and vacuum seal bags in hazardous environments depends on a basic understanding of what specific conditions contribute to the potential danger as well as what protective features are required on the bag sealer itself to mitigate these threats. When used prudently, a bag sealer that is configured with the required safety equipment can operate in a manner that does not contribute significantly to the possibility of explosion.

The goal: Achieving a safer workplace.

For over forty years, the Occupational Safety & Health Administration (OSHA) has developed policies that make employers responsible for a safe workplace. To achieve safer workplace conditions they set and enforce standards, provide training, and offer outreach, education and assistance. Employers are mandated to comply with all applicable OSHA standards, including those pertaining to how certain activities are conducted in hazardous locations.

One of the first steps in creating a safer workplace is identifying a hazardous location and the prevailing conditions that make it so. The National Electrical Code (NEC) defines hazardous locations as those areas where fire or explosion hazards may exist due to flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers. A major part of the NEC guideline focuses on hazardous locations, as electrical equipment can become a ready source of ignition in these volatile areas. NEC classifies hazardous locations in general categories: Type, Condition, and Nature. According to the NEC, there are three types of hazardous locations.

Types of hazardous locations

Class I Locations

The first type of hazardous location is created by the presence of flammable gases or vapors in the air, such as natural gas or gasoline vapor. When these materials are found in the atmosphere, a potential for explosion exists, which could be ignited if an electrical or other source of ignition is present. Typical Class I locations include:

- Dry cleaning plants where vapors from cleaning fluids can be present
- Spray finishing areas
- Aircraft hangars and fuel servicing areas
- Operations involving storage and handling of liquefied petroleum or natural gas

All of these Class I (gas or vapor) hazardous locations require very special equipment and operator training that is adapted specifically for use in Class I hazardous locations.

Avoiding the Big Bang: Explosion-Proof Bag Sealers

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Class II Locations

The second type of hazardous location is an area made dangerous by the presence of combustible materials, which may be suspended in the atmosphere (dust) and cause a powerful explosion. Typical Class II locations include:

- Grain elevators
- Flour and feed mills
- Plants that manufacture, or use magnesium or aluminum powders
- Producers of medicines and fireworks
- Producers of starch or candies
- Sugar and cocoa processing plants
- Coal plants and other carbon handling areas

Class III Locations

Class III hazardous locations are areas where there are easily ignited fibers present. Though the fibers are not likely to be suspended in the air, they can collect around machinery or on electrical fixtures and where heat, a spark, or exposure to hot metal can ignite them. Typical Class III locations are:

- Textile mills
- Plants that cut wood and create sawdust
- Paper recycling facilities

Understanding the conditions that are present in a hazardous location

In addition to the types of hazardous locations, the conditions under which these hazards are present are of concern as well. Hazardous material may exist in different kinds of conditions, which are generally described as, “normal conditions”, and, “abnormal conditions”. In the normal condition, the hazard would be expected to be present in everyday operations – vehicle or equipment fueling, for example. However, when the hazardous material is expected to be confined within closed containers or closed systems and will be present only through accidental leakage or faulty operation, the situation is referred to as an “abnormal condition.” The two conditions are defined very simply: Division-1 (normal conditions) and Division-2 (abnormal conditions). Class I, II and III hazardous locations can be either Division-1 or Division-2.

A good example of a Class I, Division-1 location would be the areas adjacent to relief valves in a petroleum refinery, because the hazardous material is expected to be present during normal routine operations. In this location, the worker would be aware of the potential hazard. In the case of a closed storage drum containing a flammable liquid in an inside storage room, one would not normally expect the hazardous vapors to escape into the atmosphere. But in the event that one of the
containers is leaking, the result is a Class I, Division-2 hazardous environment. In this scenario, the worker may not be fully aware of the potential for danger.

Classifying hazardous substances

The gases and vapors of Class I locations are broken into four groups: A, B, C, and D. These materials are grouped according to the ignition temperature of the substance, explosion pressure, and other flammable characteristics. The only substance in Group A is acetylene. Group B is another relatively small segment of classified areas. Group C and Group D are by far the most common Class I groups, and they comprise the greatest percentage of Class I hazardous locations. Many of the most common flammable substances such as butane, gasoline, natural gas and propane are found in Group D.

In Class II (dusty locations) one finds the hazardous materials in Groups E, F, and G. These groups are classified according to the ignition temperature and the heat conductivity of the hazardous substance. Heat conductivity is an important consideration in Class II locations, especially with potentially volatile fine metal dusts. Metal dusts are categorized as Group E. Included here are aluminum and magnesium dusts and other metal dusts of similar nature. Group F atmospheres contain such materials as carbon black, charcoal dust, coal and coke dust. Group G includes very common dusts from grains, flour, starch, cocoa, fine saw dust and similar types of particle materials.

Interactions with hazardous conditions and substances

Electrical equipment, including bag sealing equipment, can become a dangerous source of ignition. There are three likely ways ignition can occur. Though often out of view, arcs and sparks produced by the normal operation of equipment (motors, contacts, and switches, etc.) can ignite in a hazardous location atmosphere. The high temperatures of some heat-producing equipment, such as lamps and lighting fixtures, can ignite flammable atmospheres if they exceed the ignition temperature of the hazardous material. Electrical equipment failure is another way an explosion could be set off. A single spark caused by a faulty terminal or connection could spark a real disaster in a hazardous location.

Sealing equipment design and construction

Specific steps need to be followed in how equipment is designed and constructed to make it suitable for use in hazardous locations - especially with those machines designed for Class I locations.

The first requirement for a Class I enclosure is strength. The enclosure must be strong enough to contain an explosion within. The walls must be thick enough to withstand the internal strain, and it has to be explosion-proof in the event gas or vapors get inside. Secondly, the sealing equipment must function at a temperature below the ignition temperature of the surrounding atmosphere. Sealed fittings are another consideration. Sealed fittings are to be filled with a chemical compound after the wires have been pulled. As the compound hardens, it seals passageways thus blocking the travel of dust and gases. In each conduit entering an enclosure for switches, circuit breakers, fuses, relays, or other apparatus which may produce arcs, sparks, or high temperatures within Class I locations, conduit seals must be placed as close as practicable and in no case more than 18 inches from such enclosures. The requirement for Class II and III Locations are less demanding. A good deal of protection is afforded by containing electrical components within NEMA Certified enclosures.

NEMA and NEMA Certified enclosures

The National Electrical Manufacturers Association (NEMA) publishes more than 600 standards, application guides and technical papers on a wide range of topics related to electrical product function and safety. The term “NEMA rating” is often used loosely to refer to a specific standard for protective electrical enclosures.

Choosing the proper NEMA enclosure

When properly installed and maintained, NEMA Type 7 and 10 enclosures are designed to contain an internal explosion without causing an external hazard. Type 9 enclosures are designed to prevent the ignition of combustible dust. Note that a nationally recognized, third party testing laboratory must certify all equipment designed for use in hazardous locations. In addition to the NEMA type, look for the appropriate hazardous location equipment markings.
NEMA Type 7: Explosion proof for indoor use.
• Class I, Division 1 hazardous locations, Groups A, B, C and D

NEMA Type 8: Explosion proof for indoor or outdoor use.
• Class I, Division 1 hazardous locations, Groups A, B, C and D

NEMA Type 9: Dust ignition proof for indoor use.
• Class II, Division 1 hazardous locations, Groups E, F and G

NEMA Type 10: MSHA. Meets the requirements of the Mine Safety and Health Administration, 30 CFR Part 18

User awareness and operating procedures

Regardless of how carefully it has been designed, every machine used in a potentially hazardous environment, must be operated in a prudent fashion. User training and situational awareness are essential. Best practices for machines operated in dusty environments, for example, mandate that the equipment be kept exceptionally free of particles and debris. Dust and debris accumulating around heating elements can, in some cases, retain enough residual heat to cause combustion. Casual cleaning with a brush or cloth may not be adequate, and users are urged to blow off machines thoroughly with compressed air if possible. Bag sealers and vacuum sealers that are specifically outfitted and certified for use in hazardous environments, and are handled by informed and responsible operators may be used with a reasonable expectation of safety.

Conclusion

Rigorous standards for hazardous location equipment have been set, and recognized testing laboratories conduct actual explosion tests under laboratory conditions. For each Class I enclosure under test, they dial in different mixtures of gas and air - from very lean mixtures to very rich mixtures, until they find the one that creates the greatest explosion pressure. To pass inspection, the equipment must not only prevent the ignition of the surrounding atmosphere, but also be able to withstand a hydrostatic test where liquid is pumped into the enclosure at high pressure to test the limits of its strength. The device will only pass if it can resist rupture at four times the maximum pressure found in the explosion tests. For example, if explosion testing shows a maximum pressure for a junction box of 250 pounds per square inch to get approval, the box must be able to withstand 1,000 psi of hydrostatic pressure – 4x the maximum anticipated pressure of 250 psi. Regardless of the cause of a hazardous location, it is necessary that every precaution be taken to guard against ignition of the atmosphere.

The National Electrical Code is the “Bible” of the electrical industry, and the primary source of reference for this article. The NEC is also the basis for OSHA standard 1926.407, Hazardous (Classified) Locations. There are several additional OSHA standards that require the installation of electrical wiring and equipment in hazardous (classified) locations according to the requirements of Subpart K, Electrical. The NEC should be consulted as a supplement to the OSHA standards for additional background information concerning hazardous locations.

We invite your questions and comments

You may contact us any time with comments, questions or topics for discussion. Our objective is to offer the latest information available on the subject of flexible packaging solutions. With decades of practical experience in the packaging industry, we can offer insight on practically every aspect of the flexible packaging business.

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