

# **Advantages of Explosion Proof LED Lighting in Confined Spaces**

## **Table of Contents**

- 1.0 Executive Summary
- 2.0 Introduction
- 3.0 LED Explosion Proof Lighting
  - 3.1 Mechanisms and Design
  - 3.2 NEC Compliance
- 4.0 LED Explosion Proof Lighting Best Practices
  - 4.1 Advantages over Traditional Lighting Products
  - 4.2 Choosing the Right Explosion Proof Lights
- 5.0 Larson Electronics LED Explosion Proof Lighting Solutions
- 6.0 Conclusion

## **1.0 Executive Summary**

This report aims to highlight the advantages of explosion proof-light emitting diode (LED) lighting in confined spaces. The study expounds on its usage and presence in various industrial sectors, as well as its primary roles in maintaining safety in the workplace. The complex aspects of the application of explosion proof lighting (EPL) will also be covered, which includes compliance with lighting classifications set forth by the National Electric Code (NEC) and other regulating institutions. Engineers, lighting specialists and professionals can use the report to better understand best practices in choosing and handling EPL products.

To ensure the proper selection of EPL fixtures, Larson Electronics showcases a range of EPL units that are designed for specific tasks in industrial environments. With emphasis on flexibility, clarity and safety, the company offers customized lighting solutions to reduce risks and bottlenecks associated with hazardous locations. Through the publication of this report, Larson Electronics displays its extensive experience and solid presence in the competitive lighting industry.

## **2.0 Introduction**

EPL plays an essential role in the industrial operations of hazardous locations. More importantly, the use of the lights in confined spaces (a location with limited entry and exit points) help streamline work performed in such areas by greatly reducing risks related to explosive gases, such as propane and methane, and flammable dust particles. EPLs can be found in several demanding sectors, including food processing facilities, oil and gas refineries, chemical processing plants, and commercial marine projects. Confined spaces are complex in nature due to their isolated and dark conditions. The presence of hazardous gases or dust further increases the risks of working in such environments. Examples of hazardous confined spaces include chemical storage units, grain silos and ship tanks.

The introduction of LED technology in the EPL space has had a positive effect on the performance of the industry's products and offerings. As a result, workers have been able to increase their reliance on the lights and engage in work-related tasks with greater efficiency. The advantages of LEDs over conventional lighting options include instant toggling, longer lifespans and greater portability. Currently, the global adoption of LED explosion proof lighting systems is increasing at an average annual rate of 5.9 percent. ElectroniCast, a market and technology research firm, predicts consumption to reach \$206.5 million by 2018 (compared to \$137.8 million in 2011). Leading the adoption of EPL products are oil-related establishments in the Europe, Middle East and African (EMEA) region.

A crucial aspect to the implementation of EPL is classification compliance. Businesses must be aware of the light's approval ratings in relation with the hazardous location. According to the Occupational Safety and Health Administration (OSHA), accidents in the workplace are usually caused by improper use of equipment and human error. To help prevent this, the governing

agency and other regulating organizations, such as the NEC, have laid out specific guidelines that entail the various classes, divisions and groups for EPL products. The NEC covers the design and installation components of electrical systems, but does not advise on the performance of the work involved.

### **3.0 LED Explosion Proof Lighting**

#### **3.1 Mechanisms and Design**

LED explosion proof lights rely on a robust design to proactively prevent ignition and sparks. In this case, the term “explosion proof” refers to the unit’s ability to isolate or contain sparks within the light, where it cannot react with flammable substances. While intrinsically safe lights are units that do not spark due to the use of low currents. Majority of EPLs are encased in thick glass, which covers the entire bulb or panel. An explosion proof box may also be utilized to house the switch, sensor and wiring. It is important to consider that such products do allow gases to enter the aluminum case (the lights are not air tight).

The main feature of the lights is to prevent an explosion from escaping (in the event of an explosion), where it could cause serious harm to workers or ignite flammable substances with low flash points in the facility. To prevent the destruction of the unit, EPLs are equipped with high quality rubber gaskets. The conduit also entails permanent packaging to prevent gases from transferring out of the protective wiring.

General applications for EPLs include:

- Enclosed fueling stations
- Aircraft maintenance
- Paint spray booths
- Food processing facilities
- Chemical processing plants
- Offshore oil and gas rigs

In addition to LEDs, there are other types of fixtures that can be incorporated in EPLs. Explosion proof fluorescent units that rely on a tube style fixture can be used in damp and corrosive environments where flammable dust, paint powder or hazardous residues are present. For general lighting requirements, explosion proof incandescent units are applied. Such units offer versatile mounting options with wattage levels up to 300W and are commonly used during tank inspection.

#### **3.2 NEC Compliance**

All EPLs must pass certification from an official regulating institution or body (in the United States and Canada, such organizations include UL, CSA and ETL) for the specific application of

the hazardous location. The context of the term “hazardous location” refers to an area that contains concentrated amounts of flammable or combustible substances (gas, vapor, dust or fiber) in the air that can cause an explosion.

Each type of EPL is approved using the following set criteria: Class, Division and Group or Zone. The National Electric Code, or the National Fire Protection Association (NFPA) 70, elaborates further on the details of each type of approval rating for EPLs. The group suggests that lighting equipment must adhere to specific temperature requirements of the installation area. This condition indicates that the operating temperature of the lights and its working components cannot be greater than the minimum threshold of the ignition or combustion temperature of the gases in the air of the facility.

Article 500 in the NEC defines the Class/Division classification (article 505 covers the Class/Zone):

- **Class I, Div. 1** - Where ignitable concentrations of flammable gases, vapors or liquids are present continuously or frequently within the atmosphere under normal operation conditions.
- **Class I, Div. 2** - Where ignitable concentrations of flammable gases, vapors, or liquids are present within the atmosphere under abnormal operating conditions.
- **Class II, Div. 1** - Where ignitable concentrations of combustible dusts are present within the atmosphere under normal operation conditions.
- **Class II, Div. 2** - Where ignitable concentrations of combustible dust are present within the atmosphere under abnormal operating conditions.
- **Class III, Div. 1** - Where easily ignitable fibers or materials producing combustible flyings are present within the atmosphere under normal operation conditions.
- **Class III, Div. 2** - Where easily ignitable fibers or materials producing combustible flyings are present within the atmosphere under abnormal operating conditions.

Common materials within associated class and group ratings:

- **Class I Areas:** Group A: Acetylene / Group B: Hydrogen / Group C: Propane and Ethylene / Group D: Benzene, Butane, Methane and Propane
- **Class II Areas:** Group E: Metal Dust / Group F: Carbon & Charcoal / Group G: Flour, Starch, Wood and Plastic
- **Class III Areas:** NO GROUP: Cotton and Sawdust

It is crucial to only use lights that meet the requirements of the applicable location. In most cases, units that meet a higher classification exceed the requirements of lower classifications. An example of this condition can be found in ANSI/NFPA 70:500.8(A)(2), “Equipment that has been identified for a Division 1 location shall be permitted in a Division 2 location of the same class, group, and temperature class.”

## 4.0 LED Explosion Proof Lighting Best Practices

### 4.1 Advantages over Traditional Lighting Products

LED explosion proof lights come with numerous advantages over traditional lighting products. Such fixtures boast an average lifespan of 50,000+ hours, compared to other lights in its class, like incandescent bulbs (1,200+ hours) and compact fluorescent lighting (8,000+ hours). LEDs are also highly resistant to vibration, due to their compact design. There are no glass parts and filaments to break or pop out of socket. As a result, the product can withstand a higher threshold of rough treatment compared to standard lights. This feature is crucial for the reliability of the equipment in confined spaces that are extremely tight, poorly ventilated and secluded. Both the extensive lifespan and the sturdy design of explosion proof LEDs contribute to the minimal maintenance benefits of the lights. Advancements in the packaging of LED chips have allowed manufacturers to decrease production costs and drastically improve lighting capabilities.

When it comes to output and efficiency, LEDs use less power per unit of light generated. Below highlights the lumens-per-watt (LPW) differences between standard lights and LEDs:

- LED: 40-100 LPW
- Compact Fluorescent: 40-70 LPW
- Mercury Vapor: 25-60 LPW
- Halogen: 12-22 LPW
- Incandescent: 10-17 LPW

LEDs operate reliably due to their heat-saving features. Such units emit an average of 3.4 btu's/hour, and are not sensitive to humidity and low temperatures. The light's ability to emit less heat decreases the risk of accidents in hazardous locations. Incandescent bulbs give off 85 btu's/hour and present some performance issues under extreme temperatures and humidity. While compact fluorescents release 30 btu's/hour, and have difficulties working outside of the optimal operating temperature range.

LED lights consume roughly 20 percent less energy than traditional lamps. The energy-saving advantages of the lights are more apparent for businesses that use the units on a regular basis. Furthermore, carbon dioxide emissions are greatly minimized when using LEDs. Establishments with eco-friendly initiatives may also find explosion proof LEDs to be advantageous over mainstream lighting options. Such units do not contain harmful metals, such as lead and mercury. The proper disposal of traditional bulbs that contain toxic metals can be costly, especially for facilities with high lighting consumption rates.

## **4.2 Choosing the Right Explosion Proof Lights**

Not all EPLs are built the same way, and each version caters to specific classifications, as well as the environmental conditions of the hazardous location. As mentioned earlier, businesses that apply the wrong type of lights in their facilities are at risk of igniting flammable gases or dust particles in the work area. To cater to the requirements and standards of confined spaces, manufacturers have created a myriad of flexible EPL designs that accommodate the respective hazardous location.

When it comes to portable options, explosion proof (EP) string lights are used for inspection activities and close work. For complete protection, such equipment comes with long explosion proof cords and plugs. A hook located on top of the fixture allow workers to latch it on bars, scaffolds and other sturdy foundations. Wattage for EP string lights vary between 26-100 watts, depending on the configuration. The use of EP manhole lights is ideal for storage tanks, railcars and locations with limited entry points. Majority of the fixtures operate at a range of 100-277 volts. The light's circular design is supported with a large plate that rests on the lip of the man-way opening. For handheld (wireless) portability, operators may consider using LED EP flashlights. Such units usually offer rechargeable battery options, as well as water resistant and non-slip grip features.

Large, permanent EP equipment typically use a tripod, cart or tower for support. Such lights are applicable during lengthy and meticulous inspections where professionals are required to be on-site of a hazardous location for an extended period of time. Compared to portable EPLs, tower units are not as flexible to accommodate extremely confined spaces, such as small tanks. However, such fixtures do carry larger lamps and provide brighter lighting capabilities, reaching 100-300 watts with an average of 20,000+ lumens. Like portable EPLs, EP tower lights usually come with explosion proof cords and plugs. Lastly, for facilities where audio communication is limited, businesses may consider making use of EP signal lights. Such fixtures are equipped with rotating strobes or beacons that provide precautionary, visual warnings in hazardous locations.

## **5.0 Larson Electronics LED Explosion Proof Lighting Solutions**

Larson Electronics (LE) offers a wide range of EPL products and industrial lighting solutions for large-scale businesses and projects. The company provides customized lighting options to meet industry-specific standards and guidelines. Customers are treated to an extensive catalog of lighting equipment, from EPL hand lamps and UV light towers to power distribution products and LED underwater lights. LE's EPL offerings are designed for hazardous locations in chemical processing plants, paint booths, food processing facilities and marine establishments. The EPL units adhere to specific UL and OSHA requirements, as well as the latest hazardous location approval ratings.

Below is a shortlist of EPL products available from LE:

- EP LED lights with tall base stand mount (100-300 watts)

- EP LED string lights with SOOW cord (1500 watts, up to 10 fixtures per batch)
- EP LED flashlights with rechargeable batteries (20 watts, accessory options available)
- EP LED and metal halide tank lights on cart, wheelbarrow or stand (70-600 watts)
- EP LED temporary manhole mount lights (10,000 lumens, 150 watts)
- EP LED strobe lights (12-36, 120-240 and 240 voltage options)
- Solar-powered EP LED lights (1,600 lumens, 12 watts with 12 hours operating time at full capacity)

## **6.0 Conclusion**

To ensure the safety of workers in hazardous locations, businesses must implement the use of EPLs in the workplace. Reducing the risk of ignitions and explosions in confined spaces require the adoption of the right EP equipment that meets the classification of the hazardous location. Due to the lighting system's ability to greatly minimize sparks and combustions of flammable gas or dust, as well as businesses' continued reliance on the fixtures for on-site safety, regulatory compliance should not hinder the spread and application of the products. But going beyond this requirement, operators must also proactively exercise caution during the transporting, handling and storing of the units.

Furthermore, the mobility and visibility limitations of confined spaces have made EPLs essential during inspection and repair work in chemical processing facilities and other hazardous locations. The adoption of LEDs in EP fixtures have increased the general lighting capabilities and safety features of the lights. It is likely that this trend will continue to unfold, as more companies recognize the efficient, eco-friendly and cost-saving benefits of LED technology.