



THE CHOICE OF LIGHTING FIXTURES IN CLASSIFIED AREAS

Once identified the dangerous areas in a plant, it's essential to make the correct choice of electrical equipment that can be installed in those areas in order to avoid the danger of an accidental explosion caused by sparks, arcs or overheating.

As we'll see, choice between various types of lighting fixtures is not easy because, besides to the "explosion protection", many other factors come into play.

We now summarize the criteria that guide the different types of protection used for the construction of explosion-proof lighting fixtures:

- a. Type of protection 'Ex d' - The explosion is contained in an explosion-proof housing.
- b. Type of protection 'Ex e' – The reliability of the internal electrical components is increased so that they do not spark during the normal use. Thus, the risk that the equipment could cause an explosion is reduced to very low levels.
- c. Type of protection 'Ex n' – It is also based on the concept of prevention. It was created as an economical alternative to the other two types of protection.

The first two types of protection can be used in Zone 1 - 2 - 21 and 22, while the type of protection "n" has been developed to be used, with a sufficient margin of safety, in Zone 2 and 22, reducing the costs of a plant.

Here below we're going to expand the general concepts, trying to understand the features of different electrical equipment and how use them in industrial plants.

'EX D' TYPE OF PROTECTION - EXPLOSION-PROOF

'Ex d' ex-proof type of protection, which responds to the European standard EN 60079-1, is based on the concept of containment. In this mode of protection, the electrical equipment is enclosed in special boxes, designed to contain a possible internal explosion and to prevent its transmission to the outside atmosphere.

The philosophy of this type of protection is to create boxes sufficiently strong to withstand the pressure developed inside of them (up to several tens of bars) preventing that any unburned products get out of the case causing an explosion.

This system maintains an unquestioned validity for most of applications in hazardous areas.

The great advantage, which permits savings in terms of cost both at the beginning and, particularly, during maintenance operations, is that standard electrical equipment is installed in these boxes. It's commercially available, since any electrical device can be used simply by inserting it in an enclosure of a suitable size.

With this system a variety of lighting fixtures have been created in order to meet all the installation requirements.

The mechanical strength of this type of construction gives considerable assurance that the security level remains unaffected over time. The routine maintenance consists in the replacement of electrical equipment inside the enclosure.



‘EX E’ TYPE OF PROTECTION - INCREASED SAFETY

'Ex e' type of protection "increased safety", which responds to the European standard EN 60079-7, is based on the concept of prevention.

The electrical apparatus is constructed in order to avoid, with a high safety factor, the possibility to produce arcs or sparks or to reach surface temperatures which may cause an explosion.

The Standard construction requirements in order to obtain a high factor of safety both in normal operation and in case of overload are very restrictive and include: connections, wiring, components, distances in air and surface, insulators, resistance to mechanical shocks and vibrations and the enclosures degree of protection (IP)...

Regarding the construction of lighting equipment, the type of protection 'Ex e' is always complemented by other types of protection, such as 'Ex d' or 'Ex m' because the 'Ex e' protection concerns only the non-sparking part such as enclosure, terminals, wirings and lamp-holder. The other components, such as the safety switch or the electronic ballast, must be individually protected with other types of protection. The system is more convenient in the maintenance phase for the shortest time spent, but the components, in case of failure, are difficult to find out and less economic than standards electrical equipment.

‘EX N’ TYPE OF PROTECTION

'Ex n' type of protection is based on the concept of prevention, avoiding, through appropriate technical means, that the electrical apparatus causes the ignition of the surrounding explosive atmosphere during the normal operation.

The principle behind this type of protection is to not consider faults or abnormal situations, relating to the protection against explosions, but use construction criteria in order to prevent that such equipment could cause them during normal service.

This principle is coherent with the overall risk criterion, which considers the danger of explosion as the sum of the risk of the presence of explosive atmosphere and the ignition by an electrical phenomenon.

We've to consider the fact that we're talking about equipment set for the category 3GD, that can be installed only in Zone 2 and Zone 22 in which the presence of gas is very limited and, therefore, the "global risk" is extremely low.

In fact, the type of protection 'Ex n', is a set of simplified methods of protection that, in daily practice, allows creating any type of electrical construction and so, it's particularly used for the production of lighting fixtures.

COMPARATIVE ANALYSIS FOR INSTALLATION IN PLANTS

In order to carry out a comparative analysis, we must assume that the 'Ex n' lighting fixtures can not be installed in Zone 1, but they are cheaper compared to fixtures with a 'Ex d', 'Ex e' or a mixed protection specifically designed to be safe in Zone 1. Therefore, the principle of selecting a 'Ex n' rather than 'Ex d' or an 'Ex e' lighting fixtures is mainly or exclusively economic.

As regards to the other types of protection, we'll see that the parameters of choice are many.

Very often we tend to prefer a way of protection than another simply on hearsay or personal beliefs that are based on negative experiences made in the past.

As in all things, perfection does not exist and the various devices should be selected on the basis of real applications in a plant.



Very often the 'Ex e' type of protection is chosen because, in the 90% of cases, are used plastic resins in the construction such as polyesters and polycarbonates. They are preferred by technicians for their natural resistance to marine corrosion and strong inorganic acids and by installers for their light weight and the easy installation and maintenance.

'Ex d' lighting fixtures, usually constructed in aluminum alloy and borosilicate glass, are used in places where, in addition to the explosion protection, is required a good mechanical protection of cables and equipment.

In this newsletter, we'll analyze the lighting fixtures most used, those with fluorescent tubes, leaving the discussion of the other forms of lighting for future articles.

We've to specify that, speaking of lighting fixtures, the type of protection is almost always mixed. As regards to 'Ex e' protection mode, we can consider, for example, Cortem lighting fixture series EXEL. As we said above, it contains components that must be manufactured according to other types of protection. The electronic ballasts, for example, are normally 'Ex d' because the protection from explosions is not achieved through the enclosure, but thanks to the security of the individual component.

Even the 'Ex d' lighting fixtures are built with an 'Ex e' entry. The equipment will be classified 'Ex de', such as the Cortem lighting fixtures FLFE series. This system avoids the use of joints and, therefore, plants in tube and barrier cable glands. The electrical connection is made through an 'Ex e' enclosure usually integrated in the same lighting fixture. It has 'Ex e' terminals and is separated from the explosion-proof equipment with a sealed joint integrated in the lighting fixtures too.

Therefore, today there are no particular differences in power systems. These days, it's not necessary to operate like in the past, with wires inside tubing systems and using resin-bonded sealing fittings, the normal use is with non-armored wires going inside the enclosures through 'Ex e' cable glands.

MATERIALS

'Ex e' lighting fixtures are manufactured with a body in reinforced polyester and a cover in transparent polycarbonate. These materials, thanks to the hot-pressing, allow realizing a device very similar to normal industrial and watertight lighting fixtures. These are preferred for the easy replacement of fluorescent tubes.

'Ex de' lighting fixtures, however, have two aluminum alloy heads and a borosilicate glass tube very thick which provides resistance to explosions.

The plastic resins are preferred for use in situations with danger of corrosion and in environments with aggressive atmospheres for the presence of strong inorganic acids.

Before choosing polycarbonate lighting fixtures, however, must be paid attention to the processes implemented in the plant that should be illuminated. Opposite to common sense, the polycarbonate is sensitive and not resistant to many substances, including the acetone, many nitrates, chlorine, ethane, ammonia and aromatic hydrocarbons. Therefore, must be checked the tables of chemical resistance.

Polycarbonate may also lose the characteristics of transparency over time, tending to yellow and, therefore, worsen the luminous flux.

Aluminum and glass are the best anti-aging. Glass always guarantees maximum transparency in the years because it's virtually resistant to any type of corrosive atmosphere.

Lighting fixtures with glass mono-tube, such as the abovementioned Cortem models FLFE series ('Ex de'), contain all the components mounted on an internal frame that can be extracted



completely allowing the replacement of fluorescent tubes or of ballast.

This operation has some advantages respect to lighting fixtures in which each enclosure contains a single fluorescent tube to be extracted and inserted, with some difficulty if the maintenance must be operated, for example, on poles. It appears, however, more complicated than the same operation performed on lighting fixtures series EXEL ('Ex e'), in which the opening is through the separation of body from the cover which remain hinged.

In economical terms, the difference between the two devices does not involve large price differences and, therefore, the choice is purely technical. In terms of maintenance operations, however, must be noted that, while the fluorescent tubes are absolutely identical for the two fixtures, the electronic ballast changes.

FLFE series contains standard electronic ballast because the enclosure guarantees protection and not the individual components. So, in case of ordinary maintenance, it's very simple find out a new ballast because it's a component available in any supplier of electrical equipment.

The electronic ballast of EXEL series, on the contrary, is an 'Ex d' component and must be purchased directly from the manufacturer and replaced by qualified personnel in order to ensure the full equipment safety.

CONCLUSIONS

As said above, a universal and perfect way of protection does not exist and, even in this quick review, we are not able to say whether the best way of protection is the 'Ex de' or the 'Ex ed'.

Each fixture is designed for specific system applications and what is important to consider is that, whatever method, is valid if it's applied according to the criteria taken into account in the design phase.

The danger is not represented by the equipment which, at the time of its construction, is certainly suitable for the use for which it was produced having a high safety factor, but rather from their use and their proper maintenance. In order to avoid accidents, it's necessary to follow the rules of proper use and maintenance of installations and, most of all, choose equipment in function of place and environmental characteristics, giving priority to equipment safety.

Moreover, an important economic consideration. A good designer must consider not only the initial equipment cost, but also the cost in terms of maintenance and monitoring over time if he wants add value to its work for a better service to customers.