

March 2014

## Explosion-proof or waterproof electrical equipment?

Very often, the explosion-proof equipment is confused with water-proof equipment, even in technical environments. This comes from the incorrect belief that it's possible to avoid an explosion preventing an explosive atmosphere to get in touch with the ignition source (spark, arc or hot spot).

This may be partially true if the hazardous substance is a powder suspended in the air, but it's a misconception if the explosive atmosphere is represented by a gas.

This belief may cause an improper use of an enclosure, incorrectly considered as water-proof, in unsuitable conditions to ensure their safety.

To analyze properly the problem, we need to step back and understand what are the principles on which is based the electrical explosion protection.

The principles are three:

- Segregation
- Prevention
- Containment

### Segregation

This principle prevents the explosive atmosphere from coming into contact with an ignition source. Different systems are used: the immersion of the equipment in oil, sand or resin. These systems, respectively 'Ex o', 'Ex q', 'Ex m', are primarily used to protect electrical components, but not for the construction of electrical panels, lighting fixtures or plugs and sockets.

### Prevention

The protection is provided through the over sizing of the equipment that prevents the creation of sparks or electric arcs, even under fault conditions.

These systems ('Ex e', 'Ex i') are used respectively for junction and pulling systems or they are applicable in the case of intrinsically safe instrumentation or to other equipment that operate at very low powers. Nobody would ever think to build an electric panel or light a refinery through an intrinsically safe system.

'Ex e' method of protection, the increased safety, is usable alone only for those equipment that, of course, cannot sparkle such as the junction boxes with terminals. But if the system contains equipment that can sparkle, they must be individually protected with another type of protection.

## Containment

And now we come to the heart of the problem that we are analyzing.

'Ex d' method of protection is based on the principle that it's not possible to absolutely prevent a gas from entering into an enclosure.

This is the oldest method of protection, but still today the one that is most commonly used and, consequently, the 'Ex d' products are the most common on the market.

The majority of applications for conventional power plant can be achieved with this type of protection: electrical panels, lighting equipment, plugs and sockets, junction boxes.

This method is based on the concept of containment: if an explosive atmosphere penetrates in a 'Ex d' enclosure and comes in contact with a trigger (for example, the contacts of a switch that may form a spark) the explosion occurs, but this remains confined inside the enclosure, constructed to resist the bars of pressure produced during the explosion.

The enclosure cannot be completely sealed, otherwise it would not be able to withstand the pressure during the explosion and it would become a bomb. So, to avoid the explosion, the technical standards require that the products of combustion generated during the explosion come out from the enclosure through the flame-paths.

The flame-paths are parts of the enclosure (for example, the body and the lid) which are machined to obtain a surface that presents lengths experimentally determined in the laboratory, with a maximum gap between the two surfaces which can be a few tenths of millimeter.

The flame formed during the explosion is laminated passing through the flame-paths and cools down, making impossible to trigger the surrounding explosive atmosphere and thus avoiding an explosion with disastrous effects.

These flame-paths, therefore, must remain free from any obstructions and, consequently, the housing cannot be deemed to be water-proof.

Normally, the IP protection of a 'Ex d' enclosure is IP54. The use of special gaskets on the outside length of the flame-paths may increase the IP protection to IP66, but the natural protection is IP54.

The same happens for the threads that cannot normally be sealed because they also represent a type of flame-paths.

Therefore, in a 'Ex d' enclosure is common that there might be the creation of internal condensation. This can be avoid using drain valves, specially designed and constructed for ex-protection, and, in some cases, using internal resistances anti-condensation.

To prevent the infiltration of water through the threads, you can use thread locker substances, such as Loctite 577, always in agreement with the manufacturer disposals.

## TECHNICAL NEWS



To be sure to be safe.

In any case, the enclosure installed should be protected from rain and direct jets of water through the construction of sheds and external protection sheets. In no way enclosures can be submerged, even if only partially.