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"Ex d IIB + H2" method of protection: a valid alternative to IIC

"Ex d" method of protection uses explosion-proof junction boxes, a particular types of box constructed in order to accommodate electrical equipment and to withstand the pressure caused by any explosion occurred inside the enclosure itself.

This protection method is used in environments with a potentially explosive atmosphere for the presence of gas.

As we have written in several newsletters, the "Ex d" method of protection is the oldest and the first used to prevent explosions, still one of the safest because based on a very simple and, therefore, unlikely fallible technology. The principle assumes that it's impossible to prevent a gas to penetrate everywhere. No gasket will never be able to prevent the entry of a gas in a junction box!

Therefore, if an explosive atmosphere penetrates in a junction box producing a trigger, for example caused by a spark between two electrical contacts, the explosion occurs, but it remains confined within the enclosure.

To ensure this principle, the junction box must be constructed with a mechanical strength able to contain the over pressure caused by the explosion, allowing the escape of the burned gases.

This is the charge of the flame-path which is the interface between two parts of a junction box, such as body and lid. The flame-path allows the burned gases to exit from the enclosure cooling down, so that they are no longer able to trigger the external atmosphere.

For this reason, the flame-path must be sufficiently long and with a gap enough narrow to guarantee the cooling of the flue gases.

There are precise rules to be respected, depending on the gas and on the volume of the junction boxes, prescribed in EN 60079-0 and EN 60079-1 standards.

Regulatory principles

The EN 60079-0 standard, which establishes the general rules for equipment that can be used in environments with a potentially explosive atmosphere, divides the electrical equipment into three groups:

- Group I
- Group II
- Group III.

The Group I includes equipment that can be used in mines where firedamp gas may be present. The Group III has equipment that can be used in areas with potentially explosive atmosphere for the presence of dusts, while those belonging to the Group II can be used in places with the presence of an explosive atmosphere due to the presence of surface gases, i.e. different from firedamp.

The electrical equipment of Group II are divided in accordance to the explosive atmosphere for the presence of those gases to which they are intended.

The division is, also in this case, into three groups:

- IIA, a typical gas of this Group is the Propane;
- IIB, a typical gas is the Ethylene;
- IIC, typical gases are Hydrogen and Acetylene.

This division is based on the maximum experimental safety gap, called MESG: the flame caused by the explosion, which may occur in the event of an accident inside the enclosure, must be cooled down passing, as we wrote above, through the flame-path which has different construction methods and length depending on the type of gas.

For less dangerous gases, as those of IIA and IIB Groups, you can use the flat, corner, cylindrical flame-path etc., while for the most dangerous gas, represented by the Group IIC, the flame-path can only be cylindrical or threaded, flanged only for very small volumes.

Without going into technical design reasons that have led to these choices, we can generalize, without getting wrong, stating that the flame-path for Groups IIA and IIB is flat, while for the IIC group it's cylindrical or threaded.

The constructive methodology between the IIA and IIB is the same, the difference is represented only by the flame-path length, greater for the IIB Group.

Construction differences and application

The majority of "Ex d" junction boxes is designed and built for IIB and IIC Groups. The structural differences between the IIA and IIB are, as we said, very limited and the cost difference, in favor of the IIA, is not enough to justify a double production. Therefore, normally, are used IIB junction boxes even for the IIA. For the IIC Group, the flame-path cannot be flat for junction boxes with volumes greater than 0.5 liters, but must be cylindrical and, therefore, the construction technology of the IIC enclosures must necessarily be different than IIB junction boxes.

Very often, the need to manufacture a cylindrical flame-path obliges the manufacturer to build round or square-shape enclosures. IIB enclosures, normally rectangular-shape, are preferred for the easier realization of switchboards composed of side by side enclosure connected through appropriate sealing fittings.

Over the years, the technicians settled the concept that, for IIC areas, have to be necessarily used junction boxes with cylindrical flame-path, which usually feature a round-shape body and fixed threaded hubs that make more complicated the construction of panel boards.

This bias is not exact. If we read the EN 60079-1 standard, paragraph 5.2.7, we find that the flat flanged flame-paths are not permitted in the IIC Group for volumes larger than 0.5 liters only if the explosive atmosphere is characterized by acetylene. Instead, they are allowed in the presence of hydrogen.

In recent years, therefore, started the production of “Ex d” explosion-proof enclosures which are usable, as well as with the gases of IIB Group, even in the presence of hydrogen.

It's possible to verify whether this application is suitable by checking the presence on the product catalog of the marking:

Ex d IIB + H2

This means that the junction box can be used in an environment containing explosive atmosphere with hydrogen. Acetylene is, therefore, excluded, but we must consider that the environments with the presence of hydrogen are much more frequent than those with acetylene.

With the method of protection Ex d IIB + H2, the junction boxes are manufactured with flanged flame-path and have all the constructive advantages typical of these boxes: as rectangular or square-shaped, they can be easily assembled to make electrical panels.

The cost

A factor not negligible, in addition to the ease of assembling of rectangular-shaped enclosures to make electrical panels, is also represented by the cost, which is normally lower for Group IIB junction boxes than those for Group IIC.