



The 'Ex d' explosion protection and the phenomenon of pressure-piling

The presence of pipes without seals can lead to the propagation of an explosion and, with it, an increase in pressure from the initial equipment to those connected to it. The industry regulations offer us a series of tools to limit the occurrence of this pressure-piling phenomena, for example by sealing the exits of the enclosures, and by limiting the occupation of the sections inside them.

The 'Ex d' protection method, today indicated as 'Ex db', is based on a simple theoretical concept: the containment by means of a robust casing and the non-propagation of the flame (flameproof enclosure). This protection method, in addition to being one of the first to be created in a historical perspective, is certainly among the most used protection methods still to this today.

An aspect that has been repeatedly addressed in explosion-proof constructions connected via pipe systems is the need to equip the enclosures with cable outlets with conduit sealing fittings. The reason is that the presence of pipes without seals can lead to the propagation of an explosion and, with it, an increase in pressure from the initial equipment to other connected pieces of equipment.

The phenomenon underlying the increase in pressure is called pressure-piling in the regulations.

The phenomenon of pressure-piling (in cases other than those involving rotating machines)

Gases (and by gas we also mean the atmosphere) contained in a volume in a static situation have approximately identical pressures at every point. The

small variations in pressure are in fact due to the weight of the gas that is higher and that presses the gas placed lower by means of the force of gravity. In our context these differences are minimal.

The situation changes when there is a flow motion and/or if energy is introduced into the system, just like the energy introduced by a combustion reaction at the basis of an explosion. Under particular conditions, when an explosion is triggered in a part of a volume where the shape is rather irregular and presents variations in section, it may happen that the mixture not yet ignited is compressed before being ignited.

This pre-compressed mixture, when it catches fire, reaches higher pressures than the compartments where the primary ignition occurred. Knowing the phenomenon, it is possible to intervene



on method sure-piling

at the product development level. The reference pressure, which is measured during the certification tests, is detected by positioning the ignition source in different points of the equipment, thus

trying to simulate the worst situation in which it can occur (worst case scenario).

The reference pressure is measured for the equipment with its free and occupied internal volumes, thus simulating the various possible pre-compressions. Sometimes, for convenience, particular elements are replaced with obstacles made of wood or other materials having the same shape.

The issue of component enclosures remains open, those that are the basis of full compliance certifications that are needed for the construction of electrical panels, or terminal boxes, which do not include enclosures for rotating machines. When they are tested to obtain the component certificate, a deflector element is used that constitutes an obstruction equal to 80% of the free section for Gas group IIB and 60% of the free section for Gas group IIC, to simulate the devices that will then be installed inside them.

Finally, let us remember the conduit sealing fittings, a more plant-related than product-related issue. They serve to block the flame front and avoid pressure-piling phenomena.

Conclusions

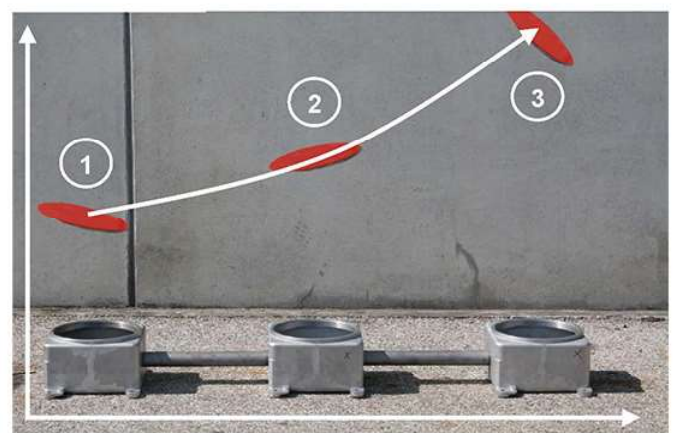
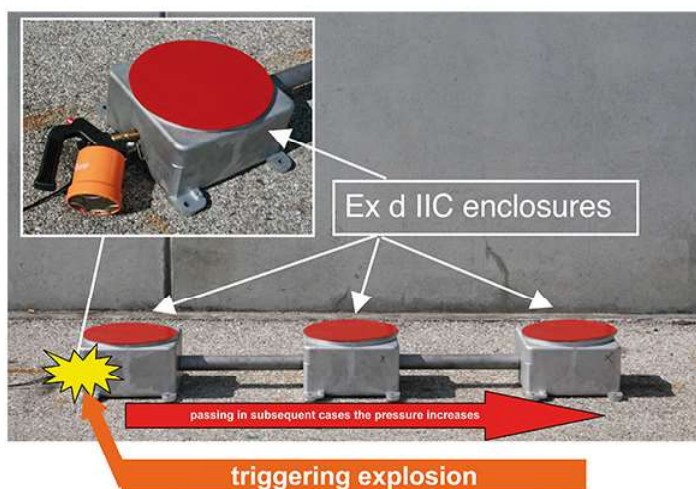
Although it is a phenomenon that is little known to technicians who purchase material suitable for installation in potentially explosive atmospheres, it is important to know that many choices in

product and system development are aimed at preventing it from occurring. The regulations, in fact, offers us a series of tools to limit the occurrence of pressure-piling phenomena, for example by sealing the exits of the enclosures, and by limiting the occupation of the sections inside them. ■

About the author



Andrea Battauz is R&D Manager of Cortem Group. After graduating in mechanical engineering, he worked on the design of robotic machines and automation and, since 2004, he approached the ATEX Directive, and the design of equipment intended for explosive atmospheres. In 2008 he joined Cortem Group where he developed new explosion-proof products, specializing in signaling and lighting devices based on LED technology. He also carries out training activities on topics related to explosion protection. Since 2010 he has been a member of the national Italian committees CT 31 and SC 31J.



INCREASED IN PRESSURE

Figure 1: In the absence of conduit sealing fittings, the explosion passes to the adjacent enclosure with an increase in pressure – Image: Cortem