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RESEARCH ON TESTS CARRIED OUT ON EXPLOSION PROOF CABLE ENTRIES

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Abstract

The purpose of this paper is to present the tests carried out on cable entries with a flameproof enclosure protection type used in potentially explosive atmospheres.
Assessment of explosion-protected electrical equipment is accomplished through tests carried out in accordance with the standard SR EN 60079-0, which includes all general requirements for explosion-protected electrical equipment. The requirements of this standard are supplemented with those for each type of protection in separate standards.
To elaborate this paper, the requirements in force were studied. It resulted that a stand for sealing test of cable glands with flameproof enclosure protection type is required. This test is essential in the process of certification of the equipment used in explosive areas.
In the first stage of the project, the test stand was conceived, whose design has been considered taking into account the specifications of the reference standard for electrical equipment used in potentially explosive atmospheres.
The paper also presents the stand for sealing test of cable glands (with type of protection flameproof enclosure). This stand was developed this year at National Institute for Research and Development in Mine Safety and Protection to Explosion-INSEMEX Petroşani.

Key words: cable entries, certification, explosive atmosphere, flameproof enclosure, increased safety

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1. Introduction

Using electric energy in potentially explosive atmospheres brings forward several particularities. Therefore, the problems that appear during the design, construction and operation of electrical equipment and installations brings forward numerous difficulties, their approach requiring special attention considering all the technical, economical and safety at work aspects (Eckhoff, 2016; GD, 2016).

The risk of explosion may occur in all fields of activity in which flammable substances are involved, such as gases, vapours, dusts and mists, which mixed with air may result in potentially explosive atmospheres (Fthenakis, 2018; Nagy and Verakis, 2017; Păsculescu et al., 2017; SR EN 60079-0, 2013).

In order to increase the occupational health and safety level in potentially explosive atmospheres generated by flammable gases or explosive dusts the ignition of explosive atmospheres must be prevented. This the electrical equipment used in such areas must be designed considering different types of protection so that it cannot ignite the explosive mixture surrounding it (GD, 2016; Yuan et al., 2015). The type of protection is defined as specific measures that are applied to electrical equipment in order to avoid the ignition of a surrounding explosive atmosphere (SR EN 60079-0, 2013).

The most used electrical equipment in potentially explosive atmosphere is made with type of protection flameproof enclosure. The type of protection shall be maintained and not to be

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invalidated at all the equipment components. The cable glands used on this type of equipment are made according to the requirements in force (SR EN 60079-0, 2013; SR EN 60079-1, 2015).

Flameproof enclosure "d", represents a type of protection which can ignite an explosive gas atmosphere. It can withstand the pressure developed during an internal explosion of an explosive mixture, and prevents the transmission of the explosion to the explosive gas atmosphere surrounding the enclosure (Magyari et al., 2015; SR EN 60079-0, 2013). In accordance with the specific standard SR EN 60079-0-2013 which includes all general requirements for explosion protected electrical equipment and for each type of protection applied to electrical equipment used in potentially explosive atmosphere, a wide range of type tests has been developed so that they can be safely used (SR EN 60079-0, 2013). In addition to the type tests described in the standard containing the general requirements, the cable glands shall also be subjected to type in accordance with specific standards.

The tests to which explosion-proof cable glands have to be subjected include the tensile test, the mechanical strength, and the sealing test (specific to flameproof enclosure protection type cable entries) (SR EN 60079-1, 2015). The objective of the paper is to examine the test stand used to perform the sealing test for cable glands, conceived at INSEMEX.

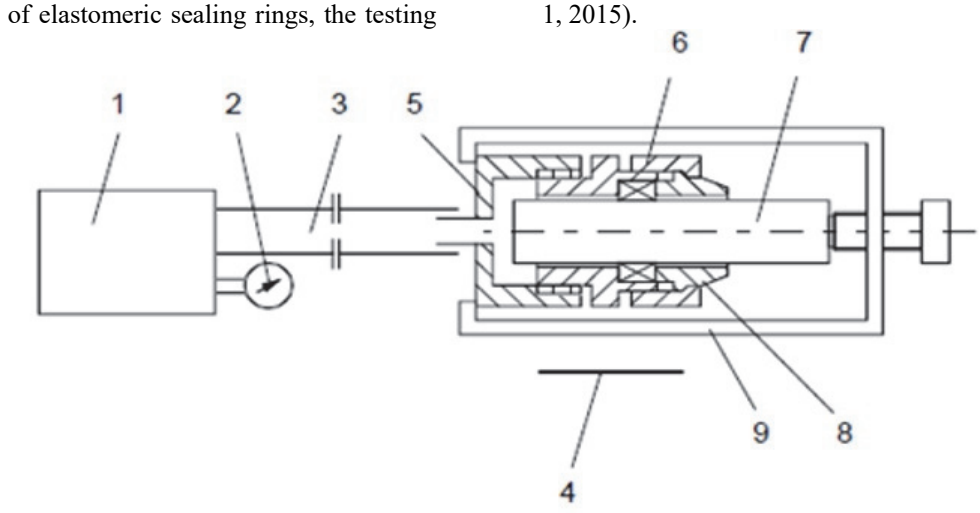
2. Material and methods

The methodology for performing the sealing tests in case of explosion proof cable glands consists in testing (for each type of cable gland) of one sealing ring from each of the different permitted sizes. For the specific case of elastomeric sealing rings, the testing methodology specifies that each ring to be mounted on a special cylindrical mandrel (made of polished mild steel). The diameter of the mandrel shall be equal to the smallest diameter of the cable admitted in the ring (based on the manufacturer specifications) (Fotău et al., 2017).

In case of metallic or composite sealing rings, each ring is mounted on the metal sheath of a clean dry sample of cable, of diameter equal to the smallest value permissible in the ring, as specified by the manufacturer of the cable gland or conduit sealing device (Fotău et al., 2017; Moldovan et al., 2017). In case of sealing rings for non-circular cables, each ring is mounted on a clean dry sample of cable, of perimeter equal to the smallest value permitted in the ring, as specified by the manufacturer of the cable gland or conduit sealing device (Ghicioi et al., 2017; SR EN 60079-1, 2015).

The testing assembly is mounted into the entry by applying a specific torque value (given by the manufacturer) to the screws (for cable entries using compression devices with flanges) or the nut (for cable entries using compression devices using screws). That is to make a seal in order to resist a hydraulic pressure of 2000 kPa (in case of Group I) or 3000 kPa (in case of Group II) (SR EN 60079-1, 2015).

The torque values may be determined experimentally prior the tests, or they may be supplied by the manufacturer of the cable gland or conduit sealing device (Fotău et al., 2017; SR EN 60079-1, 2015). The assembly is then mounted into a hydraulic testing device using coloured water or oil as the liquid, with the principle illustrated in Fig. 1. The hydraulic circuit is purged and then the hydraulic pressure is gradually increased (Fotău. et al., 2017; SR EN 60079-1, 2015).



Components

1 hydraulic pump	6 sealing ring
2 pressure gauge	7 mandrel/ metal-sheated cable
3 hose	8 compression component
4 blotting paper	9 retaining clamp
5 adapter	

Fig. 1. Standard design of the device for the sealing tests for cable glands

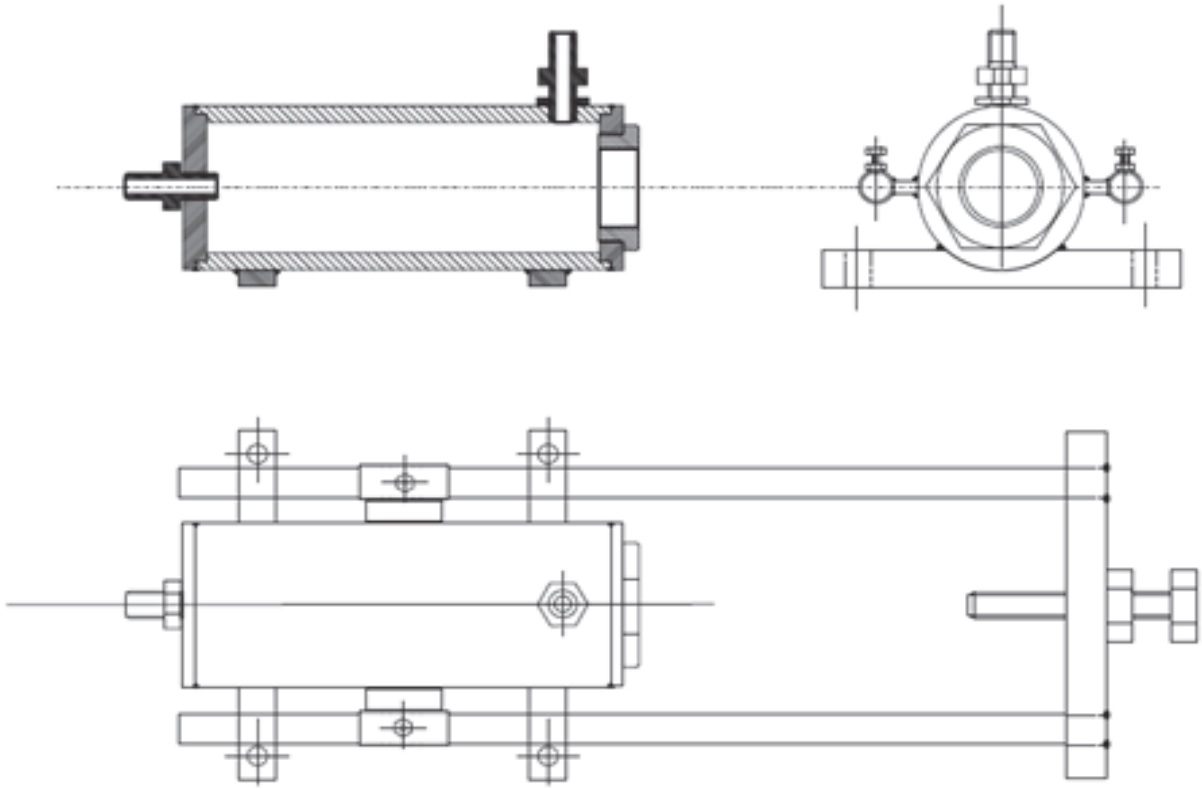


Fig. 2. Project of the device for the sealing tests for cable glands

After the pressure has been maintained at 2000 kPa for Group I and 3000 kPa for Group II at least 10 s, if the blotting paper is free from any trace of leakage the sealing is considered satisfactory. Sometimes it is required to seal all the joints (different to those associated with the tested sealing ring) of the cable gland (that is installed in the test device). It might be necessary, in case of using a core sample of the metal cord used for the test to provide some specific measures in order to avoid the application of pressure to the ends of the conductors or on the inside of the cable (Fotău et al., 2017; SR EN 60079-1, 2015).

3. Results and discussion

The results from studies indicated that a stand for sealing test for cable glands with type of protection flameproof enclosure is required. This test is essential in the process of certification of equipment used in explosive areas. The first step consisted in conceiving the project of the test stand (Fig. 2) that took into account the specifications of the reference standard for electrical equipment used in potentially explosive atmosphere SR EN 60079-0 (2013) and the reference standard for the type of protection flameproof enclosure SR EN 60079-1 (2015).

After analyzing the design of the stand, the components necessary to conceive the device for the sealing tests of cable glands with type of protection flameproof enclosure were acquired. A hydraulic pump, that can produce a pressure of up to 60 bars, has been purchased in order to get the necessary pressure to perform the test (Fig. 3). The device for the sealing test of cable glands (fastening element) was designed at INSEMEX, according specifications described in SR EN 60079-1 (Fig. 2), and then it was built (Fig.4) and connected to a hydraulic pump.

The test stand is designed according the requirements of the relevant standards, but it also has some elements that make it unique and provide some versatility in use (using different adapters, different types of cable glands can be tested). The element in which the cable gland is secured, is detachable and so it can be easily replaced with another one suitable to the cable gland to be tested. This way we can easily test a wide range of cable glands in a short period of time. The conceived stand was successfully used to test samples of cable glands (Fig. 5).

Fig. 3. Hydraulic pump

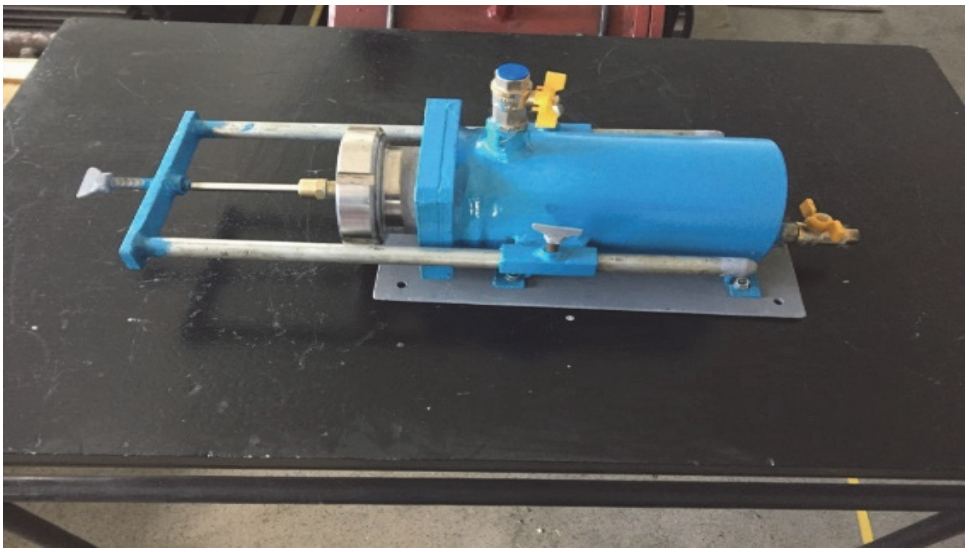


Fig. 4. Fastening element for cable glands

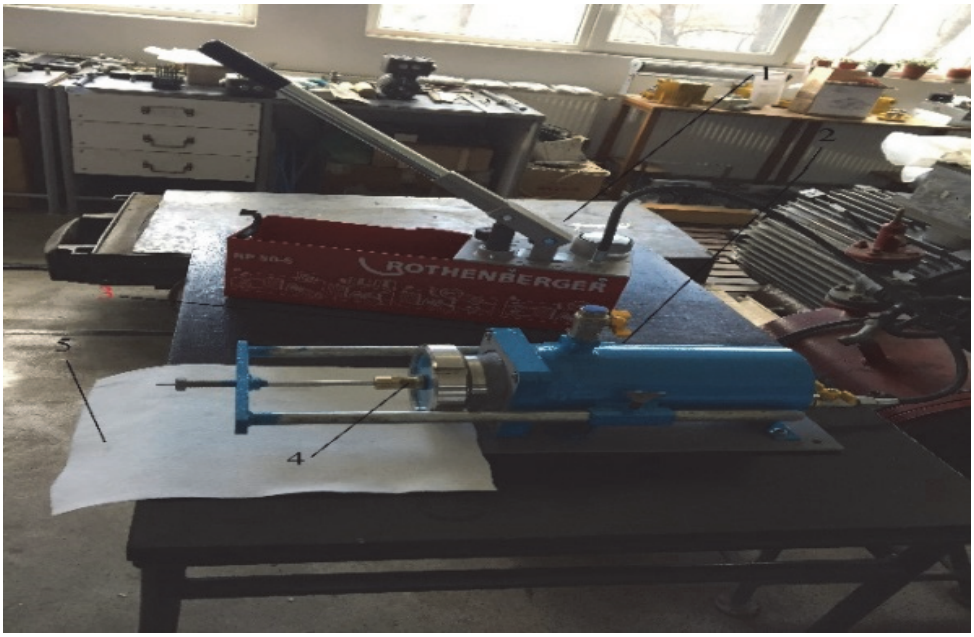


Fig. 5. Device for the sealing tests for cable glands
(1. Hydraulic pump, 2. Fastening element, 3. Detachable element, 4. Cable gland, 5. Blotting paper**)**

4. Conclusions

According to the requirements in relevant standards, in the process of certification of Ex equipment, cable entries must be tested in order to verify if the explosion protection characteristics are maintained. In this paper were revealed the tests to be carried out. To protect people who work in explosive environments, it is important that equipment operating in such areas to comply with the requirements in relevant standards, and be properly maintained.

The device designed this year at INSEMEX represents a useful tool because helps us to test properly, in a short period of time the cable glands with type of protection flameproof enclosure. The detachable element of fastener allows us to test cable glands of different diameters (from 6mm-60mm) pretty fast.

The hydraulic pump we purchased is also detachable and can be used on other test stands. In the laboratories of INSEMEX cable glands of different sizes have been tested with the testing device for cable glands.

After having obtained the necessary pressure, it was maintained 10 seconds. The sealing is considered satisfactory because the blotting paper is free from any trace of leakage.

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