THERMAL ENDURANCE TESTS PERFORMED AS PART OF THE CERTIFICATION PROCESS ON EQUIPMENT USED IN POTENTIALLY EXPLOSIVE AREAS

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Abstract: Evaluation of explosion-proof protected electrical equipment in scope of certification is extremely important considering the risk of explosion that has to be minimized in order to ensure life safety and health of workers and to prevent damaging of property and the environment, as well as free movement of goods when they meet the essential safety requirements at European level. The purpose of this paper is to present aspects regarding the importance of thermal endurance tests performed on the electrical equipment used in potentially explosive atmosphere. The paper also presents laboratory facilities for performing the thermal endurance test.

Keywords: thermal test, flameproof enclosure, increased safety, certification, explosive atmosphere.

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 devices and installations brings forward numerous difficulties, their approach requiring special attention considering all the technical, economical and labour safety aspects [4], [7], [11].

The risk of explosion may appear in all the fields of activity in which flammable substances are involved, such as gases, vapors, dusts, mists, which mixed with air may result in potentially explosive atmospheres [5], [8], [12].

In order to increase the occupational health and safety level in potentially explosive atmospheres generated by flammable gases or explosive dusts we have to prevent the ignition of explosive atmospheres. In order to do this the electrical equipment used in such areas must be made with different types of protection so that it can not ignite the explosive mixture surrounding it [4], [9].

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The type of protection means the specific measures applied to electrical equipment to avoid ignition of a surrounding explosive atmosphere [1], [17].

For each type of protection applied to electrical equipment used in potentially explosive atmosphere, a wide range of type tests have been developed so that they can be used safely [1], [10].

In addition to type tests, on the equipment the thermal endurance test must be performed.

2. THERMAL ENDURANCE TESTS PERFORMED ON EQUIPMENT USED IN POTENTIALLY EXPLOSIVE ATMOSPHERE

The enclosure of the equipment, due to unfriendly conditions in which they operate, can be damaged quite easily. In order to preserve the type of protection of the equipment it is very important that their enclosures remain intact in the event of an accidental impact.

During the certification process, the equipment is subjected to an impact test to determine the resistance of the enclosure. According to the standardized requirements before carrying out these tests, the equipment enclosure must be subjected to thermal endurance tests. This test is performed using the climate chamber, specifically designed for testing enclosures [1], [6], [18].

The thermal endurance to heat shall be determined by submitting the enclosures or parts of enclosures in non-metallic materials, on which the integrity of the type of protection depends, to tests according to Table 1 [2].

Table 1. ***Thermal endurance test***

Service temperature Ts	**Test condition**	**Alternative test condition**
Ts ≤ 70 °C	672 $^{0}_{+30}$ h at (90 ± 5) % RH, at Ts + 20 ± 2 K (but not less than 80 °C test temperature)	
70 °C < Ts ≤ 75 °C	672 $^{0}_{+30}$ h at (90 ± 5) % RH at Ts + 20 ± 2 K	504 $^{0}_{+30}$ h at (90 ± 5) % RH at (90 ± 2) °C followed by 336 $^{0}_{+30}$ h dry at Ts +20 ± 2 K
Ts > 75 °C	336 $^{0}_{+30}$ h at (90 ± 5) % RH at (95 ± 2) °C, followed by 336 $^{0}_{+30}$ h dry at Ts + 20 ± 2 K	504 $^{0}_{+30}$ h at (90 ± 5) % RH at (90±2) °C followed by 336 $^{0}_{+30}$ h dry at Ts +20 ± 2 K

At the conclusion of the test according to Table 1, the enclosures or parts of enclosures in non-metallic materials that were tested shall be subjected to (20 ± 5) °C at (50 ± 10) % relative humidity for 24 0 +48 h, and then immediately followed by the thermal endurance to cold test [2], [13], [16].

The test values given in Table 1 include two test conditions. The conditions shown in the 2nd column were used in previous editions of this standard and allow previously obtained test results to remain valid for this edition.

The conditions shown in the 3rd column have been added to allow testing at temperature/humidity conditions that are more readily achieved, although at an increased test time [1], [14].

It is generally acknowledged that glass and ceramic materials are not adversely affected by the thermal endurance to heat test, and testing may not be necessary [1].

The thermal endurance to cold shall be determined by submitting the enclosures and parts of enclosures of non-metallic materials, on which the type of protection depends, to storage for 24 h 0+2 + in an ambient temperature corresponding to the minimum service temperature reduced according to standardized requests [1], [3], [15].

It is generally acknowledged that glass and ceramic materials are not adversely affected by the thermal endurance to cold test, and testing may not be necessary. [1], [3], [19]

3. RESULTS OBTAINED

During the process of certification of a equipment used in potentially explosive atmosphere, at National Institute for Research and Development in Mine Safety and Protection to Explosion – INSEMEX laboratories are performed thermal endurance tests. The equipment is tested in the climatic chamber.

Fig.1. Climatic chamber

After the equipment was submitted to thermal endurance to cold and to heat, it was tested for resistance to impact. Following this test, the equipment did not suffer deformations or cracks, so it can be safely used in explosive atmosphere for which it was designed. This test is essential in the process of certification of equipment used in explosive areas.

Fig.2. Lamps subjected to thermal endurance tests

Table 2. ***Results of the resistance to impact test***

Equipment subjected to resistance to impact test.	The height from which the equipment is hit	Impact energy (m*g*h)	Results
Lamp used in potentially explosive atmosphere	0.4 m	1 kg*9.8m/s^2*0.4m =3.92 Joul	The equipment has not been deformed or cracked

Following numerous applications for product certification received by INSEMEX, it has been decided to purchase a larger climate chamber to test a wide range of products.

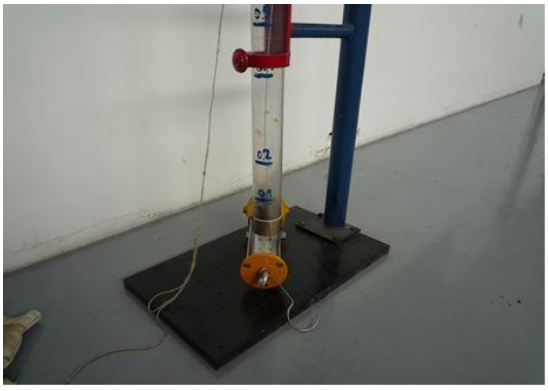

Fig.3. Lamp subjected to resistance to impact test

4. CONCLUSIONS

To protect people who work in explosive environments, it is important that equipment operating in such areas to comply with the requirements in force, and be properly maintained.

According to the requirements in force, in the process of certification of Ex equipment call of them must be tested in order to verify if the explosion protection characteristics are maintained at their level. In this paper was revealed the importance of thermal endurance tests performed on equipment used in potentially explosive atmosphere. Also after the studies made in the laboratories, it became necessary to acquire a large climate chamber, which will be done within this year.

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