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The comparison of reference pressure between obstacle light and compact fluorescent light fixture explosion proof type in the explosion proof test chamber (Group IIA)

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Abstract

This paper presents the light fixture standard in hazards or explosion areas for instance gases, fuel station and chemical storage room to be an environmentally safe zone area. The examples for case study donated from the fuel stations in Thailand are the typical obstacle 1×40W and compact fluorescent 1×11W light fixture. For testing in high voltage, flame proof obstacle and compact fluorescent light fixture for propane in the explosion proof chamber is correspondent with group IIA standardized gas. The experimental results show that the reference flame pressure is 3.0 and 0.755 bars, respectively. The obstacle and compact fluorescent light fixture are in good condition without any damage in any part of light fixture.

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Keywords: Explosion-chamber; Explosion-proof; Flame-proof; Non-transmittance test; Proof test; Reference-pressure

1. Introduction

Light fixture which equips fluorescent lamps is the main light source. All design is for home and general purposes such as general lighting, local lighting and security lighting. Fluorescent lamp desk is designn for studying and reading. However, the following types are excluded from this application: explosion-proof types, heat resistant types, dust-proof types, corrosion-resistant types, and types designed for hazardous locations areas [1, 2].

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2. Area Classification Systems

2.1 International

Internationally (and more recently in North America, for Class I hazardous locations), areas where explosive gas atmospheres are likely to be present are divided into three IEC-defined zones [3, 4, 5].

Zone 0 - An area in which an explosive gas atmosphere is continuously presented or presented for long periods.

Zone 1 - An area in which an explosive gas atmosphere is likely to occur in normal operation.

Zone 2 - An area in which an explosive gas atmosphere does not normally exist.

2.2 Area classification - Division versus Zone Comparing Divisions versus Zones

Division 1 corresponds closely to zones 0 and 1. Division 2 corresponds closely to zone 2. The most important difference between the division and zone systems is the difference in marking conventions. Division markings identify the locations where the product could be used. The markings for the zone method show the type of protection, according to IEC 60079 as shown in Table 1.

Table 1. Divisions and zones in hazard area

Type of Area	NEC & CEC (North America)	CENELEC & IEC
Continuous Hazard	Division 1 or Zone 0	Zone 0
Intermittent Hazard	Division 1 or Zone 1	Zone 1
Hazard Under Abnormal Conditions	Division 2 or Zone 2	Zone 2

3. Types of Gases for Testing

3.1 Apparatus Grouping

Table 2. Apparatus grouping for US and Canada [3]

	Apparatus Grouping	
Typical Gas/ Dust/ Fibers/ Flyings	US (NEC) Canada (CEC)	US (NEC) Canada (CEC) IEC,CENELEC
Acetylene	Class I ,Group A	Group IIC
Hydrogen	Class I ,Group B	
Ethylene	Class I ,Group C	Group IIB
Propane	Class I ,Group D	Group IIA
Methane	Gaseous Mines*	Group I*
Magnesium	Class II ,Group E	IEC, CENELEC
Coal	Class II ,Group F	
Grain	Class II ,Group G	Do not subdivide by material types
Cotton	Class III	

*Not within scope of NEC or CEC Class I – gas/vapour/mist, Class II – Dust, Class III – fibres/flyings

3.2 Temperature Code & Temperature Class

Table 3. Temperature code and temperature class for US and Canada [3]

Maximum surface temperature (Celsius)	US (NEC) Canada (CEC)	US (NEC) Canada (CEC) IEC, CENELEC	Maximum surface temperature (Celsius)	US (NEC) Canada (CEC)	US (NEC) Canada (CEC) IEC, CENELEC
450	T1	T1	180	T3A	_
300	T2	T2	165	T3B	_
280	T2A	_	160	T3C	_
260	T2B	_	135	T4	T4
230	T2C	_	120	T4A	_
215	T2D	_	100	T5	T5
200	T3	T3	85	T6	T6

4. Testing Facilities

CSA International's hazardous locations laboratories provides the expertise, test facilities, and services needed to evaluate your products in accordance with applicable CSA, UL, FM, CENELEC and IEC standards [1]. The explosion test chamber is designed to contain test gas mixtures for evaluating flame propagation and for determining maximum explosion pressure. The overpressure test system or hydrostatic test system is available for testing leak-free equipment to a maximum standard pressure. These systems are used to test an enclosure's ability to withstand pressure. This pressure withstand test is based on a multiplier of the maximum explosion pressure obtained in the explosion pressure test.

5. Test Equipments

5.1 Explosion proof test chamber with CCTV Camera and the chamber shall be large enough to contain the complete light fixture [1]

5.2 Auxiliary drive mechanism for motoring the light fixture [2]

5.3 Gas analyzer for measuring/ monitoring the percent of methane in the engine’s intake air [3]

5.4 Pressure measuring devices/ sensors [3]

5.5 Temperature measuring devices/ thermocouples [4]

5.6 Electric spark ignition source [6]. The spark ignition test is carried out to confirm that an electric spark induced in the electric circuit constituting the intrinsically safe circuit is in no danger of igniting the explosive gas during the normal operation or in the circumstance of accident of the intrinsically safe equipment or related intrinsically safe equipment. *Propane is used as the test gas.

5.7 Obstacle light fixture 1×40W explosion type, compact fluorescent light fixture 1×11W explosion type with an auxiliary part [5]

6. Procedure

The testing of flame-proof obstacle light fixture and compact fluorescent light for propane is in the explosion proof chamber (Group IIA). This explosion-proof test is an endurance correspondence with IEC standard or IEC/EN60079-1 [2, 3]. This standard consists of explosion pressure test or reference pressure test, over pressure test, non-transmission test, degree of protection (IP), surface temperature test, impact test and temperature class test. And this research concerns only the topic of explosion pressure test or reference pressure test.

6.1 Prepare to test the light fixture package as follows:

Fig. 1. The obstacle light fixture 1×40W explosure type

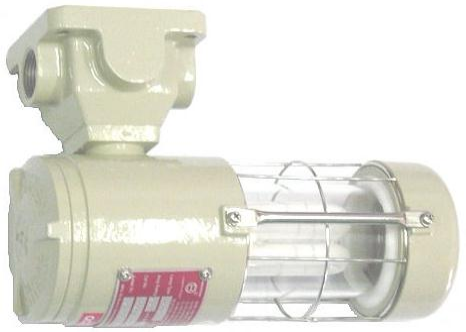

Fig. 2. The compact fluorescent light fixture 1×11W explosure type

6.1.1 Conduct the flame-proof obstacle light fixture and compact fluorescent lighting fixture in the explosion proof chamber.

6.1.2 The light fixture, lamp with socket, gasket and inside flange joint, auxiliary parts will assembly in the fixture as shown in Fig. 1 and 2.

6.1.3 The another connector and outside flange joint auxiliary parts must be test in the condition of worst-case.

6.1.4 Complete the flame-proof obstacle light fixture lamp 1×40W with socket holder gasket and flange joint, auxiliary parts to tap gas and tightening according to IEC/EN60079-1 standard.

6.1.5 Insert the gas pressure sensor temperature sensor inside and outside the light fixture cover under the explosion test chamber and room temperature.

6.1.6 Close and lock the explosion test chamber door.

6.1.7 This test is an apparatus grouping in group IIA. Fill propane gas at 1 atm to the explosion test chamber. The gas inside the explosion test chamber will be a mixing gas between natural gas and propane 4.6% with purify more than 95-99%.

6.1.8 Start the test of the control panel until ready to record the parameter data when the spark ignition is armed.

6.1.9 If the entire laboratory test set up is ready, start the test by pressing the spark ignition switch.

6.1.10 Record and print all parameter data and plot the reference pressure with times by computer.

6.1.11 To protect the explosion in the test chamber, press blower switch to blow the gas inside the explosion test chamber before open the explosion test chamber door. After that, open the chamber door to examinine the flange joint gasket auxiliary parts and fixture cover and compare with the standard.

6.1.12 Inspection the flange joint gasket auxiliary parts and fixture cover and compare with the standard. If there is no any permanent deflect or deform or leakage in any part of the joint or cover, the inspection condition will be passed the test.

6.1.13 If the results of inspection the flange joint gasket auxiliary parts and fixture cover and there are some of any permanent deflect or deform or leakage in any part of the joint or cover. The inspection condition will be failed the test and not allowed to re-use.

6.1.14 If the results inspection pass, the test procedure will be started again from topic 6.1.1 to 6.1.14 two times or three times including the first time. In the case of pressure rise time lower than 5 ms the test shall be test about 5 times.

6.1.15 If the results from topic 6.1.13 shows that the test passes the condition, calculate the reference pressure by average maximum pressure from the data the maximum pressure source and then multiply by factor k. This reference pressure will be a standard benchmark pressure for overpressure test system or hydrostatic test system is available for testing leak-free equipment to a maximum standard pressure. These systems are used to test an enclosure's ability to withstand pressure.

6.1.16 Conduct the flame-proof compact fluorescent lighting fixture 1×11W in the explosion proof chamber.

6.1.17 Repeat the test from the topic 6.1.2-6.1.15

7. Experimental Results

7.1 Print the reference test pressure graph of obstacle light fixture 1×40W explosion proof type in Fig. 3.

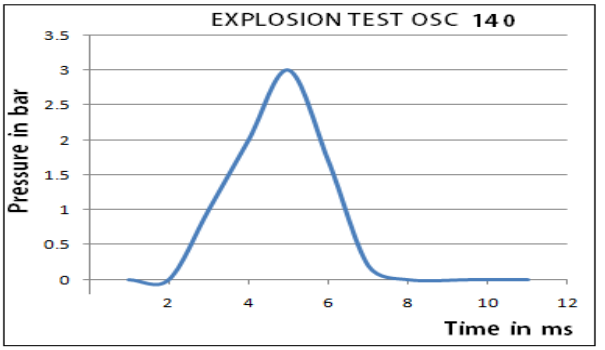

Fig. 3. The reference pressure test curve of obstacle light fixture 1×40W explosion proof type

7.2 Print the reference test pressure graph of compact fluorescent lighting fixture 1×11W explosion proof type in Fig. 4.

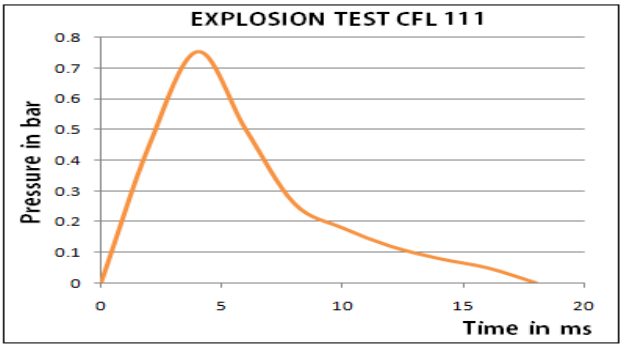

Fig. 4.The reference pressure test curve of compact fluorescent light fixture 1×11W explosion proof type

8. Conclusions

The reference pressure of obstacle light and compact fluorescent light fixture explosion proof type in the explosion proof test chamber (Group IIA) is presented. The obstacle lamp 1×40W (OSC-140) and compact fluorescent light lamp 1×11W (CFL-111) donated from the fuel stations in Thailand is tested for case study. The IIA is apparatus grouping by mean mixing gas in explosion chamber. Mixer gas is used in volumetric ratio of air and atmospheric pressure one atm with 4.6% and pure propane more than 95-99%. When the ignition is fired in the light enclosure, the reference pressure will be recorded in computer system. This pressure can examine that the enclosure or fixture cover suffers is enough to permanent deformation or damage affecting the type protection. The reference pressure for obstacle lamp 1×40W light fittings 1×40W OSC-140 and compact fluorescent light lamp 1×11W (CFL-111) is 3.0 and 0.755 bars, respectively. The reference pressure ratio between obstacle lamp 1×40W and compact fluorescent light fittings 1×11W is 3.97 indicated that the standard hydro static test of the obstacle lamp 1×40W and compact fluorescent light fittings 1×11W have to test under the pressure at least 4.5 and 1.2 bars, respectively.

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