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Limassol 20th August, 2015

RE: USE OF FIREPRO IN POTENTIALLY EXPLOSIVE ATMOSPHERES

This document is intended to provide clarification on the use of FirePro Condensed Aerosol Generators in Potential Explosive Atmospheres (ATEX). ATEX derives its name from the French title of the 94/9/EC directive: *Appareils destinés à être utilisés en ATmosphères EXplosives.*

Introduction:

As of July 2003, organizations within the EU must follow the directives to protect employees from explosion risk, in areas with a potentially explosive atmosphere. The two ATEX directives available are the following:

- ATEX 95 equipment directive 94/9/EC, (Equipment and protective systems),
- ATEX 137 workplace directive 99/92/EC, (Minimum Health & Safety requirements).

99/92/EC directive requires that employers must assess and categorize the potentially hazardous explosive atmospheres into zones. The classification of each zone identifies the probability occurrence of an explosion and its time frame or duration, if it occurs.

Zone classification includes both gas/vapors and dust as the combustible (or explosive) substance and the various classes are listed in table 1. Zone 0 (gas) and 20 (dust) marked yellow, represent the areas with highest explosive potential hazard.

Combustible	European and IEC Classification	Definition of zone or division	North American Classification
Gases	Zone 0	Area in which an explosive mixture is continuously present or for long periods	Class I/Division 1
Gases	Zone 1	Area in which an explosive mixture is likely to occur in normal operation	Class I/Division 1
Gases	Zone 2	Area in which an explosive mixture is not likely to occur in normal operation and if it occurs it will exist for a short time.	Class I/Division 2
Dust	Zone 20	Area in which an explosive mixture is continuously present or for long periods	Class II/Division 1
Dust	Zone 21	An area in which an explosive mixture is likely to occur in normal operation	Class II/Division 1
Dust	Zone 22	An area in which an explosive mixture is not likely to occur in normal operation and if it occurs it will exist for a short time.	Class II/Division 2

Table 1 (Classification of Zones or Class with the relevant explosive hazard and its duration)

Products intended to be installed within ATEX areas must have the equivalent Ex. Label. This procedure in general requires third-party testing (by an accredited certifying body), however manufacturers can 'self-certify' Category 3 equipment (for zone-2/zone-22) and Category 2 non-electrical equipment for (zone-1/zone-21) accordingly.

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Suitability for explosive areas (ATEX)

AREA CLASSIFICATION – ZONING

			Dusts		***Category 1 equipment***		***Gases, vapours and mists***				
			A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently.	**Class II Division 1 (dusts)**	**Zone 20:**	**Zone 0:**	**Class I Division 1 (gases)**	The part of a hazardous area in which a flammable atmosphere is continuously present or present for long periods. (As a guide for Zone 0, this can be defined as over 1000 hours/year or >10% of the time) for example inside liquid fuel storage tanks.			
					Category 2 equipment						
Group III IIIC Electrically conductive dusts	**Group III** IIIB Non-conductive dust	**Group III** IIIA Combustible flyings	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur in normal operation occasionally.	**Class II Division 1 (dusts)**	**Zone 21:**	**Zone 1:**	**Class I Division 1 (gases)**	That part of a hazardous area in which a flammable atmosphere is likely to occur in normal operation (As a guide for Zone 1, this can be defined as 10–1000 hours/year or 0.1–10% of the time) for example re-fuelling areas.	**Group II** IIA (Propane)	**Group II** IIB (Ethylene)	**Group II** IIC (Hydrogen)
					Category 3 equipment						
Group III IIIC Electrically conductive dusts	**Group III** IIIB Non-conductive dust	**Group III** IIIA Combustible flyings	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only.	**Class II Division 2 (dusts)**	**Zone 22:**	**Zone 2:**	**Class I Division 2 (gases)**	That part of a hazardous area in which a flammable atmosphere is not likely to occur in normal operation, and if it occurs, it will only exist for a short period (As a general guide for Zone 2, unwanted substances should only be present under 10 hours/year or 0–0.1% of the time) for example solvent storage areas. The solvent is normal contained in sealed drums however, if a drum is damaged during the process of moving it then a potentially explosive atmosphere could exist for a short period.	**Group II** IIA (Propane)	**Group II** IIB (Ethylene)	**Group II** IIC (Hydrogen)
				North American Classification	**European and IEC Classification**	**European and IEC Classification**	**North American Classification**				

FirePro suitability for explosive areas (ATEX)

Non-hazardous: Areas that do not fall into any of the above (IS NOT 'SAFE AREA')

Max Surface Temperature (°C) / Ignition temperature of the flammable substance	Temperature class CENELEC
450	**T1**
300	**T2**
200	**T3**
135	T4
100	T5
85	T6

Acetic Acid (**T1**),Acetone(**T1**),Ammonia(**T1**),Butane(**T2**),Cyclohexane(**T3**),Ethanol (ethyl alcohol)(**T2**),Kerosene(**T3**),Methane (natural gas)(**T1**),Methanol (methyl alcohol)(**T2**),Propane(**T1**),Propanol (isopropyl alcohol)(**T2**),Toluene(**T1**),Xylene(**T1**)	**IIA**	**Group II**
Ethylene(**T2**),Methyl Ethyl Ketone (MEK)(**T2**),Tetrahydrofuran (THF)(**T3**)	**IIB**	
Hydrogen(**T1**),Acetylene(**T2**)	**IIC**	

Notes: Loucas Michaelides

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FirePro Testing and Appraisal regarding ATEX environments:

FirePro full range of Condensed Aerosol Generators were assessed for their safe operation in explosive atmospheres by the following international accredited institutions:

1. UL/ULC: Underwriters Laboratory USA and Canada – Pyrotechnic Containment Test
2. GEMPI: Designated Testing Laboratory and Certification Organization Hungary

1. Pyrotechnic Containment Test (conducted by Underwriters Laboratory to be in compliance with UL2775 standard and part of the UL listing procedure).

The test protocol no. 26 is described in Figure 1 (below).

26 Pyrotechnic Reaction Containment Test

26.1 Aerosol generator samples representative of each size and design of extinguishing system unit and automatic extinguisher unit shall operate as intended and not ignite an explosive atmosphere of propane and air (4 percent stoichiometric mixture).

26.2 An explosive mixture of propane and air (4 percent stoichiometric mixture) is to be introduced into a minimum 0.49 m^3 (17.4 ft^3) cylindrical test vessel with an aspect ratio less than two. The test vessel shall be fitted with a vent to provide visual evidence of an explosion via vented flame. Twenty ±2 seconds after introduction of the mixture, the explosive mixture is to be ignited using a 5 kJ chemical igniter centrally located within the test vessel to verify the explosive atmosphere. Following verification of the mixture, each sample shall be installed within the chamber and the explosive mixture introduced into the test vessel. Each sample shall be activated at 20 ±2 seconds, while observing for ignition of the mixture.

Figure 1 (Pyrotechnic Containment Test Protocol no. 26)

Pyrotechnic Containment Test Summary:

The aim of the test was to discharge the aerosol generators inside an enclosure with an explosive air – gas mixture. The intention of this test is to avoid igniting the explosive mixture upon and during discharging of the aerosol generator. UL requires that each test must be repeated 3 times.

Initially, the explosive gas mixture is ignited for 3 consecutive times to demonstrate that the concentration used is explosive.

Then the aerosol generator is installed (inside the enclosure) where the gas mixture is introduced and measured with calibrated gas analyzers, to reach the explosive value.

Finally the generator is electrically actuated and the aerosol agent is discharged inside the enclosure without causing any explosion but instead, the discharged aerosol forms an inert atmosphere. Results of this test can be found in UL Test Record EX6960.

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2. **GEPMI** Number of Test Report: J-10302/2014 5 GÉPMI Kft.

The GEPMI test was conducted as a single and multiple configuration set-up, as illustrated in Figure 2 and 3 respectively (below).

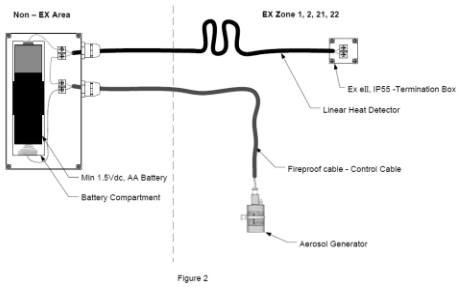

Figure 2

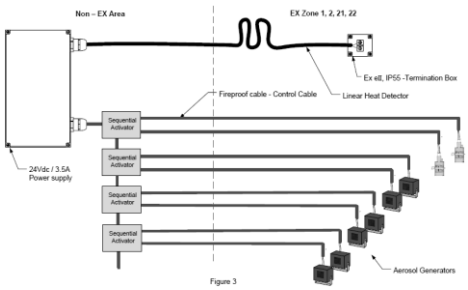

Figure 3

Test Protocol

The installation is set-up by placing the electrical components of the system (module, sequential activators and battery) outside the ATEX zone, whilst the sensors (Linear Heat Cable and Aerosol Generators) are installed within. The fire rated linear heat cable (LHC) acts as the sensor thus allowing current to flow to the generators (from the battery) when the heat within the ATEX enclosure increases past the LHC temperature rating. The termination of the linear heat detector cable (within ATEX enclosure) is done using a termination box that has ex-certification of Ex II 2GD Eex e II with standard terminal blocks.

Test Summary

The FirePro aerosol generators, the linear heat detector cable and the Ex II 2GD ATEX termination box can be used in a) Zone 1 and 2 with presence of gases of IIA, IIB and IIC hazard groups and b) Zone 21 and 22 with presence of dusts of IIIA, IIIB and IIIC hazard groups.

The FPC-4 control module can only be installed outside explosion hazardous areas, together with any power supply inside a case that has a minimum of IP 54 protection.

The FP-BTA type can be used in Zone 1, 2, 21 and 22, because it does not contain any external source of ignition. Results of this test can be found at Test Report No. J-10302/2014 5 GÉPMI Kft.

Conclusions:

As a result of the above two (2) test reports, it can be concluded that FirePro Condensed Aerosols can be used in the following ATEX zones:

a) Zone 1 and 2 with presence of gases of IIA, IIB and IIC hazard groups

b) Zone 21 and 22 with presence of dusts of IIIA, IIIB and IIIC hazard groups.

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Case Study: Assessment of Diesel Generator Rooms & Fuel Storage Areas as Potentially Explosive Areas

Diesel is a combustible fuel and widely used in many industry applications from power generators to engines for (vehicle, railway, pumps, marine, etc.).

Although Diesel is confined within the storage tank, fuel hoses and the engine cylinders, spillages may still occur (within the enclosure) either through 1) minor leakages (such as wetted seals) or 2) failures (such as breakdown of pump seals, gaskets, injectors or any other accidents).

ATEX zone assessment for Diesel Generator rooms take into account A1) the release rate of the fuel, A2) flash point, A3) ignition temperature and A4) air ventilation. Each of the individual factors (A1 - A4) is explained further below.

A1) The release rate of the fuel (or spillage) is proportional to the explosive hazard.

Release rates are measured in hours and grouped as follows:

Zone 0: Large spillages > 1000 hours

Zone 1: Medium spillages = 10 – 1000 hours

Zone 2: Small spillages < 10 hours

NOTE: An oil spillage within a generator room or fuel storage area will not exceed 10 hours.

A2) The definition of the Flash Point is the lowest temperature at which sufficient vapors are given off a liquid as to form a flammable mixture (with air), that can be ignited by an arc, spark, naked flame, etc.

The danger to create a potential explosive air-gas mixture is when the room ambient temperature increases beyond the Flash Point temperature of the substance. Diesel has a flash point above 60°C.

NOTE: The expected ambient temperature within a generator room or fuel tank area is not expected to exceed 50°C.

A3) The Auto Ignition Temperature is the one at which the combustible substance will automatically ignite. Diesel has an Auto Ignition Temperature of 257°C.

*NOTE: The surface temperature of the generator itself is not expected to exceed 1*50°C.

A4) Ventilation plays a major factor on the concentration build-up of potentially explosive fumes within the enclosure itself. Diesel generator rooms and fuel storage areas are typically designed to accommodate excessive air movement within the area.

NOTE: Diesel generator rooms and fuel storage areas are typically designed to accommodate excessive air movement within the area.

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Results:

Taking into consideration the assessment factors A1 – A4, it can be concluded that Diesel Generator Rooms and Fuel Storage Areas can be classified as Zone 2 according to ATEX classification, but typically they are classified as non-hazardous areas because of the low spillage duration time, high flash point, very high auto ignition temperature and excessive ventilation rates.

Furthermore, NFPA 37 "Standard for the installation and use of stationary combustion engines and gas turbines" identifies safety methods to avoid the development of potentially explosive conditions within these areas such as cut-off fuel supply prior to agent discharge and ventilation requirements.

References and Extracts

NFPA 2010 – engineering guidelines for fixed aerosol fire-fighting systems

NFPA 37 - standard for the installation and use of stationary combustion engines and gas turbines

UL Test Record EX6960.

Test Report No. J-10302/2014 5 GÉPMI Kft.