FirePro.

Design, Installation & Maintenance Manual

FirePro CONDENSED AEROSOL GENERATORS
FOR ATEX APPLICATIONS

Models: FP-100EX, FP-200EX, FP-500EX, FP-1200EX, FP-2000EX,FP-3000EX, FP-4200EX, FP-5700EX

This Manual (2/11/2018, version 1, rev.0) shall be used in conjunction with the latest version of the FirePro Information, Instruction & User Manual.

II 1G Ex s IIC T3 Ga T_{amb} = -54 °C +54 °C

II 1D Ex s IIIC T200 °C Da

I M1 Ex s T450 °C Ma

Reinventing
Fire Suppression

List of Contents

1. Scope

This manual is written for those who are designing, installing and maintaining FirePro condensed aerosol fire extinguishing systems for total flooding applications in Explosive Atmospheres and Hazardous locations.

The technical data contained in this manual are strictly limited for informational purposes only, FirePro believes this data to be accurate, but they are published and presented without any warranty or guarantee whatsoever; FirePro disclaims any liability for any use that may be made of the data and information contained herein by any and all other parties.

This manual should be used in conjunction with the latest version of the FirePro Information Instruction and User Manual.

2. Reference Standards, Laws and Regulations

FirePro ATEX Condensed Aerosol Generators are built in accordance with the following standards:

2014/34/EU-ATEX	ATEX (Explosive Atmospheres) Directive
EN IEC 60079-0	Explosive atmospheres. Equipment. General requirements
EN IEC 60079-14	Explosive atmospheres. Electrical Installations, design, selection and erection
EN IEC 60079-10	Explosive atmospheres. Classification of areas
EN IEC 60079-17	Explosive atmospheres. Electrical Installations, inspection and maintenance
IEC 60079-33	Explosive atmospheres. Equipment protection by special protection “s”
EN 1127-1:2011	Explosive Atmospheres – Explosion prevention and protection Part 1 – Basic concepts and methodology
ISO 15779	Condensed aerosol fire extinguishing systems -- Requirements and test methods for components and system design, installation and maintenance -- General requirements
EN 15276-1:2019	Fixed firefighting systems. Condensed aerosol extinguishing systems Requirements and test methods for components
EN 15276-2:2019	Fixed firefighting systems. Condensed aerosol extinguishing systems Design, installation and maintenance
UL 2775	Standard for Fixed Condensed Aerosol Extinguishing System Units
NFPA 2010	Standard for Fixed Aerosol Fire-Extinguishing Systems

3. FirePro Condensed Aerosol fire extinguishing action

Traditionally, there were three distinct elements assumed as necessary for combustion: heat, fuel, and oxygen, popularly known as the “fire triangle”.

Typical fire extinguishment involves either removing the fuel from the fire, limiting oxygen to the fire (smothering), or removing the heat (quenching).

This physical theory had to be modified as halons became more widely used and better understood.

The halons, as well as other agents like the **FirePro** condensed aerosol do not extinguish fire in any of these ways, but instead break up the uninhibited chain reaction of the combustion process.

This extinguishing mechanism is not completely understood, yet there is definitely a chemical reaction that interferes with the combustion process by removing the active chemical species involved in the flame chain reaction.

The **FirePro** condensed aerosol extinguishing mechanism works by removing the active chemical species involved in the flame chain reaction.

Upon activation, the FPC (patented solid compound contained in the **FirePro** condensed aerosol generators), immediately starts a chemical reaction that in few seconds produces condensed dry aerosol in the discharge density defined by the system designer (i.e. potassium compounds (K_2CO_3), H_2O, N_2, CO_2 and other gas particles in small quantities.

The **FirePro** condensed aerosol thus generated consists of micro-sized particles of potassium compounds suspended in inert gases in an extremely high ratio between the exposed surface and their reaction mass.

The **FirePro** condensed aerosol then remains in suspension for a relatively long time into the protected volume allowing its active inhibitor to flow into the combustion core transported by its own natural convection currents and breaking the chain reaction upon flame contact with extremely high efficiency.

Potassium is an alkaline metal and requires the least amount of energy for ionization because of its very low ionization potential. Therefore a certain amount of energy is removed from the combustion itself to eliminate the atoms’ electrons during this ionization process. This is the physical action of the extinguishing process of **FirePro** condensed aerosol.

Its chemical process of the **FirePro** condensed aerosol fire extinguishment is characterized by certain reactions in rapid sequence taking place between atoms and fragments of unstable molecules, which is called “chain reactions of radicals”.

Since the radicals are unstable, they tend to reach a final stable condition. The stable final products, among others, are carbon dioxide (CO_2) and water (H_2O).

The potassium atoms derived by the disassociation of the potassium compounds contained in the **FirePro** condensed aerosol, reacts during combustion with the free radicals of unstable hydroxides forming potassium hydroxide (KOH). At this stage the chain reaction of the free radicals is halted and the flame is extinguished. KOH reacts further in the presence of $\mathbf{CO_2}$ and forms $\mathbf{K_2CO_3}$.

The reactions’ sequence is shown in the following page.

FirePro Condensed aerosol fire extinguishing reaction sequence

Oxidation of hydrogen in the flames:

$H_2 + O_2 \rightarrow 2\ OH^-$

$OH^- + H_2 \rightarrow H_2O + H^+$

$H^+ + O_2 \rightarrow OH^- + H^+$

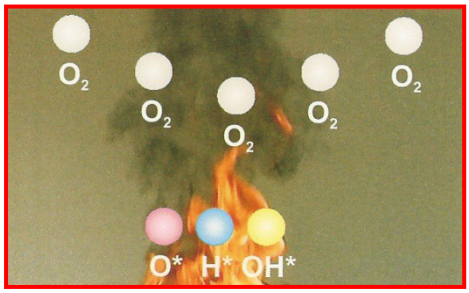
$O^{- -} + H_2 \rightarrow OH^- + H^+$

Oxidation of carbon monoxide in the flame:

$H_2 + O_2 \rightarrow 2\ OH^-$

$OH^- + CO^{+ +} \rightarrow CO_2 + H^+$

$H^+ + O_2 \rightarrow OH^- + O^{- -}$



Therefore, in the flame, during combustion, further to water and carbon dioxide (stable), only unstable hydroxyl radicals are formed which allow the reaction to continue (phenomenon of auto catalysis).

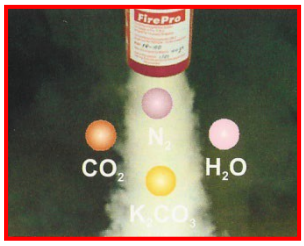
The chain reaction is interrupted by the Potassium atoms, which react with the unstable hydroxyl as follows:

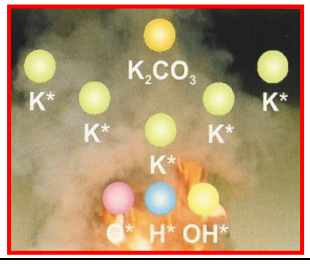
$OH^- + K^+ \rightarrow KOH$ (and flames are thus extinguished)

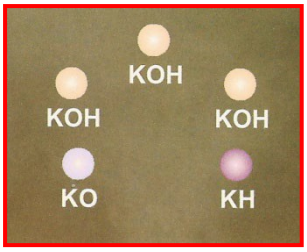
Notice that the potassium hydroxide (KOH) is formed in quantities smaller than micrograms.

The KOH reacts further in the presence of CO_2 and form K_2CO_3.

During this process we can verify that the extinguishing action of potassium compounds is not achieved either through smothering or quenching but through a reaction in presence of flame with consequent termination of the chain reaction.







Legend:

H_2	hydrogen stable
O_2	oxygen stable
OH^-	hydroxyl radicals unstable
H_2O	water stable
H^+	hydrogen atoms unstable
O^-	Oxygen atoms unstable
$CO^{+ +}$	carbon monoxide unstable
CO_2	carbon dioxide stable

4. Areas and hazardous zones

Explosion Hazardous areas are those where, under certain conditions, explosive atmospheres may occur.

An explosive atmosphere is a mixture with air, under atmospheric conditions, of flammable substances in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture.

The user, or his representative, is required to make UNDER HIS OWN RESPONSIBILITY the assessment of the zones type. He will also have to draw up a comprehensive risks assessment (possibly making use of qualified personnel) in which all the equipment and the possible risks are taken into consideration.

EN 60079-10-1 and EN 60079-10-2 provide criteria for the classification of hazardous areas in relation to chemical, physical characteristics and quantity of the substances used, as well as a function of frequency and of the time period in which such mixture may be present. Please see figure 1 below.

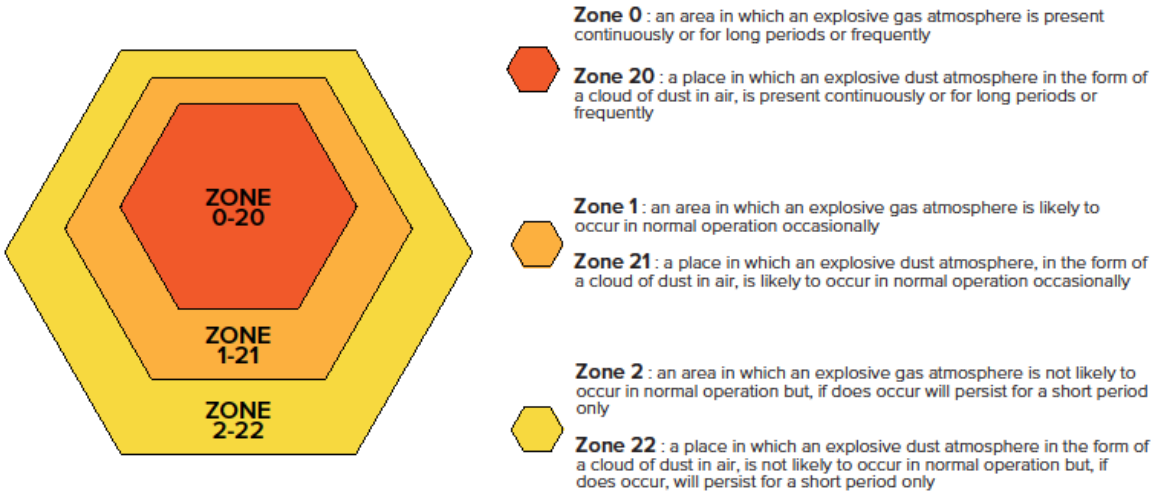


Figure 1 *ATEX zones definition scheme according to EN 60079-10 and EN 50281-3 with the allowed product categories for each zone.*

5. Temperature classes (for potentially explosive atmosphere in the presence of combustible gas)

All devices in hazardous areas shall be classified according to the maximum surface temperature that may be developed both in normal operation and in case of failure.

The European standard EN 60079-0 provides, for maximum surface temperature, six classes from T1 to T6 (see table below) with a reference ambient temperature of +40 [°C]. In case of different reference temperature, the variation must be specified on the appliance/device.

Temperature class	Maximum surface temperature (°C)
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

Table 1 *Temperature class description*

6. Installation

FirePro Condensed Aerosol Generators installation in environments with a potentially explosive atmosphere, is sole responsibility of the user.

Prior to installation users shall:

- Assess the risks of the environment in which they intend to install the equipment;
- Identify the type of hazardous atmosphere (Gas or Dust);
- Define the Zone (0 – 1 – 2 for gas, or 20 – 21 – 22 for dust);
- Identify the Product category (1G – 2G – 3G or 1D – 2D –3D);
- Be sure that the license nameplate of the FirePro Condensed Aerosol Generator corresponds to the ordering data.

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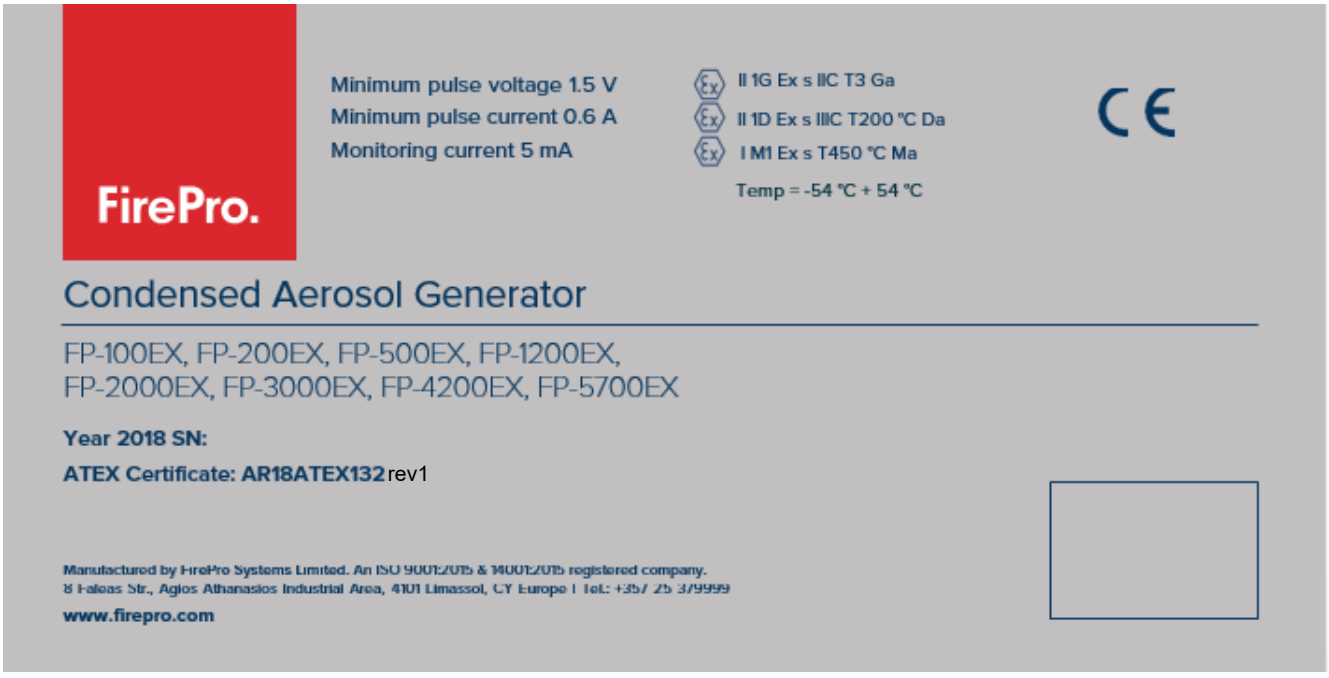
7. FIREPRO ATEX Condensed Aerosol Generators nameplate

In accordance with the ATEX directive 2014/34/EU (Ref Chapter III, art. 10), FirePro ATEX Condensed Aerosol Generators designed to operate in potentially explosive atmospheres are identified by a nameplate. Furthermore the nameplate indicates the elements of ATEX classifications in which the Condensed Aerosol Generators can be used.



. **Picture 2** FirePro ATEX Condensed Aerosol Generators Nameplate

8. ATEX Marking

⟨Ex⟩ II 1G Ex s IIC T3 Ga

⟨Ex⟩	ATEX LOGO
II	Non mining equipment
1	Category 1, can be used in zones 0 ,1 and 2
G	Gas atmosphere
Ex	Explosion protection
s	Special protection - IEC 60079-33
IIC	Explosion Group (most dangerous group)
T3	Maximum permitted housing temperature of 200 °C
Ga	Equipment protection level

⟨Ex⟩ II 1D Ex s IIIC T200 °C

⟨Ex⟩	ATEX LOGO
II	Non mining equipment
1	Category 1, can be used in zones 20, 21 and 22
D	Dust atmosphere
Ex	Explosion protection
s	Special protection - IEC 60079-33
IIIC	Conductive dust
T200 °C	Maximum permitted housing temperature of 200 °C
Da	Equipment protection level

⟨Ex⟩ I M1 Ex s T450 °C Ma

⟨Ex⟩	ATEX LOGO
I	Mining equipment
M1	Category 1, can be used in zones 0 or 20
Ex	Explosion protection
s	Special protection - IEC 60079-33
T450 °C	Maximum permitted housing temperature of 450 °C
Ma	Equipment protection level

FirePro.

DECLARATION OF CONFORMITY EU

FIREPRO SYSTEMS LTD
8 FALEAS STR., AGIOS ATHANASIOS INDUSTRIAL AREA, CY4101 LIMASSOL – CYRPUS EU

This declaration of conformity is issued under the sole responsibility of the manufacturer

Condensed Aerosol Generators: **FP-100EX, FP-200EX, FP-500EX, FP-1200EX, FP-2000EX, FP-3000EX, FP-4200EX, FP-5700EX**

II 1G Ex s IIC T3 Ga T_{amb} = -54 ºC +54 ºC

II 1D Ex s IIIC T200 ºC Da

I M1 Ex s T450 ºC Ma

The object of the declaration described above is in conformity with the relevant European Union harmonization legislation:

2014/34/EU-ATEX

This conformity is declared referencing to the relevant harmonized standards: EN 1127-1:2011 – EN 60079-0:2012/A11:2013 – IEC 60079-33:2012 (partially)

THE NOTIFIED BODY ALBARUBENS srl (N. 2632) ISSUED THIS EU-TYPE EXAMINATION CERTIFICATE:

AR18ATEX132rev1

(date of first issue: 23.11.2018)

THE NOTIFIED BODY TÜV CYPRUS (TÜV NORD) LTD (N. 2261) ISSUED THIS PRODUCTION QUALITY ASSURANCE NOTIFICATION:

TÜV CY 19 ATEX AT0206135

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10. FIREPRO EX Condensed Aerosol Generators data sheets

FP-100EX

TECHNICAL INFORMATION	
Model	FP-100EX
Activation method	Electrical (Minimum pulse voltage: 1.5 V DC, Minimum pulse current: 0.6 A, Minimum pulse duration: 0.5 s)
Current intensity to be tested	maximum 5 mA
Weight gross	1830 g
Weight net extinguishing agent	100 g
Operational discharge time	5 - 10 seconds
Discharge outlet	1
Discharge length	1.0 m
Size	d:84 mm x 170 mm (incl. connector housing)
Self-activation temperature	300° C
Fire class	A, B, C, F
APPLICATIONS	

ATEX areas

II 1G Ex s IIC T3 Ga T_{amb} = -54 °C +54 °C

II 1D Ex s IIIC T200 °C Da

I M1 Ex s T450 °C Ma

FP-200EX

TECHNICAL INFORMATION	
Model	FP-200EX
Activation method	Electrical (Minimum pulse voltage: 1.5 V DC, Minimum pulse current: 0.6 A, Minimum pulse duration: 0.5 s)
Current intensity to be tested	maximum 5 mA
Weight gross	2315 g
Weight net extinguishing agent	200 g
Operational discharge time	5 - 10 seconds
Discharge outlet	1
Discharge length	2.0 m
Size	d: 84 mm x 200 mm (incl. connector housing)
Self-activation temperature	300° C
Fire class	A, B, C, F
APPLICATIONS	

ATEX areas

II 1G Ex s IIC T3 Ga T_{amb} = -54 °C +54 °C

II 1D Ex s IIIC T200 °C Da

I M1 Ex s T450 °C Ma

FP-500EX

TECHNICAL INFORMATION	
Model	FP-500EX
Activation method	Electrical (Minimum pulse voltage: 1.5 V DC, Minimum pulse current: 0.6 A, Minimum pulse duration: 0.5 s)
Current intensity to be tested	maximum 5 mA
Weight gross	3770 g
Weight net extinguishing agent	500 g
Operational discharge time	5 - 10 seconds
Discharge outlet	1
Discharge length	3.0 m
Size	d:84 mm x 310 mm (incl. connector housing)
Self-activation temperature	300° C
Fire class	A, B, C, F
APPLICATIONS	

ATEX areas

II 1G Ex s IIC T3 Ga T_{amb} = -54 °C +54 °C

II 1D Ex s IIIC T200 °C Da

I M1 Ex s T450 °C Ma

FP-1200EX

TECHNICAL INFORMATION	
Model	FP-1200EX
Activation method	Electrical (Minimum pulse voltage: 1.5 V DC, Minimum pulse current: 0.6 A, Minimum pulse duration: 0.5 s)
Current intensity to be tested	maximum 5 mA
Weight gross	17050 g
Weight net extinguishing agent	1200 g
Operational discharge time	10 - 15 seconds
Discharge outlet	1
Discharge length	3.5 m
Size	365 x 450 x 310
Self-activation temperature	300° C
Fire class	A, B, C, F
APPLICATIONS	

ATEX areas

II 1G Ex s IIC T3 Ga T_{amb} = -54 °C +54 °C

II 1D Ex s IIIC T200 °C Da

I M1 Ex s T450 °C Ma

FP-2000EX

TECHNICAL INFORMATION	
Model	FP-2000EX
Activation method	Electrical (Minimum pulse voltage: 1.5 V DC, Minimum pulse current: 0.6 A, Minimum pulse duration: 0.5 s)
Current intensity to be tested	maximum 5 mA
Weight gross	21650 g
Weight net extinguishing agent	2000 g
Operational discharge time	10 - 15 seconds
Discharge outlet	1
Discharge length	3.5 m
Size	365 x 450 x 310
Self-activation temperature	300° C
Fire class	A, B, C, F

APPLICATIONS

ATEX areas

II 1G Ex s IIC T3 Ga T_{amb} = -54 °C +54 °C

II 1D Ex s IIIC T200 °C Da

I M1 Ex s T450 °C Ma

FP-3000EX

TECHNICAL INFORMATION	
Model	FP-3000EX
Activation method	Electrical (Minimum pulse voltage: 1.5 V DC, Minimum pulse current: 0.6 A, Minimum pulse duration: 0.5 s)
Current intensity to be tested	maximum 5 mA
Weight gross	22450 g
Weight net extinguishing agent	3000 g
Operational discharge time	15 - 20 seconds
Discharge outlet	1
Discharge length	4.0 m
Size	365 x 450 x 310
Self-activation temperature	300° C
Fire class	A, B, C, F

APPLICATIONS

ATEX areas

II 1G Ex s IIC T3 Ga T_{amb} = -54 °C +54 °C

II 1D Ex s IIIC T200 °C Da

I M1 Ex s T450 °C Ma

FP-4200EX

TECHNICAL INFORMATION	
Model	FP-4200EX
Activation method	Electrical (Minimum pulse voltage: 1.5 V DC, Minimum pulse current: 0.6 A, Minimum pulse duration: 0.5 s)
Current intensity to be tested	maximum 5 mA
Weight gross	30910 g
Weight net extinguishing agent	4200 g
Operational discharge time	15 - 20 seconds
Discharge outlet	1
Discharge length	5.0 m
Size	365 x 450 x 420
Self-activation temperature	300° C
Fire class	A, B, C, F

APPLICATIONS

ATEX areas

II 1G Ex s IIC T3 Ga T_{amb} = -54 °C +54 °C

II 1D Ex s IIIC T200 °C Da

I M1 Ex s T450 °C Ma

FP-5700EX

TECHNICAL INFORMATION	
Model	FP-5700EX
Activation method	Electrical (Minimum pulse voltage: 1.5 V DC, Minimum pulse current: 0.6 A, Minimum pulse duration: 0.5 s)
Current intensity to be tested	maximum 5 mA
Weight gross	33710 g
Weight net extinguishing agent	5700 g
Operational discharge time	15 - 20 seconds
Discharge outlet	1
Discharge length	8.0 m
Size	365 x 450 x 420
Self-activation temperature	300° C
Fire class	A, B, C, F

APPLICATIONS

ATEX areas

II 1G Ex s IIC T3 Ga T_{amb} = -54 °C +54 °C

II 1D Ex s IIIC T200 °C Da

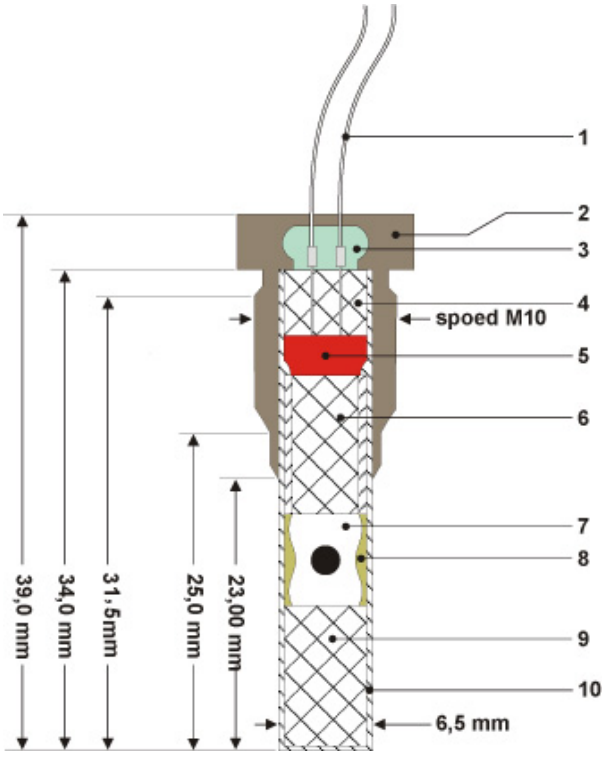
I M1 Ex s T450 °C Ma

11. FirePro Initiator (Electrical Activator)

FirePro Initiator (electrical activator)

The initiator is connected to the activation power circuit through heat resistant wires. The applied power will activate the electrical coil (4) which will heat up the FPC Solid Compound thermal booster (5) initiating an exothermic reaction The heat developed will transfer thorough the cylinder outlets (7) starting the exothermic reaction of the FPC Solid Compound (9) thus the thermal energy will be sufficient to start the reaction of the whole mass of FPC Compound contained inside the aerosol generator, transforming the FPC into a particulate (microsized particles) and carrier gases.

Initiator cut-off view



Legend	
1	heat resistant wires (feed)
2	steel housing
3	polymeric resin
4	electric coil
5	FPC (solid compound-thermal booster)
6	chemical stabilizer
7	cylinder with 2 outlets
8	sealing
9	FPC (solid compound)
10	lacquered surface

Electrical values	
Bridge resistance	1.6-3.0 Ohms (Ω)
Minimum Pulse Energy	0.8 mWs/Ω
Minimum Pulse Voltage (V)	1.5 Vdc
Minimum Pulse Current (A)	0.6 A
Minimum Pulse Duration	0.5 s
No Fire Current (A)	0.02 A
Duration of Heat Emission	3 - 4 s

Working temperature(not to exceed)	
Deployment temperature	-54° C to 100° C
Storage temperature	-54° C to 54° C

The initiator is a standard component of all the FirePro aerosol generators

12. Equipment – General requirements

Reference: IEC 60079-0:2011 Explosive atmospheres – Part 0: Equipment – General requirements

For requirements related to Connection facilities for earthing (grounding) or bonding conductors, Equipment requiring earthing, Size of conductor connection, Secureness of electrical connections refer to **IEC 60079-0:2011 clause15.**

For requirements related to Entries into enclosures, Identification of entries, Cable glands, Blanking elements, Thread adapters, Temperature at branching point and entry point, Electrostatic charges of cable sheaths refer to **IEC 60079-0:2011 clause 16.**

13. Electrical design, selection and installation

Reference: IEC 60079 -14 Explosive atmospheres – Electrical installations design, selection and erection.

For requirements related to Potential equalization, refer to **IEC 60079 -14 clause 6.**

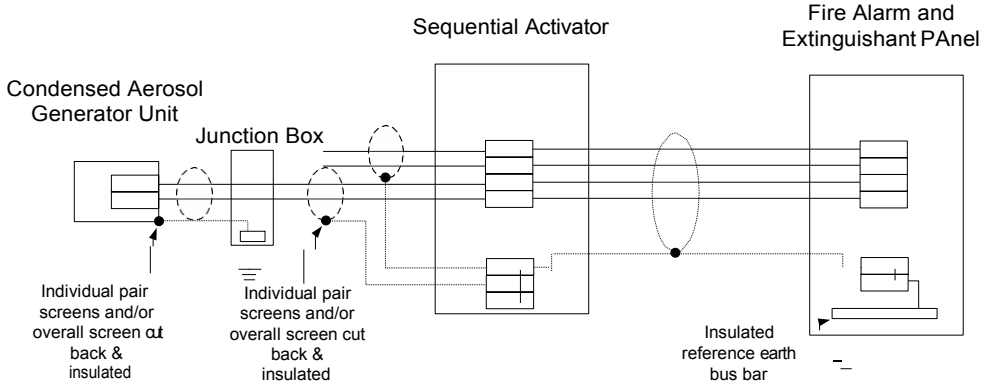
For requirements related to Earthing of conducting screens, Cable armour bonding, Installation of cables and wiring, Conductors of intrinsically safe circuits, Unused cores in multi-core cables, Earthing of intrinsically safe circuits refer to **IEC 60079 -14 clause 12.**

Earthing / Grounding details:

Multiple grounds throughout an installation could result in a difference of potential between Condensed Aerosol Generators and possibly could also create ground fault problems to the Fire Extinguishing Panel. Use of local bonding to earth (grounding) of the Condensed Aerosol Generator metallic enclosure could be beneficial for reasons, such as:

a. Lightning Protection
b. Protection against voltage surges
c. Provision of “clean earth” system
d. Shielding against electromagnetic interference noise
e. Protection against electrostatic discharge

However, the above benefits would be effective only in case the bonding/grounding is done properly. It is advised that the bonding / grounding of the Condensed Aerosol Generator metallic enclosure is done locally, and individually from the braid of the cable. The cable braid should be grounded at the common earthing terminal within the Fire Alarm and Extinguishing Panel side only.



It is mandatory to consult FirePro Systems Ltd or its authorized distributor before using FirePro ATEX Condensed Aerosol Generators in potentially explosive atmospheres;

14. Inspection and Maintenance

Reference: EN IEC 60079 -17 Explosive atmospheres – Electrical installations inspection and maintenance. For requirements related to:

Maintenance requirements, refer to **EN IEC 60079 -17 clause 4.6**
Isolation of equipment, intrinsically safe installations, refer to **EN IEC 60079 -17 clause 4.8.2**
Earthing and equipotential bonding refer to **EN IEC 60079 -17 clause 4.9**
Inspection Schedules refer to **EN IEC 60079 -17 clause 4.12**
Cable gland, refer to **EN IEC 60079 -17 clause 4.12.5**
Type of cable, refer to **EN IEC 60079 -17 clause 4.12.6**
Sealing, refer to **EN IEC 60079 -17 clause 4.12.7**
Cable screens, refer to **EN IEC 60079 -17 clause 5.3.7**

Important Note:
Even though, the Ex rated gland, the cabling and the Aerosol Generator are pre-assembled at the factory, it is the responsibility of the installer to check and verify the integrity of the complete assembly.

The membrane (sticker) which hermetically seals the outlets of the Condensed Aerosol Generators should be replaced every two years or whenever damage is observed.

15. Design Calculation.

The quantity (mass) of aerosol agent to be used should be determined as per Design Calculation Section of the latest EN Information Instruction and User Manual.