CONDENSED AEROSOL
FIRE EXTINGUISHING SYSTEMS

TECHNICAL MANUAL
Installation and operating manual

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CONDENSED AEROSOL

AN INNOVATING, CLEAN AND ECONOMICAL EXTINGUISHING AGENT

In the range of the new generation of extinguishing agents, an innovative product is now available for the realization of effective fire-prevention systems, it's economical and totally ecological: the Potassium salts aerosol. It can be classified as an extinguishing agent that belongs in the category of the dry powders, commonly used in portable fire-extinguishers. By definition, "an aerosol is a system of solid or liquid particles that are suspended in a gaseous environment". For example, smoke is the resulting aerosol produced by the combustion process. It's formed by particles that measure a few microns in diameter (one millionth of a meter).

The extinguishing agents made from Potassium salts (abbreviation Î€A) in an aerosol provides a unique method of extinguishing fires. Through the process of vaporization the substance is thinly dispersed in the environment and later, due to the condensation of the same substance, the fire is extinguished. The extinguishing action of the aerosol can be explained as the result of the interruption of the auto-catalysis of the fire (in other words, the interruption of the chain of reaction). Due to its unique chemical composition, the aerosol is capable of extinguishing fires even if its not sprayed directly into the fire; such a result is obtained through the saturation of the environment. Besides, another characteristics of the aerosol is that its slow decaying process in the environment (the substance tends to stratify) which allows it to maintains enough inertia to prevent relighting of the fire hotbeds. The Potassium salts aerosol extinguishers are also seen as effective and alternative substitutes of halogen gas. The use of Halon and its derivates is now forbidden by law because they're proven harmful to the ozone layer. Furthermore, the aerosol extinguishers in Potassium dust offer remarkable advantages by eliminating the heavy components of the gas hydraulic systems and by offering a greater flexibility of use thanks to the drastic reduction in size, cost and weight of the fixed fire-prevention systems.

And last, the aerosol extinguishers are totally compatible with the environment since they do not contribute in anyway to the destruction of the ozone layer.
Beside its great effectiveness in extinguishing fires, aerosol have other qualities such as:

- It's completely non-toxic
- It does not produce any toxic by-products during the decomposition process.
- It's compatible with the environment.
- It's chemically stable
- Aerosol not corrode other substances when cleared away in a reasonable time.
- It does not absorb humidity.
- It has a specific particle size
- It has a specific gravity that is suitable to guarantee a stabilization action.

**HOW DOES IT WORKS**

The condensed aerosol extinguishing agents (resulting from Implementation of generators) are formed by tiny solid particles of alkaline metals salts (about 40% of the weight of the generated aerosol) and gas (about 60% of the weight of the generated aerosol), mostly nitrogen, carbon dioxide and water vapour.

Aerosol extinguishes fire through **chemical working**, interfering with the chain reaction of combustion, removing the free radicals (they aren't disposable any more for banking up combustion). **Physically**, the aerosol takes energy from the combustion environment (cooling action). This two reactions occurs mainly on the surface of solid aerosol particles; therefore, the more particles are little, the larger surface of reaction is available, the more effective is the extinguishing action.

These atoms have the capability of capturing other free radicals which in turn are produced by the chain reaction of the combustion process, and in doing so cause its interruption.

It should be noted that, regardless of the anionic portion (bicarbonate) Potassium proves to have a powerful inhibiting effect on the chain reaction thanks to the low ionization potential that characterizes it.

**WHERE AEROSOL INSTALLATION IS POSSIBLE**

The extinguisher made from potassium aerosol is suitable for fighting fires in closed environments, where the risk is caused by the presence of:

- solid combustible material as woods, papers, cloths, composed materials, plastic material and other such things. (Fire class A)
liquid combustible materials as lubricating oils, gasoline and other such products resulting from the refining of petroleum, organic solvents, resins, etc. (Fire class B)

- electrical and electronics appliances, even under live tension, up to 20KV, for example low tension electrical switchboards, dry or oil transformers, cable tunnels, cable shafts, transformation and distributing cabinets, telephone and telematics devices (Fire class C)

LIMITATION OF USE
The extinguishant referred to this international standard shall not be used on fires involving the following fuels unless relevant testing has been carried out to the satisfaction of the authority:

a) chemicals containing their own supply of oxygen, such as cellulose nitrate;
b) mixtures containing oxidizing materials, such as sodium chlorate or sodium nitrate;
c) chemicals capable of undergoing autothermal decomposition such as some organic peroxides;
d) reactive metals (such as sodium, potassium, magnesium, titanium and zirconium), reactive hydrides, or metal amides, some of which may react violently with some aerosol extinguishants;
e) oxidizing agents such as nitric oxides and fluorine;
f) pyrophoric materials such as white phosphorous or metallo-organic compounds.

The above list may not be exhaustive.

The aerosol extinguishant is contraindicated to extinguish fires involving alkaline substances and substances which burn in the absence of oxygen.

The designer, during the design phase / specifications, will have to provide any mechanical ventilation system in the case where it considers that the existing ventilation is inadequate and / or not suitable for post-download the local reclamation.

ELECTROSTATIC DISCHARGE
Care shall be taken when discharging extinguishant into potentially explosive atmospheres. Electrostatic charging of aerosol generators or other conductors not bonded to earth may occur during the discharge of extinguishant. These conductors may discharge to other objects with sufficient energy to initiate an explosion. When the system is used for inertin, generators shall be adequately bonded and earthed.
AEROSOL CHARACTERISTICS

The extinguishing aerosol is essentially made of tiny solid particles of oxides and sulphates from alkaline metals, therefore:

- the aerosol is not dangerous for the human beings
- it doesn’t corrode or damage other materials
- it’s removable with common vacuum cleaner
- it’s washable with water.

The aerosol is not recommended for fires where alkaline substances or other substances that burn in the absence of oxygen are involved.

The designer has to consider a mechanical ventilation system when he designs (or during technical specifications phase) if he thinks that the existing system isn’t sufficient for the reclaim after supply.

WHAT TO DO AFTER DISCHARGE

If a discharge occurs because of a false alarm or improper activation, it is important to ventilate promptly the room, if possible in an hour, in order to avoid an excessive deposit of aerosol particles on flat surfaces.

Laboratory test has proved the high water-soluble level of aerosol residues. To clean the hydrophilic surfaces like paper, use a wad of cotton-wool imbibed in distilled water. It’s possible to have to repeat the action more times.

If the discharge occurs in premises where important working electronic devices are protected, it is necessary to provide for a prompt careful cleaning of electronic boards.

Electrical devices:

To do a prompt cleaning of electrical circuit. The customer will decide how to remove the extinguishing product and if use his practiced personnel or a specialize company. All devices have to be switch off and turn on just after reclaim.

Surface: metal leaf

To clean use a rag wet with cleaning degreasing soap (plus bleach).

Surface: floor

To clean: use the hoover and normal soap.
Surface: generic level surface
To clean: use the hoover and dust mop.
All write up has to do when the system supplies without fire.
After ventilation, for cleaning the room the personnel have to have use: long latex gloves, filter face mask, ocular mask in box.
To enter in the room after discharge, the personal have to use: tnt polypropylene coverall with elastic on face, cuff, ankles and waste; hood, long latex gloves, filter and antigas face mask (UNI 143; UNI EN 141).

**FIRE FIGHTING SYSTEMS**
The aerosol extinguishing compound is contained in special metal containers that are produced in several different versions:
- Fixed fire-fighting systems to be used in civil industrial or military internal areas.
- Fire-fighting systems for the various transportation means (trains, automobiles, private and commercial boats and aeroplanes).
- Portable fire-fighting systems (as part of the equipment given to Fire Brigade officers responsible for the company’s safety, fire-prevention posts during public manifestations, etc.).

Such extinguishing systems are effective in putting out fires that involve solid combustible materials, flammable liquids and electrically ignited fires.
Characteristics of the aerosol extinguishing systems such as the effectiveness in quickly defeating the flames, the lack of toxic elements, and the lack of electrical conductivity allows a great flexibility in its use.
The main application of the systems is in total flooding systems, which work through a total saturation of the environment (volumetric application).

**MAXIMUM TOXIC LEVEL TABLE**

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Maximum Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Monoxide (CO)</td>
<td>10 ppm from 0 and 30 seconds of combustion</td>
</tr>
<tr>
<td></td>
<td>33 ppm from 0 and 2 minutes of combustion</td>
</tr>
<tr>
<td></td>
<td>57 ppm from 0 until 15 minutes of combustion</td>
</tr>
<tr>
<td>Nitric oxide (NOx)</td>
<td>5 ppm from 0 and 20 minutes of combustion</td>
</tr>
</tbody>
</table>
Aerosol Extinguishers 17 mg/ m³ from 0 and 2 minutes of combustion (salts and sulphates) 8,5 mg/ m³ after 10 minutes of combustion

*data obtained from the documents produced by the Chemical Laboratories of the University "La Sapienza" in Rome.

ENVIRONMENTAL COMPATIBILITY VALUES *

A.L.T. (Atmospheric Life Time) not relevant
O.D.P. (Ozone Depletion Potential) 0
G.W.P. (Global Warming Potential) 0

*data obtained from the documents produced by the Chemical Laboratories of the University "La Sapienza" in Rome

TECHNICAL CHARACTERISTICS

Electrical activation 1,5 - 24 Vcc max 2A
Surveillance current max. 5 mA
Activation time immediate
Usage temperature from ï 30°C to +150°C
Humidity up to 98% U.R.
Extinguishing Class A, B
Granulometry from 0,5 to 4 microns
Electrical conductivity none up to 20 KV
Corrosiveness none
Thermal shock none
Electrostatic discharge none
Condensation phenomenon none
Residues after discharge not relevant

CRITIRIA OF DESIGN

TOTAL FLOODING SYSTEM

The conditions and the criteria needed to design an aerosol total flooding system are essentially the same as the ones needed for gas fire-prevention systems.

Of course unless the hydraulic distributing elements and the components related to the pressure required by the pipe network, which are not needed with the aerosol total flooding system.
Since the extinguishing agent can be compared to a **gaseous body**, and since it reacts mainly through chemical effect, we can define the followings as:

- **Extinguishing Factor**
  The minimal quantity of the extinguishing aerosol compound, expressed in grams per cubic meter, needed for putting out a fire under pre-determined testing conditions, excluding all safety factors.
  FPG- Firecom Automotive Extinguishing factor in total flooding system, tested by a qualified and authorized engineer according to ISO 15779:2012 is fixed at:
  
  **For Aerosol Generator AR Series is 67 g/m³**
  **For Aerosol Generator AS Serie is 50 g/m³**

- **Design Factor**
  The quantity of the extinguishing aerosol compound, expressed in grams per cubic meter that takes into consideration the safety factor, **including** all the characteristics of the environment. **The safety factor** may have a minimum value of 30% and maximum of 100% in relation to the geometrical characteristics and to the degree of ventilation of the sites that need to be protected.
  
  **Firecom Automotive Design Factor will be:**
  
  AR serie generators = 67 gr/m3.x1.3 (safety factor) = 87.1 g./m³
  AS serie generators = 50 gr/m3.x1.3 (safety factor) = 65.0 g./m³

- **Maximum concentration**
  The quantity of the extinguishing aerosol compound applied to a specific project. Usually, it coincides with the Design concentration, although it can be greater in particular cases.

  In volumes over false ceiling and under false floor, it is suggested to use smaller aerosol generators in order to insure a better distribution of the aerosol.
  **These values are applicable with a limit of 7 meters in height.** For premises that have heights over 7 meters and up to a maximum of 12 meters, it should be considered the installation of the system at two different height levels.
The applicable mathematical formula that should be used is:

\[ m = \rho \times V \]

- \( m \) = the total flooding quantity, in g
- \( \rho \) = is design application density, in g/m³
- \( V \) = is protected volume, in m³

**CALCULATION AND DISTRIBUTION OF THE GENERATORS**

In order to determine the appropriate number of fire-extinguishing generators to be distributed in the environment, the following formula is used:

\[ n = \frac{m}{m_{g}} \]

- \( n \) = number of fire-extinguishers generators
- \( m \) = is the design application density, in grams
- \( m_{g} \) = is the effective mass of aerosol in one generator, in gram

Where if “\( n \)” does not match a whole number, it’s rounded up in excess.

**SAFETY RULES**

- During the installation procedures the aerosol generator must be always handled with care, since they contain flammable substances.
- Avoid crash and keep far from heating source or free flames.
- Do not smoke.
- If a fire starts during the installation procedures and/or in case of accidental activation, evacuate the premises, close the doors behind you and avoid taking any personal initiatives to fight the fire.
- Immediately alert the Fire Department or the surveillance personnel where available. If the immediate evacuation would not be possible and in case the aerosol fire-extinguisher has been activated, the inhalation of the extinguishing substance is easily neutralized by filtering it through the use of clothes, anti-dust masks, strips of gauze, etc.
- The product doesn’t contain toxic or dangerous substances for the human body and the exposure to the aerosol particles will cause a light irritation of the mucous tissues.
INTERDICTIONS
- It is prohibited to weld or to perform any other activity where the use of a free flame is involved at a distance of at least 2 meter from the aerosol generator device.
- Do not smoke.
- It is prohibited to make holes, to disassemble the generator or to do any sort of mechanical action on the metal surface of the device itself.

MARKING, PACKAGING, TRANSPORTATION AND STORAGE
- Serial number or lot number, the date of production and the quantity of the extinguishing agent, are reproduced on the label of each generator
- Package must original from the supplier.
- Generators packed in their original package may be shipped with no restrictions. For further details on transport contact the supplier.
- Aerosol generators may be stocked up and stored in their original packaging in closed places where the temperature is maintained between +20 °C and -60°C; and the humidity level is maximum 80%, and in the absence of aggressive or extremely aggressive atmospheric factors.
- Aerosol generators, continues to be efficient even after having been exposed to vibrations with acceleration of 0.5 g and with a frequency range that goes from 0.5 to 35 Hz.
- The aerosol generators have a 5 year warranty (valid under prescribed condition and limitation of use).
- From February 2009, generators are produced with replaceable activation. When five years warranty expires, it will be possible to replace the activation and extend for other three years the warranty. ATTENTION: only a “Firecom Automotive Aerosol Specialist” trained by Firecom Automotive is authorized to replace the activator.
INSTALLATION WARNINGS

The following prescription must be observed when installing Aerosol Generators System:

- The aerosol generators should be positioned as uniformly as possible throughout the surface of the premises, in order to guarantee the distribution of the aerosol in the environment as evenly and uniformly as possible.
- The minimum distance between the axes of two generators should not be less than 0.4 m.
- The position and installation of generators must guarantee a free flow of the aerosol jet (recommended minimum distance from outlet holes and objects approx cm 80)
- The connection between each aerosol generator must be in series.
- The position of the generators must exclude the possibility that aerosol flow could directly reach people.
- To allow an easy check and maintenance, generators shell be installed in easily accessible position.
- Generators installed in a single room must be activated in the same moment.
- Where the room has a forced ventilation/conditioning system, ventilation shell be shut off before discharge of the aerosol generators.
- Where aerosol is installed in occupied facilities, the system shell have a manual activation. Only detection will be automatic on. Two push button will be installed for each compartment protected: one for activation and one for inhibition.
- During the discharge it may be possible that some hot burning residues may flow from the generator: it is recommended not to place materials that could be damaged (furniture, chairs, electrical instruments, etc.) directly under the generator.
- In case of accidental activation aerosol particulate may darken the paper exposed without causing further damages.
- In case of ill-timed mechanical aspiration of aerosol, it's possible have some organic deposit up the surfaces.
- Damaged connection cables to be replaced by the manufacturer, service agent or similar qualified person to avoid hazard

Some organic oil waste can be have onto plane surface (especially if there are surface made with resin) if you didn’t quickly ventilated the room.
**MAINTENANCE**

As every fire fighting systems, aerosol system must be verified and maintained every six months.

Six month inspection must include sight control of:

- regularity and continuity of electric lines on sight
- correct fixing of lines junction hoses
- correct fixing of generators

The technician has to have personal protection device:

- junction box’s cables gland
- enter generators’s cables gland

During the second six month inspection in addition to the described above:

- generators must be disconnected to the line and an impedance measurement must be run on each generator:
  - value of the measurement must not be infinite or less than 0.6 Ohm.
- For those generators produced from February 2009 when it is found a wrong measurement it will have to be replaced the activator to get the system fully functioning.

**DISPOSAL OF THE GENERATORS**

a) Discharged generators: follow the local rules for products containing hazardous substances

b) Not discharged generators: contact your local distributor and/or the manufacturer to accord for possible barter and/or disposal

**WARNING**

DO NOT TAMPER WITH THE GENERATORS