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</tbody>
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FOREWORD

This manual is written for those who are installing a FirePro® condensed aerosol fire extinguishing systems for total flooding applications.

FirePro® assumes no responsibility for the application of any system other than those addressed in this manual.

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

Any question concerning the information presented in this manual should be addressed to:

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Cyprus Registered Company, Certificate of Incorporation no. HE 137692
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Cyprus

P.O.Box 54080 Limassol-3720, CYPRUS
Phone:+357 25 379999, Fax: +357 25 354432
E-mail: mail@firepro.info
1. Administration

1.1. Scope.

This manual is a comprehensive guide that contains all the necessary information to design, install, operate and maintain the FirePro® condensed aerosol fire extinguishing systems for total flooding applications.

However the manual does not address information related to fire detection.

1.2. Purpose.

This manual is prepared for the use by a competent fire engineers as a basic knowledge of FirePro® systems and guidance of those charged with purchasing, designing, installing, operating, and maintaining FirePro® condensed aerosol fire extinguishing systems, so that FirePro® system will function as intended throughout its life.

The provisions of this manual are considered necessary to provide a sufficient level of protection from loss of life and property from fire. The manual reflects the state of the art at the time the manual was issued.

1.3. Trade Marks and Patent

FirePro® condensed aerosol fire extinguishing systems for total flooding applications is a registered trade mark of:

Celanova Limited, Cyprus Registered Company, Certificate of Incorporation no. HE 142136

FirePro® condensed aerosol fire extinguishing systems for total flooding applications is a proprietary patent of:

Celanova Limited,
Cyprus Registered Company, Certificate of Incorporation no. HE 142136
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Cyprus

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E-mail: mail@firepro.info

1.4. Units and Formulas.

Metric units of measurement in this manual are in accordance with the modernized metric system known as the International System of Units (SI). See IEEE/ASTM SI 10, Standard for Use of the International System of Units (SI): The Modern Metric System.

The values in this manual are given in SI, if followed by an equivalent value in other units, the first stated in SI is to be considered as the requirement, the equivalent value in other units could be approximate.
1.5. **REferenced Publications**

Referenced Publications as per NFPA 2010 shall apply to this manual.

**See Appendix “E”**

1.6. **Definitions**

Definitions as per NFPA 2010 shall apply to this manual.

**See Appendix “F”**
2. ENVIRONMENTAL SUMMARY

2.1. **SIGNIFICANT NEW ALTERNATIVES POLICY (SNAP LIST)**

Submission to the U.S. Environmental Protection Agency’s (EPA) SNAP Program. The SNAP Program was originally outlined in 59 FR 13044.

![United States Environmental Protection Agency Logo]

**Significant New Alternative Policy**

**SNAP List Listed**

Protection of Stratospheric Ozone: Listing of Substitutes for Ozone-Depleting Substances--Fire Suppression and Explosion Protection

**Direct Final Rule – Acceptable Substitute:**

**Powdered Aerosol E (FirePro)**
The official EPA document, issued by the Federal Register, is available at Vol. 71, No. 187/ Wednesday, September 27, 2006/ Rules and Regulations.


C. Powdered Aerosol E (FirePro) – Acceptable subject to use conditions.
2.2. **FirePro® Condensed Aerosol Environmental Parameters**

The attention for the human health protection linked to the environmental protection developed in 1987 the Montreal Protocol and the Kyoto Conference on 1997 sees [http://www.unep.org/ozone](http://www.unep.org/ozone)

<table>
<thead>
<tr>
<th>Environmental parameters</th>
<th>FirePro®</th>
</tr>
</thead>
<tbody>
<tr>
<td>ODP (Ozone Depletion Potential)</td>
<td>Zero</td>
</tr>
<tr>
<td>GWP (Global Warming Potential)</td>
<td>Zero</td>
</tr>
<tr>
<td>ALT (Atmospheric Life Time)</td>
<td>Negligible</td>
</tr>
<tr>
<td>Toxicity for human life</td>
<td>Very low within the parameters for use</td>
</tr>
<tr>
<td>Electrical conductivity</td>
<td>Nil up to 75KV</td>
</tr>
<tr>
<td>Corrosion</td>
<td>Negligible within the parameters for use</td>
</tr>
<tr>
<td>Extinguishing efficacy</td>
<td>High</td>
</tr>
<tr>
<td>Oxygen depletion after agent discharge</td>
<td>Negligible within the parameters for use</td>
</tr>
</tbody>
</table>
3. SAFETY SUMMARY

3.1. GENERAL.

For Material Safety Data Sheet refers to Appendix A

The discharge of a FirePro® aerosol extinguishing systems could potentially create a hazard to personnel due to the nature of the aerosol.

Unnecessary exposure of personnel to either the FirePro® agent or to the by-products generated by the fire or the fire to be extinguished or extinguished should be avoided.

3.1.1. Health Effects.

The FirePro® potential adverse health effects are minimal as:

Hazard for humans related to the SBK (solid aerosol forming compound) has not been found.

Hazard to humans related to the aerosol released by the reaction of the solid compound (SBK) have not been established because the TLV’s are not applicable, however it is reputed that hazard to humans are not present when the FirePro® aerosol is applied as guided by this manual.

Signs and symptoms related to the aerosol phase are only referred to acute exposure and/or chronic overexposures. In a real life the exposure to the generated aerosol will occur accidentally only and will be very short, like in the event of an accidental or unexpected discharge when occupant of the protected space has not evacuated previously. The FirePro® aerosol extinguishing system shall be installed in normally unoccupied spaces and/or in spaces where personnel may be present utilizing suitable safeguards.

3.2. HAZARDS TO PERSONNEL.

3.2.1. Potential Hazards.

Potential hazards to be considered for individual FirePro® systems in the protected space and other areas where the aerosol agent can migrate are the following:

1. Noise:
The discharge of a FirePro® system or aerosol generator may cause noise loud enough to be startling but insufficient to cause traumatic injury.

2. Turbulence:
The high-velocity discharge from FirePro® generators’ outlets may dislodge light objects directly involved or impinged by the generated aerosol stream. The FirePro® system discharge may cause turbulence inside the protected enclosures to move unsecured paper and light objects.

3. Reduced Visibility
When activated, the FirePro® condensed aerosol generators reduce visibility both during and after discharge period.

4. Thermal hazard:
The FirePro® condensed aerosol discharges at elevated temperatures. Depending on the intended application(s) of the FirePro® aerosol system, the temperature and minimum clearance from the discharge outlet are specified by the FirePro® generators’ data sheets (see APPENDIX “C”). Immediately after discharge, the FirePro® aerosol generators can be hot; protective gloves should be worn by personnel handling generators after discharge.
5. **Eye irritation:**
Direct contact with the aerosol solid particles being discharged by the FirePro® system can result in irritation of the eyes. Exposure of the FirePro® condensed aerosol to the eyes should be avoided.

3.2.2. **Pre-discharge Alarms and Time Delays.**

A human exposure to the FirePro® condensed aerosol agents shall be prevented by providing a warning of a pending discharge and a delay in the discharge to allow personnel to exit the protected space. Suitable egress shall be provided to assure a safe egress of personnel, in case of failure of the pre-discharge alarm and the time delay.

3.2.2.1. **Egress.**

Suitable egress shall be provided to allow the personnel to exit the protected space within the time delay.

The effect of reduced visibility on egress time shall be considered.

3.2.3. **Reduced Visibility.**

The discharged FirePro® condensed aerosol will cause occupants to evacuate the protected space under conditions of low visibility, appropriate safety measures shall be used such that occupants can evacuate safely. The safety measures shall include, but not limited to:

- personnel training,
- goggles,
- audio devices,
- floor mounted directional lighting,
- evacuation plans and exit drills.

3.2.4. **Toxicity.**

See the Material Safety Data Sheet contained in Appendix A and chapters 3.1 and 3.1.1 of this manual.

3.2.5. **Thermal Hazards**

FirePro® condensed aerosol generators shall not be employed at less than the minimum safe distance from personnel and combustible materials as specified in chapter 5.1.2 and inside the FirePro® Condensed Aerosol Generators data sheets contained in appendix “C” of this manual.

Protective gloves shall be worn by personnel removing discharged FirePro® condensed aerosol generators.
4. **FirePro® Condensed Aerosol Fire Extinguishing Action**

4.1. **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 the extinguishing mechanism works by removing the active chemical species involved in the flame chain reaction.

Upon activation, the SBK (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 (K₂CO₃), H₂O, N₂, CO₂ 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 (CO₂) and water (H₂O).

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), which is a very stable compound.

At this stage the chain reaction of the free radicals is halted and the flame is extinguished.

The reactions’ sequence is shown in the following page.
FirePro® Condensed aerosol fire extinguishing reaction sequence

Oxidation of hydrogen in the flames:
\[ H_2 + O_2 \rightarrow 2 \text{OH} \]
\[ \text{OH}^+ + H_2 \rightarrow \text{H}_2\text{O} + \text{H}^+ \]
\[ \text{H}^+ + O_2 \rightarrow \text{OH}^+ + \text{H}^+ \]
\[ \text{O}^- + H_2 \rightarrow \text{OH}^- + \text{H}^+ \]

Oxidation of carbon monoxide in the flame:
\[ H_2 + O_2 \rightarrow 2 \text{OH} \]
\[ \text{OH}^- + \text{CO}^{++} \rightarrow \text{CO}_2 + \text{H}^+ \]
\[ \text{H}^+ + O_2 \rightarrow \text{OH}^- + \text{O}^- \]

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:
\[ \text{OH}^- + \text{K}^+ \rightarrow \text{KOH} \] (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\(_2\)CO\(_3\).

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:

<table>
<thead>
<tr>
<th>(H_2)</th>
<th>hydrogen stable</th>
</tr>
</thead>
<tbody>
<tr>
<td>(O_2)</td>
<td>oxygen stable</td>
</tr>
<tr>
<td>(\text{OH}^-)</td>
<td>hydroxyl radicals unstable</td>
</tr>
<tr>
<td>(\text{H}_2\text{O})</td>
<td>water stable</td>
</tr>
<tr>
<td>(\text{H}^+)</td>
<td>hydrogen atoms unstable</td>
</tr>
<tr>
<td>(\text{O}^-)</td>
<td>Oxygen atoms unstable</td>
</tr>
<tr>
<td>(\text{CO}^{++})</td>
<td>carbon monoxide unstable</td>
</tr>
<tr>
<td>(\text{CO}_2)</td>
<td>carbon dioxide stable</td>
</tr>
</tbody>
</table>
4.2. **Particles Distribution in the FirePro® Aerosol Phase**

The *FirePro®* condensed aerosol phase consists of a gas phase with micro sized solid particles in suspension.

Laser beam diffraction tests analyses have shown the correlation between solid and gaseous components of 52% solid and 48% gas.

The percentage distribution of the solid compounds as per their diameter’s size expressed in microns is as follows:

<table>
<thead>
<tr>
<th>Particle’s size (dia. μm)</th>
<th>Percent %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1</td>
<td>52</td>
</tr>
<tr>
<td>1 + 2</td>
<td>19</td>
</tr>
<tr>
<td>2 + 5</td>
<td>17</td>
</tr>
<tr>
<td>&gt; 5</td>
<td>12</td>
</tr>
</tbody>
</table>
5. **FirePro® Condensed Aerosol Fire Use and Limitations**

5.1. **Use and Limitations.**

5.1.1. Systems.

The FirePro® condensed aerosol systems shall be installed to protect hazards within the limitations that have been established by the present manual.

5.1.2. Use and application

FirePro® condensed aerosol extinguishing systems are effective in extinguishing Class A, B, and C fires.

FirePro® condensed aerosol extinguishing systems provide an efficient and effective means to extinguish gas and liquid fires and burning solid substances, substances derived from hydrocarbons (natural gas, oil products, inflammable lubricants, etc.), as well as fires in electrical equipment with an operating voltage not exceeding 75,000 Volts.

FirePro® condensed aerosol extinguishing systems shall not be used to protect areas or hazards or spaces containing flammable liquids vapors or dusts that may form an explosive air/fuel mixture unless they have been tested to the satisfaction of the authority having jurisdiction and/or proven by experimental test carried out by a third party laboratory.

FirePro® condensed aerosol extinguishing systems shall not be used on metal fires and substances generating self sustaining combustion and on the following substances unless they have been tested to the satisfaction of the authority having jurisdiction and/or proven by experimental test carried out by a third party laboratory:

- Deep seated fires in Class A materials
- Class D fires:
  - D1 - light metals (aluminum - Al; magnesium - Mg; Titanium ...)
  - D2 - alkali metals (potassium - K; natrium - Na; lithium - Li ...);
  - D3 - organic-metallic compounds (methyl magnesium chloride - CH3MgCl; methyl magnesium iodide - CH3MgI; triethyl aluminium - (C2H5)3Al...)
- Metal hydrides (aluminium hydride - AlH3; lithium hydride - LiH ...).
- Reactive metals such as, lithium, sodium, potassium, magnesium, titanium, zirconium, uranium, and plutonium.
- Chemicals or mixtures of chemicals capable of rapid oxidation in the absence of air, such as cellulose nitrate, gunpowder, etc.
- Chemical compounds containing oxidizers such as sodium chlorate or sodium nitrate.
- Certain chemicals or mixtures of chemicals, such as cellulose nitrate and gunpowder, that are capable of rapid oxidation in the absence of air.
- Chemicals capable of undergoing auto-thermal decomposition, such as certain organic peroxides and hydrazine.

The above list may be not exhaustive, contact the FirePro® and or the local FirePro® dealer.
The *FirePro*® condensed aerosol generators shall not be employed at less than the minimum safe distances specified in the present manual (see the Aerosol generators Data Sheets in Annex “C”).

The minimum safe distance between the *FirePro*® condensed aerosol generators discharge ports and personnel shall be based on an aerosol agent discharge temperature, at that distance, not exceeding 75°C (167°F).

The minimum safe distance between the *FirePro*® condensed aerosol generators discharge ports and combustible materials shall be based on an aerosol agent discharge temperature, at that distance, not exceeding 200°C (392°F).

The total flooding *FirePro*® condensed aerosol extinguishing systems shall be installed in enclosures protecting the hazards that allows the specific agent design application density to be achieved and maintained for the specified period of time.

Where the *FirePro*® condensed aerosol extinguishing agents are used in spaces containing sensitive equipment the potential adverse effects of *FirePro*® condensed aerosol particulate residue shall be considered.

### 5.2. **Environmental Factors**

Despite that *FirePro*® condensed aerosol extinguishing systems do not represent any significant environmental concern the unnecessary emission of aerosol extinguishing systems shall be avoided.

All phases of design, installation, testing, and maintenance of *FirePro*® condensed aerosol extinguishing systems shall be performed with the goal of no emission to the environment.

### 5.3. **Compatibility with Other Agents.**

Unless specifically approved, systems employing the simultaneous discharge of different agents to protect the same enclosed space shall not be permitted.

Where unrelated extinguishing or suppression systems are provided, and can operate prior to, or during the hold time of the *FirePro*® condensed aerosol extinguishing systems, the other agent shall not adversely affect the aerosol.
6. FirePro® Condensed Aerosol Generators Description

6.1.1. General description of the FirePro® aerosol generators units

The range of FirePro® condensed aerosol generators is shown in the appendix “B”

The FirePro® condensed aerosol generator is formed by the following main components:

6.1.1.1. The solid aerosol-forming compound SBK;

The solid aerosol-forming compound SBK is the originator of the condensed extinguishing aerosol (generated by the SBK activation):

Upon actuation the solid aerosol-forming compound SBK will undergo a combustion reaction generating the fire extinguishing condensed aerosol.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Chemical Formula</th>
<th>CAS #</th>
<th>% by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>CO₂</td>
<td>124-38-9</td>
<td>13%-14%</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>N₂</td>
<td>7727-37-9</td>
<td>21%-22%</td>
</tr>
<tr>
<td>Water Vapor</td>
<td>H₂O</td>
<td>7732-18-5</td>
<td>10%-12%</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>CO</td>
<td></td>
<td>1%-2%</td>
</tr>
<tr>
<td>Methane</td>
<td>CH₄</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrogen</td>
<td>H₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particulate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium Carbonate</td>
<td>K₂CO₃</td>
<td>584-08-7</td>
<td>47%-49%</td>
</tr>
<tr>
<td>Potassium Nitrate</td>
<td>KNO3</td>
<td>7757-79-1</td>
<td>2%-3%</td>
</tr>
<tr>
<td>Potassium Chloride</td>
<td>KCl</td>
<td>7447-40-7</td>
<td>&gt; 1%</td>
</tr>
<tr>
<td>Other elements</td>
<td>See KEMA report</td>
<td>---</td>
<td>&gt; 1 %</td>
</tr>
</tbody>
</table>

6.1.1.2. The ignition device (initiator);

FirePro® condensed aerosol generators are initiated by applying the appropriate voltage across the electric wires terminals of the aerosol generator, so that the solid aerosol forming compounds SBK will be activated and transformed into the condensed aerosol (the extinguishing agent).
6.1.1.3. The cooling mechanism;

*FirePro®* condensed aerosol generators are equipped with a physical heat-absorbing mechanism (the cooling mechanism) the generated aerosol will exit the generator via the cooling mechanism, the condensed aerosol will be cooled down before flooding the protected volume.

6.1.1.4. The housing (external steel casing);

The *FirePro®* condensed aerosol generator casing is formed by a non-pressurized container. The aerosol is generated by a reaction (combustion process) of the solid aerosol-forming compound SBK, and the condensed aerosol is carried by gases generated by the reaction.

6.1.1.5. The mounting brackets;

Mounting brackets are provided for each *FirePro®* condensed aerosol generator, allowing the generator appropriate orientation. The mounting brackets are constructed by galvanized carbon steel plate of suitable shape and strength to hold the *FirePro®* condensed aerosol generators.

6.1.1.6. The end plate discharge outlets;

A specially designed outlet with holes, which ensure a smooth and fast discharge of aerosol phase

6.1.1.7. The sealing

A special membrane of adhesive polymer sheet is applied internally the discharge outlets protecting them from the entering of moisture, dirty or anything undesirable. The membrane will be broken by the generated aerosol upon the *FirePro®* condensed aerosol generator actuation.
6.1.2. *FirePro*® Initiator (electrical activator)

The initiator is connected to the activation power circuit (minimum current required 0.8 A for 3-4 seconds) by heat resistant wires. The activation power will heat up the electric coil (4) thus the (5) solid aerosol forming compound (SBK) will initiate an exothermal reaction. The heat developed will transfer through the cylinder (7) outlets starting the exothermal reaction of the (9) SBK thus the thermal energy will be sufficient to start the reaction of the whole mass of SBK contained inside the aerosol generator, transforming the SBK into a particulate aerosol and carrier gases.

---

**Initiator cut-off view**

**Legend**

1. heat resistant wires (feed)
2. steel housing
3. polymeric resin
4. electric coil
5. SBK (solid bound compound)
6. chemical stabilizer
7. cylinder with 2 outlets
8. sealing
9. SBK (solid bound compound)
10. leaguered surface

**Electrical values**

- Bridge resistance: 1.6 - 3.0 Ohms ($\Omega$)
- Ignition pulse: From 1 - 2 mWs/$\Omega$
- No fire value: $\leq$ 20 mA $t = 300s$
- Direct current (DCV): 6 - 36 V / 0.8 A
- Ignition time: 3 a 4 sec.

**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.
7. FirePro® TOTAL FLOODING SYSTEMS DESIGN

7.1. INTRODUCTION

7.1.1. Working documents

The design of a FirePro® condensed aerosol total flooding fire extinguishing systems shall be prepared only by a person qualified and experienced in designing extinguishing systems, in accordance with the advice of the authority having jurisdiction.

Deviation from the working documents shall require the permission and the agreements of the authority having jurisdiction.

The working documents shall include, as minimum requirement, the following:

7.1.1.1. Specifications.

- Designation of the authority having jurisdiction,
- Variances from the standard to be permitted by the authority having jurisdiction,
- Design criteria,
- System sequence of operations,
- Functional testing to be performed after installation of the system,
- System’s owner/user training requirements.

7.1.1.2. Working plans:

- Point of compass and symbol legend.
- Name of owner and identification of the occupant/user;
- Location of building, including street and address;
- Location and construction characteristics of protected enclosure walls and partitions; location of fire walls.
- Enclosure cross-section, full height or schematic diagram, including raised access floor and suspended ceiling;
- Description of occupancies and hazards to be protected; identification of enclosures normally occupied
- Description of enclosures/facilities/exposures surrounding the enclosure.
- Plan view of protected area showing enclosure partitions (full and partial height); detection, alarm, and control system including all devices and schematic of wiring interconnection; end-of-line device locations; location of controlled devices such as dampers and shutters; location of instructional signage.
- Type of FirePro® condensed aerosol generators used; including nominal capacity expressed as agent solid compound mass.
- FirePro® condensed aerosol design application density.
- Drawings indicating the location and distribution of FirePro® condensed aerosol generators.
- Equipment list of materials showing device identification, model or part number, quantity and description;
Description of fire detection, actuation and control systems

Enclosure pressurization report and venting calculations where applicable;

Description of wire or cable used including classification, gauge [American Wire Gauge (AWG)], shielding, number of strands in conductor, conductor material, and color coding schedule, with the segregation requirements of various system conductors clearly indicated and the required method of making wire terminations detailed.

Description of the detector mounting.

Scale drawing showing the layout of the annunciator panel graphics if required by the authority having jurisdiction.

Complete step-by-step description of the system sequence of operations including functioning of abort and maintenance disconnect switches, delay timers, and emergency power shutdown.

Point-to-point wiring schematic diagrams showing all circuit connections to the system control panel, to the graphic annunciator panel and to external or add-on relays.

Complete calculations to determine the size of backup batteries and method used to determine number and location of audible and visual indicating devices and number and location of detectors.

Minimum clearances to combustible materials and the means of egress.

Details of any special features.

Information shall be submitted for approval to the authority having jurisdiction pertaining to the location and function of:

- Detection devices,
- Operating devices,
- Auxiliary equipment,
- Electrical circuitry, if used.

All the apparatus and devices used shall be identified.

Any special features shall be explained.

The as-built installation drawings and the instruction and maintenance manual that includes a full sequence of operations.

A full set of drawings and calculations shall be maintained on site.

### 7.1.1.3. Approval of Plans.

Plans and calculations shall be approved prior to installation.

Where field conditions necessitate any change from approved plans, the change shall be approved prior to implementation.

When such changes from approved plans are made, the working plans shall be updated to accurately represent the system as installed.

### 7.1.2. Enclosure.

In the design of a FirePro® condensed aerosol total flooding fire extinguishing system, the integrity of the protected enclosure shall be considered.

The area of non closable openings in the protected enclosure shall be kept to a minimum.
7.1.2.1. Loss of Agent.

To prevent loss of agent through openings to adjacent hazards or work areas, openings shall be permanently sealed or equipped with automatic closures.

Where reasonable confinement of agent is not practicable, protection shall be expanded to include the adjacent connected hazards or work areas or additional agent shall be introduced into the protected enclosure using an extended discharge configuration.

Forced-air ventilating systems shall be shut down or closed automatically where their continued operation would adversely affect the performance of the fire extinguishing system or result in propagation of the fire.

Completely self-contained recirculation ventilation systems shall not be required to be shut down.

The volume of the ventilation system and associated ductwork shall be considered as part of the total hazard volume when determining the quantity of agent.

The protected enclosure shall have the structural strength and integrity necessary to contain the agent discharge.

If the developed pressures present a threat to the structural strength of the enclosure, venting shall be provided to prevent excessive pressures.

7.1.3. Condensed Aerosol System Agent Supply.

7.1.3.1. Quantity.

- **Primary FirePro® condensed aerosol Agent Supply.**
  The primary FirePro® condensed aerosol agent supply shall be determined by calculating the required mass of the solid aerosol forming compound needed to meet the design application density.

- **Reserve FirePro® condensed aerosol Agent Supply.**
  Where required, a reserve FirePro® condensed aerosol agent supply shall consist of as many multiples of the primary agent supply as the authority having jurisdiction considers necessary.
7.1.4. Design Application Density.

7.1.4.1. Determining Design Application Density.

The FirePro® condensed aerosol extinguishing application density shall be used in determining the agent design application density for a particular fuel.

For combinations of fuels, the extinguishment value for the fuel requiring the greatest FirePro® condensed aerosol design application density shall be used, unless specifics tests are made on the actual mixture.

7.1.4.2. Extinguishment.

- **Class B Fuels:**
  The extinguishing application density of FirePro® condensed aerosol for Class B fuels has been determined by test as per UL 2775.
  The minimum design application density for a Class B fuel hazard is the extinguishing application density multiplied by a safety factor of 1.3.

- **Class A Fuels:**
  The extinguishing application density of FirePro® condensed aerosol for Class A fuels has been determined by test as per UL 2775.
  The minimum design application density for a Class A Fuels fire hazard is the extinguishing application density multiplied by a safety factor of 1.3.

- **Class C Fuel:**
  The minimum design application density of FirePro® condensed aerosol for Class C hazards shall be at least that for the Class of fire hazard being protected.""

- **Fuel combination:**
  For combinations of Class A and B fuels the design application density shall be the value for the fuel requiring the greatest design application density.

<table>
<thead>
<tr>
<th>Table 7.1.4.2</th>
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<tbody>
<tr>
<td>Class of Fire</td>
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<td>Class B Fuels:</td>
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<td>Class A Fuels:</td>
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<tr>
<td>Class C Fuel:</td>
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<tr>
<td>Fuel combination:</td>
</tr>
</tbody>
</table>
7.1.5. Total Flooding Quantity.

7.1.5.1. Quantity calculation.

The mass of FirePro® condensed aerosol forming compound required shall be calculated from the following formula:

\[ m = d_a \times f_a \times V \]

where

- \( m \) = total flooding quantity, in [g(lb)]
- \( d_a \) = design application density, in [g/m\(^3\) (lb/ft\(^3\))]  
- \( f_a \) = additional design factors (see 7.1.5.2)  
- \( V \) = protected volume, [m\(^3\) (ft\(^3\))]

7.1.5.2. Additional Design Factors.

In addition to the FirePro® condensed aerosol agent quantity determined by the design application density, additional quantities of agent are required through the use of additional design factors to compensate for any special conditions that would affect the extinguishing efficiency.

The designer shall assign and document other design factors for each of the following:

1. Non-closable openings and their effects on design application density
2. Height of protected volume (As per maximum height related to each generator)
3. Re-ignition from heated surfaces
4. Fuel type, configurations, scenarios not fully accounted for in the extinguishing application density, enclosure geometry, and obstructions and their effects on distribution.

7.1.6. Duration of Protection

The FirePro® condensed aerosol agent design application density shall be maintained for the specified period of time to prevent reignition of the fire before effective emergency action can be taken by trained personnel.

7.1.7. Discharge time

For the FirePro® condensed aerosol generators discharge time see the Data Sheets in appendix “C”
7.1.8. Extended Discharge.

When an extended discharge is necessary to maintain the design application density for the specified period of time, additional FirePro® condensed aerosol agent quantities shall be applied.

When an extended discharge is necessary, the rate shall be sufficient to maintain the desired factor for the required hold time. In such applications the condensed aerosol generators may be activated in sequence.

7.1.9. Safety vents

When FirePro® condensed aerosol is discharged into a closed volume, a certain overpressure may be developed due to the amount of gases generated and the effects of increased temperature of the atmosphere.

Later, the combined volume of aerosol and air will become greater than the initial room volume; the final result will increase the pressure or will exhaust the excess volume through vent openings. The air temperature is increased during the discharge but will return to normal levels as heat is adsorbed from solids surfaces in the room.

The designer/installer shall provide reliable calculations for venting requirements for each system if applicable, since experience has shown that most ordinary rooms have a sufficient leakage thought cracks around doors and windows and general porosity to prevent noticeable pressure built up.

In rooms that may be sealed or close to be sealed a safe vent area for low-strength structures can be estimated on the basis of the discharge flow rate.

7.1.10. Generator Choice and Location.

The FirePro® condensed aerosol generators shall be suitable for the intended purpose and shall be placed within the protected enclosure in compliance with the instruction and limitations contained on this manual with regard to spacing, floor coverage, thermal clearances and alignment.

The type of FirePro® condensed aerosol generators selected, their number, and their placement shall be such that the design application density will be established in all parts of the hazard enclosure.

The *FirePro*® condensed aerosol generators and ancillaries’ system components shall be arranged to allow easy inspection and maintenance activities, minimizing the interruption of protection.

*FirePro*® condensed aerosol generators shall not be located where they can be mechanically damaged or exposed to chemicals or to adverse weather conditions, that may render them inoperative. Suitable protective provisions shall be adopted, if necessary.

*FirePro*® condensed aerosol generators shall be securely installed following the guidance given by this manual.

8.1.1.2. Minimum safe distances:

Minimum safe distances:

- *FirePro*® condensed aerosol generators shall not be installed at less than the minimum safe distances as specified in the *FirePro*® condensed aerosol generators data sheet contained in appendix “C”.

- The minimum safe distance between the *FirePro*® condensed aerosol generators generator casing and personnel shall be the distance from the generator casing to where the temperature does not exceed 75°C (167°F) during and after discharge.

- The minimum safe distance between the *FirePro*® condensed aerosol generators casing and combustible materials shall be the distance from the generator casing to where the temperature does not exceed 200°C (392°F) during and after discharge.

8.1.2. Safety Requirements.

Personnel shall not enter a protected space during or after the *FirePro*® agent discharge.

Safeguards shall be provided to ensure prompt evacuation of and prevent entry or re-entry into the protected enclosure post *FirePro*® system discharge.

Shall be provided means for prompt rescue of any trapped personnel, including the following:

1. Provision of adequate aisle ways/routes of exit, and procedures to keep them clear at all times
2. Provision of emergency lighting and directional signs if necessary to ensure quick, safe evacuation.
3. Provision of alarms in such areas that will operate immediately on detection of the fire.
4. Provision of only outward-swinging, self-closing doors at exits from hazardous areas and, where such doors are latched provision of panic hardware.
5. Provision of continuous alarms at entrances to such areas until the atmosphere has been restored to normal.
6. Provision of warning and instruction signs at entrances to and inside such areas. These signs should inform persons in or entering the protected area that a *FirePro*® aerosol
The FirePro® CONDENSED AEROSOL FIRE EXTINGUISHING SYSTEM USER MANUAL

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system is installed and shall contain additional instructions pertinent to the conditions of the hazard.

7. Provision for the prompt discovery and rescue of persons rendered unconscious in such areas. This should be accomplished by having such areas searched immediately by trained personnel equipped with proper breathing equipment. Self-contained breathing equipment and personnel trained in its use and in rescue practices, including cardiopulmonary resuscitation, should be readily available.

8. Provision of instruction and drills for all personnel in or in the vicinity of such areas, including maintenance or construction people, to ensure their correct action when a FirePro® condensed aerosol system operates.

9. Provision of means for prompt ventilation of such areas, including forced ventilation if necessary. Atmospheres containing FirePro® condensed aerosol shall be readily dissipate taking care do not move them to another location.

10. Prohibition of smoking until the atmosphere has been determined to be free from the FirePro® condensed aerosol.

11. Removal of FirePro® condensed aerosol generators after discharge shall be done according the instruction given by this manual. Protective clothing, gloves and goggles should be worn, including a respirator or mask if necessary.

12. Any further provision or safeguards shall be adopted if a particular situation indicates as necessary to prevent injury or death.

13. Specific attention shall be given to the possibility of the FirePro® condensed aerosol may potentially migrating to adjacent areas, outside of the protected space.

8.2. ELECTRICAL CLEARANCES.

All FirePro® system components shall be located to maintain no less than a minimum clearances from energized electrical parts as per:

1. ANSI C2
2. NFPA 70
3. 29 CFR 1910, Subpart S
4. Canadian Electrical Code, CSA C22.1

Where the design basic insulation level (BIL) is not available, and where nominal voltage is used for the design criteria, the highest minimum clearance listed for this group shall be used.

The selected clearance to ground shall satisfy the greater of the switching surge or BIL duty, rather than being based on nominal voltage.

The clearance between non insulated, energized parts of the electrical system equipment and any portion of the FirePro® condensed aerosol extinguishing system shall not be less than the minimum clearance provided elsewhere for electrical system insulations on any individual component.
8.3. **PRECAUTIONS HANDLING THE FIREPRO® GENERATORS UNITS**

Handling the FirePro® aerosol generators do not:

- ▶ Disassemble the FirePro® condensed aerosol generators;
- ▶ Exert force of impact or carry out other actions to the FirePro® condensed aerosol generators which may cause distortion and physical or other mechanical damage to the casing.
- ▶ Carry out any welding work in the vicinity of the FirePro® condensed aerosol generators and/or FirePro® condensed aerosol fire extinguishing system components.
- ▶ Smoke in the vicinity of the FirePro® condensed aerosol generators and/or FirePro® condensed aerosol fire extinguishing system components.
- ▶ Where a FirePro® condensed aerosol generator, during handling or installation, is dropped or subjected to an impact shall ensure that the electric circuit of the ignition and the other FirePro® condensed aerosol generator components have not been damaged.
- ▶ Where a FirePro® condensed aerosol generator shows external damages to the casing it shall not be installed.

8.4. **STORAGE AND TRANSPORT**

The FirePro® condensed aerosol generators are classified as Hazard Class or Division as 9.

The FirePro® units shall be transported by ships and by airfreight in accordance with the regulations and requirements applicable to the above category of cargo.

Transport by road of the FirePro® condensed aerosol generators is permitted utilizing all types of transport vehicles without any restrictions.

The containers carrying the FirePro® condensed aerosol generators shall be firmly secured on the vehicle and be protected against dirt, moisture and shocks.

Do not drop FirePro® Aerosol Generators or the containers carrying them during vehicles loading/unloading operations.

The FirePro® Aerosol Generators shall be stored in their own packaging on racks in warehouses (either heated, or unheated with natural ventilation, at a distance of at least one meter from heating appliances).

The FirePro® condensed aerosol generators comply with the requirements of the U.S. Department of Transportation (DOT) or the Canadian Transport Commission and are classified IAW 49 CFR 172.101, Subpart B or the Canadian equivalent.

8.5. **STORAGE CONDITIONS:**

- ▶ Temperature : between −54 and +54°C
- ▶ Humidity : maximum 98% RH

8.6. **REPLACEMENT / REMOVAL FROM SERVICE**

Service life: 10 years (years of manufacture appears on each generator)
This manual does not address information related to fire detection; however the following general information shall be considered.


Detection, actuation, alarm, and control systems shall be installed, tested, and maintained in accordance with NFPA 70 and NFPA_72

In Canada the equipment shall be certified to the requirements of CAN/ULC S524-01 and CAN/ULC-S 529-02.

Automatic detection and automatic actuation shall be used unless a manual-only actuation is approved by the authority having jurisdiction.

9.1.2. Raceways.

FirePro® system initiating circuits and auxiliary equipments releasing circuits shall be installed in raceways.

Unless shielded and grounded, alternating current (ac) and direct current (dc) wiring shall not be combined in a common conduit or raceway.

9.1.3. Automatic Detection.

Automatic detection shall be a UL listed system capable of detecting and indicating heat, flame, smoke, combustible vapors, or an abnormal condition in the hazard, such as process trouble, that is likely to produce fire.

Automatic detection shall be UL listed and compatible with the control panel.

Reliable primary and 24-hour minimum standby sources of energy shall be used to provide for operation of the detection, signaling, control, and actuation requirements of the system.

9.1.4. Operating Devices.

Operating devices shall include FirePro® system actuation devices, discharge controls, and shutdown equipment.

All operating devices shall be UL listed and compatible with the control panel.

The FirePro® system actuation shall cause simultaneous operation of FirePro® condensed aerosol generators.

All devices/component shall be designed suitable for the specific intended service and working conditions; all devices shall not be susceptible to being rendered inoperative or to accidental operation.

All devices/component shall be installed in appropriate locations or adequately protected, to
avoid being subject to mechanical, chemical, or any damages that would render them inoperative.

FirePro® system manual actuation/release shall be accomplished by an electrical manual release; the arrangement shall include the control equipment monitoring the battery condition, including a low battery signal/alarm.

FirePro® system manual control(s) for actuation shall be located for easy accessibility at all times, including at the time of a fire:

The FirePro® system manual control(s) shall be of distinct appearance and clearly recognizable for the purpose intended.

Operation of any control station shall cause the complete FirePro® system to operate.

Manual controls shall not require a pull of more than 178 N (40 lb) nor a movement of more than 356 mm (14 in.) to secure operation.

At least one FirePro® system manual control station for activation shall be located not more than 1.2 m (4 ft) above the floor.

All devices for shutting down auxiliary/supplementary equipment shall be considered integral parts of the FirePro® system and shall function with the FirePro® system operation.

All the manual operating devices shall be identified as to the hazard they protect.

9.1.5. Control Equipment.

Electric Control Equipment.

The control equipment shall supervise the actuating devices and associated wiring and, as required, cause the FirePro® system actuation.

The control equipment shall be a UL listed Fire Alarm Control Panel that is compatible with the extinguishing system units.

Refer to the Control Panel Manual for compatibility information.

9.1.6. Operating Alarms and Indicators.

Alarms or indicators or both shall be used to indicate the operation of the FirePro® system, hazards to personnel, or failure of any supervised device.

All alarms or indicators devices shall be UL listed and compatible with the control panel.

The type (audible, visual), number, and location of the devices shall be such that their purpose is satisfactorily accomplished.

The extent and type of alarms or indicator equipment or both shall be approved.

Warning Devices:

Audible and visual pre-discharge alarms shall be provided within the protected area to give positive warning of the FirePro® system impending discharge.
The operation of the warning devices shall continue after FirePro® condensed aerosol discharge, until positive action has been taken to acknowledge the alarm and proceed with appropriate action.

9.1.7. Abort Switches.

Where provided, the FirePro® system abort switches shall be located within the protected area and shall be located near the means of egress for the area.

All abort switches shall be UL listed and compatible with the control panel.

A telephone should be located near the abort switch.

An abort switch shall not be operated unless the cause for the condition is known and corrective action can be taken.

The abort switch shall be of a type that requires constant manual pressure to cause abort.

The abort switch shall not be of a type that would allow the system to be left in an aborted mode without personnel present. In all cases the manual emergency control shall override the abort function.

Operation of the abort function shall result in both audible and distinct visual indication of system impairment.

The abort switch shall be clearly recognizable.

9.1.8. Alarms indicating failure of supervised devices / equipment

Alarms indicating failure of supervised devices or equipment shall give prompt and positive indication of any failure and shall be distinctive from alarms indicating operation or hazardous conditions.

9.1.9. Warning and instruction signs

Warning and instruction signs at entrances to and inside protected areas shall be provided.


For the FirePro® aerosol extinguishing systems, a pre-discharge alarm and time delay, sufficient to allow personnel evacuation prior to discharge, shall be provided.

For hazard areas subject to fast growth fires, where the provision of a time delay would seriously increase the threat to life and property, a time delay shall be permitted to be eliminated.

Time delays shall be used only for personnel evacuation or to prepare the hazard area for discharge.

Time delays shall not be used as a means of confirming operation of a detection device before automatic actuation occurs.
9.1.11. Unwanted System Operation.

Care shall be taken to thoroughly evaluate and correct any factors that could result in unwanted discharges of the FirePro® system.

To avoid unwanted discharge of a FirePro® aerosol system during maintenance or when anyone enters the protected enclosure, a supervised disconnect switch shall be provided.

The disconnect switch shall interrupt the releasing circuit to the FirePro® condensed aerosol system.

The disconnect switch shall be UL listed and compatible with the control panel.
10. FirePro® TOTAL FLOODING SYSTEMS INSTALLATION

ILLUSTRATION 10a:
RECOMMENDED FirePro® condensed aerosol arrangement

Ceiling

ILLUSTRATION 10b:
RECOMMENDED FirePro® condensed aerosol arrangement

Top of side walls
The location of FirePro® generators shown above is incorrect. The generators aerosol outlets are pointing the aerosol stream in the direction of the opening (a door).

If the door will left open at the time of the FirePro® generators activation the generated aerosol will escape from the protected volume. Thus depleting the aerosol design factor that may result in failure to extinguish the fire.

The location of FirePro® generators shown above is correct.
## 10.1. GENERAL

Do not install FirePro® condensed aerosol generators close to openings.

The recommended optimal distance between the floor of the safeguarded volume and the FirePro® condensed aerosol generators are reported inside the FirePro® condensed aerosol generators data sheets, see appendix “C”.

The discharge outlets of the FirePro® condensed aerosol generators shall not be obstructed.

Minimum safe distances:

- FirePro® condensed aerosol generators shall not be installed at less than the minimum safe distances as specified in the FirePro® condensed aerosol generators data sheet contained in appendix “C”.
- The minimum safe distance between the FirePro® condensed aerosol generators generator casing and personnel shall be the distance from the generator casing to where the temperature does not exceed 75°C (167°F) during and after discharge.
- The minimum safe distance between the FirePro® condensed aerosol generators casing and combustible materials shall be the distance from the generator casing to where the temperature does not exceed 200°C (392°F) during and after discharge.

The FirePro® condensed aerosol generators shall be positioned in the protected space/volume so that the aerosol flow does not obstruct/impede the evacuation of personnel.

## 10.2. FIREPRO® CONDENSED AEROSOL GENERATORS INSTALLATION PROCEDURE

The FirePro® condensed aerosol generators are installed utilizing the brackets provided inside the package.

Attention:

Before proceeding ensure that the FirePro® condensed aerosol generator is firmly secured.

Installation procedure:

A. Fix firmly the brackets to the enclosure walls or ceiling, according the system design and the generators location.
B. Check the resistance of the electric activation element.
C. Connect the wires to the terminals of the FirePro® condensed aerosol generator.
D. Connect the wires to the fire detection / fire system control panel.
E. Connect the wires to the power supply.

On completion ensure that the FirePro® condensed aerosol generators have been installed in the correct manner, i.e. that all requirements contained in this manual have been accomplished, and note the installation on the installation certificate or on the technical documentation of the protected premises.

Warning:

Before the FirePro® condensed aerosol system installation read carefully this manual and the
manuals and technical instructions for installation and management of the fire detection system and the fire control panel.

10.3. **FirePro® condensed aerosol generator height limitations**

The height limitation for each specific FirePro® condensed aerosol generator are reported by the FirePro® condensed aerosol generator data sheets, see appendix “C”.

The “Stream Length” value of each generator should be considered as the maximum height at which it should be installed above the floor or object to protect, whenever the aerosol stream from the generator’s outlet is vertical (at 90 degrees). Whenever a different angle is applied, then the height should be reduced accordingly.

In multiple FirePro® condensed aerosol generator installations, they shall be distributed throughout the protected enclosure in accordance with the height limitation (coverage) of each FirePro® condensed aerosol generator.
11. FirePro® Condensed Aerosol Generators Installation

11.1. **FirePro® Condensed Aerosol Generator Initiation (Activation)**

The FirePro® condensed aerosol generators are initiated (activated) by means of an electric impulse of:

- 6 - 36 Volts direct-current (DC).

The required current shall be delivered through the connector to the initiator of the FirePro® condensed aerosol generator (see Illustration 11.1a).

The FirePro® condensed aerosol generators are equipped with the Initiator described in Chapter 6.1.2.

These FirePro® condensed aerosol units require a minimum of 0.8 A activation current each. The power may be delivered by a 6-36V battery pack. Care shall be taken in observing the maximum current required.
11.1.1. Automatic activation mode by means of a Fire Detection System (heat, smoke or gas detectors).

Automatically by means of heat, smoke or gas detectors, which are connected to a Fire Detection and Control Panel, for the sequence of activation see Illustration 11.1.1.

ILLUSTRATION 11.1.1a:

LEGEND

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Abort Button (Isolation Switch)</td>
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<td>2</td>
<td>Extinguishing Control Pane</td>
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<td>3</td>
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<td>6</td>
<td>FirePro® condensed aerosol generators</td>
</tr>
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<td>7</td>
<td>Electrical cable connection to FirePro initiator</td>
</tr>
</tbody>
</table>

Control panel back-up batteries at 65% capacity: The 65% value represents the worst case voltage scenario based on the expected battery charge and transmission loss after 48 hours on battery power. This is considered as the overall limitation regardless of battery capacity. Max. 4 Aerosol Generators can be used in series connection.
Layout of a FirePro® condensed aerosol system, in addressable system configuration

**ILLUSTRATION 11.1.1b:**

**ILLUSTRATION 11.1.1c:**
12. **FirePro® TOTAL FLOODING SYSTEMS COMMISSIONING**

12.1. **GENERAL.**

The completed FirePro® condensed aerosol system shall be reviewed and verified by qualified personnel to meet the approval of the authority having jurisdiction.

All the FirePro® condensed aerosol system components and auxiliary devices used shall be UL/ULC listed type only.

12.2. **INSTALLATION ACCEPTANCE.**

12.2.1. **General.**

First it shall be determined that the protected enclosure is in conformance with the construction documents.

12.2.1.1. **Basic checks.**

The FirePro® condensed aerosol generators shall be securely fastened to prevent unacceptable vertical or lateral movement during discharge.

The FirePro® condensed aerosol shall be oriented in such a manner that optimum agent dispersal can be effected.

The FirePro® condensed aerosol generators stream shall not directly impinge on areas where personnel could be found in the work area.

The FirePro® condensed aerosol stream shall not directly impinge on any loose objects or shelves, cabinet tops, or similar surfaces where loose objects could be present and become missiles.

Adequate number/quantity of FirePro® condensed aerosol generators to produce the desired specified design application density shall be provided.

The actual room volumes shall be checked against those indicated on the system drawings to ensure the proper quantity of FirePro® condensed aerosol agent.

Fan coast down (inertia) and damper closure time shall be taken into consideration.

12.2.2. **Review Enclosure Integrity.**

All FirePro® condensed aerosol total flooding systems shall have the enclosure examined and tested to locate and then effectively seal any air leaks that could result in a failure of the enclosure to hold the specified FirePro® condensed aerosol design application density for the specified holding period.

12.2.3. **Review Electrical Components.**

12.2.3.1. **Wiring.**

All wiring systems shall be installed in compliance with local codes and the system drawings.

Alternating current (ac) and direct current (dc) wiring shall not be combined in a common conduit or raceway unless shielded and grounded.
12.2.3.2. Field circuits

All field circuits shall be free of ground faults and short circuits.

Where field circuitry is being measured, all electronic components, such as smoke and flame detectors or special electronic equipment for other detectors or their mounting bases, shall be removed and jumpers shall be installed to prevent the possibility of damage within these devices. Components shall be replaced after measuring.

12.2.3.3. Power Supply

Power shall be supplied to the control unit from a separate dedicated source that will not be shut down on system operation.

Reliable primary and 24-hour minimum standby sources of energy shall be used to provide for operation of the detection, signaling, control, and actuation requirements of the system.

12.2.3.4. Auxiliary Functions.

All auxiliary functions such as alarm-sounding or alarm-displaying devices, remote annunciator, air-handling shutdown, and power shutdown shall be checked for operation in accordance with system requirements and design specifications.

If possible, all air-handling and power-cutoff controls shall be of the type that, once interrupted, requires manual restart to restore power.

Silencing of alarms, if desirable, shall not affect other auxiliary functions such as air handling or power cutoff if required in the design specification.

The detection devices shall be checked for proper type and location as specified on the system drawings.

Location:

- Detectors shall not be located near obstructions or air ventilation and cooling equipment that would appreciably affect their response characteristics.
- Where applicable, air changes for the protected area shall be taken into consideration.

The detectors shall be installed in a professional manner and in accordance with technical data regarding their installation.

Manual pull stations shall be installed, readily accessible, accurately identified, and protected to prevent damage.

All manual stations used to release agents shall require two separate and distinct actions for operation.

- All manual station used to release FirePro® condensed aerosol system shall be identified.
- Particular care shall be taken where manual release devices for more than one FirePro® condensed aerosol system are in close proximity and could be confused or the wrong system actuated.
- Manual stations in this instance shall be clearly identified as to which zone or suppression area they affect.

For systems using abort switches, the switches shall be of the dead man type requiring constant manual pressure, installed, readily accessible within the hazard area, and clearly identified.

- Switches that remain in the abort position when released shall not be used for this purpose.
- Manual pull stations shall always override abort switches.

The control unit shall be installed and readily accessible.
12.2.4. Functional Testing.

12.2.4.1. Preliminary Functional Tests.

The following preliminary functional tests shall be provided:

1. If the system is connected to an alarm receiving office, notify the alarm receiving office that the fire system test is to be conducted and that an emergency response by the fire department or alarm station personnel is not desired.

2. Notify all concerned personnel at the end-user’s facility that a test is to be conducted and instruct personnel as to the sequence of operation.

3. Disable the FirePro® condensed aerosol system actuation mechanism so that activation of the release circuit will not actuate the FirePro® condensed aerosol generators.

4. Reconnect the system actuation mechanism/ circuit with a functional device in lieu of the FirePro® condensed aerosol generators.

5. Check each detector for response.

6. Check that polarity has been observed on all polarized alarm devices and auxiliary relays.

7. Check that all end-of-line resistors have been installed across the detection and alarm bell circuits where required.

8. Check all supervised circuits for trouble response.

12.2.4.2. System Functional Operational Test.

The following system functional operational tests shall be performed:

1. Operate detection initiating circuit(s).

2. Verify that all alarm functions and time delay occur according to design specification.

3. Operate the necessary circuit to initiate a second alarm circuit if present.

4. Verify that all second alarm functions occur according to design specifications.

5. Operate manual release.

6. Verify that manual release functions occur according to design specifications.

7. Operate abort switch circuit if supplied.

8. Verify that abort functions occur according to design specifications.

9. Confirm that visual and audible supervisory signals are received at the control panel.

12.2.4.3. Remote Monitoring Operations.

The following testing of remote monitoring operations, if applicable, shall be performed:

1. Operate one of each type of input device while on standby power.

2. Verify that an alarm signal is received at remote panel after device is operated.

3. Reconnect primary power supply.

4. Operate each type of alarm condition on each signal circuit and verify receipt of trouble condition at the remote station.
12.2.4.4. Control Panel Primary Power Source.

The following testing of the control panel primary power source shall be performed:

1. Verify that the control panel is connected to a dedicated circuit and labeled

2. Test a primary power failure in accordance with the manufacturer's specification with the system fully operated on standby power.

The control panel shall be readily accessible, yet restricted from unauthorized personnel.

12.2.4.5. Return of FirePro® condensed aerosol System to Operational Condition.

When all pre discharge work is completed, the FirePro® condensed aerosol generators shall be reconnected so that activation of the release circuit will actuate the FirePro® condensed aerosol generators, releasing the FirePro® condensed aerosol agent.

The FirePro® condensed aerosol system shall be returned to its fully operational design condition.

The alarm-receiving office and all concerned personnel at the end-user's facility shall be notified that the FirePro® condensed aerosol fire system test is complete and that the system has been returned to full service condition.
13. **FirePro® TOTAL FLOODING SYSTEMS DESIGN INSPECTION, AND MAINTENANCE**

13.1. **INSPECTION.**

At least every 30 days, an inspection shall be conducted to assess the FirePro® condensed aerosol fire system operational condition.


At least every 12 months, the enclosure protected by the FirePro® condensed aerosol fire system shall be thoroughly inspected to determine if penetrations or other changes have occurred that could adversely affect agent leakage or change volume of hazard or both.

- Where the inspection indicates conditions that could result in inability to maintain the FirePro® condensed aerosol design application density, they shall be corrected.
- If uncertainty still exists, the enclosures shall be retested for integrity.

13.2. **MAINTENANCE.**

- At least annually, all FirePro® condensed aerosol systems shall be subjected to the manufacturer's test and maintenance procedures by competent personnel.

A periodic inspection of the aerosol fire extinguishers and fire extinguishing systems to check the following components:

- Electric wiring
- Terminals of the electrical ignition
- Electric contacts (clamped fit?)
- Fixing bolts (tightly fitted?)
- The maintenance report with recommendations shall be filed with the owner.
- Replace generators after 10 years

13.2.1. Penetrations:

- Any penetrations made through the enclosure protected by the FirePro® condensed aerosol fire system shall be sealed immediately.
- The method of sealing shall restore the original fire resistance rating of the enclosure.

13.2.2. FirePro® condensed aerosol generators inspection

Inspections to FirePro® condensed aerosol generators shall be executed by a competent personnel only and the results recorded on both of the following:

1. A record tag permanently attached to each FirePro® condensed aerosol generator.
2. An inspection report

A completed copy of the inspection report shall be delivered to the owner of the system or to the Authority Having Jurisdiction; the records shall be retained by the owner/user for the life of the FirePro® condensed aerosol system.

Where external visual inspection indicates that the FirePro® condensed aerosol generator casing or the generator has been damaged, additional the unit shall be replaced.
13.3. **TRAINING.**

All persons who could be expected to inspect, test, maintain, or operate the FirePro<sup>®</sup> condensed aerosol fire extinguishing systems shall be thoroughly trained and kept thoroughly trained in the functions they are expected to perform.

Personnel working in an enclosure protected by a FirePro<sup>®</sup> condensed aerosol fire system shall receive training regarding agent safety issues.

13.4. **SAFETY.**

Safe procedures shall be observed during installation, servicing, maintenance, testing, managing the FirePro<sup>®</sup> condensed aerosol fire system.
14. FirePro® TOTAL FLOODING SYSTEMS POST DISCHARGE INTERVENTION

14.1. Residues Removal

The solid aerosol forming compound SBK when activated is transformed into a rapidly expanding aerosol, formed by solid particles suspended in a gas phase. The size of such particles is of a few microns, see Chapter 4.2.

The FirePro® condensed aerosol composition is of Potassium compounds, it is non-corrosive, non electrical conductive, it does not cause any damage to any sensitive protected equipment and do not react on electronic components, metals, etc.

The FirePro® solid aerosol forming compound SBK do not contain any Halogen compounds that may react with the flame, thus the FirePro® condensed aerosol does not produce corrosive halogen-acid by products in its reaction with the flames.

The FirePro® condensed aerosol solid particles suspended into the aerosol phase are in concentration of few milligrams per cubic meter. These particles are in an anhydrous phase and settle at the bottom of the protected enclosure after a period of time as a fine dust, it can be easily removed by cleaning, before absorbing humidity.

The FirePro® condensed aerosol by-products after the extinguishing action consists mainly of KOH in very low concentration (transformed rapidly in K2CO3) in an anhydrous phase, as the FirePro® condensed aerosol particles.

14.1.1. Guidelines to clean the residue of FirePro® condensed aerosol.

- Clean the residues shortly after discharge (within maximum few hours)
- Wipe off dry residues on floor and metal surfaces using wet cloth or brush
- Dust away the residues on electrical components using a fan/blower
- Use special sprays suitable to clean the residues settled on electronic components

If the FirePro® condensed aerosol particles will be removed by cleaning, as suggested, shortly before they can absorb moisture and mix with the combustion residues present in the atmosphere after the fire, they will not react/affect the electronic components, metal etc.

If the FirePro® condensed aerosol particles (dust) will remain for a longer period, they can absorb moisture, the moisture will react with metals (especially uncoated) thus that oxidation could occur.
14.1.2. Dismantling FirePro® condensed aerosol generators

When the FirePro® condensed aerosol generators have to be dismantled, the following steps shall be accomplished:

- Disassemble or switch off the drive from the fire detection system and ensure that it cannot be switched on;
- Disconnect the power wires from the FirePro® condensed aerosol generators and ensure that they cannot be connected;
- Ensure that you are standing firmly and comply with the rules for working at height (Working Conditions Act);
- Remove the FirePro® condensed aerosol generators by unscrewing the bolts and nuts fixing them;
- Carefully remove the FirePro® condensed aerosol generators from the brackets and place it on a stable surface;
- After removing the FirePro® condensed aerosol generators, put the fire detection and alarm installation back into operation in accordance with the guidance of the Authority Having Jurisdiction.
- If the FirePro® condensed aerosol generators are still warm (after activation), wear heat-resistant gloves.

14.1.3. Waste and environment

After activation the FirePro® condensed aerosol generators they can be disposed of as normal waste after dismantling.

If the FirePro® condensed aerosol generators removed has not been activated and the solid aerosol forming compound SBK is still inside the generators they shall be returned to the local FirePro® Distributor / Dealer.
15. APPENDIX "A" (MATERIAL SAFETY DATASHEETS)

**FirePro Systems Ltd./ Celanova Ltd.**

Issue date: 01.05.2010

### 1. Identification of the Substance/Company

1.1 Trade name: FirePro®

1.2 Manufacturer/Supplier:
   - FirePro Systems Ltd./Celanova Limited
   - 6, Koumandarias & Spyrou Araouzou Str.,
   - Tonia Court II, 6th Floor
   - Limassol - 3076, Cyprus
   - Phone: 00357-25-379999
   - Fax: 00357-25-354432
   - e-mail: mail@firepro.info
   - website: www.firepro.info

1.3 Telephone number in case of emergency: +357-25-379999

### 2. Composition/Information on Ingredients

2.1 Component | Wt.% | CAS No. | EINECS | Class, R and S phrases
--- | --- | --- | --- | ---
Potassium Nitrate | 77 | 7757-79-1 | 231-818-8 | See section 15
Potassium Carbonate | 4 | 584-08-7 | 209-529-3 | See section 15
Magnesium | <1 | 7439-95-4 | 231-104-6 | See section 15
Epoxy Resin Polymer | 18 | 25068-38-6 | any "polimerize, polycondensate, or polyadduct" is exempted by 81/437/EEG | See section 15

### 3. Hazards Identification

- Hazards for humans related to the SBK solid compound has not been found.
- Hazards for humans related to the aerosol released by the solid compound have not been established because TLV’s are not applicable.
- Signs and symptoms related to the aerosol phase are only referred to acute exposure and/or chronic overexposures, while in real life the exposure will be very short (i.e. in the event of an accidental discharge when people were not evacuated on time).

3.1 For humans

- **Threshold Limit Values**: None established
- **Signs and Symptoms by acute exposure**:
  - Eye Contact: At normal contact no injury
  - Inhalation: Not a likely route of entry
  - Skin Contact: At normal contact no injury
  - Ingestion: At normal contact no injury
  - Chronic Overexposure: At normal contact no injury
  - Medical Conditions Generally Aggravated by Exposure: None known
  - For Environment: None established

### 4. First-Aid Measures

First-Aid measures are referred to acute exposure and/or chronic over exposure

4.1** Inhalation**: Remove from exposure area to fresh air.
- **Eye Contact**: If necessary wash eyes.
- **Skin Contact**: Change clothing and shoes. Wash skin with soap.
- **Ingestion**: Not likely.
### 5. Fire fighting Measures

<table>
<thead>
<tr>
<th>5.1 Extinguishing Media</th>
<th>This is an Extinguishing Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2 Unusual Fire and Explosion Hazards</td>
<td>The material does not present an explosion danger. It can be ignited by means of a fire. Hot aerosol is present in the close up area of the outlets</td>
</tr>
<tr>
<td>5.3 Special Procedures</td>
<td>In places where there is a fire always wear personal protecting equipment and clothing</td>
</tr>
</tbody>
</table>

### 6. Accidental Release Measures

| 6.1 Personal Precautions | Respiratory Protection: at normal contact not needed |
| Hand Protection: at normal contact not needed |
| Eye Protection: at normal contact not needed |
| Skin and Body Protection: at normal contact not needed |
| 6.2 Environmental Precautions | Waste Disposal Methods: See section 13 |
| 6.3 Clean up Precautions | Sweep up |

### 7. Handling and storage

| 7.1 Handling Precautions | Avoid contact with combustible materials. |
| 7.2 Storage Precautions | Should be stored in original container. Keep dry. |
| Storage Class | 9 miscellaneous, solid |

### 8. Exposure Controls and Personal Protection

| 8.1 Exposure | Before entering a room with the material in aerosol phase vent properly to avoid unnecessary exposure. |
| 8.2 Personal protection | Respiratory Protection: at normal contact not needed |
| Hand Protection: at normal contact not needed |
| Eye Protection: at normal contact not needed |
| Skin and Body Protection: at normal contact not needed |

### 9. Physical and Chemical Characteristics

| 9.1 Appearance | Solid |
| Colour | Off white |
| Odour | None |
| Relative Density | Not applicable |
| Solubility in water | Insoluble |
| Ph (if in water, % Conc.) | Not determined |
| Boiling Point | Not applicable |
| Vapour Pressure (mm Hg) | Not applicable |
| Vapour Density | Not applicable |
| Flash Point | Not applicable |
| Flammability Limits in Air (% by volume) | Not applicable |
| Auto Flammability | Not applicable |
| Explosive Properties | Not applicable |
| Oxidizing Properties | Not determined |
10. Stability and Reactivity

10.1 Stability
Conditions to avoid: Stable

10.2 Hazardous Reactions
Conditions to avoid: Will not occur

10.3 Materials to Avoid
: None known

10.4 Hazardous Decompositions Products
: None ascertained

11. Toxicological Information

The TLV’s (Threshold Limit Values) of the chemicals released in the aerosol phase are applicable only in case of long, as long as a complete professional life, exposure. This is not the case of a real life situation.

11.1 Product

The potential damage is not caused by the product mixture composition, but by the fact that it is respirable. The TLV’s apply in case of long exposure, sometimes exposure during a complete professional life, whilst in this case is once only and short (in case of accidental discharge when evacuation does not take place on time).

In case of fire the toxicity is caused by the fire itself and the products involved in the fire.

11.2 Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Toxicity</th>
<th>Target Organs</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium Nitrate</td>
<td>Oral LD₅₀ (rat) 3750 mg/Kg</td>
<td>Blood, central nervous system</td>
<td></td>
</tr>
<tr>
<td>Potassium Carbonate</td>
<td>Oral LD₅₀ (rat) 1870 mg/Kg</td>
<td>Respiratory system</td>
<td></td>
</tr>
<tr>
<td>Magnesium</td>
<td>Oral LD₅₀ (dog) 230 mg/Kg</td>
<td>Central nervous system, liver, kidneys</td>
<td></td>
</tr>
<tr>
<td>Epoxy Resin Polymer</td>
<td>Oral LD₅₀ (rat) 11.4 g/Kg</td>
<td>Skin (guinea pig) 2750 mg/55 days Inert Eye (rabbit) 100 mg Mild</td>
<td></td>
</tr>
</tbody>
</table>

12. Ecological Information

12.1 Mobility
Absorption/Desorption: with present data no problems

12.2 Degradability
Biotic and Abiotic Degradation: with present data no problems
Aerobic and Anaerobic Degradation: with present data no problems
Persistence: with present data no problems

12.3 Accumulation
Bioaccumulation Potential: with present data no problems
Biomagnification: with present data no problems

12.3 Short and Long Term Effects on
Ecotoxicity: with present data no problems
Aquatic Organisms: with present data no problems
Soil Organisms: with present data no problems
Plants and Terrestrial animals: with present data no problems

12.4 Other Adverse Effects
Ozone Depleting Potential (ODP): none
Photochemical Ozone Creation Potential: none
Global Warming Potentials (GWP): none
Effects on Waste Water Treatment Plants: with present data no problems

13. Disposal Considerations

13.1 Dispose of in Compliance with local, state and national regulations.
## Transportation Information

<table>
<thead>
<tr>
<th>Hazard Class or Division</th>
<th>9 miscellaneous, solid</th>
</tr>
</thead>
</table>

For additional transport information contact FirePro Systems Ltd / Celanova Limited

## Regulatory Information

For 15.1 Components:
The EU classification and R&S phrases, referred to the components of the SBK compound are related only to the single components considered as separate chemical entities. Once mixed in the production of the SBK compound, the risk sentences of the single components are not applicable being the SBK compound a separate chemical entity.

### 15.1 Product

<table>
<thead>
<tr>
<th>Product</th>
<th>EU Classification</th>
<th>Oxidizer</th>
<th>R Phrases</th>
<th>S Phrases</th>
<th>S Phrases</th>
<th>R Phrases</th>
<th>S Phrases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium Nitrate</td>
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<td>16</td>
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<td>EU Classification</td>
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<td>S Phrases</td>
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<tr>
<td>Potassium Carbonate</td>
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<td>36/37/38</td>
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<td>37/39</td>
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<tr>
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<td>EU Classification</td>
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<tr>
<td>Magnesium</td>
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<td>EU Classification</td>
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<tr>
<td>Epoxy Resin Polymer</td>
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<td>36/38</td>
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</table>

Limit Values for Exposure:
- None listed

EINECS Status:
- All components are included in EINECS inventories

Restrictions on Marketing and Use:
- None (Refer to any other national measures that may be relevant)

Contact with water liberates highly flammable gases
Spontaneously flammable in air
Keep out of reach of children
In case of fire never use water
Keep container tightly closed and dry

Contact with combustible material may cause fire
Keep away from sources of ignition
– No smoking
In case of fire and/or explosion, do not breathe fumes

Harmful if swallowed
Irritating to eyes, respiratory system and skin
In case of contact with eyes, rinse immediately with plenty of water and seek medical advice
Wear suitable gloves and eye/face protection

Avoid release to the environment.
Refer to special instructions/ Safety Data Sheets
**16. Other Information**

| 16.1 | None Known |

**17. Disclaimer**

| 17.1 | The data in the above material safety data sheet reflect the current state of knowledge of our product and shall be used only as a guideline. No binding statements as to the contractually agreed product characteristics may be inferred there from. |
16. APPENDIX “B” FirePro Aerosol Generators

16.1. GENERATORS OVERVIEW

<table>
<thead>
<tr>
<th>FP-100S</th>
<th>FP-200S</th>
<th>FP-500S</th>
<th>FP-1200</th>
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<thead>
<tr>
<th>FP-2000</th>
<th>FP 3000</th>
<th>FP 5700</th>
</tr>
</thead>
</table>
17. APPENDIX “C”: FirePro® Generators Datasheets
18. APPENDIX “D”: FirePro® Generators Drawings
19. Appendix “E”: Referenced publication
Excerpt from NFPA 2010


They are adopted in this manual as a consistent reference with the code.


The documents or portion thereof listed in this chapter are referenced within this manual and shall be considered part of the guidance of this manual.

19.2. NFPA Publication.

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471
- NFPA 70 National Electrical Code®, 2005 Edition

19.3. ANSI Publication.

American National Standard Institute, Inc., 25 West 43rd Street, 4th Floor; New York, NY10036

19.4. IMO Publication.

International Maritime Organization, 4 Albert Embankments, London, SE1 7SR, United Kingdom.
- IMO MSC/Circ.1270, Guidelines for the Approval of Fixed Aerosol Fire-Extinguishing Systems Equivalent to Fixed Gas Fire-Extinguishing Systems, as Referred to in SOLAS 74, for Machinery Spaces; 2008 Edition

19.5. ISO Publication.

International Organization for Standardization, 1, Rue de Varembe, Case postale 56, CH-1211 Geneve 20, Switzerland.
19.6. **U.S. Government Publications.**


- Title 49, Code of Federal Regulations, Part 172.101, Subpart B.

19.7. **Other Publication.**


19.8. **References for Extracts in Mandatory Sections.**


They are adopted in this manual as a consistent reference with the code.

The definitions contained in this chapter shall apply to the terms used in this manual. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinary accepted meanings within the context in which they are used.

Merriam-Webster’s Collegiate Dictionary, 11th edition, shall be the source for the ordinarily accepted meaning.

20.1. General

20.1.1. Approved.

Acceptable to the authority having jurisdiction.

20.1.2. Authority Having Jurisdiction (AHJ).

An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

20.1.3. Listed.

Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

20.1.4. Shall.

Indicates a mandatory requirement.

20.1.5. Should.

Indicates a recommendation or that which is advised but not required.


A document, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Non-mandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.
20.2. **GENERAL DEFINITIONS.**

20.2.1. Actuating mechanism.

A mechanism whose automatic or manual operation leads to the discharge of extinguishing agent.

20.2.2. Condensed Aerosol.

An extinguishing medium consisting of finely divided solid particles, generally less than 10 microns in diameter, and gaseous matter, generated by a combustion process of a solid aerosol-forming compound.

20.2.3. Agent Quantity.

Mass of solid aerosol-forming compound required to achieve the design application density within the protected volume within the specified discharge time.

20.2.4. Automatic.

That which provides a function without the necessity of human intervention. [101, 2006]

20.2.5. Automatic/manual switch.

Means of converting the system from automatic to manual actuation.

20.2.6. classification for Fires

- **Class A Fire.**
  Fires in ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics. [10, 2002]

- **Class B Fire.**
  Fires in flammable liquids, petroleum greases, tars, oil, oil-based paints, solvents, lacquers, alcohols, and flammable gases. [10, 2002]

- **Class C Fire.**
  Fires that involve energized electrical equipment. [10, 2002]

20.2.7. Clearance.

- **Electrical Clearance.**
  The unobstructed air distance between extinguishing system equipment, including piping and nozzles, and unenclosed or uninsulated live electrical components not at ground potential.

- **Thermal Clearance.**
  The air distance between a condensed aerosol generator and any structure or components sensitive to the temperature developed by the generator.

20.2.8. Coolant.

A heat-absorbing medium or process.
20.2.9. **Density.**

Design Application Density (g/m³). Extinguishing application density, including a safety factor, required for system design purposes.

Extinguishing Application Density (g/m³). Minimum mass of a specific aerosol-forming compound per m³ of enclosure volume required to extinguish fire involving particular fuel under defined experimental conditions excluding any safety factor.

Particulate Density. The density of solid particulate in g/m³ after discharge of the aerosol system at the design application density. This information is used to assess the degrees of visibility obscuration and the potential health effects of accidental exposure to the agent.

20.2.10. **Discharge Port.**

A passage such as nozzles or openings on an aerosol generator where aerosol is released when the generator is actuated.

20.2.11. **Disconnect Switch.**

A manually operated switch, electrically supervised and secured from unauthorized use, that prevents the automatic or manual electrical activation of the aerosol generators during maintenance by electrically opening the releasing circuit.

20.2.12. **Generator.**

A device for creating a fire-extinguishing medium by pyrotechnical means.

20.2.13. **Generator Casing.**

The surface of the generator, excluding the surface containing the discharge ports.

20.2.14. **Hold Time.**

Period of time during which an extinguishant is required to maintain an even distribution throughout the protected volume in an amount at least at the extinguishing application density.

20.2.15. **Hot work.**

Work involving burning, welding, or similar operation that is capable of initiating fire or explosion. [51B, 2003]

20.2.16. **Inspection.**

A visual examination of a system or portion thereof to verify that it appears to be in operating condition and free of physical damage. [820, 2003]

20.2.17. **Maintenance.**

Work performed to ensure that equipment operates as directed by the manufacturer.

20.2.18. **Manual.**

Requiring intentional intervention to accomplish a function.

An area or space where, under normal circumstances, persons are present.

20.2.20. Normally Unoccupied.

An area or space not normally occupied by people but that can be entered occasionally for brief periods.

20.2.21. Protected Volume.

Volume enclosed by the building elements around the protected enclosure, minus the volume of any permanent impermeable building elements within the enclosure.

20.2.22. Release.

The physical discharge or emission of aerosol as a consequence of the condensed aerosol generator’s actuation or operation of the dispersed aerosol agent container.

20.2.23. Solid Aerosol-Forming Compound.

A solid mixture of oxidant, combustible component and technical admixtures that produces a condensed aerosol upon actuation.

20.2.24. Total Flooding Extinguishing System.

A system arranged to discharge an extinguishant into an enclosed space to achieve a uniform distribution of that extinguishant, at or above the design application density, throughout the space.

20.2.25. Unoccupiable.

An area or space which cannot be occupied due to dimensional or other physical constraints.
20.3. **SPECIAL DEFINITIONS FOR MARINE SYSTEMS.**

The following definitions shall be applicable to marine aerosol extinguishing systems.

20.3.1. **A-60 Class Division.**

A bulkhead or deck designed to resist the passage of smoke and flame for 1 hour, including limiting the temperature rise on the unexposed side to 180° C (325° F).

20.3.2. **Heat-Sensitive Material.**

A material whose melting point is below 1700°F (926.7°C). [13, 2002]

20.3.3. **Marine System.**

An aerosol system installed on a merchant vessel, ship, barge, boat, pleasure craft, offshore platform or other floating structure.

20.3.4. **Space.**

- **Cargo Space.**
  A space for the carriage or storage of items or products that are transported by the vessel.

- **Machinery Space.**
  A space protected by an aerosol system containing an internal combustion engine or mechanical equipment for handling, pumping, or transferring flammable or combustible liquids as a fuel to internal combustion engine.

20.3.5. **Supervisory Signal.**

A signal indicating the need for action in connection with the supervision of guard tours, the fire suppression systems or the maintenance features of related systems. [72, 2002].

20.3.6. **Vessel.**

- **Inspected vessel.**
  A vessel operated on the navigable waterways of the United States that is subject to the regulations in 46 CFR, which require it to be certificated and inspected as a passenger ship, cargo ship, oceanographic ship or a tank vessel.

- **Uninspected vessel.**
  A vessel operated on the navigable waterways of the United States that is subject to the regulations in 46 CFR Subchapter C, Parts 24 - 28, including pleasure craft, tugboats, towing vessels and certain fishing vessels.