

## INDUSTRIAL FIXED AEROSOL FIRE SUPPRESSION SYSTEM

# ***DESIGN, OPERATION & MAINTENANCE MANUAL***

**April 2014**

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## **Document Revision Control Schedule**

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| 1.1                | March 2006           | Changes in Technical Characteristics | CP              |
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|                    |                      |                                      |                 |
|                    |                      |                                      |                 |

## **FOREWORD**

This Manual is intended for use with Pyrogen Industrial Fire Suppression Systems. The systems are designed as fixed systems for **occupied** (requires approval from local authority having jurisdiction), **unoccupiable** and **normally unoccupied areas**.

Pyrogen systems for total flooding applications shall comply with the requirements of the following Standards:

- |                       |   |
|-----------------------|---|
| - AS/NZS 4487:1997    | Australia/New Zealand Standard<br>Pyrogen Fire Extinguishing Systems; and   |
| - AS/NZS 1851.16:1997 | Australia/New Zealand Standard<br>Maintenance of Fire Protection Equipment<br>Part 16: Pyrogen Fire Extinguishing Aerosol Systems               |
| - NFPA 2010           | Standard on Aerosol Fire-Extinguishing Systems<br>2006 Edition  |
| - CEN/TC 191          | Fixed fire fighting systems – Condensed aerosol<br>extinguishing systems – Part 1: Requirements and test methods for<br>components (WI00191148) |
| - CEN/TC 191          | Fixed fire fighting systems – Condensed aerosol<br>extinguishing systems – Part 2: Design, Installation and Maintenance<br>(WI00191149)         |

For the protection of a specified risk area a specific advice and approval may be required from an appropriate authority having jurisdiction.

Those who design, operate, own and maintain these systems should read the entire Manual. Specific sections would be of particular interest depending on one's responsibility. If there should be any questions regarding this manual, please contact our representatives from a Pyrogen office below or contact the nearest Pyrogen Authorised Representative.

Where required persons who install and commission Pyrogen systems must be approved by the Appropriate Authorities. System Design Approval Certificates must be completed and sent to a Pyrogen office for endorsement prior to supply and installation of a Pyrogen Fire Suppression System.

Approved companies may also be required to supply details to the Approval Authority prior to each installation and provide a Commissioning Certificate upon completion of the installation in the specified risk areas.

The Pyrogen Fire Suppression System requires minimal maintenance, mainly supervision of electrical circuitry, however the system should be inspected at regular intervals to provide maximum assurance that your fire suppression system will operate effectively and safely. Inspection and maintenance should be conducted in accordance with the inspection and maintenance schedule included in this Manual.

This Manual is limited for use with Pyrogen Industrial Fire Suppression Systems and within the requirements and the limitations of use detailed within this Manual.

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**INDUSTRIAL  
FIXED AEROSOL FIRE SUPPRESSION SYSTEM**

**SECTION 1**

***GENERAL***

## SECTION 1. GENERAL

### 1.1 Terminology

The following definitions apply to this document:

Actuating mechanism: automatic or manual activation leading to the physical discharge of the extinguishant.

Aerosol: an extinguishant consisting of finely divided solid particles and gaseous matter, these being combustion products of solid aerosol-forming compound.

Aerosol-forming compound: a mixture of a solid combustible components, a solid potassium salt based oxidant and solid technical admixtures that when combusted produces a fire extinguishing aerosol.

Aerosol generator: same as Pyrogen generator

Aggressive environment: where environmental variables such as temperature and/or vibration undergo cycling at or close to the extreme limits of the Pyrogen generator. Corrosive atmosphere may also be a factor.

Automatic: performing a function without the necessity of human intervention.

Automatic/Manual Switch: a device that can be operated before a person enters a space protected by Pyrogen fire suppression system to prevent automatic release of fire extinguishing aerosol. Normal detection sequence is unaffected.

Class A fires: fire involving solid materials, usually of organic nature. Can be further categorised into surface burning fires and deep-seated fires. Deep-seated fires smoulder and may combust slowly beneath the surface of the hazard.

Class B fires: fires involving liquids or liquefiable solids, fats and cooking oils.

Class C fires: fires involving gases.

Class E fires: electrically energised fuels.

Control device: a device to control the sequence of events leading to the release of the extinguishant.

Cooling element: a heat absorbing material contained inside Pyrogen generator.

Design application density ( $\text{g/m}^3$ ): the mass of Pyrogen solid aerosol-forming compound per  $\text{m}^3$  of enclosure volume required to extinguish a specific type of fire, including a safety factor.

Design quantity: the mass of Pyrogen solid aerosol-forming compound necessary to extinguish a fire in a particular risk, including a safety factor.

Extinguishant: aerosol produced from Pyrogen generator.

Holding time: the period during which the extinguishant is required to maintain a minimum effective concentration.

Hot Work: grinding, welding, thermal or oxygen cutting or heating and other related heat-producing or spark-producing operations.



**Location drawing:** a plan of the risk clearly indicating the as-installed location of all Pyrogen generators, controls and maintenance isolate switch.

**Manual:** requiring human intervention to accomplish a function.

**Monitoring:** the supervision of the operating integrity of an electrical control feature of a system.

**Normally occupied area:** an area where, under normal circumstances, humans are present.

**Normally unoccupied area:** an area that is not occupied by humans under normal circumstances but may be entered occasionally for brief periods.

**Unoccupiable area:** an area that is not occupied by humans under any circumstances.

**Operating device:** any component involved between actuation and release.

**Pyrogen generator:** a device capable of generating the Pyrogen aerosol extinguishant when activated either electrically or thermally. Consists of an electrical and/or thermal activation device, solid aerosol-forming compound and cooling element enclosed within a corrosion-resistant casing incorporating an end-plate nozzle.

**Release:** the action leading to the physical discharge or emission of the extinguishant into the enclosure.

**Smouldering:** slow combustion of material without visible light and generally evidenced by smoke and an increase in temperature.

**System isolate switch:** see Automatic/Manual switch.

**Thermal activation device:** a linear fuse or any other device, which automatically activates at a rated temperature or when exposed to a naked flame and arranged to activate the solid aerosol forming element.

**Total flooding system:** a fixed fire suppression system, which distributes the extinguishing medium throughout the protected enclosure.

## **1.2 Pyrogen Product Standards/Testing**

Standards/Testing on Pyrogen includes the following bodies:

| Organisation                    | Description   | Date           |
|---------------------------------|---|----------------|
| Australian/New Zealand Standard | AS/NZS 4487:1997 Standard for Pyrogen Fire Suppression Systems<br>AS/NZS 1851.16:1997 Maintenance of Fire Protection Equipment; Part 16:PyroGen Fire Extinguishing Aerosol Systems                          | 1997           |
| US EPA                          | Listed under SNAP program for total flooding applications in normally unoccupied areas.   | 21 July 1995   |
| CEN/TC 191                      | Fixed fire fighting systems – Condensed aerosol extinguishing systems –<br>Part 1: Requirements and test methods for components (WI 00191148)<br>Part 2: Design, Installation and Maintenance (WI 00191149) | August 2004    |
| NFPA 2010                       | Standard on Aerosol Fire-Extinguishing Systems 2006 Edition   | 18 August 2005 |

### 1.3 What is Pyrogen?

Pyrogen is a self-generated Aerosol Fire Extinguishing Agent, and is **one of the most efficient Halon Alternative products currently available.**

The principle of extinguishing action employed by Pyrogen is unique - a special solid chemical, Pyrogen aerosol-forming compound, when electrically or thermally activated, undergoes a combustion reaction to produce micron sized dry chemical particles and gases. Dry chemical particles - mainly potassium carbonates, and gases - mainly carbon dioxide, nitrogen and water vapour, mix together into a uniform aerosol, which represents an actual extinguishing medium.

Before being released into a protected area, the aerosol propels itself through Pyrogen cooling element, which absorbs heat, thus ensuring a low temperature discharge and uniform distribution of the aerosol within the area.

As aerosol is self-generated it requires **No pressure cylinders** and does not need to be stored. The aerosol generating chemical reaction provides a sufficient driving force for a rapid discharge and efficient distribution of the aerosol. **No piping is required.**

The solid aerosol-forming compound, together with the solid cooling element and activation devices is contained in a small non-pressurised canister with one or two end-plate delivery nozzles. The canisters are called EXA generators and vary in size depending on the mass of solid aerosol-forming compound contained in the generator.

EXA canisters are very compact and normally placed inside the protected enclosure.

Operation of the generator is either electrical automatic, electrical manual or thermal automatic.

The electric activation device functions upon receipt of an electrical signal, while the thermal activation device functions upon a direct contact with flame or when temperature reaches a rated value, to ignite a special booster charge, which in turn, ignites the aerosol-forming compound to produce Pyrogen aerosol. The aerosol propels itself through the cooling element and out of the delivery nozzle into the protected area.

Pyrogen aerosol is whitish gas-like medium that is close in density to air. **Small particle size ensures three-dimensional distribution qualities and long suspension times.**

**Pyrogen aerosol is non-conductive and non-corrosive.**

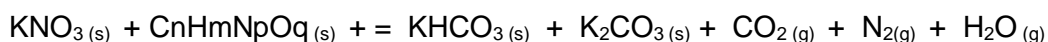
As Pyrogen aerosol stays in suspension for extended periods, it can be removed from the protected area by any airflow. Solid fraction of the aerosol that has settled can easily be brushed, blown or washed away.

### 1.4 Pyrogen Chemical Identity

The secret to Pyrogen's power is in a unique formulation contained inside each Pyrogen canister - the solid aerosol-forming compound.

The solid aerosol-forming compound is a mixture consisting of an oxidiser, a combustible binder and technological additives. The oxidiser is a solid potassium nitrate ( $\text{KNO}_{3(s)}$ ), the combustible binder is an organic polymer ( $\text{C}_n\text{H}_m\text{N}_p\text{O}_q(s)$ ) and technological additives include an activator of the oxidiser's decomposition, chemical and mechanical stabilisers and some other ingredients.

When activated the solid aerosol forming compound undergoes a combustion reaction, which can schematically be represented as follows:



Combustion products consist of potassium carbonates ( $\text{KHCO}_3$ ,  $\text{K}_2\text{CO}_3$ ), carbon dioxide gas ( $\text{CO}_2(\text{g})$ ), nitrogen gas ( $\text{N}_2(\text{g})$ ) and water vapour ( $\text{H}_2\text{O}(\text{g})$ ) and represent the actual extinguishing agent.

As the reaction temperatures are high, potassium carbonates are formed in the gas phase, but as the vapour cools, the potassium carbonates condense to a liquid and then a solid. As solid potassium carbonates are produced by condensation, ***the particle size is very small - approximately from 1 to 10 microns***. Micron sized solid particles mix with the gaseous carbon dioxide, nitrogen and water into a uniform homogeneous gas-like medium - an aerosol.

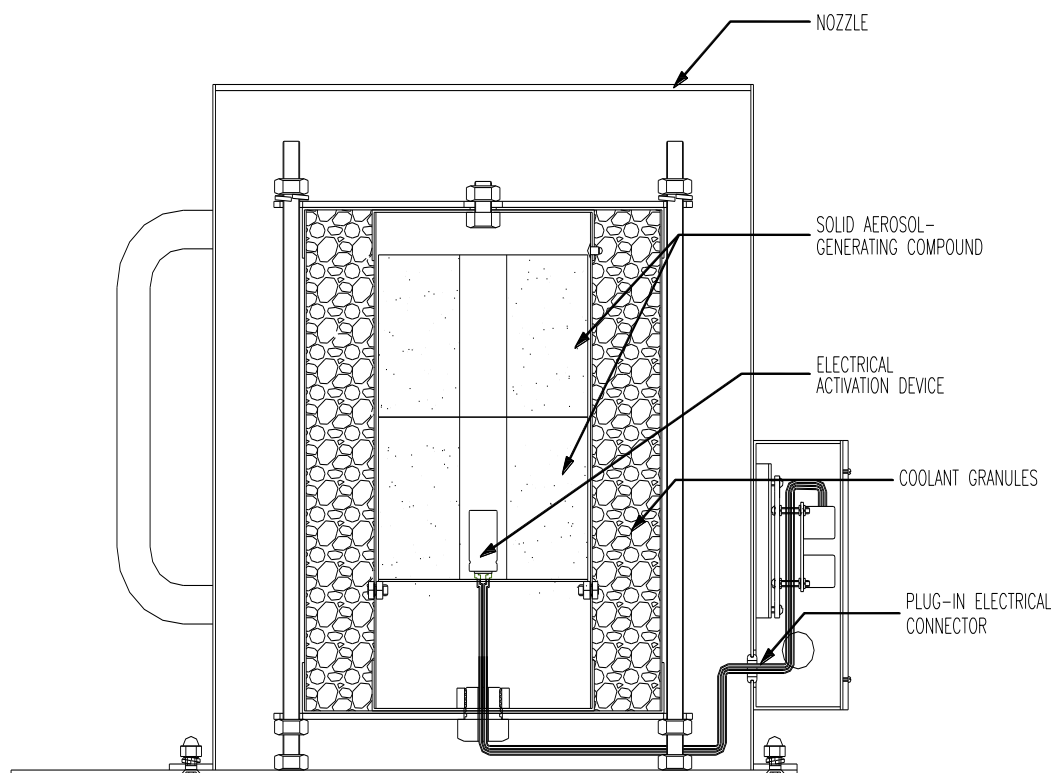
Thus, ***Pyrogen extinguishing aerosol is a suspension of the micron sized solid particles, mainly potassium carbonates, in the gas mix of carbon dioxide, nitrogen and water vapour.***

Being a combustion product of the aerosol-generating compound, Pyrogen aerosol is hot upon formation. Although, Pyrogen aerosol is the most effective in terms of the actual fire extinguishment when in its hottest state, the negative impacts of very high temperatures are obvious.

That is where a cooling element comes into action. When the hot Pyrogen aerosol passes through the cooling element, the coolant absorbs heat ensuring uniform distribution of the aerosol within the area, which certainly contributes to the reliability and safety of the extinguishment.

### **1.5 Pyrogen Generator Construction**

## **PYROGEN GENERATOR : CONSTRUCTION**



**Diagram 1-1**

## 1.6 Pyrogen Extinguishing Action

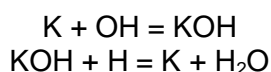
***Pyrogen aerosol is an exceptional fire suppressant.***

Pyrogen extinguishing action is achieved primarily by interfering chemically with the fire reaction. Two chemical mechanisms can be underlined:

### 1. ***Removal of flame propagation radicals - “chain carriers” OH, H and O in the flame zone:***

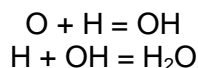
As it has been mentioned above, the main component of Pyrogen aerosol - potassium carbonates - are formed in the gas phase. In the flame zone they dissociate producing potassium radicals K. Potassium radicals are very active and react with “chain carriers” OH, H and O removing them from the fire zone, and as such disrupting the fire reaction.

The chemical action of potassium radicals in Pyrogen is similar to that of bromine radicals in Halon and can be schematically represented as follows:



### 2. ***Recombination of flame propagation radicals - “chain carriers” OH, H and O on aerosol particle surface:***

Gaseous potassium carbonates condense to a liquid and then a solid form producing a large number of micron sized particles. Being so small, the particles produce a large surface area, where recombination of “chain carriers” takes place:

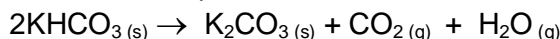


Secondarily, Pyrogen extinguishing action is achieved by lowering the fire temperature to a temperature below which the fire reaction cannot continue (thermal cooling). Several physical mechanisms can be underlined:

#### 1. ***Heat absorption via endothermic phase changes:***



#### 2. ***Heat absorption via endothermic decomposition reaction:***



3. ***Dilution of the fire combustion zone by the aerosol cloud (additional fuel molecules cannot participate in the combustion process); physical hindrance to flame propagation (aerosol particles slow down velocity of a flame front propagation) and etc.***

The extremely high surface area of the micron-size aerosol particles increases the likelihood of radical recombination and heat absorbing reactions, thus ensuring rapid extinguishment with a small amount of agent.

***Pyrogen has the lowest extinguishing concentration known among commercially available agents*** - flammable liquids (class B fires) are extinguished at the Design application density of 100 g/m<sup>3</sup> compared to 330 g/m<sup>3</sup> for Halon 1301.

***Micron sized aerosol particles exhibit gas-like three-dimensional qualities*** that allow the agent to rapidly distribute throughout the enclosure and reach the most concealed and shielded locations. Homogeneous distribution is achieved in a matter of seconds, while long holding times all help to prevent fire re-ignition.

Pyrogen aerosol is suitable for the protection of a variety of potential fire hazards, including those involving flammable liquids, combustible solids, oils and energised electrical equipment. Like all total flooding agents, ***Pyrogen aerosol is most effective when used in an enclosed risk area.***

### **1.7 Pyrogen Applications**

Pyrogen may be used as a total flooding fire suppressant for ***occupied*** (requires approval from local authority having jurisdiction), ***unoccupiable and normally unoccupied areas*** to fight fires of classes A, B, C and E.

For class C fires, consideration should be given to the use of vapour detection, explosion venting or explosion suppression systems where an explosion potential may exist, owing to the possible presence of gaseous, volatile or atomised fuels either before or following a fire. It may be dangerous, under certain conditions to extinguish a burning jet of flammable gases without first shutting off its supply.

The design application density required to suppress normal fires involving flammable gases and liquids at atmospheric pressure shall apply if it can be shown that a potentially explosive atmosphere cannot exist in the enclosure either before or as a result of the fire.

The minimum design application density for Classes C and E fire hazards shall be determined by test as part of a listing program.

An occupied area is an area that is occupied by humans under any conditions.

A normally unoccupied area is an area that is not occupied by humans under normal circumstances but may be entered occasionally for brief periods.

**Total Flooding Applications:** May be used where the hazard is within an enclosure that will permit the establishment of the required concentration and the maintenance of that concentration for the required period, for example, for-

- *Marine:* machinery spaces, engine rooms.
- *Transport:* engine compartments.
- *Aviation:* aircraft dry-bays, cargo compartments, engine nacelles.
- *Industrial:* enclosed flammable liquid storage, storage tanks & processing areas.
  - enclosures such as rooms, warehouses, garages, control rooms, engine rooms, vaults.
  - enclosed machines, data processing equipment, mining equipment.
  - enclosed electrical hazards such as transformers, control cubicles, switchboards, circuit breakers & rotating equipment.
  - security boxes (ATM, tender & post boxes) & remote locations.

**Pre-engineered Packaged Systems:** Designed and tested for a specific application.

- *Modular package system:* up to 10 m<sup>3</sup>.
- *Four wheel drive package system:* up to 3 m<sup>3</sup>.
- *Marine package system:* up to 20 m<sup>3</sup> with dedicated electrical manual release panel.

### ***1.8 Limitations of Use:***

Pyrogen systems are not suitable for fires involving the following:

- Certain chemicals or mixtures of chemicals such as cellulose nitrate and gunpowder, which are capable of rapid oxidation in the absence of air.
- Reactive metals such as sodium, potassium, magnesium, titanium, zirconium, uranium, and plutonium.
- Metal hydrides or metal amides.
- Chemicals capable of undergoing auto-thermal decomposition such as certain organic peroxides and hydrazine.
- Pyrophoric materials such as white phosphorous or metal-organic compounds.
- Oxidising agents such as nitric oxides and fluorine.

### **Limitations on Temperature of Discharge**

The temperature at the specified minimum clearance as established for every generator model shall not exceed 200°C. Please refer to Section 2.10 Design Limitations.

### **Non Enclosed Areas and Local Applications**

Where a fire hazard requires a local application, due to the protected area being an open space or one with high leakage rates, special application and engineering of the Pyrogen product will be required. In these instances the local main Pyrogen office should be contacted.

### **Electrical Machinery/Equipment**

***In the event of fire due to electrical hazards, power to the electrical machinery/equipment must be cut-off prior to operation of the fire protection system for effective suppression of fire.***

### 1.9 Pyrogen Safety Data

Pyrogen is intended for use in **occupied** (requires approval from local authority having jurisdiction), **unoccupiable and normally unoccupied areas**.

Visibility: Pyrogen aerosol produces smoke-like obscuration during and after discharge.

Oxygen Levels: Pyrogen chemically attacks the fire, breaking the flame chain reaction. It **does not extinguish fires by oxygen depletion**. After discharge, oxygen levels will remain at or about normal.

Toxicity: **Inadvertent exposure to Pyrogen aerosol should always be avoided.** Toxicological information refers to an inadvertent exposure to the aerosol in the event of accidental discharge in a non-fire situation.

The main ingredients of the Pyrogen aerosol are solid potassium carbonates, nitrogen gas, carbon dioxide gas and water vapour. At normal extinguishing concentrations these products present little health hazard to personnel. However, small amounts of potentially hazardous by-products of the aerosol-generating combustion reaction, such as carbon monoxide and nitrogen oxides will be produced. Their actual concentrations depend on Pyrogen design application density used and the type of enclosure under protection. Their toxicological characteristics depend upon the actual concentrations achieved and duration of exposure.

**Exposure to a Pyrogen design application density of 100 g/m<sup>3</sup>, which is typical for class B fires in total flooding applications, for up to 5 minutes, is normally considered to represent a minor risk to personnel and may cause only moderate local irritation of the upper respiratory tract and to the eyes.**

Post Fire Exposure: One of the key advantages of Pyrogen over Halon 1301 and over some of the replacement agents available is that **Pyrogen does not produce toxic and highly corrosive halogen acids when exposed to fire or hot surfaces**. Safety requirements dictate, however, that unnecessary exposure to post-fire atmospheres should be avoided. **CAUTION! Venting of the post-fire atmosphere should be to an open-air area, where possible, to prevent the inadvertent exposure of personnel to any combustion products of the fire and aerosol-generating reaction.**

Thermal Hazard: There is a potential hazard of high temperatures (250°C+) of Pyrogen aerosol at the end-plate nozzle, but within the minimum clearances from the discharge nozzle as specified for every type of EXA generator, the temperature does not exceed its specified value. Those distances should be observed during installation. For further information please see Section 2.10.

**Immediately after discharge the generators can be hot**, therefore, protective gloves should be worn before handling generators up to 15 minutes after discharge.

Hot Work: As naked flame or prolonged exposure to temperatures above 400°C may cause activation of the generators, **hot work must not be carried out within the vicinity of any generator**. If so they shall be removed prior to any hot work being carried out.

Thermal automatic operation: **Pyrogen thermal activation device may be used in unoccupied areas only.**

Re-entry: Following the use of Pyrogen, **personnel should not enter the protected area until it has been thoroughly ventilated**. Exposure to the fire by-products and extinguishant mixture should be avoided. Wearing a respirator or other available means of protection may be required should it be necessary to enter the area before it is fully ventilated.

Clean-up Procedure: Following a system discharge the aerosol particles that have settled should be vacuumed, blown, brushed or, if appropriate, washed away. **Protective gloves and goggles should be worn**. A respirator or mask may be required. Large amounts of residue that is allowed to absorb moisture may become electrically conductive over a period of time.

**Dangerous Goods Classification:** Pyrogen is a Class 4.1 article in accordance with the United Nations Dangerous Goods Classification Code.

**CoSHH Statement:** A by-product of Pyrogen aerosol-generating combustion reaction is fine potassium carbonate particles, small enough to be respirated by persons not wearing RPE. **There are no known toxicological long-term effects** of these soluble micron sized particles, and physiological effects of deep lung penetration are usually a concern for *insoluble* sub-micron particles as they can interfere with pulmonary functions.

However, there are clear European guidelines controlling the exposure of persons to fine particles, irrespective of their nature. Further information is available in BS EN 481:1993 & BS EN 451:1993, and in CoSHH supportive documents EH40/98 & EH44 and MDHS 14/2.

**Noise:** The sound output & frequency at the time of activation and during discharge is similar to that produced by other extinguishing agents. Consequently, no specific precautions need to be taken.

### **1.10 Pyrogen Environmental Characteristics**

**Pyrogen does not affect earth's ozone layer**, since it does not contain chlorine or bromine in its molecular structure.

Ozone Depleting Potential (ODP) is calculated ozone depletion per unit mass of material released relative to a standard, normally CFC-11 (CCl<sub>3</sub>F).

**Ozone Depleting Potential (ODP) of Pyrogen is zero.**

Contribution of Pyrogen to global warming is negligible, since the only one component that could contribute to global warming - carbon dioxide - is present in minor quantities at normal extinguishing concentrations.

Global Warming Potential (GWP) is a calculated change in warming resulting from the emission of a unit mass of a chemical relative to that of a reference. In the past CFC-11 was often used as a reference; carbon dioxide is now typically used.

The GWP depends on three variables:

- 1) the integrated infrared radiation absorption spectrum band strength.
- 2) the location of the infrared bands; and
- 3) the atmospheric lifetime

**Global Warming Potential (GWP) of Pyrogen relatively to carbon dioxide is zero.**



### **1.11 Pyrogen Technical Characteristics**

#### Min System Design Application Density

|                                   |                      |
|-----------------------------------|----------------------|
| Class B and surface Class A fires | 100 g/m <sup>3</sup> |
| Dense cable fires                 | 200 g/m <sup>3</sup> |

#### Min Particle Size

1 micron

#### Min/Max Suspension of Aerosol

30 / 60 min

#### ODP

0

#### GWP

0

#### Obscuration

high

#### Toxicity

low

#### Temperature range of application

from -50°C to + 65°C

#### Humidity range of application

0-98 %, non-condensing

#### Electric activation:

nominal resistance

2.0 – 4.0 Ohms (EXA Series)

1.1 – 1.9 Ohms (EXA-M Series)

activation current

0.5A – 1.0A

maximum test current

≤ 50 milliamps / 5 min

supervisory current

less than 5 milliamps

actuation time

1 – 2 milliseconds

#### Dangerous Goods Classification

4.1 class, category C

#### Service Life

5 - 10 years



## **AEROSOL FIRE SUPPRESSION SYSTEM**

### **SECTION 2:**

### ***SYSTEM DESIGN FOR TOTAL FLOODING APPLICATION***

## SECTION 2. SYSTEM DESIGN FOR TOTAL FLOODING APPLICATIONS

### 2.1 General

The Pyrogen system of aerosol generators distributed within the risk eliminates the complications associated with traditional gaseous agent systems. ***Pyrogen does not require pressurised cylinders of liquefied gas, traditional pipe and nozzle networks, or engineered hydraulic calculations to determine nozzle orifices.***

The Installer only needs to determine the size and number of Pyrogen generators required as well as their location within the enclosure. A System Design Approval Certificate has been included in Appendix A (Form 1), which gives a step-by-step guide on how to carry out these simple design calculations.

### 2.2 Design Methodology

The outline for the design of a Pyrogen total flooding fire suppression system generally involves the following at a minimum:

1. Identify all possible hazards within the protected enclosure. Please refer to Section 1.8 for the list of fire hazards/ fuel types that are unsuitable for use with Pyrogen. For fire hazards/ fuel types not covered in Section 1.8, please refer the query to an Authorised Pyrogen representative.
2. Identify possible points of agent loss within the protected enclosure
3. Determine volume of the protected enclosure. It may be necessary to derive the net protected volume in enclosures containing large impermeable structures/ machinery Identify if the required coverage extends to the ceiling void and/or raised floor and determine the protected volume for these.
4. Calculate the quantity of agent required for the hazard and fuel type within the enclosure. Factors such as non-closable openings, forced ventilation, low altitude, low temperature and other conditions may affect the quantity of agent required.
5. Select the model and quantity of generators required to achieve the minimum design quantity.

### 2.3 Design application density

Pyrogen design calculations refer not to the design concentration of the actual extinguishing agent - aerosol, but to the Design application density, which is the mass of solid aerosol-generating compound per unit of enclosure volume required to extinguish a specific type of fire, including a safety factor.

- Pyrogen Design application density is expressed in  $\text{g/m}^3$ .
- Pyrogen minimum Design application density for Class B fires, involving flammable liquids such as petrol, diesel, hydraulic oil and automotive distillate is  $100 \text{ g/m}^3$ .
- Pyrogen minimum Design application density for Class A surface fires, involving non-smouldering combustible solids such as wood, textile and ordinary plastics is  $100 \text{ g/m}^3$ .
- Pyrogen minimum Design application density for Class A non-surface fires, involving dense cables is  $200 \text{ g/m}^3$ .

Advice from Pyrogen Technologies or authorised Pyrogen Representative should be sought for any fire/ fuel type not covered by the above minimum Design application densities.

## 2.4 Design Quantity

For normal total flooding applications based on a static volume enclosure with all openings sealed and all ventilation systems shut down prior to Pyrogen discharge, the total flooding quantity is determined as follows:

$$\text{Total Flooding Quantity (g)} = \text{Design application density (g/m}^3\text{)} \times \text{Enclosure Volume (m}^3\text{)}$$

Total Flooding Quantity refers to the total mass of solid aerosol-generating compound required to suppress fire in a given volume, including safety factor.

## 2.5 Number of EXA generators

For normal total flooding applications based on a static volume enclosure with all openings sealed and all ventilation systems shut down prior to Pyrogen discharge, the number of EXA generators is determined as follows:

$$\text{Number of EXA} = \frac{\text{Total Flooding Quantity (g) [as calculated in Section 2.4]}}{\text{Mass of the solid aerosol-forming compound in one EXA generator}}$$

The above calculation refers to the same size of EXA generators only. However, different sizes of EXA generators may be selected, in which case the total mass of aerosol-forming compound shall be not less than the Total Flooding Quantity.

Please refer to Section 2.6 for a complete list of Pyrogen EXA generators available.

The type of EXA generator selected is typically based on several considerations as follows:

1. Height of Protected Enclosure: EXA generators chosen must be appropriate for the height of the protected enclosure. Please refer to Section 2.10 for the height limitation list.
2. Minimum Clearance: minimum clearance is an essential criteria to ensure that the possibility of damage due to heat of the discharge is minimised. Please refer to Section 2.10.
3. Distribution of Aerosol: Although Pyrogen aerosol has the three-dimensional distribution of a gas, the even and rapid attainment of the minimum extinguishing concentration throughout the protected enclosure would obviously be desirable. E.g. In applications such as the protection of cable ducts and trenches, which are typically long and narrow, it would be appropriate to select several smaller units and spread them out evenly along the protected volume although one large unit may fulfil the agent quantity requirement.
4. Mounting Locations: Certain protected enclosures may have very specific permissible mounting locations. This may influence the quantity and orientation of the units selected.
5. Cost Factors: The price/m<sup>3</sup> of the different EXA units may differ. The best cost option without sacrificing technical requirements is the elements of good design.

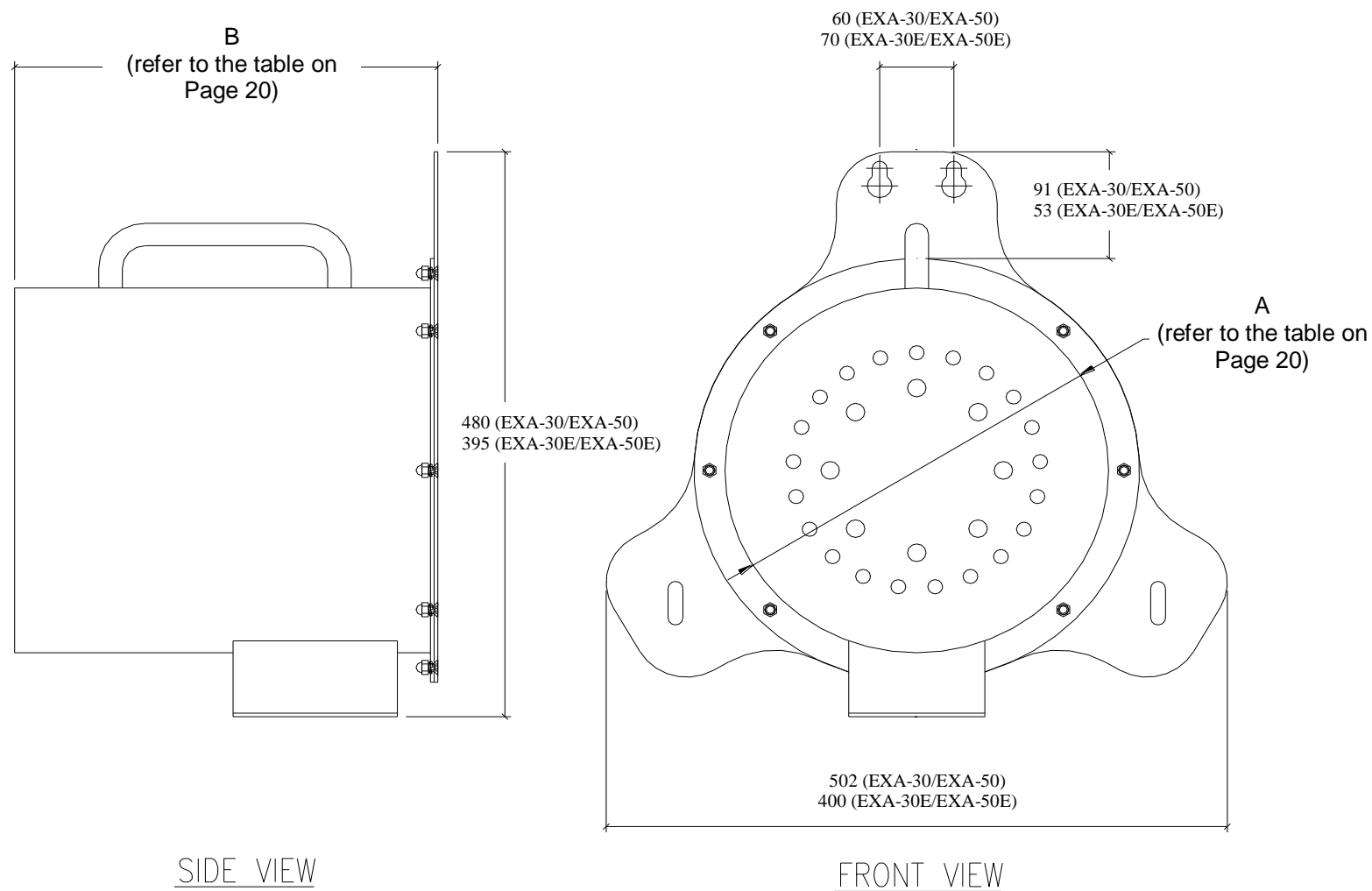
## 2.6 Pyrogen Range

Pyrogen comes in a form of small non-pressurised canisters with one or two end-plate delivery nozzles. The canisters are called EXA generators and vary in size depending on the mass of solid aerosol-generating compound contained in the generator. Technical parameters of the current range of EXA generators are as follows:

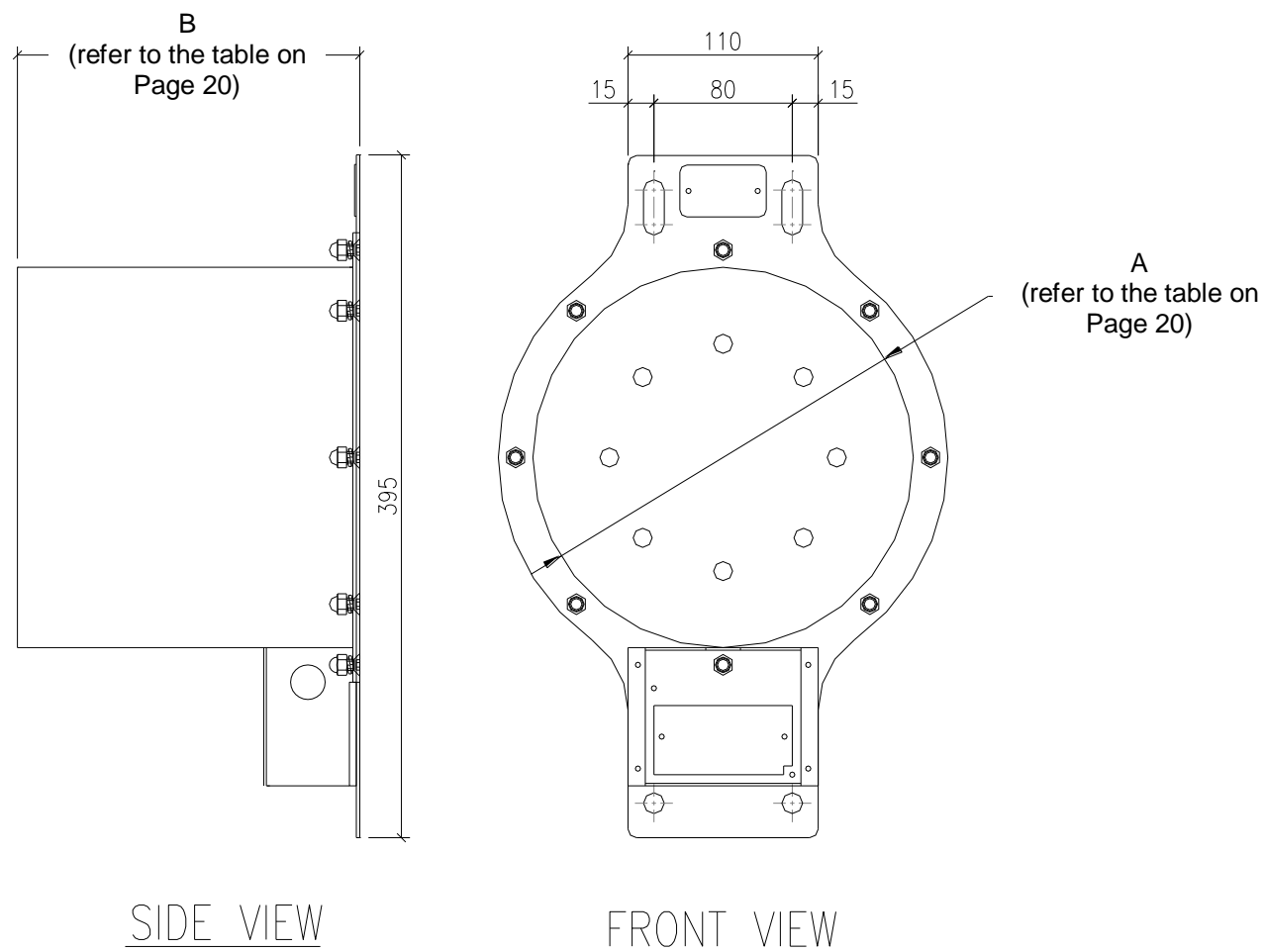
**TABLE 2-1**

|   | GENERAL SERIES |       |       |       |       |               |        |        |        |        |        | M-SERIES |       |       |       |       |       |       |       |
|---|----------------|-------|-------|-------|-------|---------------|--------|--------|--------|--------|--------|----------|-------|-------|-------|-------|-------|-------|-------|
| Parameter EXA                             | Z3             | Z6    | 1     | 2     | 5     | 10            | 20     | 30     | 50     | 30E    | 50E    | M-Z2     | M-Z6  | MS-1  | ML-1  | M-2   | M-5   | M-10  | MB-10 |
| 1. Mass of generator, g                   | 360            | 650   | 940   | 1,700 | 3,100 | 9,000         | 11,500 | 23,000 | 27,500 | 22,000 | 26,500 | 300      | 650   | 800   | 800   | 1,200 | 2,300 | 8,500 | 8,500 |
| 2. Mass of aerosol-generating compound, g | 30             | 60    | 100   | 200   | 500   | 1,000         | 2,000  | 3,000  | 5,000  | 3,000  | 5,000  | 20       | 60    | 100   | 100   | 200   | 500   | 1,000 | 1,000 |
| 3. Max protected volume, m <sup>3</sup>   | 0.3            | 0.6   | 1     | 2     | 5     | 10            | 20     | 30     | 50     | 30     | 50     | 0.2      | 0.6   | 1     | 1     | 2     | 5     | 10    | 10    |
| 4. Nozzle outlet                          | Mono           | Mono  | Mono  | Mono  | Mono  | Mono / Radius | Mono   | Mono   | Mono   | Mono   | Mono   | Mono     | Mono  | Mono  | Mono  | Mono  | Mono  | Mono  | Bi    |
| 5. Length of generator, B (mm)            | 101            | 121   | 122   | 200   | 215   | 200           | 254    | 342    | 450    | 310    | 353    | 80       | 160   | 105   | 240   | 162   | 242   | 434   | 434   |
| 6. Diameter of generator, A (mm)          | 38             | 51    | 64    | 76.2  | 89    | 220           | 220    | 310    | 310    | 265    | 265    | 40       | 40    | 70    | 40    | 70    | 113   | 113   | 113   |
| 7. Discharge time, s                      | <20.0          | <25.0 | <30.0 | <30.0 | <30.0 | <30.0         | <30.0  | <35.0  | <35.0  | <35.0  | <35.0  | <5.0     | <10.0 | <15.0 | <15.0 | <15.0 | <15.0 | <20.0 | <20.0 |

<sup>1</sup> Based on Design application density of 100g/m<sup>3</sup>



**Diagram 2-1: Typical Construction of Pyrogen Generators – EXA-30, EXA-50, EXA-30E & EXA-50E**

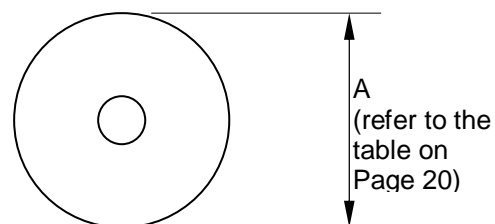


**Diagram 2-2: Typical Construction of Pyrogen Generators EXA-10 & EXA-20**

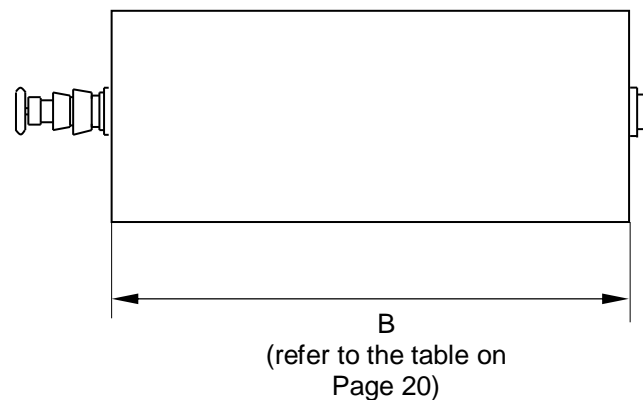




FRONT VIEW



SIDE VIEW



**Diagram 2-3: Typical Construction of Pyrogen Generators  
EXA-M-Z2, EXA-Z3, EXA-M-Z6, EXA-Z6, EXA-ML-1, EXA-MS-1, EXA-1,  
EXA-M-2, EXA-2, EXA-M-5, EXA-5, EXA-M-10 & EXA-MB-10**

## 2.7 Minimum Holding Time

Upon Pyrogen discharge a minimum holding time of 3 minutes should be allowed, for fires involving flammable liquids (class B fires) and non-smouldering combustible solids (class A surface fires).

**For fires involving electrical cables and smouldering solids the minimum holding time should be extended to 10 minutes.**

## 2.8 Enclosure Requirements

The area of non-closable openings shall be kept to a minimum. The presence of unclosable openings in the ceiling should be avoided. **The total area of unclosable openings should not exceed 1 % of the total area of the protected enclosure.**

**Air-handling systems serving the protected area should generally be shut down or isolated by dampers.**

Any services within the enclosure, such as fuel valves and pumps, heating appliances and others which if left running would impair the efficiency of Pyrogen, shall be shut down prior to or simultaneously with the release of the extinguishant.

For tight enclosures, venting of an enclosure may be necessary to relieve pressure build-up due to the discharge of large quantities of extinguishant.

Venting requirements refer to large EXA units only and are as follows:

| EXA model | Minimum venting area, cm <sup>2</sup> |
|-----------|---------------------------------------|
| EXA-20    | 70                                    |
| EXA-30    | 100                                   |
| EXA-50    | 150                                   |

Minimum venting area includes existing natural gaps, ventilation outlets and etc. Where additional pressure relief venting is required the installed vents should be of an appropriate type, such as closeable flaps, and suitably located to ensure maximum possible containment of Pyrogen aerosol within the enclosure during and after discharge.

## 2.9 Design Limitations

### Height Limitations

The Pyrogen extinguishing aerosol, being a combustion product of the aerosol-forming compound, is generated at elevated temperature and, therefore, has a tendency to rise upward on its release due to buoyancy forces. As such, the aspect of spatial distribution needs to be addressed.

This requires that a height limitation for the protected enclosure be set for each individual Pyrogen generators:

**Table 2-4**

| GENERAL SERIES |        |       |       |       |        |        |        |        |         |         |
|----------------|--------|-------|-------|-------|--------|--------|--------|--------|---------|---------|
| EXA-Z3         | EXA-Z6 | EXA-1 | EXA-2 | EXA-5 | EXA-10 | EXA-20 | EXA-30 | EXA-50 | EXA-30E | EXA-50E |
| 1 m            | 1.25m  | 2.0m  | 2.5m  | 3.0m  | 3.5m   | 4.0m   | 4m     | 4.5m   | 4m      | 4.5m    |

| M-SERIES |          |          |          |         |         |          |           |
|----------|----------|----------|----------|---------|---------|----------|-----------|
| EXA-M-02 | EXA-M-06 | EXA-ML-1 | EXA-ML-2 | EXA-M-2 | EXA-M-5 | EXA-M-10 | EXA-MB-10 |
| 1 m      | 1.25m    | 2.0m     | 2.5m     | 2.5m    | 3.0m    | 3.5m     | 3.5m      |

For large enclosures where several generators are distributed evenly throughout the area, the total height shall not exceed the height limitations for a single generator, unless uniformity of the aerosol distribution within accepted time period has been proved for the greater height by a discharge test.

#### Minimum clearances

Due to a potential hazard of high temperatures (100°C-150°C) of Pyrogen aerosol at the end-plate nozzle, the minimum clearances from the discharge nozzle for each type of EXA generator should be observed during installation:

**Table 2-5**

|                |                         |                |
|----------------|-------------------------|----------------|
| GENERAL SERIES | EXA-Z3                  | 200 mm         |
|                | EXA-Z6                  | 300 mm         |
|                | EXA-1                   | 400 mm         |
|                | EXA-2                   | 700 mm         |
|                | EXA-5                   | 700 mm         |
|                | EXA-10                  | 1000 mm        |
|                | EXA-20...EXA-50         | 1500...2000 mm |
| M-SERIES       | EXA-M-02                | 150mm          |
|                | EXA-M-06                | 300mm          |
|                | EXA-ML-1                | 400mm          |
|                | EXA-MS-1                | 400mm          |
|                | EXA-M-2                 | 700mm          |
|                | EXA-M-5                 | 700mm          |
|                | EXA-M-10                | 1000mm         |
|                | EXA-M-B10 (at each end) | 700 mm         |

## **2.10 Pyrogen Discharge**

Depending on the selected size(s) of Pyrogen generators the discharge of aerosol lasts from 5 to 50 seconds. Rapid discharge ensures attaining of Pyrogen design concentration in a very short time upon actuation of the aerosol generators, which is vital in minimizing damage caused by the fire. Installation location of Pyrogen generators and the resultant distribution of the extinguishing aerosol is an important factor in achieving a rapid and even distribution of the extinguishant.

As Pyrogen does not rely on oxygen depletion to extinguish the fire, the ambient atmosphere inside the enclosure during and after discharge remains breathable, with oxygen level remaining approximately at 18-19%.

As Pyrogen does not contain any halogen compounds in its molecular structure, it does not produce corrosive halogen-acid by-products when in contact with flame.

As Pyrogen's prime extinguishing action is a chemical interference with a fire chain reaction, a certain amount of the discharged aerosol will be consumed during extinguishing process, the actual amount depending on the type and size of the fire as well as Pyrogen system design parameters. The rest of the aerosol will be left to prevent any likelihood of fire re-ignition.

Being a suspension of finely dispersed solids in a gaseous medium, Pyrogen aerosol has a natural ability to stay in suspension for approximately 30-40 minutes after its discharge into a sealed enclosure.

Following this period of natural suspension the remaining aerosol, if not ventilated, will start settling down due to agglomeration and sedimentation of the micron sized solid particles. Settled down aerosol forms a dust-like fine fire retardant residue, which is easily wiped off, brushed, blown or, if appropriate, washed away.

Due to a low extinguishing concentration of Pyrogen aerosol and its very fine structure, the amount of residue left is minimal.

The actual Pyrogen aerosol is non-conductive and non-corrosive. However, the settled aerosol residue, being an ionic compound (salt), may become conductive if allowed to build up in large quantities and absorb adequate amounts of moisture. Therefore, for sensitive applications it is recommended that the protected area be ventilated immediately after post-discharge minimum holding time period.

### **2.11 Pyrogen Service Life**

The Service life of Pyrogen fire suppression system is a period from the date of installation to expiry date. The service life depends on the ambient conditions inside the protected area and conditions of generators' use.

| Operation conditions   | Service life - 10 yrs  | Service life - 5 yrs                                |
|--|------------------------|---|
| Temperature range  | From 0 ° C to + 40 ° C | from - 50 ° C to 0 ° C;<br>from + 40 ° C to +65 ° C |
| Humidity range   | 0 – 90 %               | Above 90 %  |
| Environments which subject the system to continuous or intense vibrations                | No                     | Yes   |
| Exterior situations exposed to the sun, ultraviolet radiation, wind, rain, or salt spray | No                     | Yes   |
| Corrosive atmospheres  | No                     | Yes   |
| Abnormally dusty or moisture-laden atmospheres   | No                     | Yes   |

A durable and easily accessible during maintenance installation and expiry dates label shall be attached to the EXA generator prior to installation. The label shall contain the date of the generator's installation and the expiry date.



## **AEROSOL FIRE SUPPRESSION SYSTEM**

### **SECTION 3:**

### ***SYSTEM DESIGN FOR LOCAL APPLICATIONS***

## SECTION 3. SYSTEM DESIGN FOR LOCAL APPLICATIONS

### 3.1 PYROGEN PACKAGED SYSTEMS.

Local application of Pyrogen fire suppression systems requires preliminary testing to determine quantity of agent, particular size and number of EXA generators as well as their location in relation to the identified hazard.

***In many cases, due to excessive leakage rates and insufficient hold times, special design requirements will need to be considered. In these cases contact your local Pyrogen office for technical assistance.***

For some specific local applications, such as engine compartments of small passenger and commercial cars, design criteria have already been established. Data sheets for Pyrogen pre-engineered Packaged Systems are available from authorised Pyrogen distributors.

Pyrogen Packaged Systems contain a full set of system components required for a specified application.

Pyrogen Packaged Systems may be configured within the range specified with each package and may include all of the operation options.

***Packaged Systems must not be used for any purpose other than its specific applications.***

Packaged Systems can be made up for any type of standardised risks, including some of total flooding applications as well as most of local applications.





## **AEROSOL FIRE SUPPRESSION SYSTEM**

### **SECTION 4:** ***SYSTEM OPERATION***



## **SECTION 4. SYSTEM OPERATION**

Operation of Pyrogen EXA generator is either electrical automatic, electrical manual or thermal automatic.

### ***4.1 Electrical automatic operation***

Electrical automatic operation is performed upon activation of the detection circuit initiating a voltage source from the Fire Control / Alarm Panel to the generator(s) electrical activation device.

### ***4.2 Electrical manual operation***

Electrical manual operation is performed electrically by manual release point located outside the protected enclosure.

### ***4.3 Thermal automatic operation***

Thermal automatic operation is provided by action of a thermal activation device – a linear detection cord or any other device, which automatically activates at a rated temperature or when exposed to a naked flame and transmits the activation to the aerosol generator.

For some applications, such as vehicle engine compartments, electrical switchboards and etc, the device may also serve as an automatic detection line connecting EXA generators and running through the most hazardous locations.

For some applications, where operation is mandatory manual only, the thermal activation device shall be removed.

### ***4.4 System isolate switch***

The discharge of electrical automatic Pyrogen generators shall be capable of being prevented by means of a system isolate switch that shall be manually operated when personnel are present in the protected area or the adjacent area which could be rendered hazardous by the discharge of extinguishant.

The system isolate switch shall be situated outside the protected area or adjacent to the main exit from the area and protected from accidental operation.

While the system isolate switch is active and the discharge of the system is inhibited, the fire detection and alarm systems shall continue to function and the system shall return to full automatic control when the switch is reactivated.

The operation of the system isolate switch shall electrically isolate and earth each conductor of the wiring to the extinguishant discharge device and initiate a yellow or amber visual indicator at the Local Control Station and Control and Indicating Equipment.

The purpose of this requirement is to provide a level of protection equivalent to a gas lock-off valve.

### ***4.5 Operating devices***

Operating devices such as system isolate switches and ancillary equipment, including shutdown equipment, dampers and door closures, required for successful system performance shall be considered integral parts of the system. All ancillaries shall incorporate manual reset facilities.

#### **4.6 Detection, alarm and control systems, indicating equipment, warning devices**

Automatic fire detection, alarm and control systems for Pyrogen as well as indicating equipment and warning devices shall comply with the standard requirements established for a specified risk as specified in AS/NZS 4487:1997.

#### **4.7 Post-fire procedure**

After discharge of Pyrogen allow a minimum holding time of 3 minutes for fire hazards involving flammable liquids (Class B) and non-smouldering combustible solids (Class A surface fires). Allow a 10 minutes holding time for fires involving PVC electrical cables and smouldering solids.

#### **Ensure first aid portable fire extinguishers are at hand.**

Ventilate the area by operating ventilation system or opening doors. **Avoid exposure to the fire by-products and extinguishant mixture.** Wearing a respirator or other available means of protection may be required should it be necessary to enter the area before it is fully ventilated.

Enter the area when it is clear of agent and fire by-products, to inspect and ensure that the fire is fully extinguished and there is no danger of re-flash from hot spots or damaged equipment.

Should any residue be left, blow, brush or, if appropriate, wash it away. Be aware, that any residue that is allowed to absorb moisture may become electrically conductive. Refer to Section 2.10 for more information on Pyrogen residue.

Contact your Pyrogen Distributor for a replacement of EXA generators.



## **AEROSOL FIRE SUPPRESSION SYSTEM**

### **SECTION 5:** ***SYSTEM COMPONENTS***

## **SECTION 5. SYSTEM COMPONENTS**

The Pyrogen Fire Suppression System comes complete with EXA generators of a specified size/s, mounting brackets, bracket supports, bolts and nuts.

Pyrogen EXA generators are made of stainless steel, powder coated red. Generator's mounting brackets are manufactured from mild steel and powder coated red. The EXA-Z3, EXA-Z6, EXA-1, EXA-2, EXA-5 generators are supplied with one bracket for normal use, while the larger EXA-10 generators are supplied with two brackets.

Generators EXA-20 to EXA-50 comes without brackets as they have mounting clamps welded to their casings.

The following Pyrogen accessories are optional and designed to complete Pyrogen System Supply for specific installations, where other components besides those supplied by manufacturer may be required:

- *Directional Nozzles* - Designed to constrict and direct the original aerosol flow in a specified application, such as Pyrogen Shut-Down Strangler System
- *Fire Stop Cable* - Shall be used in Pyrogen electrical wiring to prevent shorting of circuitry in an event of fire as well as accidental discharge due to an induction or electromagnetic interference.
- *System Isolate Switch* - Designed for normally unoccupied areas. Represents a guarded switch, which prevents a discharge of electrically operated Pyrogen generators. Operated manually. Located outside the protected area.
- *Manual Release Point* - Designed for a manual electrical operation of Pyrogen generators. Available as the Guarded Push Buttons and the Guarded Switches.
- *Pyrogen Signs* - Designed for normally unoccupied areas. The following signs are available:
  - Label displayed at the entrance to the enclosure;
  - Instruction Label displayed inside the enclosure;
  - System Isolate Switch Label;
  - Instruction Label displayed at manual release point.

*For more information on Warning and Instruction signs, please refer to Section 7.2.*



## **AEROSOL FIRE SUPPRESSION SYSTEM**

### **SECTION 6:** ***SYSTEM INSTALLATION***

## SECTION 6. SYSTEM INSTALLATION

### 6.1 Prior to installation

#### - Integrity and resistance of the electric activation circuit

It is important that prior to the installation of EXA generators the integrity and resistance of the electric activation circuit for each EXA generator be checked with the use of a **digital** multi-meter. The maximum test current shall not exceed 50 milliamps for a period of 5 minutes. The monitoring current shall not exceed 5 milliamps.

Resistance of the electric activation circuit shall be within 2.0-3.0 Ohms for the EXA Series generators and shall be within 1.1-1.9 Ohms for the EXA-M Series generators.

It is also important to check earth fault of every EXA generator. Earth fault resistance must not be less than 0.1MΩ.

#### - Thermal activation device

Should automatic thermal operation of the Pyrogen EXA generator be required in addition or alternatively to automatic/manual electric operation, ensure the thermal activation device has been incorporated in the system.

Should automatic thermal operation of the Pyrogen EXA generator not be required in addition or alternatively to automatic/manual electric operation, ensure the thermal activation device has not been incorporated in the system.

### 6.2 Spacing and Location

Once the size and number of Pyrogen EXA generators has been determined, they should be securely mounted on to a bulk head or similar location, observing the following:

#### - Even distribution

**Generators should be evenly distributed within the risk area**, to achieve an unhindered distribution of the agent discharge.

#### - Orientation of aerosol discharge

Aerosol discharge should not be orientated across any route of exit.

Generators should be oriented so as to reduce a possible thermal damage caused by the elevated temperatures of the discharged aerosol and the generator's casing. There should be no flammable or highly combustible materials or equipment within a specified minimum clearance from the generator's nozzle.

If there are any un-closable openings that cannot be avoided the aerosol generators should be located so as to ensure maximum containment of the discharged aerosol within the enclosure.

#### - Clear obstructions

While Pyrogen aerosol is an extremely penetrating extinguishing agent, severe obstruction of the aerosol discharge pattern should be avoided. Several small generators may be preferable to one large generator, should design limitations for smaller units allow such a replacement. If it is not possible, the distance from the nozzle to the obstacle shall be not less than the specified minimum clearance from the nozzle.

In case of multiple obstacles the Design application density shall be increased, such increase to be determined by preliminary tests conducted in the premises concerned.

- Environment

Temperature range of application for EXA generators is from -50°C to + 65°C.

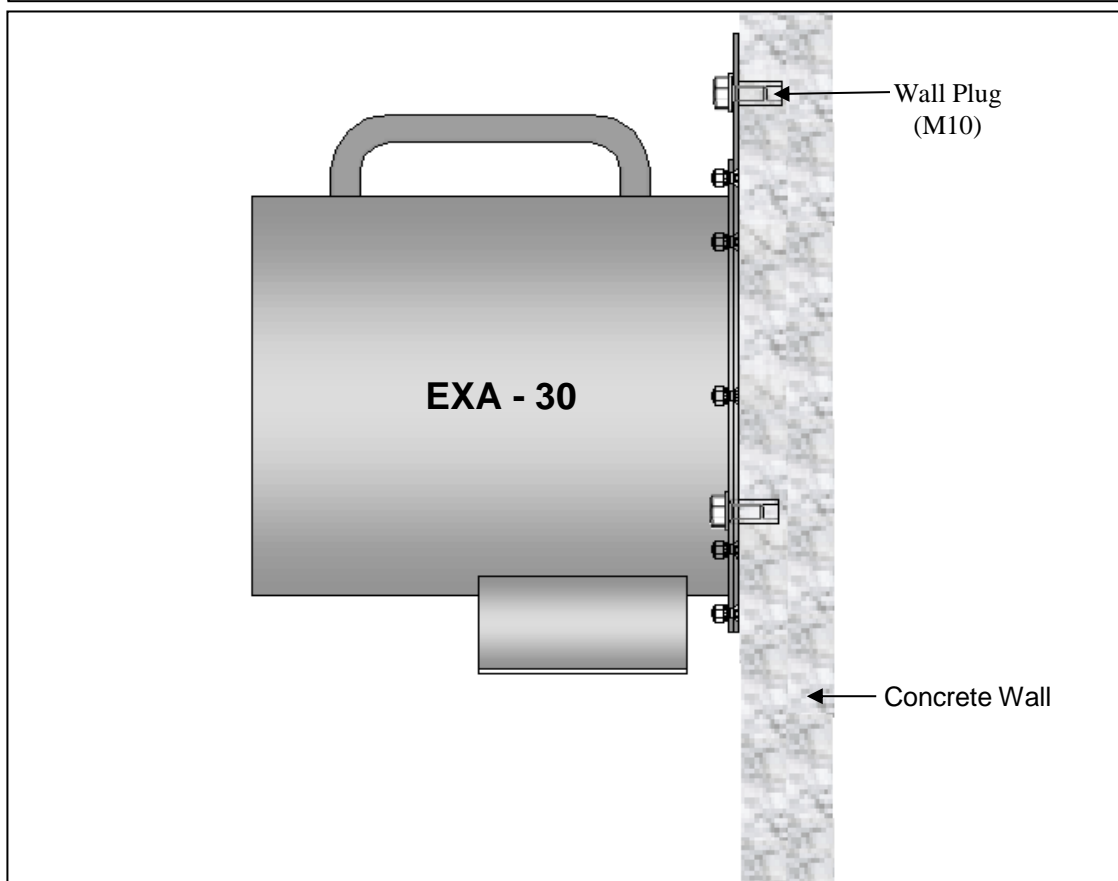
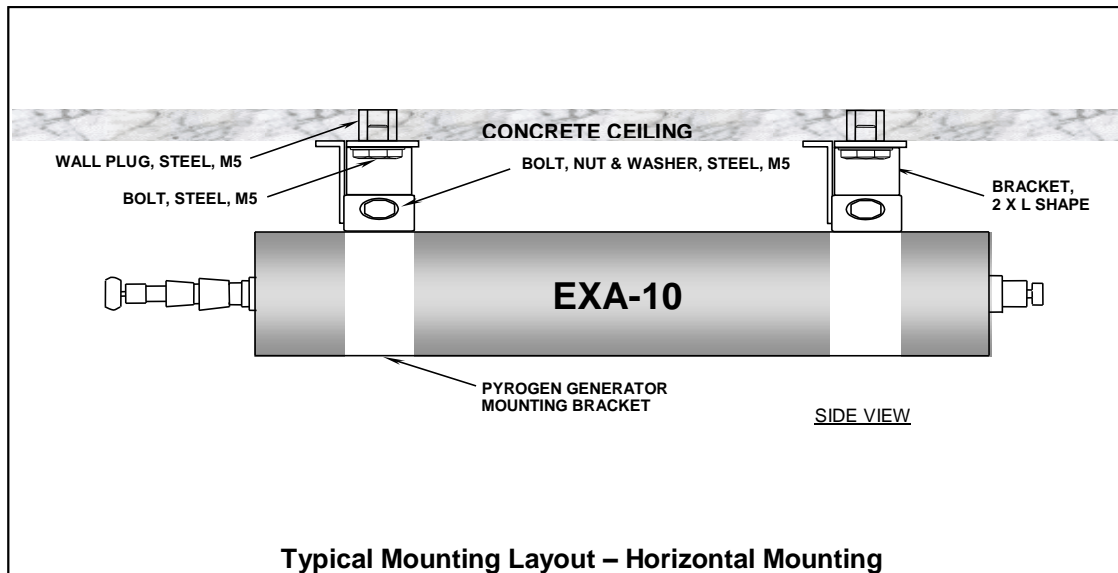
Humidity range of application for EXA generators is up to 98 % humidity, non-condensing.

For installations where fire-conducting cord is used, the lowest temperature of application has been limited to -15 °C.

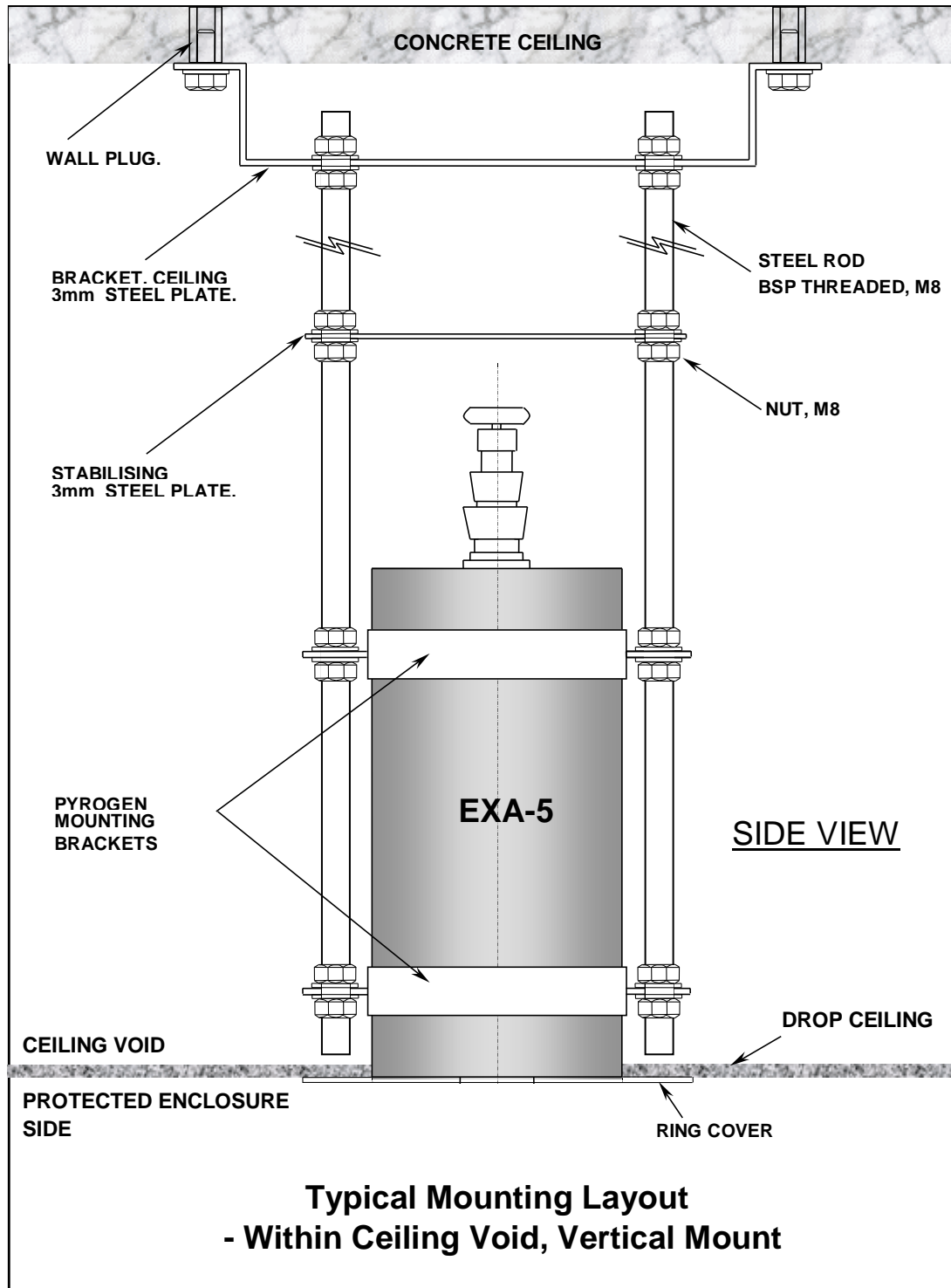
Generators shall not be subjected to severe weather conditions or to mechanical, chemical or other damage. Where excessive climatic or mechanical exposures are expected, suitable guards or enclosures shall be provided.

### 6.3 Mounting Methods

Pyrogen generators could be mounted in any orientation without its aerosol generating capability being affected. It is however important to bear in mind that the resultant aerosol being warm would tend to rise at the onset, which could potentially affect its distribution in the lower sections of the enclosure. The lateral mounting position on the ceiling is considered a most unfavourable orientation.







**Diagram 6-3**

#### **6.4 Electric Wiring**

Up to ten Pyrogen EXA generators may be connected on a single discharge circuit with one power source. Should more than ten generators be required for one enclosure, two circuits with two separate power sources should be used.

***Wiring between generators shall be by parallel configuration only.***

##### **- Cable**

**Cables should be fire-resistant.** Conductors should be of copper, each having a cross-sectional area of not less than 1 mm<sup>2</sup>, or if stranded, not less than 0.5 mm<sup>2</sup> should be used.

The cable shall be screened and the care taken when the cable runs through a high frequency energy zone, such as a two-way radio, a sonar, etc.

Should the cabling run alongside electric magnetic fields of high intensity, such as high voltage transformers in power substations or cable tunnels, the cables shall be enclosed into a steel conduit.

Cable screen and steel conduit shall be grounded in accordance with standard requirements.

Should there be any possibility of mechanical damage, the cables shall be enclosed in a plastic or metal conduit.

##### **- Power Sources**

A standard power source that provides at least 2 Amp current and 12 to 24 Volts voltage shall be used.

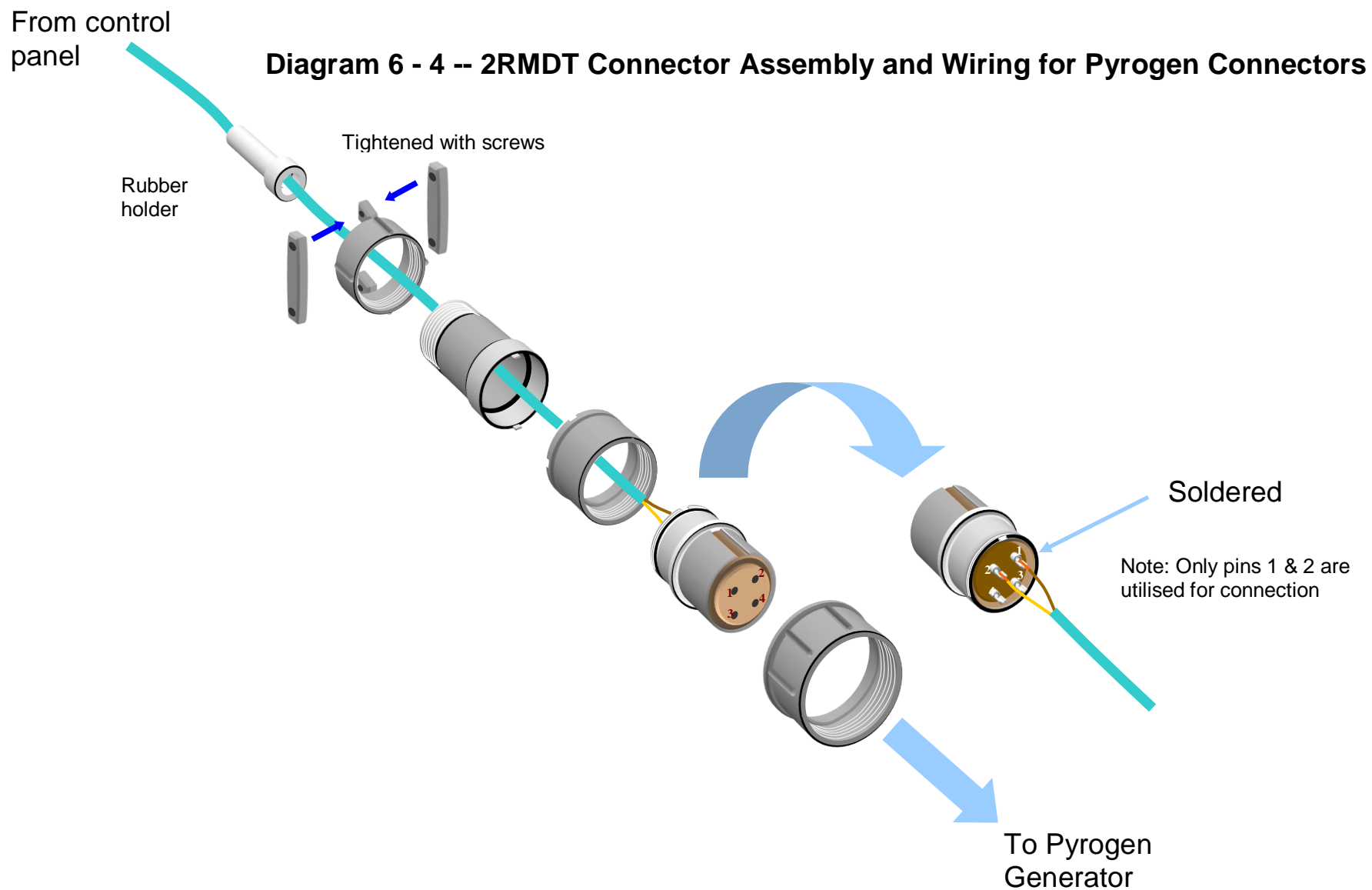
The power source shall have a backup power supply of the same voltage range. Where the backup power is shared with other devices, sufficient capacity for a minimum of 24 hour's standby condition, 1-hour alarm condition and thereafter, sufficient capacity remaining to discharge the generators shall be provided for.

##### **- Wiring procedure**

- 1) Install electrical wiring;
- 2) Install and connect such devices as audible and visual alarm devices, manual release points, automatic activation fire panel, heat or flame detectors, timer, etc;
- 3) Connect miniature filament lamps with 12-24 Volts voltage and current up to 50mA ***in place of EXA generators;***
- 4) Ensure the manual release point or the automatic activation fire panel has been protected from the accidental discharge. Placing a sign "Do not press. Device is under service" is recommended.
- 5) Connect the circuit to a power supply;
- 6) Activate the system. All devices shall operate and all lamps shall glow. Should the system fail to operate properly, disconnect the power supply, check connections between devices, reconnect the power supply and repeat the procedure.
- 7) Reset the system. All lamps shall be switched off;

***WARNING! Prior to connecting EXA generators ensure the wires leading to the generators are not carrying voltage. Connection of EXA generators should always be the last function in electrical wiring procedure.***

- 8) Disconnect all of the lamps and connect the EXA generators in its place. All installation recommendations for installation and connection of EXA generators shall be observed.
- 9) Remove the sign on the manual release point or the automatic activation fire panel.





## **AEROSOL FIRE SUPPRESSION SYSTEM**

### **SECTION 7:**

### ***SYSTEM MARKINGS***

## SECTION 7. SYSTEM MARKINGS

### 7.1 Pyrogen Product Label

Each Pyrogen EXA generator is complete with its product label stating vital information regarding the product. The general format is as follows:

# AEROSOL FIRE SUPPRESSION GENERATOR

www.pyrogen.com.my

# EXA-




*Manufactured by Pyrogen Manufacturing Sdn Bhd,  
an ISO 9001:2000 Certified Company*

|   |  |
|---|--|
| Mass of aerosol element <input type="text"/> kg.<br>Single use only - Non-refillable<br>Classification : Class 4.1<br>UN 3178      Hazchem 1[T] | <b>DO NOT DISASSEMBLE<br/>OR INCINERATE CANISTER.</b>              |
| Serial Number : <input type="text"/>  | <input type="text"/>   |
| Date of Manufacture : <input type="text"/> / <input type="text"/> / <input type="text"/>  | <input type="text"/> / <input type="text"/> / <input type="text"/> |
| Expiry Date : <input type="text"/> / <input type="text"/> / <input type="text"/>  | <input type="text"/> / <input type="text"/> / <input type="text"/> |
| Installed On : <input type="text"/> / <input type="text"/> / <input type="text"/>   | <input type="text"/> / <input type="text"/> / <input type="text"/> |
| Min. Clearance from Nozzle : <input type="text"/> m   | <input type="text"/> m   |
| Temperature Range : <input type="text"/>  | -50°C ~ +65°C  |
| Patent No. : <input type="text"/>   | EP 1 109 601 B1  |
| ActivFire Listing : <input type="text"/>  | Afp-1781   |
| Class of Fire : <input type="text"/>  | A, B, C, E   |
| <b>IN CASE OF EMERGENCY,<br/>CONTACT YOUR NEAREST DISTRIBUTOR, OR<br/>PYROGEN MANUFACTURING SDN. BHD. +6019-281 9661</b>                        |  |

### 7.2 Pyrogen Installation and Expiry Date Label

The following label is “filled in” and affixed to every generator used in the system by the installation contractor.

|                          |       |
|--------------------------|-------|
| <b>PYROGEN GENERATOR</b> |       |
| INSTALLED DATE:          | _____ |
| EXPIRY DATE:             | _____ |

Expiry date for a specific installation is determined by the ambient conditions inside the protected area and conditions of the generators’ use. Please refer to Section 2.11 for Pyrogen service life versus operation conditions.

### 7.3 Pyrogen Warning & Instruction Signs

The following Warning and Instruction Signs shall be firmly attached to specified locations by the installer on completion of Pyrogen installation in normally unoccupied areas, where people may enter the enclosure for brief periods:

a) Label to be displayed at entrance to enclosure:

|  |
|--|
| <p>THIS AREA IS FITTED WITH A PYROGEN FIRE EXTINGUISHING AEROSOL SYSTEM</p> <p><b>DO NOT ENTER</b><br/><b>UNLESS THE FIRE SUPPRESSION SYSTEM IS ISOLATED</b></p> <p>AFTER AEROSOL DISCHARGE DO NOT ENTER<br/>UNTIL AREA HAS BEEN THOROUGHLY VENTILATED</p> |
|--|

b) Label to be displayed inside enclosure

|   |
|---|
| <p>THIS AREA IS FITTED WITH A PYROGEN FIRE EXTINGUISHING AEROSOL SYSTEM</p> <p><b>EVACUATE AREA ON SOUND OF ALARM</b></p> <p>AFTER AEROSOL DISCHARGE DO NOT ENTER<br/>UNTIL AREA HAS BEEN THOROUGHLY VENTILATED</p> |
|---|

*c) Label to be displayed at System Isolate Switch*

PYROGEN SYSTEM ISOLATE SWITCH

**WARNING**  
**CHECK THAT THE AREA IS CLEAR OF PERSONNEL BEFORE RE-  
ACTIVATING THE SYSTEM**

*d) Label to be displayed at Manual Release Point*

PYROGEN FIRE EXTINGUISHING AEROSOL SYSTEM

MANUAL RELEASE POINT

**ENSURE AREA IS EVACUATED BEFORE RELEASE OF PYROGEN  
AEROSOL**







## **AEROSOL FIRE SUPPRESSION SYSTEM**

### **SECTION 8:**

### ***SYSTEM COMMISSIONING***

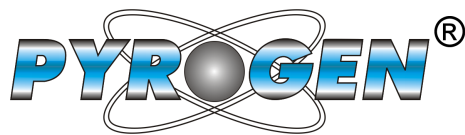
## **SECTION 8. SYSTEM COMMISSIONING**

A Pyrogen Warranty Card is required to be completed by a contractor upon Pyrogen installation and sent to your Pyrogen Key Representative/Distributor.

The completed Pyrogen installation shall be commissioned in accordance with Commissioning Checklist attached in Appendix A (Form 2).

On completion and acceptance of the commissioning procedure, the installation contractor shall issue a Notice of Completion in Appendix A (Form 3).

***Commissioning should be carried out by trained and authorised personnel only.***



## **AEROSOL FIRE SUPPRESSION SYSTEM**

### **SECTION 9:** ***SYSTEM MAINTENANCE***

## SECTION 9. SYSTEM MAINTENANCE

***The user of the installation should ensure that the system is in good working order at all times.***

The user should carry out monthly inspections of the fire suppression equipment. This should include looking out for obstruction of the discharge nozzle, extension/alteration of the protected enclosure, openings left unclosed that were not catered for during design, and that the position and orientation of the Pyrogen generators remain in the designed position.

***The installation should be inspected at least twice a year by an authorised inspector.*** The inspection plan should include all components of the system and parts of the premises necessary for the effective operation of the system.

***A system maintenance log should be kept*** and status of every maintenance visit is recorded. For a typical system maintenance report refer to the attached Maintenance Checklist in Appendix A (Form 4).

***Periodic check-up is required for electrical circuitry of Pyrogen system.*** The following steps shall be undertaken:

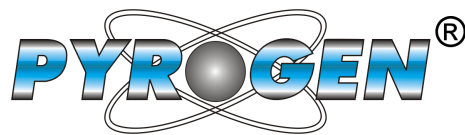
If the control system is designed to transmit alarm signals to a remote manned centre, always ensure that the link is disabled, or in the event that disabling the link is not an option, it would be essential to notify the centre before undertaking the test. Occupant of the premises should also be notified that the system test might result in the sounders being activated.

***WARNING! Prior to the start of ANY maintenance work, always ensure as the first step, that the wiring to all Pyrogen generators have been electrically isolated. Failure to do so may result in unwanted spurious discharge.***

- 1) ***Disconnect the wiring at EVERY single EXA generator.*** This is extremely important to ensure that there are no generators inadvertently left connected.
- 2) Connect miniature filament lamps with 12-24 Volts voltage and current up to 50 mA ***in place of EXA generators.***
- 3) Connect the circuit to a power supply.
- 4) Activate the system. All devices shall operate and all lamps shall glow. Should the system fail to operate properly, disconnect the power supply, check connections between devices, reconnect the power supply and try again.
- 5) Reset the system. All lamps shall be switched off.

***WARNING! Prior to connecting EXA generators, ensure the wires leading to the generators are not carrying voltage. Connection of EXA generators should always be the last function in electrical wiring procedure.***

- 6) Disconnect all of the lamps and connect the EXA generators in its place. Install EXA generators in accordance with installation recommendations.
- 7) Remove the sign on the manual release point or the automatic activation fire panel.



## **AEROSOL FIRE SUPPRESSION SYSTEM**

### **SECTION 10:**

### ***SAFETY MEASURES***

## SECTION 10. SAFETY MEASURES

### 10.1 Personnel safety

The uses of Pyrogen automatic total flooding systems are classified into **occupied** (requires approval from local authority having jurisdiction), **unoccupiable and normally unoccupied areas**. In any proposed use of Pyrogen where there is a possibility that people may enter the protected enclosure or be close to the protected risk, the following safety aspects shall apply:

- thermal automatic operation shall not be used;
- a system isolate switch shall be located at the entrance to the protected area to prevent actuation during abnormal periods of occupation, such as maintenance and repair;
- a location drawing shall be located at any manual actuation points;
- exit routes kept clear at all times, emergency lighting and adequate direction signs shall be in place to minimise travel distances;
- consideration should be given to canister location in the event of spurious activation. Unless absolutely unavoidable, canisters should not be placed at head height or in close proximity to egress doors or emergency exits.
- outward-swinging doors shall be self-latching and incorporate a self-closing mechanism to prevent possibility of doors opening inadvertently due to increase of pressure within the protected enclosure during discharge. Doors should be able to be opened from the inside including when locked from the outside.
- continuous visual and audible alarms at entrances and designated exits shall operate until the protected area has been made safe;
- warning and instruction signs in accordance with Section 7.2 shall be provided;
- pre-discharge alarms shall operate immediately upon detection of the fire.
- a time delay shall be incorporated within the manual release point and commence upon Pyrogen system operation.
- means for ventilation after discharge shall be provided, forced draft ventilation will often be necessary. Care should be taken to completely dissipate hazardous atmospheres and not just to move them to other locations.
- written instructions appropriate to the risk, instructions and drills shall be provided to all personnel within or in the vicinity of protected area, including maintenance or construction personnel who may be brought into the area, to ensure their correct actions when the system operates.

### 10.2 Potential hazards

The discharge of Pyrogen in fire extinguishing concentrations represents potential hazards to personnel in protected area. The hazards include the following:

- **high obscuration caused by the aerosol during and after discharge.**
- **potential toxicity due to some by-products of the aerosol-generating combustion reaction .**
- **thermal hazard due to a high temperature at the end plate nozzle .**

Please refer to Sections 1.8, ... for the detailed information on the above hazards.

### 10.3 Re-entry

Following the use of Pyrogen, personnel should not enter the protected area until it has been thoroughly ventilated. The minimum holding times should be observed prior to ventilation of the protected area (please refer to Section 2.10 for minimum holding times). Unless stated otherwise the minimum holding time permitted before re-entry is 3 minutes.

**Avoid exposure to the fire by-products and extinguishant mixture.**

The wearing of suitable RPE & other available means of protection may be required should it be necessary to enter the area before it is fully ventilated.

### 10.4 Clean- up

Following a system discharge the aerosol particles that have settled should be vacuumed, using HEPA filter fitted equipment, brushed or, if appropriate, washed away.

Protective gloves and goggles should be worn. A suitable RPE or mask may be required.

**Be aware, that any residue that is allowed to build up in large quantities and to absorb moisture may become electrically conductive.**

**When replacing EXA generators, be aware that immediately after discharge the canisters outer surface may exceed 200°C. Therefore, protective gloves should be worn before handling generators until at least 15 minutes after discharge.**

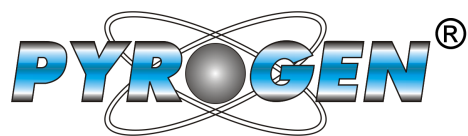
### 10.5 Hot Work

As naked flame or prolonged exposure to temperatures above 400°C may cause activation of the generators, **hot work must not be carried out within the vicinity of any generator.** If so they shall be removed prior to any hot work being carried out.

### 10.6 Storage and Transportation

Storage and transportation shall be in accordance with Class 4.1 Dangerous Goods Classification.





## **AEROSOL FIRE SUPPRESSION SYSTEM**

### **APPENDIX A:**

### ***APPROVAL DOCUMENTATION***

## APPENDIX A -- APPROVAL DOCUMENTATION

### PYROGEN INDUSTRIAL FIRE SUPPRESSION SYSTEM

#### **FORM 1 -- SYSTEM DESIGN APPROVAL CERTIFICATE**

*To be completed by the contractor to seek the approval of the appropriate authority prior to installation (where required for a specified risk area)*

*Forms an integral part of Pyrogen Warranty Card to be completed upon Pyrogen installation and sent to a local Pyrogen Key Representative/Distributor.*

##### **1. CLIENT INFORMATION:**

Address:.....

Telephone:.....Fax:.....

Contact:.....

Name:.....

##### **2. CONTRACTOR:**

Name:.....

Address:.....

Telephone:.....Fax:.....

Contact:.....

##### **3. FIRE HAZARD CLASSIFICATION (Type of Fire: Class A, B, C or E) (Please refer to Section 2.3 of the Design, Operation and Maintenance Manual):**

.....

.....

**4. PROTECTED SPACE IDENTIFICATION:**

Name of Space.....

Occupancy: unoccupiable.....  
normally unoccupied.....

**5. ELECTRIC POWER SUPPLY AVAILABLE:**

Main.....

Emergency.....

**6. NUMBER AND ELECTRICAL CHARACTERISTICS OF EQUIPMENT TO BE SHUTDOWN**

.....

**7. DESIGN CALCULATIONS:**

Protected space dimensions:

Height.....m

Length.....m

Width.....m

Area.....m<sup>2</sup>

Total area of unclosable openings to the total area of the enclosure.....%

Protected space volume:

Maximum Gross volume .....m<sup>3</sup>

Add for exhaust and inlet ducts..... m<sup>3</sup>

Deduct non-removable equipment, e.g. tanks, etc.....m<sup>3</sup>

Design Net volume..... m<sup>3</sup>

Quantity of agent required:

Design application density: (Typ. 100 g/m<sup>3</sup>) .....

Minimum Design Quantity: Minimum Design application density x Design Net vol.....g

Actual Design Quantity (should compensate for aerosol losses via unclosable openings, due to forced ventilation and other special conditions be required) .....g

Pyrogen generators selected:      Type                      Quantity

|      |       |
|------|-------|
| EXA- | ..... |
| EXA- | ..... |
| EXA- | ..... |
| EXA- | ..... |
| EXA- | ..... |

Installed quantity of agent as determined by sizes of Pyrogen generators available:.....g

***This quantity shall never be less than the minimum design quantity.***

Pressure relief venting arrangements:

Venting required: Yes/ No

Min venting area (if venting required):.....cm<sup>2</sup>

Type, number and location of vents:.....

**8. METHOD OF ACTUATION**

a) Automatic Electrical .....  
(i.e. Control Panel & detection system required – please provide for further data)

Automatic Thermal .....  
(Typically Engine, Marine & Machinery Applications)

Automatic Electrical/Thermal .....

b) Manual Electrical .....  
(Typically Engine, Marine & Machinery Applications)

---

*This form must be completed by the contractor to seek the approval of the appropriate authority, which may require that approved installers are to submit details to the authority before installation.*

*This form shall form part of the Pyrogen Warranty Card to be completed by the contractor upon Pyrogen installation and sent to a local Pyrogen Key Representative/Distributor.*

PYROGEN INDUSTRIAL FIRE PROTECTION SYSTEM  
**FORM 2 -- COMMISSIONING AND ACCEPTANCE TESTING**

Criteria for Acceptance

*The completed Pyrogen system shall be commissioned in accordance with this Commissioning Checklist. On completion and acceptance of the commissioning, the installation contractor shall issue a commissioning report.*

**COMMISSIONING CHECK LIST**

| No  | Inspection  | Compliance verified | Remarks |
|-----|---|---------------------|---------|
| 1   | <b><i>Obtain a copy of the System Design approval Certificate ( Form 1)</i></b>                           |                     |         |
| 2   | <b><i>Isolate Pyrogen generators by disconnecting generators power supply or system power supply.</i></b> |                     |         |
| 3   | <b><i>Risk area classification</i></b>  |                     |         |
| (a) | Is it the same as the System Design Approval Certificate (Item 3 Form 1)                                  |                     |         |
| (b) | Is the occupation the same as the System Design Approval Certificate (Item 4 Form 1)                      |                     |         |
| (c) | Are air handling shutdown relays and fire dampers provided  |                     |         |
| (d) | Are there any unclosable openings   |                     |         |

|     |  |  |  |
|-----|--|--|--|
| 4   | <b>Design Calculations</b>   |  |  |
| (a) | Are volumes the same as System Design Approval Certificate (Item 7 Form 1)   |  |  |
| (b) | Are the dimensions of the enclosure the same as System Design Approval Certificate (Item 7 Form 1)   |  |  |
| (c) | What is minimum Design application density?<br>Does this correspond to the type of hazardous materials involved? (Item 8 Form 1)                                     |  |  |
| (d) | Check minimum design quantity. Is it correct?  |  |  |
| (e) | If unclosable openings are present, have calculations of maximum design quantity been effected as required? Are they correct?  |  |  |
| (f) | Are design limitations in terms of enclosure height, length and width not exceeded for the type of EXA generators selected?  |  |  |
| (g) | Check number of EXA generators can supply the design quantity required   |  |  |
| (h) | Is pressure relief venting required? If yes, is min vent area the same as System Design Approval Certificate Item 7 Form1)? Check type, number and location of vents |  |  |
| 5   | <b>Power source</b><br>Check there are not less than two (2) separate sources of power, one being emergency source remote from the protected area                    |  |  |
| 6   | <b>Manual release system</b> (where appropriate)   |  |  |
| (a) | Is manual release system installed outside the protected space?  |  |  |
| (b) | Check the connection of manual release system to Pyrogen generators  |  |  |
| (c) | Is 30 seconds time delay incorporated within the release mechanism?  |  |  |

|     |   |  |  |
|-----|---|--|--|
| 7   | <b>Electrical circuitry</b>   |  |  |
| (a) | Disconnect the wiring circuit(s) to the generators at the manual release point  |  |  |
| (b) | Check integrity of the electrical circuit of the whole system. Use digital multi-meter only (supervisory current not to exceed 0.05 A for the period of 5 min)  |  |  |
| 8   | <b>Instruction and warning signs</b>  |  |  |
| (a) | Is the warning sign fitted inside the space?  |  |  |
| (b) | Is the warning sign fitted next to the entrance outside the space?  |  |  |
| (c) | Is operation sign for the manual release point fitted?  |  |  |
| 9   | <b>Alarm test</b><br>Perform a functional alarm system check.<br>Ensure evacuation/visible/audible alarms operate.  |  |  |
| 10  | <b>Timer &amp; Release test</b><br>Check the operation of the 30s time delay by operating the manual release mechanism at the manual release point. Alarms should sound and after 30 s sufficient power should be available to the disconnected generator circuit(s). |  |  |
| 11  | <b>Post fire ventilation</b>  |  |  |
| (a) | Do the ventilation systems work satisfactory?   |  |  |
| (b) | Check operational conditions of air handling shutdown relays and fire dampers if provided. Do they open and close satisfactorily?   |  |  |
| 12  | <b>Reconnection of the system</b><br>Reconnect generators by reconnecting the power supply and ensure the system is left in operable condition.<br>This should always be the last commissioning function.   |  |  |

## PYROGEN INDUSTRIAL FIRE PROTECTION SYSTEM

### FORM 3 -- NOTICE OF COMPLETION

TO BE COMPLETED BY INSTALLER FOLLOWING THE  
COMMISSIONING CHECK

I (name of installer).....

of (company).....hereby certify  
that

we have completed on (date)..... to the  
(name/address/identification of protected area).....

a PYROGEN Fire Suppression System installation in accordance with the requirements detailed in the  
System Design Approval Certificate.

Commissioning test(s) were conducted by.....

.....Date.....

.

Commissioning test(s) were witnessed  
by.....

.....Date.....

.

*This notice of completion shall have the following attached:*

- a) System Design Approval Certificate
- b) Commissioning Check List

Signature of installer.....

Date.....



## PYROGEN INDUSTRIAL FIRE PROTECTION SYSTEM

### **FORM 4 -- MAINTENANCE CHECK LIST**

Maintenance Organisation.....

Premises.....

Address.....

| No | ITEM  | MONTHLY,<br>BY OWNER | ANNUALLY,<br>BY AUTHORISED<br>INSPECTOR |
|----|---|----------------------|---|
| 1  | Electrically isolate Pyrogen generators.  | √                    | √                                       |
| 2  | Confirm the generators are secure, undamaged and free from corrosion  | √                    | √                                       |
| 3  | Check that generators' nozzles are unobstructed within the specified in Sec. 2.9 minimum clearances   | √                    | √                                       |
| 4  | Confirm all electrical wiring and connections are intact  | √                    | √                                       |
| 5  | Open the manual release point enclosure   | √                    | √                                       |
| 6  | Confirm that 30 sec time delay, evacuation and/or audible, visual and fire alarms operate   | √                    | √                                       |
| 7  | Check that instruction and warning signs are legible  | √                    | √                                       |
| 8  | Inspect power source condition  | √                    | √                                       |
| 9  | Inspect emergency power source (back-up battery) condition  | √                    | √                                       |
| 10 | Confirm that all previously requested rectification's or modifications have been completed  | √                    | √                                       |
| 11 | Inspect the area to confirm there are no unclosable openings  | -                    | √                                       |
| 12 | Inspect controls for closing pressure relief vents where applicable. Inspect for damage, corrosion, accessibility and test correct operation. | -                    | √                                       |
| 13 | Check the post fire ventilation facilities are functional.  | -                    | √                                       |
| 14 | Check that the expiry date of all generators will not occur within the next 12 months and report to the owner.                                | -                    | √                                       |
| 15 | Check the generator's electric activation circuit. Follow steps 1-8 of Section 9.   | -                    | √                                       |
| 16 | Check that all system controls are returned to normal and system is "on line"   | -                    | √                                       |
| 17 | Reconnect Pyrogen generators.   | -                    | √                                       |
| 18 | Record all inspections and necessary rectification's  | -                    | √                                       |
| 19 | Inform owner  | -                    | √                                       |

Signed:.....

Date:.....

## PYROGEN INDUSTRIAL FIRE SUPPRESSION SYSTEM

### **FORM 5 -- ANNUAL MAINTENANCE CERTIFICATE**

*TO BE COMPLETED BY THE MAINTENANCE CONTRACTOR AFTER EACH ANNUAL  
MAINTENANCE SERVICE*

I .....  
(name of Service Person)

of.....  
(company)

hereby certify that we have completed the Annual Maintenance on

.....  
(protected area)

on.....  
(date)

at.....  
(location)

in accordance with the attached Maintenance Checklist.

Signature of Service Person.....

Date.....



## **AEROSOL FIRE SUPPRESSION SYSTEM**

### **APPENDIX B:**

### **LIST OF EXA MODULES, SYSTEM COMPONENTS AND SPARE PARTS**

## APPENDIX B -- LIST OF EXA MODULES, SYSTEM COMPONENTS AND SPARE PARTS

### PYROGEN EXA FIRE SUPPRESSION SYSTEM FOR INDUSTRIAL APPLICATIONS

| Pyrogen EXA Modules |              |                   |                           |                     |
|---------------------|--------------|-------------------|---------------------------|---------------------|
| Part Number         | Pyrogen Name | Description       | Technical Characteristics |                     |
|                     |              |                   | Aerosol Mass (kg)         | Generator Mass (kg) |
| 500-FG-02-002       | EXA-Z3       | Aerosol Generator | 0.03                      | 0.36                |
| 500-FG-01-001       | EXA-Z6       |                   | 0.06                      | 0.65                |
| 500-FG-03-002       | EXA-1        |                   | 0.1                       | 0.94                |
| 500-FG-04-005       | EXA-2        |                   | 0.2                       | 1.70                |
| 500-FG-06-003       | EXA-5        |                   | 0.5                       | 3.10                |
| 500-FG-05-001       | EXA-10L      |                   | 1.0                       | 9.0                 |
| 500-FG-05-002       | EXA-10R      |                   | 1.0                       | 9.0                 |
| 500-FG-08-004       | EXA-20       |                   | 2.0                       | 11.5                |
| 500-FG-09-003       | EXA-30       |                   | 3.0                       | 23.0                |
| 500-FG-10-002       | EXA-50       |                   | 5.0                       | 27.5                |
| 500-FG-09-004       | EXA-30E      |                   | 3.0                       | 22.0                |
| 500-FG-10-004       | EXA-50E      |                   | 5.0                       | 26.5                |
| B-FG-EM-02          | EXA-M-Z2     |                   | 0.02                      | 0.3                 |
| B-FG-EM-06          | EXA-M-Z6     |                   | 0.06                      | 0.65                |
| B-FG-EM-1           | EXA-ML-1     |                   | 0.1                       | 0.8                 |
| B-FG-EM-1A          | EXA-MS-1     |                   | 0.1                       | 0.8                 |
| B-FG-EM-2           | EXA-M-2      |                   | 0.2                       | 1.2                 |
| B-FG-EM-5           | EXA-M-5      |                   | 0.5                       | 2.3                 |
| B-FG-EM-10          | EXA-M-10     |                   | 1.0                       | 8.5                 |
| B-FG-EM-10B         | EXA-MB-10    |                   | 1.0                       | 8.5                 |

#### Notes:

- The Generator Mass tolerances are as follows:-  
EXA-Z3/Z6/1 ± 30g; EXA-2/5 ± 50g; EXA-10/20 ± 300g; EXA-30/50 ± 500g
- PMSB reserves the right to change the above information without prior notice

| <b>Detection and Activation Systems</b>                 |                     |   |                          |
|---|---------------------|---|--------------------------|
| <b>Part Number</b>                                      | <b>Pyrogen Name</b> | <b>Description</b>  | <b>Operating Voltage</b> |
| 101 2ZWDIS  | 101 2ZWDIS          | FireChase Detection and Actuation System With Isolation Switch  | 12-24 VDC                |
| 102 2ZD   | 102 2ZD             | FireChase Detection and Actuation System  | 12-24 VDC                |
| 103 2ZIP  | 103 2ZIP            | FireChase Detection system two circuit  | 12-24 VDC                |
| 104 4ZIP  | 104 4ZIP            | FireChase Detection system four circuit   | 12-24 VDC                |
| 107 CNC FDDP  | 107 CNC FDDP        | FireChase CNC Detection and Actuation System  | 12-24 VDC                |
| <b>Accessories for Detection and Activation Systems</b> |                     |   |                          |
| <b>Part Number</b>                                      | <b>Pyrogen Name</b> | <b>Description</b>  | <b>Operating Voltage</b> |
| 201 DOB2  | 201 DOB2            | Dual-Output Booster (fully monitored) to increase number of connected canisters or use high current output for ancillaries up to 5Amp             | 12-24 VDC                |
| 202 JB-1IN  | 202 JB-1IN          | Junction Box for Monitoring 1 Discharge Line (metal case for industrial panel)  | N/A                      |
| 203 JB-2/3 MA   | 203 JB-2/3 MA       | Junction Box for Monitoring 2(3) Discharge Lines (plastic case for marine & automotive applications)  | N/A                      |
| 204 JB-4/5 MA   | 204 JB-4/5 MA       | Junction Box for Monitoring 4(5) Discharge Lines (plastic case for marine & automotive applications)  | N/A                      |
| 205 FMP CP 101-4  | 205 FMP CP 101-4    | Flush-mounting Plate for Detection and Activation System  | N/A                      |
| 206 IIU   | 206 IIU             | Igniter Interface Unit (IIU) to monitor Discharge line through SFM (1 IIU per canister)   | N/A                      |
| 207 SFM   | 207 SFM             | Supervision Firing Module (SFM) - universal interface to monitor & discharge (up to 10) canisters by any type of Detection and Activation Systems | 24 VDC                   |
| 208 ALJB-2/3 MA   | 208 ALJB-2/3 MA     | Junction Box for Monitoring 2(3) Discharge Lines (aluminum casting case suitable for aggressive environment in marine & automotive applications)  | N/A                      |
| 209 ALJB-4/5 MA   | 209 ALJB-4/5 MA     | Junction Box for Monitoring 4(5) Discharge Lines (aluminum casting case suitable for aggressive environment in marine & automotive applications)  | N/A                      |

| <b>Activation Devices</b>                                   |                     |  |                          |
|---|---------------------|--|--------------------------|
| <b>Part Number</b>  | <b>Pyrogen Name</b> | <b>Description</b>   | <b>Operating Voltage</b> |
| 302 T-45  | 302 T-45            | Thermal activation device T-start-45C  | N/A                      |
| 303 T-72  | 303 T-72            | Thermal activation device T-start-72C  | N/A                      |
| 304 T-110   | 304 T-110           | Thermal activation device T-start-110C   | N/A                      |
| 305 T-man   | 305 T-man           | Activation device T-start Manual   | N/A                      |
| 306 DCJB  | 306 DCJB            | Detection Circuit Junction Box for T-start / TAD                               | N/A                      |
| 307 P CUP   | 307 P CUP           | Protective Cup   | N/A                      |
| 308 HL-PAWIS  | 308 HL-PAWIS        | High Lithium Power Accelerator For T-start / TAD With Isolation Switch         | N/A                      |
| 309 SEP-PAWIS   | 309 SEP-PAWIS       | Solid Electrolyte Power Accelerator For T-start / TAD With Isolation Switch    | N/A                      |
| 310 BUR-PAWIS   | 310 BUR-PAWIS       | Back up Rechargeable Power Accelerator For T-start / TAD With Isolation Switch | 12-24 VDC                |
| 502-AS-TS-018   | 502-AS-TS-018       | Thermal activation device TAD-45   | N/A                      |
| 502-AS-TS-001   | 502-AS-TS-001       | Thermal activation device TAD-72   | N/A                      |
| 502-AS-TS-006   | 502-AS-TS-006       | Thermal activation device TAD-110  | N/A                      |
| TAD-man   | TAD-man             | Activation device TAD-Manual   | N/A                      |
| 502-AS-MR-002   | 502-AS-MR-002       | Dual Action Manual Push Button for TAD   | 12-24 VDC                |
| <b>Warning Devices for Detection and Activation Systems</b> |                     |  |                          |
| <b>Part Number</b>  | <b>Pyrogen Name</b> | <b>Description</b>   | <b>Operating Voltage</b> |
| 513SIWS-EVAC  | 513SIWS-EVAC        | Sign Illuminated with Sounder EVAC   | 12-24 VDC                |
| 514SIWS-DNE   | 514SIWS-DNE         | Sign Illuminated with Sounder DNE  | 12-24 VDC                |