

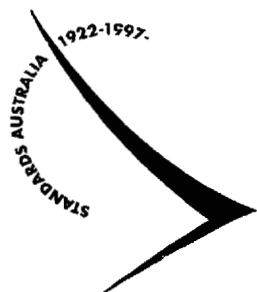
AS/NZS 4487:1997

Australian/New Zealand Standard<sup>®</sup>

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**Pyrogen fire extinguishing systems**

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**AS/NZS 4487:1997**

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 Fire Trainers Association of Australia  
 Institute of Security Executives  
 Metal Trades Industry Association of Australia  
 New Zealand Fire Equipment Association  
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## Pyrogen fire extinguishing systems

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## PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee FP/11 on Fire Extinguishing Systems.

The objective of this Standard is to provide users of Pyrogen fire extinguishing aerosol systems with specific requirements for the control of fires of Classes A, B, C, E and F type. It does not cover the design of explosion suppression systems.

It is essential that fire extinguishing equipment be carefully maintained to ensure instant readiness when required. The importance of maintenance cannot be too highly emphasized. The maintenance requirements for Pyrogen fire extinguishing aerosol systems for fire protection equipment are detailed in another Standard.

It is a basic assumption in all technical Standards work that each Standard be used only by persons competent in the field of application with which it deals. This is of particular importance in fire protection work. Accordingly, it is emphasized that the design requirements in this Standard are to be interpreted only by trained and experienced designers.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

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## FOREWORD

It is important that the fire protection of a building or plant be considered as a whole. Pyrogen fire extinguishing aerosol systems form only a part, though an important part, of the available facilities. However, it should not be assumed that their adoption necessarily removes the need to consider supplementary measures such as the provision of portable fire extinguishers or mobile appliances for first aid or emergency use, or measures to deal with special hazards.

Pyrogen is recognized as an effective extinguishant for Class A, Class B, Class C, Class E and Class F fires, but it should not be forgotten in the planning of the comprehensive schemes that there may be hazards for which this technique is not suitable, or that in certain circumstances or situations there may be dangers in its use which require special precautions.

## STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

**Australian/New Zealand Standard****Pyrogen fire extinguishing aerosol systems**

## SECTION 1 SCOPE AND GENERAL

**1.1 SCOPE** This Standard sets out requirements for design, installation and commissioning of fire extinguishing systems utilizing SOYUZ pyrogenically generated fire extinguishing aerosol for use as single or multiple systems for total flooding applications in normally unoccupied areas. The SOYUZ pyrogenically generated fire extinguishing aerosol shall be generally referred to as Pyrogen in this Standard.

**1.2 APPLICATION** Pyrogen fire extinguishing aerosol systems shall be generally referred to as 'a system' or 'the system' in this Standard and shall comply with the requirements of this Standard.

**1.3 NEW DESIGN AND INNOVATIONS** Any alternative materials, designs, methods of assembly, procedures and the like that do not comply with specific requirements of this Standard, or are not mentioned in it, but give equivalent results to those specified are not necessarily prohibited. The specified approval remains the prerogative of the authority.

**1.4 REFERENCED DOCUMENTS** The following documents are referred to in this Standard:

**AS**

- 1216 Classification, hazard identification and information systems for dangerous goods
- 1216.1 Part 1: Classification and classes of labels for dangerous goods
- 1319 Safety signs for occupational environment
- 1603 Automatic fire detection and alarm systems
- 1603.4 Part 4: Control and indicating equipment
- 1670 Automatic fire detection and alarm systems—System design, installation and commissioning
- 2220 Emergency warning and intercommunication systems in buildings
- 2430 Classification of hazardous areas
- 2700 Colour Standards for general purposes
- 2706 Numerical values—Rounding and interpretation of limiting values.
- 3000 Electrical installations—Buildings, structures and premises (known as the SAA Wiring Rules)
- 3100 Approval and test specification—General requirements for electrical equipment

**AS/NZS**

- 1850 Portable fire extinguishers—Classification, rating and performance testing

**AS/NZS**

- 1851 Maintenance of fire protection equipment
- 1851.16 Part 16: Pyrogen fire extinguishing aerosol systems

**UL**

- 1058 Standard for halogenated extinguishant extinguishing system units

**1.5 INTERPRETATION OF SPECIFIED LIMITING VALUES** For the purpose of assessing compliance with this Standard, the specified limiting values shall be interpreted in accordance with the 'rounding method' described in AS 2706, i.e the observed or calculated value shall be rounded to the same number of figures as in the specified limiting values and then compared with the specified limiting value. For example, for specified limiting values of 2.5, 2.50, and 2.500, the observed or calculated value would be rounded respectively to the nearest 0.1, 0.01, or 0.001.

**1.6 DEFINITIONS** For the purpose of this Standard, the definitions below apply.

**1.6.1 Actuating mechanism**—automatic or manual activation leading to the physical discharge of extinguishant.

**1.6.2 Aerosol**—a pyrogenically generated extinguishant consisting of finely divided solid particles and gaseous matter, these being combustion products of solid aerosol-forming composition.

**1.6.3 Aggressive environment**—aggressive service environments include the following or as defined by the appropriate authority:

- (a) Exterior situations exposed to the sun, ultraviolet radiation, wind, rain, or salt spray.
- (b) Corrosive atmospheres.
- (c) Abnormally dusty or moisture-laden atmospheres.
- (d) Environments which subject the system to continuous or intense vibrations.
- (e) Environments having extremes of temperature.

**1.6.4 Appropriate authority**—a Minister of the Crown, a government department, or other public authority having power to issue regulations, orders or other instructions having the force of law in respect of any subject covered by an Australian Standard or, in the case where none of these apply, the owner or the owner's agent.

**1.6.5 Approved and approval**—approved by, or the approval of, the appropriate authority.

**1.6.6 Automatic**—performing a function without the necessity of human intervention.

**1.6.7 Combustion reaction**—a reaction resulting from the ignition of a solid aerosol-forming composition which produces fire extinguishing aerosol.

**1.6.8 Control device**—a device to control the sequence of events leading to the release of the extinguishant.

**1.6.9 Coolant**—a heat absorbing medium.

**1.6.10 Design concentration(g/m<sup>3</sup>)**—the mass of a particular aerosol per m<sup>3</sup> of enclosure volume required to extinguish a specific type of fire, including a safety factor.

**1.6.11 Design factor (g/m<sup>3</sup>)**—the mass of a solid aerosol-forming composition per m<sup>3</sup> of enclosure volume required to achieve the design concentration necessary to extinguish a specific type of fire.

**1.6.12 Design quantity**—the mass of solid aerosol-forming composition necessary to extinguish a fire in a particular risk, including a safety factor.

**1.6.13 Extinguishant**—aerosol produced from Pyrogen generator.

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

**1.6.15 Hot work**—grinding, welding, thermal or oxygen cutting or heating and other related heat-producing or spark-producing operations.

**1.6.16 Inerting**—the prevention of ignition of a flammable or explosive atmosphere by establishing a suitable concentration of extinguishant.

**1.6.17 Igniter**—any device which is able to ignite the solid aerosol-forming composition.

**1.6.18 Listing authority**—an internationally recognized fire protection test and approval body such as—

- (a) Factory Mutual (FM);
- (b) Underwriters Laboratories (UL);
- (c) Loss Prevention Council (LPC); or
- (d) Scientific Services Laboratory (SSL).

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

**1.6.20 Manual**—requiring human intervention to accomplish a function.

**1.6.21 Monitoring**—the supervision of the operating integrity of an electrical, mechanical, pneumatic or hydraulic control feature of a system.

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

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

**1.6.24 Operating device**—any component involved between actuation and release.

**1.6.25 Primary release**—release of extinguishant initiated by detection system or manual operation under normal conditions.

**1.6.26 Pyrogen**—SOYUZ pyrogenically generated fire extinguishing aerosol.

**1.6.27 Pyrogen generator**—a device consisting of at least an outer case containing an ignition device, a solid aerosol-forming composition, coolant and end plate nozzle(s).

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

**1.6.29 Shall**—indicates that a statement is mandatory.

**1.6.30 Should**—indicates a recommendation.

**1.6.31 Solid aerosol-forming composition**—a mixture of combustible component, potassium salt based oxidant and technical admixtures producing fire extinguishing aerosol upon ignition.

**1.6.32 System isolate switch**—a manually operated switch that prevents automatic discharge of the extinguishant.

**1.6.33 Thermal ignition device**—a linear fuse, which automatically ignites at a rated temperature or when exposed to a naked flame and arranged to ignite the solid aerosol forming composition.

**1.6.34 Total flooding system**—a fire extinguishing system consisting of a supply of extinguishant arranged to discharge into an enclosure or enclosures.

## 1.7 USES AND LIMITATIONS OF PYROGEN

**1.7.1 General** Pyrogen consists of four main components—

- (a) a solid aerosol-forming composition;
- (b) a chemical coolant;
- (c) an electric igniter; and
- (d) end plate nozzle(s).

The components are brought together in a Pyrogen generator. A schematic of a typical Pyrogen generator is given in Figure 1.1. Pyrogen is applied to a risk through a generator(s) only.

When an electrical current is applied to the igniter, the solid aerosol-forming composition undergoes a chemical reaction of combustion to produce the fire extinguishing aerosol. The aerosol propels itself through the coolant, which decomposes, absorbing a great amount of heat from the aerosol so that at the end plate nozzle(s), the discharge temperature would not exceed 250°C.

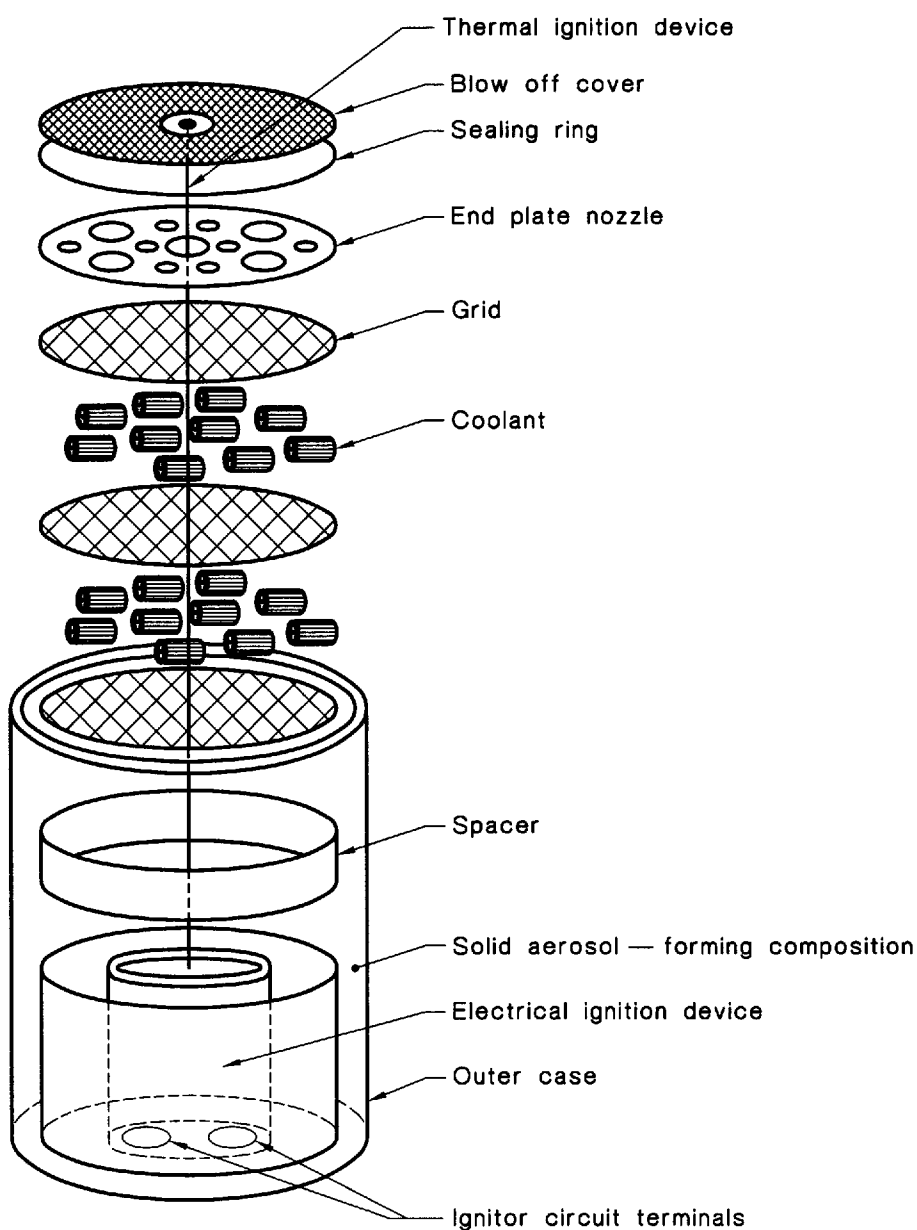


FIGURE 1.1 SCHEMATIC OF PYROGEN GENERATOR

**1.7.2 Extinguishing mechanism** Pyrogen is a pyrogenic aerosol consisting of finely divided solid particles (40% by mass) based on potassium compounds and gas (60% by mass), mainly comprised of nitrogen, carbon dioxide and water vapour. Pyrogen aerosol is a whitish, electrically non-conductive gas-like medium, close in density to air.

Pyrogen aerosol extinguishes fires chemically, interfering with the flame chain reaction by removing the reactive free radicals and physically, by cooling the seat of the fire. Both actions take place mainly on the surface of the aerosol particles, and as such, the finer the particles the more effective is the extinguishment.

### **1.7.3 Uses for Pyrogen systems**

**1.7.3.1 General** Pyrogen may be used as a total flooding extinguishant for normally-unoccupied areas to fight fires of Classes A, B, C, E and F as defined in AS/NZS 1850. Where a flammable or combustible atmosphere may be present, the possibility of explosion during and after system discharge should be considered (see Clause 2.3.4).

**1.7.3.2 Total flooding systems for normally unoccupied areas** 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, thereby ensuring effective extinguishment, for example, for—

- (a) enclosures such as rooms, vaults, enclosed machines, containers, storage tanks and bins;
- (b) enclosed electrical hazards such as transformers, control cubicles, switchboards, circuit-breakers and rotating equipment;
- (c) enclosed flammable liquid storage and processing areas;
- (d) engines using flammable fuels; and
- (e) computers, data processing equipment and control rooms.

NOTE: In cases where the typical risk is from deep-seated fires, higher than normal concentrations of extinguishant together with long holding periods, may be required in order to achieve extinguishment.

**1.7.4 Limitations of Pyrogen systems** Pyrogen systems are not suitable for fires involving the following:

- (a) Certain chemicals or mixtures of chemicals such as cellulose nitrate and gunpowder, which are capable of rapid oxidation in the absence of air.
- (b) Reactive metals such as sodium, potassium, magnesium, titanium, zirconium, uranium, and plutonium.
- (c) Metal hydrides or metal amides.
- (d) Chemicals capable of undergoing autothermal decomposition such as certain organic peroxides and hydrazine.
- (e) Pyrophoric materials such as white phosphorous or metallo-organic compounds.
- (f) Oxidizing agents such as nitric oxides and fluorine.

The foregoing list may not be exhaustive.

**1.7.5 Protection of multiple risks** The system may be used to protect one or more risks by means of separate generators. Where two or more risks may be simultaneously involved in fire, each risk shall be protected with an individual system with the combination of systems arranged to discharge simultaneously.

## SECTION 2 SAFETY REQUIREMENTS

**2.1 POTENTIAL HAZARDS** The discharge of Pyrogen in fire extinguishing concentrations may create serious hazards for personnel in both the protected area and areas to which it may migrate. These hazards include the following:

- (a) *Reduced visibility* Reduced visibility both during and after discharge period.
- (b) *Potential toxicity* When activated, Pyrogen may produce toxic levels of gases such as carbon monoxide, nitrogen oxides and ammonia, which are typical by-products of the aerosol generating reaction. Actual concentrations of these by-products depend on the chemical compositions of the solid aerosol-forming mixture and coolant, engineering design of Pyrogen generators and conditions of the enclosure under protection.

Unnecessary exposure to Pyrogen aerosol shall be avoided.

When selecting a system careful consideration should be given to independent occupational health and safety data.

NOTE: Information of Pyrogen toxicity is provided in Appendix A.

- (c) *Thermal hazard* The temperature at the end plate nozzle(s) may reach 250°C. Within 0.5 m from the nozzle the temperature shall not exceed 75°C.
- (d) *Turbulence* The turbulence caused by high-velocity discharge from the nozzle may be enough to dislodge substantial objects directly in its path, such as ceiling tiles and light fittings. Therefore, tiles and light fittings should be properly secured. Aerosol discharge may also cause enough general turbulence to move unsecured paper and light objects.

**2.2 PROTECTION OF OCCUPANTS** Reduced visibility during and after discharge together with potential toxicity restricts the use of a Pyrogen total flooding system to normally unoccupied areas only. 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, suitable safeguards such as personnel training, warning signs, pre-discharge alarms and system isolate switches shall be provided. Means of ventilation after fire should be readily available.

### 2.3 SAFETY ASPECTS

**2.3.1 General** In areas protected by total flooding systems that are capable of being occasionally entered, the provision of the following safety aspects shall apply:

- (a) A system isolate switch at the entrance to the protected area.
- (b) A location drawing at the manual release point (see Figure 2.1).
- (c) Exit routes which shall be kept clear at all times and emergency lighting and adequate direction signs to minimize travel distances shall be provided.
- (d) Outward-swinging self-closing doors which are able to be opened from the inside including when locked from the outside.
- (e) Continuous visual and audible alarms at entrances and designated exits, until the protected area has been made safe.
- (f) Warning and instruction signs in accordance with Section 8.
- (g) Pre-discharge alarms within such areas will operate immediately upon detection of the fire.

- (h) Means for ventilation of such areas after any discharge of extinguishant. Forced draft ventilation will often be necessary. Care should be taken to completely dissipate hazardous atmospheres and not just move them to other locations.
- (i) Written instructions appropriate to the risk, instructions and drills of all personnel within or in the vicinity of protected areas, including maintenance or construction personnel who may be brought into the area, to ensure their correct actions when the system operates.

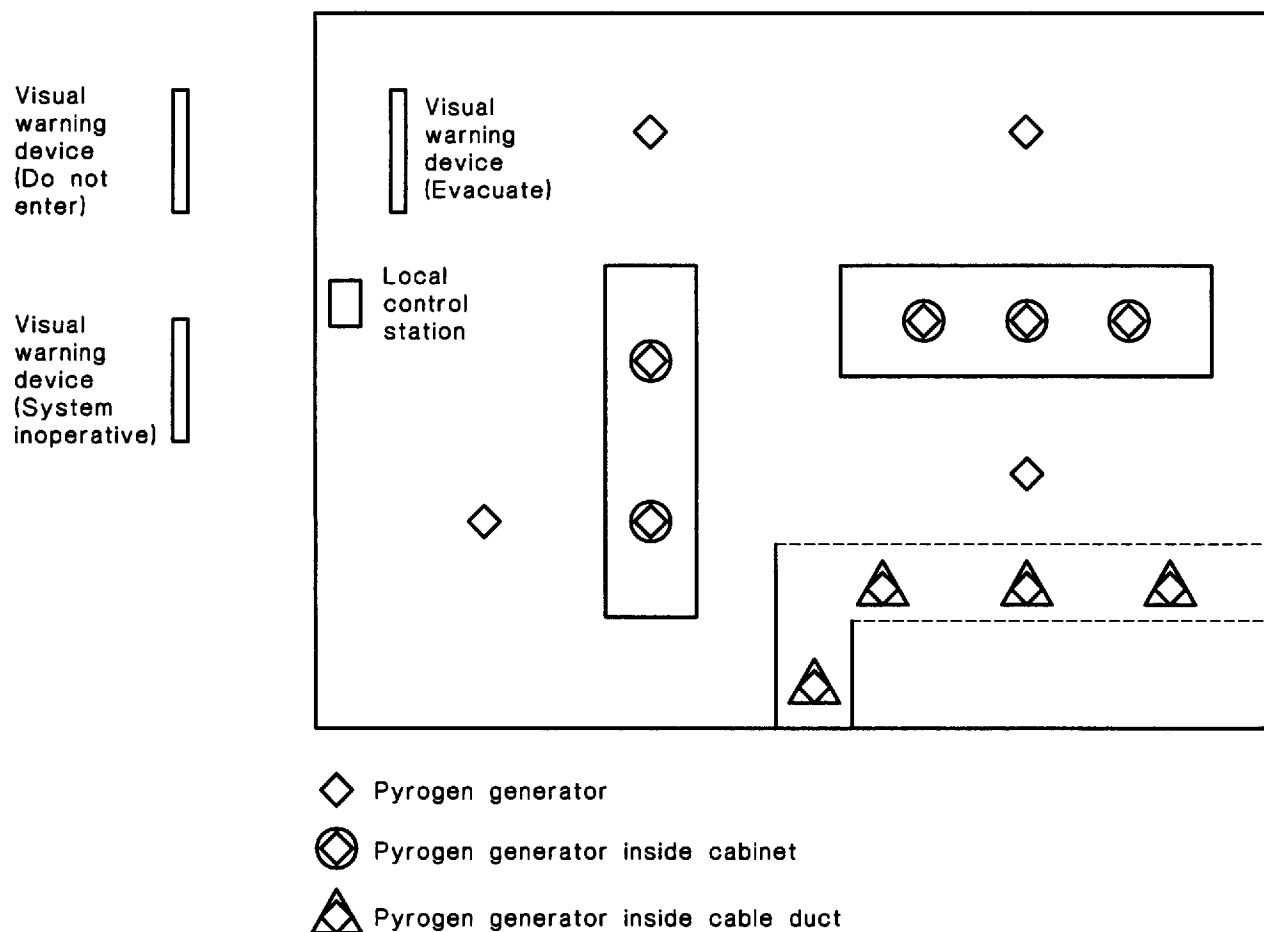


FIGURE 2.1 TYPICAL LOCATION DRAWING

**2.3.2 Installer's responsibility** The installer shall be responsible for the provision of the following:

- (a) Warning and instruction signs in accordance with Section 8.
- (b) Alarms within the area that will operate immediately on detection of fire.
- (c) Continuous alarms at the entrance to the protected area to be sounded until the atmosphere has been restored to normal.
- (d) Instruction to disarm the system during periods of inspection, maintenance or modification.
- (e) Instruction to the owner to remove Pyrogen generator(s) before allowing any hot work to be conducted inside the protected area.
- (f) System isolate switches at the entrance to the protected area.

**2.3.3 Owner's responsibility** The owner shall be responsible for the provision of the following:

- (a) Written procedures appropriate to the risk, instruction and drills of all personnel within or near the protected area.
- (b) Adequate aisles and routes of exit and keeping them clear at all times.
- (c) Only outward-swinging, self-closing doors at exit from protected areas and, where doors are latched, provision of panic hardware.
- (d) Safety features for other personnel as indicated by careful study of each particular situation.
- (e) Sufficient post-fire ventilation, natural or mechanical, of the protected area. Care should be taken to dissipate products of combustion and not merely move them to other locations which may be occupied at any time.
- (f) Maintenance of the system in accordance with AS/NZS 1851.16.
- (g) Any additional signage required to implement the procedures.
- (h) The owner shall arrange for the removal of the Pyrogen generators prior to the commencement of hot work in the area.

**2.3.4 Electrical clearance** All system components shall be located so as to maintain minimum clearances from live parts in accordance with AS 3000.

For the purpose of this Standard, 'clearance' is the air distance between extinguishant equipment, including nozzles and unenclosed or uninsulated live electrical components.

**2.3.5 Hazardous areas** All parts of a system required to be installed in a hazardous area as defined in AS 2430, shall be of a suitable form as determined from AS 3000 or certified for the application.