



# Fire Protection for Electrical Enclosures

“Micro environment” protection

September 2009



Details on fires in Electrical equipment and how to suppress them using **FIRETRACE**® automatic suppression systems

# Background Information

There are many types of Electrical Cabinets within an organisation and they are there to maintain and control all kinds of vital processes throughout the business.

Whether they are Machinery Control Cabinets (MCC's), Switchgear, Substations or simple Fuse Boxes, they are vital to the continued operation of a business and the loss or damage of such a piece of equipment could have devastating consequences.

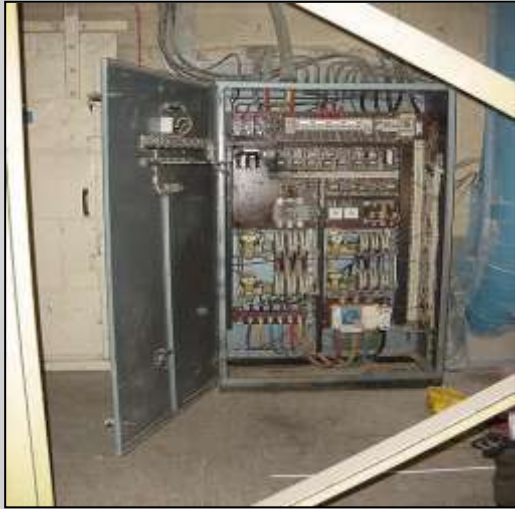


Fire is one of the major causes of damage to these items of essential equipment and the ability to prevent such losses, through simple fire protection engineering can mean the difference between business success and failure.

Typically fires in electrical panels start from loose connections and faulty wires, when there is power running through them the electricity can arc. This arced electricity is extremely hot and causes the plastic coatings on the wires to burn and spread to other components. One thing to note is that low voltage and high voltage connections and equipment are both fire risks and deserve equal amounts of protection. By running the tubing directly above any connections and components such as switches and transformers you will minimize the time it takes to detect and suppress the fire.

Financial Loss, Operational Downtime or even the complete destruction of your operation can be a frightening reality, with around 40% of all organisations experiencing a fire, never recovering.

***According to UK National Statistics, around 30% of non-dwelling, accidental fires are caused by faulty electrical equipment and leads.***



**FIRETRACE®** has been installed in hundreds of cabinets at the new DIAL international airport using our patented Firetrace Detection Tubing.

Systems require no external power to operate, and very little maintenance

System only activates in the event of a fire, no false alarms

**FIRETRACE®** systems can be fitted in a matter of hours

Easy to retrofit old cabinets and new builds

Pressure gauges allow for quick and easy checks on the system to make sure they are always operational



**FIRETRACE®** is fitted to pumping stations in Qatar to ensure there is constant coverage

Quick acting so only minimal damage is done to equipment

System can be quickly replaced after a fire has taken place

# Worst Case Scenario

This is a recent photo of a burnt out MCC at a location in Europe which did not have any automatic in cabinet fire protection. It was a control cabinet for vital functions within this company's operation. The loss through downtime and effected stock was considerable. Though the smoke alarm was triggered by the time the fire brigade could extinguish the fire the damage had been done. An engineer on site tried to tackle the fire with a hand held CO2 portable extinguisher but the smoke and flames and the enclosure around the burning components meant that he was unable to affect the fire in any way.



## Small Fire – High Value Risk

A small fire starting in a low cost electrical cabinet can spread and cause millions of dollars worth of incremental damage. A Fire of this nature can impact the whole operation of a business and cause serious life safety issues. Small Fires can lead to huge damage and cost. A small electrical cabinet fire in the Cargo section of Turkey's Ataturk Airport in June 2006 is thought to have developed to go on to cause tens of millions of dollars of further damage. Protecting Electrical cabinets with a low cost but highly effective Firetrace Protection System can be part of responsible Fire Risk Reduction program inside an organization.

# Why use Firetrace?

Firetrace Systems have been installed on thousands of electrical control cabinets all over the world, from pumping stations in Qatar to Airport Control Cabinets in Delhi. Whether they are high or low-voltage enclosures, Firetrace Systems are ideal for the early detection and protection against fire in these environments, being automatic, clean and safe for use on electrical equipment and with a choice of system sizes available, able to protect many different types of application.

The Firetrace Systems used on electrical control cabinets consist of a small, pressurized container using either FM200 or 3M™ Novec™ 1230 as the extinguishing medium. This is connected to a length of Firetrace Detection Tube (FDT) that is appropriately routed all around the compartment(s) to provide linear, pneumatic detection in a 360 degree environment.

In the event of a fire, or high temperature rise, the FDT will burst and discharge the extinguishing agent directly on to the fire at its source, rapidly knocking down any fire.

The agent quickly fills the compartment, rapidly knocking down the flame and suppressing the fire within a matter of seconds. Suppression is by means of cooling, with some chemical reaction with the flame and both types of agent are clean, non-toxic and confirmed as suitable for use on electrical fires.



Unlike some other technologies there is no delay in the build-up of an extinguishing concentration or a delay caused because the extinguishing gas must find a way into the cabinet and to the source of the fire from the outside. Firetrace systems localise the fire and prevent fire damage to the cabinet components.

Systems that discharge through pipe work and nozzles have the difficulty in delivering the extinguishing agent rapidly onto the fire source. Electrical Cabinet manufacturers are hesitant about maintaining warranty and type test certificates on Electrical / Machinery Control Columns that might be installed with electrically conductive (metal) pipe work.

Firetrace Detection Tubing is ideal for fire detection in electrical control cabinets, as it is treated just like another cable. It is electrically non conductive, flexible, easy to install and will not affect any rating of the cabinets and their compartments. It is also suitable for use in all environments, be they clean or dusty and is not affected by high air-flow or low temperatures.

Following a system discharge, no clean-up of the agent is required, as they are clean, non-toxic gases when discharged in a fire situation.

Should you be unlucky enough to experience a fire in your equipment, you'll find you can be operational in only a short space of time. By only having to maybe repair a small part of your unit and with the simple re-charging or replacement of your Firetrace system, you can be up and running, with full protection in no time, ensuring any business interruption is kept to a minimum.

## **FIRETRACE®** Detection Tubing (FDT)

At the heart of all **FIRETRACE®** systems is the Firetrace Detection Tubing, or FDT. This flexible, pneumatic tubing is the primary fire detection and unit activation method used in all **FIRETRACE®** Automatic Suppression Systems. It is flexible enough to be used in the most difficult installations, yet durable enough to withstand harsh conditions and continue to perform as intended.



### Firetrace Detection Tubing

The FDT is a linear, pneumatic, fire detection device that responds to a combination of heat and radiant energy generated by a fire. When exposed to these conditions, the properties of the FDT in this localized area change. The material becomes softer and weaker than the surrounding areas. In this weakened state, the gas contained inside of the FDT is able to burst through, releasing the pressure in the entire length of FDT. This rupture and depressurization of the FDT is what activates the rest of the system, which discharges the fire suppression agent.



FDT after Detection

The FM Approved Firetrace Detection Tubing (FDT) is a linear, pneumatic, fire detection device that responds to a combination of the heat and radiant energy from a fire. The FDT is non-porous, so it can contain internal pressure for an extended time. The FDT is also resilient to most common chemicals or substances. The FDT is made of an inert, non-conductive blend of proprietary resins, and then extruded using a special process to ensure that the tubing is non-porous. This unique blend of materials gives the FDT the following attributes:

- Excellent Physical Durability and Flexibility
- High Pressure Performance
- Wide Temperature Range
- Good Chemical Resistance\*
- Excellent UV Resistance

\*Tests on chemical resistivity performed by Oxford University

# System Specifications

## Novec 1230 Fire protection fluid

The extinguishing agent used in **FIRETRACE**<sup>®</sup> pre-engineered automatic indirect fire suppression units is Dodecafluoro-2-methylpentan-3-one, more commonly known as Novec 1230.

Novec 1230 (1,1,1,2,2,4,5,5,5-NONAFLUORO-4-(TRIFLUOROMETHYL)-3-PENTANONE) is a colourless low odour fluid, low in toxicity, electrically non-conductive, leaves no residue, and is an extremely effective fire suppression agent. Novec 1230 is included in NFPA-2001, under the generic name FK-5-1-12, and has been evaluated and approved for use in occupied areas as a Total Flooding agent; when used as specified under the U.S. Environmental Protection Agency (EPA) SNAP Program rules.

Refer to the SNAP Program rules for more information.



### Cleanliness

Novec 1230 is clean and leaves no residue, thereby minimizing after fire clean up along with keeping expensive downtime to a minimum. Most materials such as steel, aluminium, stainless steel, brass, as well as plastics, rubber and electronic components are not affected by exposure to Novec 1230. This agent is also environmentally friendly, having ozone depletion potential (ODP) of 0.00 and an atmospheric lifetime of 5 days (the closest halocarbon alternative is 33 years). (3M, 2003)

### 3M™ Novec™ 1230 Fire Protection Fluid Environmental Properties Comparison

Properties	Novec 1230	Halon 1211	Halon 1301	HFC-125	HFC-227ea	HFC-23
Ozone Depletion Potential (ODP) <sup>1</sup>	0.0	5.1	12.0	0.0	0.0	0.0
Global Warming Potential-IPCC <sup>2</sup>	1	1300	6900	3400	3500	12000
Atmospheric Lifetime (years)	0.014	11	65	29	33	260
SNAP (Yes/No)	Yes	N/A	N/A	Yes	Yes	Yes

<sup>1</sup> World Meteorological Organization (WMO) 1998, Model-Derived Method

<sup>2</sup> Intergovernmental Panel on Climate Change (IPCC) 2001 Method, 100 Year ITH

Not for specification purposes

All data other than those for Novec 1230 fluid were compiled from published sources

## HFC-227ea Extinguishing Agent

An alternative extinguishing agent used in **FIRETRACE**® pre-engineered automatic direct fire suppression units for electrical enclosures is Heptafluoropropane, more commonly known as HFC-227ea, or FM200. HFC-227ea (1,1,1,2,3,3,3-heptafluoropropane,  $\text{CF}_3\text{CHF}_2\text{CF}_3$ ) is a colourless odourless gas, low in toxicity, electrically non-conductive, leaves no residue, and is an extremely effective fire suppression agent.

HFC227ea has been the standard clean agent for many years and is well know and trusted worldwide

HFC-227ea is included in NFPA-2001 and has been evaluated and approved for use in occupied areas as a Total Flooding agent.

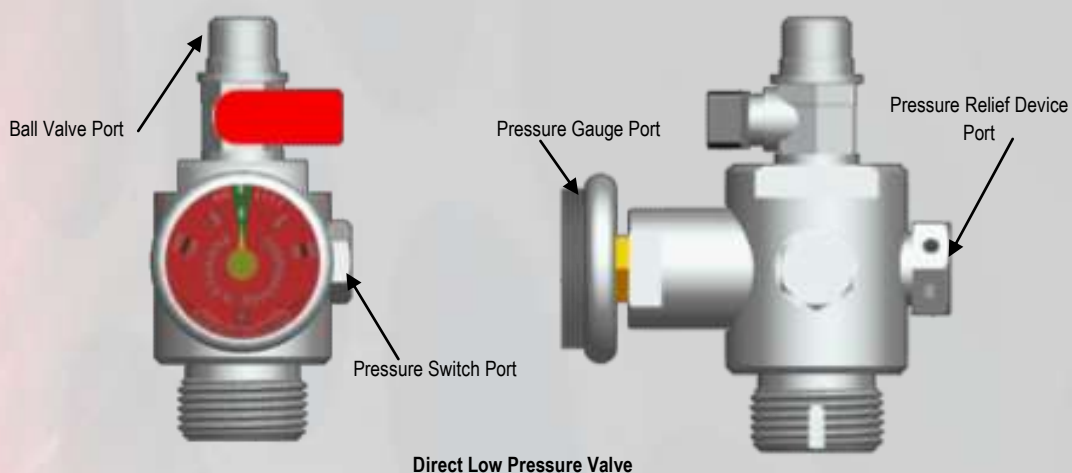
HFC-227ea is clean and leaves no residue, thereby minimizing after fire clean up along with keeping expensive downtime to a minimum. Most materials such as steel, aluminium, stainless steel, brass, as well as plastics, rubber, and electronic components are not affected by exposure to HFC-227ea. This agent is also environmentally friendly, having an ozone depletion potential (ODP) of 0.00.

For hazard information, decomposition information, and physical properties of FM200 please refer to the Material Safety Data sheet located in the System Manual, or contact Firetrace International Ltd.

### Valve Assembly

Each cylinder is equipped with a nickel plated brass valve, a pressure gauge to monitor cylinder pressure, and a quarter turn ball valve that interfaces with the Firetrace detector tubing. The ball valve must be kept closed at all times when the cylinder is not in service.

In addition, all DOT cylinder valves are equipped with a pressure relief (rupture disc) device in compliance with safety requirements



(CE Manufactured Systems for the European market do not require a pressure relief device)



## Pressure switch

A pressure switch is provided to monitor system pressure, system actuation and/or to energize or de-energize electrically operated equipment. This unit can be connected at the end of the line of the **FIRETRACE®** detector tubing, or on the container valve assembly to provide additional electrical functions as may be required. **FIRETRACE®** recommends that all systems use a pressure switch coupled with some device to alert personnel in the event of a system discharge

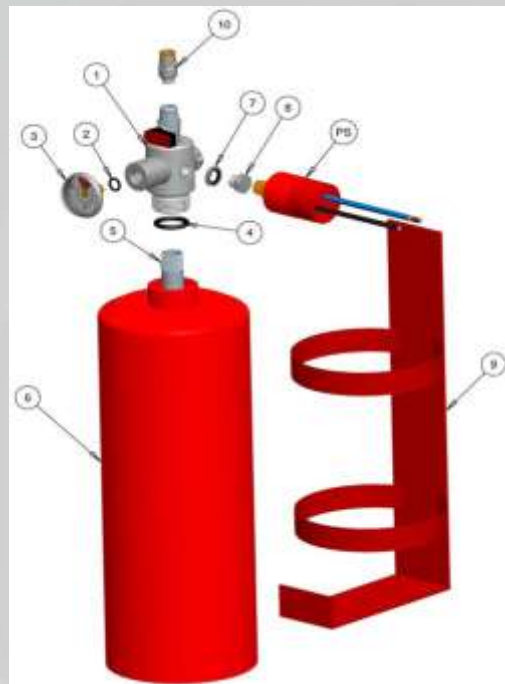
## Cylinder/Valve Assembly

The extinguishing agent is stored in steel or aluminium cylinders super-pressurized with nitrogen to 150 psig at 70°F, for FM200 (10.3 bar at 21°C) or to 195 psig at 70°F for 3M™ Novec™ 1230 (13.4 bar at 21°C). Each cylinder is equipped with a straight siphon tube and can only be mounted in a vertical (upright) position.

A wall mounted painted steel bracket is used to mount the cylinder/valve assembly in a vertical (upright) position. Each bracket is equipped with two (2) integral quick-clamp straps

### ITEM DESCRIPTION

- 1 DLP Valve
- 2 O-Ring, Pressure Switch/Pressure Gauge
- 3 System Gauge
- 4 Collar O-ring DLP
- 5 Siphon Tube
- 6 Low Pressure Cylinder
- 7 Bonded seal (pressure switch on valve)
- 8 Plug, pressure switch port on valve
- 9 Low Pressure System Bracket
- 10 HP Slip-on union



# FIRE ALARM INTEGRATION

The Firetrace system is delivered including a factory installed normally open / normally closed Low Pressure Switch. This allows the discharge of a Firetrace system to be monitored and integrated with the Fire Alarm or Building Management system.

This output signal can perform other functions as required i.e. sounding alarms, shutting down equipment, activating dampers, fire doors etc.



The Firetrace systems do not need to be connected to an external power supply source so even in the event of a general power failure the Firetrace System is always on and ready to protect critical equipment against the risk of fire.

# System Design



Direct System Example

Electrical equipment such as fuse boxes can be protected using our direct low pressure system filled with a clean agent such as Novec 1230 or FM-200. Using the same cylinder and detection tube the Direct **FIRETRACE**<sup>®</sup> system discharges the suppression agent directly from the burst hole in the tube, this will be the closest point to the fire, and will allow the fastest extinguishing time and minimum spread of the fire

A small 1kg (2.5lb) cylinder will apply the agent directly to the fire's source while it is still a small fire, this means that there is minimal damage to the component in the panel and can reduce the downtime of the whole machine, you can also use one system to cover multiple cabinets or enclosures. Again this system can be integrated with a pressure switch to signal an alarm or shut down power.

Novec 1230 is a clean agent meaning that it leaves no residue, and is electrically non-conductive. This means it will not cause any damage to electrical components and it is also safe for people, this will be important as it could be located near the driver. Novec 1230 has a global warming potential of 1 which is the lowest possible, this makes it the greenest clean agent available.

Quantity	Part No.	Description
1	890001	1 x 1kg Direct low pressure Novec System CE
		<b>OR</b>
1	895001	1 x Small 2.5Lb Novec Direct Low Pressure System D.O.T
		<b>WITH</b>
1	821605	1 x 5 meters 4/6 Firetrace Detection Tube Kit (FT Tube + Fittings)

## **FIRETRACE®** *Detection Tube Testing*

### **Leakage rate:**

The FDT passed the Underwriters Laboratories and Factory Mutual Research long term leakage tests. Twelve sample systems, each with 52 feet of FDT were weighed and then placed in a secure storage area. The maximum allowable leakage rate was 0.0075 ounces leakage over a period of one year. Each quarter of a year, 4 random samples were selected and weighed. At the end of the full year, all twelve samples were weighed. There was no measurable leakage. The FDT passed the test.



### **Exposure to UV radiation:**

Samples of FDT, each 12 inches in length, were subjected to the UV Light and Water Test in accordance with ASTM 154 utilizing the UVB 313 Lamp. Test duration was 1000 hours. Following this test, the samples were examined for cracking or deterioration. None was found. These same samples were then subjected to a hydrostatic test of six times the normal operating pressure ( $150 \times 6 = 900$  psi) of the tubing for a period of one minute. There was no burst or leakage as a result of this test. Pressure was then raised to 1000 psi for a period of one minute with no burst. Each sample was then raised to burst pressure. Average burst pressure of the twelve samples was 1200 psi.

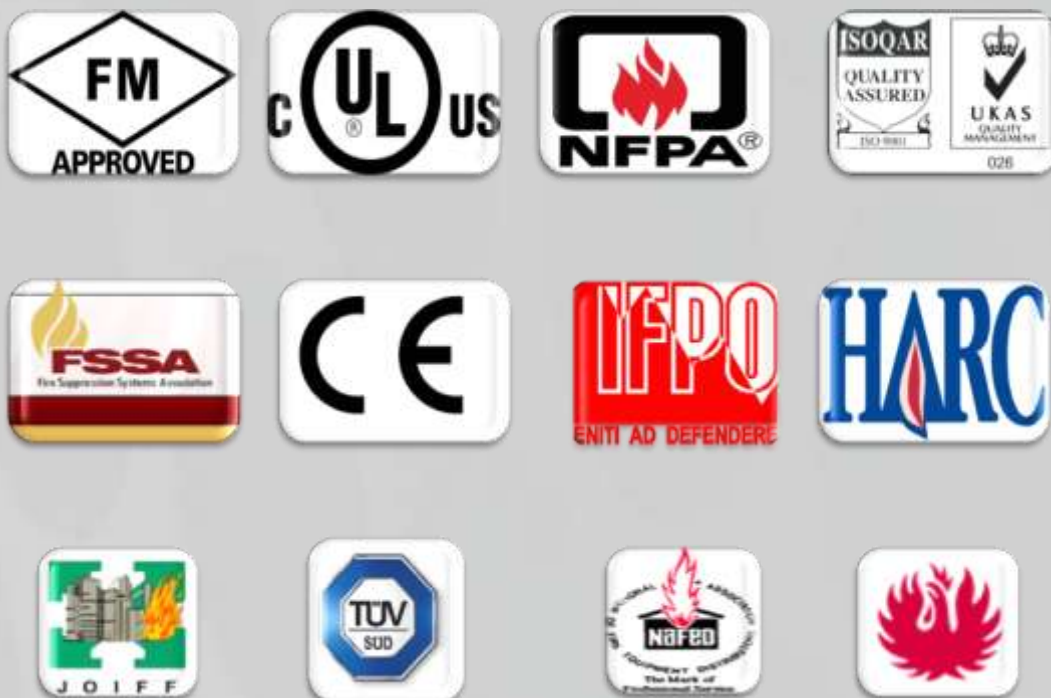
### **Aging Test:**

A total of twelve samples of FDT, each twelve inches in length, were subjected to an air-oven aging test for 180 days at 212°F (100°C). Following this test, the samples were examined for cracking or deterioration. None was found. These same samples were then subjected to a hydrostatic test of six times the normal operating pressure ( $150 \times 6 = 900$  psi) of the tubing for a period of one minute. There was no burst or leakage as a result of this test. Pressure was then raised to 1000 psi for a period of one minute with no burst. Each sample was then raised to burst pressure. Average burst pressure of the twelve samples was 1200 psi.

### **30 Day Extreme Temperature Leakage Test:**

A total of twelve fully charged FIRETRACE® Indirect systems, charged with FM-200™ Clean Extinguishing Agent and super pressurized with nitrogen to 150 psi and including 24 inches of detection tubing (also charged to 150 psi) were exposed to the temperature extremes, 0°C (32°F) to 54.44°C (130°F), for a period of 30 days. A total of six charged systems were exposed to 0°F and six charged systems were exposed to 130°F. Weight (in grams) was recorded before and after the test. There was no loss of weight noted of any of the samples at the end of the test. Following this test the systems were discharged with a standard propane torch impinging on the FDT. System actuation was within two seconds and in each case, discharged as intended.

# Approvals & Listings



**FIRETRACE**® International's systems carry several internationally recognised approvals and listings and have been independently tested by third parties for exposure to many types of chemicals, solvents and UV radiation. As an **ISO 9001** accredited company you can be sure of the fact that all systems are manufactured and tested in a quality environment.

**Australia** – SSL Listing No. AFP 1368 Scientific Services Laboratory, Victoria, Australia

**Austria** – Prufstelle fur Brandschutztechnik

**Bahrain** – State of Bahrain Ministry of the Interior, Protection and Prevention Section

**Belgium** – ANPI/NVBB Rapport D'essai no. SPT/ME 020/1987.12.08

**China** – CNAACL No. China National Accreditation of Laboratories

**Czech Rep** – Strojirensky Zkusebni Ustav S.P Engineering Test Institute

**Denmark** – Danish Institute of Fire Technology

**France** – CNPP GC01 0017 CNPP IE 99 5585

**Germany** – BAM/TUEV Approval

**Greece** – Approval Report 44672 701.6

**Hungary** – Belugyminiszterium Tuezoltosag Orszagos Parancnoksag Szum 188/31/1999

**Israel** – The Standards Institution of Israel Test Certificate 8013107171

**Italy** – TESI No. 094/B Tecnologie Sviluppo Industriale

**Netherlands** – TNO Netherlands Project Ref 006.10329.01.02

**Romania** – SC Instal Somet SA Act de Omologare No. 7/2000

**Qatar** – Civil Defence

**Sweden** – SBF 128:1 Swedish Bus Approval

**United States** - Factory Mutual Approval / UL & ULC Listing

## ***Frequently Asked Questions***

### **What pressure is the system working to?**

The **FIRETRACE**<sup>®</sup> systems are super pressurized with Nitrogen to a pressure of 195psi, around 13.4bar.

### **What happens if I have more than one fire simultaneously?**

Because the system is design is based on the volume of the enclosure, there is sufficient agent within the container to “total flood” the whole space. Should there be more than one fire, the Fire Detection Tube will burst at the hottest point first and all of the agent will be dispersed from that point. The whole area however, will rapidly fill with a cloud of dry chemical agent which will quickly suppress any other fires that there may be.

### **How can the operator check if the system is available and functioning?**

A Firetrace system is fitted with two monitoring devices. A pressure gauge for visual inspection and also as described above the systems can be fitted with a set of low pressure switches which change state on 5bar falling pressure and can create “a fault” signal on a fire control panel. (Control panels normally supplied by 3rd parties but Firetrace can supply these also).

### **If the system is activated, do I need to replace the whole system?**

No. Should you have the unfortunate incident of a fire, the system will operate as intended and some works will obviously need to be carried out to bring the system back into operation again. This involves re-charging the contents of the container via an approved agent, or for speed purposes, replacing the container with an identical one that is already filled. The Fire Detection Tube will not normally need to be replaced, as the burst point can be cut from the tube and the tube can then be re-connected with a straight adapter. The system can then be pressurized and reset for use.

In theory, your system could be operational again within only a few minutes and at minimal cost.

### **I've heard about HF, will this cause damage to my equipment?**

The agents themselves are described as “Clean Agents” as they will not damage any equipment, or leave any residue, should they come into contact with any electrical components. However, they decompose at high temperatures and it is therefore important to avoid applications involving hazards where continuously hot surfaces are involved. Upon exposure to flame these agents will breakdown to form halogen acids. Their presence will be readily detected by a sharp, pungent odour long before maximum hazardous exposure levels are reached.

It has been concluded from fire toxicity studies that decomposition products from the fire itself especially carbon monoxide, smoke, oxygen depletion and heat may create a greater hazard.