FIRETRACE
AUTOMATIC FIRE SUPPRESSION SYSTEMS

Fire Protection for Fume Hoods

"Micro Environment" Protection

Details on fires in Fume hoods and how to suppress them using FIRETRACE® automatic suppression systems

Background Information

The pharmaceutical industry is a large and diverse environment leading the way forward in all manner of discoveries. With experimental work there is also an element of risk, allot of these involve volatile or flammable materials and inevitable fires do happen, **FIRETRACE®** can offer dedicated 24 hour protection against fires stopping them before they have time to spread .

With labs often running at all hours of the day with varying levels of staff monitoring them it is easy to see how one spilt chemical can ignite and spread very quickly especially if there are flammable liquids stored close by. **FIRETRACE® overcomes this problem by detecting the fire inside the fume hood directly at its source, this allows for early detection and subsequently minimal damage and downtime.**

FIRETRACE® Systems have been installed in many large pharmaceutical laboratories as well as universities and chemical storage areas.

January 2001: in a lab based in Texas a 4 litre bottle of flammable liquid broke inside a cabinet and onto several hotplates. A researcher attempted to extinguish the fire with 2 fire extinguishers with no success the fire and spread to other flammable storage areas where it caused a small explosion.

FIRETRACE® systems are fully automatic, easy to maintenance and require no power to run. All this adds up to FIRETRACE® systems detecting and suppressing fires throughout the world

FIRETRACE® has been installed in many fume hoods all around the world 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 due to smoke or fumes

Detection is run both on the ceiling and behind the baffle board to catch the hot air flow

Easy to retrofit old labs and new builds

Firetrace systems can utilise both high and low pressure systems depending on the hazard type and location

Can be used to protect critical chemical storage areas as well

Quick acting so only minimal damage is done to equipment

System can be quickly replaced after a fire has taken place

FIRETRACE® in Action

Southampton University

February 2005

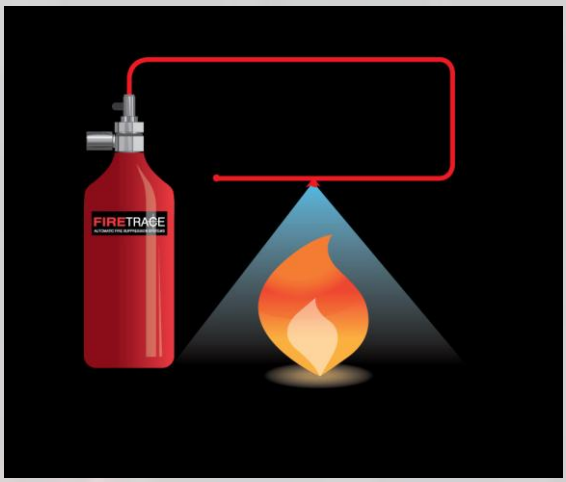
Suffers two fires in a month in both instances hot plates have overheated causing a solvent fire but fortunately both laboratory fume cabinets were protected by Firetrace automatic fire protection systems. On one occasion a laboratory assistant witnessed the incident, but reported that when he returned seconds later with a hand extinguisher the fire was already out.

Laboratory Manager Dr. Kinerson said 'Thanks to the quick reaction of our Firetrace systems. Damage was limited to a few components and a bit of a spring clean. Had the fire spread into our extract ducting, we could have lost the entire laboratory'

How FIRETRACE® works

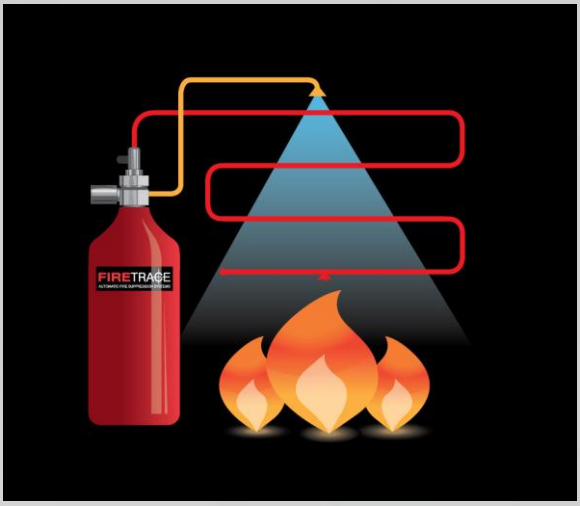
FIRETRACE® employs a flexible detection and delivery system called Firetrace Tubing. The tubing is manufactured from specially processed polymer materials to achieve the desired heat detection and delivery characteristics.

The **FIRETRACE®** Tubing, which is pressurized, is placed within an enclosed area above potential fire hazards and secured in place with brackets provided. Extinguishing mediums can be matched to the particular application. Various system sizes are available to accommodate the appropriate amount of agent. The systems require no power to run and require minimum maintenance.



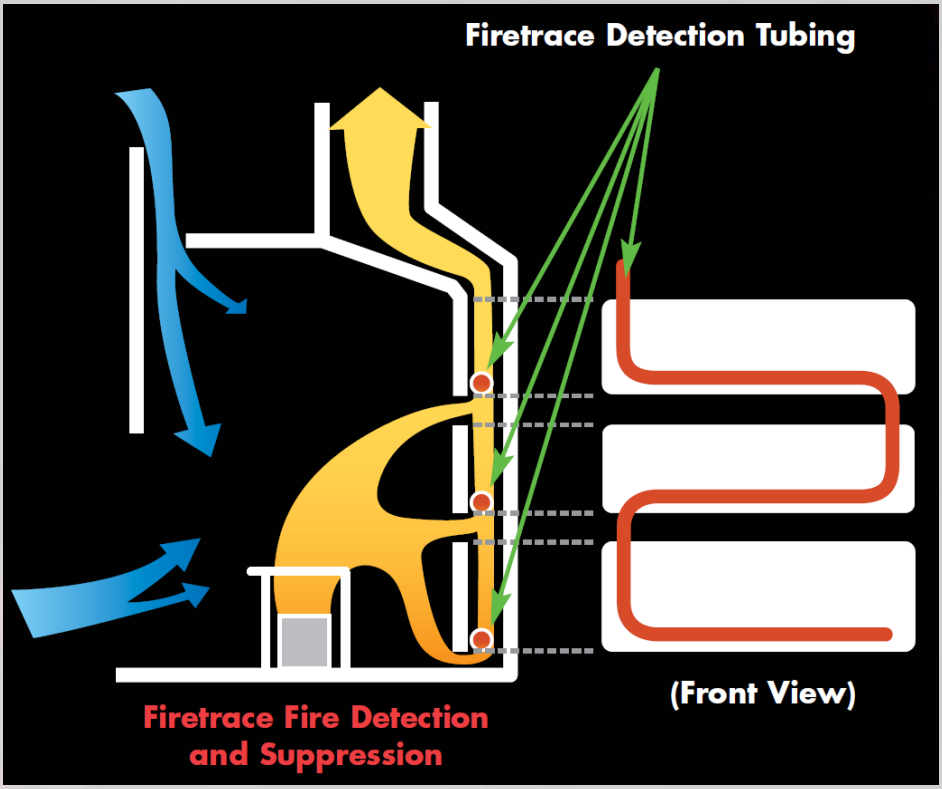
The Direct **FIRETRACE®** system discharges the suppression agent directly from the burst hole in the tube, this will be the closest point to the fire, and will allow the fastest extinguishing time and minimum spread of the fire.

The Indirect **FIRETRACE®** system discharges the suppression agent into the protected area via plumbed diffusers that are initiated by the Firetrace tube bursting, this allows agent to be delivered quickly and directed at a specific point.



Targeting the application

Fume hoods have always been a tough environment to monitor as there is a whole cocktail of experimental chemicals being used and unpredictable amounts of smoke or reactions taking place. This leaves you with the problem of how to accurately and consistently determine the difference between a hotplate and a fire.



FIRETRACE® utilises the fume hoods fundamental design by laying detection tubing behind the baffle boards. As air is being fed through the cabinet it most of it will go behind this baffle board and out through an extractor fan, this includes any hot air created by fire! **FIRETRACE®** places the detection tube behind this board to the fire is detected as fast as possible, the tube is very resilient to a many common chemicals and is unaffected by smoke of high air flow.

A simple hotplate will not raise the ambient air temperature in the cabinet to set the system off but in the event of a fire the hot air will be forced behind the baffle board and directly on to the **FIRETRACE®** tubing, this will activate the system and flood the space with fire fighting agent.

Agents

The **FIRETRACE®** fire detection system can be offered as either a direct or indirect system, with localised suppression and total envelopment of the fire with a range of agents, including but not limited to:-

- CO_2
- Dry Powders
- Foam

Carbon Dioxide

The extinguishing agent used in Firetrace pre-engineered automatic high-pressure extinguisher units is Carbon Dioxide, more commonly known as CO_2. CO_2 is a colourless, odourless, electrically nonconductive inert gas that is an extremely effective fire suppression agent. As it is an inert gas it is also safe to apply to unpredictable chemical reactions without it causing any negative effects.

When the CO2 is released it will suffocate the fire and also cool it at the same time, this leads to the fire being extinguished.

CO_2 is clean and leaves no residue, thereby minimizing any 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 CO_2. This agent is also environmentally friendly, having an ozone depletion potential (ODP) of 0.00.

Foams

Firetrace can offer a range of AFFF foams to cover the fire. When activated nozzles distribute the foam all over the fires source, this creates a barrier between the fuel and the oxygen and starves the fire.

Foams are safe for people and safe to use in occupied spaces. They are very efficient and are easy to cleanup.

Dry Chemical Extinguishing Agents

The dry chemical extinguishing agent used in the **FIRETRACE®** dry chemical pre-engineered automatic fire suppression units is Mono Ammonium Phosphate ($NH_4H_2PO_4$) also known as ABC or multi-purpose powder. ABC powder is one of the most common agents used in hand held fire extinguishers and is a particularly effective fire suppression agent pound for pound.

Dry powder will spread over surfaces quickly and creates a barrier between the fuel and the oxygen, in the case of liquid based fires it will also help to absorb the fuel and stop it from burning.

ABC Powder is included in NFPA-17 and has been evaluated and approved for use in occupied areas, provided the proper safety precautions have been taken.

Dry Chemical is a finely divided powder that has been treated to be water repellent and capable of being fluidized and free flowing so that it can be discharged through hoses and piping under the influence of an expellant gas. When discharged, dry chemical will drift through the air and settle on surrounding surfaces.

Clean agents

FIRETRACE® can also offer clean agent systems filled with either FM-200 of Novec 1230 however for laboratory environments we typically do not recommend it. Clean agents are complex chemicals designed to break the bonds that cause combustion, however in an environment where experimental chemicals are being used it would be hard to ensure that a negative reaction does not occur.

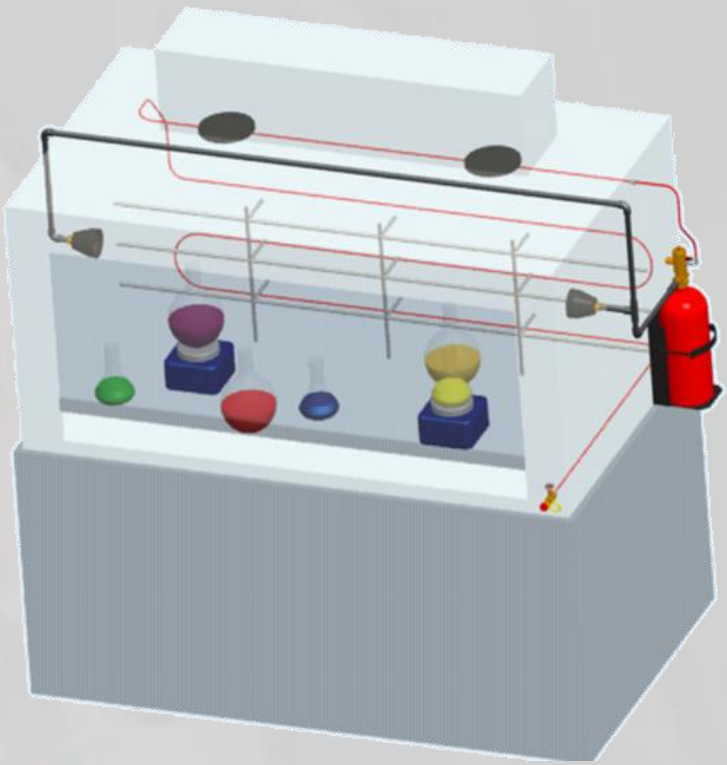
Typical system for fume hoods

The **FIRETRACE®** Systems used Fume hoods is an indirect high pressure system filled with CO2. The detection tube is laid out behind the baffle board and also over the extraction ducts putting it in the prime position to detect an abnormally hot airflow. For bench top cabinets we can typically install 2 nozzles to discharge the agent directly on the work surface, for walk in cabinets we can also fit 2 extra low level diffusers to fill the whole cabinet more quickly.

In the event of a fire, or high temperature rise, the FDT will burst and activate the valve, now the agent is released through the discharge pipes and onto the fire. The agent quickly fills the cabinet and extinguishes the fire, it leaves no residue and is electrically non conductive so will not cause and damage to the equipment.

The system is also fitted with a pressure switch that constantly monitors the contents of the container and can be used to sound an alarm or be integrated into an existing fire alarm panel. It can also be used to shut powder down to the extractor fan

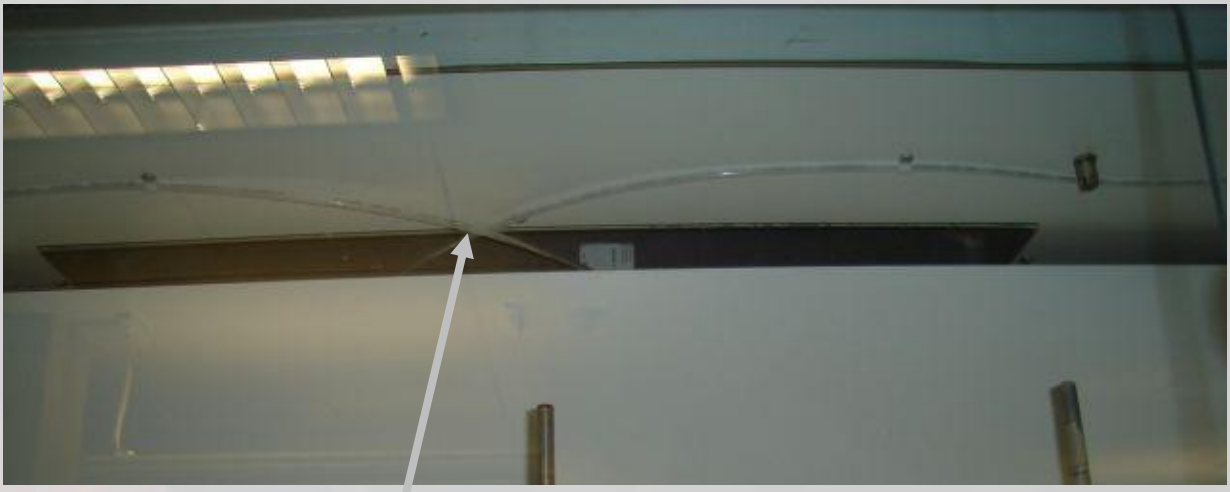
Firetrace Detection Tubing is ideal for fire detection in these environments as it is unaffected by occasional smoke or chemicals. Also, being pneumatically operated they require no power to run and do not rely on any electronic sensor equipment, this means we only discharge the system if there is a fire, no false alarms.



Clear FIRETRACE® detection tube

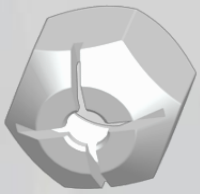
FIRETRACE® tubing has been tested by Oxford University to determine its compatibility with common chemicals and solvents over long periods of time. Based on these results for the standard red tubing we noticed that the tube retained its functionality however in some cases the dye in the tube had become discoloured.

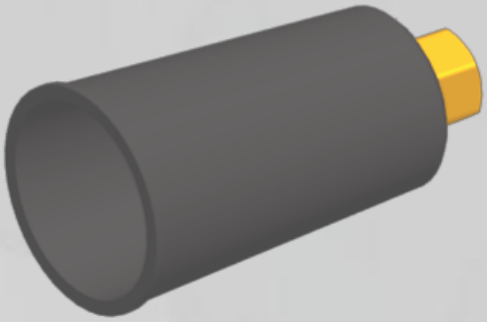
We recommend that the Firetrace Detection Tube used in Fume Cabinet applications is transparent (dye free version) so that it does not become discoloured or faded over time. As an additional benefit this clear transparent tube is discreet and not easily noticed in the laboratory and is thus more aesthetically pleasing. It provides exactly the same high quality functionality as the standard red tubing but without the dye.



Clear Firetrace detection tubing run over the extractor ducts

Low and high pressure nozzles available dependant on agent



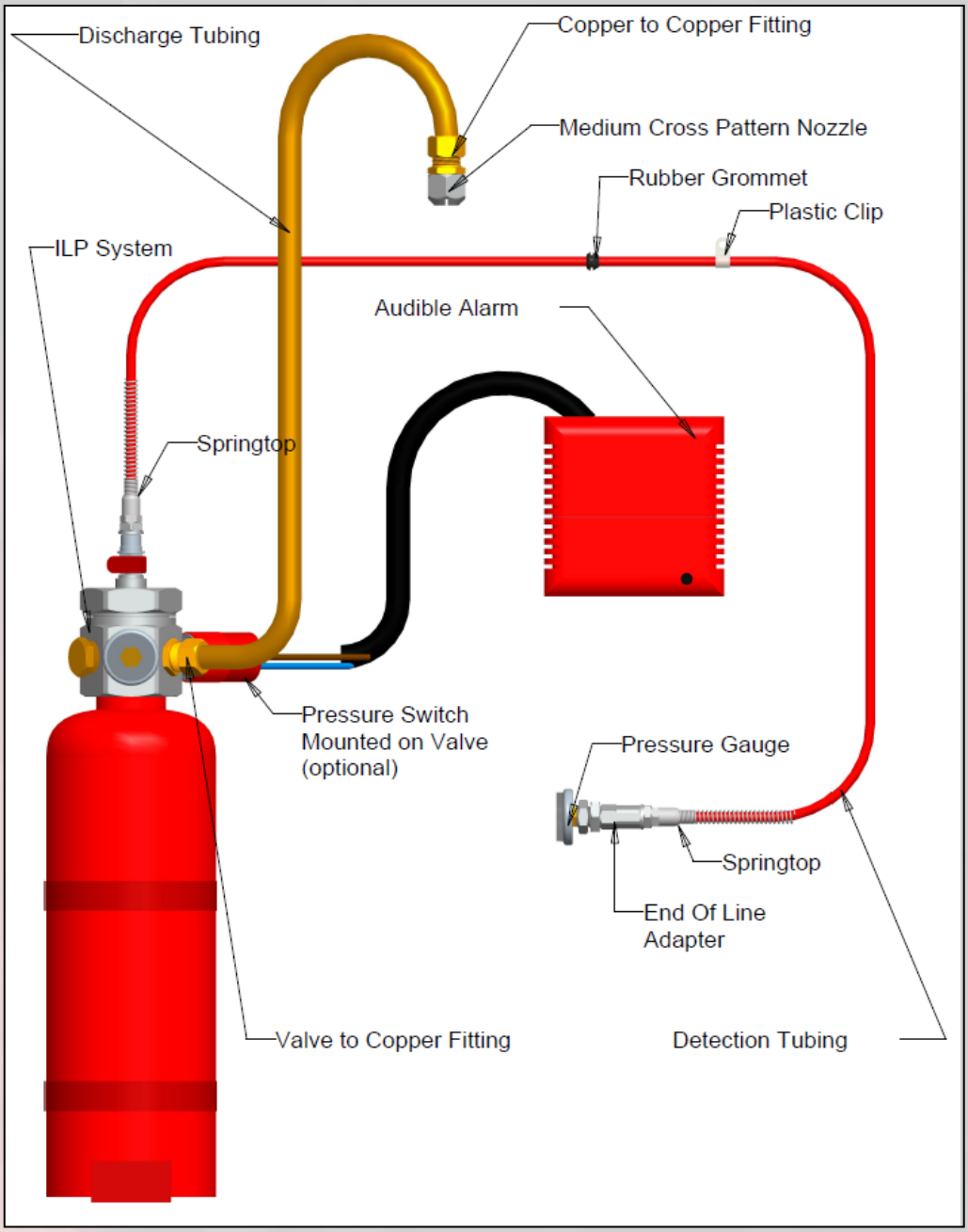


System specifications

Cylinder and Mounting Bracket

FIRETRACE® systems can utilise both TPED and D.O.T cylinders made from either aluminium or steel. Each cylinder is finished in red and painted to resist corrosion. These cylinders are available in high and low pressure; they also meet all of the local demands for CE and DOT equipment

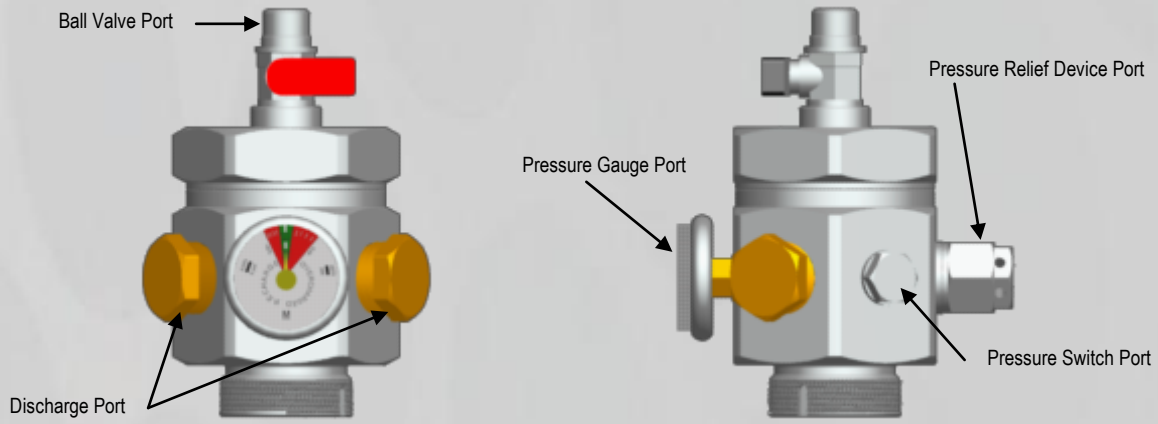
A wall mounted painted steel bracket is used to mount the cylinder/valve assembly in a vertical (upright) position. Each bracket is equipped with integral quick-clamp straps and locking pin.



Low pressure valves

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



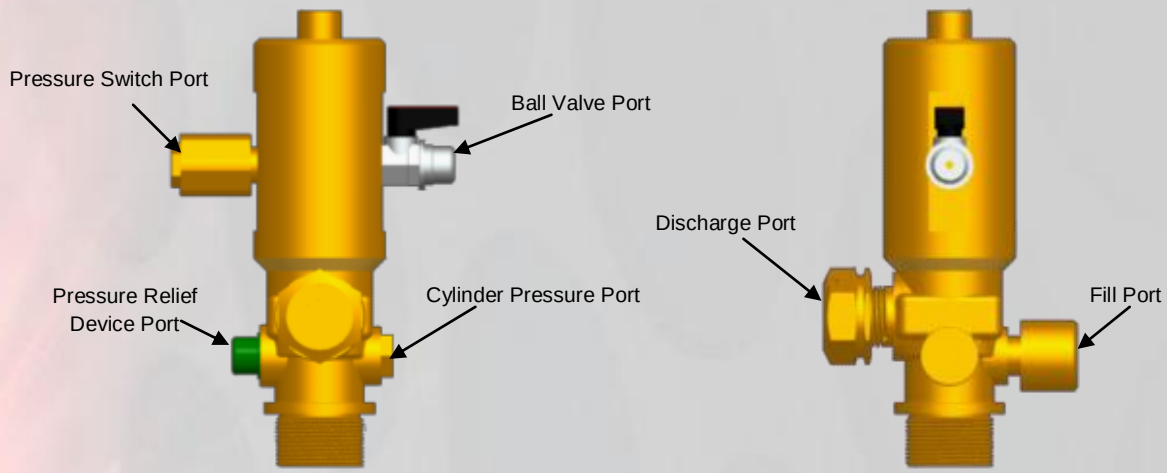
Medium Indirect Low Pressure Valve

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

High pressure valves

Each cylinder is equipped with a nickel plated brass valve for use with high pressure agents, and one ½" discharge port. A quarter turn ball valve interfaces with the Firetrace detector tubing to ensure the system is inactive during transport and maintenance.

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



Indirect High Pressure Valve

Manual Release

All indirect systems come equipped with a manual release device which can be mounted in the front of the machine. This will allow the system to be activated manually in the event of an emergency

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 and/or to shut down ventilation to the cabinet.

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 assets.

Extraction System Protection

FIRETRACE® systems are highly diverse and can be implemented in many sections of a laboratory including the extraction systems and electrical control cabinets.

One area that will need additional protection is the extraction and dust collection systems, over time dust and fumes can build up in the pipe work and cause large flash fires. A fire here could spread quickly as the extraction system will draw flames and hot air through the entire system.

Above shows CO2 systems used to protect the extractions system for a large pharmaceutical company

In the event of a fire, or high temperature rise, the FDT will burst and activate the valve, now the agent is released through the discharge pipes and onto the fire. Upon activation the integrated pressure switch can be used to shut down the extractor fan and prevent it from drawing flames up into the exhaust and into other areas.

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

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 x 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 x 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

Compatibility with common chemicals:

Results of chemical testing of Firetrace tubing undertaken by Oxford University

Solvent	Vapour	Liquid
Ether	no action	loss of black type/slightly harder
THF	no action	loss of black type/slightly harder
Toulene	no action	slightly harder
Ethyl acetate	no action	no action
N-methylmorpholine	no action	loss of colour
Petrol	no action	no action
Acetone	no action	no action
Methanol	no action	no action
Dichioromethane	no action	no action
Triethylamine	no action	loss of black type
Chloroform	no action	no action
Pyridine	no action	slight loss of colour
Acetyl chloride	no action	slight attack
Sodium hydroxide	no action	no action
Dimethylformamide	no action	slight attack
Acetonitrile	no action	loss of black type
Butyl ethyl ether	no action	loss of shine on surface
Carbon tetrachloride	no action	loss of black type
Benzene	no action	no action
Benzyl bromide	no action	pitted the plastic
T-butanol	no action	no action
Trifluoroacetic acid	plastic attacked	soup
Formic acid	no action	soup
Dimethyl sulphoxide	no action	hardened plastic
Acetic anhydride	no action	no action
Diglyme	no action	no action
Trimethylsilyl chloride	no action	no action
Styrene	no action	hardened plastic
Methyl acrylate	no action	hardened plastic
Disopropylamine	no action	hardened plastic
Nitric acid 70%	eaten away	soup
Hydrochloric acid 35%	eaten away	soup
Acetic acid/hydrogen bromide	eaten away	soup
Thionyl chloride	eaten away	not quite soup
Phosgene in toluene	no action	slightly harder plastic
Ammonia 35% aqueous	no action	no action
Hydrogen peroxide	no action	plastic softened

All chemicals were in contact with the tubing for five days (vapour and liquid)

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 – CNACL 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?

FIRETRACE® low pressure systems are super pressurized with Nitrogen to a pressure between 195psi (13.4bar) and 150psi (10.3bar).

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 throughout the entire cabinet.

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 are normally supplied by 3rd parties but **FIRETRACE®** can supply these also).

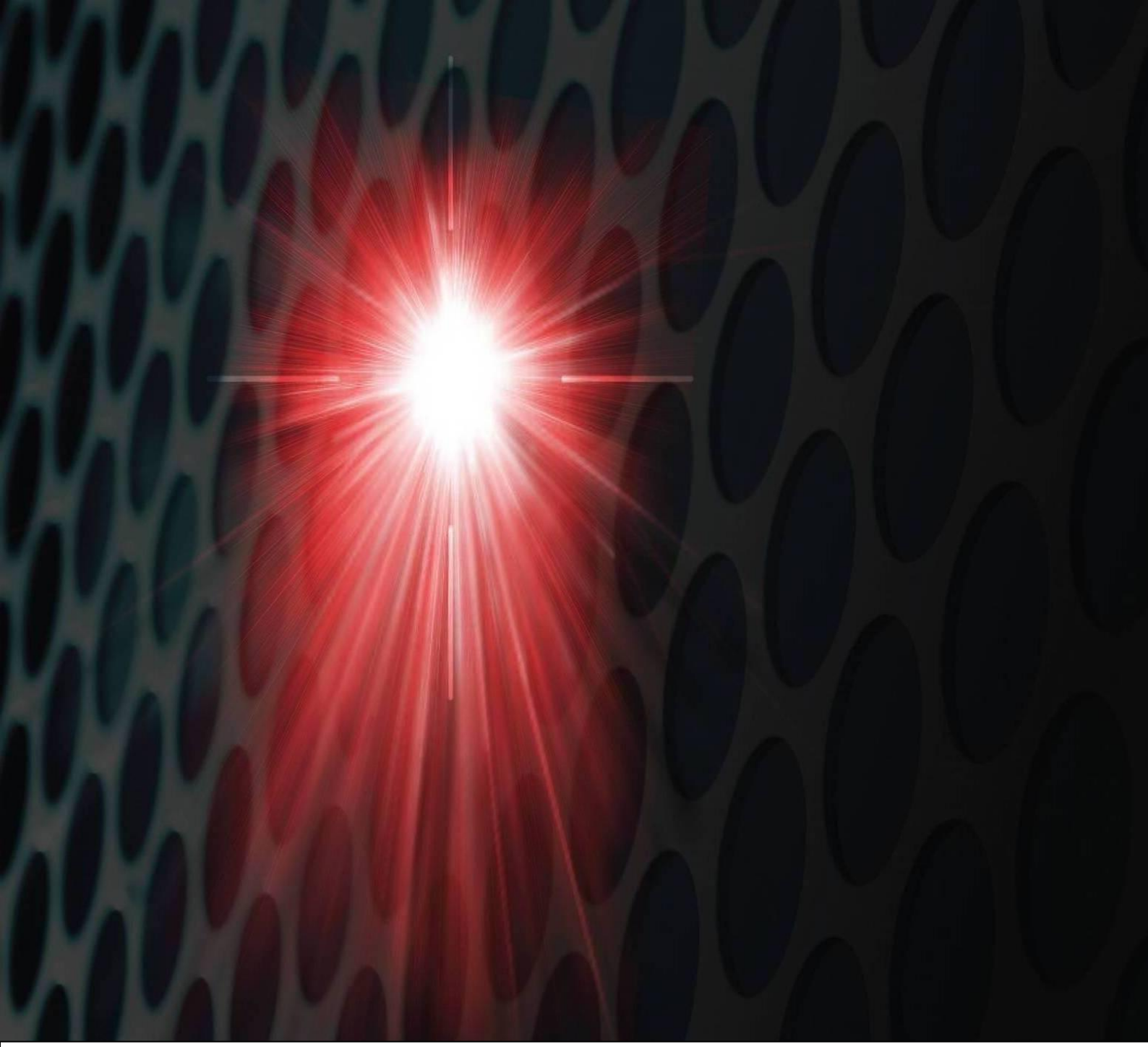
If the system is activated, do I need to replace the whole system?

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.

Will the temperature from a hotplate not activate the system as chemicals are boiling at temperatures over 100ºC?

No the temperature of the liquid may be high but it will not be high enough o raise the ambient air temperature to a high enough level to activate a **FIRETRACE®** system. the tube is also place at a far enough distance so the air will be much cooler by the time it is drawn behind the baffle board and over the detection tubing.



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