



Fire Protection for Power Generation Facilities

“Micro Environment” Protection

December 2009



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

Background Information

The importance of a reliable and steady power source has grown indispensable to the modern world and with constant growth will likely become even more of a necessity. Whether it is an uninterrupted power supply, backup generator or the power transfer, **FIRETRACE®** can offer a unique solution.



Power supplies are vital to the modern world, they deal with high voltages constantly throughout their lifetimes and inevitable failures occur which can result in fires. By catching and suppressing these fires at their source a minimal amount of downtime can be achieved and reduce any losses.

FIRETRACE® Systems are simple yet highly effective suppression systems which can be adapted to fit into almost any environment. **FIRETRACE®** Systems require no power to run or operate and are robust enough to excel in the harshest of environments.



FIRETRACE® has been installed in thousands of power applications 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 vibration

Easy to retrofit old machinery and new builds

Targeting inside the equipment means detection and suppression is directly where needed

Systems can be adapted to fit a wide range of applications from switchgear to diesel generators



Protect the whole facility by targeting the fire risks

Quick acting so only minimal damage is done to equipment

System can be quickly replaced after a fire has taken place

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.



Common applications

FIRETRACE® systems are used to protect:

- **Generators**
- Uninterrupted power supplies (UPS)
- Cable tunnels and trenches

FIRETRACE® systems are extremely flexible so if there is an application specific to you please let us know and we can arrange a solutions tailored to protect anything critical to you.



Pressure switches can be integrated into all systems to signal an alarm or alert the operator in the event of a fire.

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

This system uses 2kg's of clean agent to completely flood the inside of this machine.

FIRETRACE® will work to design a system specifically for the equipment critical to you and your business.



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:-

- Novec 1230
- FM-200 (HFC227ea)
- CO₂
- Dry Powders (multi-purpose and class D)
- Foam

Novec 1230 Fire protection fluid

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

Novec 1230 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.



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, 2003)

Properties	Novec 1230	Halon 1211	Halon 1301	HFC-125	HFC-227ea	HFC-23
Ozone Depletion Potential (ODP) ¹	0.0	5.1	12.0	0.0	0.0	0.0
Global Warming Potential-IPCC ²	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

Not for specification purposes

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

¹ World Meteorological Organization (WMO) 1998, Model-Derived Method
² Intergovernmental Panel on Climate Change (IPCC) 2001 Method, 100 Year ITH

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 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 for its effectiveness and quality.

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.

Dry Chemical Extinguishing Agents

The dry chemical extinguishing agent used in the **FIRETRACE**[®] dry chemical pre-engineered automatic fire suppression units shall be Mono Ammonium Phosphate ($\text{NH}_4\text{H}_2\text{PO}_4$) 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.

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.

System Choice for Generators

The **FIRETRACE**[®] Systems used on generators typically consist of a small, pressurized container using clean agent, Dry chemical, or CO₂ as the extinguishing medium. This is connected to a length of **FIRETRACE**[®] Detection Tube (FDT) that is appropriately routed around the generator, dynamo, and fuel lines to provide linear, pneumatic detection. Nozzles will be placed in strategic locations around the hazard area to flood the space as quickly as possible.

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 volume and extinguishes the fire; the systems can also be fitted with a highly visible manual activator in case of emergencies.

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 whole unit or just the extraction fan to help retain the fire fighting agents.

FIRETRACE[®] Detection Tubing is ideal for fire detection in generators, it is pneumatically operated so has none of the shortfalls of false alarms due to smoke or vibration. The tube will resist dirt and grime exceptionally well to ensure that it only operates during a fire. As the systems require no power to run they are suitable for the most remote of locations or offshore backup generators.

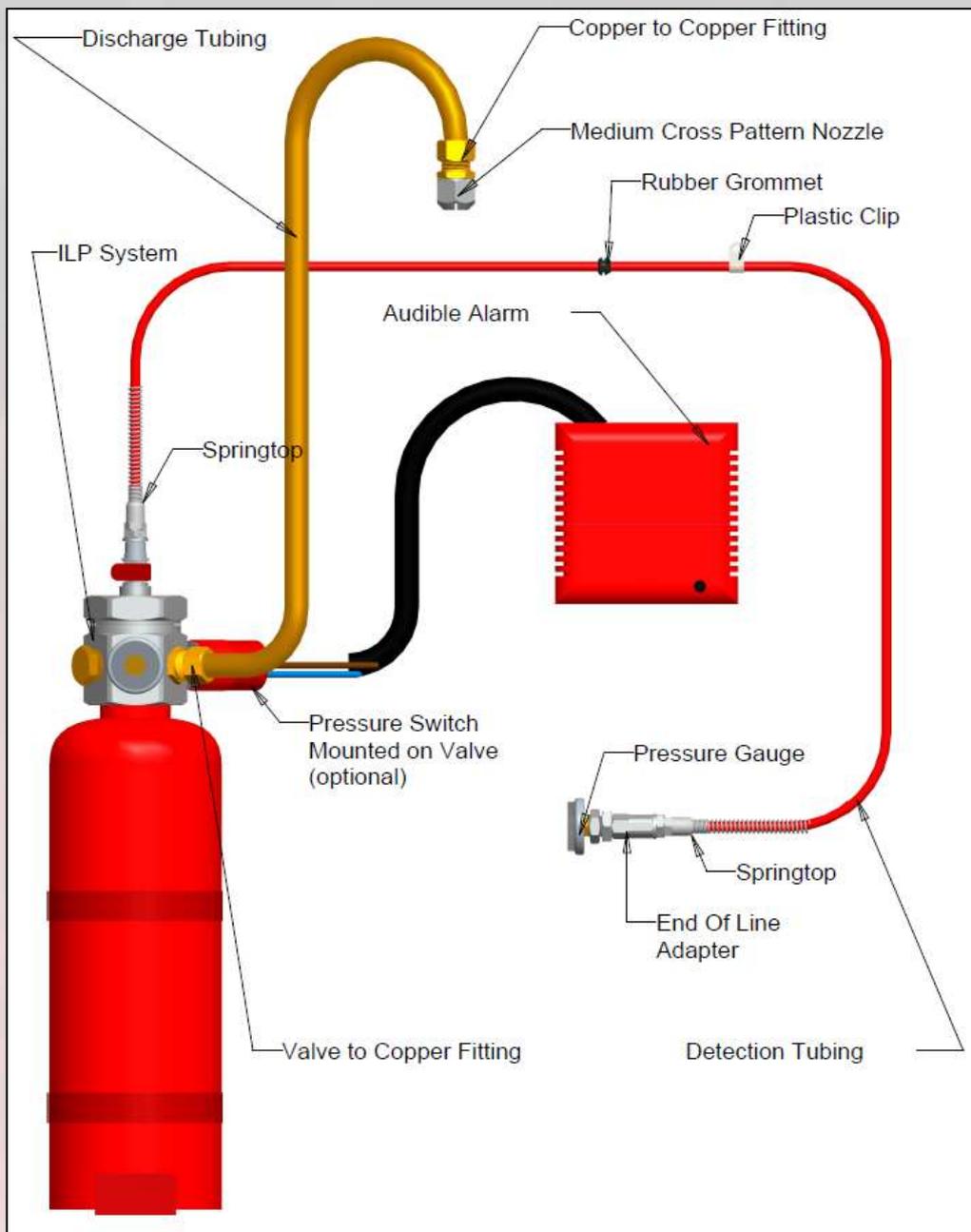


System specifications

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.

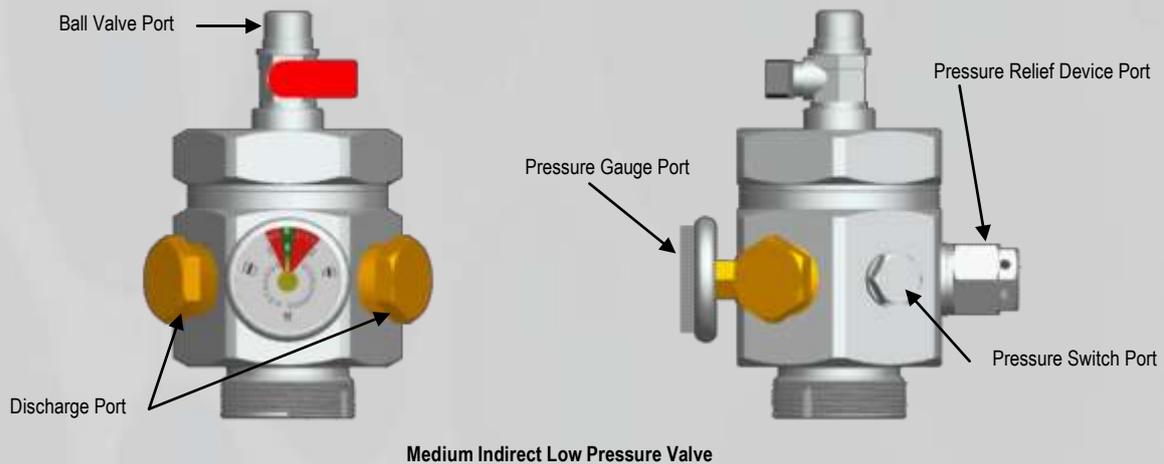
A wall mounted painted steel bracket is used to mount the cylinder/valve assembly in a vertical (upright) position. Each bracket is equipped with integral quick-clamp straps and locking pin.



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)

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.

Protection on the move



FIRETRACE® automatic fire detection and suppression systems can protect these from Fire. Because Diesel Generators are mobile and often placed in remote locations a fire detection and suppression system needs to be stand alone and mobile with the generator.

Fortunately **FIRETRACE**® systems require no electrical supply to operate and they are easily and quickly installed. Once installed the **FIRETRACE**® Detection and Suppression system is ready to go wherever the Generator goes.

FIRETRACE® also provides dedicated systems for Electrical cabinets, (MMC's, MVC's) High and Low Voltage Equipment as well as fuel store/pumps, Vehicles, construction machinery, production equipment, filters, HVAC, and small enclosures / fire hazards either open or closed, lifts, escalators, conveyor belts, airport applications, offshore, marine, oil and gas and military.



System choice for UPS's

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 involving high or low-voltage equipment, **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.

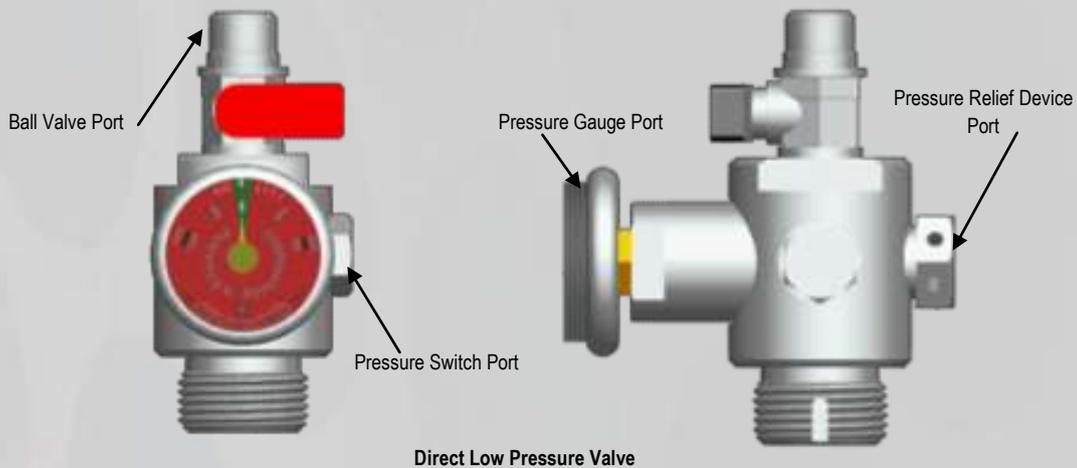
Should you be unlucky enough to experience a fire in your equipment, you'll find you can be operational in only a short space of time. By only having to maybe repair a small part of your unit and with the simple re-charging or replacement of your **FIRETRACE**® system, you can be up and running, with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



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

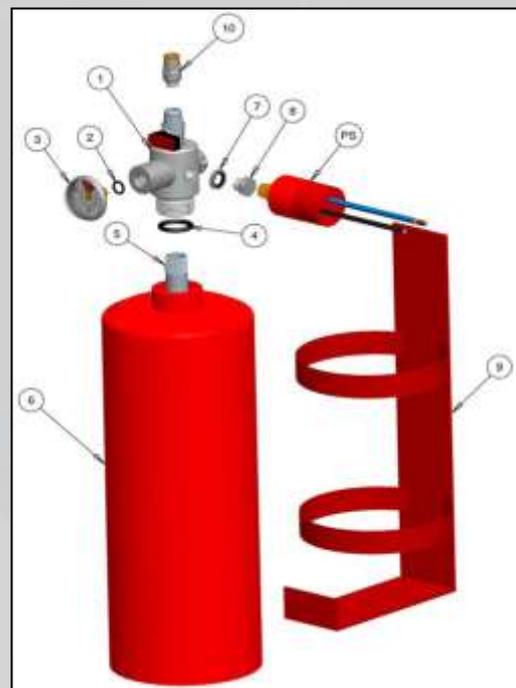


(CE Manufactured Systems for the European market do not require a pressure relief device)

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



Cable Tunnels and Trenches

Direct **FIRETRACE®** systems can be applied to cable tunnels and trenches under machinery to complete the protection in a power generation facility. Cables are often a source of fire situations in confined spaces such as tunnels. Often tightly packed together and in large quantities, they can generate a lot of heat which can cause the cable to burn at any point along its length, which makes detection and extinguishment of a cable fire particularly tricky.



By running the **FIRETRACE®** detection tubing along the cables length it will not only react to any abnormally high heat sources but will also “burst” at that point, this means then agent is delivered directly at the heart of the problem and solves a tricky problem. Conventional fixed nozzle systems would require masses of pipe work and many nozzles to cover a long distance where the simple yet effective **FIRETRACE®** tubing is essentially a nozzle anywhere along its length.

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.

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 ($150 \times 6 = 900$ 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 – Prüfstelle für 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 – Belügyminiszterium Tűezoltóság Országos Parancnokszag 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), high pressure systems run at around 58bar.

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. The whole

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.

How to contact us

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