



# Fire Protection for Bus and Transit Vehicles

“Micro Environment” Protection

**FIRETRACE**<sup>®</sup>  
AUTOMATIC FIRE SUPPRESSION SYSTEMS

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Details on fires in buses and how to suppress them using Firetrace automatic suppression systems

# The Firetrace Companies

**FIRETRACE**<sup>®</sup>  
AUTOMATIC FIRE SUPPRESSION SYSTEMS

**FIREPANEL**<sup>™</sup>  
VEHICULAR FIRE PROTECTION SYSTEMS

**FA** *Firetrace*  
*Aerospace*<sup>™</sup>  
HELPING ENSURE A SAFE RETURN

**REGULUS**  
FIRE SYSTEMS



# About Firetrace

**FIRETRACE** manufactures reliable, cost-effective, automatic fire detection and suppression systems designed to protect "micro-environments" – i.e., any small enclosed space where high value/mission critical assets are located or where an increased risk of fire could be mitigated by an automatic fire suppression system. Firetrace systems are completely self-contained, require no electrical power, and are easy to install and maintain.

**FIRETRACE** systems are compatible with most commercially available fire-suppressing clean agents, foams, and dry chemicals and are the only systems of their type to carry major listings and approvals from UL, ULC, CE, FM, and more than 20 other international agencies.

**FIRETRACE** pre-engineered systems are specially designed to protect small enclosures of all kinds. The system type, size and fire extinguishing agent are determined by the contents of the enclosure.

**FIRETRACE** low-pressure clean agent options are typically 300 cubic feet (8.5 cubic meters) or smaller, with options for dry chemical and high pressure agents up to 1500 cubic feet (42 cubic meters).

**FIRETRACE** also manufactures Engineered 500psi / 34.5 bar Total Flooding Clean Agent Systems which are available with 3M™ Novec™ 1230 Fire Suppression Fluid. Total Flooding systems are available in eight capacities with fill volumes ranging from 8 to 1300 lbs. (4 to 590 kg). The 1300 lbs. / 590 kg cylinder is the largest in the industry, so even the largest of facilities can be effectively protected.

Today, **FIRETRACE** International has facilities in London, Singapore, Sydney, New Delhi, Dubai and Sao Paulo to better serve clients worldwide.

- **FIRETRACE** International is a division of Firetrace USA, a privately held LLC
- **FIRETRACE** USA companies have sold than 250,000 fire suppression systems worldwide
- **FIRETRACE** is an ISO 9001:2008 / AS 9100C Registered company
- **FIRETRACE** maintains a 65,000 sq. ft. USA facility and a 3,500 sq. ft. UK facility

# Introduction

A fire in a bus presents a very dangerous situation. Bus fires have the potential to spread very quickly and can fill the passenger compartment with smoke and toxic gases in under a minute. The danger increases when passengers are elderly or physically challenged or when a fire occurs as a result of a collision or crash. Even a short delay in exiting a burning bus can result in serious injury or death.

There are many causes of bus fires, with mechanical failures and electrical malfunctions at the top of the list. The engine compartment presents the most obvious source of risk, because it contains fuels such as gasoline, diesel or CNG. Other risk areas for bus fires include generator compartments, auxiliary heaters, electrical panels, brakes and wheel bearings.



*In order to save lives and property, fast, reliable fire detection and suppression is critical.*

**FIRETRACE** systems have been installed on thousands of buses around the world, protecting engine spaces, electrical generators, AHU's, cable runs and other high-risk areas. By detecting and extinguishing the fire at source, rapidly and before any growth of the fire is experienced, **FIRETRACE** provides effective fire protection and ensures peace of mind for bus operators, manufacturers and passengers.

**FIRETRACE** systems can be found on buses in major cities in the UK, USA, Sweden and UAE as a result.

**FIRETRACE** gained the internationally recognised SBF-128:1 approval in Sweden for the protection of buses using a direct low pressure system with ABC Dry Chemical as the extinguishing agent.

# How Firetrace Works

**FIRETRACE** employs a unique, proprietary detection and delivery system called Firetrace Detection Tubing (FDT). The flexible tubing is manufactured from specially processed polymer materials to achieve the desired heat detection and delivery characteristics.

The **FIRETRACE** Detection Tubing, which is pressurized with nitrogen, is placed within an enclosed area above potential fire hazards. In the event of a fire, the FDT bursts at the point of highest heat, triggering the release of the fire extinguishing agent. Extinguishing agents 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 operate and require minimum maintenance.

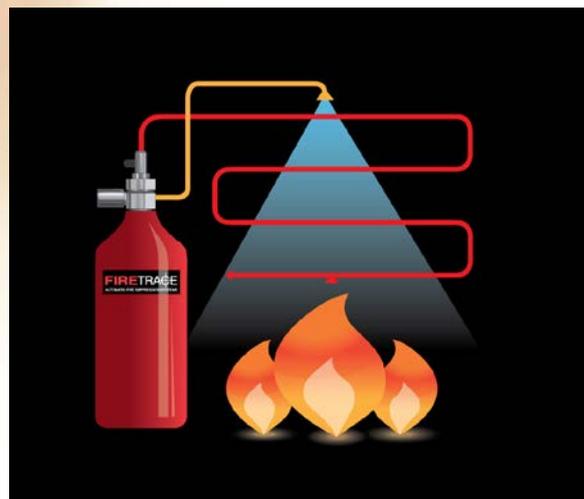


## Direct Release System

The Direct Release System utilizes the Firetrace Detection Tubing as both the fire detection device and the fire suppressant delivery system. The portion of the tube nearest the hottest point of the fire ruptures, forming an effective discharge “nozzle”. The pressure drop in the tube releases the entire contents of the cylinder through this nozzle.

## Indirect Release System

With the Indirect Release System, the Firetrace Detection Tubing is used only as a detection device. The fire suppression agent is delivered via copper tubing, stainless steel tubing or braided hose. When the tubing “bursts”, the suppressant is discharged through strategically placed nozzles within the fume cabinet.



# Targeting the Application

**FIRETRACE** systems typically used on buses consist of a pressurized cylinder filled with ABC Dry Chemical extinguishing agent. The cylinder is connected to a length of Firetrace Detection Tubing (FDT) that is routed throughout the engine bay to provide linear, pneumatic detection in a 360 degree environment.

In the event of a fire, the FDT will burst and discharge the Dry Chemical. The agent quickly fills the engine bay area and leaves a residue which absorbs flammable liquids and prevents re-ignition. The agent is non-toxic, suitable for use on electrical fires, those involving liquid fuels and operates at a low pressure of around 13.5 bar (195 psi)

The system can be fitted with a pressure switch that can be used to sound an alarm in the driver area of the bus, in the event of a system discharge following a fire.

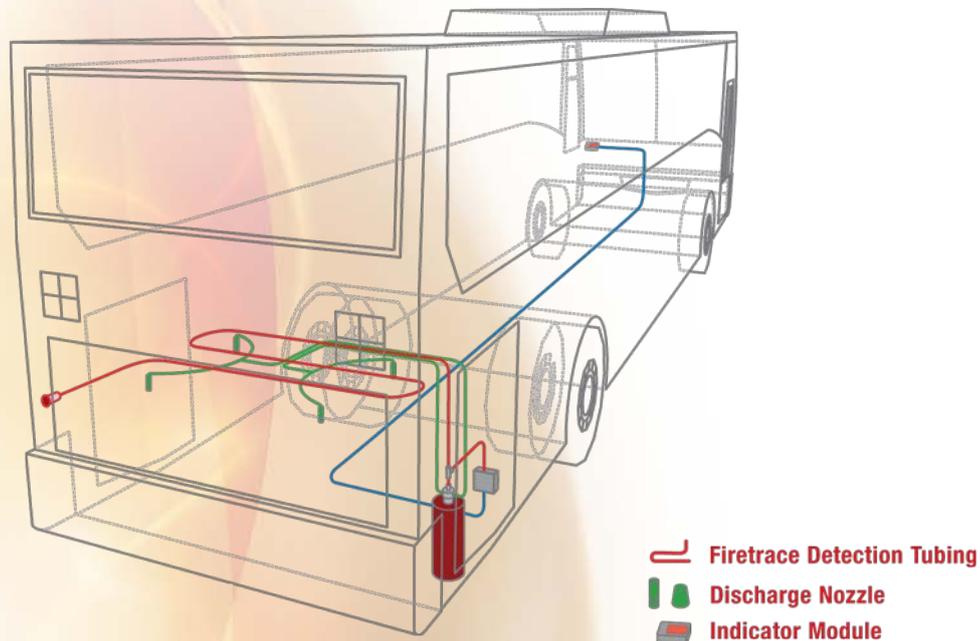


Firetrace Detection Tubing is ideal for fire detection in buses as it tolerates the vibration, dirt, temperature extremes in which buses operate. Also, being pneumatically operated, the system requires no power from the vehicle to operate and therefore does not place any strain on the vehicle's electrical system.



Following a discharge, simple cleaning is required to remove the powder from the surfaces within the engine bay. The particles of powder are too large to penetrate engine air filters and thus only the external engine surfaces require cleaning. ABC Dry Chemical Powder can be cleaned up by one of the following methods; wiping, vacuuming, or washing the exposed areas. In some cases the powder will have to be scraped off a surface, if that surface was hot at the time of discharge.

# Typical Rear Engine System



A typical bus rear engine compartment can be protected using a Direct Low Pressure (DLP) system with ABC Dry Chemical powder and large diameter Firetrace Detection Tubing. The 8mm OD Firetrace Detection Tubing must be installed in a way that the compartment airflow will not negatively affect detection or discharge. Generally, there may be no floor, along with a fan, to bring air into the compartment.

The Firetrace Detection Tubing must be placed above all hazards, as the ABC powder will travel downwards and out the bottom of the compartment. Magnets may be used along the compartment ceilings, with zip ties used to attach to existing bundles or compartment components. As with all DLP systems, secure Firetrace Detection Tubing installation is essential. A maximum of 35cm between fixing location is necessary ensure properly located discharge.

# Detection Tubing

The heart of every **FIRETRACE** system is the Firetrace Detection Tubing (FDT). This flexible, pneumatic tubing is the primary fire detection and unit activation method used in all **FIRETRACE** automatic fire suppression systems. The FDT 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 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

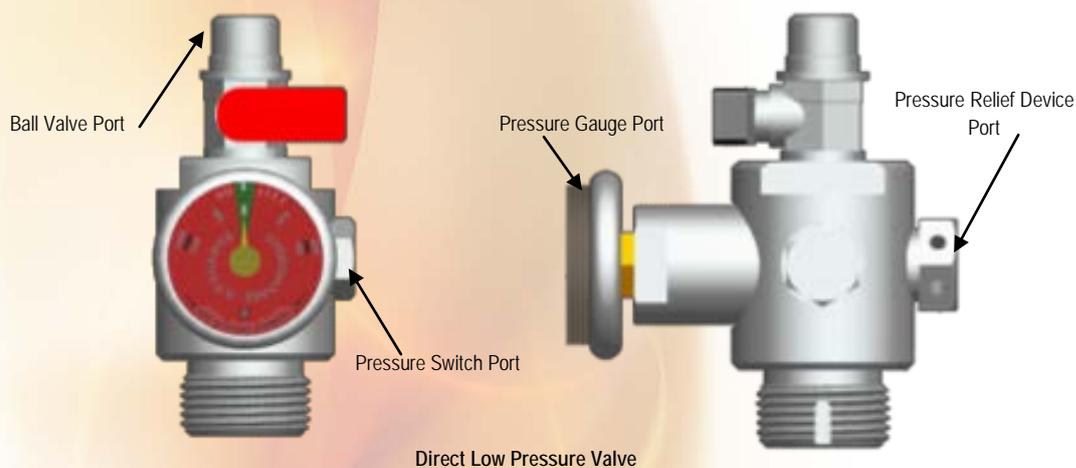
\*Tests on chemical resistivity performed by Oxford University

# System Specifications

## *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)

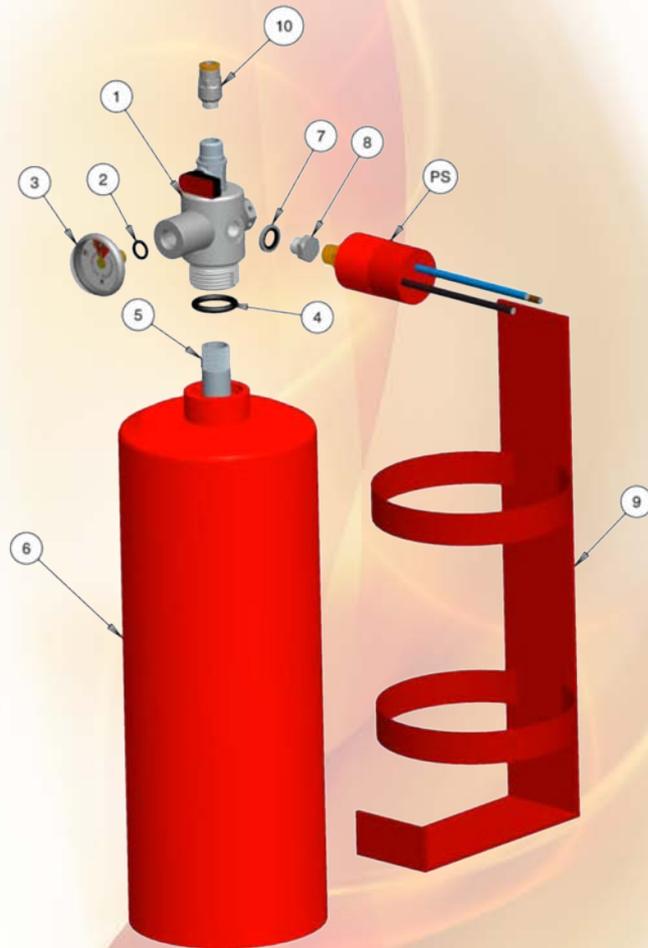
## *Pressure switch*

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 Mounting Bracket

The ABC Dry Chemical Powder 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 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 connector valve, man rel, EOL
- PS Pressure Switch

# Extinguishing Agent

**FIRETRACE** bus and transit systems typically use the dry chemical extinguishing agent Mono Ammonium Phosphate ( $\text{NH}_4\text{H}_2\text{PO}_4$ ) also known as ABC powder or multi-purpose powder.

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.

|                           |                                  |
|---------------------------|----------------------------------|
| Chemical Name             | Mono Ammonium Phosphate          |
| Vapor Density             | N/A                              |
| Specific Gravity          | Approximately 0.85               |
| Solubility in Water       | Not Soluble                      |
| Vapor Pressure            | N/A                              |
| Melting Point             | N/A                              |
| Boiling Point             | N/A                              |
| pH (10% Solution)         | Approximately 4-5                |
| Flash Point               | N/A                              |
| Auto Ignition Temperature | N/A                              |
| Appearance and Color      | Finely divided, yellowish powder |



**FIRETRACE** provides fast, reliable detection and suppression for bus and transit vehicles

**FIRETRACE** is currently protecting thousands of buses around the world from fire risks

**FIRETRACE** Detection Tubing is installed inside the engine compartment to assure the fastest possible detection and suppression

**FIRETRACE** provides around-the-clock protection for bus and transit vehicles

**FIRETRACE** systems only activate in the event of an actual fire, there are no "false alarm" discharges

**FIRETRACE** provides a pressure gauge for quick and easy system "charged and operational" status



**FIRETRACE** systems require no internal or external electrical power to operate

**FIRETRACE** systems can be quickly and cost effectively serviced and recharged after a fire

**FIRETRACE** systems do not interfere with vehicle operation or maintenance

# Listings



**FIRETRACE** 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** – Belugyminiszterium Tuezoltosag Orszagos 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

The image features a large, abstract graphic on the left side, composed of several overlapping, flowing, and semi-transparent bands of color. The colors range from light yellow and orange to deep red and maroon. These bands curve and swirl, creating a sense of movement and depth. The background is a plain, bright white. The word "Addendum" is centered horizontally in the upper-middle portion of the page, positioned to the right of the graphic.

## Addendum

# 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.

## Frequently Asked Questions

### What pressure is the system working to?

**FIRETRACE** systems are super pressurized with Nitrogen between 10.3bar to 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?

**FIRETRACE** systems are 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 service will be needed 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 Detection Tubing 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.



# **FIRETRACE**<sup>®</sup>

AUTOMATIC FIRE SUPPRESSION SYSTEMS

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Firetrace currently has more than 20 international approvals and listings, including:  
UL, CE, FM, ULC & ISO9001. Approvals and listings vary by system type and agent.