FIRETRACE
AUTOMATIC FIRE SUPPRESSION SYSTEMS

Fire Protection for Buses

“Micro environment” protection

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

Background Information

Bus Fires are a relatively common and potentially devastating occurrence in the world today, with many fires occurring every day across the globe. Without protection, a bus can be completely destroyed by the uncontrolled growth of a small fire in a very short space of time.

Reports by relevant bodies such as the NFPA in the USA, or the Department for Transport in the UK demonstrate that the majority of these fires are non-collision related and are most likely to start in the engine compartment. The most common cause of engine fires is due to electrical faults which arc electricity and ignite combustible material around it, the other cause is due to leaked fluids igniting on hot surfaces

FIRETRACE® Systems have been installed on thousands of buses around the world, protecting not only engine spaces, but also electrical generators, AHU's, cable runs and other similar 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 when needed and ensures peace of mind for operators, manufacturers and passengers on the buses.

Many cities now mandate that Automatic Fire Suppression Systems are installed on buses and **FIRETRACE®** Systems can be found on buses in major cities in the UK, USA, Sweden and UAE as a result.

Recently FIRETRACE® gained the internationally recognised SBF-128:1 Approval in Sweden for the protection of buses using ABC Dry Chemical as the extinguishing agent.

FIRETRACE® has been installed in thousands of buses all around the world using our patented Firetrace Detection Tubing.

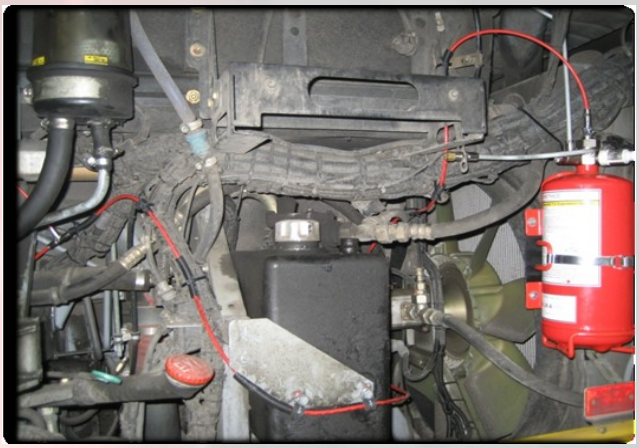
Systems require no external power to operate, and very little maintenance

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

FIRETRACE® systems can be fitted in a matter of hours

Easy to retrofit old buses and new builds

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



Quick acting so only minimal damage is done to equipment

System can be quickly replaced after a fire has taken place

Minimal Downtime

System Choice

The **FIRETRACE®** Systems used on buses consist of a small, pressurized container using ABC Dry Chemical as the extinguishing medium. This is connected to a length of Firetrace Detection Tube (FDT) that is appropriately routed all around the engine bay 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 operate the system valve, discharging the Dry Chemical agent through strategically placed nozzles and rapidly knocking down any fire. The agent quickly fills the engine bay area and leaves a residue which absorbs flammable liquids and helps avoid 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 (195psi)

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 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 of the environments in which the buses operate. Also, being pneumatically operated, they require no power from the vehicle to operate and do not place additional 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. This is also the case with any water-based system, as they have anti-freeze added to the water for use in cold temperatures, which is corrosive. The particles of powder are too large to penetrate engine air filters and thus only the external engine surfaces will need to be cleaned. ABC 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.

The Department for Transport in the UK recommends Dry Chemical Powder as the most effective extinguishing medium for engine bay fires.

Report S111D/VE states

"….Water based systems work well in the passenger compartment but are not as effective as powder systems in extinguishing engine fires. Automatic systems were found to be ideal for engine compartments but were not suitable for the passenger compartment because there is no control over the extent and direction of the spray. Conversely, manual systems were judged to be effective only if the operating staff were trained in their use."

Typical Rear Engine system

A typical bus rear engine compartment can be protected using a 5kg/10 lb ILP unit with ABC Dry Chemical and large diameter FDT. The 8mm OD FDT 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 FDT 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 ILP systems, secure FDT installation is especially important. A maximum of 35cm between fixing location is necessary ensure properly located discharge.

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

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 ($NH_4H_2PO_4$) also known as ABC or multi-purpose powder.

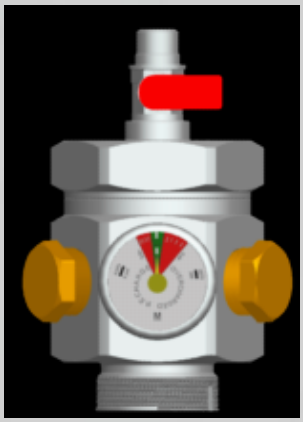
ABC Powder is included in NFPA-17 and has been evaluated and approved for use in occupied areas, provided the proper safety precautions have been taken.

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

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. The ILP Valve has two discharge ports and these can be connected to either hard pipe or flexible hoses to deliver the agent to the strategically positioned nozzles.



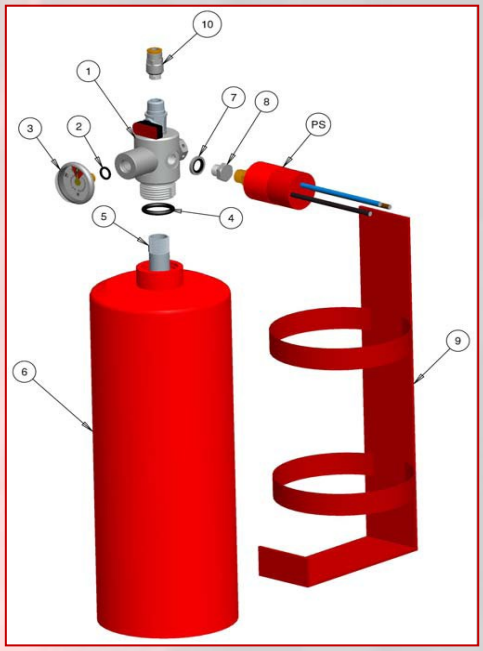
In addition, all cylinder valves are equipped with a pressure relief (rupture disc) device in compliance with safety requirements.

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 ILP Valve
2 O-Ring, Pressure Switch/Pressure Gauge
3 System Gauge
4 Collar O-ring ILP
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

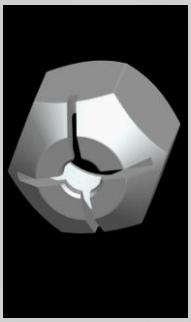
Manual Release

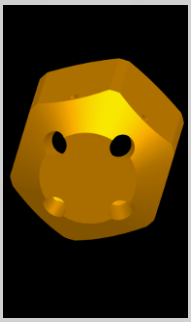
This assembly is used to manually operate an Indirect System. Mounted in the driver area, the activation of the device causes a depressurization of the FDT, which will activate the system and discharge the contents into the engine area.

The Manual Release also contains a Schrader valve port that can be used for all of the same functions as the End of Line Adapter. There is a safety ring pull which must be removed before activating the plunger. When the plunger is depressed it pierces a thin metal disk which allow the pressure to release in the tube.

Nozzles

All Indirect Systems must also use at least one nozzle to disperse the fire suppression agent. Firetrace Indirect Bus Protection Systems use at least two nozzles which are positioned to ensure maximum dispersal of the agent in a fire scenario.
The nozzles can be connected to the system by use of hard steel pipe, or flexible rubber hoses, supplied by Firetrace.





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

Typical systems

Firetrace currently recommends the use of 5kg (10lbs) of ABC dry chemical powder to properly suppress a fire within an engine bay, this powder is extremely effective and considerations have been made regarding losses due to large fans or open bottomed engine bays.

The system uses the Indirect Low-Pressure Valve and Cylinder Assembly connected to a length of Firetrace Detection Tubing, which is supplied separately. This tubing comes complete with an end of line adapter allowing the system to be pressurised with nitrogen on site. This allows far more flexibility when it comes to servicing the systems and also allows the user to use the correct length of the detection tube to fit the application perfectly. This end of line adapter can be fitted with an extra pressure gauge which can be positioned in a convenient place to make it easier for maintenance teams to monitor the pressure. The optional Manual Release Actuator can be taken off a separate feed from the FDT and be located in the driver's cab.

The main advantage comes from the integration of a low pressure switch as this device requires no power and it will constantly monitor the system. When there is a fire and the system discharges this pressure switch can be used to signal an alarm or even shut down power. This can be vital as if a bus continues driving after the fire suppression system activates it is likely that the original fault will reoccur and ignite another fire. The residue left by the dry powder will resist re-ignition however it is always best for the bus to stop in the first safe place and the problem be fixed.

The system is available both to CE and DOT standards, the latter being FM Approved.

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

As mentioned earlier in the text, Firetrace has recently gained the internationally recognised SBF-128:1 Approval in Sweden for the protection of buses using ABC Dry Chemical as the extinguishing agent.

Frequently Asked Questions

What pressure is the system working to?

The **FIRETRACE®** dry chemical system is super pressurized with Nitrogen to a pressure of 195psi, around 13.4bar.

What happens if I have more than one fire simultaneously in the engine bay area?

Because the system is design is based on the volume of the engine bay, 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 Engine bay area, however, will rapidly fill with a cloud of dry chemical agent which will quickly suppress any other fires that there may be.

If the system puts out the fire, why does the driver need to know there has been a problem?

Often the source of a fire in a bus engine is electrical, or down to a mechanical fault with parts such as the starter-motor, fuel pump or turbo unit. If the bus were to continue to operate after a system had extinguished a fire, then the faulty unit could re-ignite a fire situation and you would then have a situation of a fire with no-further protection. By stopping the bus, the fuel supply to the engine would cease and any electrical fault eliminated by removing the power.

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 dry chemical powder cause any damage to the engine?

No. However, as with any chemical agent discharge following a fire scenario, some clean-up will be required. This is the same for water-based extinguishing systems too, as they will have had chemicals added to prevent freezing. This will involve some wiping, vacuuming, or washing of the exposed areas and in some cases the powder will have to be scraped off a surface, if that surface was hot at the time of discharge. However, the powder itself will not penetrate through air-filtration units and get into the internal workings of the engine.