



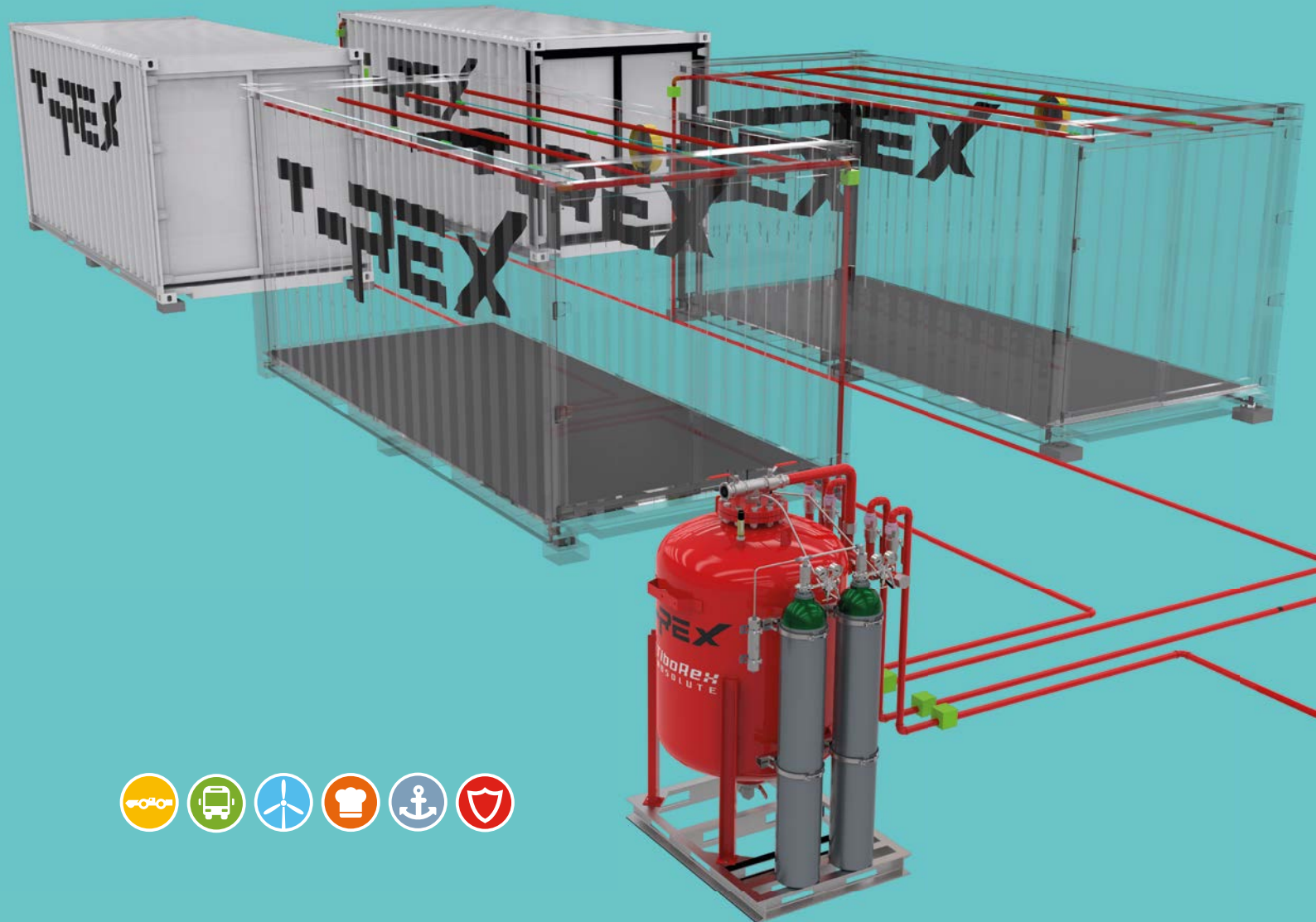
**ESS - Energy Storage Systems**

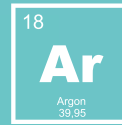
# Revolutionary Fire Suppression Systems



## T-REX

***One system for multiple containers  
Tiborex Absolute Liquid Extinguishing  
Argon Gas Combination  
Directional Valve  
Connection to Fire Brigades***





**Tiborex**  
ABSOLUTE



## Triple-Stage protection system



Pre-detection  
(smoke detector)  
Argon gas extinguishing



Fire detection  
(Spy thermo-pneumatic detectors)  
Liquid /gas extinguishing  
(Tiborex Absolute / Argon)



Fire brigade connectivity  
for aftermath

**In the first stage,** in the first phase, there is an alarm via smoke detectors. This detection activates the Argon gas extinguishing system. In this way there is a prior deprivation of oxygen inside the container, removing the strength of the fire and avoiding explosions.

Argon gas is very effective and does not generate toxic fumes with the mixture of components from a battery fire.

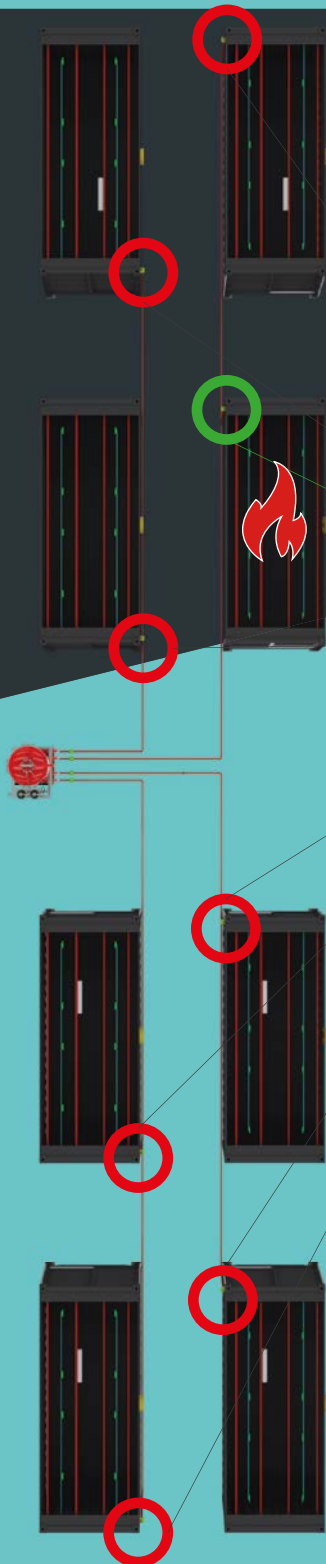
**In the second stage,** if an anomalous temperature is detected, the system starts the second fire extinguishing phase. The special extinguishing agent Tiborex Absolute is driven into the container in which the SPY temperature detector was triggered. Mixed with the propellant Argon, there is a 10x greater cooling effect than water and a drastic reduction of the oxygen inside the container. We have hereby the best formula for extinguishing a fire.

**In the third stage,** an aftermath is considered. The container keeps the oxygen levels low for some time. In combination with Tiborex, it is ensured that there are no re-ignitions. When the fire brigade arrives, they can connect their water hoses to the container and reduce the levels of noxious gases and oxygen with an extra Argon bottle. In this way, they can safely follow up to the stage of opening the container door, without any danger of explosion or fire from the sudden influx of oxygen.



## ONE SYSTEM ➔ MULTIPLE CONTAINERS

It only extinguishes the fire in the affected container



Can protect up to  
**12 containers**  
simultaneously!

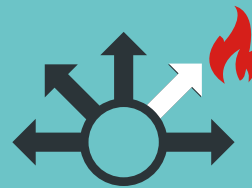
### DIRECTIONAL VALVE SYSTEM

A fire always has a precise point of origin.

The fire location is the only place where the extinguishing agent is addressed.

By doing this, the extinguishing agent is effectively directed exclusively in the necessary areas.

= increased amount of extinguishing agent at the fire spot!



### Effective with:

- Open doors
- Ventilated places

### Pressure Relief Flaps

- Explosive and noxious gas exhaust duct.
- Activates when the pressure rises inside container.

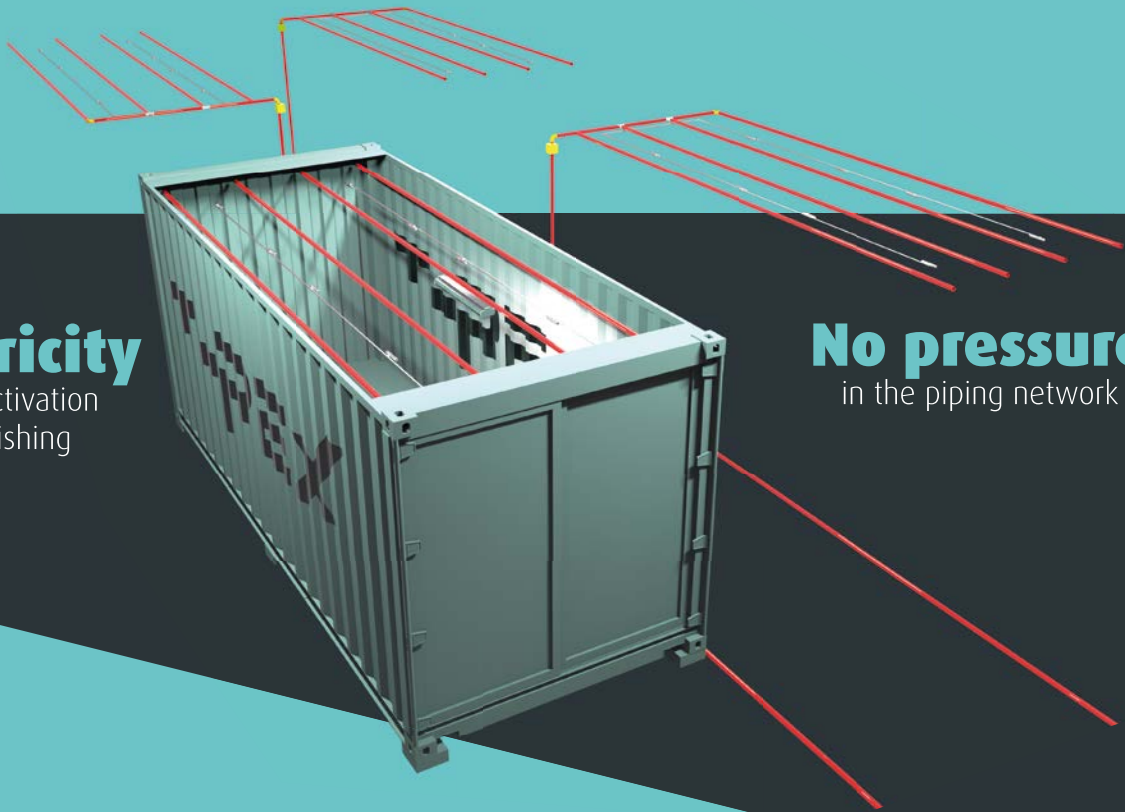


### No electricity

required for activation and extinguishing

### No pressure

in the piping network



### In the event of a power failure, the fire suppression system will always be active!

The T-rex is based on protecfire's patented technology. Fully Thermo-pneumatic!

Thermo-pneumatic detection (SPY) and Argon-powered activation make the whole system independent of any power connections.

### CONNECTION for FIRE BRIGADES

- Connect to T-REX via local fire brigade fittings (e.g. Storz)
- Flooding of the container by water supplied by the fire brigade. The T-Rex receives this water directly and sprays it through its own piping system, without the need for the fire brigade to put itself in danger.





## “In-container” solution

- Plug & play solution.
- Easily transportable.
- Equipment protection against wild life and vandalism.
- Weather protection.
- Optional temperature control inside the container.



## Why Tiborex Absolute Liquid Agent?

- Less Chances to re-ignite.
- High penetration due to the fine spray.
- Extreme cooling effect (10x higher than water).
- Extreme oxygen deprivation and suffocation effect, enhanced with the mixed Argon propellant.

## Will Liquid damage our systems?

Yes. Tho, the systems are already damaged or are not fit for reuse after a fire. The protection is so that the surrounding systems do not burn out as well.



## System Components



### SPY thermo-pneumatic detector

- Unique patented detector
- No electricity required
- High-finish stainless steel
- Response speed: Ultra Fast Response RTI 12
- Available detection temperatures:  
-57°C -68°C -79°C -93°C -110°C -141°C -182°C -230°C 260°C



### Directional Valve

- Ability to redirect the extinguishing agent only to the spot that activated the detector. In this way, the extinguishing agent will be directed more accurately and without waste.



### Fine-Spray Nozzles

- Unique patented nozzle solution
- Quick and easy to install - Reduces installation time by ~70%.
- Very small - Virtually fits anywhere
- Stainless steel
- Up to 90° spray pattern
- High quality, heavy-duty nozzle caps



### Pneumatic Manual Actuator

- Unique patented pneumatic activation system
- Stainless steel
- Safety locking system
- Argon gas activation



### Extinguishing Agent Containers

- Liquid Agent: Tiborex Absolute - exclusive extinguishing agent
- Argon Gas: propellant and extinguishing agent
- Environment friendly
- High quality manufacture
- Stainless steel
- "In-container" solution



## Extinguishing Agents Comparison

	Tiborex Absolute	Water	Foam	Powder	Gas
Fast Temperature Reduction	+	-	-	-	-
Surface Blanketing	+	-	+	-	-
Quenching Effect	+	-	+	-	+
Fine-Spray Technology	+	+	-	-	-
Fluorine Free	+	+	-	-	+
Temperature Range -50°C to +80°C	+	-	-	+	-
Danger to Persons	+	+	-	-	-

### Ultrafast extinguishing

Only small amounts of extinguishing agent required. Tiborex rapidly delivers a huge cooling power. The object to be protected remains almost undamaged.

### Quenching effect

Rapid removal of thermal energy therefore removing heat, hence no combustion or fire in hidden cavities.

### Residue monitoring and guaranteed quality

Residues of the extinguishing agent on the object can be identified with the help of ultraviolet light. A chemical analysis (DNA) can verify and confirm that the original Tiborex Absolute was used.

### Ultrafast cooling

Enormous reduction of surface temperature. Avoidance of re-ignition. Reduced effect of fire. Quick interruption of combustion process.

### Blanketing fat and oil fires

When mineral, animal or vegetable fats and oils burn, Tiborex Absolute uses chemical reactions to form a closed, gas-proof protective layer quenching the fire and protecting the hot fat or oil from re-ignition by cooling them down very quickly.

### Environmental friendliness

Ecological and 100% fluorine-free extinguishing agent. Biodegradable. Non toxic to humans and animals.

### The cooling effect

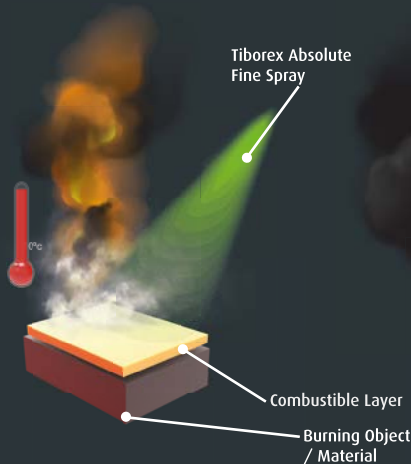
The enormous cooling effect of Tiborex Absolute is mainly based on **two physical properties**:

**Cooling effect due to water evaporation:** The fine-spray nozzles developed specially for Tiborex Absolute produce very fine droplets, smaller than 100µm, when discharging the extinguishing agent. As a result, ultra-fast evaporation of the liquid share in the extinguishing agent is achieved. Due to the required enthalpy of evaporation of 2.26 MJ/kg (equivalent to 1 litre of water) energy is extracted from the burning object in a minimum of time and it cools down substantially.

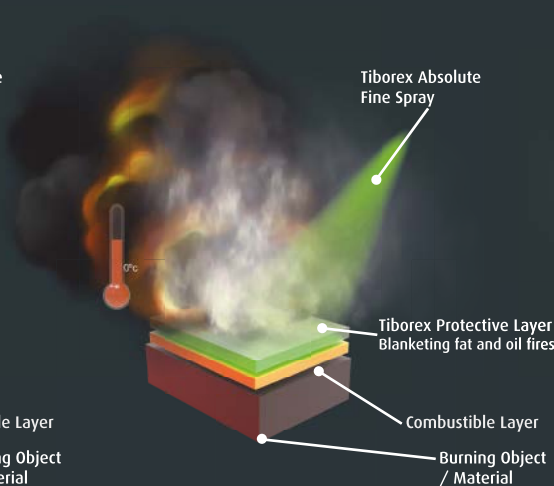
**Cooling effect due to sublimation:** During the evaporation of the aqueous phase some of Tiborex Absolute's main components form crystalline structures. With the still existing combustion temperature, these solid structures change from the crystalline phase to a gaseous phase. The enormous enthalpy of evaporation (heat) required for this amounts to 7.23 MJ/kg.

## 3 stages fire suppression

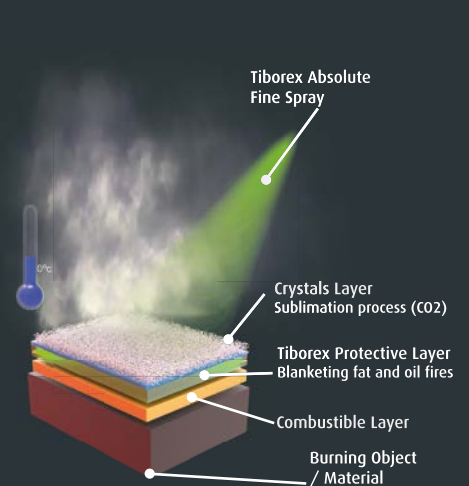
### 1 Cooling Effect Fine Spray Droplets that penetrate fire



### 2 Oxygen Suffocation by evaporation



### 3 Ultra Cooling through Sublimation Layering with solid crystals that convert to gas



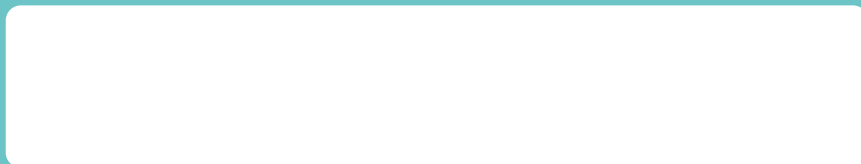


## Fire Suppression Systems for ESS - Energy Storage Systems



protecfire GmbH  
Weidekamp 10  
D-23556 Lübeck  
Germany

Tel.: +49 (0) 451 399 61-10  
Fax: +49 (0) 451 399 61-20  
@: [info@protecfire.de](mailto:info@protecfire.de)  
[www.protecfire.de](http://www.protecfire.de)



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