



## NASA TEST STAT-X EXTINGUISHING AEROSOL

A fire in a lithium battery proves difficult to extinguish. It is often recommended to cool the battery pack with a lot of water. But after a while most of the fires flare up again. There is also a risk, when extinguishing a lithium battery with water, it might result in a burst of flame. A test conducted by NASA has shown that Stat-X extinguishing aerosol is suitable to suppress these types of fire. With regard to battery fire hazards we can distinguish lithium-ion batteries and lithium metal batteries. Lithium metal batteries are non-rechargeable. Lithium ion batteries are rechargeable.



A typical lithium-ion battery is composed of two densely packed electrodes: a carbon anode and a lithium metal oxide cathode. There is an ultra-thin polymer separator in between. The separator separates the electrodes. If it is damaged it can shortcircuit causing the flammable electrolyte solution, which transports the ions, to ignite.

### Ignition of electrolyte

When lithium metal or ion batteries are misused, damaged, improperly packed, overloaded, faulty or poorly constructed, there is a risk that they will ignite due to overheating caused by short circuiting. The bursting of battery cells through the heating and ignition of the liquid electrolyte is, next to explosion, the biggest risk for the onset of fire. Most dangerous is when a self-reinforcing process emerges whereby the chemical lithium will react vigorously with the other materials in the battery. This self-reinforcing chemical process is called thermal runaway.

### Thermal runaway

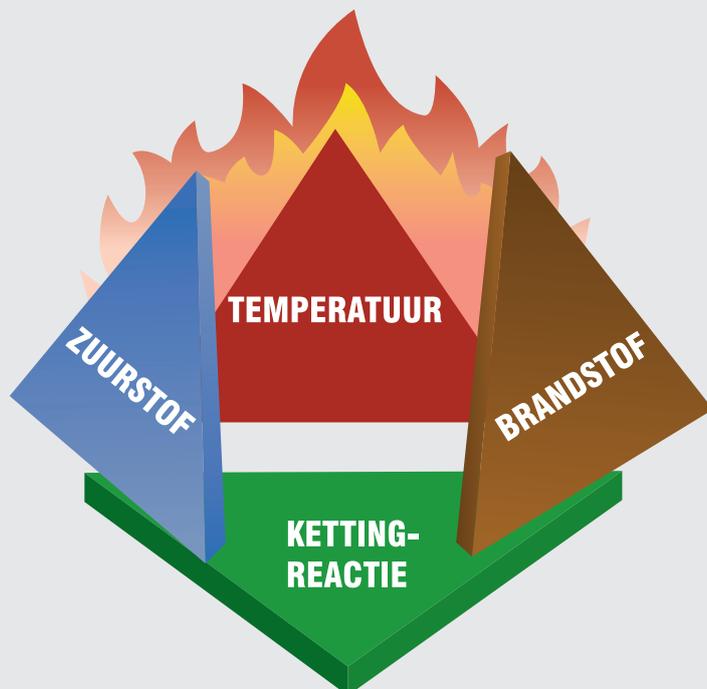
A cell might ignite because a lot of heat is generated by chemical reactions during the overheating of the battery. In addition, gases can cause explosions. The thermal runaway hit of lithium-ion batteries is caused by a short circuit in the battery. This is a particular threat while formatting cells. Thermal runaway can occur during the discharge of the battery. Unlike other kinds of batteries, lithium-ion batteries contain flammable electrolyte that is released at high temperatures.

In short, because lithium batteries tend to ignite violently at excessive heat, even large quantities of packaged batteries may pose a significant risk. What started as a relatively small fire can result in an uncontrolled fire. To extinguish the fire with water is unwise and dangerous. Lithium fire may react vigorously with water since flammable hydrogen gas and corrosive vapours such as lithium oxide are formed.

### Metal fire

A lithium-battery fire is a metal fire, this is a fire which involves metal as a fuel. These metals that are very reactive and very easily oxidized, such as magnesium, titanium, zirconium, Lithium, sodium or potassium. Metal Fires are classified as class D and can be very dangerous, especially when they are improperly dealt with. Conventional extinguishing agents such as water and carbon dioxide, are unsuitable for extinguishing metal fires. They tend to aggravate the fire. Metal fires can be extinguished with dry powder extinguishers, such as sand, graphite or sodium chloride. Powders ensure that there is no more oxygen supplied and they will lead away the heat quickly.





### Stat-X extinguishing process

#### Burn proces:

- Fire emerges by combination of fuel, oxygen, and ignition temperature
- Free radicals emerge (free radicals are unstable particles O, H and OH)
- The free radicals cause a chain reaction that maintains fire

#### Stat-X aerosol extinguishes the fire:

- Stat-X-radicals (K) reacts with fire-radicals (O, H and OH)
- Stable molecules arise and suppress fire (KOH, KH, KO, H<sub>2</sub>O)
- Then Stat-X also suppresses the fire by cooling and diluting the inflammable medium with gas

### Aerosol fire suppression

Can fire suppression aerosol based on potassium nitrate provide a solution? An aerosol like Stat-X does not suppress or extinguishes fire by oxygen depletion or cooling. Stat-X- aerosol suppresses fire by chemically interfering with the free radicals of flame.

Stat-X fire suppression aerosol has been UL approved for Class A, B and C for solids, liquid, gas and electricity fires. Just because Stat-X aerosol has not been tested on Class D, does not mean that there are no possibilities to do so.

### NASA Johnson Space Center Test

NASA Johnson Space Center has tested Stat-X aerosol on lithium-ion battery fires. Lithium-ion batteries are used in NASA space suits, space vehicles and space ships. NASA confirmed to the manufacturer of Stat-X Fireaway, that the tests were successful. NASA is convinced that fire suppression aerosol can be applied effectively in fighting lithium-ion battery fires.

### Fire control

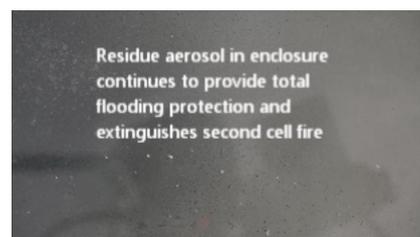
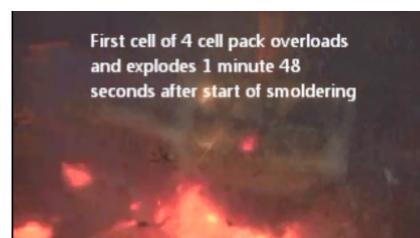
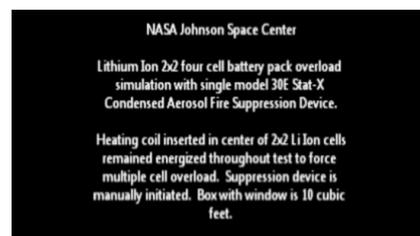
For this test NASA had a 4 cell lithium battery hit thermal runaway in a space 10ft<sup>3</sup> (0,3m<sup>3</sup>). It was extinguished with 30 grams of Stat-X aerosol. In first instance the result of this test was that the fire was not completely extinguished, but the fire was under control.

### Preventing expansion of fire

NASA testing shows that the battery fire is controlled without causing additional damage. The fire suppression aerosol prevents expansion of the fire to the separator. This also prevents the release of flammable electrolyte. Therefore a dangerous escalating fire in the battery with multiple cells is smothered.

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Watch the video of the NASA test at: [www.blussysteem.com/video-s/video-bij-li-batterijbrand/](http://www.blussysteem.com/video-s/video-bij-li-batterijbrand/):



Frames NASA Stat-X test video