

# The Dangers of Lithium Ion Battery Fires and why they can not be Safely Extinguished using only Halon and Water

## The Dangers of a Lithium Ion Battery Fire in Electronic Devices

A fire that occurs in a battery-powered electronic device (laptop computer, cellular phone, tablet PC, digital camera, MP3 Player or e-Reader) can not to be taken lightly. This is a Lithium Ion battery fire and is a very dangerous situation. These fires must be properly controlled and contained in order to prevent serious injury to persons or property. Should this type of fire occur on an airplane or ship, or in an office building or other confined space, the situation is greatly worsened because there is no where to run or hide from the flames, toxic fumes, heat and smoke.

## Lithium Ion Battery Fires in Aircraft

The possibility of a Lithium Ion battery fire occurring on an airplane is very real. In fact there have been nearly 100 related “in-flight” incidences over the last 10 years. With the rapid growth of electronic devices being brought on board aircraft, the probability of these type events will only become more frequent. This has resulted in several government safety alerts for operators of aircraft. These alerts propose that Lithium Ion battery fires can be safely extinguished using a combination of Halon and Water.

However, there are significant problems with the proposed Halon and water method:

- Halon does not prevent adjacent cells from continuing to go into thermal runaway
- Halon and water do nothing to contain or control exposure to toxic fumes and smoke which are emitted

## Evaluate and Compare Methods

Over the next pages compare excerpts from an actual Lithium Ion Material Safety Data Sheet (MSDS) highlighting recommended procedures and potential health hazards with excerpts from current recommended Halon and water procedure approved by various regulatory entities. Note that some of the more dangerous problems posed by this type fire are not addressed by the procedure – or for that matter by any other procedure or device available on the market (flexible pouches, various fire extinguishment sprays, etc.)

- There are more dangers in this type event than just the flames from the burning device. Current containment procedures being used by the airlines and supported by the regulatory entities pay no attention to the dangers of toxic fumes created by the burning device that are harmful when breathed.
- Halon and Water method is insufficient and unpredictable.

## Excerpts from an actual Lithium Ion Battery Material Safety Data Sheet:

### Material Safety Data Sheet

Lithium Ion

#### SECTION 3 – PHYSICAL AND CHEMICAL CHARACTERISTICS

<b>Special Fire Fighting Procedures</b>	Use a positive pressure self-contained breathing apparatus if batteries are involved in a fire. Full protective clothing is necessary. During water application, caution is advised as burning pieces of flammable particles may be ejected from the fire.
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<b>Unusual Fire and Explosion Hazards</b>	Cells or batteries may flame or leak potentially hazardous organic vapors if exposed to excessive heat or fire. Damaged or opened cells or batteries can result in rapid heating and the release of flammable vapors. Vapors may be heavier than air and may travel along the ground or be moved by ventilation to an ignition source and flash back.
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#### SECTION 5 – HEALTH HAZARDS

<b>Threshold Limit Value</b>	NA
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<b>Signs and Symptoms of Exposure</b>	Irritancy: The electrolytes contained in this battery can irritate eyes with any contact. Prolonged contact with the skin or mucous membranes may cause irritation.
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<b>Medical Conditions Generally Caused by Exposure</b>	The materials contained in this battery may only represent a hazard if the integrity of the battery is compromised or if the battery is physically or electrically abused. <b>Acute exposure:</b> Electrolyte may irritate skin and eyes.
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<b>Routes of Entry</b>	Skin, Eyes, Swallowing
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#### SECTION 7 – SPECIAL PRECAUTIONS – SPILL AND LEAKAGE PROCEDURES

<b>Precautions to be Taken when Handling and Storing</b>	Batteries are designed to be recharged. However, improperly charging a cell or battery may cause the cell or battery to flame. Use only approved chargers and procedures. Never disassemble a battery or bypass any safety device. Should a battery unintentionally be crushed, thus releasing its contents, rubber gloves must be used to handle all battery components. Avoid inhalation of any vapors that may be emitted.
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<b>Other Precautions</b>	Do not store batteries above 60 °C or below -32°C. Store batteries in a cool (below 21°C (70°F)), dry area that is subject to little temperature change. Elevated temperatures can result in reduced battery service life. Battery exposure to temperatures in excess of 130°C will result in the battery venting flammable liquid and gases. Do not store batteries in a manner that allows terminals to short circuit.
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<b>Steps to be Taken if chemicals are spilled</b>	If cells are leaking or rupture, prevent skin and eye contact and collect all released material in a plastic lined metal container. Personal protective equipment for damaged batteries should include chemical resistant gloves and safety glasses.
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## Details and Explanation of the Proposed Halon and Water Method

### FAA Fire Safety Highlights **LAPTOP COMPUTER FIRE EXTINGUISHMENT**

Laptop computers and other battery powered electronic devices can pose a significant fire hazard when carried aboard passenger aircraft. The lithium-ion batteries may malfunction and overheat, often during the charging process. This can cause the battery pack to catch fire. Laptop computer batteries contain up to nine lithium-ion cells. These cells become dangerous when the internal temperature reaches 350 degrees Fahrenheit. At that temperature the cell goes into thermal runaway. The cell gets extremely hot, then overpressures, releasing flammable liquid electrolyte and may explode. A single cell in thermal runaway generates enough heat to cause adjacent cells to also go into thermal runaway, a chain reaction process.

The FAA, in conjunction with the airline industry, embarked on a series of tests to determine the optimum procedure for fighting a laptop computer fire on board an aircraft. Halon 1211, the typical fire extinguisher installed in passenger aircraft, was effective in extinguishing the burning electrolyte, but did not prevent adjacent cells from going into thermal runaway and catching on fire. It was determined that water was the most effective agent in cooling the remaining cells and stopping the chain reaction. A training video was developed by the Fire Safety Team, which illustrates effective and practical methods of extinguishing a cabin fire involving lithium batteries in a laptop computer. The video, “Extinguishing In-Flight Laptop Computer Fires,” may be viewed at the Fire Safety Team website: [www.fire.tc.faa.gov](http://www.fire.tc.faa.gov).

The FAA issued a Safety Alert for Operators (SAFO 09013, June 23, 2009) entitled, “Fighting Fires Caused by Lithium Type Batteries in Portable Electronic Devices”. The purpose of the SAFO is to recommend procedures for fighting fires caused by lithium type batteries in portable electronic devices. Based on testing by the Fire Safety Team of the FAA William J Hughes Technical Center, the SAFO recommends a two phase procedure: (1) extinguishment of the fire, and (2) cooling the remaining cells to stop thermal runaway. Halon 1211 or water fire extinguishers are effective at extinguishing the fire and preventing its spread to additional flammable materials. After extinguishing the fire, dousing the electronic device with water or other non-alcoholic liquids cools the device and prevents additional battery cells from reaching thermal runaway. The SAFO references the FAA training video, “Extinguishing In-Flight Laptop Computer Fires,” for additional information and demonstration of the fire fighting techniques.

**But, as you can see in the above document, the procedure does not address the fact that while water may stop the thermal runaway, it does absolutely nothing to stop the exposure of the passengers and crew to the dangerous toxic fumes created by the burning Lithium Ion battery and electrolyte!!! These fumes will spread throughout the cabin!!**

**Does this sound like a good ‘Solution’ to the problem????**

HighWater Innovations believes that the Halon and Water method is unpredictable, dangerous and extremely uncomfortable for both flight crew and passengers. The toxic gases and the burning electronic device will still harm persons and property and the flight must still be diverted.

**PlaneGard™ by HighWater Innovations offers the following solutions:**

- At the first sign of smoke, the electronic device can be safely stowed in **PlaneGard** and an emergency landing and/or flight diversion can be avoided saving time, money and public relations headaches.
- Should a major fire occur in an electronic device, **PlaneGard** is always there and ready. No worries about how to handle a burning laptop. Using **PlaneGard**, the burning device can be safely scooped up and stowed where no harm can be done. This action requires a minimum of exposure by the flight crew to the burning device.
- The toxic battery fumes, heat and smoke are safely contained and filtered inside **PlaneGard**. The aircraft's passengers and crew need not be exposed to these very toxic gases (for toxicity statement see the language in the Lithium Ion Battery MSDS).
- With the **PlaneGard** case, water is used to safely submerge and flood the electronic device inside the **PlaneGard** case, thus permanently extinguishing the fire. Pouring water onto the keyboard as proposed in the Halon and Water method is much less effective due to the water-proof design of modern keyboards. (Pouring water on a flaming keyboard will also frighten & upset many nearby passengers!)
- No need to use a Halon extinguisher (and potentially other spraying chemicals), which can be most unpleasant and very, very messy!
- With **PlaneGard** the burning electronic device is safely contained where it can do no further damage. No need to worry about the fire re-igniting. With PlaneGard it's "Case Closed"!

**A Lithium Ion battery fire needs PlaneGard on board:**

- **Make containment of the burning device safe and predictable.**
- **Eliminate exposure to the toxic fumes and smoke which are emitted.**