

## Frequently Asked Questions | Li-ion Tamer



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## Li-ion Tamer FAQs

### Q 1: What are the stages Lithium-ion Battery Failure?

A:

- Stage 1: Abuse factor
  - Thermal, electrical, or mechanical abuse
- Stage 2: Off-gas generation
  - Occurs regardless of cell form-factor
- Stage 3: Smoke generation
  - Catastrophic failure is imminent
- Stage 4: Fire generation
  - Likelihood of propagation drastically increases (thermal runaway)

### Q 2: What gases does Li-ion Tamer detect?

A:

- Li-ion Tamer is designed to respond to volatile organic compounds (VOCs) which are emitted during a lithium-ion battery off-gas event that occurs prior to thermal runaway.
- Li-ion Tamer will also detect the composition of gases (CO, H<sub>2</sub>, VOCs, etc.), released at thermal runaway.

### Q 3: Does Li-ion Tamer detect different Lithium-ion Chemistries?

A:

- Chemistry is often referring to anode and cathode chemistry, such as LFP (Lithium FerroPhosphate or lithium iron phosphate) or NMC (Nickel Manganese Cobalt).
- Li-ion Tamer can detect off-gassing of different battery chemistries; it does this by detecting the presence of battery electrolyte solvent vapors which are common to all battery chemistries. It is agnostic towards the types of anode and cathode chemistries used.

### Q 4: How do you stop thermal runaway?

A:

- Li-ion Tamer can detect off-gassing of different battery chemistries; it does this by detecting the presence of battery electrolyte solvent vapors which are common to all batteries.
- Off-gas events are the earliest indicator of thermal runaway and once detected provides sufficient time to initiate containment measures, such as automatically isolating electrical systems, and ventilation activation to remove flammable gas accumulation.

### Q 5: Doesn't Battery Management Systems (BMS) provide sufficient protection?

A:

- Despite the presence of BMSs, thermal runaway events are occurring. BMSs monitor temperature and electrical loading but these systems may have insufficient resolution or granularity at a cell level allowing an initial cell failure to occur. BMSs may also experience sensor failure.
- The Li-ion Tamer product provides an independent and reliable monitoring solution for all lithium-ion batteries and is an essential safety layer within a Failure Modes Effects Analysis (FMEA) for improving the overall safety.

## Q 6: Can Li-ion Tamer tell me where the off-gas event has occurred?

A:

- Yes, the Li-ion Tamer system indicates which individual sensor detected an off-gas event which allows subsequent localized investigation; typically to 1 or 2 battery racks. Every Li-ion Tamer system deployed will deliver on single cell off-gas event detection.
- Li-ion Tamer systems can be designed to suit customer needs; maximum granularity for faster investigation, targeted mitigating action or cost effectiveness.

## Q 7: How many minutes of early warning does Li-ion Tamer provide?

A:

- The Li-ion Tamer product typically provides between 2 and 30 minutes warning of a thermal runaway event. The severity of the abuse factor greatly effects the amount of time between the cell venting and thermal runaway.
- When using the UL 9540A recommended failure method, Li-ion Tamer consistently delivers early warning with many different types of cell manufacturers, chemistries, and form factors.

## Q 8: What is the physical arrangement of the hardware?

A:

- The Li-ion Tamer is built up of two primary components: the Li-ion Tamer sensor that detect the off-gas event and the Li-ion Tamer Controller that monitors and reports an event.
- Li-ion Tamer sensors can be deployed as either monitoring sensors and reference sensors.
  - Monitoring sensors are placed near the battery racks and monitor for off-gas events.
  - Reference sensors are distributed in potential nuisance alarm locations to increase system reliability.
- Controllers have two communication protocols:
  - Digital outputs can be used to activate relays
  - MODBUS RTU can be converted to MODBUS TCP/IP

## Q 9: What is the detection level?

A:

- The Li-ion Tamer sensor has been designed to operate in a binary state; either in a normal or alarm state. This allows Li-ion Tamer to focus on the smallest presence of an off-gas event in any concentration as an abnormal condition for immediate alarm reporting.
- The detection alarm is also based around a rate of gas generation consistent with an off-gas event or cell venting occurring.

## Q 10: Does Li-ion Tamer meet ESS Codes and Standards?

A:

- Li-ion Tamer meets NFPA 855 4.2.9.2 and NFPA 855 9.3.
    - NFPA 855 4.2.9.2  
The Energy Storage Management System (ESMS) shall electrically isolate the components of the ESS or place it in a safe condition if potentially hazardous temperatures or other hazardous conditions are detected.  
*Li-ion Tamer helps meet this by detecting hazardous conditions other than temperature.*
    - NFPA 855 9.3  
Thermal Runaway Protection. Where required by Table 9.2, a listed device or other approved method shall be provided to preclude, detect, and minimize the impact of thermal runaway.  
*Li-ion Tamer helps detect events that preclude thermal runaway (i.e. the initial cell venting) as well as being able to detect the gases released by thermal runaway.*
  - Li-ion Tamer is pursuing the UL 2075 gas detection performance standard and is CE marked and IEC 610101 compliant.
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## **Q 11: Is there third-party testing of Li-ion Tamer?**

**A:**

- Yes, the Li-ion Tamer system has been tested by many third-party entities. Li-ion Tamer participated in a joint-industry program to increase the safety of lithium-ion batteries organized by DNV-GL. DNV-GL showed in their testing that Li-ion Tamer was able to prevent thermal runaway. (<https://www.dnvgl.com/maritime/publications/Technical-Reference-for-Li-ion-Battery-Explosion-Risk-and-Fire-Suppression-report-download.html>)
- Li-ion Tamer has been implemented in UL 9540A tests to generate supplemental information for select customers.

## **Q 12: How can you be sure Li-ion Tamer works in my systems' airflow?**

**A:**

- Li-ion Tamer has been extensively tested in many different battery environments, under varied ventilation conditions. During the applications engineering process, the ESS air flow patterns are considered to ensure the system operates within its performance envelope.
- If you have a specific battery configuration that requires off-gas detection; individual assessment or testing can be conducted. Additionally, if UL9540A testing is going to be performed, Li-ion Tamer hardware can be implemented for evaluating product functionality.