Application Note:

# L3 Limitless Lithium Series

## Aerosol Fire Suppression System Overview

## 1. Product Overview

The Sol-Ark L3 Limitless Lithium series includes the L3 HV-40, L3 HV-60, and L3 HVR-60 lithium iron-phosphate BESS (battery energy storage system). The series is listed to **UL 9540 Ed. 2-2021** and has completed **UL 9540a Ed. 4-2019** unit-level testing for "Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems" with no external flames, flying debris, or explosion observed with thermal runaway contained by the unit's integral design features.

The L3 Series battery packs use Tier-1 lithium cells based on lithium iron phosphate (LFP) BESS chemistry. Unlike other compositions used in consumer and grid batteries such as nickel manganese cobalt oxide (NMC) or lithium nickel cobalt aluminum oxide (NCA), LFP offers key safety advantages:

- **Thermal Runaway Resistance**: LFP has strong internal chemical bonds that resist decomposition and the release of large amounts of heat, even when damaged. This minimizes the risk of thermal runaway.
- **High Ignition Temperature**: LFP cells have a runaway initiation threshold of over 180 °C[1] before entering thermal runaway and potential ignition. By comparison, NMC chemistries begin around 120-130 °C. Using LFP cells allows more time to prevent or manage overheating situations.
- **Low Operating Voltage**: LFP operates at lower cell voltages than other lithium-ion chemistries, resulting in lower energy potential, which is less likely to fuel fires in a fault condition.

[1] Shen et al., "Thermal Runaway Characteristics and Gas Composition Analysis of Lithium-Ion Batteries with Different LFP and NMC Cathode Materials under Inert Atmosphere"

Copyright © 2026 Sol-Ark LLC

## 2. Aerosol-Based Fire Suppression System

The L3 Series features an integrated aerosol-based fire suppression system at the battery module and cabinet (for L3 HVR) level. In the rare event of a thermal runaway, the aerosol canister will rapidly deploy, filling the battery module or cabinet interior with a non-toxic agent to suppress any potential fire before it spreads. This unique, industry-leading safety capability from Sol-Ark ensures maximum protection for commercial and industrial users.

This proprietary system activates automatically in two ways, depending on the product:

**Module Level – For L3 HV and L3 HVR:** Each battery module contains a 12-gram aerosol agent canister (shown in Figure 1). It contains a thermal deployment mechanism that activates automatically when heat inside the module reaches potentially unsafe levels due to thermal runaway or external fires (185 °C ±10 °C). By building the suppression system directly into the battery next to the cells, the system is able to suppress fires precisely where needed, rather than relying on suppression methods external to the module, such as a water-based sprinkler system in a battery room.

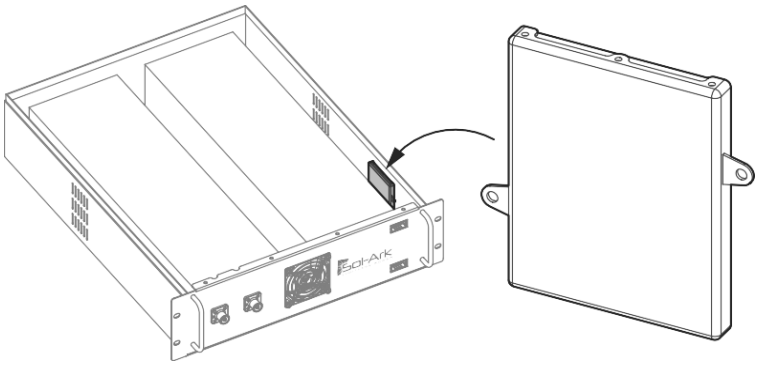


Figure 1: Module-level aerosol agent canister

**Cabinet Level – For L3 HVR Only:** Each L3 HVR cabinet contains a larger 300-gram aerosol canister in the top right corner. This unit is electronically activated based on signals from the fire detection sensors inside the cabinet. Smoke, heat, and $CO_2$/gas sensors will detect abnormal operating conditions and deploy the aerosol from the canister, filling the inside of the cabinet.

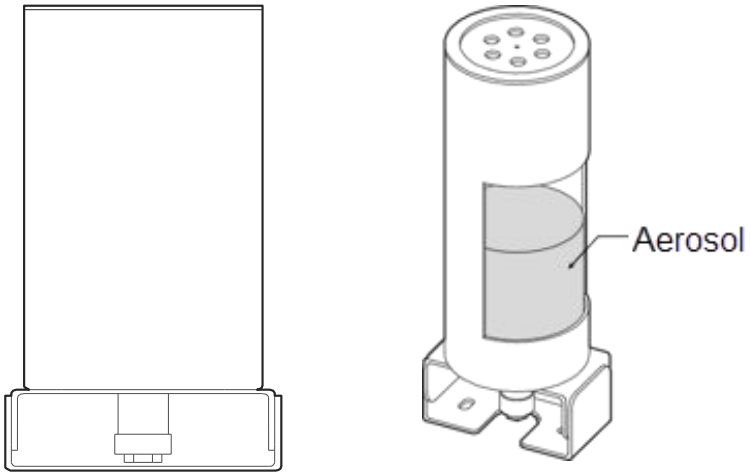



Figure 2: Cabinet-level aerosol agent canister

## 3. Aerosol Canister Photos

The following photos show the location of the aerosol canister inside the battery cabinet or battery module.




Figure 3: External view of the L3 HV Battery Module



Figure 4: Close-up of the L3 HVR aerosol canister



Figure 5: Close-up of the module aerosol canister

# 4. Aerosol Suppression Agent Operating Theory

The following content is excerpted from the aerosol manufacturer JIANDUN's *Installation and Operation Manual for the Aerosol Fire Extinguishing Device, Model: QRR0.012G/S-QT-003*, used inside the battery modules.

## Cooling and Extinguishing Effect of Endothermic Decomposition

The cooling effect of aerosol fire extinguishing agents relies mainly on endothermic decomposition of metal oxides and carbonates. The heat that's quickly released by any fire is limited. If the solid particles in the aerosol can absorb some of the heat released by the fire source in a short period of time, the temperature of the flame will be lowered and radiated to the burning surface. This means that heat for cracking the gasified, combustible molecules into free radicals is reduced, and the combustion reaction is somewhat inhibited.

## Gas-Phase Chemical Inhibition

Under the action of heat, vaporized metal ions such as Sr, K, Mg, or electron-losing cations decomposed by aerosol fire extinguishing agents exist in the form of steam, which interacts with the active groups H•, •OH, and O in combustion. This is a secondary chain reaction.

### Example with Sr:

$$Sr+2{\bullet}OH \rightarrow Sr(OH)_2 \quad Sr+O{\bullet} \rightarrow SrO \quad Sr(OH)_2+2H{\bullet} \rightarrow Sr+2H_2O$$

Repeatedly, the active groups in the combustion are consumed in large quantities, the concentration is continuously reduced, and the combustion is suppressed.

## Solid-Phase Chemical Inhibition

The solid particles in the aerosol fire extinguishing agent can absorb the chain reaction intermediates • OH, H,• and O•, and catalyze their reorganization into stable molecules. This interrupts the branched chain reaction of the combustion process.

### Example with K:

**K2O(s)+2H(g)→2KOH(s) KOH(s)+OH(g)→KO(s)+H2O(g) K2O(s)+O(g)→2KO(s) KO(s)+H(g)→KOH**

In the fire-extinguishing effects mentioned above, several fire-extinguishing mechanisms interact and work synergistically, but the gas transport, endothermic effects, and cooling effects of metal oxides or carbonates are only auxiliary effects; the main fire-extinguishing effect still relies on gas for chemical inhibition of the solid phase.

## Document Revision History

| Rev. | Date | Description of Changes |
|---|---|---|
| 1 | 2024 | Document created. |
| 2 | 2024 | Document updated. |
| 3 | 08/27/2026 | Minor updates to improve accuracy and consistency. |