

# UL 2596 Test Report for Elven Technologies Battery Enclosure: FireGuard Light 10mm

## Project Details

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Project Name: Battery Enclosure Safety Program

Test Standard: UL 2596

Testing Laboratory: Underwriters Laboratories, Northbrook, IL

Testing Team: Bret Tittle, Thomas Buzzi

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Approval: Sandro Chubinidze, Vamekh Kherkheulidze

## Scope of Report

The document provides detailed analysis of the Torch and Grit test on FireGuard Light in accordance with the UL 2596 standard *Battery Enclosure Thermal Runaway Barriers*. The objective is to verify the material's ability to maintain structural integrity and limit heat/pressure transmission during extreme thermal-runaway events in lithium-ion cells.

## Sample Specification

- Sample ID: TAG B
- Thickness: 10 mm
- Density / Basis Weight:  $0.22\text{g cm}^{-3}$
- Flexibility: Yes
- Colour: Black

# Test Procedure – Torch and Grit Test

1. Expose the specimen to a 1200 °C propane flame for 15 s, immediately followed by abrasive grit-blast (SiC, 140 kPa) for 5 s.
2. Repeat up to 10 cycles or until the sample breaches.
3. Continuously record time-to-breach and back-face temperature.

## Test Results

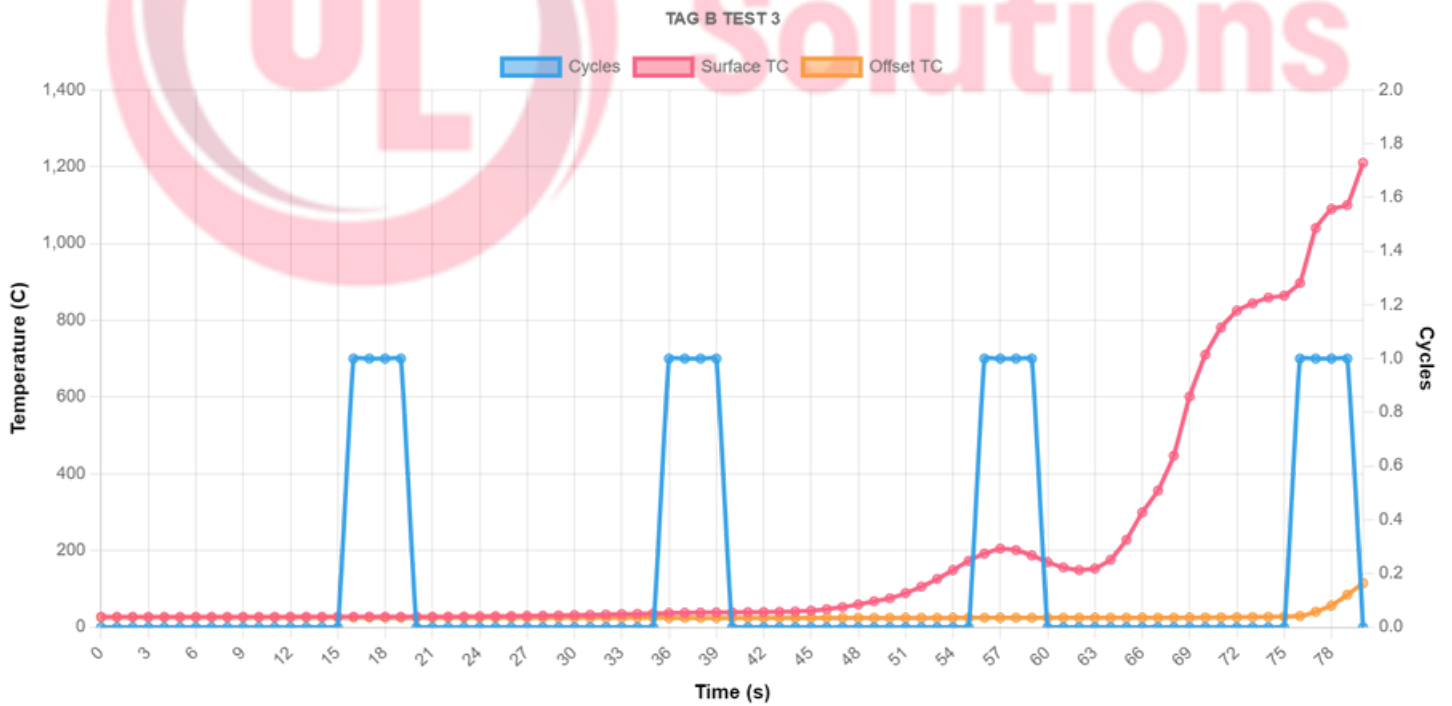
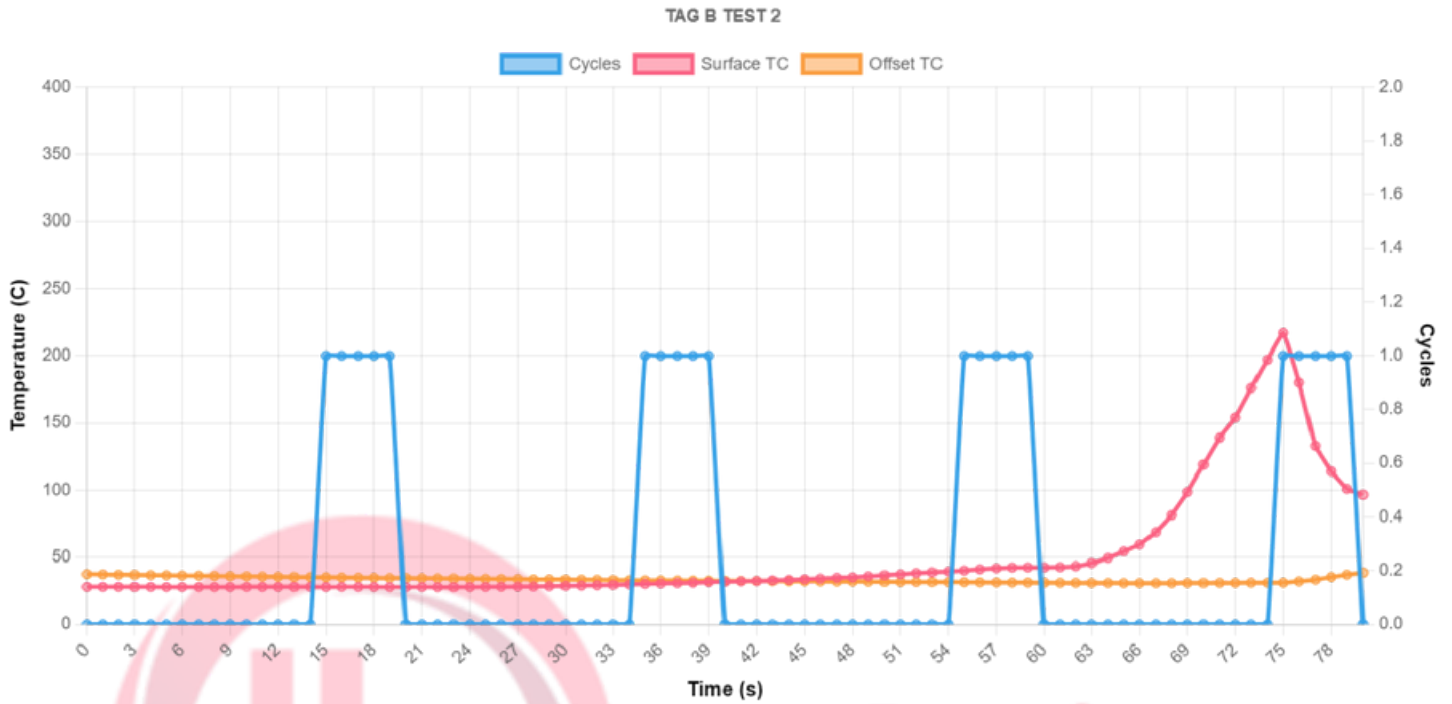
Sample	Torch Temperature and Power Set Point	Torch Dwell Time	Grit Dwell Time	Sample Breach (Y/N)	Approximate Time to Sample Breach (s)	Temperature Measurement at Breach (°C)	Observations (Note: Temperature measurements charts are included in Addendum "A")
TAG B TEST 2	1200 °C 3 KW	15s	5s	Yes	76	217	Breach at cycle 4 grit
TAG B TEST 3	1200 °C 3 KW	15s	5s	Yes	68	356	Breach at cycle 4 torch
TAG B TEST 4	1200 °C 3 KW	15s	5s	Yes	69	34.5	Breach at cycle 4 torch
TAG B TEST 5	1200 °C 3 KW	15s	5s	Yes	76	124	Breach at cycle 4 grit
TAG C TEST 1	1200 °C 3 KW	15s	5s	No	N/A	N/A	No Breach after 10 cycles
TAG C TEST 2	1200 °C 3 KW	15s	5s	No	N/A	N/A	No Breach after 10 cycles
TAG C TEST 3	1200 °C 3 KW	15s	5s	No	N/A	N/A	No Breach after 10 cycles
TAG C TEST 4	1200 °C 3 KW	15s	5s	No	N/A	N/A	No Breach after 10 cycles
TAG C TEST 5	1200 °C 3 KW	15s	5s	No	N/A	N/A	No Breach after 10 cycles
TAG D TEST 1	1200 °C 3 KW	15s	5s	No	N/A	N/A	No Breach after 10 cycles
TAG D TEST 2	1200 °C 3 KW	15s	5s	No	N/A	N/A	No Breach after 10 cycles
TAG D TEST 3	1200 °C 3 KW	15s	5s	No	N/A	N/A	No Breach after 10 cycles
TAG D TEST 4	1200 °C 3 KW	15s	5s	No	N/A	N/A	No Breach after 10 cycles
TAG D TEST 5	1200 °C 3 KW	15s	5s	No	N/A	N/A	No Breach after 10 cycles

## Key Observations

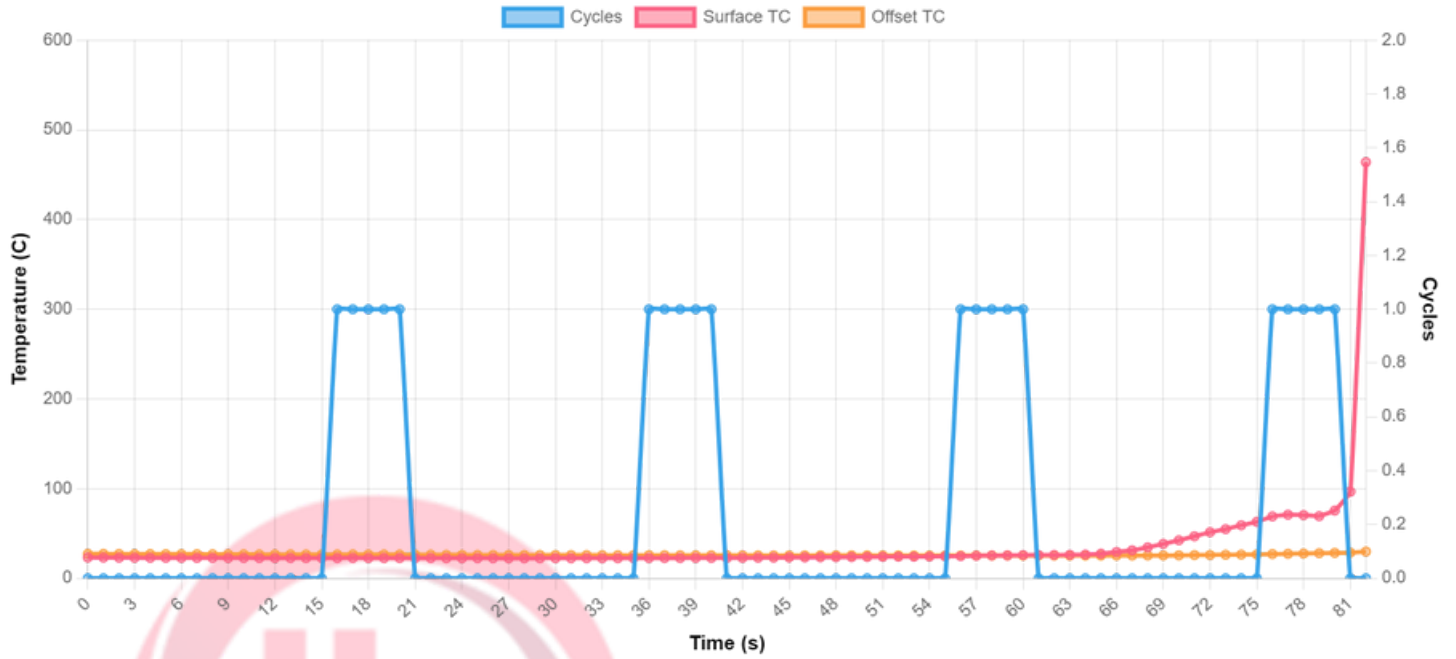
- **Strong thermal shielding under direct flame:** Maintained a cool protected side during alternating **1200 °C** flame and grit exposure, reducing risk of heat transfer to adjacent components and finishes.
- **Good erosion resistance:** Withstood multiple flame/grit cycles before any through-penetration; hot face showed superficial pitting only, with **no delamination** across the laminate.
- **Predictable, controlled failure mode:** If breach occurs, it initiates as a localized pinhole in the primary exposure zone—**no fragment ejection** and no sustained flaming on the protected face.

## Conclusion

**FireGuard Light (10 mm) demonstrates robust thermal insulation and credible resistance to simultaneous flame impingement and grit erosion, while exhibiting stable, non-violent failure characteristics. As a general-purpose high-temperature insulation, it is recommended for use in enclosures and structures requiring lightweight, conformable protection against short-to-moderate flame exposures, with straightforward pathways to higher endurance through minor durability enhancements.**



**TAG B TEST 4**



**TAG B TEST 5**

