

BATTERY INNOVATION GROUP

Inherently Safe Batteries Everywhere

LITHIUM-ION BATTERY FIRES: RARE, BUT FEROCIOS!

SOURCE: NEW YORK CITY FIRE DEPARTMENT



WHY DO BATTERIES SPONTANEOUSLY IGNITE?

- Mechanical abuse
 - Vibrations and shock can unsettle the positioning of the cell components, creating short circuits
- Thermal abuse
 - Use while cold or hot can create areas of electrochemical instability, whether due to plating, electrolyte/salt distribution, or degrades areas, creating short circuits
- Electrical abuse
 - Persistent overcharging, over discharging—even in regions caused by non-uniformities—can cause plating or copper dissolution, resulting in plating and short circuits.

SAFETY STANDARDS

Safety standards provide a list of tests that must be passed.

→ They are necessary to protect society, but in many cases are not sufficient.

The trouble with standards is that, among all the cells that pass the standards, they give no indication of which ones are most likely to withstand different types of abuse.

They check the safety box. But nearly every battery fire is caused by a cell that passed the safety standard.

PROPOSAL: A BATTERY SAFETY RATING SYSTEM

- Test cells to failure
- Score them based on the conditions that cause failure, and the type of failure that occurs
- Propose to develop three tests each for mechanical, electrical and thermal abuse
- Presenting the first test of each type here, with initial results

TESTS UNDER DEVELOPMENT

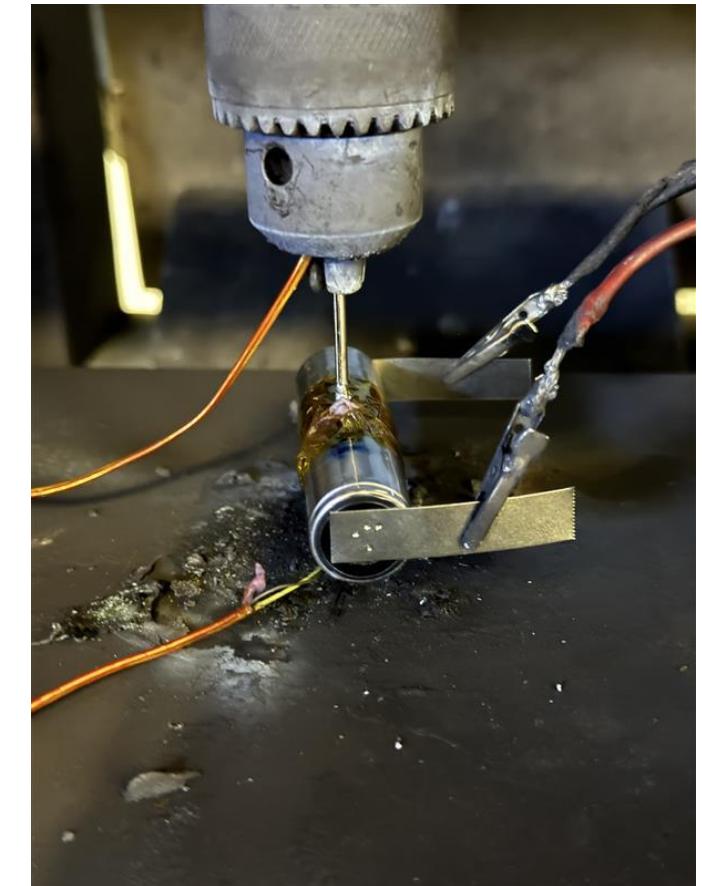
- **Slow Nail Penetration:** using a slow nail penetration test to determine the degree of internal short circuits that a cell can tolerate
- **Thermal Ramp:** Ramping temperature slowly until failure, to determine the temperatures at which a cell becomes less safe.
- **Repeated Drop Test:** Repeated 10m drop test, dropping to failure or 20 drops, to determine the degree of shock a cell can withstand before failure.

CELLS BEING TESTED

Maker	Model Number	Capacity (Ah, C/5)
LG	MJ1	3.5
Samsung	35E	3.5
EVE	33V	3.2
Cham	FC9	3.0
Voltaplex	Life (Gold)	3.0
Voltaplex	Life (Gold +)	3.0
Voltaplex	MPCC (Cham)	3.0
Voltaplex	MPCC (BAK)	3.0

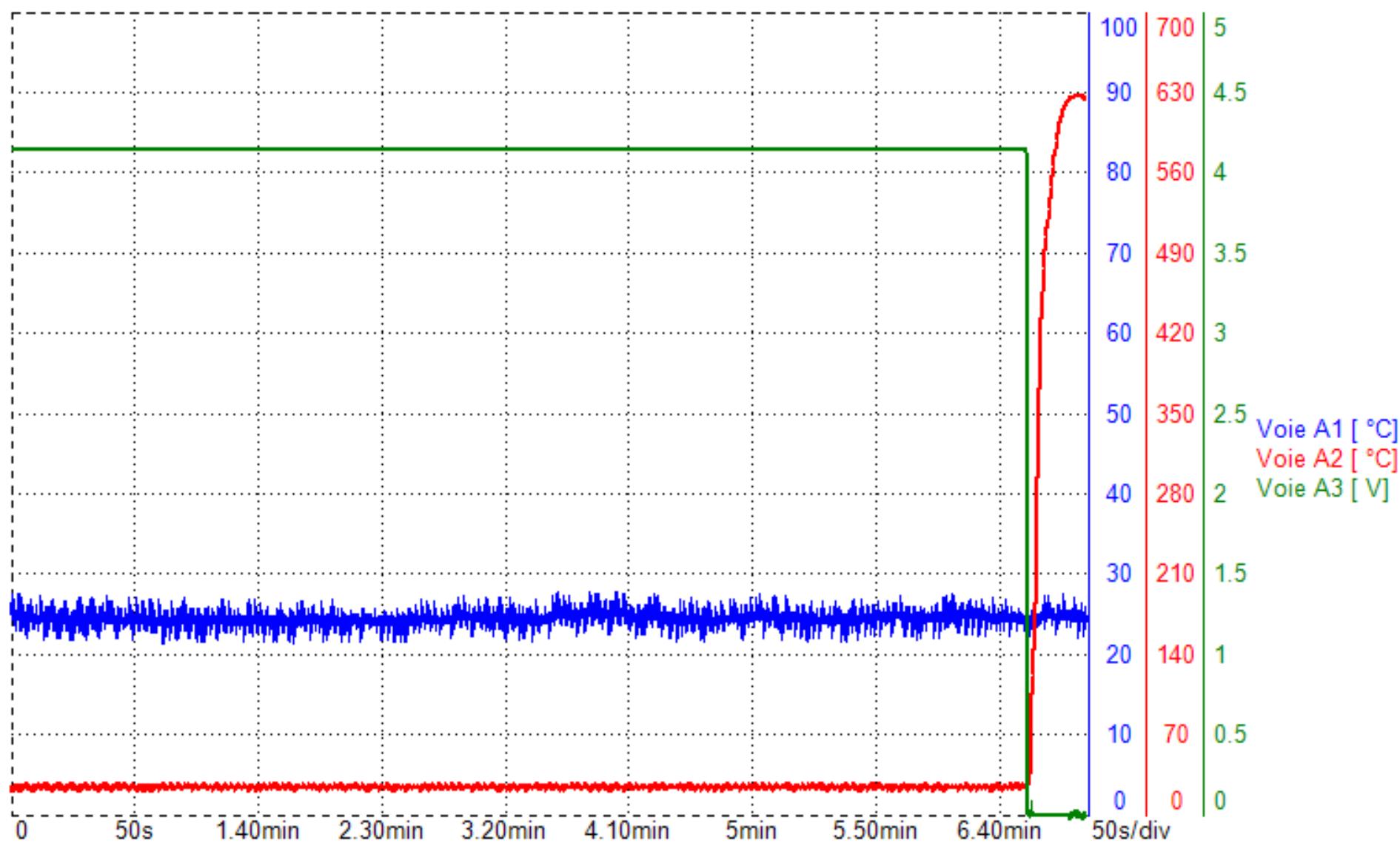
SLOW NAIL PENETRATION TESTS

Maker	0.05 mm/s	0.02 mm/s	0.01 mm/s	Average
LG	1.57 mm	1.73 mm	0.61 mm	1.30 mm
Samsung	2.09 mm	3.50 mm	3.25 mm	2.95 mm
EVE	1.28 mm	1.62 mm	1.78 mm	1.56 mm
Cham	1.68 mm	1.46 mm	1.39 mm	1.51 mm
Voltaplex Life (Gold)	2.45 mm	2.48 mm	4.05 mm	3.00 mm
Voltaplex Life (Gold+)	2.00 mm	2.08 mm	1.15 mm	1.74 mm
Voltaplex MPCC (Cham)	1.53 mm	1.91 mm	9.0 mm	4.15 mm
Voltaplex MPCC (BAK)	9.0 mm	4.5 mm	9.0 mm	7.5 mm

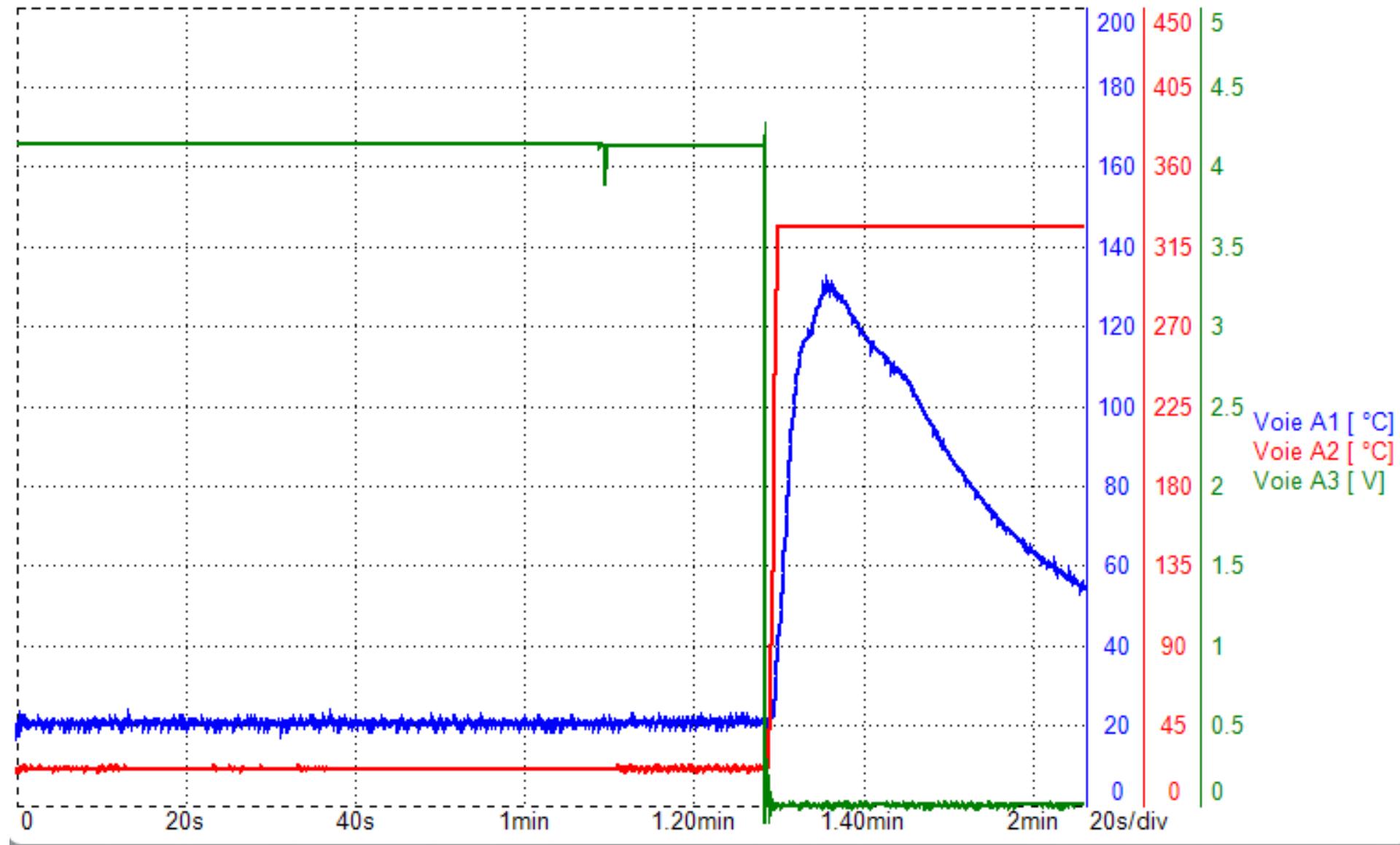


Nail is driven in at a speed such that electrical short and thermal effects dominate over mechanical damage.
Test each cell at three speeds for consistency & differentiation.

LifeAu 0.01 4.05mm TR.rec (43565 Samples/channels) Sample Rate :10ms Date :1/13/2026 3:32:24 PM



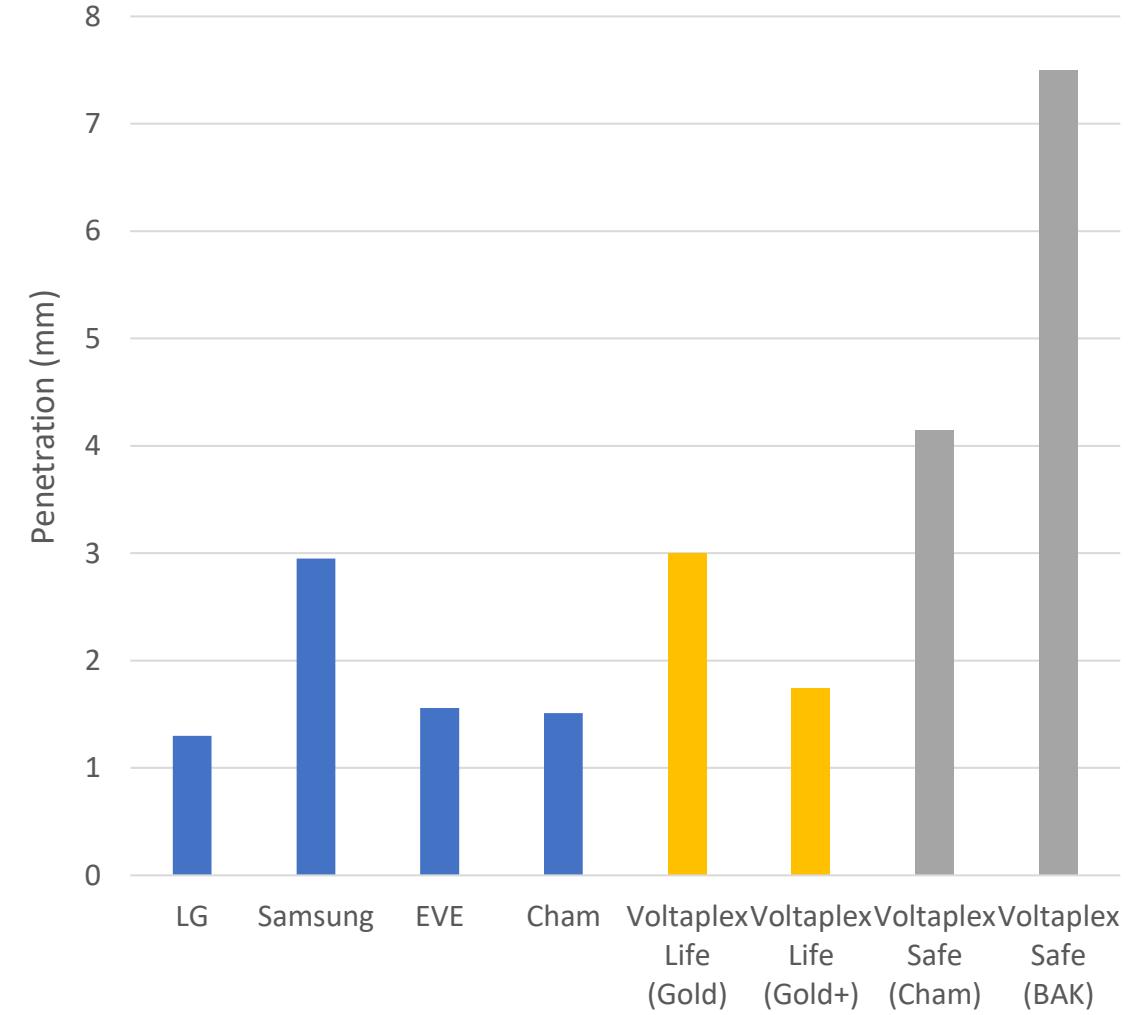
LG 0.02 1.73mm TR.rec (12619 Samples/channels) Sample Rate :10ms Date :1/13/2026 11:10:41 AM



SLOW NAIL PENETRATION TESTS

Maker	Average
LG	1.30 mm
Samsung	2.95 mm
EVE	1.56 mm
Cham	1.51 mm
Voltaplex Life (Gold)	3.00 mm
Voltaplex Life (Gold+)	1.74 mm
Voltaplex MPCC (Cham)	4.15 mm
Voltaplex MPCC (BAK)	7.5 mm

Slow Nail Penetration Test



Test each cell at three speeds for consistency & differentiation.

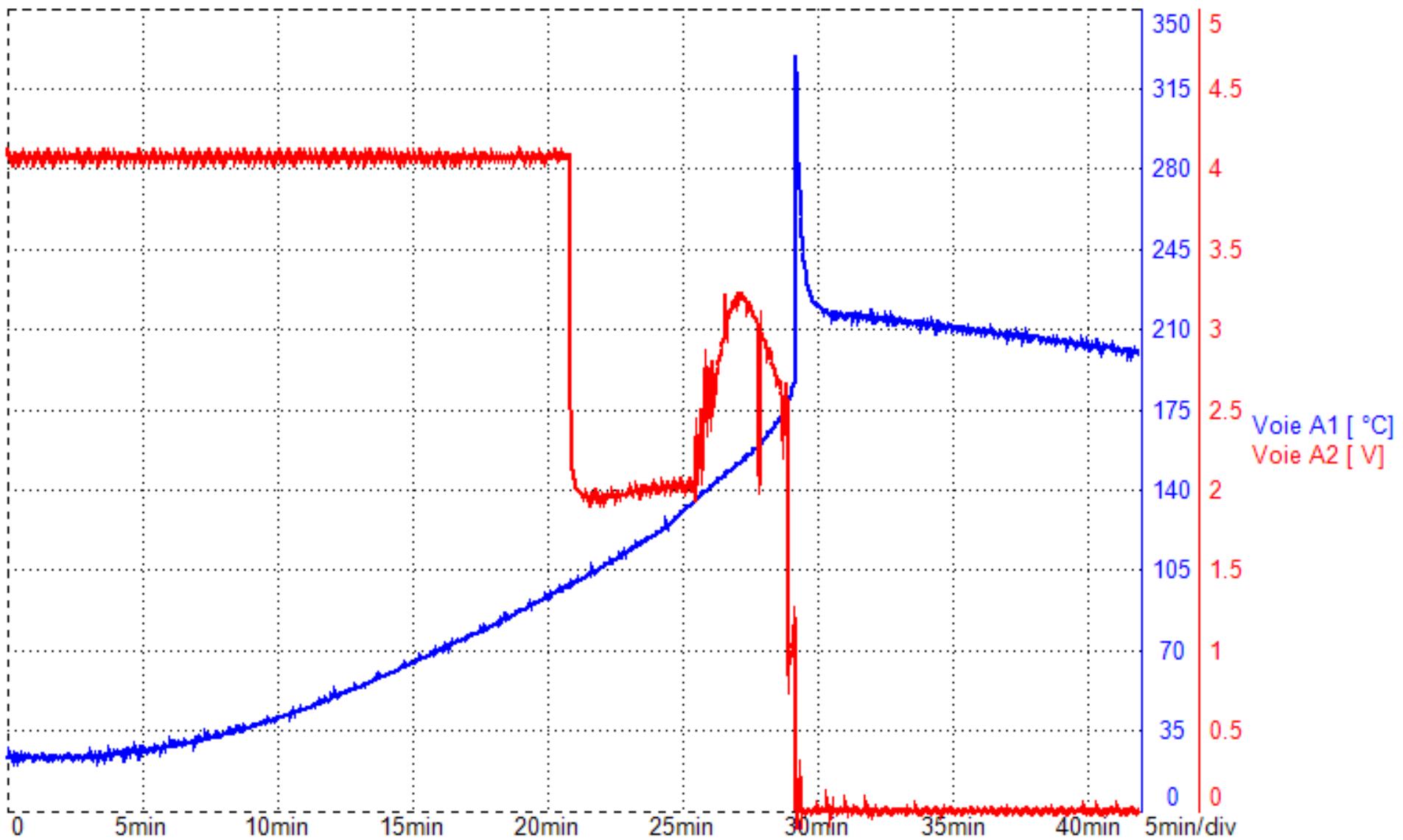
THERMAL RAMP TESTS

T Short = First big voltage drop
T Vent = Second big voltage drop, or dip in temp
T TR = Onset of thermal runaway
Time Short – TR: Time from Short to TR in minutes

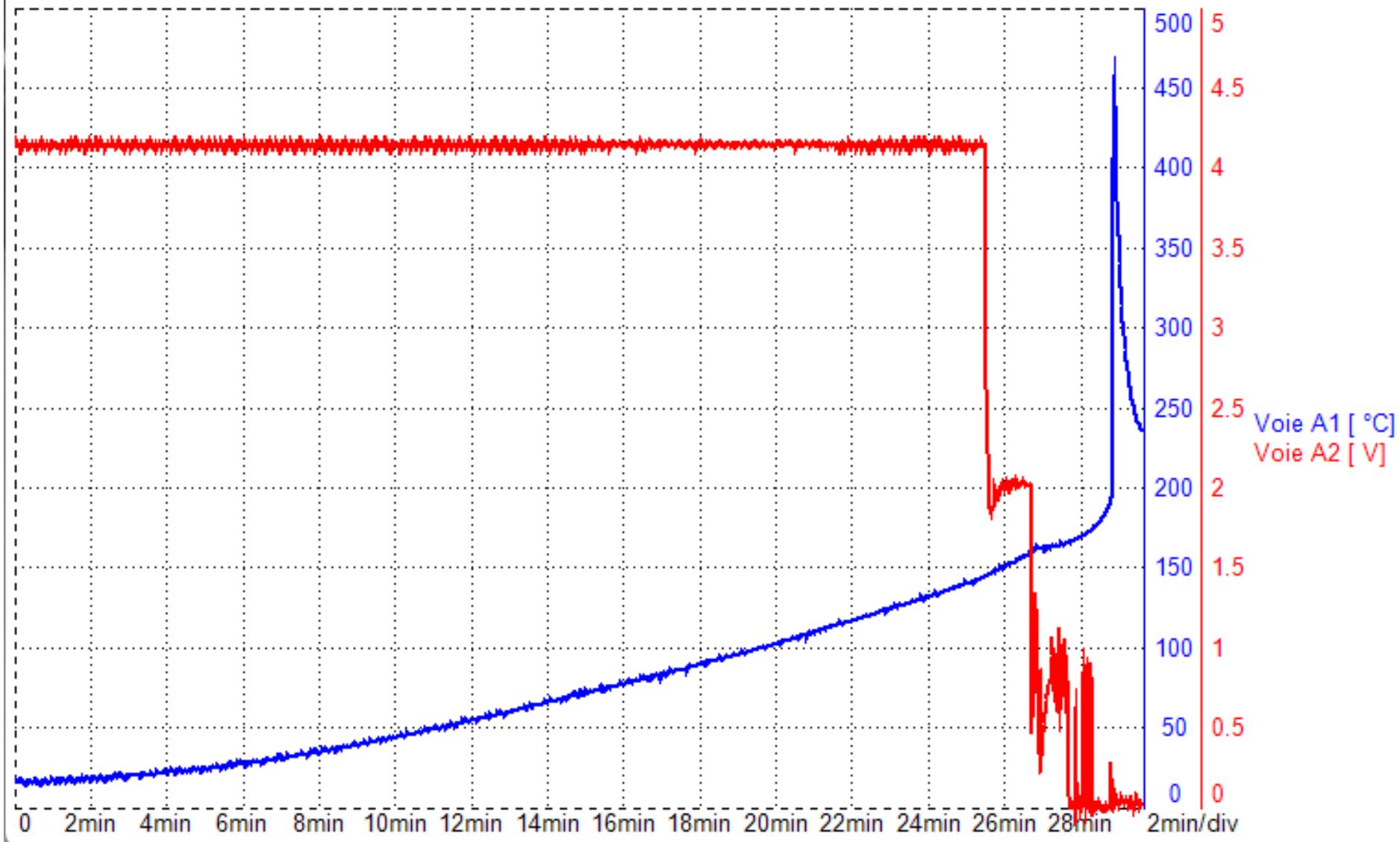
Maker	T Short	T Vent	T TR	Time Short - TR	Max TR Temp
LG	95	150	200	8	335
Samsung	100	125	170	4	350
EVE	90	135	190	6	550
Cham	135	159	198	14	315
Voltaplex Life (Gold)	140	160	200	4	375
Voltaplex Life (Gold+)	135	155	190	5	335
Voltaplex MPCC (Cham)	141	161	198	8	410
Voltaplex MPCC (BAK)	135	175	180	7	275
Voltaplex Life (Ahlstrom)	152	168	200	6	

Repeat each test twice for consistency.

LG Thermal Cap200°C TR.rec (251775 Samples/channels) Sample Rate :10ms Date :1/14/2026 10:35:35 AM



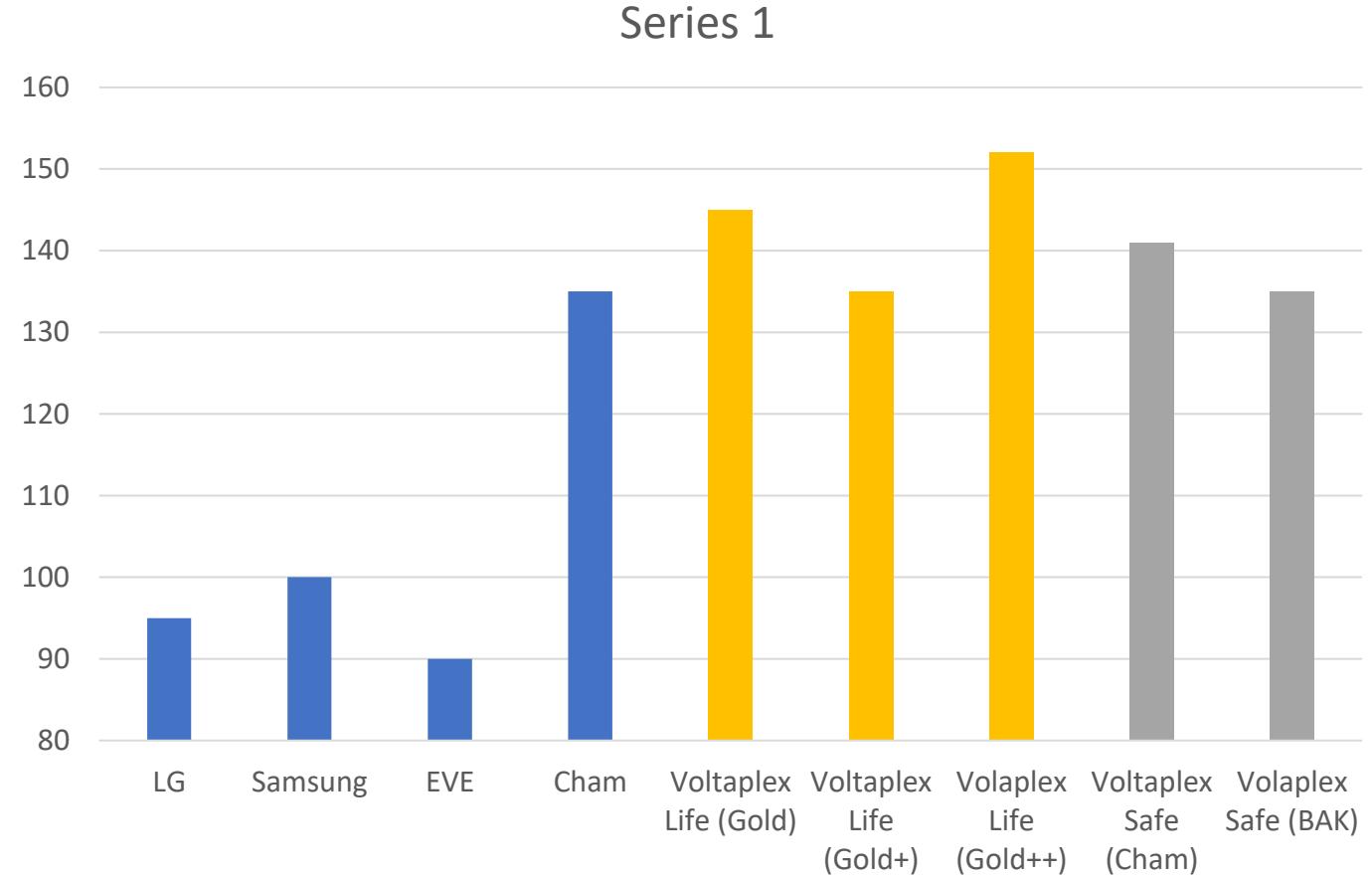
LifeAu Thermal Cap200°C TR.rec (177838 Samples/channels) Sample Rate :10ms Date :1/14/2026 11:58:52 AM



THERMAL RAMP TESTS

T Short = First big voltage drop
T Vent = Second big voltage drop, or dip in temp
T TR = Onset of thermal runaway
Time Short – TR: Time from Short to TR in minutes

Maker	T Short
LG	95
Samsung	100
EVE	90
Cham	135
Voltaplex Life (Gold)	140
Voltaplex Life (Gold+)	135
Voltaplex MPCC (Cham)	141
Voltaplex MPCC (BAK)	135
Voltaplex Life (Ahlstrom)	152



Repeat each test twice for consistency.

REPEATED 10M DROP TESTS

Maker	Avg # drops to event	Type of event
LG		
Samsung	18	Vent
EVE	20	None
Cham	17	Vent
Voltaplex Life (Gold)		
Voltaplex Life (Gold+)	10	TR
Voltaplex MPCC (Cham)		
Voltaplex MPCC (BAK)		



Repeat each test 5x for consistency.

SUMMARY

Maker	Electrical	Thermal	Mechanical
LG	Average	Average	
Samsung	Good	Average	Very Good
EVE	Average	Average	Best
Cham	Average	Good	Very Good
Voltaplex Life (Gold)	Good	Very Good	
Voltaplex Life (Gold+)	Average	Very Good	Average
Voltaplex MPCC (Cham)	Very Good	Good	
Voltaplex MPCC (BAK)	Best	Good	

OTHER POTENTIAL TESTS

- Electrical
 - Cold over charge/hot over discharge, then overcharge to failure
- Thermal
 - FTRC or other measure of energy out at TR
- Mechanical
 - Tumble to failure

IDEAS TO IMPROVE SAFETY

- Current Collectors: MPCC, thermal responsive
- Separators: thermal stability, mechanical properties, wettability, thickness
- Electrolyte: flame retardant additives, non-flammable
- Mechanical: can stiffness, packing/winding tightness, end stability

SHORT SOTERIA ADVERTISEMENT

NEW PRODUCTS WILL DRIVE NEAR-TERM REVENUE GROWTH



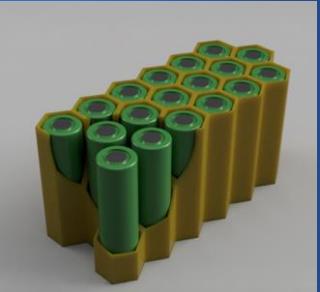
Voltaplex LIFE™

- 3x Cycle life
- In production now
- First repeat customer
- Utilizing Soteria technology



Soteria Sense™

- Advanced warning for battery events
- Fully designed & functional
- Distributors eager
- Industrial market first
- Production 3Q25



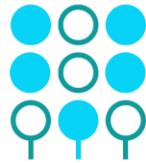
Soteria Hive™

- Thermal insulation
- Prevent fire propagation
- Easy to install
- Light weight
- Based on existing structure



E-bike Safety Standard

- Four essential features
- Prevent fire propagation
- Part of licensing portfolio



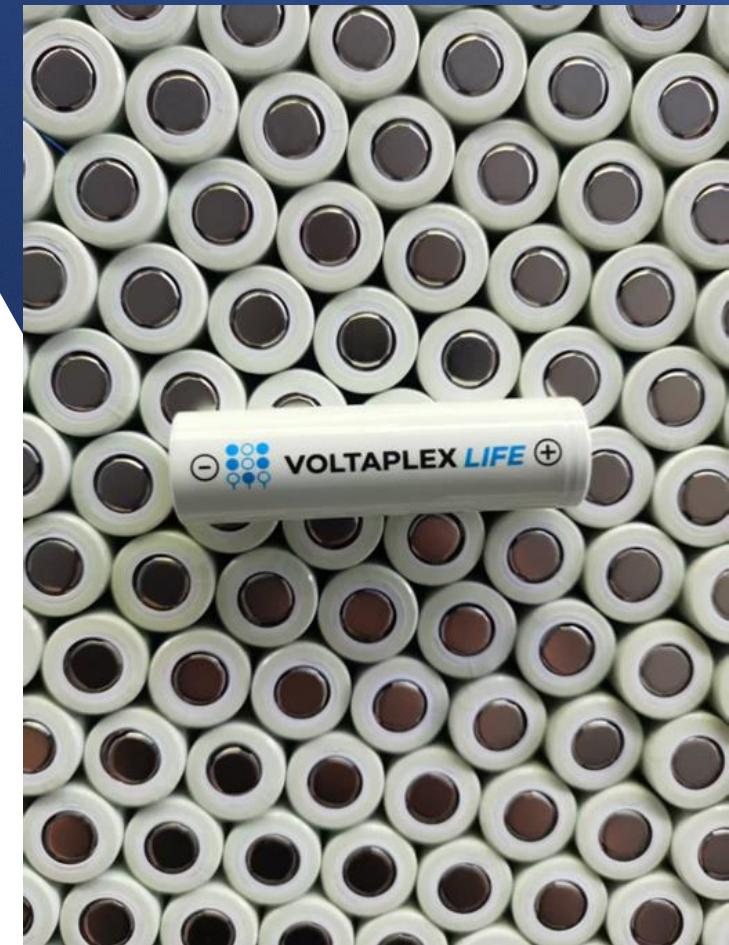
VOLTAPLEX *LIFE*

Available NOW!
3x cycle life
1/3 charge time

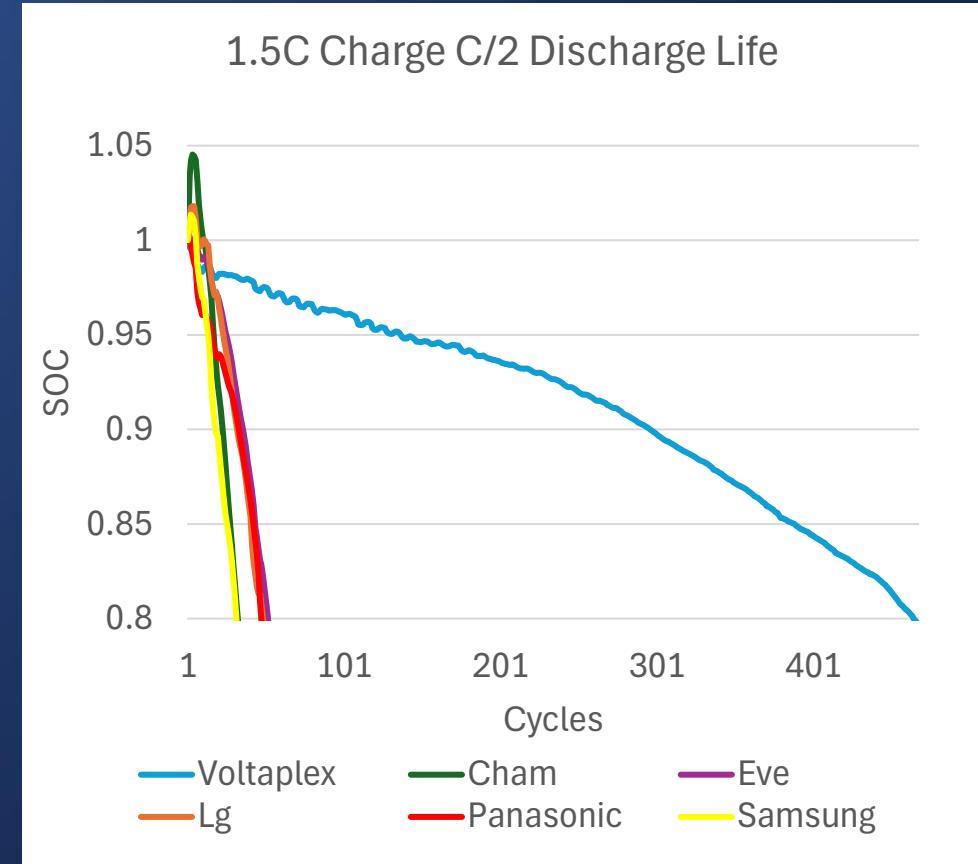
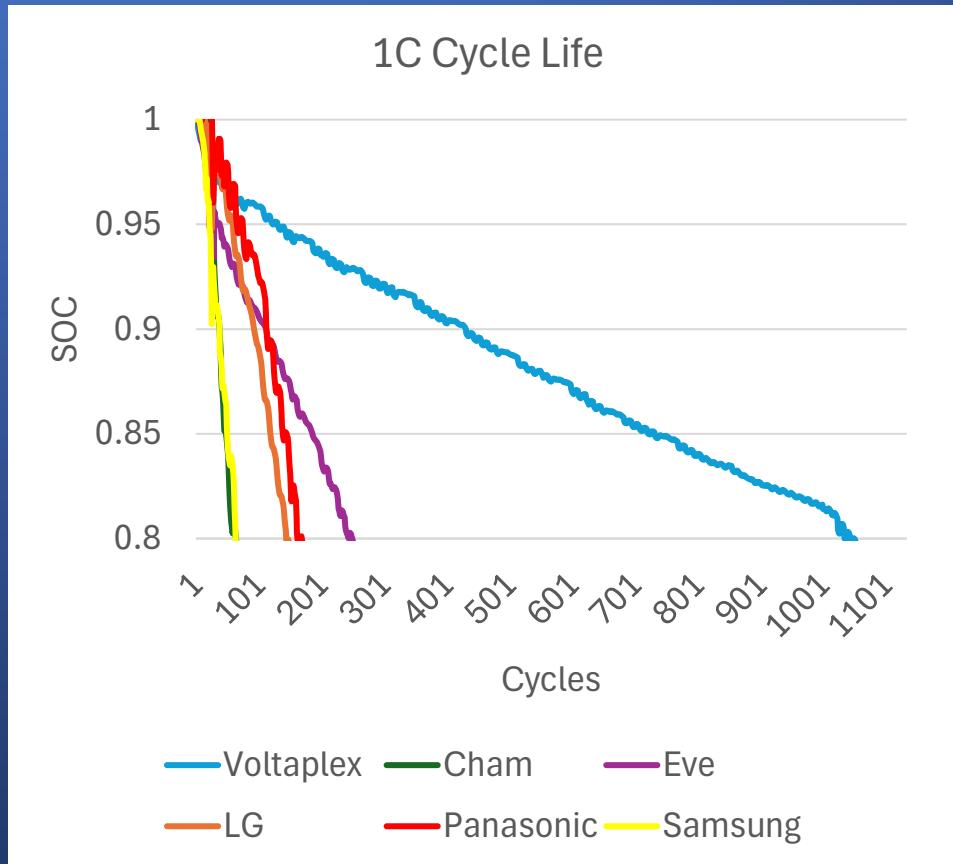


- Sold with Voltaplex wrap.
- Certified to UN 38.3 safety test.
- First of a series of **advanced cells for critical environments**.
- Contract manufactured for **capital-light** business model.

FIRST VOLTAPLEX-BRANDED, FABLESS CELL PRODUCT



VOLTAPLEX LIFE: ENHANCED CYCLE LIFE AND FAST CHARGE



By using the Dreamweaver separator to neutralize acid and keep the electrolyte healthy, the **Voltaplex Life™** cells can **triple the cycle life** and **triple the charge rate** compared to top commercial cells.

SENSE: IMPLEMENTATION & DISTRIBUTION

- 1,000 devices delivering in 1Q26
- Software, app & cloud implemented
- Delivering through distribution & direct to larger customers

Slots are open now for Sense pilots:

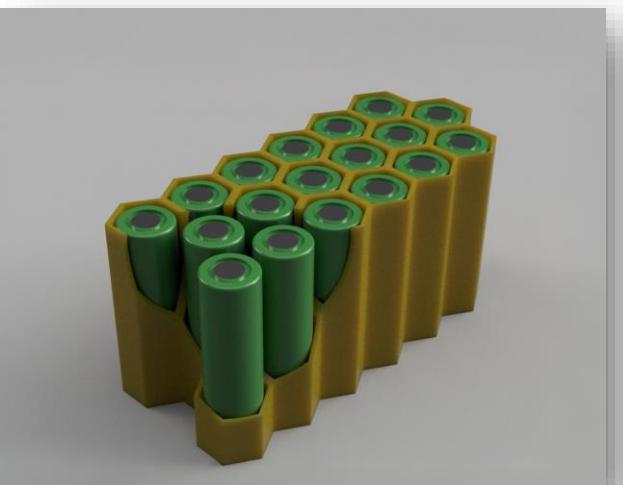
- 30% discount on 10+ units (~~\$200~~ → \$140 each)
- On-site support for setup and placement
- One-year free Professional software
- Contact Abby.Zielsdorf@soteriabig.com

Can be used to protect manufacturing, laboratories, warehousing, workshops, and other battery-intensive areas.



NEW PRODUCTS: SAFE & HIVE

- Safe: Soteria AI MPCC in LiPo pouch cells for rugged electronics market.
 - See video →
- Hive: honeycomb insulator for easy implementation in cylindrical packs



SOTERIA BIG CONSORTIUM : ACTIVE CONSORTIUM SPANS SUPPLY CHAIN

Join the innovators
advancing safety today:



MATERIAL & EQUIPMENT MEMBERS



CELL & PACK LEVEL MEMBERS



END USER MEMBERS



RECYCLER MEMBERS



TECHNOLOGY MEMBERS



INTELLICOSTING, LLC
A World Leader in Product Cost Analysis

BUSINESS MODEL: TECHNOLOGY → PRODUCT → LICENSING

Collaborative Innovation



Work with consortium to understand problems and develop solutions.

Validate in High Value Segments



Develop & sell

- Products for critical environments
- Materials for battery producers

Maximize Access to Safety Technology



License to the broader markets.



BATTERY INNOVATION GROUP

Inherently Safe Batteries Everywhere

Brian Morin, CEO, Brian.Morin@Soteriabig.com

