

Nail Penetration Results (5 Ah) - Temperature

Purpose:

To demonstrate the **excellent thermal stability** of a SafeCoat-enabled cell in a comparison with a leading consumer pouch cell.

Separator Type →	SafeCoat DDS	Benchmark Cell
Peak Temperature	66 °C	456 °C
Mass loss	0.3%	21.5%

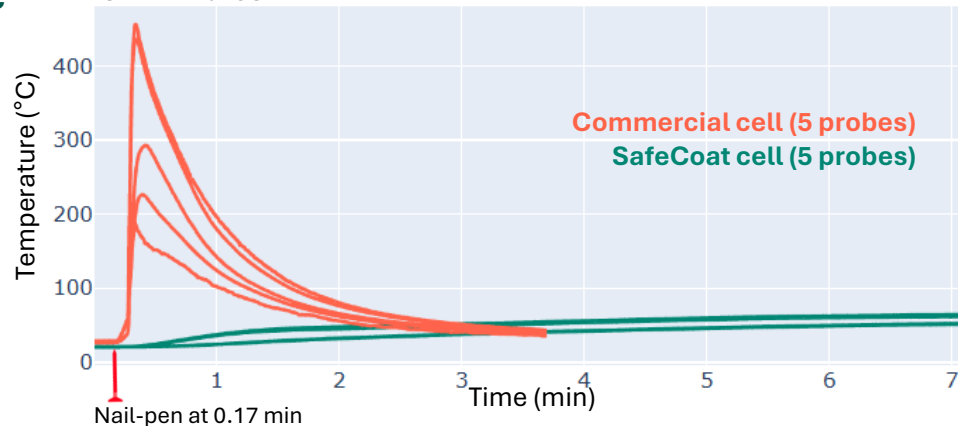
- SAE J2464 protocol was used with identical nails. Third-party report is available.

Materials ↓	SafeCoat	Benchmark Cell ¹
Separator	20 µm SafeCoat ²	12µm PE + 2µm Alumina
Cathode	NCM 523, 1.7 mAh/cm ² , 79x100 mm, 20 sheets	NCM
Anode	Graphite, 1.9 mAh/cm ² , 83x104 mm, 21 sheets	Graphite
Electrolyte	1M LiPF ₆ in 1:1:1 EC:DMC:DEC solvent	Commercial

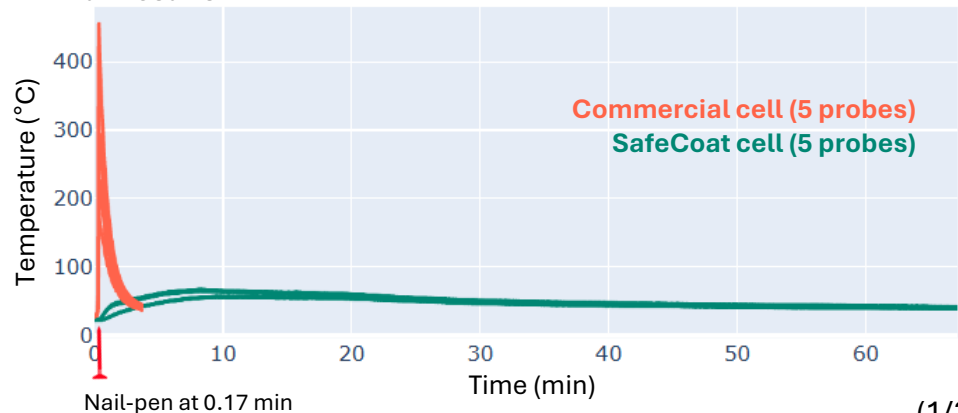
1. Benchmark cell reflects top-tier commercial design and performed well in testing.

2. SafeCoat cell showed minimal impact from thickness; confirmed in 15 µm in-house test (next page).

First 7 minutes



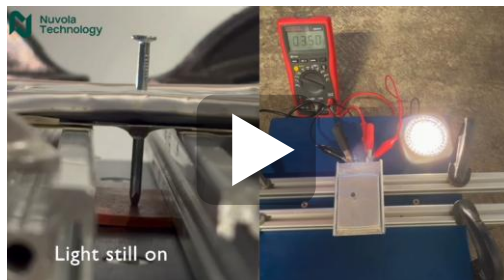
Full results



Nail Penetration Results (5 Ah) - Voltage



5 Ah 20 μm SafeCoat cell after 1 hr



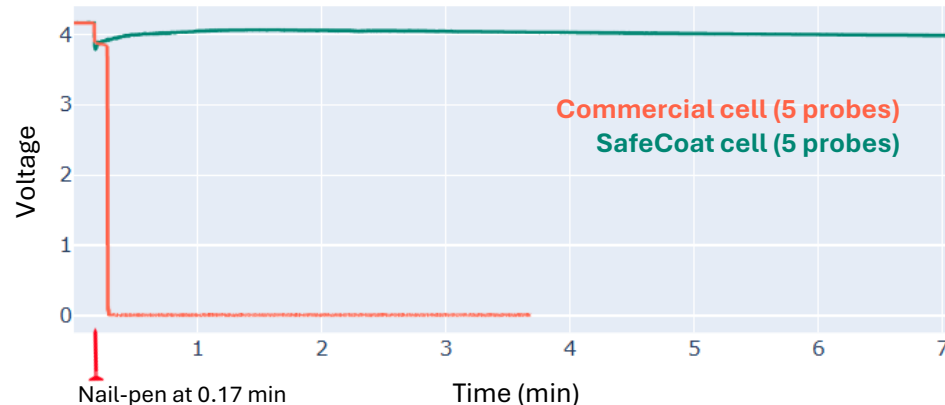
1.5 Ah 15 μm SafeCoat cell test [video](#)

- 20 μm / 5 Ah SafeCoat cell endures 1-hour nail-penetration test at 100% SOC without thermal runaway or sudden discharge
- Nail short gradually discharges the cell from 4.16 V to 3.68 V over 1 hour without sharp voltage drop
- 15 μm / 1.5 Ah SafeCoat cell verified with 2-nail penetration test in-house ([video link](#))

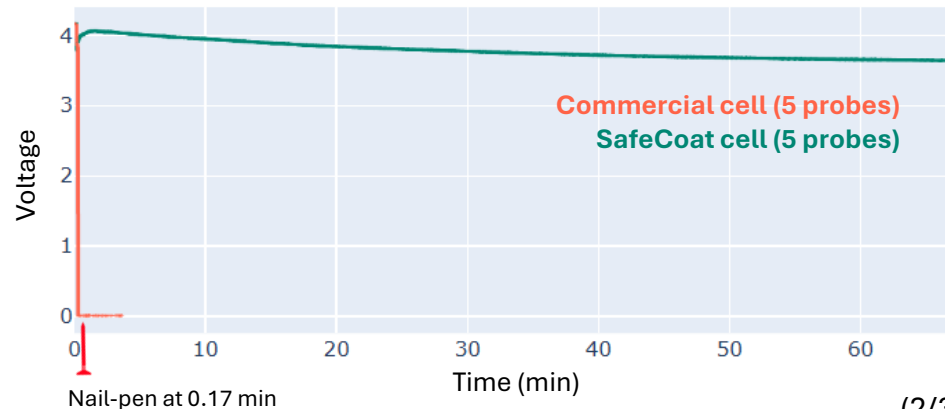
Conclusions:

SafeCoat Cell demonstrates outstanding thermal stability and prevents fire, mass loss and runaway heating. The cell remains effectively functional, apart from the short pathway provided by the nail.

First 7 minutes



Full results



Cycling Comparison (1.5 Ah)

Purpose:

To validate the performance of SafeCoat DDS in a head-to-head comparison with ceramic-coated separator using the same cell chemistry.

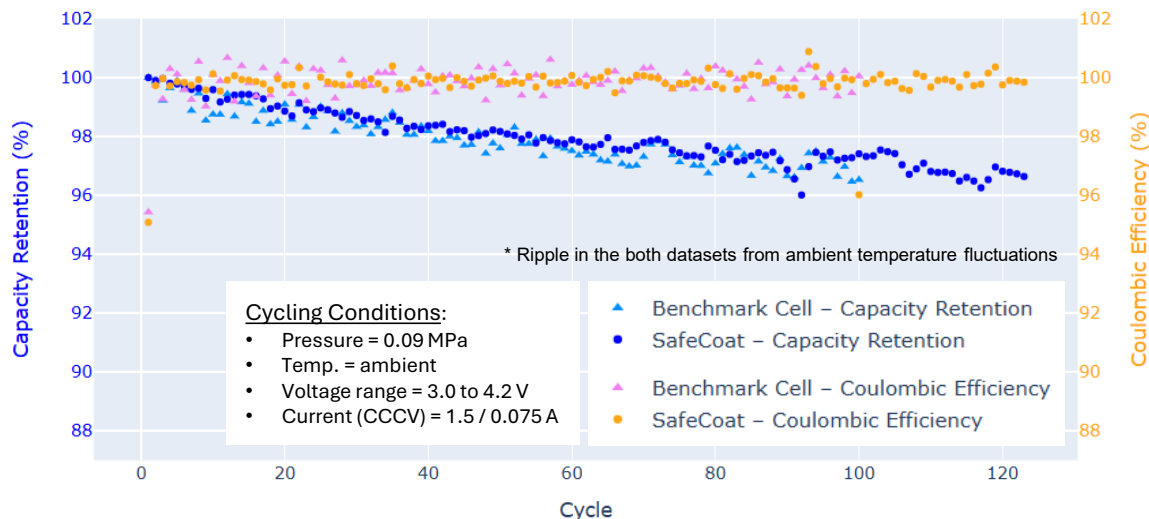
- Both Cells prepared from research-grade electrodes, rated for 500 cycles at 0.2C
- These electrodes are not optimized for high cycle life at 1C
- System is design for direct comparison of separator performance with same electrodes

Conclusion:

SafeCoat Cell matches the capacity retention performance of the cell with ceramic-coated separator at 1C, 1.5 A.

Notes:

- Benchmark cell uses the same electrodes and packaging materials as our pilot cells, providing a directly comparable reference.
- SafeCoat cells were manually assembled for initial validation, yet showed performance comparable to automated commercial cells.



Materials ↓	SafeCoat Cell	Benchmark Cell
Separator	15 μm SafeCoat	16μm PE + 2μm Alumina
Cathode	NCM 523, 1.7 mAh/cm ² , 41x55* mm, 20 electrodes	NCM 523, 1.7mAh/cm ² , 43x56* mm, 20 electrodes
Anode	Graphite, 1.9 mAh/cm ² , 45x58 mm, 21 electrodes	
Electrolyte	1M LiPF ₆ in 1:1:1 EC:DMC:DEC solvent	
Discharge Capacity* (Ah) ↓	SafeCoat Cell	Benchmark Cell
Formation discharge (C/10)	1.511	1.568
First cycle (1C)	1.418	1.483

* SafeCoat Cell: manual stacking and welding requires smaller cathodes.