Performance and Safety of COTS 18650 Li-ion Cells from Various Manufacturers

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Outline

- Cell Characteristics
- Performance of Panasonic Cells
- Safety of Panasonic Cells
- Performance of Moli STOBA cells
- Safety of Moli STOBA cells
- Performance of LG cells at Different Temperatures

18650 Lithium-ion cells

Panasonic 3.1 Ah

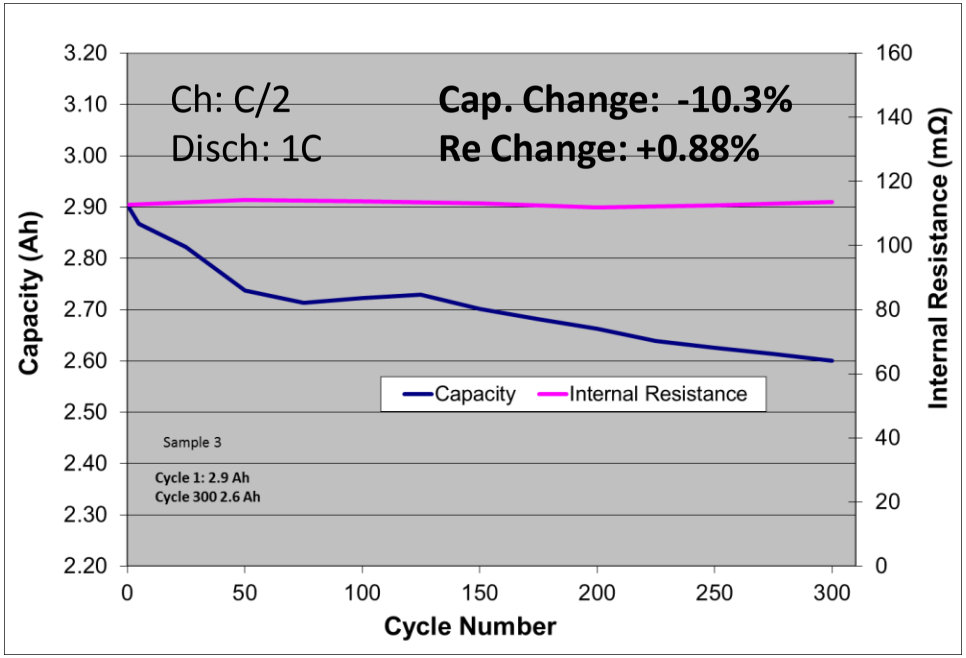
LG 2.8 Ah

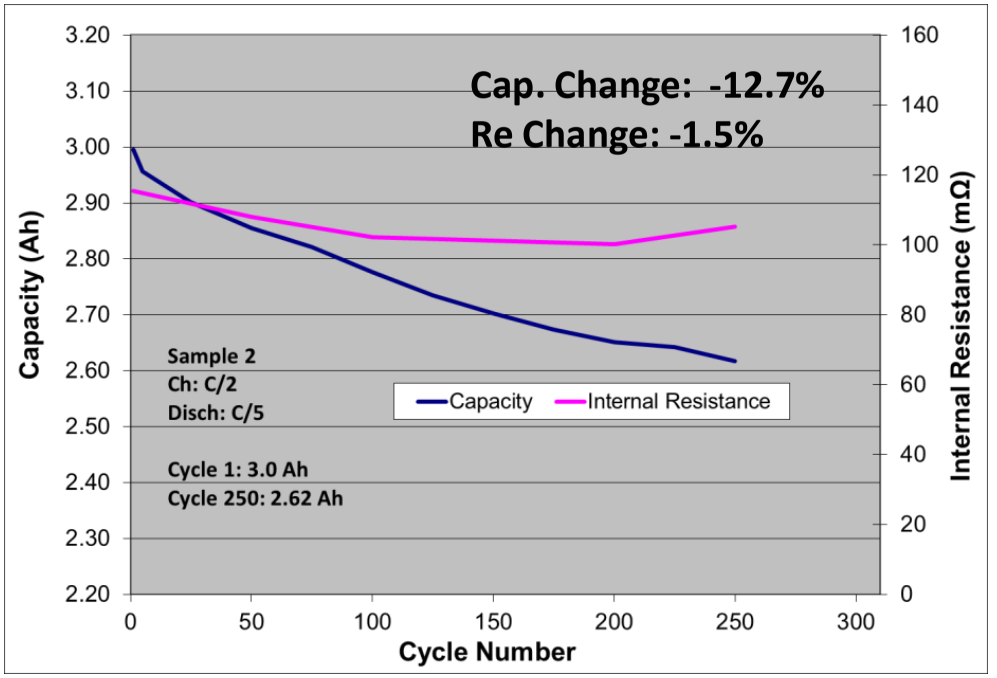
Moli STOBA 2.0 Ah

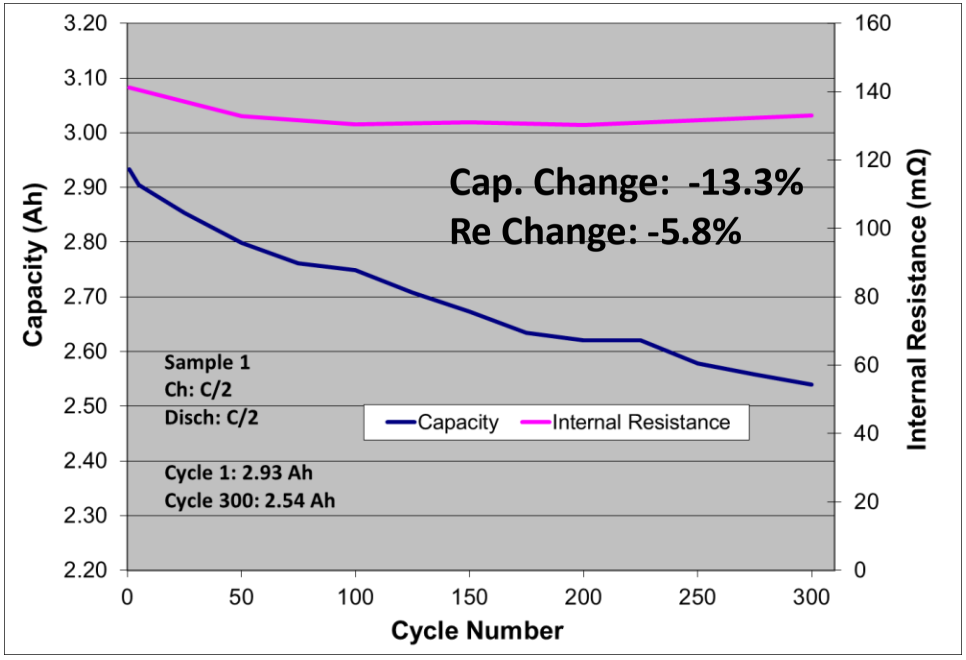
Panasonic 3.1 Ah Li-ion 18650 Cell

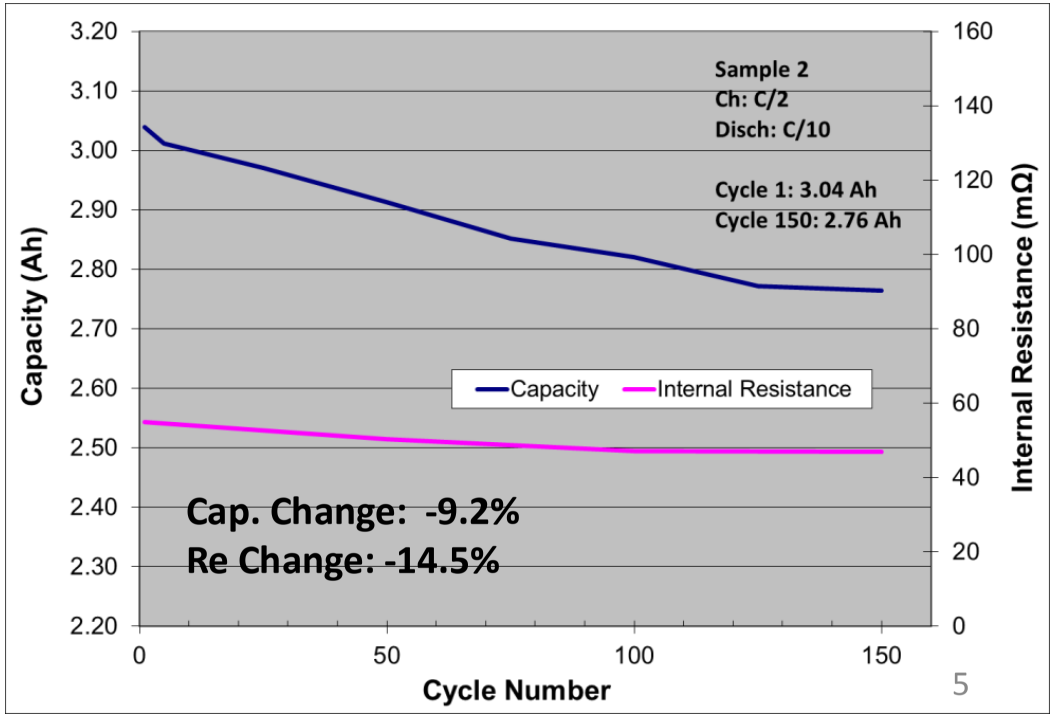
Performance and Safety Test Data

Panasonic 3.1 Ah Li-ion 18650 Cell

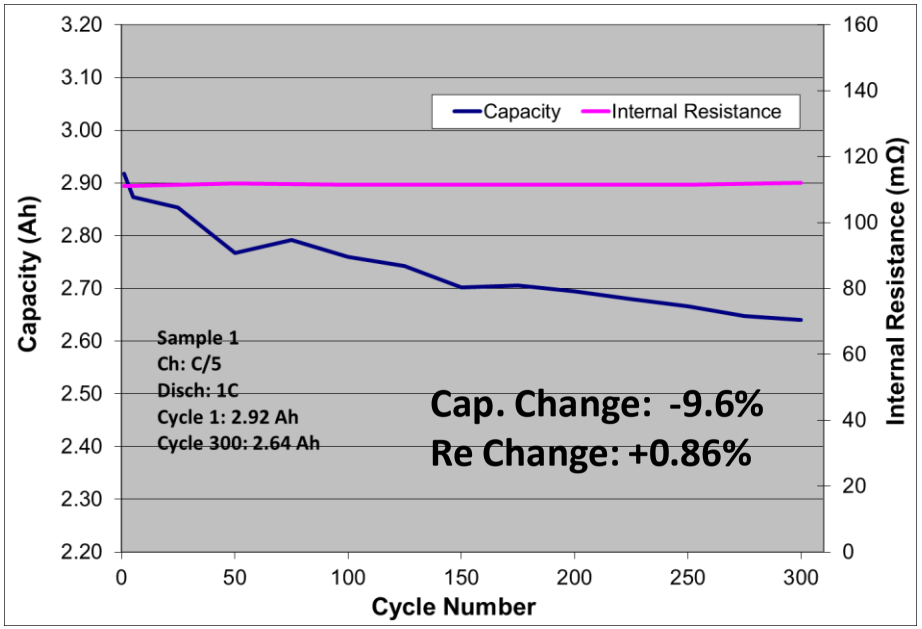


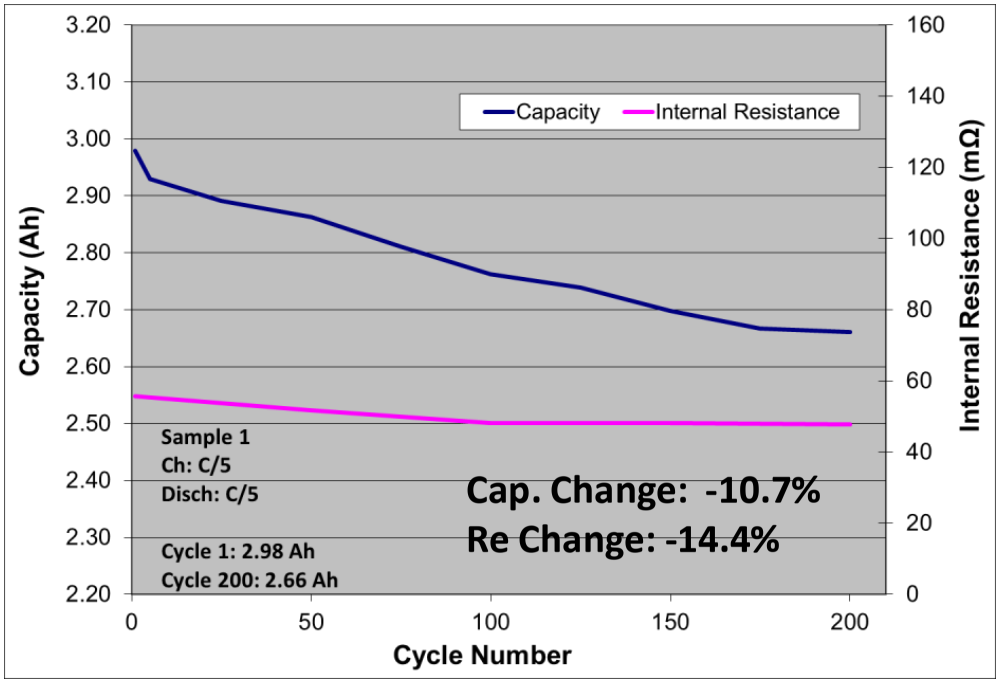


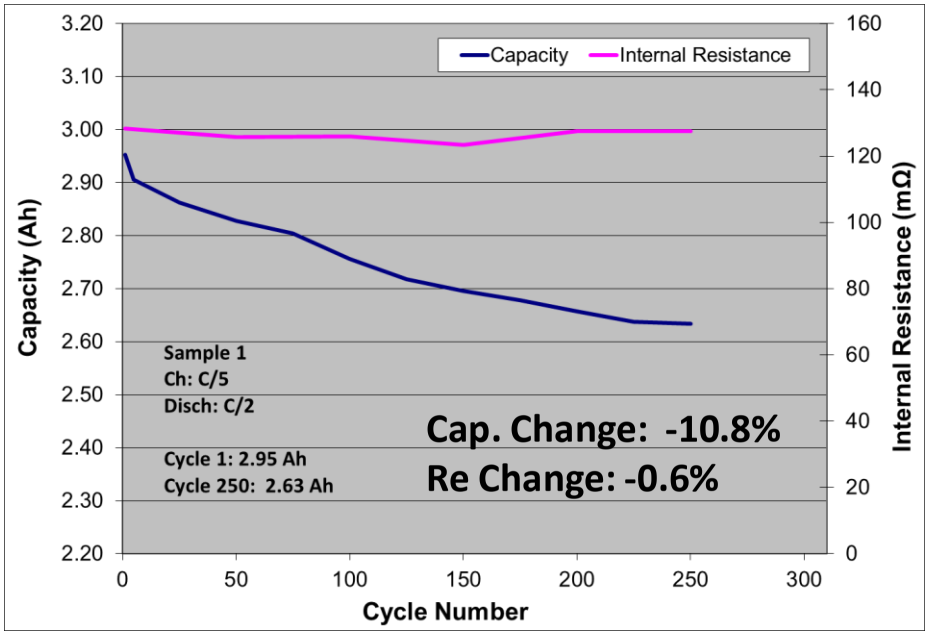


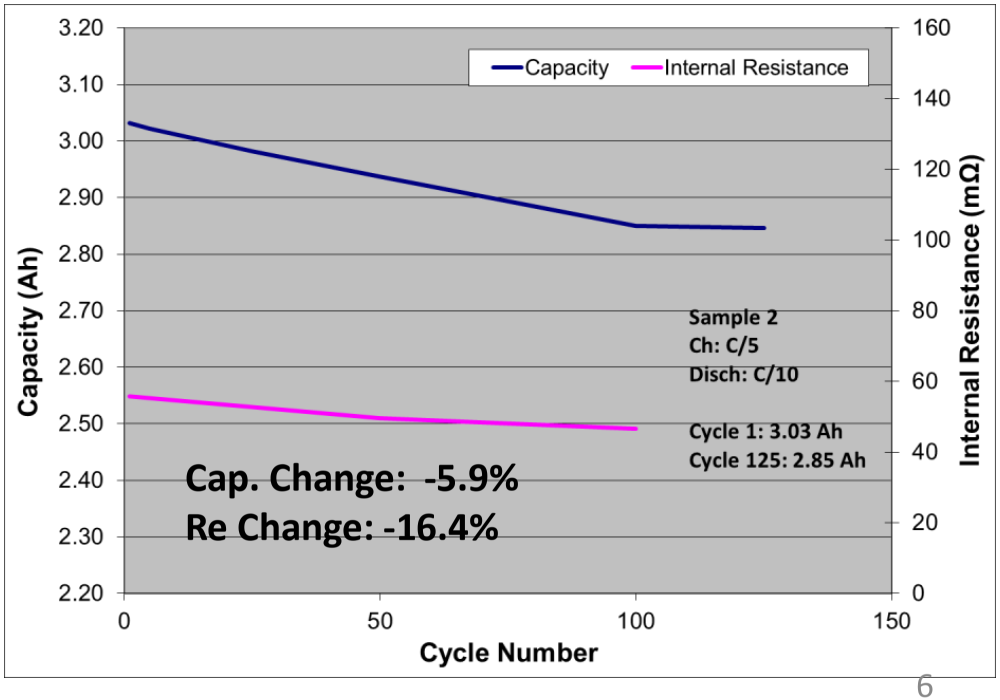


Panasonic Li-ion 3.1 Ah 18650 Cell









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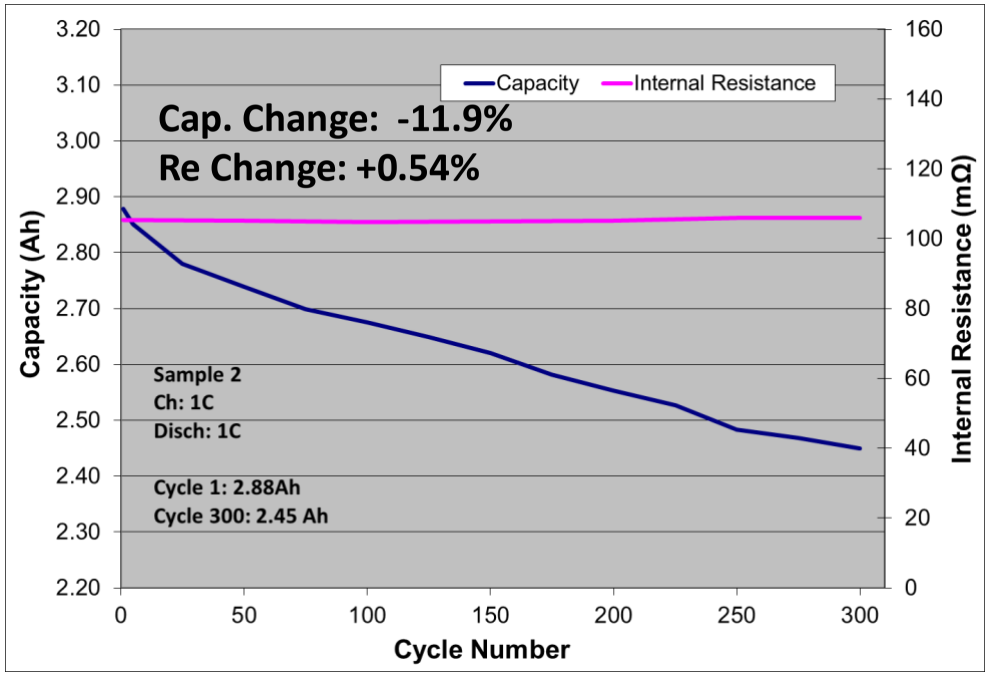

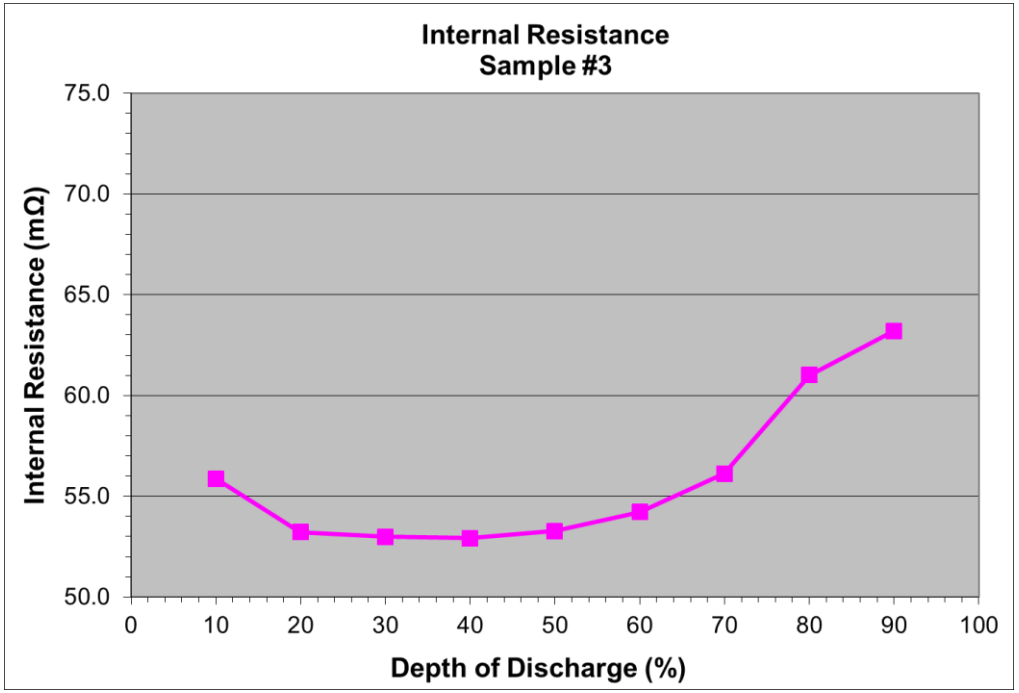

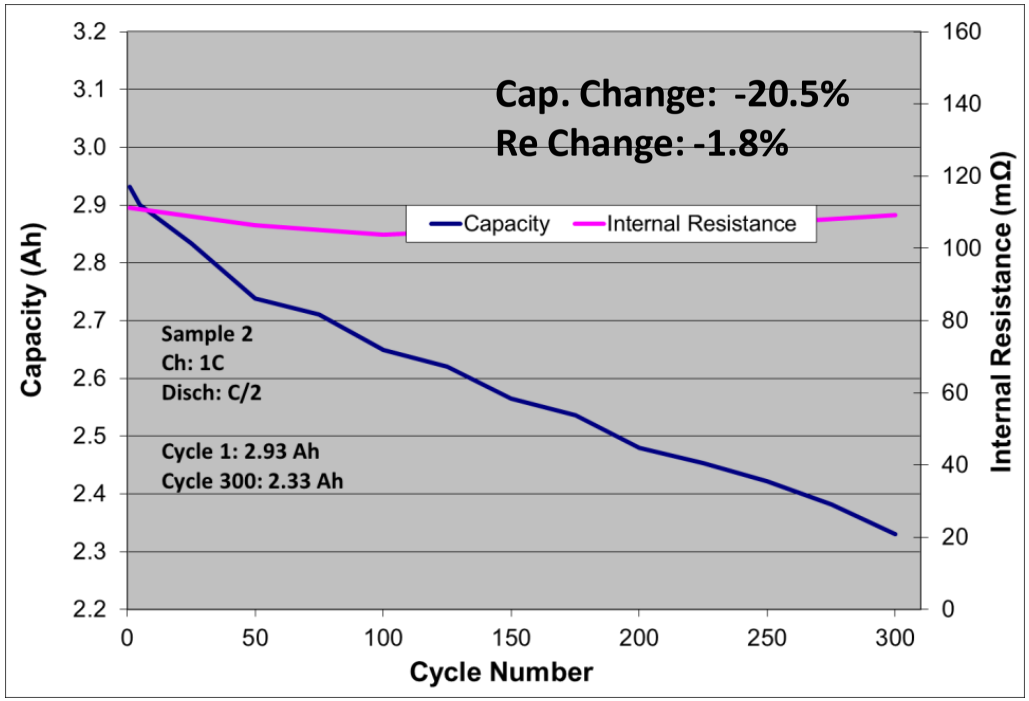

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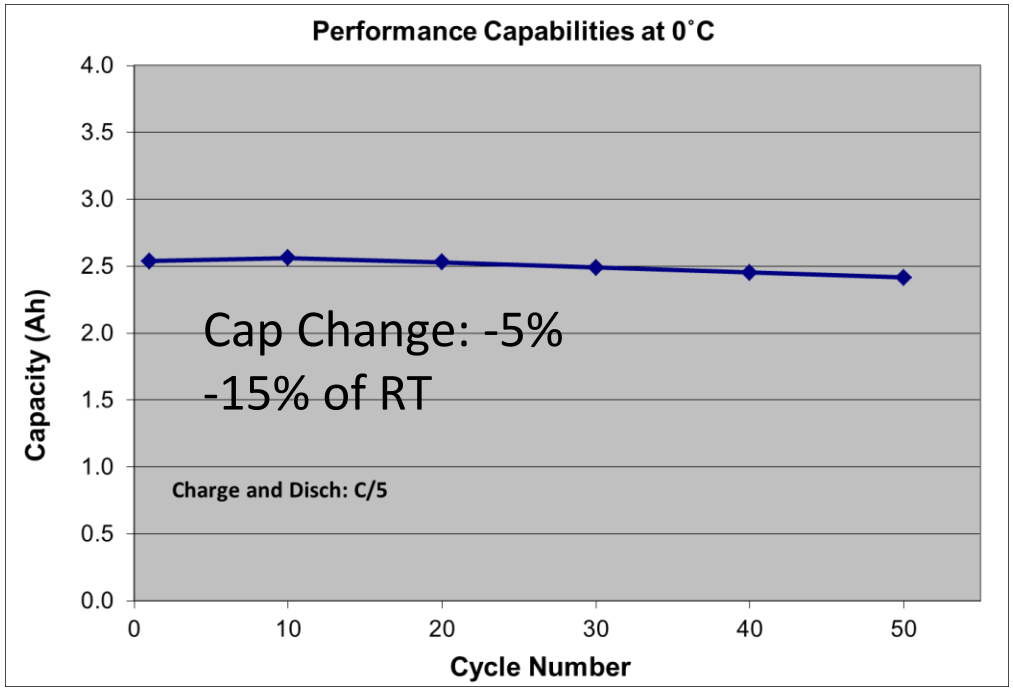

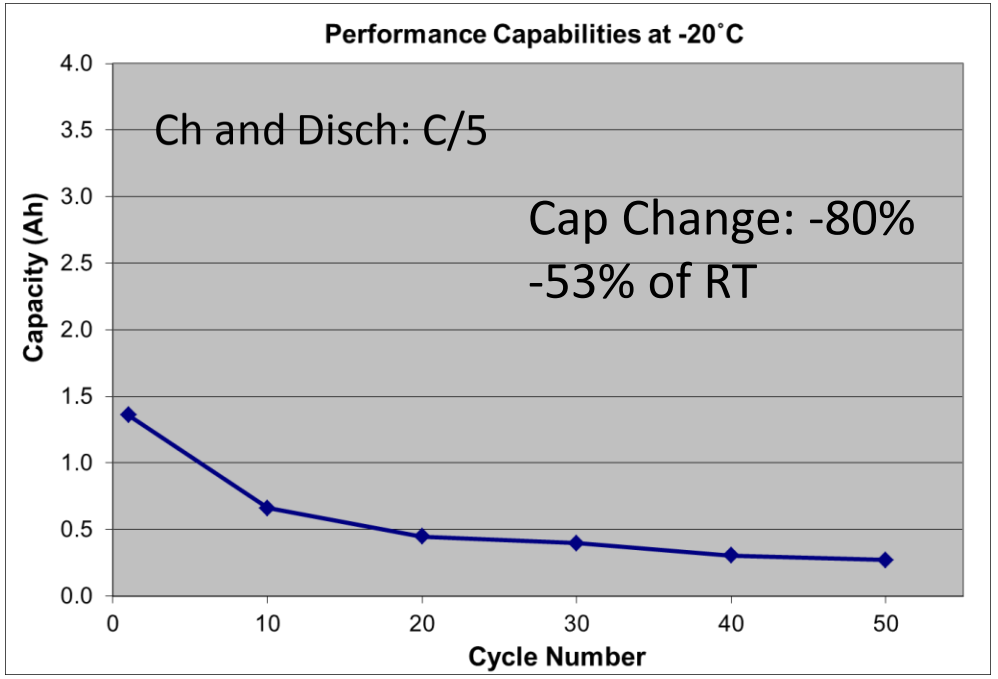

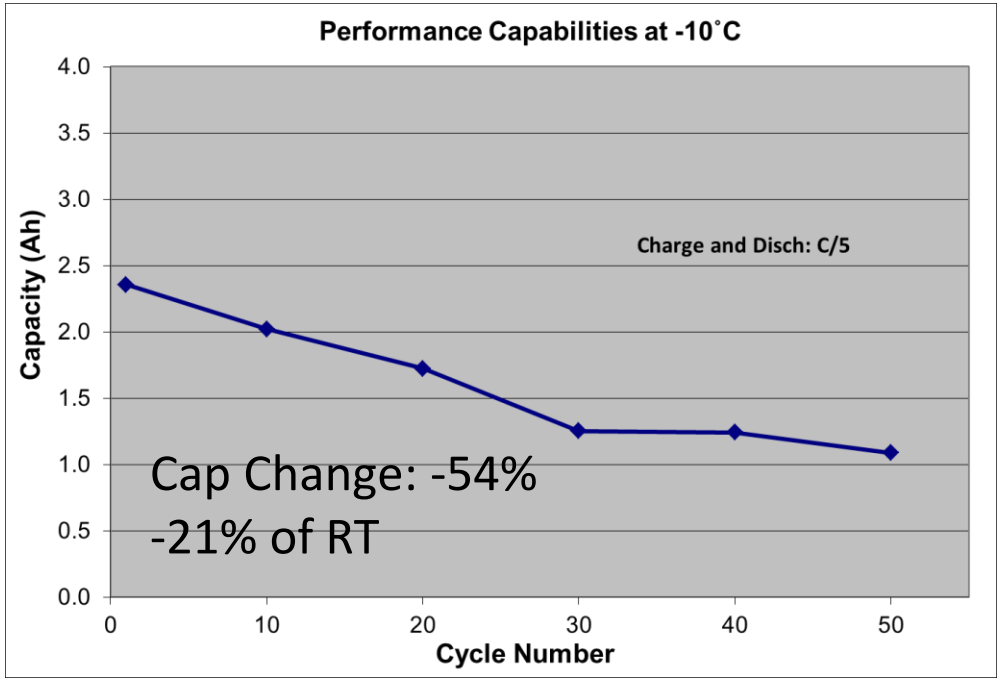

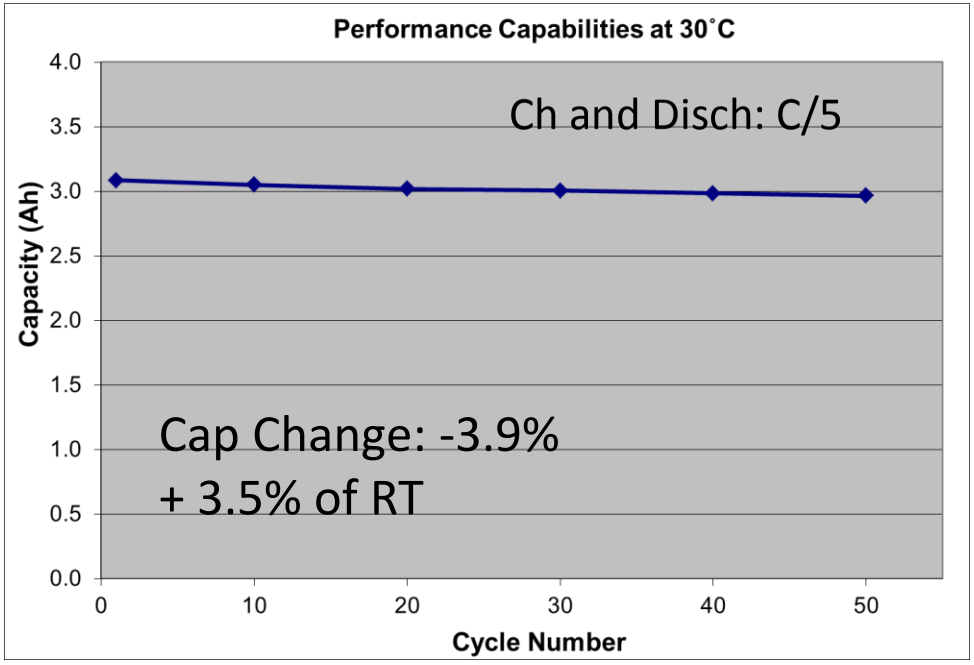

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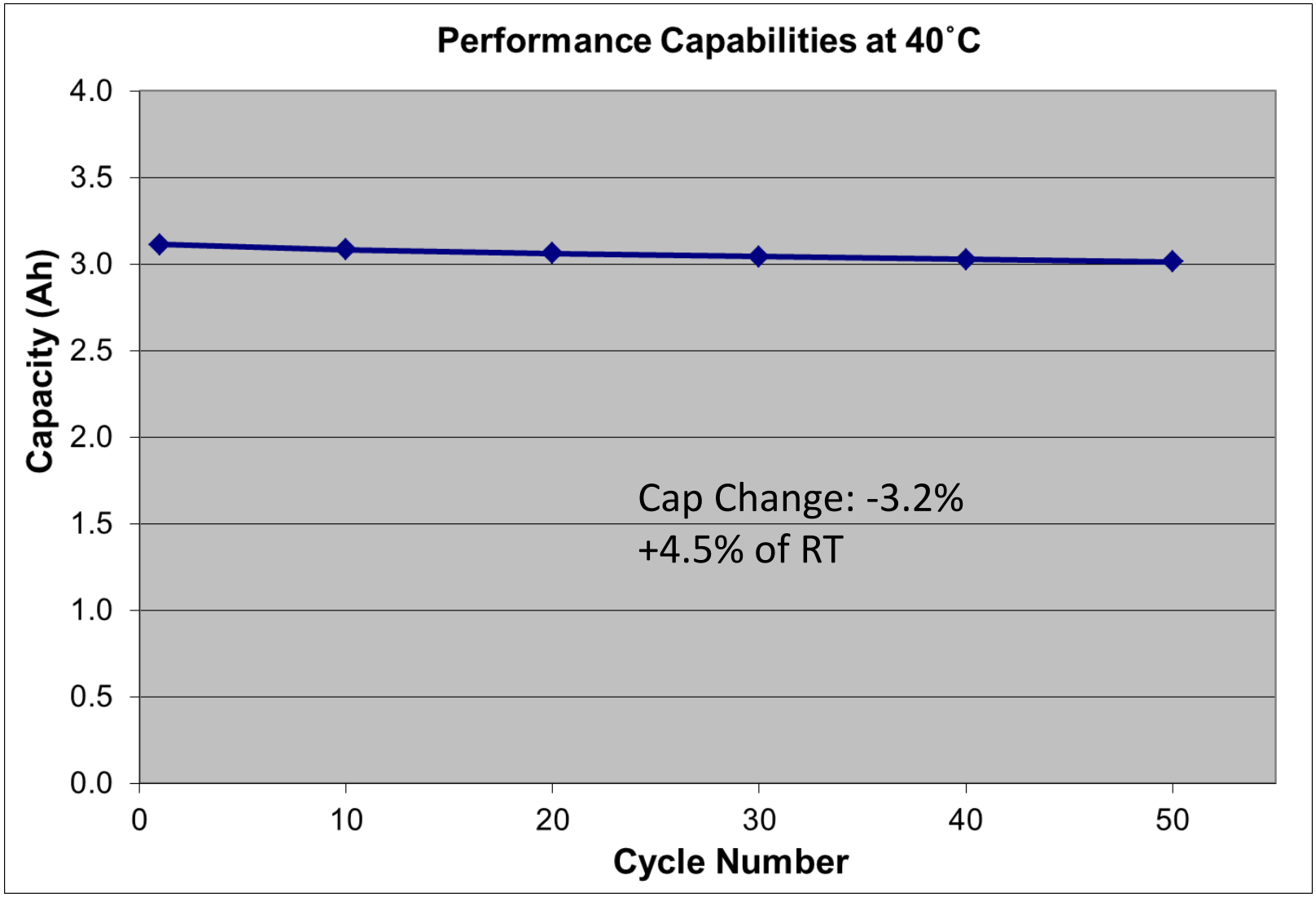

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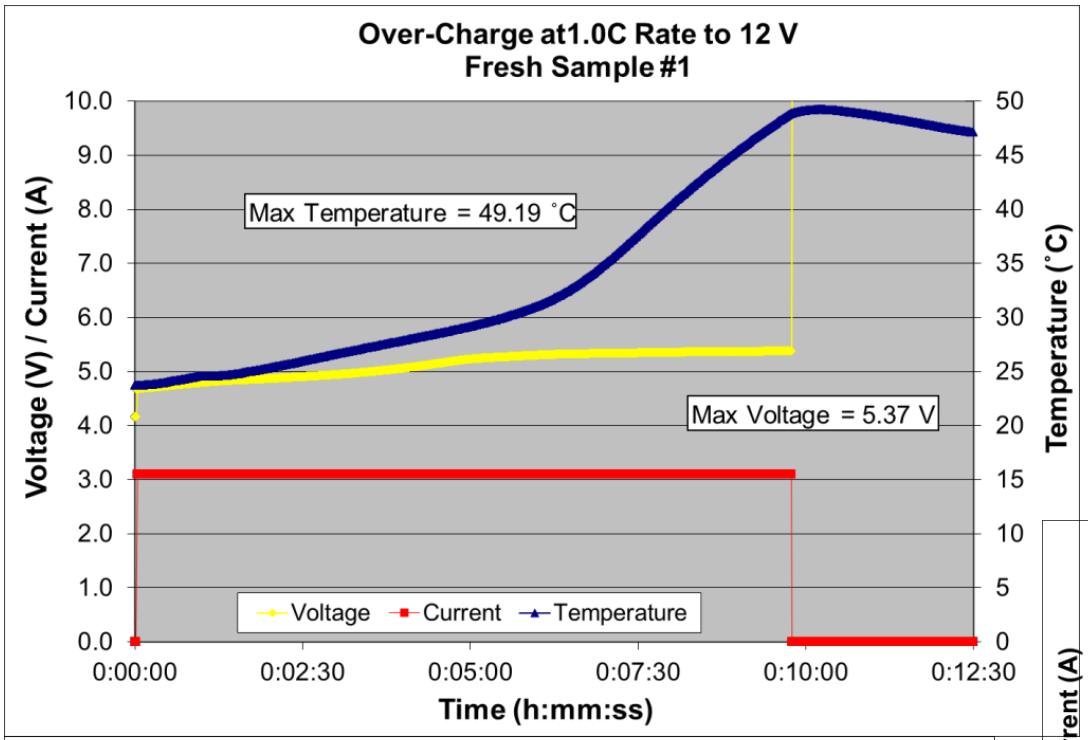
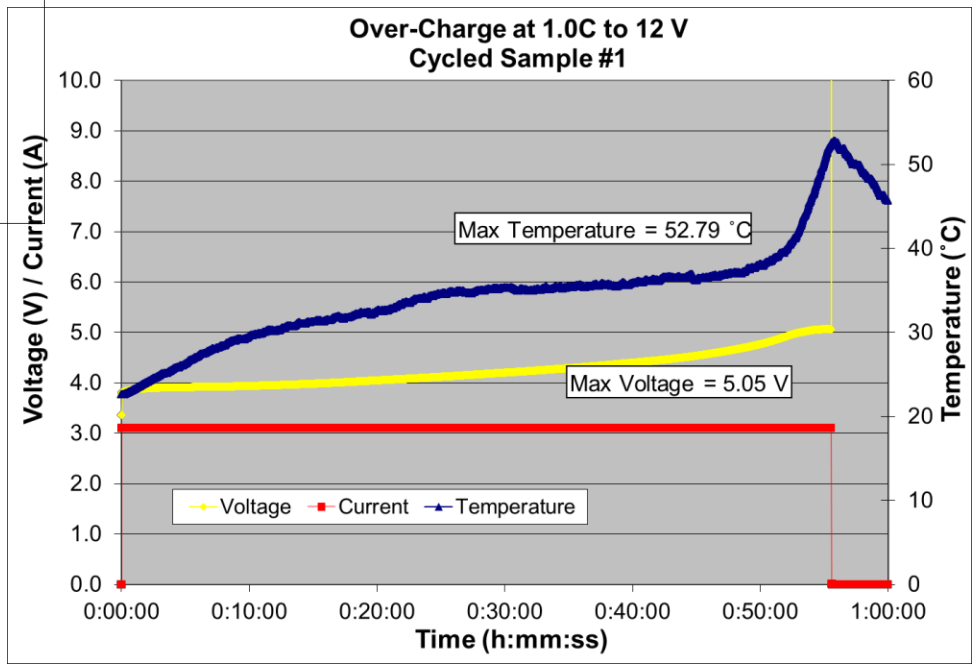
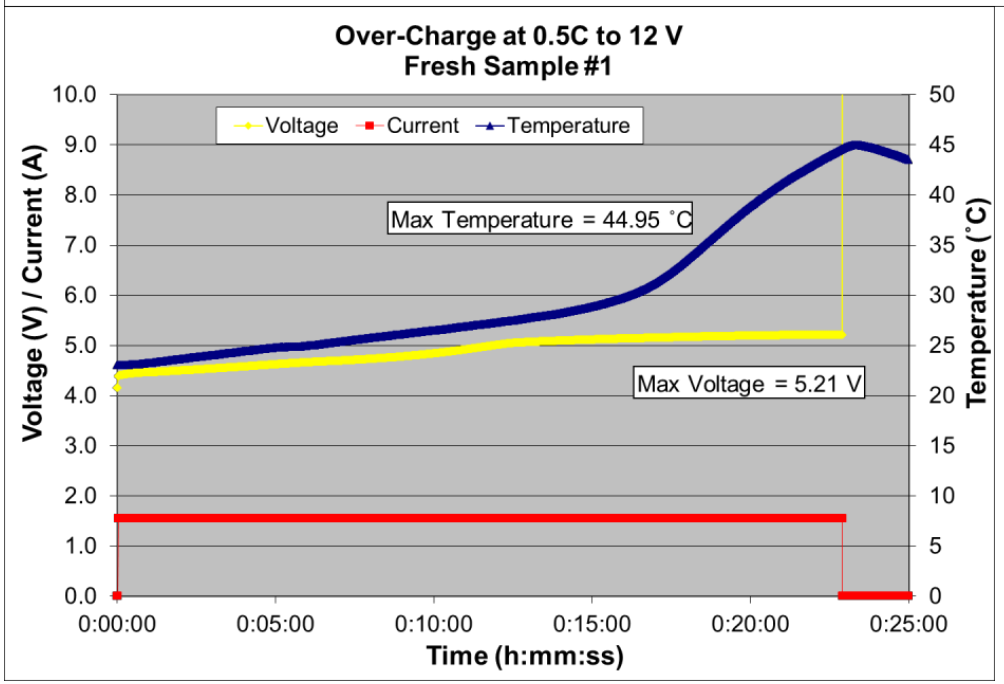
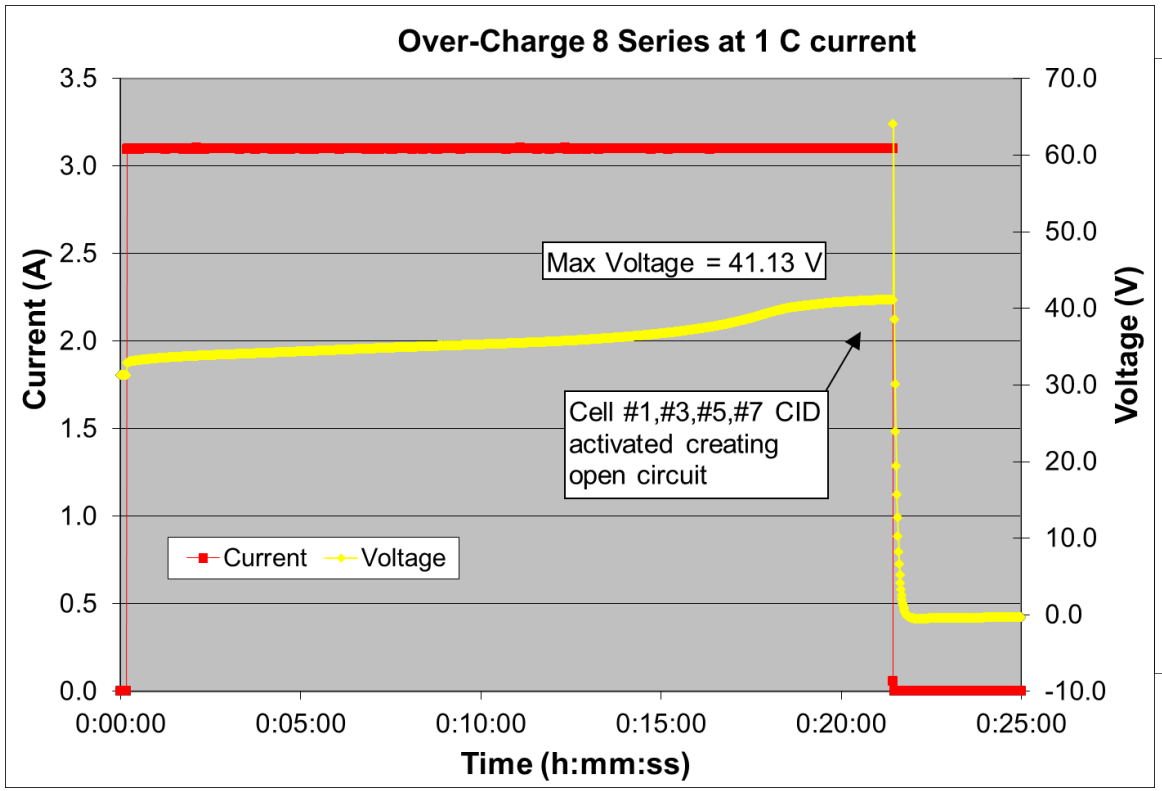
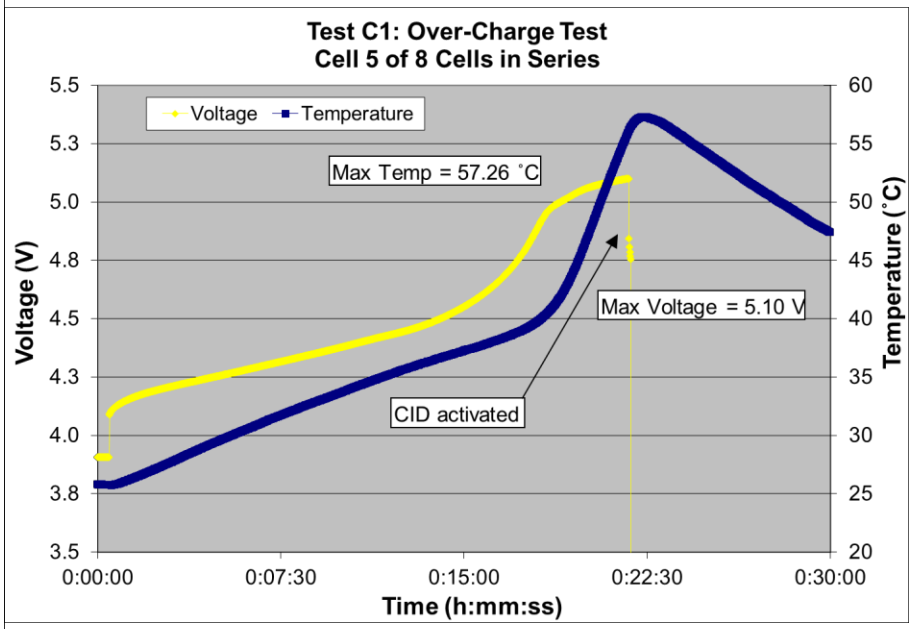






Panasonic 3.1 Ah 18650 Li-ion Cell





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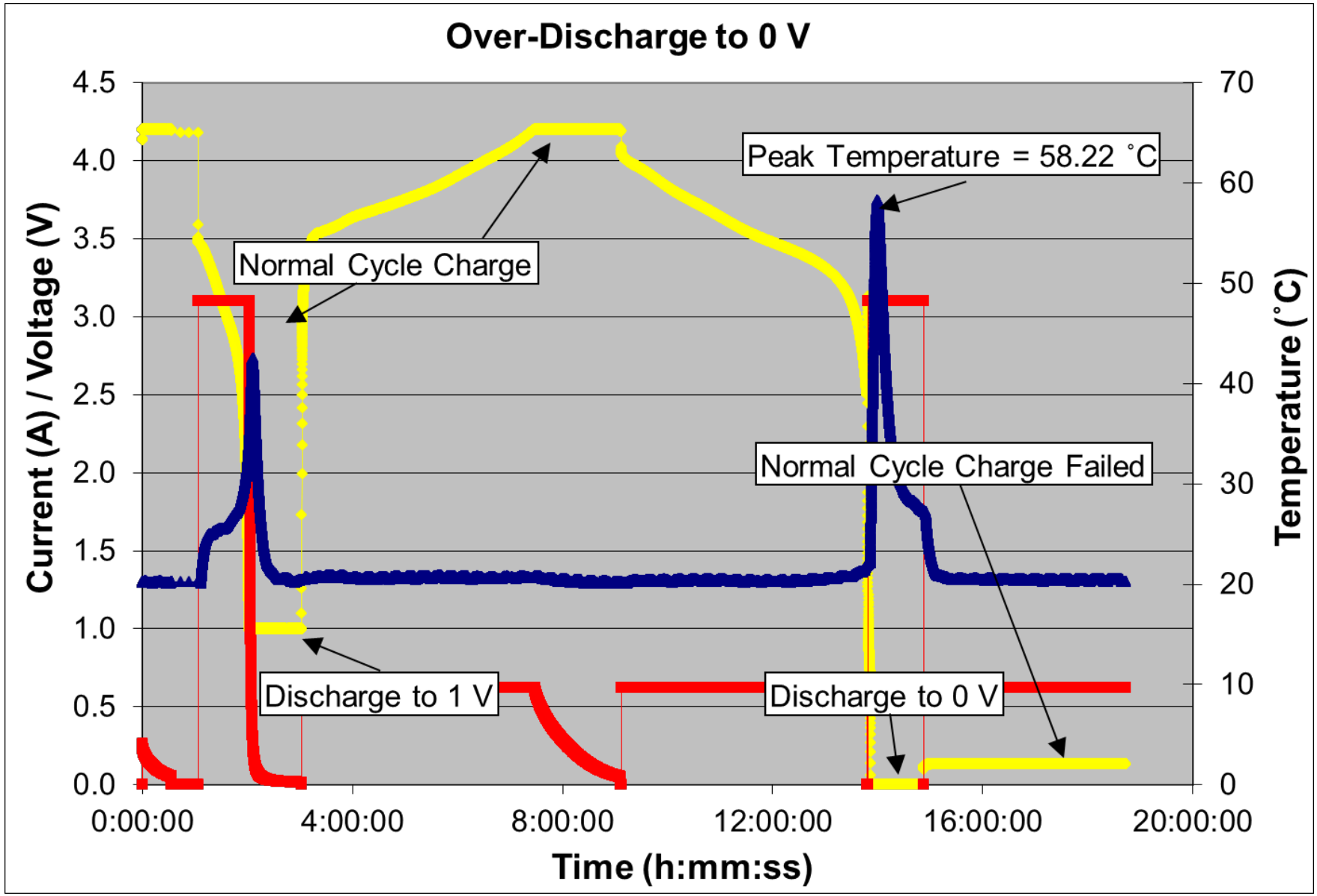

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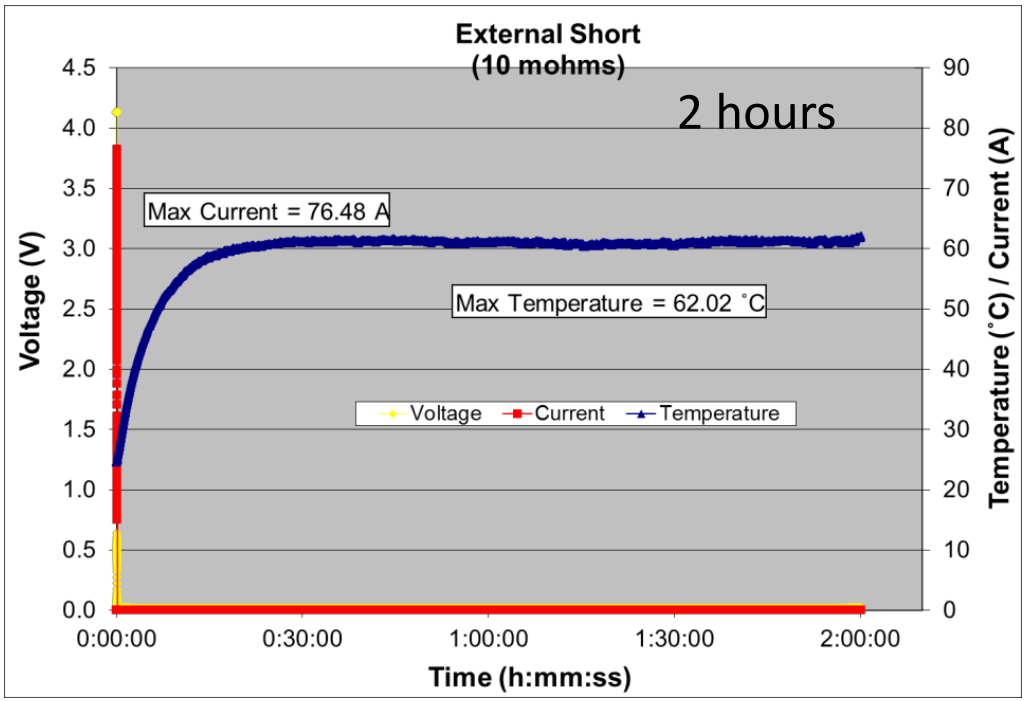
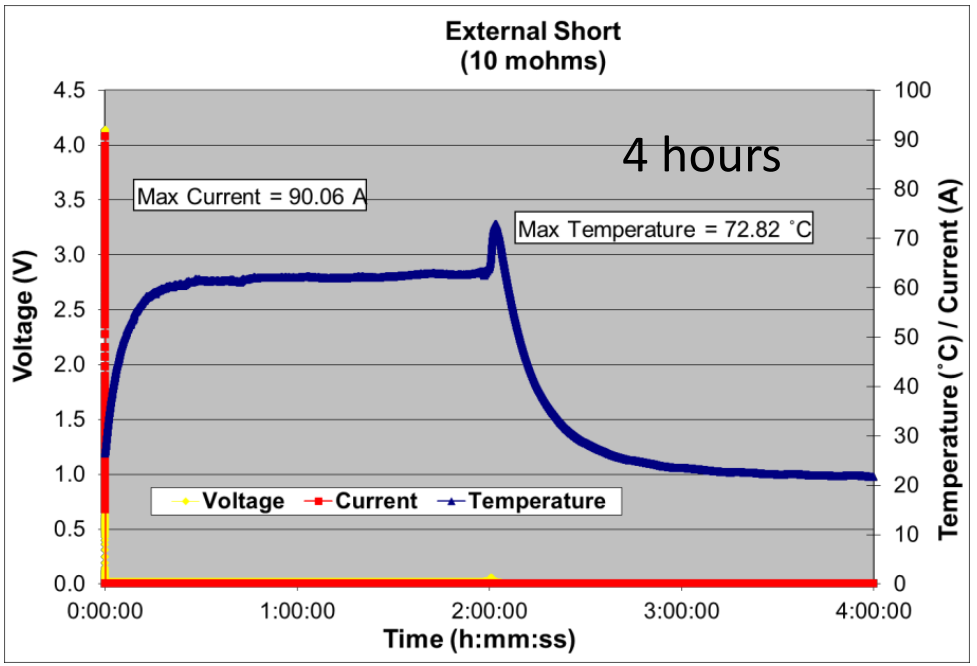
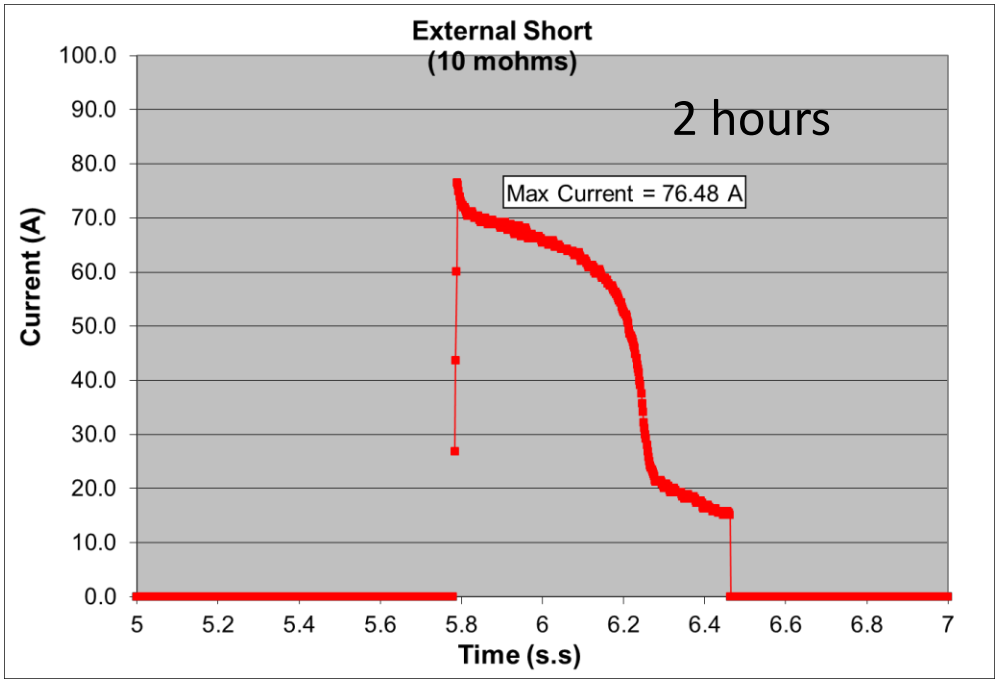
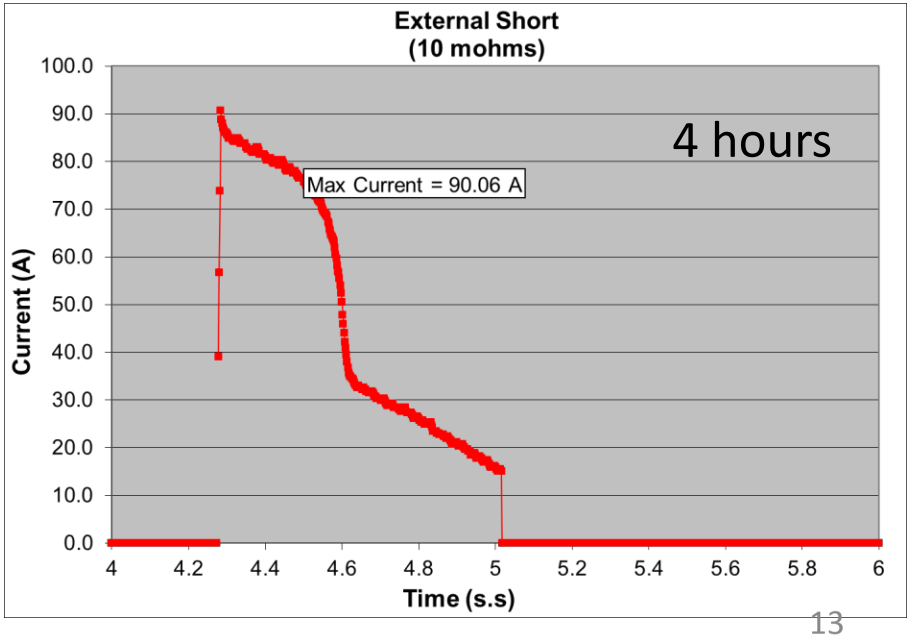
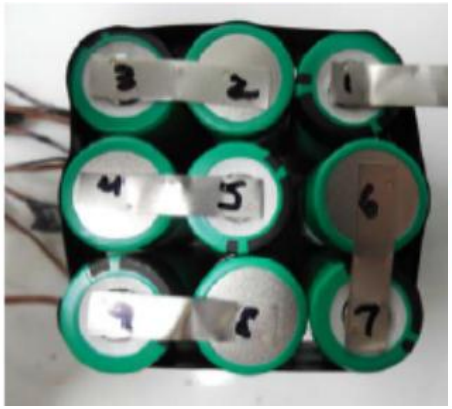


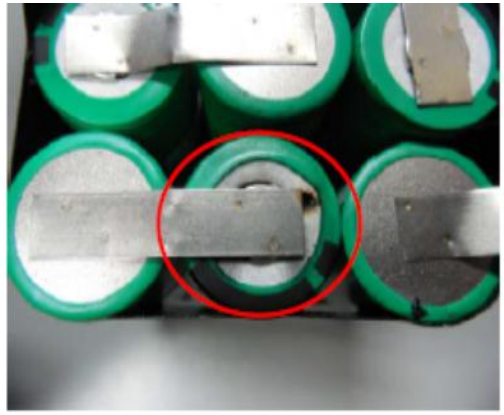






Panasonic 3.1 Ah Li-ion 18650 Cell
Series String External Short (10 mohms)

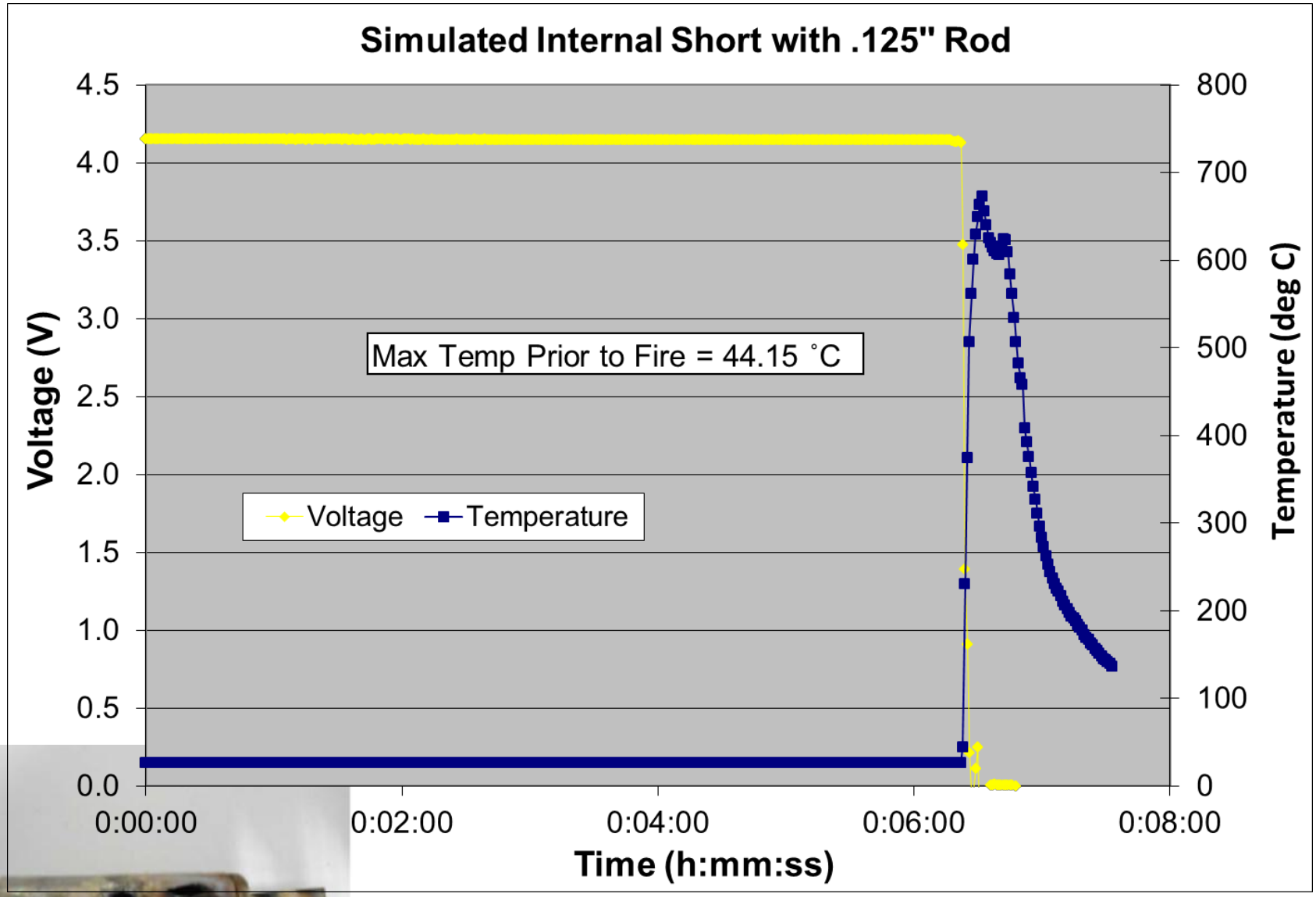




Cell #	Final Voltage (V)	External Resistance (mOhm)	Maximum Current (A)	Maximum Temp ('C)	Notes
1	4.05	-	-	23.57	No vent or fire
2	4.04	-	-	24.83	No vent or fire
3	4.05	-	-	26.43	Smoked, no fire, burn mark on cathode tab
4	4.04	-	-	24.84	No vent or fire
5	4.05	-	-	26.73	No vent or fire
6	4.05	-	-	37.68	No vent or fire
7	0.00	-	-	56.27	No vent or fire
8	4.05	-	-	38.36	No vent or fire
Overall	-	9.7	92.13	-	No vent or fire

Cell #	Final Voltage (V)	External Resistance (mOhm)	Maximum Current (A)	Maximum Temp ('C)	Notes
1	3.95	-	-	31.60	No vent or fire
2	3.95	-	-	32.73	No vent or fire
3	3.95	-	-	30.96	No vent or fire
4	3.95	-	-	31.04	No vent or fire
5	3.95	-	-	35.15	No vent or fire
6	3.94	-	-	42.42	No vent or fire
7	0.00	-	-	45.43	No vent or fire
8	3.94	-	-	38.63	Smoked, no fire, burn mark on cathode tab
9	3.95	-	-	31.12	No vent or fire
Overall	-	9.7	89.45	-	No vent or fire

Panasonic 3.1 Ah Li-ion 18650 Cell



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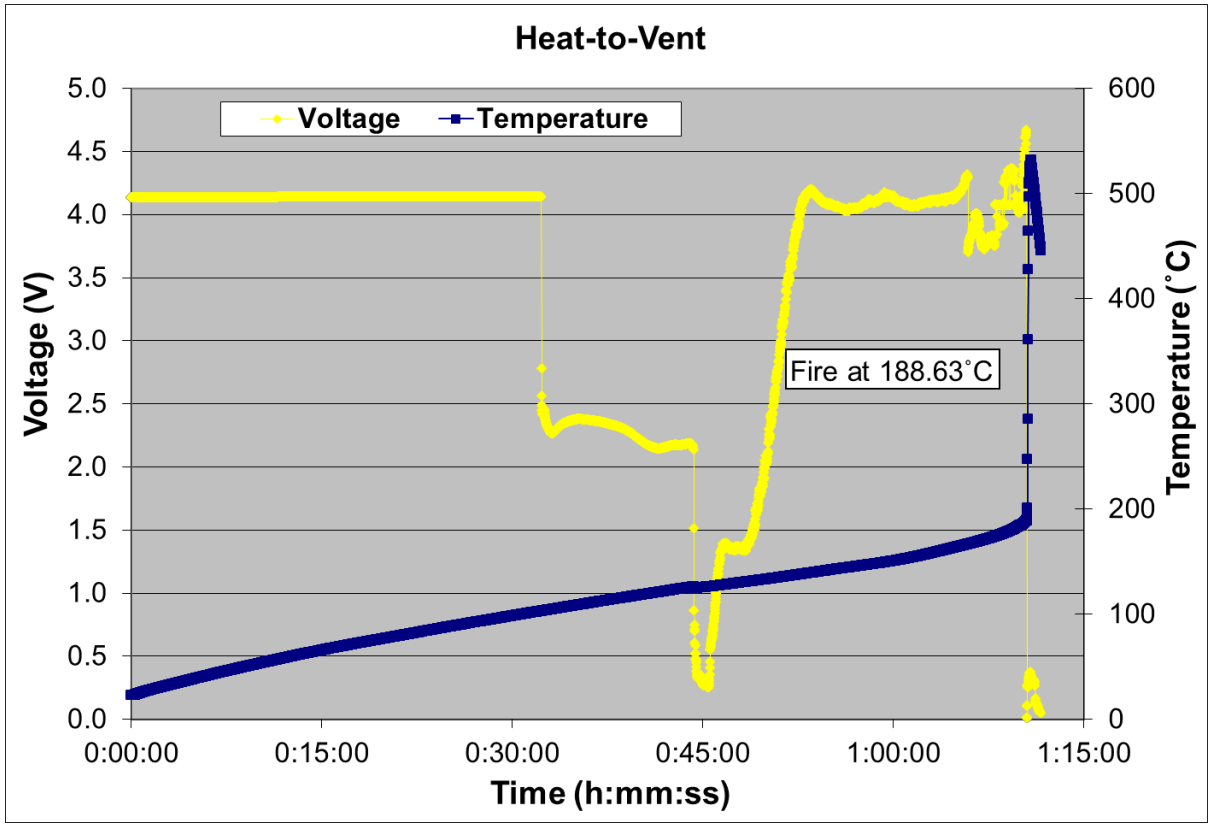
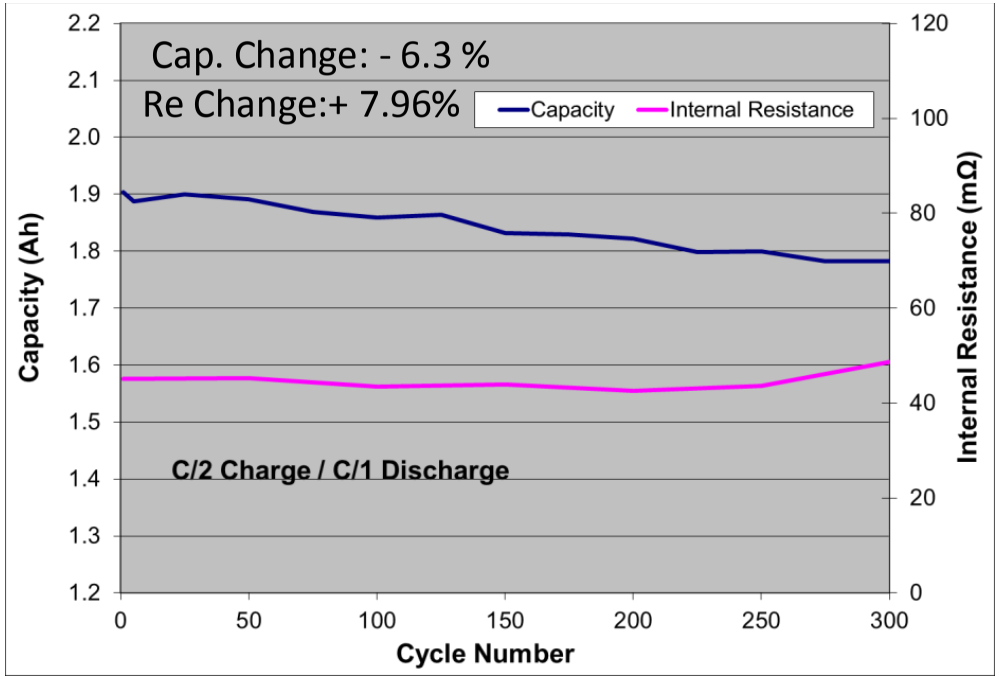
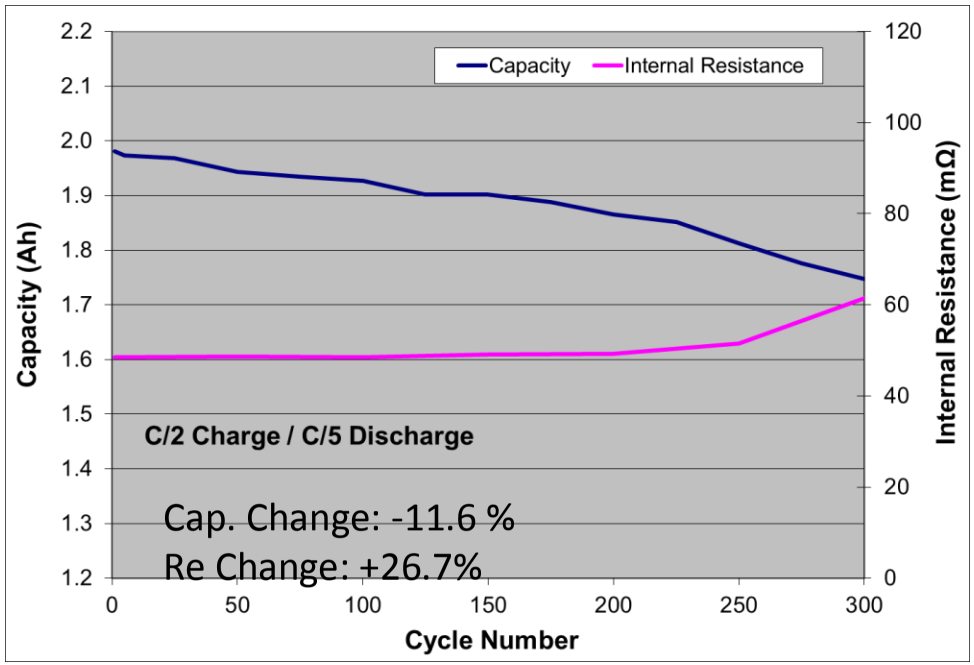


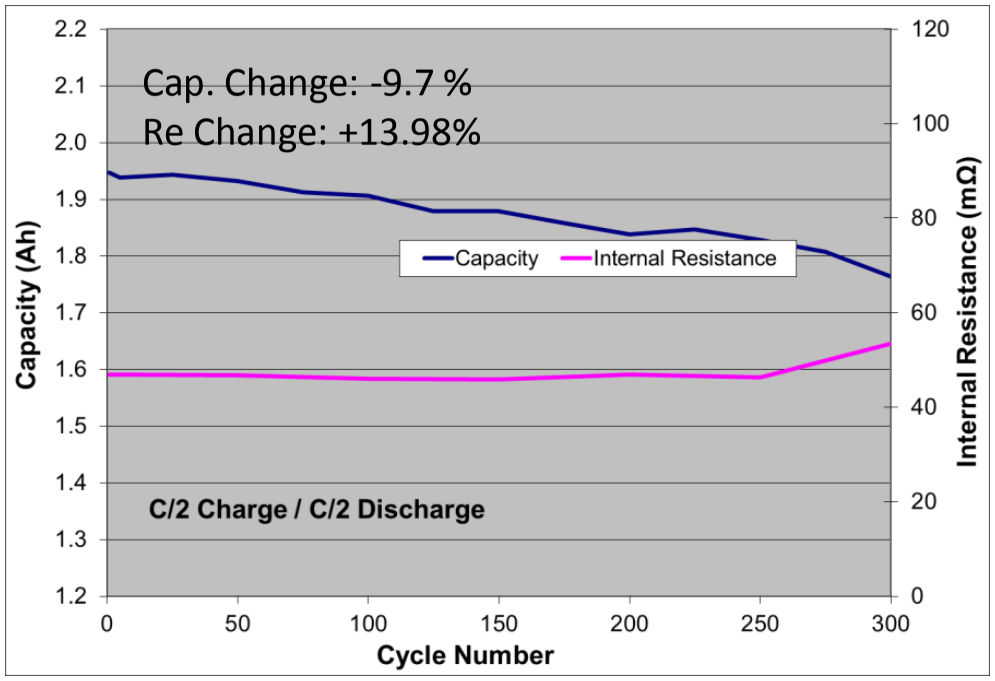
Moli STOBA 2.0 Ah Li-ion 18650 Cell

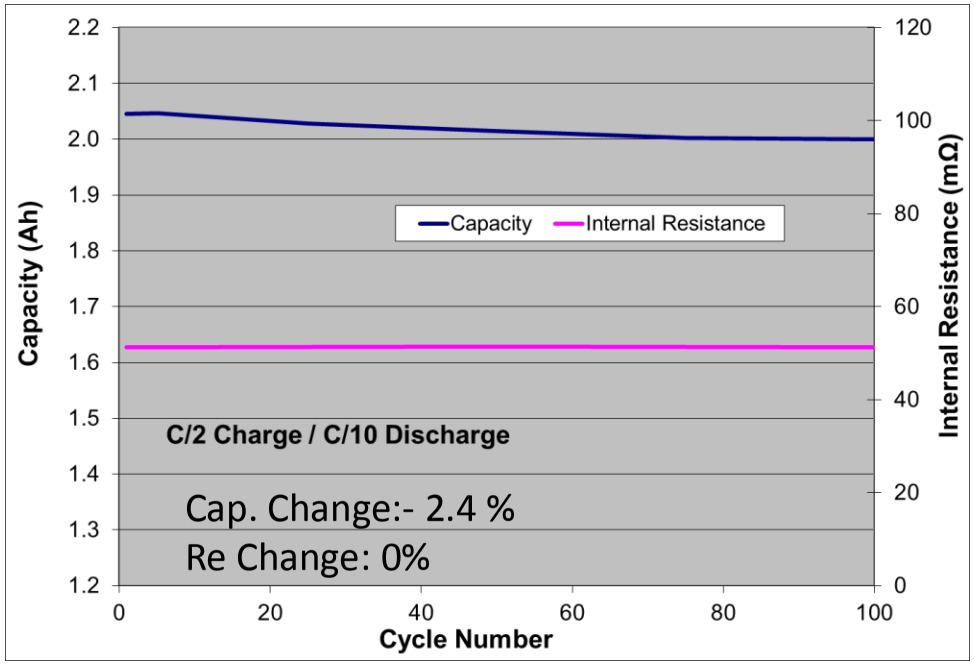
Performance and Safety Test Data

Moli STOBA 2.0 Ah Li-ion Cell









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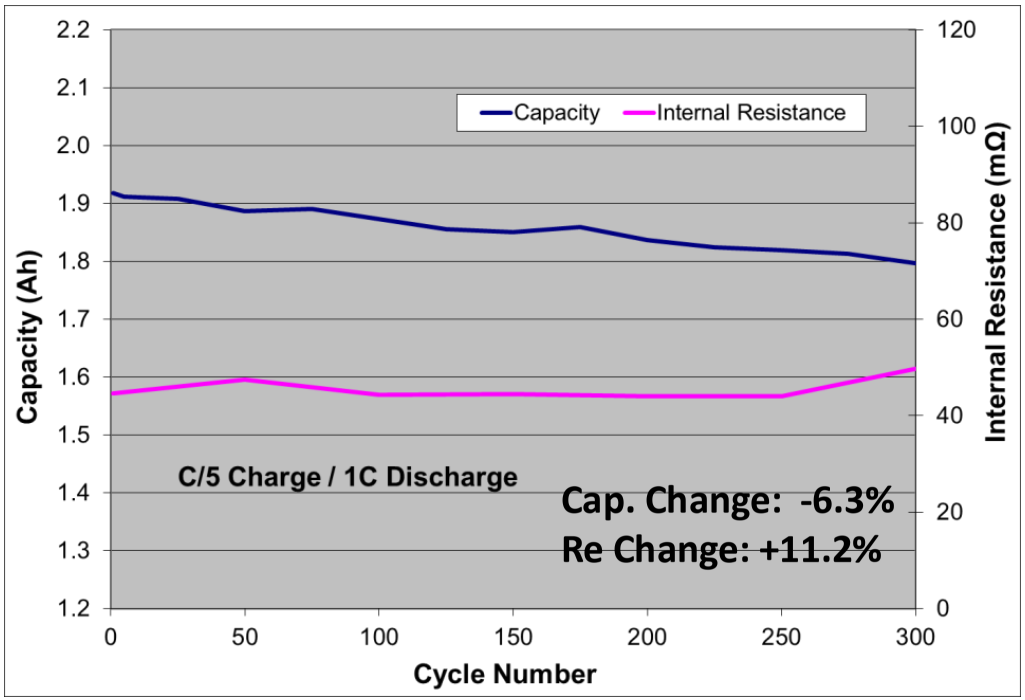

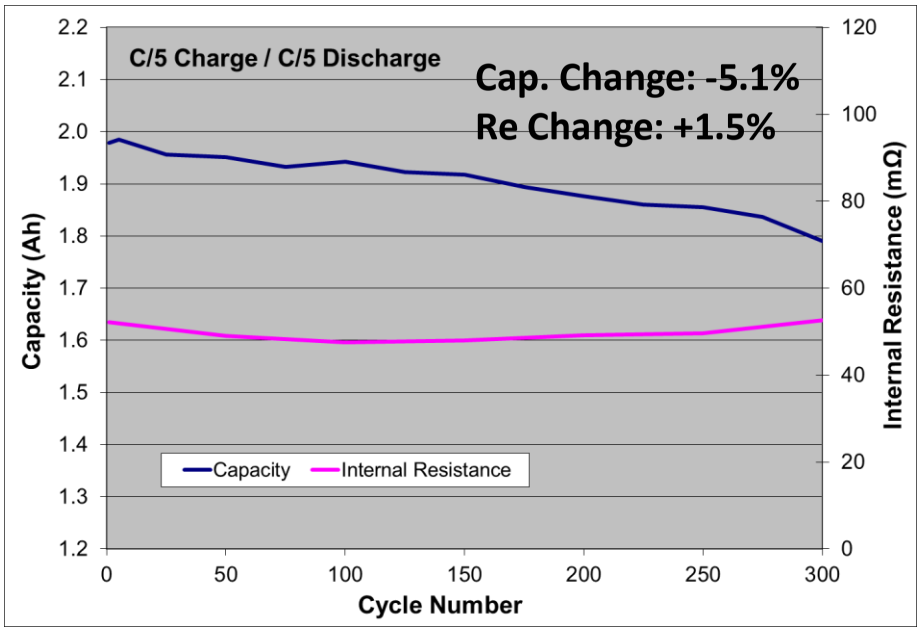

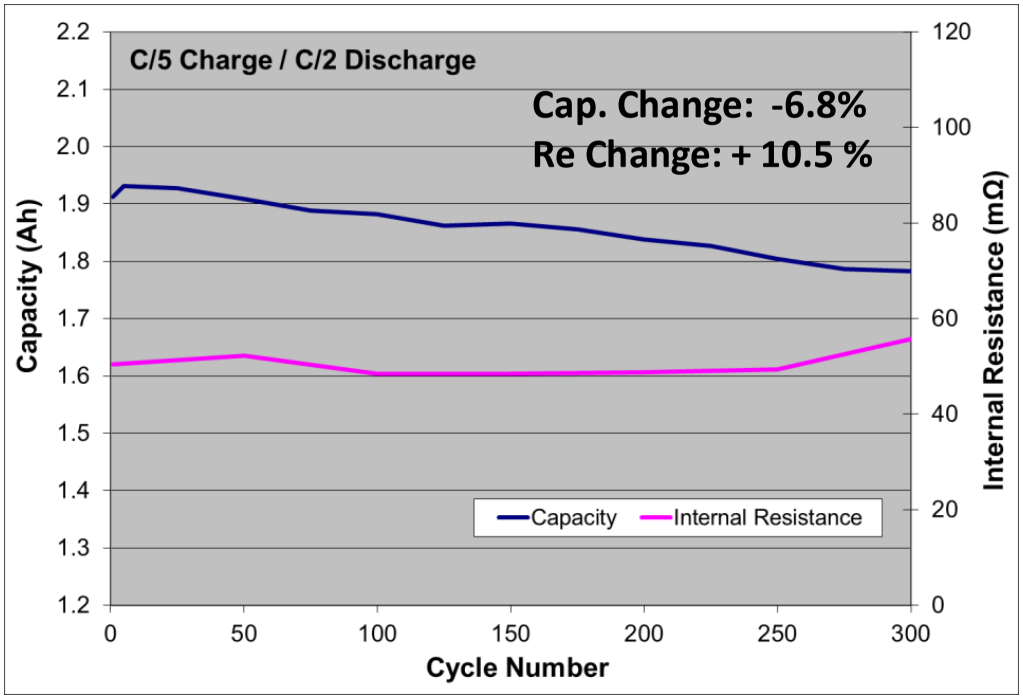

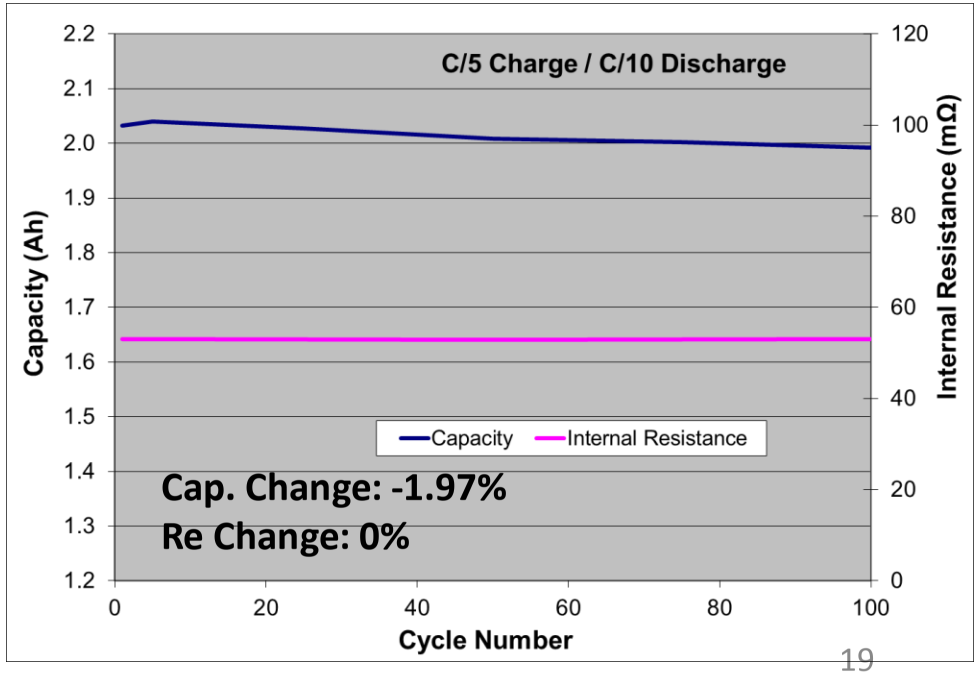

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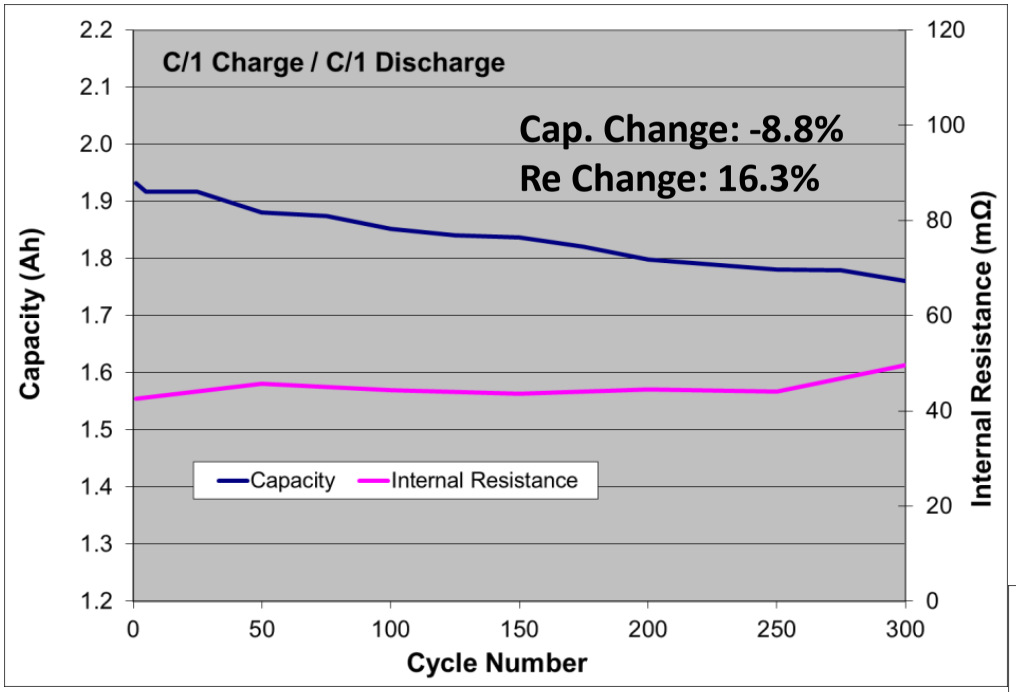

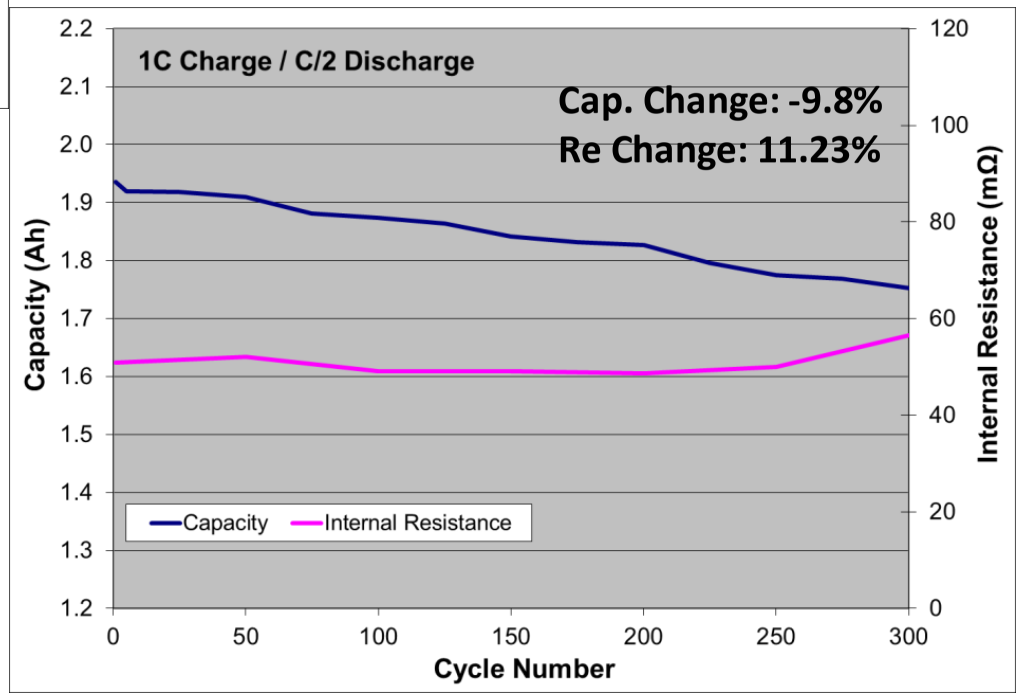

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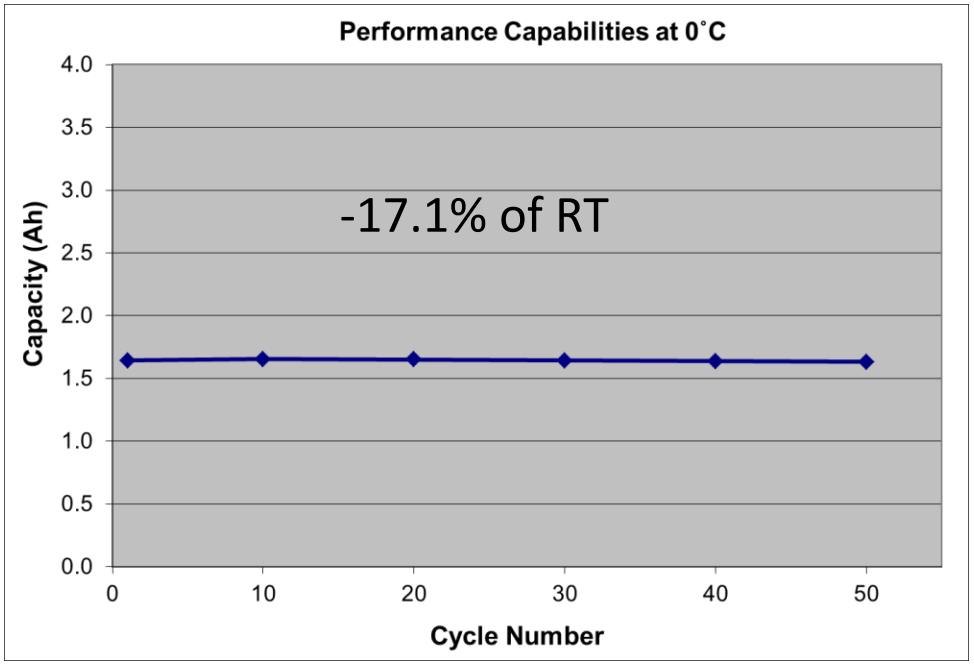

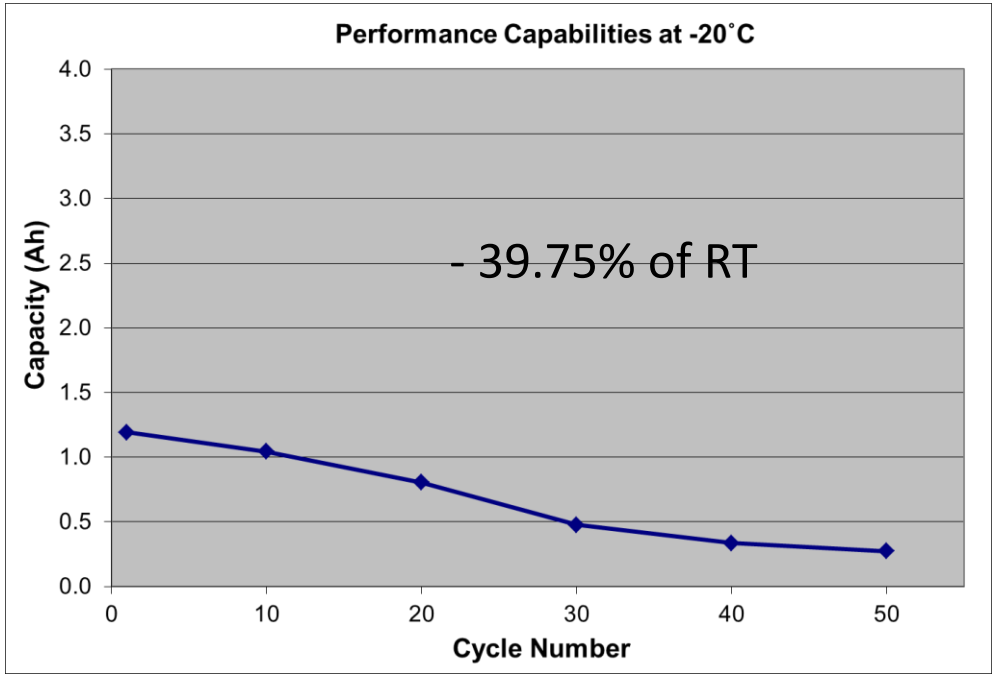

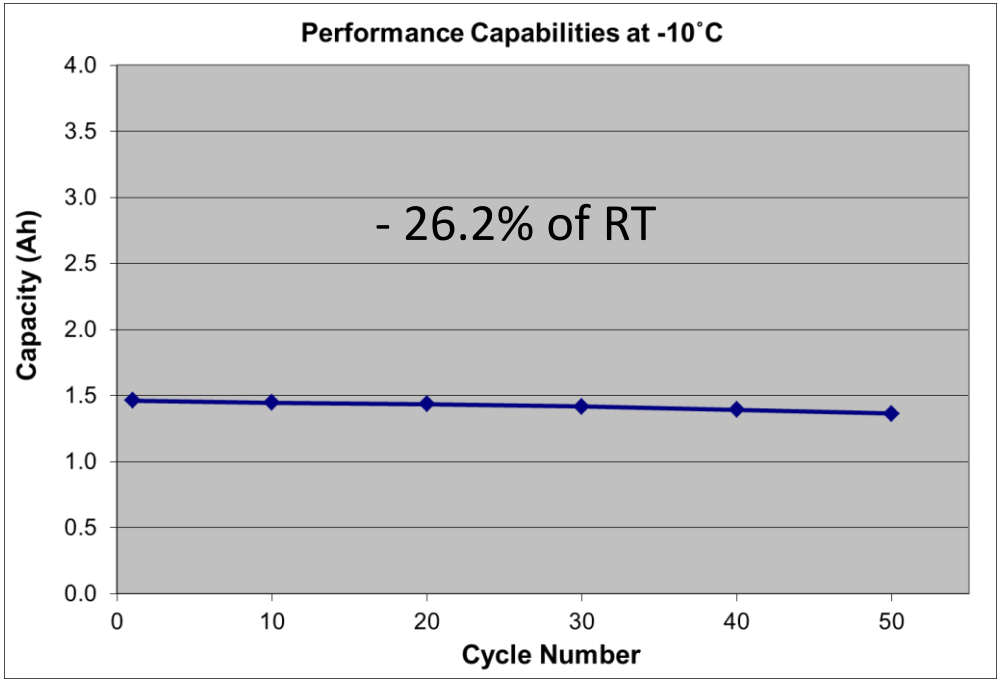

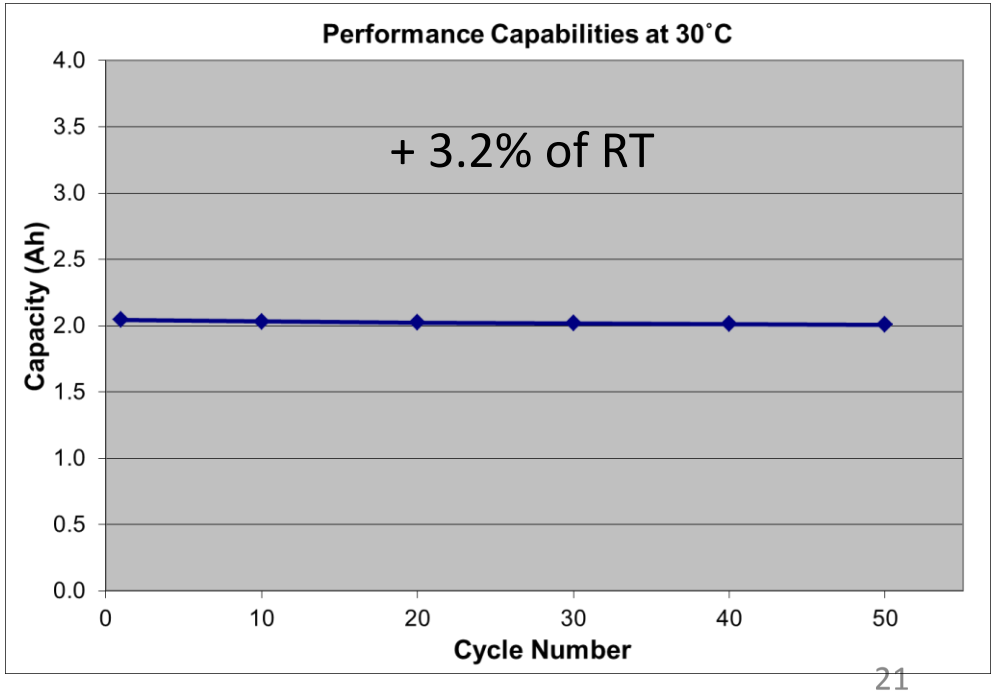

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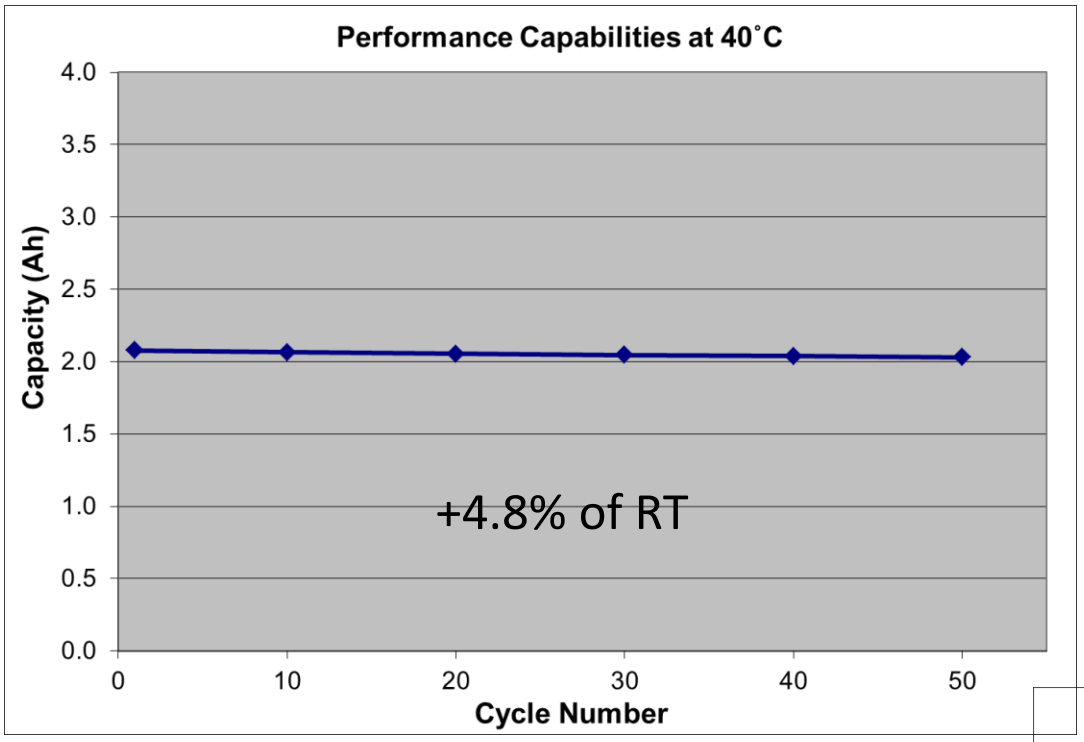
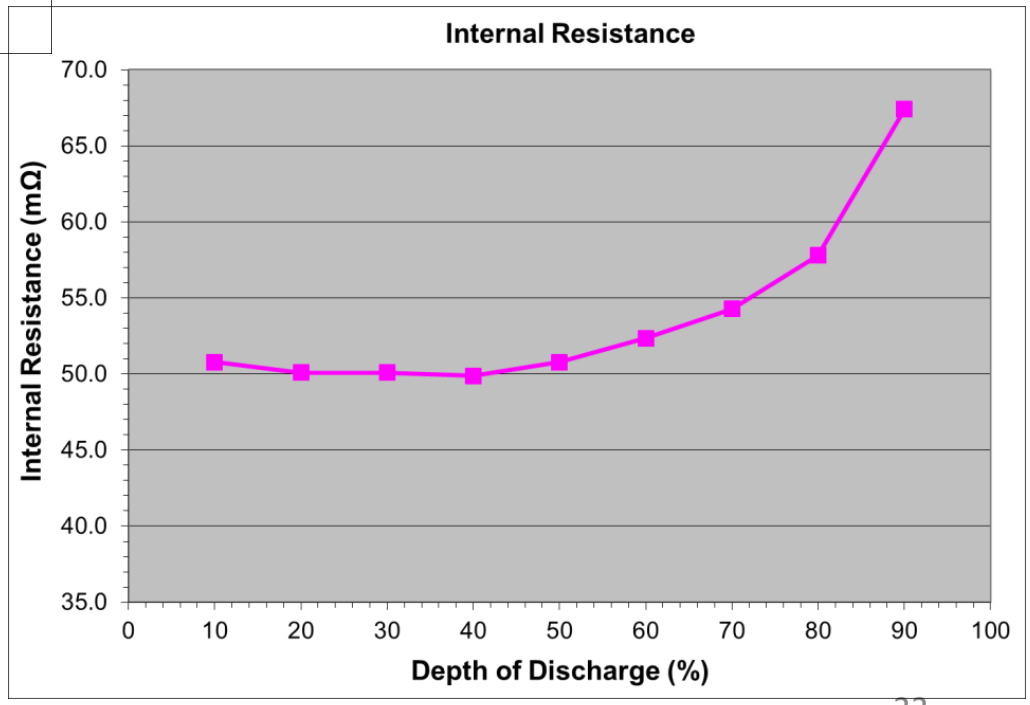
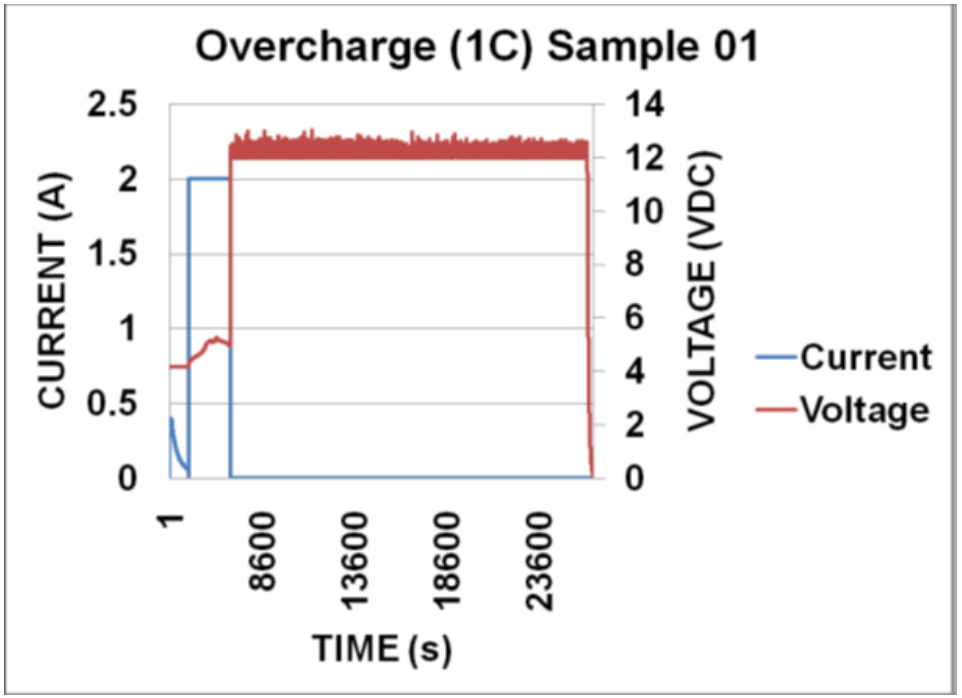


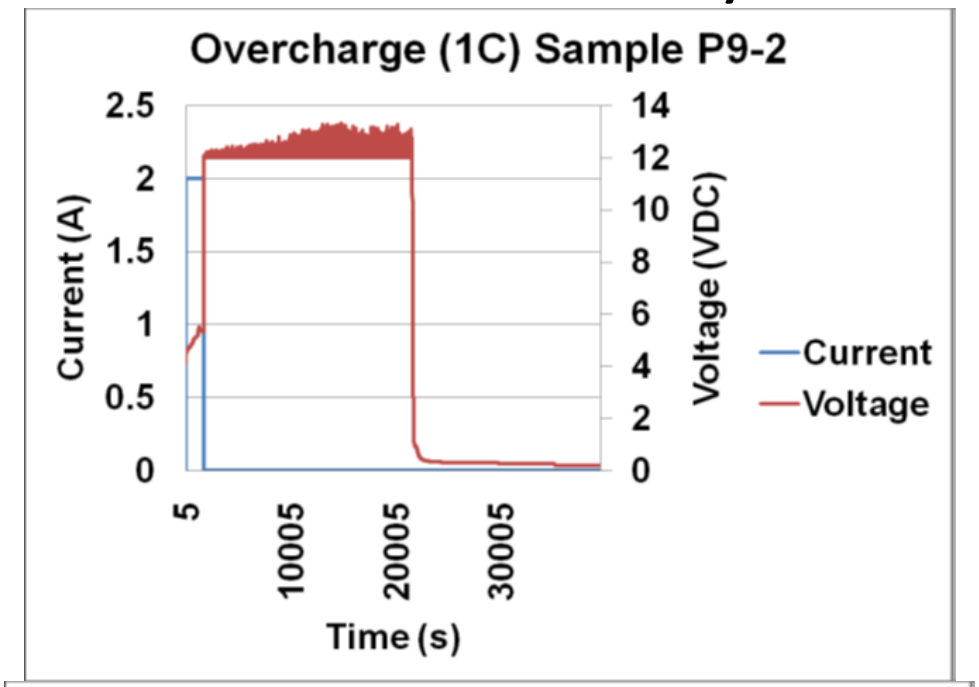


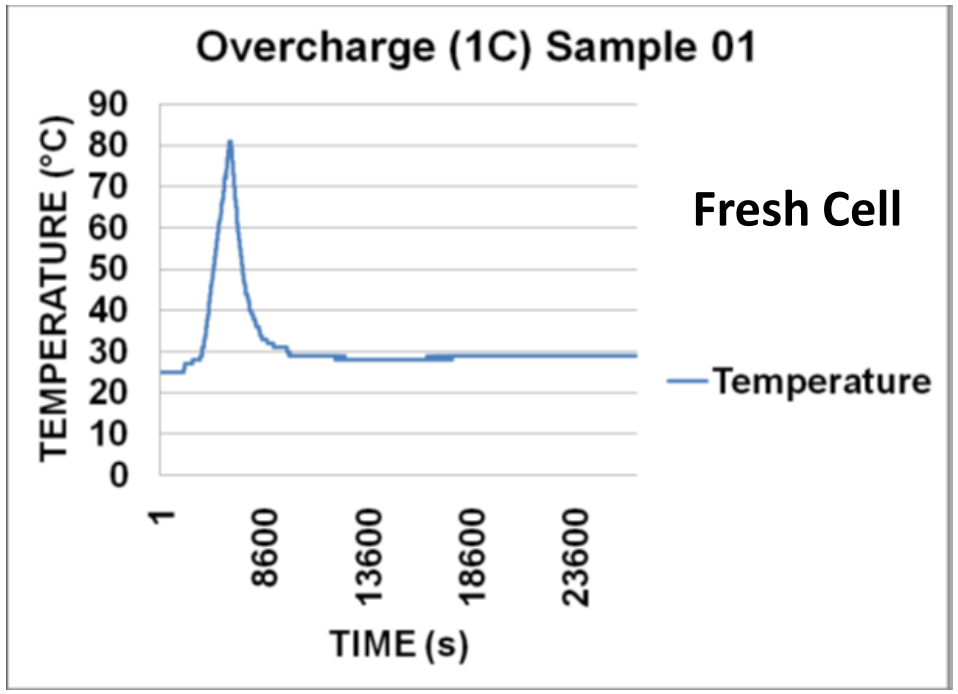
Moli STOBA 2.0 Ah Li-ion Cell

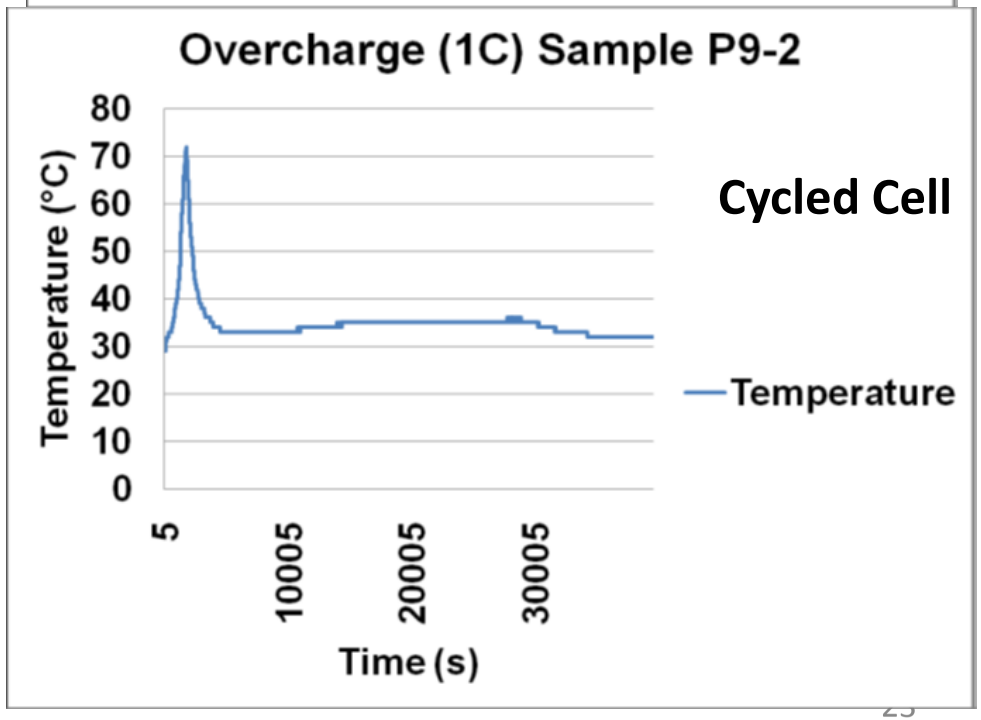
Fresh Cell



Cycled Cell







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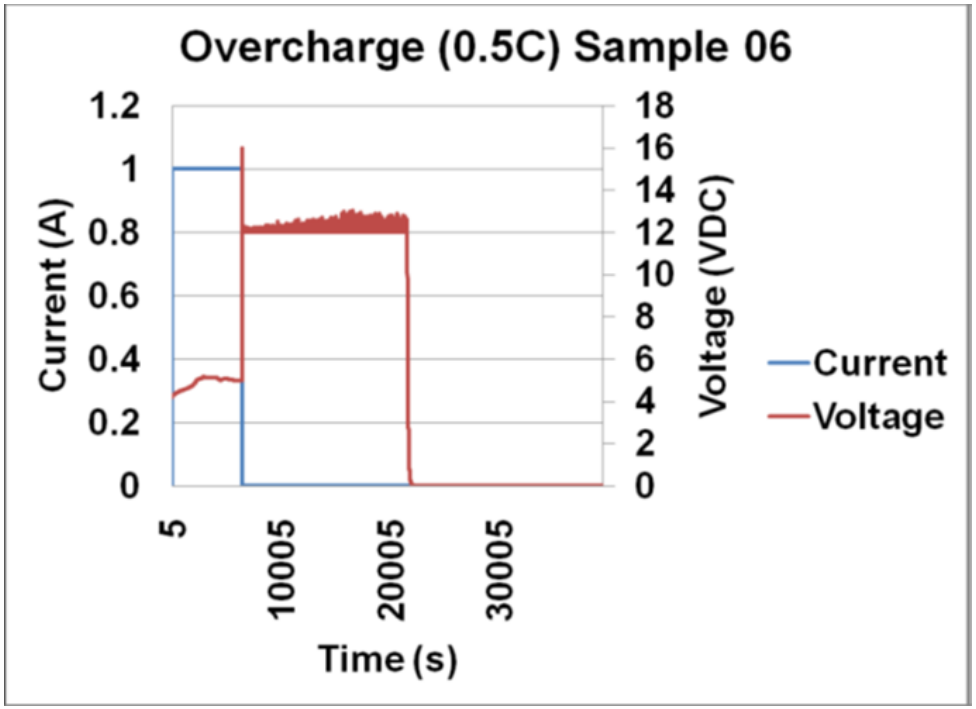

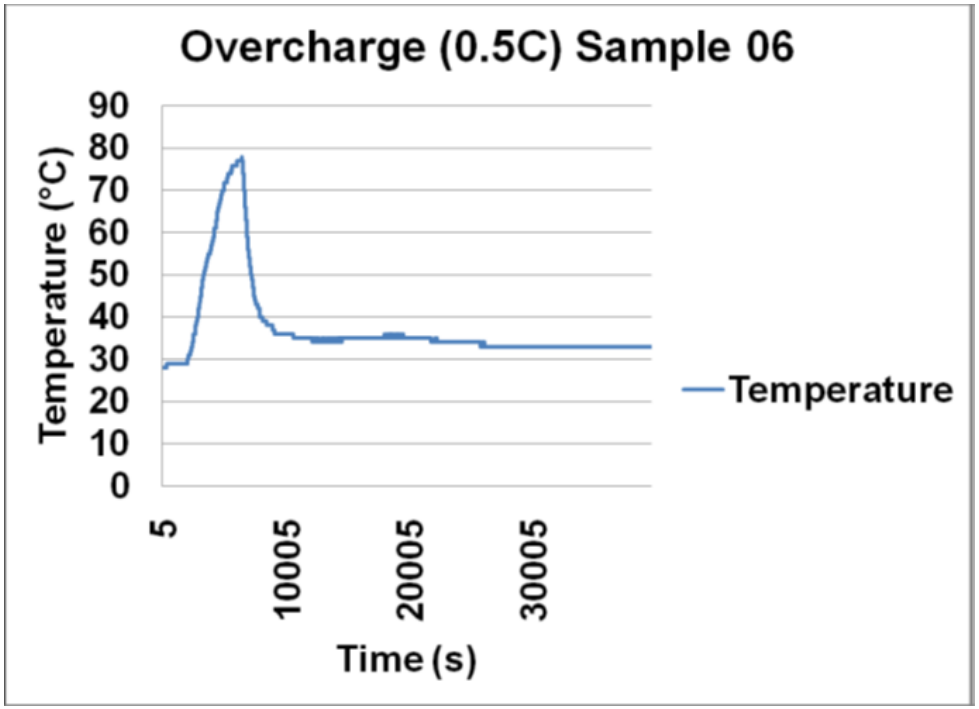

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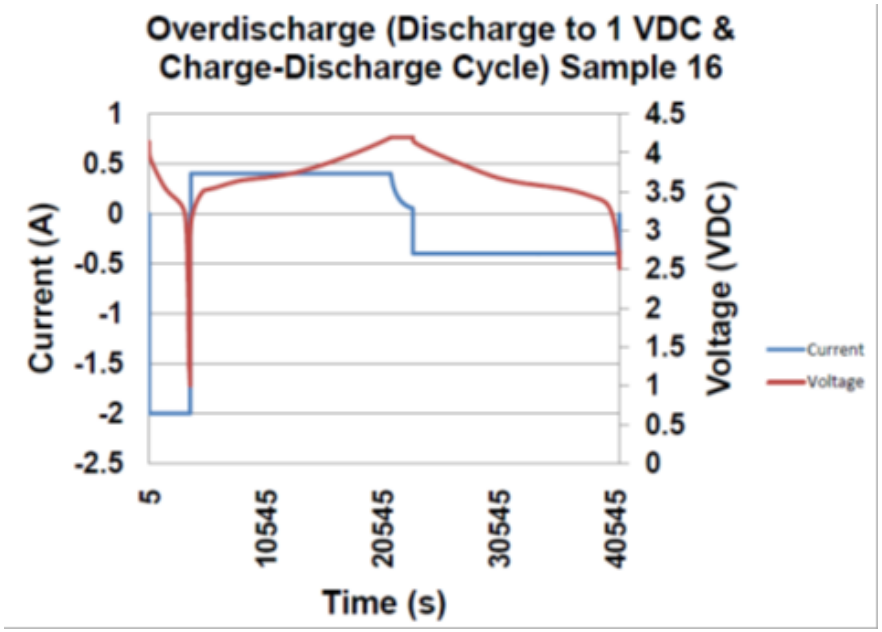
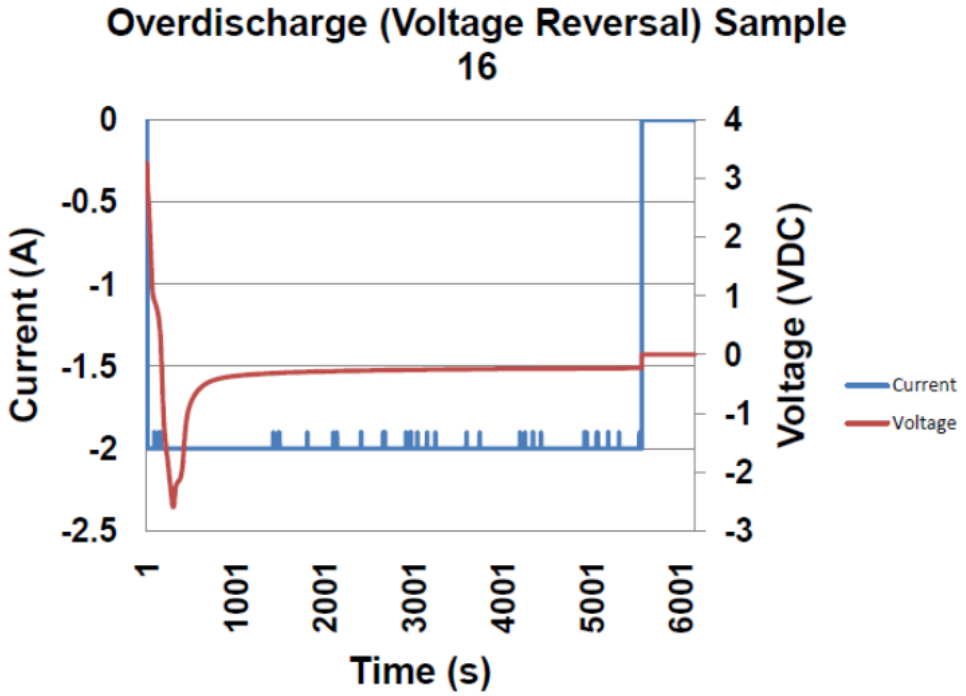
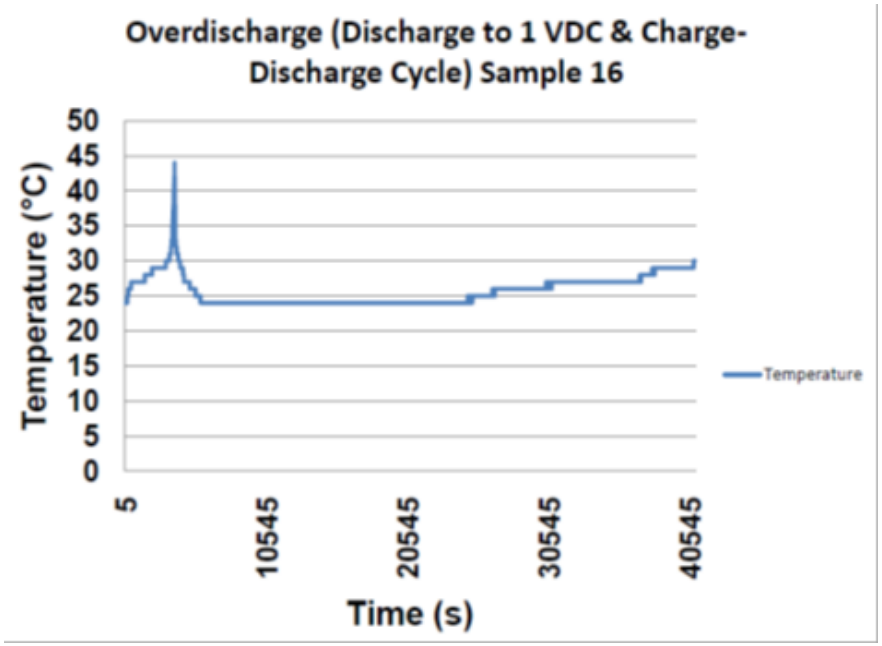
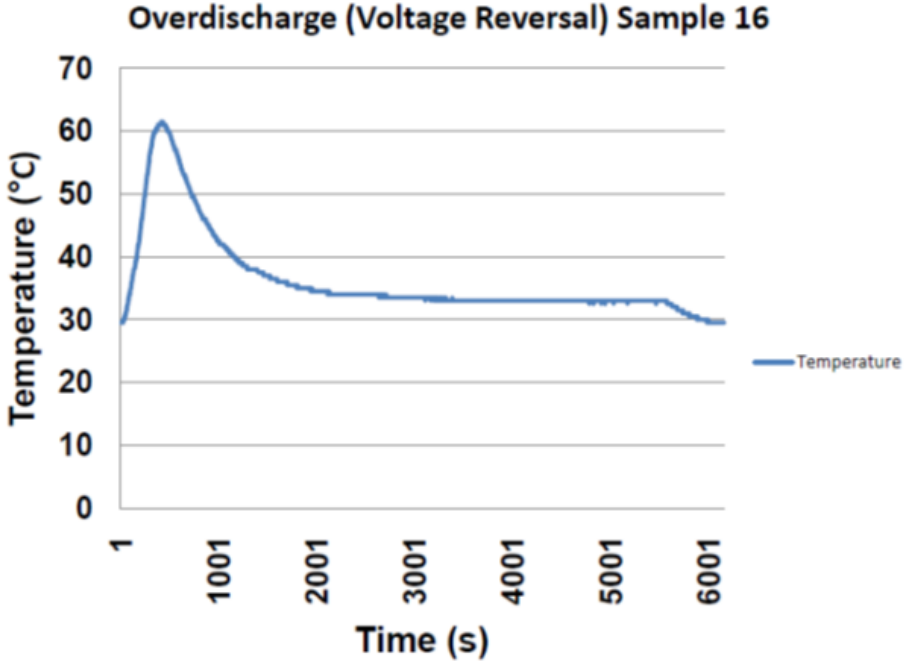
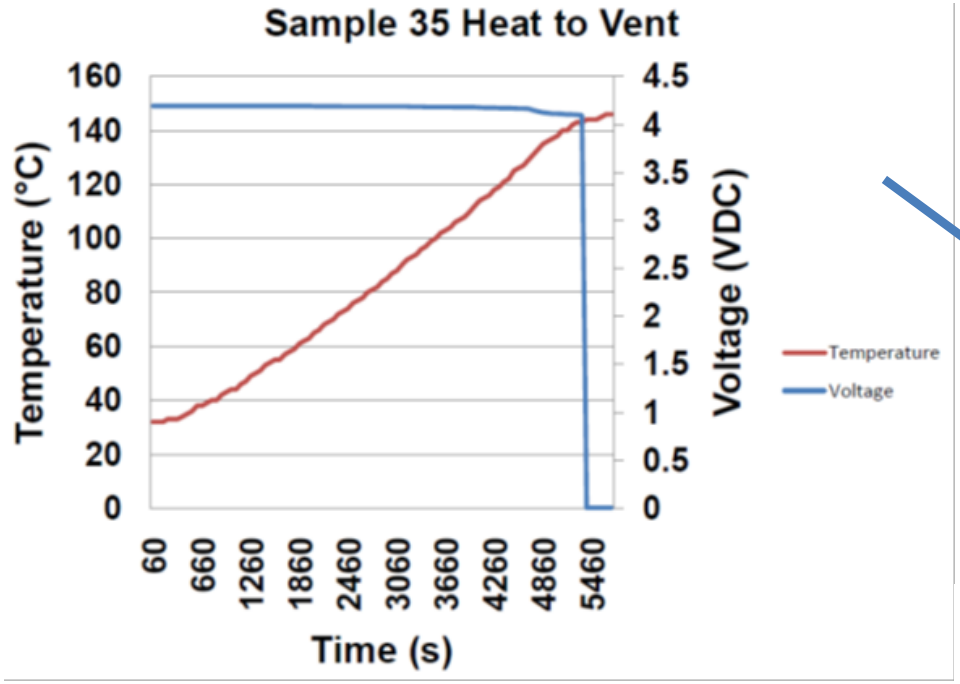








Moli STOBA 2.0 Ah Li-ion Cell

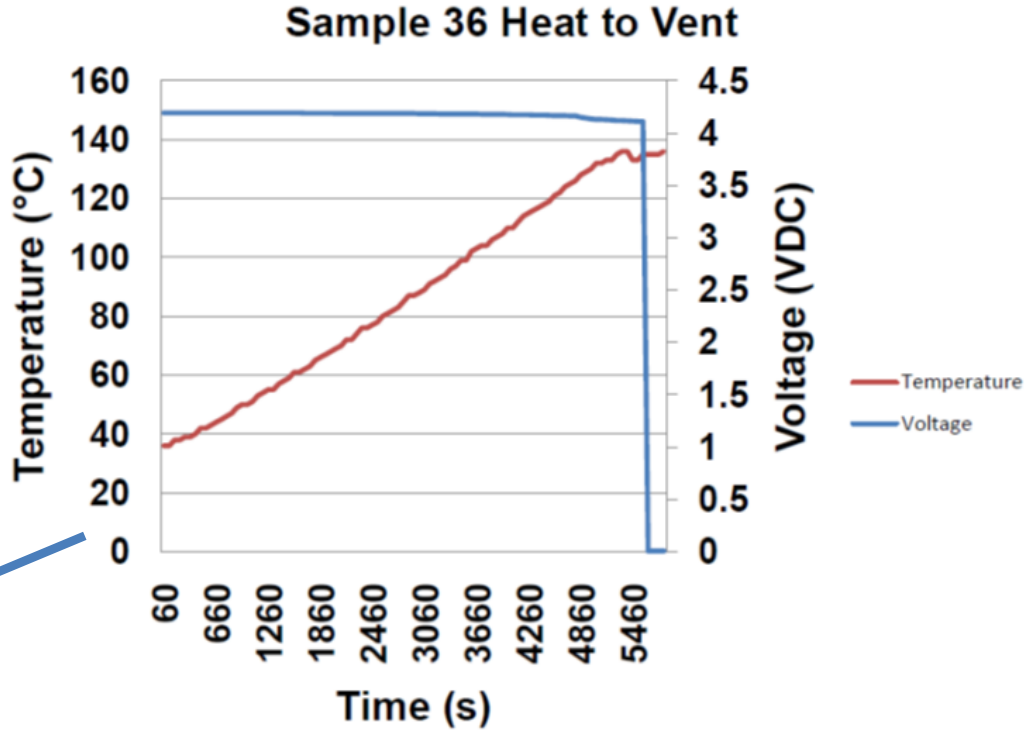


Cell 35

No fire; swelling of can observed; some electrolyte leakage observed

Temp Ramp Rate: 1.5 deg C/min.

Cell 36



Moli STOBA 2.0 Ah Li-ion Cell

Vent and Burst Pressure Test Data

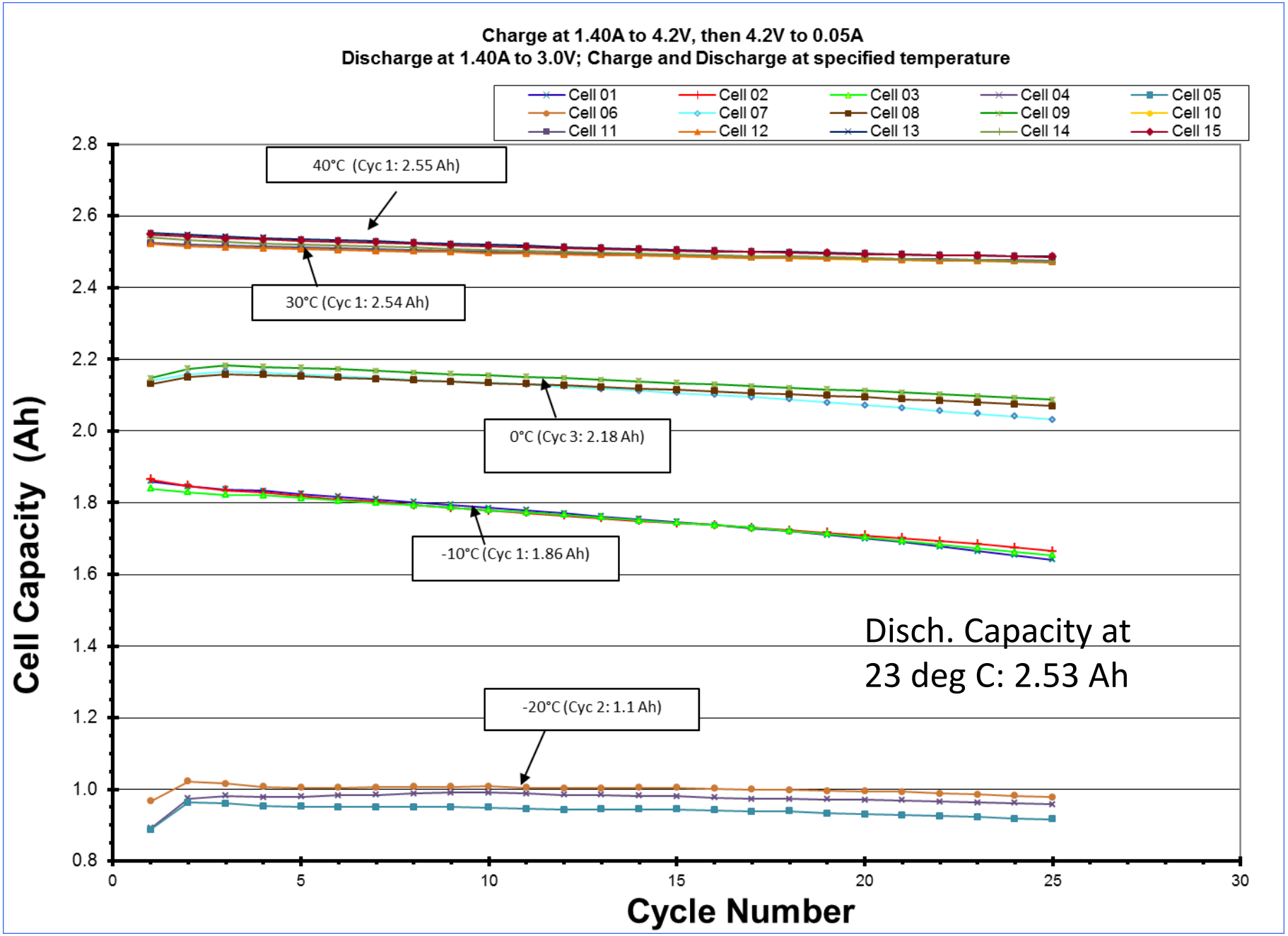
Sample 14 vent opened at a pressure of 155 psi.
Sample 15 vent opened at a pressure of 145 psi.

Sample 10 burst at a pressure of 859 psi. Failure around crimp seal.
Sample 11 burst at a pressure of 645 psi. Failure around crimp seal.

LG 2.8 Ah Li-ion 18650 Cell

Performance at Various Temperatures

LG 2.8 Ah Li-ion 18650 Cell



Summary and Conclusions

- Single cells of 18650 cell design are safe under off-nominal conditions but do not remain so under multi-cell configurations.
- Moli STOBA cell seems to have a higher tolerance to abuse than traditional cells without the STOBA.
- LG cells show a significantly low performance below -10 deg C.
- Tests and results provided are for the protocols studied. Projects should carry out their testing under relevant worst-case conditions (loads and environment) to determine the level of controls required to obtain a safe design, especially for human-rated environments.

Acknowledgments

- PCTest Engineering
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