

Q1-1695
Cell Cycle Life Test Report

Prepared for:
QuantumScape Corporation

Testing Performed by:

Mobile Power Solutions
6260 SW Arctic Dr.
Beaverton, OR 97005

Phone 503-645-6789

Prepared for: QuantumScape	Page 1 of 15	Report date 10/21/2021
Test report numbers: Q1-1695		
Prepared by: Spencer Poff, Engineering Manager		

Executive summary

This report covers a group of 3 samples run at 1C charge and discharge, 25°C, to assess cycle life performance. Decrease in capacity was less than 10% after 800 cycles for all of the samples tested.

Cells

Manufacturer	QuantumScape
Charge termination voltage, V	4.2
Discharge termination voltage, V	3.0
Cell Chemistry	Solid-State Lithium-Metal

Test Equipment Used

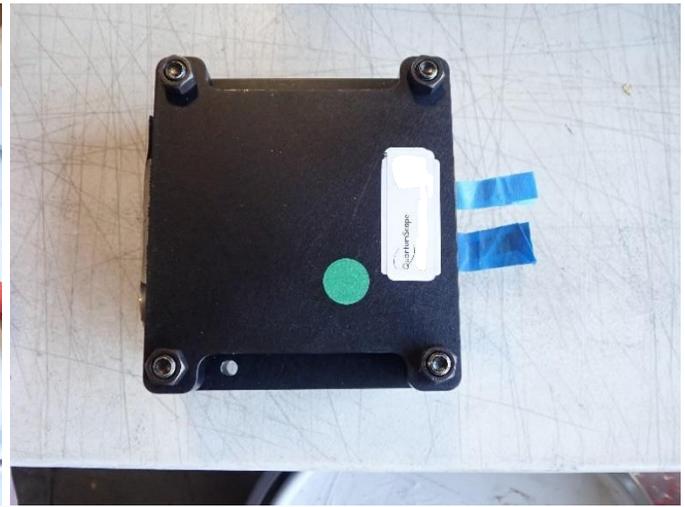
MPS #	Equipment	Calibration	Last Cal	Cal Due
388	Maccor Series 4000	Maccor Factory Calibration	7/14/2021	7/14/2022
403	Keysight 34972A Data Logger	ANAB Accredited AC-2489.01 NIST traceable	2/8/2021	2/8/2022
385	Keysight 34901A (Chamber temperature logging)	ANAB Accredited AC-2489.01 NIST traceable	12/10/2020	12/10/2021

Receiving

- The cells arrived in Pelican cases that were enclosed in vermiculite-filled steel drums. None of the shock indicators were tripped.



Prepared for: QuantumScape	Page 2 of 15	Report date 10/21/2021
Test report numbers: Q1-1695		
Prepared by: Spencer Poff, Engineering Manager		



Incoming inspection – cells

- Cells were visually inspected, and representative photos were taken. Any damage or visible anomalies were noted.
- Voltage was recorded.

Job # Q1-1695
 Task: Incoming Inspection

Number of cells received:	3
---------------------------	---

Take a complete set of pictures during the incoming inspection.
 Visually inspect each sample. Verify that there is no sign of fire, explosion,
 Capture serial numbers (if applicable). Document any anomalies found.

MPS #	Equipment	Calibration Due date
425	DMM	5/13/2022
NA	Scale	
NA	Check weight	

Write sample number on each sample.

INSPECTION PIC(S) INITIALS:

Samples for 25°C Testing

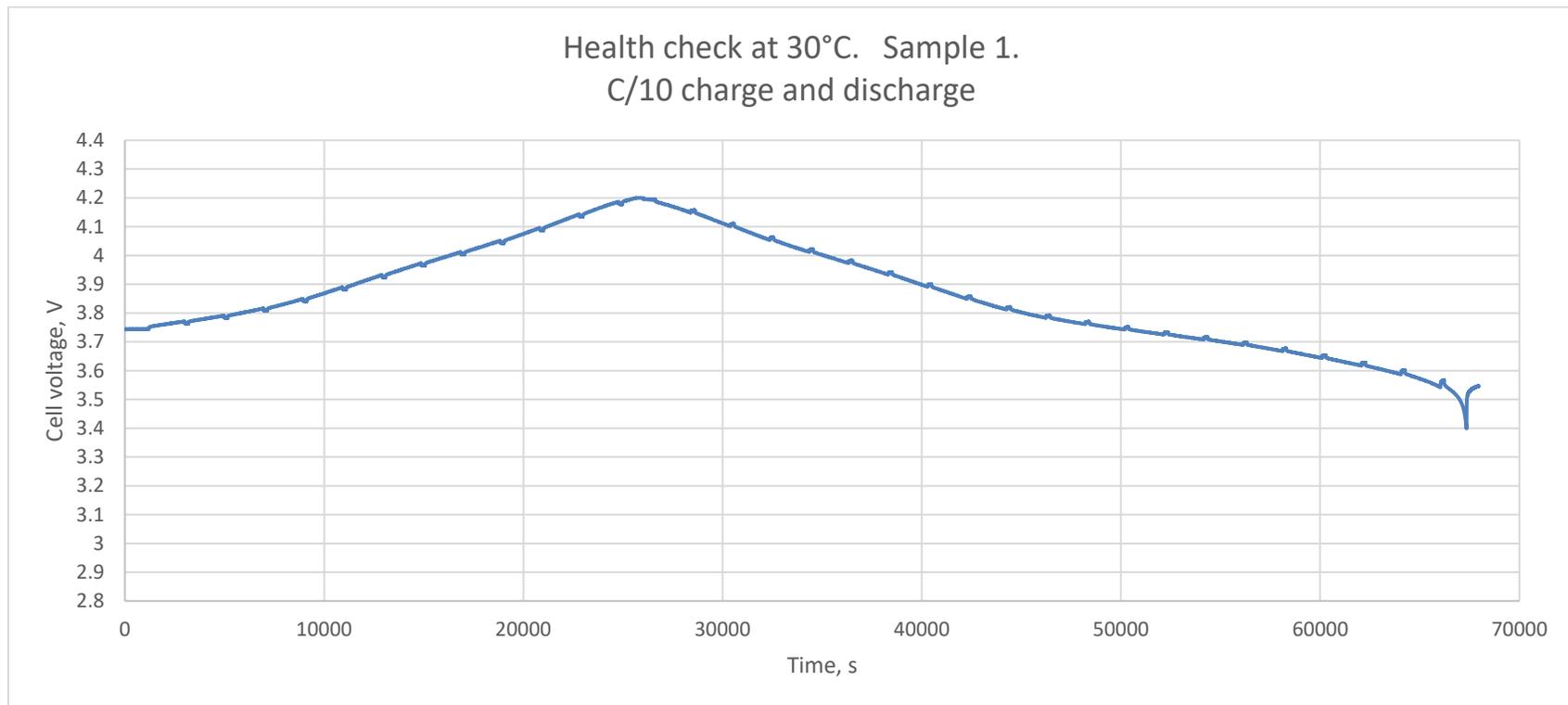
MPS Sample ID	Cust #	Fixture Markings	Cells Markings	Visual Inspection	OCV as-received	Date	Comments and/or other notable markings	Initials
1	QSC006AH-PS00-04			*	3.744	7/20/2021	All Samples received in aluminum clamps	ES, HP
2	QSC006AG-PS00-06			*	3.744	7/20/2021	All Samples received in aluminum clamps	ES, HP
3	QSC006AE-PS00-09			*	3.744	7/20/2021	All Samples received in aluminum clamps	ES, HP

Notes:

* All samples received in good condition

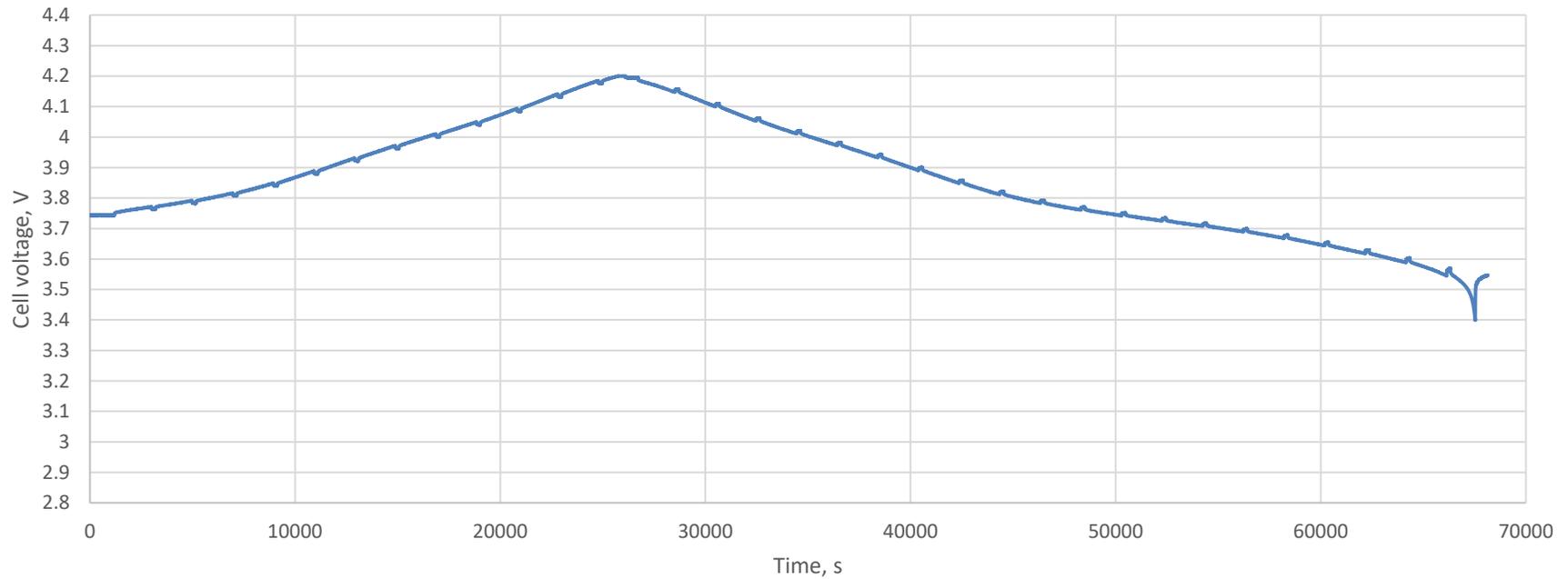
Health Check at 30°C

- Samples were placed in a chamber and the temperature was set to 30°C.
- A Post-shipping data check from 3.4-4.2V; CC/CV (C/10 charge and discharge with intermittent rests) was run.

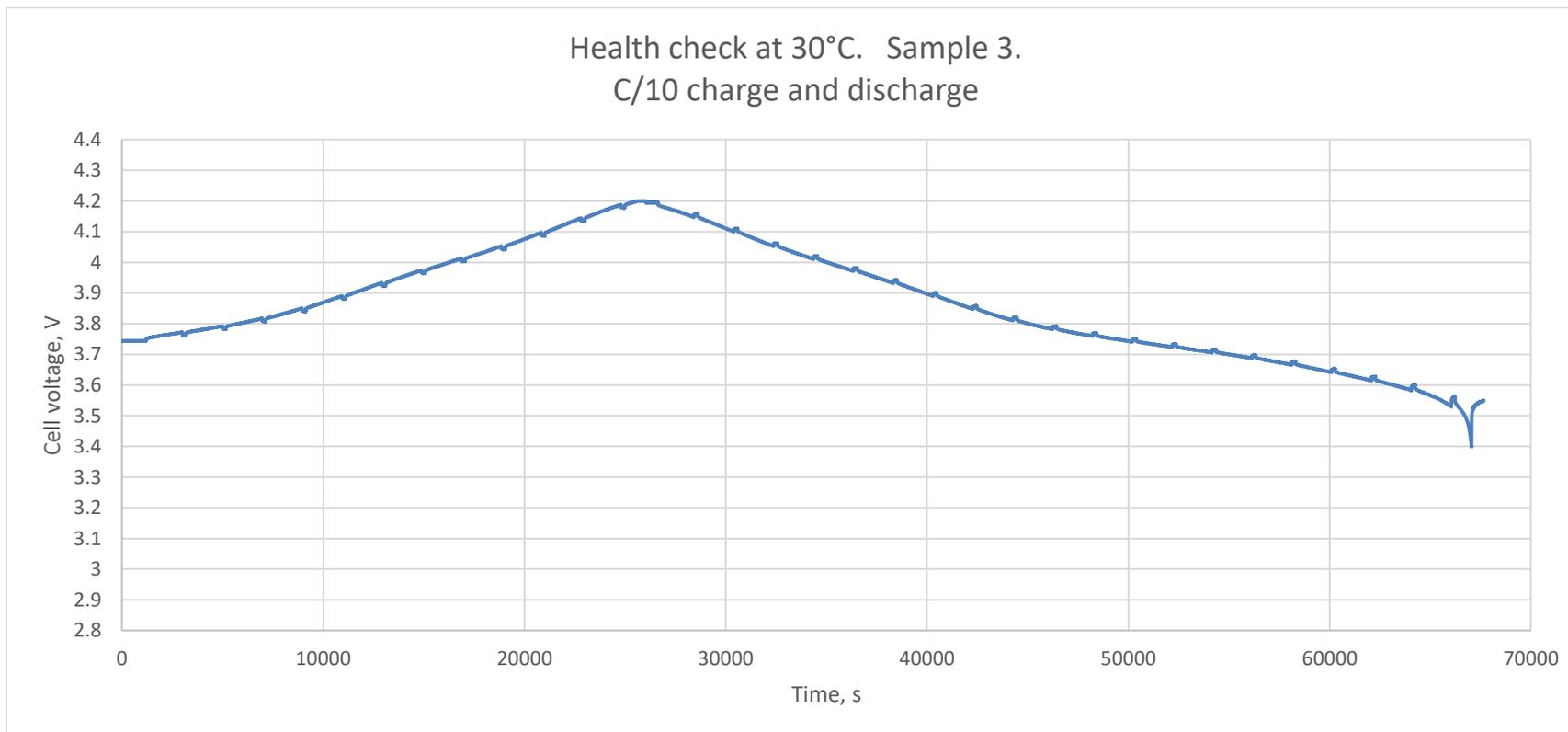


Prepared for: QuantumScope	Page 5 of 15	Report date 10/21/2021
Test report numbers: Q1-1695		
Prepared by: Spencer Poff, Engineering Manager		

Health check at 30°C. Sample 2.
C/10 charge and discharge



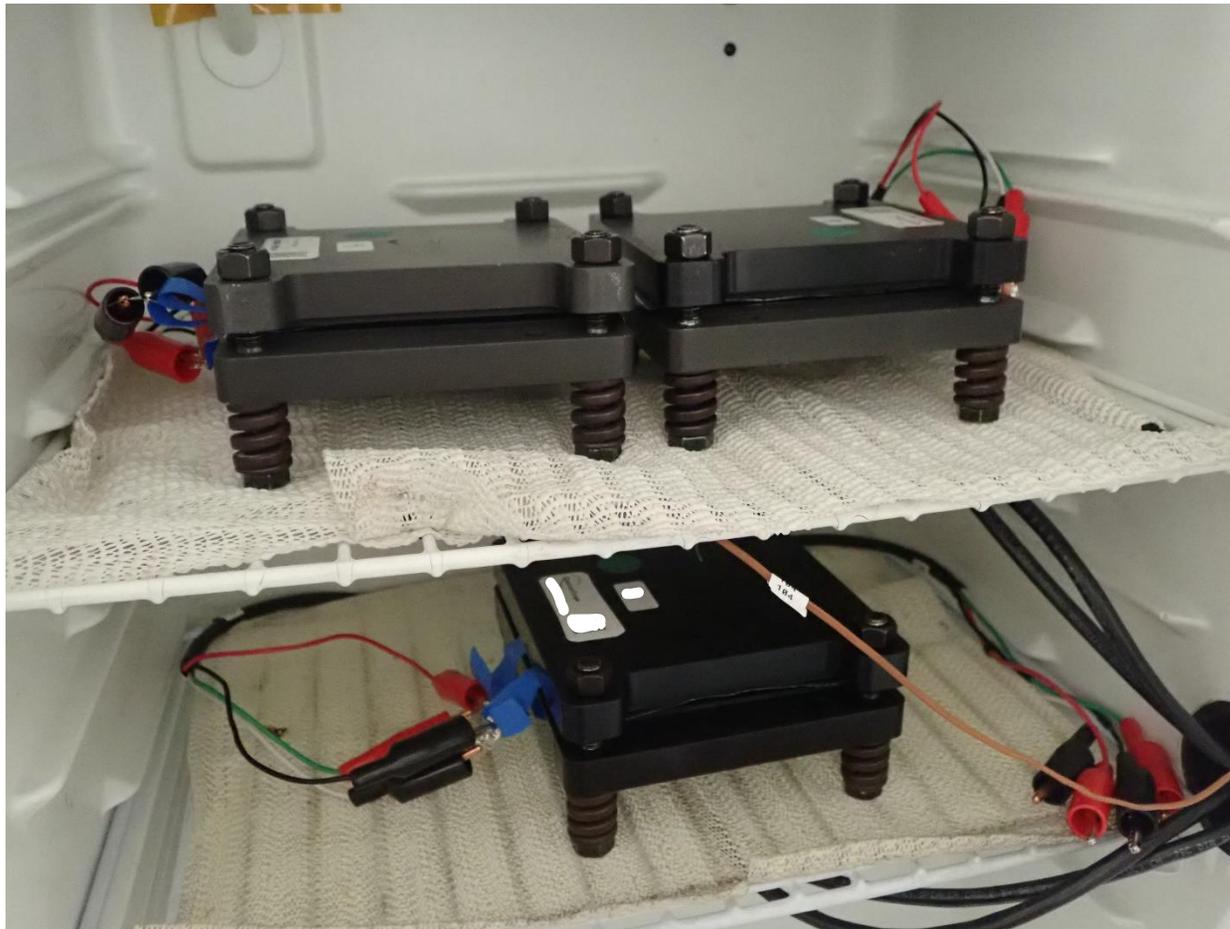
Prepared for: QuantumScape	Page 6 of 15	Report date 10/21/2021
Test report numbers: Q1-1695		
Prepared by: Spencer Poff, Engineering Manager		



Cycle Life at 25°C

Three samples were placed in an environmental chamber set to 25°C and cycled 800 times at a 1C charge/discharge rate with the following parameters:

- 3.0-4.2V; CC/CV charge with C/10 cut current or 10 minutes at CV (whichever is first).
- C/3 capacity check after every 50 cycles with DCIR pulses at multiple SOC.

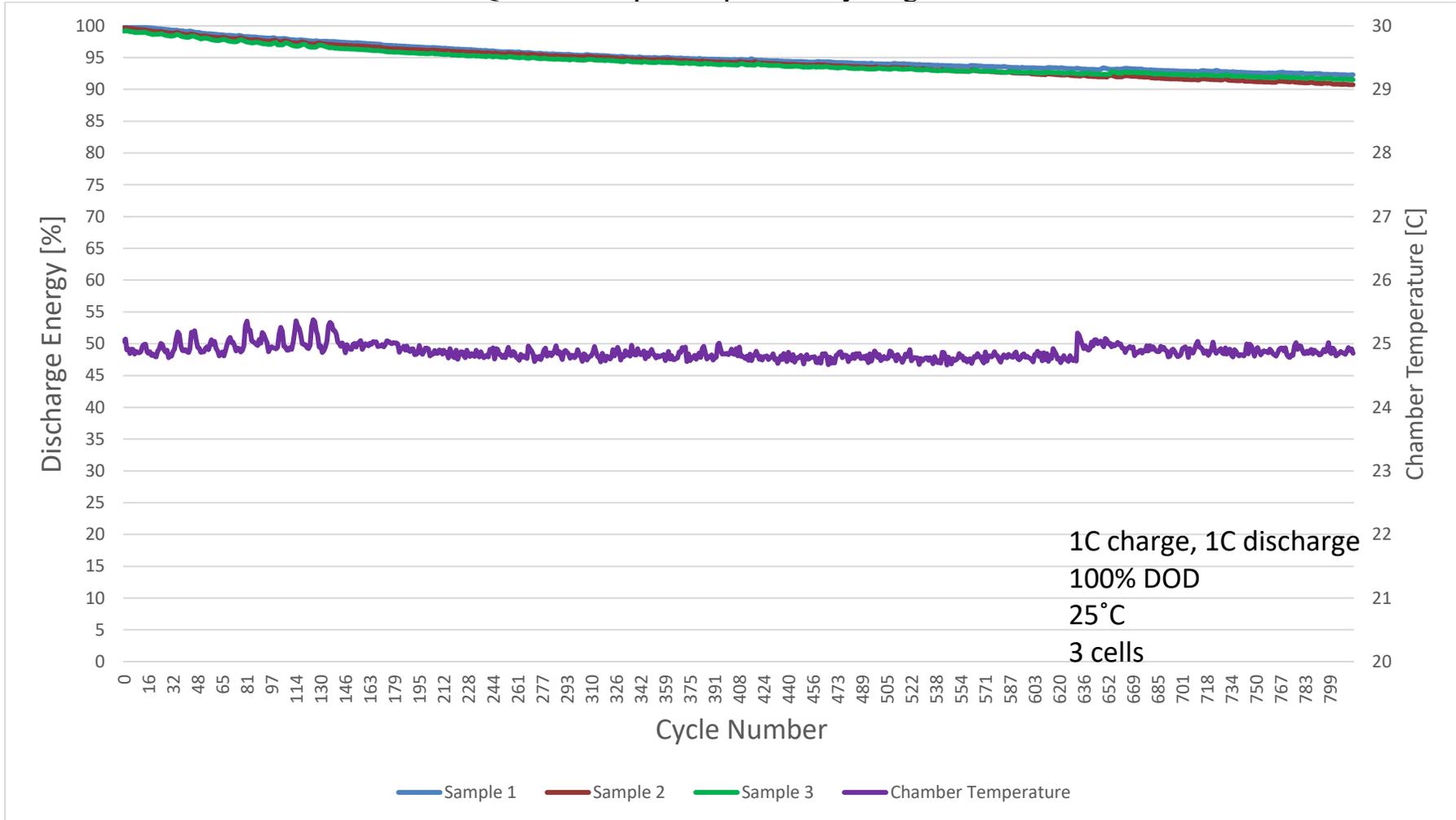


Prepared for: QuantumScape	Page 8 of 15	Report date 10/21/2021
Test report numbers: Q1-1695		
Prepared by: Spencer Poff, Engineering Manager		



Prepared for: QuantumScape	Page 9 of 15	Report date 10/21/2021
Test report numbers: Q1-1695		
Prepared by: Spencer Poff, Engineering Manager		

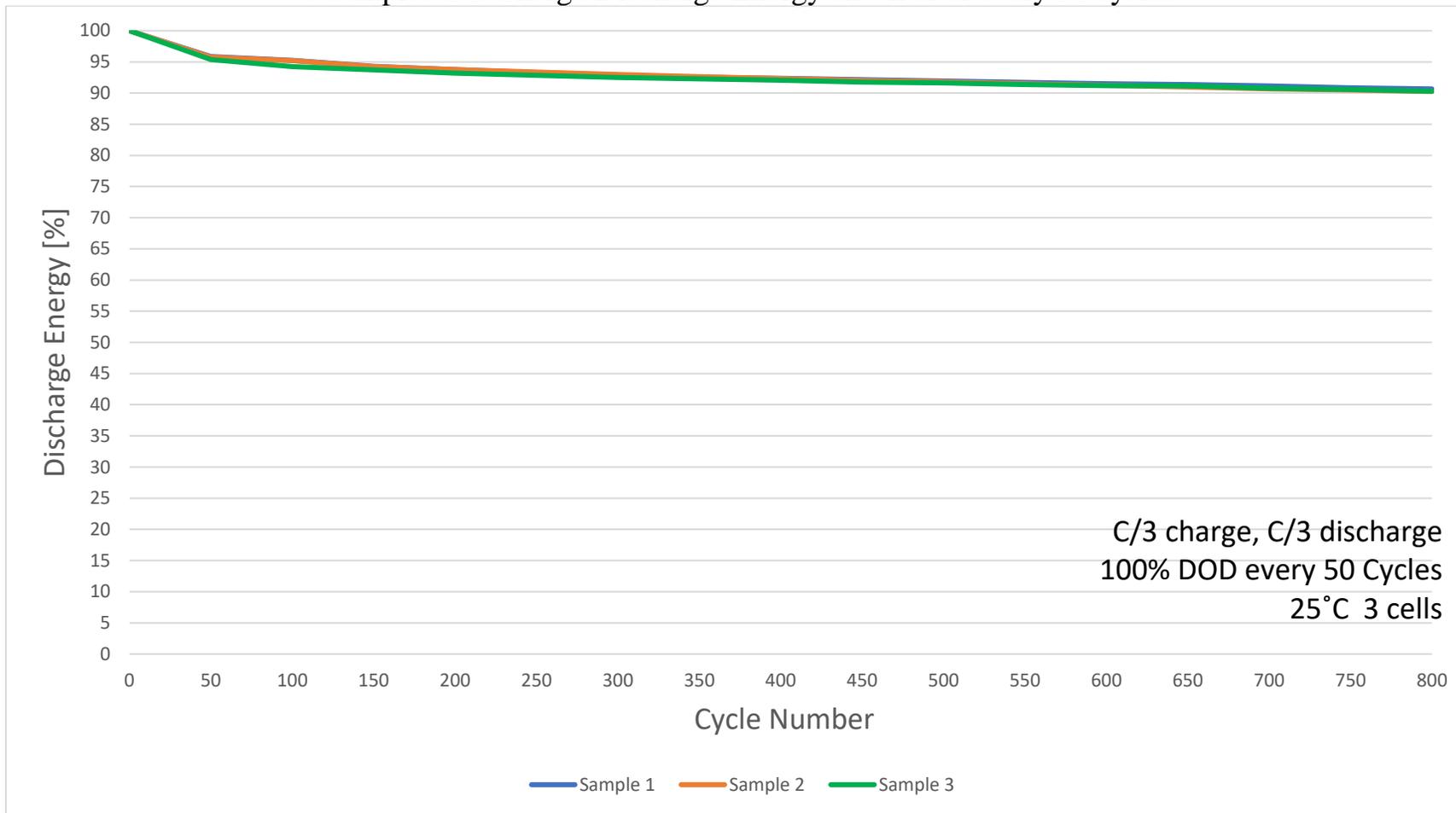
3 QuantumScape Samples 1C Cycling at 25°C



Cell configuration as provided by manufacturer

Cathode thickness	Current Density	Anode	Area	Pressure	Layers
3.1 mAh/cm ²	3.1 mA/cm ²	Anode-free Li metal	70x85mm	~3.4 atm	1

3 Samples C/3 Charge/Discharge Energy check after every 50 cycles

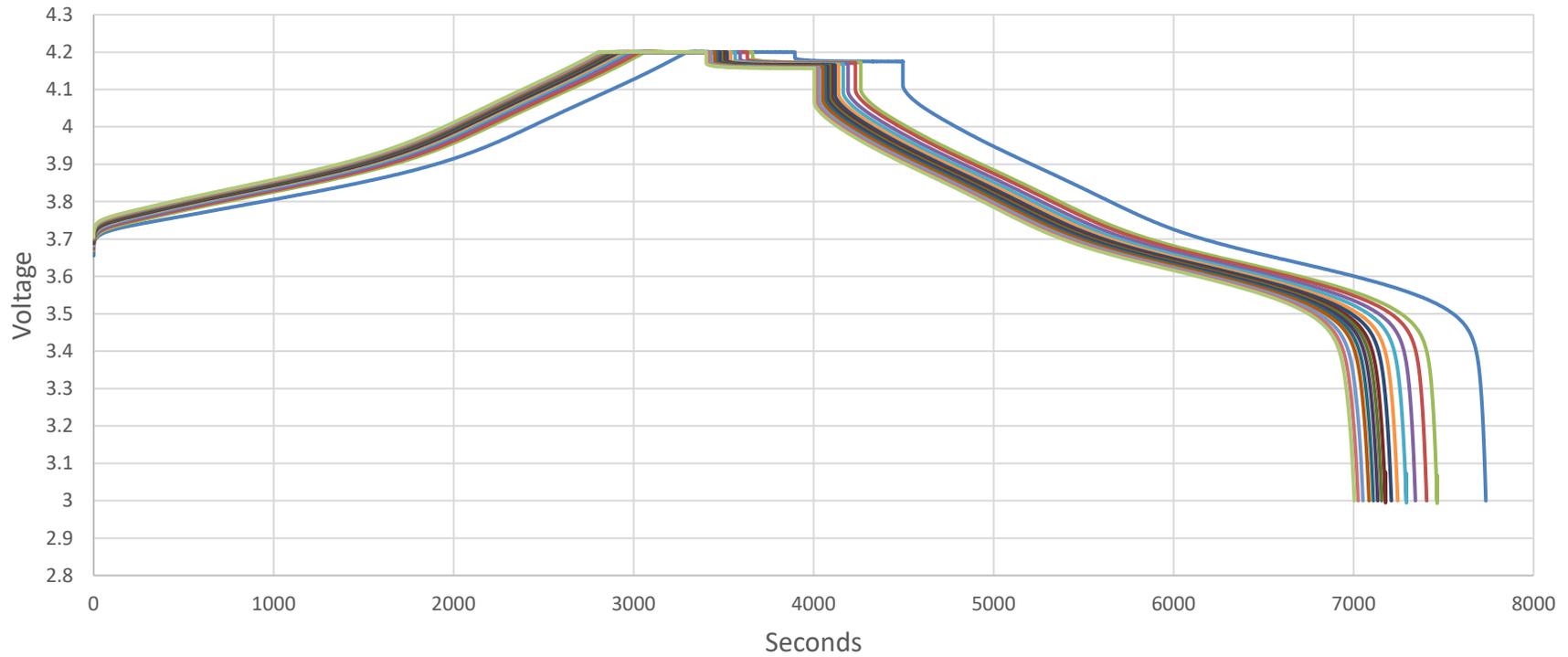


Cell configuration as provided by manufacturer

Cathode thickness	Current Density	Anode	Area	Pressure	Layers
3.1 mAh/cm ²	3.1 mA/cm ²	Anode-free Li metal	70x85mm	~3.4 atm	1

Prepared for: QuantumScape	Page 11 of 15	Report date 10/21/2021
Test report numbers: Q1-1695		
Prepared by: Spencer Poff, Engineering Manager		

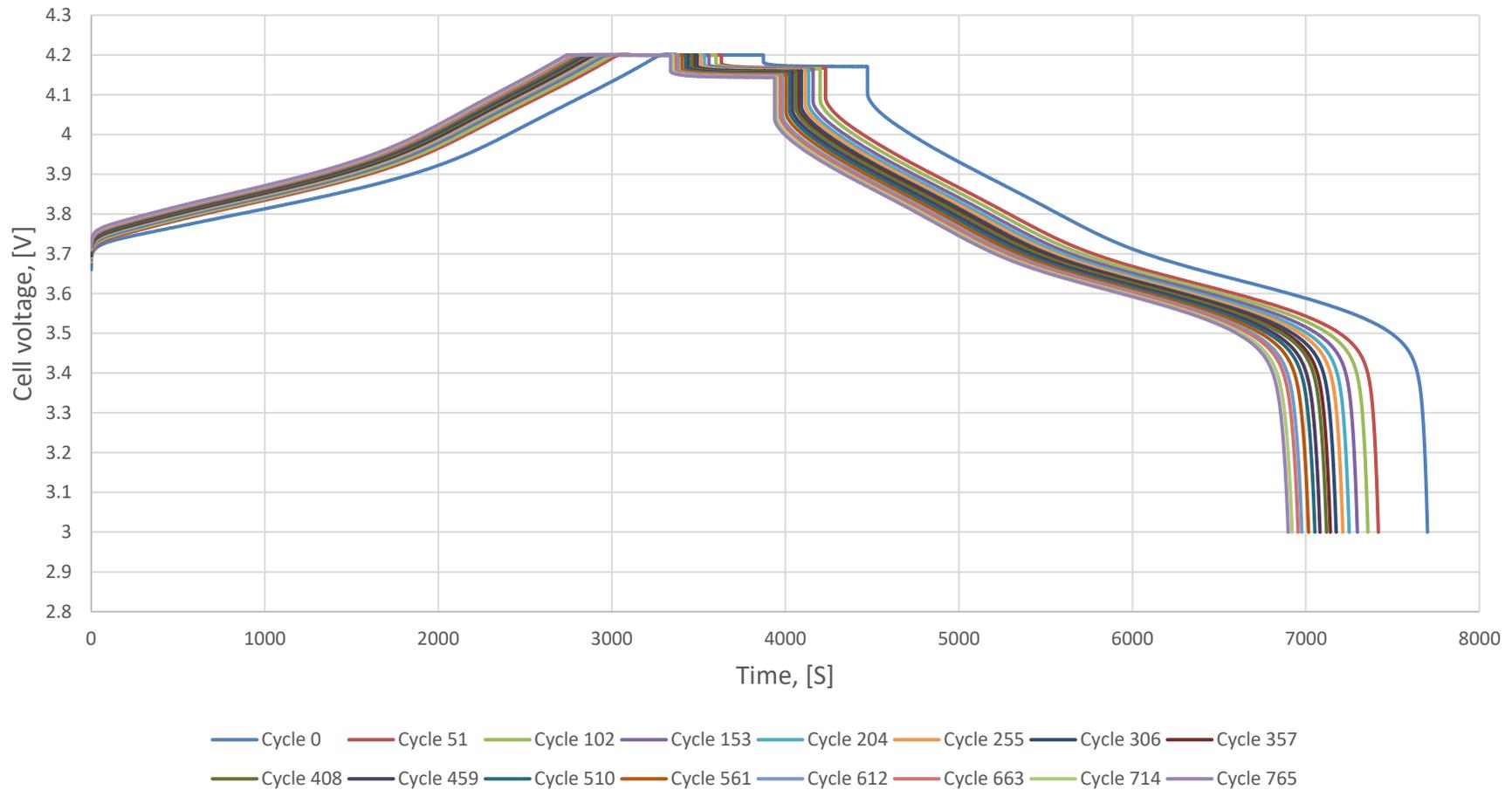
Sample 1 1C Voltage vs Cycle Time



- Voltage, Cycle 0 Voltage, Cycle 51 Voltage, Cycle 102 Voltage, Cycle 153 Voltage, Cycle 204
- Voltage, Cycle 255 Voltage, Cycle 306 Voltage, Cycle 357 Voltage, Cycle 408 Voltage, Cycle 459
- Voltage, Cycle 510 Voltage, Cycle 561 Voltage, Cycle 663 Voltage, Cycle 714 Voltage, Cycle 765

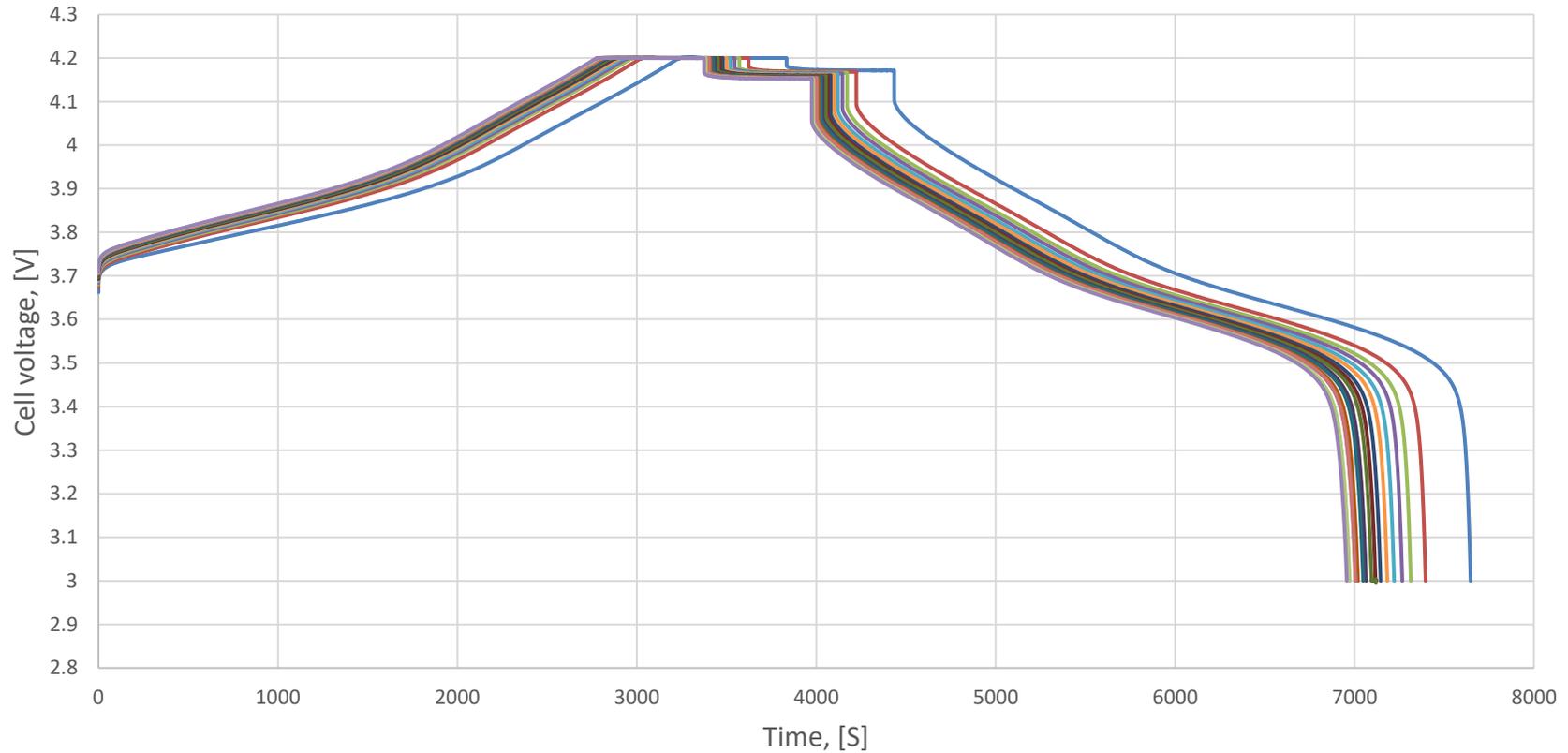
Prepared for: QuantumScape	Page 12 of 15	Report date 10/21/2021
Test report numbers: Q1-1695		
Prepared by: Spencer Poff, Engineering Manager		

Sample 2 1C Voltage vs Cycle Time



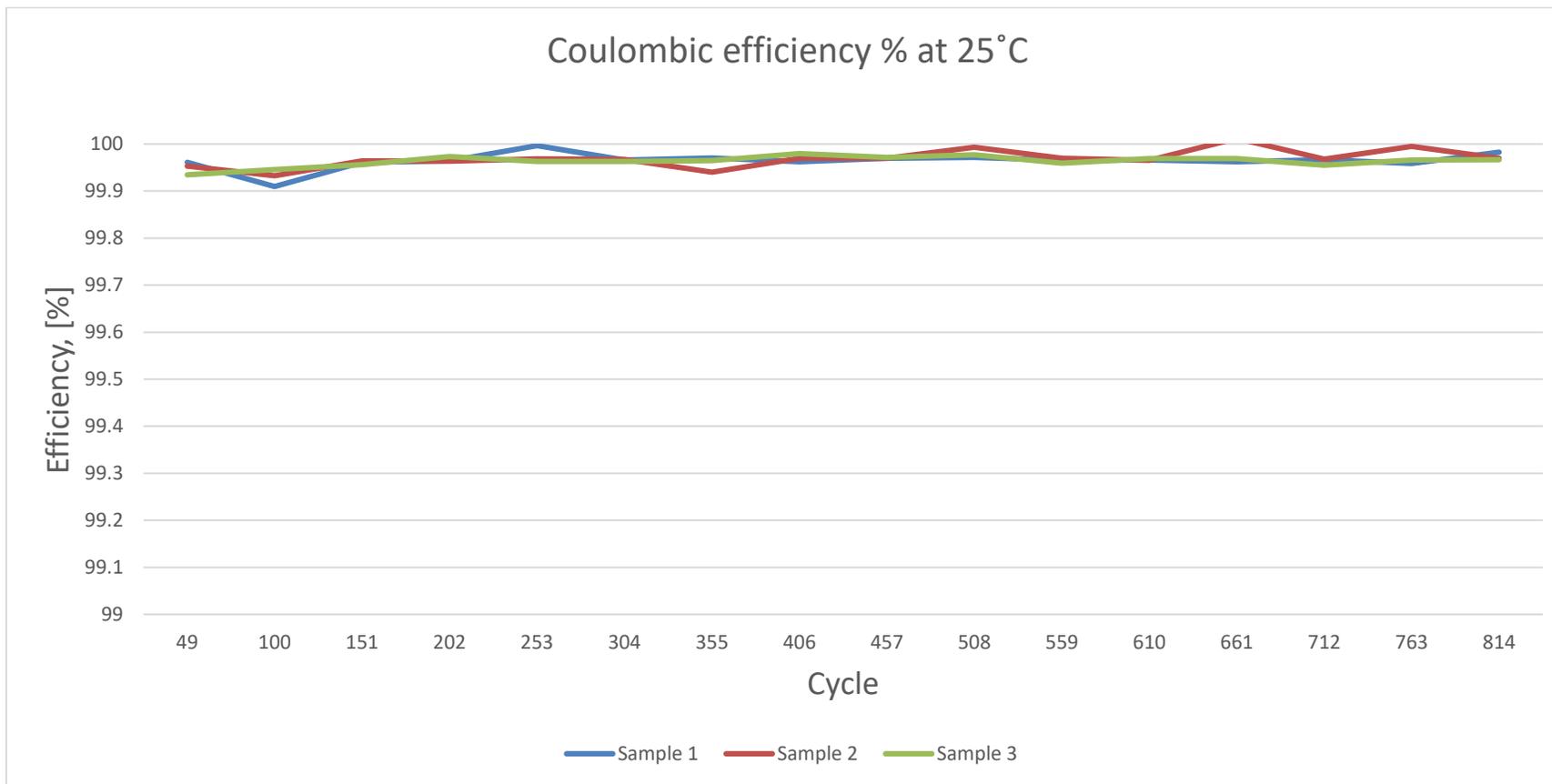
Prepared for: QuantumScape	Page 13 of 15	Report date 10/21/2021
Test report numbers: Q1-1695		
Prepared by: Spencer Poff, Engineering Manager		

Sample 3 1C Voltage vs Cycle Time



- Cycle 0
- Cycle 51
- Cycle 102
- Cycle 153
- Cycle 204
- Cycle 255
- Cycle 306
- Cycle 357
- Cycle 408
- Cycle 459
- Cycle 510
- Cycle 561
- Cycle 612
- Cycle 663
- Cycle 714
- Cycle 765

Prepared for: QuantumScape	Page 14 of 15	Report date 10/21/2021
Test report numbers: Q1-1695		
Prepared by: Spencer Poff, Engineering Manager		



Coulombic efficiency of each cell was evaluated at approximately 50 cycle intervals.

The cells were charged at a 1C rate, and the charge amp-hours were recorded. Next, the cells rested 10 minutes, then discharged at 1C rate to 3.0 volts. Discharge amp-hours were recorded. Coulombic efficiency for each point was determined by the formula: (discharge capacity / charge capacity) X 100.

(End of report)

Prepared for: QuantumScape	Page 15 of 15	Report date 10/21/2021
Test report numbers: Q1-1695		
Prepared by: Spencer Poff, Engineering Manager		