



DOUBLE SUGAR SHOT
BATTERY CHARACTERIZATION UNDER VACUUM
“AAA” LITHIUM BATTERIES TEST

REV. 2011/12/29

1. Introduction

Following the Battery Characterization under Vacuum Test Plan three AAA lithium batteries will be connected in series and subjected to various simulated electrical loads and a vacuum of at least 29 inches for one minute and then returned to ambient pressure. A fresh set of batteries will be used for each electrical load tested. Each test will then be repeated with no vacuum applied to compare the results.

2. Equipment

AAA Energizer Lithium Batteries



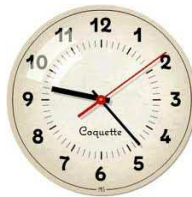
Vacuum Chamber



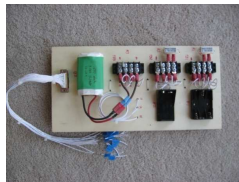
Multi-Meters



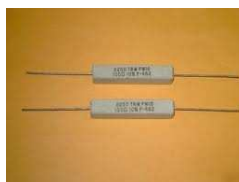
Clock



Test Bed



Simulated Electrical Loads



3. Procedure

With both multi-meters off and the switch in the “current loop” off the batteries will be placed in the battery holder and the simulated electrical load will be installed. The test bed will be slid into the vacuum chamber and the chamber will be sealed. When testing is ready to begin the multi-meters will be turned on, the vacuum pump will be activated, and the switch in the “current loop” turned on. At this point the voltage, current, and vacuum will be documented and clock started. Readings were taken in one minute intervals. Each simulated load will be tested with a vacuum and with out vacuum in the same manner.

4. Test Performance

"AAA" Battery test with 100 ohm load				
Time (minutes)	Voltage	Current (amperage)	Vacuum (inches)	Power (W)
0	4.45	0.05	1	0.22
1	4.43	0.05	28	0.22
2	4.43	0.05	28.75	0.22
3	4.43	0.05	29	0.22
4	4.43	0.05	29	0.22
5	4.43	0.05	29	0.22
6	4.43	0.05	29	0.22
7	4.43	0.05	29	0.22
8	4.43	0.05	29	0.22
9	4.43	0.05	14	0.22
10	4.43	0.05	1	0.22

"AAA" Battery test with 100 ohm load NO VACUUM				
Time (minutes)	Voltage	Current (amperage)	Vacuum (inches)	Power (W)
0	4.41	0.05	0	0.22
1	4.40	0.05	0	0.22
2	4.40	0.05	0	0.22
3	4.40	0.05	0	0.22
4	4.40	0.05	0	0.22
5	4.40	0.05	0	0.22
6	4.40	0.05	0	0.22
7	4.40	0.05	0	0.22
8	4.40	0.05	0	0.22
9	4.40	0.05	0	0.22
10	4.40	0.05	0	0.22

"AAA" Battery test with 33 ohm load				
Time (minutes)	Voltage	Current (amperage)	Vacuum (inches)	Power (W)
0	4.29	0.13	1	0.56
1	4.27	0.13	28	0.56
2	4.26	0.13	29	0.55
3	4.26	0.13	29.25	0.55
4	4.26	0.13	29.25	0.55
5	4.26	0.13	29.25	0.55
6	4.26	0.13	29.25	0.55
7	4.26	0.13	29.25	0.55
8	4.26	0.13	29.25	0.55
9	4.26	0.13	12	0.55
10	4.25	0.13	1	0.55

"AAA" Battery test with 33 ohm load NO VACUUM				
Time (minutes)	Voltage	Current (amperage)	Vacuum (inches)	Power (W)
0	4.20	0.13	0	0.55
1	4.20	0.13	0	0.55
2	4.20	0.12	0	0.50
3	4.20	0.13	0	0.55
4	4.20	0.13	0	0.55
5	4.20	0.13	0	0.55
6	4.20	0.13	0	0.55
7	4.20	0.12	0	0.50
8	4.20	0.13	0	0.55
9	4.20	0.13	0	0.55
10	4.20	0.12	0	0.50

"AAA" Battery test with 10 ohm load				
Time (minutes)	Voltage	Current (amperage)	Vacuum (inches)	Power (W)
0	3.85	0.36	1	1.39
1	3.83	0.36	27.75	1.38
2	3.83	0.36	28.75	1.38
3	3.82	0.36	28.75	1.38
4	3.83	0.36	28.75	1.38
5	3.83	0.36	28.75	1.38
6	3.83	0.36	28.75	1.38
7	3.83	0.36	28.75	1.38
8	3.83	0.36	28.75	1.38
9	3.83	0.36	14	1.38
10	3.83	0.36	1	1.38

"AAA" Battery test with 10 ohm load NO VACUUM				
Time (minutes)	Voltage	Current (amperage)	Vacuum (inches)	Power (W)
0	3.81	0.36	0	1.37
1	3.82	0.36	0	1.38
2	3.81	0.36	0	1.37
3	3.79	0.36	0	1.36
4	3.79	0.36	0	1.36
5	3.78	0.36	0	1.36
6	3.79	0.36	0	1.36
7	3.79	0.36	0	1.36
8	3.79	0.36	0	1.36
9	3.79	0.36	0	1.36
10	3.79	0.36	0	1.36

5. Results

The Energizer AAA lithium batteries provided consistent current and voltage throughout each of the load tests between vacuum and no vacuum. No physical changes to the batteries were experienced in tests above but with the 10 ohm load they were noticeably warmer to the touch under vacuum and with no vacuum.

- a. In the [Battery Characterization under Vacuum Test Plan](#) it was recommended to not use the 1.2 ohm load however I did try this and found a great deal of change in current and voltage as compared to the other tests. The batteries also became very hot and some of the wrapper on one battery changed color and began to peel back. No further tests with this load were conducted as it was considered to be unrealistically severe.

