



DOUBLE SUGAR SHOT  
BATTERY CHARACTERIZATION UNDER VACUUM  
9 VOLT BATTERIES TEST

REV. 2011/12/29

## 1. Introduction

Following the Battery Characterization under Vacuum Test Plan one 9 volt battery will be 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 battery will be used for each electrical load tested. Each test will then be repeated with no vacuum applied to compare the results.

## 2. Equipment

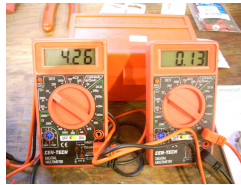
9 Volt Energizer Battery



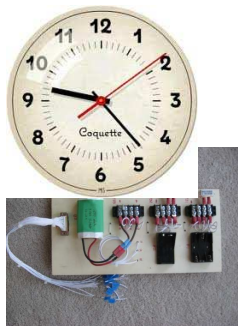
Vacuum Chamber



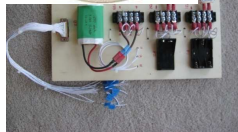
Multi-Meters



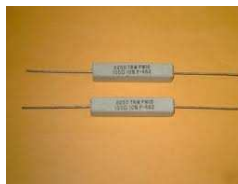
Clock



Test Bed



Simulated Electrical Loads



### 3. Procedure

With both multi-meters off and the switch in the “current loop” off the battery 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 30 second intervals. Each simulated load will be tested with a vacuum and with out vacuum in the same manner.

### 4. Test Performance

"9V" Battery test with 100 ohm load				
Time (minutes)	Voltage	Current (amperage)	Vacuum (inches)	Power (W)
0	9.03	0.09	1	0.81
0.5	8.88	0.09	10	0.80
1	8.82	0.09	23	0.79
1.5	8.77	0.09	27	0.79
2	8.73	0.09	29	0.79
2.5	8.7	0.09	29	0.78
3	8.68	0.09	29	0.78
3.5	8.65	0.09	20	0.78
4	8.62	0.09	14	0.78
4.5	8.61	0.09	7	0.77
5	8.59	0.09	1	0.77

"9V" Battery test with 100 ohm load NO VACUUM				
Time (minutes)	Voltage	Current (amperage)	Vacuum (inches)	Power (W)
0	9.33	0.09	0	0.84
0.5	9.11	0.09	0	0.82
1	9.04	0.09	0	0.81
1.5	8.98	0.09	0	0.81
2	8.93	0.09	0	0.80
2.5	8.89	0.09	0	0.80
3	8.86	0.09	0	0.80
3.5	8.83	0.09	0	0.79
4	8.8	0.09	0	0.79
4.5	8.78	0.09	0	0.79
5	8.75	0.09	0	0.79

"9V" Battery test with 33 ohm load				
Time (minutes)	Voltage	Current (amperage)	Vacuum (inches)	Power (W)
0	9.48	0.26	1	2.46
0.5	8.54	0.25	16	2.14
1	8.39	0.25	25	2.10
1.5	8.3	0.24	28	1.99
2	8.21	0.24	28.5	1.97
2.5	8.16	0.24	29	1.96
3	8.11	0.24	29	1.95
3.5	8.06	0.24	29	1.93
4	8	0.24	22	1.92
4.5	7.95	0.24	15	1.91
5	7.92	0.24	10	1.90
5.5	7.88	0.23	1	1.8124

"9V" Battery test with 33 ohm load NO VACUUM				
Time (minutes)	Voltage	Current (amperage)	Vacuum (inches)	Power (W)
0	8.4	0.25	0	2.10
0.5	8.32	0.24	0	2.00
1	8.25	0.24	0	1.98
1.5	8.19	0.24	0	1.97
2	8.11	0.24	0	1.95
2.5	8.06	0.24	0	1.93
3	8.01	0.23	0	1.84
3.5	7.97	0.23	0	1.83
4	7.93	0.23	0	1.82
4.5	7.89	0.23	0	1.81
5	7.85	0.23	0	1.81

## 5. Results

### a. 100 ohm load

As shown above the Energizer 9 volt batteries provided consistent current on the 100 ohm load test under vacuum and at ambient pressure. The voltage however did drop during both tests a loss of .44 volts while under vacuum and a loss of .58 volts at ambient pressure. The rate at which voltage loss occurred was also similar in both tests. No physical changes to the battery occurred during this test.

### b. 33 ohm load

During this test the current dropped by .03 amps under vacuum and .02 amps at ambient pressure and voltage as well with loss of 1.6 volts under vacuum and .55 volts at ambient. The majority of the voltage loss while under vacuum came in the first 30 seconds and was .98 volts. This was most likely due to me recording the starting voltage a split second later on the ambient pressure test than the test under vacuum. As with the 100 ohm load voltage drop and current were very similar between vacuum and ambient pressure. And

performance was similar between the 100 ohm load and 33 ohm load. No physical changes to the battery occurred during this test.

c. 10 ohm load

Prior to receiving the chart with the recommended loads for each battery outlined in the battery characterization under vacuum report I had ran the tests with the 9V batteries using the 10 ohm load. Do to this load being outside of the batteries normal operating range the batteries predictably performed badly and since this load was out of scope no further testing will be done.