

PERFORMANCE TEST REPORT SUMMARY

- APPARATUS : Lithium primary battery(Li/SOCL2)
- VOLTAGE RATINGS : 3.65V
- APPLIED STANDARD : IEC62281(Edition 4.0)/UN 38.3 6th Edition
- TYPE OF BATTERY : LITHIUM METAL BATTERY
- MASS : 8.8g
- LITHIUM METAL CONTENT PER CELL : 0.30g
- PHYSICAL DESCRIPTION OF CELL(BATTERY) : CYLINDRICAL BATTERY
- MODLE NAME : SB-AA02
- MANUFACTURER INFO.:Name of the company : VITZROCELL
 ADDRESS : 70, Indusparkro, Hapdeok-eup, Dangjin-si, Chung-Nam, S.KOREA
 TEL : 82 02 2024 3244,
 Web : www.vitzrocell.com / Email : overseas@vitzrocell.com
- DATE OF TESTS : July 3st. 2015 ~ July 18th. 2015
- DATE OF ISSUE :November 20th. 2019
- TEST HOUSE : VITZROCELL RELIABILITY TEST CENTER (Address,Tel, Web, Email are the same with Manufacturer Info)
- TEST SUMMARY : VITZROCELL Batteries have been successfully tested and comply with UN model Regulation UN Manual of Tests and Criteria, PartIII Subsection 38.3(6th EDTION)

List of Tests Conducted	Result
38.3.4.1 T1 Altitude simulation	Pass
38.3.4.1 T2 Thermal	Pass
38.3.4.3 T3 Vibration	Pass
38.3.4.4 T4 Shock	Pass
38.3.4.5 T5 External short	Pass
38.3.4.6 T6 Impact	Pass
38.3.4.7 T7 Overcharge	N.A.
38.3.4.8 T8 Forced discharge	Pass

- Tests T1 through T5 shall be conducted in sequence on the same cell or battery
- * T7 is evaluates the ability of a rechargeable battery to withstand overcharge



Approved

S.I Jung

(quality department chef)

Verified

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(testcenter management)

Prepared

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Vitzrocell Reliability Test Center

List of the tests

Description of tests	Test circuit	Sheet NO.
Altitude simulation test	–	4/9
Thermal test	–	5/9
Vibration test	–	6/9
Shock test	–	7/9
External short test	–	8/9
Impact test	–	9/9
Forced discharge test	–	9/9

1. Altitude simulation test

Specimen No.	State of charge	Test procedure & requirement	Voltage and weight of cells Before and after test				Result	Photo
			Voltage (V)		Weight (g)			
			Before	After	Before	After		
#01	Un-Discharged Cells	[Test Procedure] Test cells were stored at a pressure of 11.6kPa for 6hours at ambient temperature (20±5℃) [Requirement] -NM / NL / NV / NC / NE / NR / NF -Open circuit voltage of the test cell after test : not less than 90% of its voltage prior to this test	3.664	3.664	8.62	8.62	* NM NL NV NC NE NR NF (PASS)	Ph.01
#02			3.695	3.695	8.67	8.67		Ph.01
#03			3.666	3.666	8.66	8.66		Ph.01
#04			3.670	3.670	8.66	8.66		Ph.01
#05			3.668	3.668	8.67	8.67		Ph.01
#06			3.664	3.664	8.70	8.70		Ph.01
#07			3.664	3.664	8.68	8.68		Ph.01
#08			3.670	3.670	8.66	8.66		Ph.01
#09			3.667	3.667	8.65	8.65		Ph.01
#10			3.665	3.665	8.64	8.64		Ph.01
#11	Fully Discharged Cells	[Test Procedure] Test cells were stored at a pressure of 11.6kPa for 6hours at ambient temperature (20±5℃) [Requirement] -NM / NL / NV / NC / NE / NR / NF	-	-	8.63	8.63	* NM NL NV NC NE NR NF (PASS)	Ph.02
#12			-	-	8.70	8.70		Ph.02
#13			-	-	8.62	8.62		Ph.02
#14			-	-	8.61	8.61		Ph.02
#15			-	-	8.63	8.63		Ph.02
#16			-	-	8.69	8.69		Ph.02
#17			-	-	8.65	8.65		Ph.02
#18			-	-	8.66	8.66		Ph.02
#19			-	-	8.64	8.64		Ph.02
#20			-	-	8.64	8.64		Ph.02

* NM : No Mass Loss, NL : No Leakage, NV : No Venting, NC : No short-circuit
 NE : No explosion, NR : No Rupture, NF : No Fire

2. Thermal test

Speci- men No.	State of charge	Test procedure & requirement	Voltage and weight of cells Before and after test				Result	Photo
			Voltage (V)		Weight (g)			
			Before	After	Before	After		
#01	Un- Discharged Cells	[Test Procedure] Test cells were stored for 6hours at 75±2℃, followed by storage for 6hours at -40 ±2℃. The maximum time interval between test temperature extreme was 30minutes. This procedure was repeated 10times, after which all test cells were stored for 24hours at ambient temperature (20±5℃) [Requirement] - NM / NL / NV / NC / NE / NR / NF - Open circuit voltage of the test cell after test : not less than 90% of its voltage prior to this test	3.664	3.664	8.62	8.62	* NM NL NV NC NE NR NF (PASS)	Ph.03
#02			3.695	3.695	8.67	8.67		Ph.03
#03			3.666	3.666	8.66	8.66		Ph.03
#04			3.670	3.670	8.66	8.66		Ph.03
#05			3.668	3.668	8.67	8.67		Ph.03
#06			3.664	3.664	8.70	8.70		Ph.03
#07			3.664	3.664	8.68	8.68		Ph.03
#08			3.670	3.670	8.66	8.66		Ph.03
#09			3.667	3.667	8.65	8.65		Ph.03
#10			3.665	3.665	8.64	8.64		Ph.03
#11	Fully Discharged Cells	[Test Procedure] Test cells were stored for 6hours at 75±2℃, followed by storage for 6hours at -40 ±2℃. The maximum time interval between test temperature extreme was 30minutes. This procedure was repeated 10times, after which all test cells were stored for 24hours at ambient temperature (20±5℃) [Requirement] -NM / NL / NV / NC / NE / NR / NF	-	-	8.63	8.63	* NM NL NV NC NE NR NF (PASS)	Ph.04
#12			-	-	8.70	8.70		Ph.04
#13			-	-	8.62	8.62		Ph.04
#14			-	-	8.61	8.61		Ph.04
#15			-	-	8.63	8.63		Ph.04
#16			-	-	8.69	8.69		Ph.04
#17			-	-	8.65	8.65		Ph.04
#18			-	-	8.66	8.66		Ph.04
#19			-	-	8.64	8.64		Ph.04
#20			-	-	8.64	8.64		Ph.04

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 NE : No explosion, NR : No Rupture, NF : No Fire

3. Vibration test

Specimen No.	State of charge	Test procedure & requirement	Voltage and weight of cells Before and after test				Result	Photo
			Voltage (V)		Weight (g)			
			Before	After	Before	After		
#01	Un-Discharged Cells	[Test Procedure] Cells were firmly secured to the platform of the vibration machine. The vibration was a sinusoidal waveform with a logarithmic sweep between 7Hz and 200Hz and back to 7Hz traversed in 15minutes. This cycle was repeated 12times for a total of 3hours for each of 3mutua-ly perpendicular mounting positions of the cells. •Frequency,Acceleration and amplitude – 7~18Hz : 1G – 18~50Hz : 1~8G(1.6mm p-p) – 50~200Hz : 8G [Requirement] – NM / NL / NV / NC / NE / NR / NF – Open circuit voltage of the test cell after test : not less than 90% of its voltage prior to this test	3.664	3.664	8.62	8.62	* NM NL NV NC NE NR NF (PASS)	Ph.05
#02			3.695	3.695	8.67	8.67		Ph.05
#03			3.666	3.666	8.66	8.66		Ph.05
#04			3.670	3.670	8.66	8.66		Ph.05
#05			3.668	3.668	8.67	8.67		Ph.05
#06			3.664	3.664	8.70	8.70		Ph.05
#07			3.664	3.664	8.68	8.68		Ph.05
#08			3.670	3.670	8.66	8.66		Ph.05
#09			3.667	3.667	8.65	8.65		Ph.05
#10			3.665	3.665	8.64	8.64		Ph.05
#11	Fully Discharged Cells	[Test Procedure] Cells were firmly secured to the platform of the vibration machine. The vibration was a sinusoidal waveform with a logarithmic sweep between 7Hz and 200Hz and back to 7Hz traversed in 15minutes. This cycle was repeated 12times for a total of 3hours for each of 3mutua-ly perpendicular mounting positions of the cells. •Frequency,Acceleration and amplitude – 7~18Hz : 1G – 18~50Hz : 1~8G(1.6mm p-p) – 50~200Hz : 8G [Requirement] – NM / NL / NV / NC / NE / NR / NF	–	–	8.63	8.63	* NM NL NV NC NE NR NF (PASS)	Ph.06
#12			–	–	8.70	8.70		Ph.06
#13			–	–	8.62	8.62		Ph.06
#14			–	–	8.61	8.61		Ph.06
#15			–	–	8.63	8.63		Ph.06
#16			–	–	8.69	8.69		Ph.06
#17			–	–	8.65	8.65		Ph.06
#18			–	–	8.66	8.66		Ph.06
#19			–	–	8.64	8.64		Ph.06
#20			–	–	8.64	8.64		Ph.06

* NM : No Mass Loss, NL : No Leakage, NV : No Venting, NC : No short-circuit

NE : No explosion, NR : No Rupture, NF : No Fire

4. Shock test

Speci- men No.	State of charge	Test procedure & requirement	Voltage and weight of cells Before and after test				Result	Photo
			Voltage (V)		Weight (g)			
			Before	After	Before	After		
#01	Un- Discharged Cells	[Test Procedure] Each test cell was subjected to a halfsine shock of peak acceleration of 150g _n and pulse duration of 6ms. Each cell was subjected to 3shocks in the positive direction followed by 3 shocks in the negative direction of 3multually perpendicular mounting positions of the cell for a total of 18 shock. [Requirement] – NM / NL / NV / NC / NE / NR / NF – Open circuit voltage of the test cell after test : not less than 90% of its voltage prior to this test	3.664	3.664	8.62	8.62	* NM NL NV NC NE NR NF (PASS)	Ph.07
#02			3.695	3.695	8.67	8.67		Ph.07
#03			3.666	3.666	8.66	8.66		Ph.07
#04			3.670	3.670	8.66	8.66		Ph.07
#05			3.668	3.668	8.67	8.67		Ph.07
#06			3.664	3.664	8.70	8.70		Ph.07
#07			3.664	3.664	8.68	8.68		Ph.07
#08			3.670	3.670	8.66	8.66		Ph.07
#09			3.667	3.667	8.65	8.65		Ph.07
#10			3.665	3.665	8.64	8.64		Ph.07
#11	Fully Discharged Cells	[Test Procedure] Each test cell was subjected to a halfsine shock of peak acceleration of 150g _n and pulse duration of 6ms. Each cell was subjected to 3shocks in the positive direction followed by 3 shocks in the negative direction of 3multually perpendicular mounting positions of the cell for a total of 18 shock. [Requirement] – NM / NL / NV / NC / NE / NR / NF	–	–	8.63	8.63	* NM NL NV NC NE NR NF (PASS)	Ph.08
#12			–	–	8.70	8.70		Ph.08
#13			–	–	8.62	8.62		Ph.08
#14			–	–	8.61	8.61		Ph.08
#15			–	–	8.63	8.63		Ph.08
#16			–	–	8.69	8.69		Ph.08
#17			–	–	8.65	8.65		Ph.08
#18			–	–	8.66	8.66		Ph.08
#19			–	–	8.64	8.64		Ph.08
#20			–	–	8.64	8.64		Ph.08

* NM : No Mass Loss, NL : No Leakage, NV : No Venting, NC : No short-circuit
NE : No explosion, NR : No Rupture, NF : No Fire

5. External short circuit test

Specimen No.	State of charge	Test procedure & requirement	Max. Temperature of during test(°C)	Result	Photo
#01	Un-Discharged Cells	[Test Procedure] Test cells were subjected to a short circuit condition with a total external resistance of less than 0.1Ω at $55\pm 2^\circ\text{C}$. The test has been continued for 1 hour after the cell external case temperature has returned to $55\pm 2^\circ\text{C}$. Test cell was observed for a further 6 hours. [Requirement] - NE / NR / NF - External temperature of the cell $\leq 170^\circ\text{C}$ (NT)	112.0	* NT NE NR NF (PASS)	Ph.09
#02			104.2		Ph.09
#03			112.8		Ph.09
#04			107.5		Ph.09
#05			89.8		Ph.09
#06			109.7		Ph.09
#07			113.5		Ph.09
#08			112.0		Ph.09
#09			113.1		Ph.09
#10			112.3		Ph.09
#11	Fully Discharged Cells	[Test Procedure] Test cells were subjected to a short circuit condition with a total external resistance of less than 0.1Ω at $55\pm 2^\circ\text{C}$. The test has been continued for 1 hour after the cell external case temperature has returned to $55\pm 2^\circ\text{C}$. Test cell was observed for a further 6 hours. [Requirement] - NE / NR / NF - External temperature of the cell $\leq 170^\circ\text{C}$ (NT)	58.0	* NT NE NR NF (PASS)	Ph.10
#12			59.1		Ph.10
#13			58.8		Ph.10
#14			60.5		Ph.10
#15			59.0		Ph.10
#16			61.2		Ph.10
#17			63.1		Ph.10
#18			57.4		Ph.10
#19			58.9		Ph.10
#20			58.4		Ph.10

* NT : No excessive temperature rise, NE : No explosion, NR : No Rupture, NF : No Fire

6. Impact test

Specimen No.	State of charge	Test procedure & requirement	Max. Temperature of during test(°C)	Result	Photo
#21	Un-Discharged Cells	[Test Procedure] A 15.8mm diameter bar was placed across the center of the fully charged cells. Then 9.1kg weight was dropped from a height of 61cm onto cells. [Requirement] - NE / NF - External temperature of the cell ≤ 170°C (NT)	40.5	* NT NE NF (PASS)	Ph.11
#22			38.1		Ph.11
#23			36.3		Ph.11
#24			37.0		Ph.11
#25			33.4		Ph.11
#26	Fully Discharged Cells	[Test Procedure] A 15.8mm diameter bar was placed across the center of the fully discharged cells. Then 9.1kg weight was dropped from a height of 61cm onto cells. [Requirement] - NE / NF - External temperature of the cell ≤ 170°C (NT)	26.4	* NT NE NF (PASS)	Ph.12
#27			27.8		Ph.12
#28			29.2		Ph.12
#29			30.5		Ph.12
#30			29.4		Ph.12

7. Forced discharge test

Specimen No.	State of charge	Test procedure & requirement	Result	Reference
#31	Fully Discharged Cells	[Test Procedure] Each cell shall be forced discharged at ambient temperature by connecting it in series with a 12V direct current power supply at an initial current equal to the maximum continuous discharge current specified by the manufacturer [Requirement] - NE / NF	* NE NF (PASS)	Ph.13/Graph1
#32				Ph.13/Graph1
#33				Ph.13/Graph1
#34				Ph.13/Graph1
#35				Ph.13/Graph1
#36				Ph.13/Graph1
#37				Ph.13/Graph1
#38				Ph.13/Graph1
#39				Ph.13/Graph1
#40				Ph.13/Graph1

* NT : No excessive temperature rise, NE : No explosion, NF : No Fire

Photographs



#01 ~ #10

Photographs of specimen before test



#01 ~ #10

Photographs of specimen after test



Photo.01 – Photographs of specimen before & after Altitude simulation test (Undischarged cells)

Photographs



#11 ~ #20

Photographs of specimen before test



#11 ~ #20

Photographs of specimen after test



Photo.02 – Photographs of specimen before & after Altitude simulation test (Fully discharged cells)

Photographs



#01 ~ #10

Photographs of specimen before test



#01 ~ #10

Photographs of specimen after test

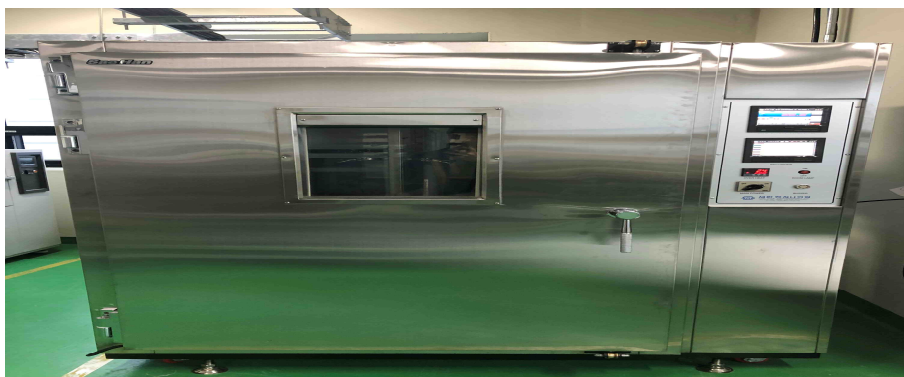


Photo.03 – Photographs of specimen before & after Thermal test (Undischarged cells)

Photographs



#11 ~ #20

Photographs of specimen before test



#11 ~ #20

Photographs of specimen after test



Photo.04 – Photographs of specimen before & after Thermal test (Fully discharged cells)

Photographs



#01 ~ #10

Photographs of specimen before test



#01 ~ #10

Photographs of specimen after test

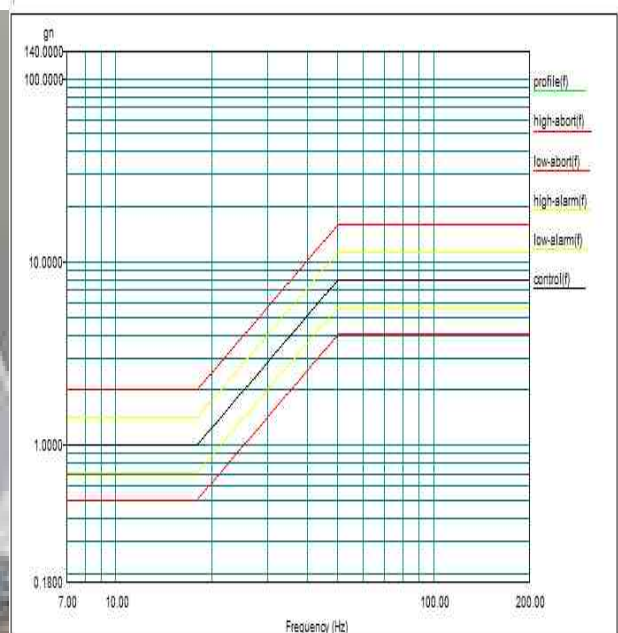


Photo.05 – Photographs of specimen before & after Vibration test (Undischarged cells)

Photographs



#11 ~ #20

Photographs of specimen before test



#11 ~ #20

Photographs of specimen after test

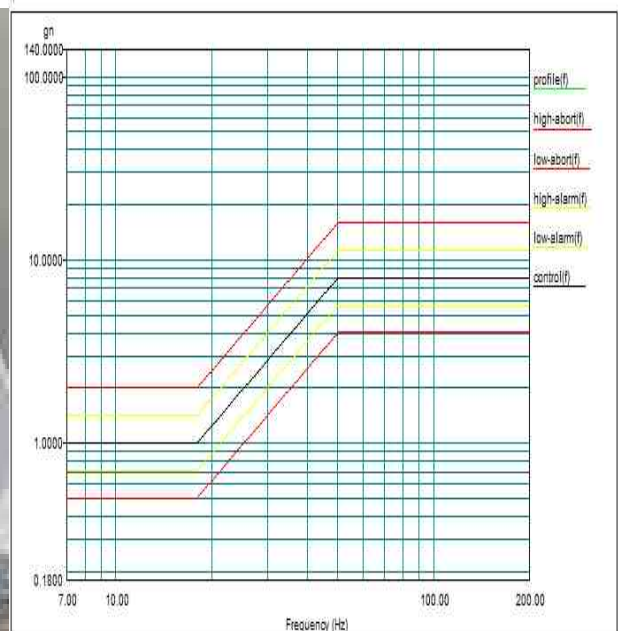


Photo.06 – Photographs of specimen before & after Vibration test (Fully discharged cells)

Photographs



#01 ~ #10

Photographs of specimen before test



#01 ~ #10

Photographs of specimen after test



Photo.07 – Photographs of specimen before & after Shock test (Undischarged cells)

Photographs



#11 ~ #20

Photographs of specimen before test



#11 ~ #20

Photographs of specimen after test



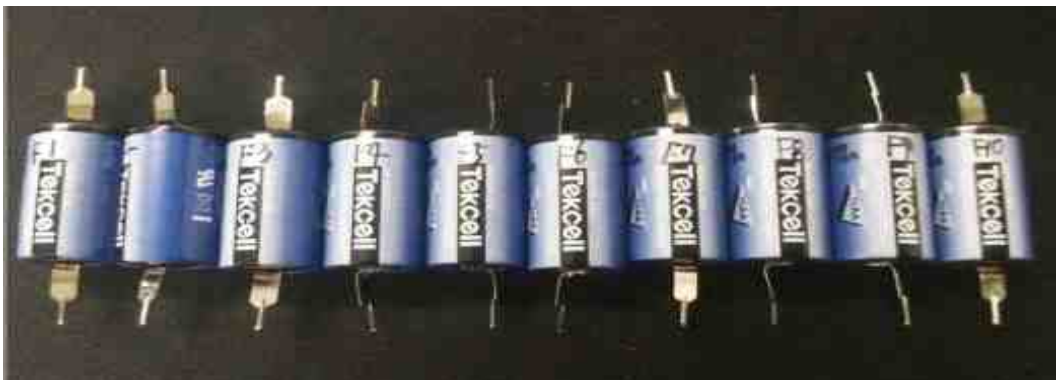
Photo.08 – Photographs of specimen before & after Shock test (Fully discharged cells)

Photographs



#01 ~ #10

Photographs of specimen before test



#01 ~ #10

Photographs of specimen after test



Photo.09 – Photographs of specimen before & after External short circuit test (Undischarged cells)

Photographs



#11 ~ #20

Photographs of specimen before test



#11 ~ #20

Photographs of specimen after test



Photo.10 – Photographs of specimen before & after External short circuit test (Fully discharged cells)

Photographs



#21 ~ #25

Photographs of specimen before test



#21 ~ #25

Photographs of specimen after test



Photo.11 – Photographs of specimen before & after Impact test (Undischarged cells)

Photographs



#26 ~ #30

Photographs of specimen before test



#26 ~ #30

Photographs of specimen after test



Photo.12 – Photographs of specimen before & after Impact test (Fully discharged cells)

Photographs



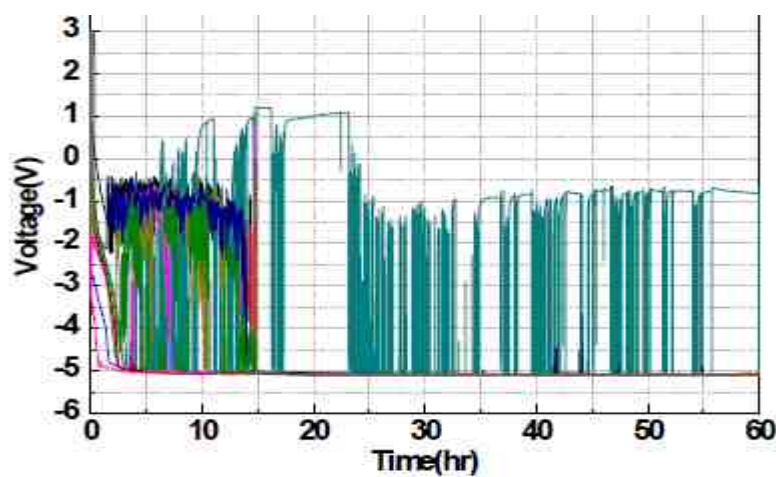
#31 ~ #40

Photographs of specimen before test



#31 ~ #40

Photographs of specimen after test



[Discharge condition : 20mA/60hours]

Photo.13 – Photographs of specimen before & after Forced discharge test (Fully discharged cells)