

UN TEST REPORT

SUPERIOR LITHIUM POLYMER CELL

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KCL255103EN1

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APPARATUS	Lithium Secondary Battery
DESIGNATION	KCL255103EN1 / KCP255103EN3
RATINGS	3.68 Vdc 103 Ah 379.0 Wh
STANDARD	UN Manual of Test and Criteria (ST/SG/AC. 10/11/Rev.7)
MANUFACTURER	Kokam Limited Company 19 GAYAGONGDAN-GIL, GAYAGOK-MYEON NONSAN-SI, CHUNGHEONGNAM-DO, KOREA 320-844
DATE OF TESTS	2021. 04. 28. ~ 2021. 05. 26.
DATE OF ISSUE	2021. 10. 12.

The following tests have been carried out in accordance with the specification of the manufacturer, based on UN Manual of Test and Criteria (ST/SG/AC. 10/11/Rev.7) (Altitude Simulation, Thermal test, Vibration, Shock, External short Circuit, Crush, Forced discharge)

The test results are presented in the record of tests along with the performance of the apparatus tested and the observations made during the tests.

Model KCL255103EN1 and KCP255103EN3 are exactly same except for model designation.

The test results apply to the specific samples tested.

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Tested: SuJin Lee



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Tested by: Su Jin Lee

Kokam Limited Company

Photographs:

Photograph. 01 – View of specimens UN 38.3 Test

RATING

Lithium Secondary Battery	
Standard	UN Manual of Test and Criteria (ST/SG/AC. 10/11/Rev.7)
Manufacturer	Kokam Limited Company
Designation	KCL255103EN1/ KCP255103EN3
Nominal Voltage	3.68 Vdc
Nominal Capacity	103.0 Ah

LIST OF TESTS

Description of Tests	No. of Pages	Note
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HISTORY OF AMENDMENTS AND MODIFICATIONS

Ref. No. ICT122-20210601-01 issued on 2021. 06. 01. (Original test report)

Ref. No. ICT122-20211012-01 issued on 2021. 10. 12. (Modification 1)

Modification 1 (From the test report ICT122-20210601-01 issued on 2021. 06. 01.)

1. Add Derivative Model name KCP255103EN3,

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T1: Altitude Simulation**Test Procedure:**

Test cells and batteries shall be stored at a pressure of 11.6 kPa or less for at least six hours at ambient temperature (20±5) °C.

Requirement:

Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire during the test and after the test and if the open circuit voltage of each test cell or battery after testing in its perpendicular mounting position is not less than 90 % of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

Condition of Cells: At first cycle, in fully charged state.

Results:

Specimen	Cell Voltage (V)		Cell Weight (g)		Verdict	Remarks
	Before the test	After the test	Before the test	After the test		
#01	4.186	4.186	1816.1	1816.1	PASS	-
#02	4.173	4.173	1814.5	1814.4	PASS	-
#03	4.173	4.173	1800.5	1800.5	PASS	-
#04	4.174	4.174	1800.7	1800.6	PASS	-
#05	4.173	4.173	1816.3	1816.3	PASS	-

Condition of Cells: At 25 cycle, in fully charged state.

Results:

Specimen	Cell Voltage (V)		Cell Weight (g)		Verdict	Remarks
	Before the test	After the test	Before the test	After the test		
#06	4.175	4.175	1816.7	1816.7	PASS	-
#07	4.162	4.162	1814.2	1814.2	PASS	-
#08	4.175	4.175	1817.5	1817.5	PASS	-
#09	4.163	4.163	1816.7	1816.7	PASS	-
#10	4.178	4.178	1800.0	1800.0	PASS	-

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T2: Thermal test**Test Procedure:**

Test cells and batteries are to be stored for at least six hours at test temperature equal to $(72\pm 2)^\circ\text{C}$, followed by storage for at least six hours at a test temperature equal to $(-40\pm 2)^\circ\text{C}$. The maximum time interval between test temperature extremes is 30 minutes. This procedure is to be repeated 10 times, after which all test cells are to be stored for 24 hours at ambient temperature $(20\pm 5)^\circ\text{C}$. For large cells and batteries, the duration of exposure to the test temperature extremes should be at 12 hours

Requirement:

Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire during the test and after the test and if the open circuit voltage of each test cell or battery after testing in its perpendicular mounting position is not less than 90 % of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

Condition of Cells: At first cycle, in fully charged state.

Results:

Specimen	Cell Voltage (V)		Cell Weight (g)		Verdict	Remarks
	Before the test	After the test	Before the test	After the test		
#1	4.186	4.132	1816.1	1816.1	PASS	-
#2	4.173	4.122	1814.4	1814.5	PASS	-
#3	4.173	4.123	1800.5	1800.5	PASS	-
#4	4.174	4.122	1800.6	1800.7	PASS	-
#5	4.173	4.123	1816.3	1816.3	PASS	-

Condition of Cells: At 25 cycle, in fully charged state.

Results:

Specimen	Cell Voltage (V)		Cell Weight (g)		Verdict	Remarks
	Before the test	After the test	Before the test	After the test		
#6	4.175	4.125	1816.7	1816.7	PASS	-
#7	4.162	4.125	1814.2	1814.2	PASS	-
#8	4.175	4.117	1817.5	1817.5	PASS	-
#9	4.163	4.114	1816.7	1816.7	PASS	-
#10	4.178	4.126	1800.0	1800.0	PASS	-

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T3: Vibration**Test Procedure:**

Cells and batteries are firmly secured to the platform of the vibration machine without distorting the cells in such a manner as to faithfully transmit the vibration. The vibration shall be a sinusoidal wave form with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of 3 hours for each of three mutually perpendicular mounting positions of the cell. One of the directions of vibration must be perpendicular to the terminal face.

The logarithmic frequency sweep is as follows

For cells and small batteries

from 7 Hz a peak acceleration of 1 g_n is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1.6 mm total excursion) and the frequency increased until a peak acceleration of 8 g_n occurs (approximately 50Hz). A peak acceleration of 8 g_n is then maintained until the frequency is increased to 200 Hz.

For large batteries

from 7 Hz a peak acceleration of 1 g_n is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1.6 mm total excursion) and the frequency increased until a peak acceleration of 2 g_n occurs (approximately 25 Hz). A peak acceleration of 2 g_n is then maintained until the frequency is increased to 200 Hz.

Requirement:

Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire during the test and after the test and if the open circuit voltage of each test cell or battery after testing in its perpendicular mounting position is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

Condition of Cells: At first cycle, in fully charged state.

Results:

Specimen	Cell Voltage (V)		Cell Weight (g)		Verdict	Remarks
	Before the test	After the test	Before the test	After the test		
#1	4.132	4.132	1816.1	1816.0	PASS	-
#2	4.122	4.122	1814.5	1814.5	PASS	-
#3	4.123	4.123	1800.5	1800.5	PASS	-
#4	4.122	4.122	1800.7	1800.7	PASS	-
#5	4.123	4.123	1816.3	1816.3	PASS	-

Condition of Cells: At 25 cycle, in fully charged state.

Results:

Specimen	Cell Voltage (V)		Cell Weight (g)		Verdict	Remarks Before the test
	Before the test	After the test	Before the test	After the test		
#6	4.125	4.125	1816.7	1816.7	PASS	-
#7	4.125	4.125	1814.2	1814.2	PASS	-
#8	4.117	4.117	1817.5	1817.5	PASS	-
#9	4.114	4.114	1816.7	1816.6	PASS	-
#10	4.126	4.126	1800.0	1799.8	PASS	-

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T4: Shock

Test Procedure

Test cells and batteries shall be secured to the testing machine by means of a rigid mount which will support all mounting surface of each test battery.

Each cell or battery shall be subjected to a half-sine shock of peak acceleration of 150 g_n and pulse duration of 6 milliseconds. Alternatively, large cells may be subjected to a half-sine shock of peak acceleration of 50 g_n and pulse duration of 11 milliseconds.

Each battery shall be subjected to a half-sine shock of peak acceleration depending on the mass of the battery. The pulse duration shall be 6 milliseconds for small batteries and 11 milliseconds for large batteries. The formulas below are provided to calculate the appropriate minimum peak accelerations.

$$\text{For Small batteries } g_n = \sqrt{\left(\frac{100850}{\text{mass}^a}\right)} \quad \text{For Large batteries } g_n = \sqrt{\left(\frac{30000}{\text{mass}^a}\right)}$$

Each cell or battery shall be subjected to three shocks in the positive direction followed by three shocks in the negative direction of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.

Requirement

Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire during the test and after the test and if the open circuit voltage of each test cell or battery after testing in its perpendicular mounting position is not less than 90 % of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states

Condition of Cells: At first cycle, in fully charged state.

Results:

Specimen	Cell Voltage (V)		Cell Weight (g)		Verdict	Remarks
	Before the test	After the test	Before the test	After the test		
#1	4.132	4.125	1816.0	1816.0	PASS	-
#2	4.122	4.115	1814.5	1814.2	PASS	-
#3	4.123	4.114	1800.5	1800.5	PASS	-
#4	4.122	4.116	1800.7	1800.6	PASS	-
#5	4.123	4.116	1816.3	1816.2	PASS	-

Condition of Cells: At 25 cycle, in fully charged state.

Results:

Specimen	Cell Voltage (V)		Cell Weight (g)		Verdict	Remarks
	Before the test	After the test	Before the test	After the test		
#6	4.125	4.118	1816.7	1816.7	PASS	-
#7	4.125	4.118	1814.2	1814.0	PASS	-
#8	4.117	4.111	1817.5	1817.4	PASS	-
#9	4.114	4.107	1816.6	1816.3	PASS	-
#10	4.126	4.119	1799.8	1799.7	PASS	-

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T5: External Short Circuit**Test Procedure**

The cell or battery to be tested shall be heated for a period of time necessary to reach a homogeneous stabilized temperature of $(57\pm4)^\circ\text{C}$, measured on the external case. This period of time depends on the size and design of the cell or battery and should be assessed and documented. If this assessment is not feasible, the exposure time shall be at least 6 hours for small cells and small batteries, and 12 hours for large cells and large batteries. Then the cell or battery at $(57\pm4)^\circ\text{C}$ shall be subjected to one short circuit condition with a total external resistance of less than 0.1 ohm. This short circuit condition is continued for at least one hour after the cell or battery external case temperature has returned to $(57\pm4)^\circ\text{C}$, or in the case of the large batteries, has decreased by half of the maximum temperature increase observed during the test and remains below that value.

Requirement

Cells and batteries meet this requirement if their external temperature does not exceed 170°C and there is no disassembly, no rupture and no fire during the test and within six hours after the test.

Condition of Cells: At first cycle, in fully charged state. Without linked busbar.

Results:

Specimen	Max. external temperature ($^\circ\text{C}$)	Verdict	Remarks
#1	65.2	PASS	-
#2	69.3	PASS	-
#3	68.4	PASS	-
#4	69.1	PASS	-
#5	66.9	PASS	-

Condition of Cells: At 25 cycle, in fully charged state. Without linked busbar.

Results:

Specimen	Max. external temperature ($^\circ\text{C}$)	Verdict	Remarks
#6	69.2	PASS	-
#7	69.7	PASS	-
#8	69.9	PASS	-
#9	67.3	PASS	-
#10	67.9	PASS	-

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T6: Crush**Test procedure**

The flat surfaces are to be brought in contact with the cells and the crushing is to be continued until an applied force of (13 ± 1) kN is reached. A cylindrical or prismatic battery is to be crushed with its longitudinal axis parallel to the flat surfaces of the crushing apparatus. A prismatic battery is also to be rotated 90 degrees around its longitudinal axis so that both the wide and narrow sides will be subjected to the crushing force.

Requirement

Cells and component cells meet this requirement if their external temperature does not exceed 170°C and there is no disassembly and no fire during the test and within six hours after this test.

Crush Condition of Cells: at first cycle at 50% charged state

Results:

Specimen	Max. external temperature ($^{\circ}\text{C}$)	Verdict	Remarks
#11	21.2	PASS	-
#12	21.0	PASS	-
#13	20.7	PASS	-
#14	20.8	PASS	-
#15	20.5	PASS	-

Crush Condition of Cells: at 25 cycle at 50% charged state

Results:

Specimen	Max. external temperature ($^{\circ}\text{C}$)	Verdict	Remarks
#16	20.8	PASS	-
#17	20.7	PASS	-
#18	20.7	PASS	-
#19	20.6	PASS	-
#20	20.5	PASS	-

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T8: Forced discharge

Test procedure

Each cell shall be forced discharged at ambient temperature by connecting it in series with a 12V D.C. power supply at an initial current equal to the maximum discharge current specified by the manufacturer.

The specified discharge current is to be obtained by connecting a resistive load of the appropriate size and rating in series with the test cell. Each cell shall be forced discharged for a time interval (in hours) equal to its rated capacity divided by the initial test current (in Ampere).

Requirement: No disassembly and no fire during the test and within seven days after the test.

Condition of Cells: At first cycle, in fully discharged state.

Results:

Specimen	Max. external temperature (°C)	Verdict	Remarks
#21	70.0	PASS	-
#22	70.8	PASS	-
#23	75.2	PASS	-
#24	73.2	PASS	-
#25	70.4	PASS	-
#26	65.1	PASS	-
#27	72.2	PASS	-
#28	71.0	PASS	-
#29	70.0	PASS	-
#30	67.5	PASS	-

Condition of Cells: After 25 cycles ending in fully discharged state.

Results:

Specimen	Max. external temperature (°C)	Verdict	Remarks
#31	69.1	PASS	-
#32	66.3	PASS	-
#33	65.8	PASS	-
#34	65.8	PASS	-
#35	65.8	PASS	-
#36	63.4	PASS	-
#37	65.5	PASS	-
#38	65.7	PASS	-
#39	66.4	PASS	-
#40	65.8	PASS	-

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Photograph. 01 – View of specimens UN 38.3 test

Top View	
Bottom View	

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