

Certificate of UN test for Lithium ion cell

M. Takahashi

T. Takahashi General Manager
Rechargeable Battery, Business Division
SANYO Electric Co., Ltd.

Global Code : US0000758
Product Name : NCR18650GA

We declare that this cell passed UN test.

Manual of Tests and Criteria (38.3 Lithium batteries)		Test results	Note	Number of test cells	
No.	Test item				
T 1	Altitude simulation	Pass		First cycle fully charged 10 cells	
T 2	Thermal test	Pass			
T 3	Vibration	Pass			
T 4	Shock	Pass			
T 5	External short circuit	Pass			
T 6	Crush	Pass		First cycle 50% charged 5 cells	
T 7	Overcharge	-	For battery only	For battery only.	
T 8	Forced discharge	Pass		First cycle, fully discharged 10 cells	After 50 cycles, fully discharged 10 cells

*The test data may contain additional test result other than above table.

Lithium ion cell Specification

Item	Nominal value	Note
Watt-hour rating	12 Wh	
Lithium equivalent content	0.99 g	

Above test procedures are compliant to the following manual.

(Manual of Tests and Criteria ST/AC.10/11/Rev.5A1, PartIII, sub-section 38.3)

UN Test Data (Model: NCR18650GA)

1.Test Item: Altitude simulation (T1)

2.Test Purpose: This test simulates air transport under low-pressure conditions.

3.Test Procedure:

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

SANYO Internal Procedure:

As above.

4.Test Requirements:

No mass loss,no leakage,no venting,no disassembly,no rupture and no fire,and the voltage retention is not less than 90%.

5.Test Date: 2018/5/13-5/18

6.Test Data

Cell No.	Mass(g)		Mass loss (%) (=<0.2%)	Voltage(V)		Voltage Retention(%) (=>90%)	Other event	Result	Judgement	
	Before test	After test		Before test	After test					
At first cycle,in fully charged states	1	46.335	46.334	0.00	4.165	4.162	99.9	0	PASS	PASS
	2	46.371	46.372	0.00	4.165	4.162	99.9	0	PASS	
	3	46.402	46.402	0.00	4.165	4.162	99.9	0	PASS	
	4	46.369	46.369	0.00	4.165	4.162	99.9	0	PASS	
	5	46.374	46.375	0.00	4.165	4.162	99.9	0	PASS	
	6	46.410	46.411	0.00	4.165	4.162	99.9	0	PASS	
	7	46.374	46.374	0.00	4.164	4.161	99.9	0	PASS	
	8	46.381	46.382	0.00	4.164	4.161	99.9	0	PASS	
	9	46.355	46.356	0.00	4.165	4.162	99.9	0	PASS	
	10	46.410	46.410	0.00	4.165	4.163	100.0	0	PASS	

Notes: L-Leakage, V-Venting, D-Disassembly, R-Rupture, F-Fire,
0-No leakage, no venting, no disassembly, no rupture & no fire

UN Test Data (Model: NCR18650GA)

1.Test Item: Thermal Test (T2)

2.Test Purpose: This test assesses cell and battery seal integrity and internal electrical connections. The test is conducted using rapid and extreme temperature changes.

3.Test Procedure:

Test cells and batteries are to be stored for at least six hours at a 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 and batteries 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 least 12 hours.

SANYO Internal Procedure:

As above.

4.Test Requirements:

No mass loss,no leakage,no venting,no disassembly,no rupture and no fire,and the voltage retention is not less than 90%.

5.Test Date: 2018/5/13~5/18

6.Test Data

Cell No.	Mass(g)		Mass loss (%) (= $<0.2\%$)	Voltage(V)		Voltage Retention(%) (= $\geq 90\%$)	Other event	Result	Judgement	
	Before test	After test		Before test	After test					
At first cycle,in fully charged states	1	46.334	46.334	0.00	4.162	4.108	98.7	0	PASS	PASS
	2	46.372	46.371	0.00	4.162	4.108	98.7	0	PASS	
	3	46.402	46.402	0.00	4.162	4.108	98.7	0	PASS	
	4	46.369	46.370	0.00	4.162	4.108	98.7	0	PASS	
	5	46.375	46.376	0.00	4.162	4.108	98.7	0	PASS	
	6	46.411	46.412	0.00	4.162	4.108	98.7	0	PASS	
	7	46.374	46.374	0.00	4.161	4.108	98.7	0	PASS	
	8	46.382	46.382	0.00	4.161	4.108	98.7	0	PASS	
	9	46.356	46.356	0.00	4.162	4.108	98.7	0	PASS	
	10	46.410	46.411	0.00	4.163	4.108	98.7	0	PASS	

Notes: L-Leakage, V-Venting, D-Disassembly, R-Rupture, F-Fire,
0-No leakage, no venting, no disassembly, no rupture & no fire

UN Test Data (Model: NCR18650GA)

1.Test Item: Vibration (T3)

2.Test Purpose: This test simulates vibration during transport.

3.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 waveform 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: from 7 Hz a peak acceleration of 1gn 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 8gn occurs (approximately 50Hz). A peak acceleration of 8 gn is then maintained until the frequency is increased to 200Hz.

SANYO Internal Procedure:

As above.

4.Test Requirements:

No mass loss, no leakage, no venting, no disassembly, no rupture and no fire, and the voltage retention is not less than 90%.

5.Test Date: 2018/5/21~5/22

6.Test Data

Cell No.	Mass(g)		Mass loss (%) (= $<0.2\%$)	Voltage(V)		Voltage Retention(%) (= $>90\%$)	Other event	Result	Judgement	
	Before test	After test		Before test	After test					
At first cycle, in fully charged states	1	46.334	46.334	0.00	4.108	4.108	100.0	0	PASS	PASS
	2	46.371	46.370	0.00	4.108	4.109	100.0	0	PASS	
	3	46.402	46.402	0.00	4.108	4.109	100.0	0	PASS	
	4	46.370	46.369	0.00	4.108	4.109	100.0	0	PASS	
	5	46.376	46.375	0.00	4.108	4.108	100.0	0	PASS	
	6	46.412	46.411	0.00	4.108	4.108	100.0	0	PASS	
	7	46.374	46.375	0.00	4.108	4.108	100.0	0	PASS	
	8	46.382	46.382	0.00	4.108	4.109	100.0	0	PASS	
	9	46.356	46.357	0.00	4.108	4.109	100.0	0	PASS	
	10	46.411	46.410	0.00	4.108	4.108	100.0	0	PASS	

Notes: L-Leakage, V-Venting, D-Disassembly, R-Rupture, F-Fire,
0-No leakage, no venting, no disassembly, no rupture & no fire

UN Test Data (Model: NCR18650GA)

1.Test Item: Shock (T4)

2.Test Purpose: This test simulates possible impacts during transport.

3.Test Procedure:

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

However, large cells and large batteries shall be subjected to a half-sine shock of peak acceleration of 50 g_n and pulse duration of 11 milliseconds. Each cell or battery is subjected to three shocks in the positive direction followed by three shocks in the negative direction of each of three mutually perpendicular mounting positions of the cell for a total of 18 shocks.

SANYO Internal Procedure:

As above.

4.Test Requirements:

No mass loss,no leakage,no venting,no disassembly,no rupture and no fire,and the voltage retention is not less than 90%.

5.Test Date: 2018/5/23

6.Test Data

Cell No.	Mass(g)		Mass loss (%) (=<0.2%)	Voltage(V)		Voltage Retention(%) (=>90%)	Other event	Result	Judgement	
	Before test	After test		Before test	After test					
At first cycle, in fully charged states	1	46.334	46.335	0.00	4.108	4.108	100.0	0	PASS	PASS
	2	46.370	46.371	0.00	4.109	4.108	100.0	0	PASS	
	3	46.402	46.402	0.00	4.109	4.108	100.0	0	PASS	
	4	46.369	46.369	0.00	4.109	4.108	100.0	0	PASS	
	5	46.375	46.375	0.00	4.108	4.108	100.0	0	PASS	
	6	46.411	46.411	0.00	4.108	4.108	100.0	0	PASS	
	7	46.375	46.372	0.01	4.108	4.108	100.0	0	PASS	
	8	46.382	46.381	0.00	4.109	4.108	100.0	0	PASS	
	9	46.357	46.355	0.00	4.109	4.108	100.0	0	PASS	
	10	46.410	46.411	0.00	4.108	4.108	100.0	0	PASS	

Notes: L-Leakage, V-Venting, D-Disassembly, R-Rupture, F-Fire,
0-No leakage, no venting, no disassembly, no rupture & no fire

UN Test Data (Model: NCR18650GA)

1.Test Item: External short circuit (T5)

2.Test Purpose: This test simulates an external short circuit.

3.Test Procedure:

The cell or battery to be tested shall be temperature stabilized so that its external case temperature reaches $55\pm 2^{\circ}\text{C}$ and then the cell or battery shall be subjected to a short circuit condition with a total external resistance of less than 0.1ohm at $55\pm 2^{\circ}\text{C}$. This short circuit condition is continued for at least one hour after the cell or battery external case temperature has returned to $55\pm 2^{\circ}\text{C}$. The cell or battery must be observed for a further six hours for the test to be concluded.

SANYO Internal Procedure:

As above.

4.Test Requirements:

External temperature of test batteries does not exceed 170°C and there is no disassembly, no rupture and no fire within six hours after this test.

5.Test Date: 2018/5/27 ~ 5/28

6.Test Data

Cell No.	Maximum temperature ($^{\circ}\text{C}$)	Other event	Result	Judgement	
At first cycle, in fully charged states	1	108.8	0	PASS	PASS
	2	106.0	0	PASS	
	3	112.3	0	PASS	
	4	107.4	0	PASS	
	5	112.5	0	PASS	
	6	103.7	0	PASS	
	7	114.2	0	PASS	
	8	109.1	0	PASS	
	9	107.5	0	PASS	
	10	99.0	0	PASS	

Notes: D-Disassembly, R-Rupture, F-Fire, 0-No disassembly, no rupture & no fire

UN Test Data (Model: NCR18650GA)

1.Test Item: Crush (T6)

2.Test Purpose: This test simulates mechanical abuse from an crush that may result in an internal short circuit.

3.Test Procedure:

Crush (applicable to prismatic, pouch cells and cylindrical cells not more than 20 mm in diameter)

A cell or component cell is to be crushed between two flat surfaces. The crushing is to be gradual with a speed of approximately 1.5 cm/s at the first point of contact. The crushing is to be continued until the first of the three options below is reached.

(a) The applied force reaches $13 \text{ kN} \pm 0.78 \text{ kN}$;

Example: The force shall be applied by a hydraulic ram with a 32 mm diameter piston until a pressure of 17 Mpa is reached on the hydraulic ram.

(b) The voltage of the cell drops by at least 100 mV; or

(c) The cell is deformed by 50% or more of its original thickness.

Once the maximum pressure has been obtained, the voltage drops by 100 mB or more, or the cell is deformed by at least 50% of its original thickness, the pressure shall be released.

A prismatic or pouch cell shall be crushed by applying the force to the widest side. A button/coin cell shall be crushed by applying the force on its flat surfaces. For cylindrical cells, the crush force shall be applied perpendicular to the longitudinal axis.

Each test cell or component cell is to be subjected to one crush only. The test sample shall be observed for a further 6 h. The test shall be conducted using test cells or component cells that have not previously been subjected to other tests.

SANYO Internal Procedure:

As above.

4.Test Requirements:

External temperature of test batteries does not exceed 170°C and there is no disassembly and no fire within six hours after this test.

5.Test Date: 2018/5/27

6.Test Data:

Cell No.	Maximum Temperature($^{\circ}\text{C}$)	Other event	Result	Judgement
At first cycle, 50% charged states	1	20.8	0	PASS
	2	20.6	0	PASS
	3	20.7	0	PASS
	4	20.7	0	PASS
	5	20.9	0	PASS
				PASS

Notes: D-Disassembly, F-Fire, 0-No disassembly & no fire

UN Test Data (Model: NCR18650GA)

1.Test Item: Forced discharge (T8)

2.Test Purpose: This test evaluates the ability of a primary or a rechargeable cell to withstand a forced discharge condition.

3.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).

SANYO Internal Procedure:

As above.

4.Test Requirements:

There is no disassembly and no fire within seven days after the test.

5.Test Date: 2018/5/26~6/3

6.Test Data

Cell No.	Maximum Temperature(°C)	Other event	Result	Judgement	
At first cycle, in fully discharged states	1	96.8	0	PASS	PASS
	2	96.7	0	PASS	
	3	98.8	0	PASS	
	4	96.6	0	PASS	
	5	93.2	0	PASS	
	6	96.4	0	PASS	
	7	96.4	0	PASS	
	8	96.8	0	PASS	
	9	96.8	0	PASS	
	10	93.7	0	PASS	
After 50 cycles ending, in fully discharged states	11	114.1	0	PASS	
	12	116.8	0	PASS	
	13	118.5	0	PASS	
	14	118.7	0	PASS	
	15	115.5	0	PASS	
	16	119.7	0	PASS	
	17	120.1	0	PASS	
	18	119.0	0	PASS	
	19	116.0	0	PASS	
	20	114.6	0	PASS	

Notes: D-Disassembly, R-Rupture, F-Fire, 0-No disassembly, no rupture & no fire