

UN Test Report

Name of Sample	Lithium Ion Battery NCR18650GA
Consignor	Panasonic Energy (Wuxi) Co., Ltd.
Manufacturer	Panasonic Energy (Wuxi) Co., Ltd.
Test Method	United Nations "Recommendations on the TRANSPORT OF DANGEROUS GOODS"
Criterion	United Nations "Recommendations on the TRANSPORT OF DANGEROUS GOODS"
Appearance	Yellow Green Tubed Cylindrical Cell
Test Date	T1:2014/05/13 - 2014/05/13 T2:2014/05/13 - 2014/05/18 T3:2014/05/21 - 2014/05/22 T4:2014/05/23 - 2014/05/23 T5:2014/05/27 - 2014/05/28 T6:2014/05/27 - 2014/05/27 T8:2014/05/26 - 2014/06/03
Test Items	Altitude simulation, Thermal test, Vibration test, Shock test, External short circuit, Overcharged
Conclusion	The sample has passed the items of UN38.3.
Remark	Certification by Original Cell Model
Consignor Address	No.40 Changjiang Rd. Wuxi New District 214028 P.R.China

Product Development Promotion Department ☐
Energy Solutions Business Division ☐
SANYO Electric Co., Ltd. ☐

N. Kuroda

Approval

K. Morina

Check

T. Takada

Writing

CONFIDENTIAL

Test summary of UN test for Lithium ion cell

Customer Model : NCR18650GA
Global Code : US0001055
Product Name : NCR18650GA
Manufacturer : SANYO Electric Co., Ltd. 222-1 Kaminaizen, Sumoto City, Hyogo 656-8555, Japan
Tel +81-799-23-3931, email prb-bp-ta@ml.jp.panasonic.com
https://industrial.panasonic.com/ww/products/batteries/

Test Laboratory : Same as the manufacturer

M. Takahashi
General Manager
Energy Solutions Business Division
SANYO Electric Co., Ltd.

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

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

Lithium ion cell Specification

Item	Value/Description	Note
Watt-hour rating	12 Wh	
Nominal voltage	3.6 V	
Weight	max. 49.5 g	
Physical description	Cylindrical cell with shrink tube	
Lithium equivalent content	0.99 g	

Above test procedures are compliant to the following manual.

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

Judgment for necessity of test items is carried out based on the latest rules, and it is not linked with the version actually tested.

Certificate of Package Drop Test for Lithium ion Cell

Customer Model : NCR18650GA
Global Code : US0001055
Product Name : NCR18650GA


H.Kuroda Senior Manager
Battery Pack Engineering Department
Energy Solutions Business Division
SANYO Electric Co., Ltd.

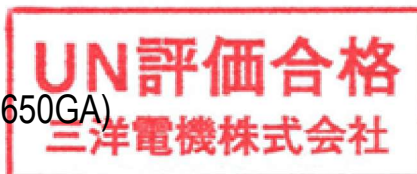
We declare that this cell passed UN test.

Test item	Test results	Note
Package Drop Test	Pass	The package shall be dropped from 1.2m high on to a concrete surface (flat and horizontal) with five orientations (drop once a sample) ;

Lithium ion cell Specification

Item	Nominal value	Note
Watt-hour rating	12 Wh	
Nominal voltage	3.6 V	
Lithium equivalent content	0.99 g	

Above test procedures are compliant to the following regulation.
(Model Regulations ST/SG/AC.10/1/Rev.21, Special Provision188)



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: 2014/5/13

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 $72\pm2^{\circ}\text{C}$, followed by storage for at least six hours at a test temperature equal to $-40\pm2^{\circ}\text{C}$.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 ($20\pm5^{\circ}\text{C}$). 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.

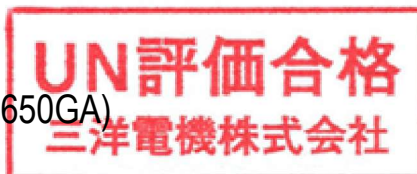
- 4.Test Requirements:
- No mass loss,no leakage,no venting,no disassembly,no rupture and no fire,and the voltage retention is not less than 90%.

5.Test Date: 2014/5/13～5/18

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. 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:

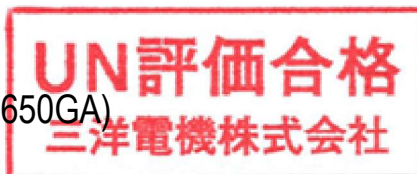
No mass loss, no leakage, no venting, no disassembly, no rupture and no fire, and the voltage retention is not less than 90%.

5.Test Date: 2014/5/21 ~ 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: 2014/5/23

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: 2014/5/27 ~ 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 tts 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: 2014/5/27

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	PASS
	2	20.6	0	PASS	
	3	20.7	0	PASS	
	4	20.7	0	PASS	
	5	20.9	0	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: 2014/5/26～6/3

6.Test Data

Cell No.	Maximum Temperature(°C)	Other event	Result	Judgement
At first cycle, in fully discharged states	1	96.8	0	PASS
	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



UN Test Data (Model: NCR18650GA)

1.Test Item: Drop Test

2.Test Purpose: This test simulates the drop of the packaging during transport.

3.Test Procedure:

Number of Test Samples (Per design type, Manufacturer) and Drop Orientation For other than flat drops the centre of gravity must be vertically over the point of impact. Where more than one orientation is possible for a given drops, the orientation most likely to result in failure of the packaging must be used.

Packaging	Number of test samples	Drop orientation
Boxes of natural wood Plywood boxes Reconstituted wood boxes Fibreboard boxes Plastic boxes Steel or aluminum boxes Composite Packagings which are in the shape of a box.	Five (one for each drop)	First drop: flat on the bottom Second drop: flat on the long side Third drop: flat on the short side Fourth drop: on a long edge Fifth drop: on a corner

SANYO Internal Procedure:

Packaging: Fiberboard boxes. Number of test samples: Five(one for each drop). It may do the drop of five orientations with one sample if the packing does not have the big damage.

Drop orientation: As above.

4.Test Requirements:

A Package passes the test if it meets the following criteria:

Each package is capable of withstanding a 1.2 meter drop test in any orientation without damage to cells or batteries contained therein, without shifting of the contents so as to allow battery to battery (or cell to cell) contact and without release of contents.

5.Test Date: 2020/12/30

6.Test Results: PASS(Drop height 1.2m)

Packaging size:
394*304*81(mm)
Packaging weight(Before) :
9.01(kg)
Packaging weight(After) :
9.01(kg)
Quantity in a packaging:
180(qty)
Mass of each cell or battery in a package:*
47(g)

* Remark: It maybe difference to the original type's mass in test data page in condition of extension type. Based on UN38.3 reuquirement, extension type can use original type's UN testing data because it was not considered as a new type.