

UN Test Report

Name of Sample	Lithium Ion Battery NCR18500
Consignor	Panasonic Energy (Wuxi) Co., Ltd.
Manufacturer	Panasonic Energy (Wuxi) Co., Ltd.
Test Method	United Nations "Recomenndations on the TRANSPORT OF DANGEROUS GOODS"
Criterion	United Nations "Recomenndations on the TRANSPORT OF DANGEROUS GOODS"
Appearance	Gray tubed cylindrical cell
Test Date	2007/12/06 – 2008/01/31
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	Cell model name of the sample cell is NCR18500 Ratio of (NCR18500)/(NCR18500) [Wh rating ratio]: 100%, [Voltage ratio]: 100%
Consignor Address	No.40 Changjiang Rd. Wuxi New District 214028 P.R.China

Technical Administration Group
Lithium-Ion Battery Business Unit
Energy Company
SANYO Electric Co., Ltd.

N. Kuroda

Approval

M. Kuroda

Check

M. Komita

Writing

CONFIDENTIAL

Certificate of UN test for Lithium ion cell

S. Watanabe



S. Watanabe General Manager
Lithium-Ion Battery Business Unit
Energy Company, SANYO Electric Co., Ltd.

Product Code : US0000209

Product Name : NCR18500

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	Impact	Pass		First cycle 50% charged 5 cells for cylindrical cell, 10 cells for prismatic cell.	
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 / Rated capacity	6.7 Wh / 1.86 Ah	
Nominal voltage	3.6 V	
Lithium equivalent content	0.56 g	

Above test procedures are compliant to the following manual.

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

Certificate of Package Drop Test for Lithium ion cell

Product Code : US0000209
 Product Name : NCR18500

H. Kuroda
 H.Kuroda General Manager
 Technical Administration Group
 Lithium-Ion Battery Business Unit
 Energy Company, SANYO Electric Co., Ltd.



We declare that this cell passed UN test.

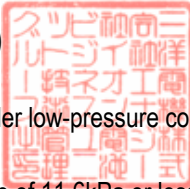
Test item	Test results	Note
Package Drop Test	Pass	The package shall be dropped from 1.2m high on to a concrete surface (flat and horizontal) with five orientations (drop once a sample) ; (1)flat on the bottom, (2)flat on the top, (3)flat on the long side, (4)flat on the short side, (5)on the corner

Lithium ion cell Specification

Item	Nominal value	Note
Watt-hour rating / Rated capacity	6.7 Wh / 1.86 Ah	
Nominal voltage	3.6 V	
Lithium equivalent content	0.56 g	

Above test procedures are compliant to the following regulation.
 (Model Regulations ST/SG/AC.10/1/Rev.17, Special Provision188)

UN Test Data (Model:NCR18500)



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(less than 0.1%),no leakage,no venting,no disassembly,no rupture and no fire,and the voltage retention is not less than 90%.

The requirement relating to voltage is not applicable to test batteries at fully discharged states.

5.Test Date: 2007/12/06

6.Test Data

Battery No.	Mass(g)		Mass loss (%) (=<0.1%)	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	32.68	32.68	0.00	4.17	4.16	99.8	0	PASS	PASS
	2	32.65	32.65	0.00	4.17	4.16	99.8	0	PASS	
	3	32.64	32.62	0.05	4.17	4.17	100.0	0	PASS	
	4	32.67	32.67	0.00	4.17	4.16	99.8	0	PASS	
	5	32.69	32.69	0.00	4.17	4.16	99.8	0	PASS	
	6	32.65	32.65	0.01	4.17	4.16	99.8	0	PASS	
	7	32.66	32.65	0.01	4.16	4.16	99.8	0	PASS	
	8	32.70	32.70	0.00	4.17	4.17	100.0	0	PASS	
	9	32.67	32.67	0.00	4.17	4.17	100.0	0	PASS	
	10	32.64	32.64	0.00	4.17	4.16	99.8	0	PASS	
At first cycle,in fully discharged states	11	32.65	32.65	0.00				0	PASS	
	12	32.65	32.65	0.00				0	PASS	
	13	32.60	32.60	0.00				0	PASS	
	14	32.62	32.61	0.00				0	PASS	
	15	32.59	32.59	0.00				0	PASS	
	16	32.58	32.58	0.00				0	PASS	
	17	32.60	32.60	0.00				0	PASS	
	18	32.62	32.62	0.00				0	PASS	
	19	32.62	32.62	0.00				0	PASS	
	20	32.64	32.64	0.00				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:NCR18500)



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 75±2 °C, followed by storage for at least six hours at a test temperature equal to -40±2 °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 ±5 °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 (less than 0.1%), no leakage, no venting, no disassembly, no rupture and no fire, and the voltage retention is not less than 90%.

The requirement relating to voltage is not applicable to test batteries at fully discharged states.

5. Test Date: 2007/12/12

6. Test Data

Battery No.	Mass(g)		Mass loss (%) (= < 0.1%)	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	32.68	32.67	0.01	4.16	4.10	98.7	0	PASS	PASS
	2	32.65	32.64	0.02	4.16	4.10	98.7	0	PASS	
	3	32.62	32.61	0.04	4.17	4.10	98.5	0	PASS	
	4	32.67	32.67	0.02	4.16	4.10	98.7	0	PASS	
	5	32.69	32.68	0.02	4.16	4.10	98.7	0	PASS	
	6	32.65	32.65	0.02	4.16	4.10	98.7	0	PASS	
	7	32.65	32.65	0.02	4.16	4.10	98.7	0	PASS	
	8	32.70	32.69	0.03	4.17	4.10	98.5	0	PASS	
	9	32.67	32.67	0.01	4.17	4.10	98.5	0	PASS	
	10	32.64	32.63	0.02	4.16	4.10	98.7	0	PASS	
At first cycle, in fully discharged states	11	32.65	32.64	0.03				0	PASS	
	12	32.65	32.65	0.02				0	PASS	
	13	32.60	32.60	0.02				0	PASS	
	14	32.61	32.61	0.03				0	PASS	
	15	32.59	32.58	0.03				0	PASS	
	16	32.58	32.57	0.03				0	PASS	
	17	32.60	32.59	0.02				0	PASS	
	18	32.62	32.61	0.03				0	PASS	
	19	32.62	32.61	0.02				0	PASS	
	20	32.64	32.64	0.02				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:NCR18500)



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 (less than 0.1%), no leakage, no venting, no disassembly, no rupture and no fire, and the voltage retention is not less than 90%.

The requirement relating to voltage is not applicable to test batteries at fully discharged states.

5. Test Date: 2007/12/14

6. Test Data

Battery No.	Mass(g)		Mass loss (%) (= < 0.1%)	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	32.67	32.67	0.01	4.10	4.10	100.0	0	PASS	PASS
	2	32.64	32.64	0.01	4.10	4.10	100.0	0	PASS	
	3	32.61	32.60	0.00	4.10	4.10	100.0	0	PASS	
	4	32.67	32.67	0.00	4.10	4.10	100.0	0	PASS	
	5	32.68	32.68	0.00	4.10	4.10	100.0	0	PASS	
	6	32.65	32.64	0.01	4.10	4.10	100.0	0	PASS	
	7	32.65	32.65	0.00	4.10	4.10	100.0	0	PASS	
	8	32.69	32.69	0.01	4.10	4.10	100.0	0	PASS	
	9	32.67	32.67	0.00	4.10	4.10	100.0	0	PASS	
	10	32.63	32.63	0.01	4.10	4.10	100.0	0	PASS	
At first cycle, in fully discharged states	11	32.64	32.64	0.00				0	PASS	
	12	32.65	32.65	0.00				0	PASS	
	13	32.60	32.59	0.00				0	PASS	
	14	32.61	32.61	0.00				0	PASS	
	15	32.58	32.58	0.00				0	PASS	
	16	32.57	32.57	0.00				0	PASS	
	17	32.59	32.59	0.00				0	PASS	
	18	32.61	32.61	0.00				0	PASS	
	19	32.61	32.61	0.00				0	PASS	
	20	32.64	32.63	0.00				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:NCR18500)



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 (less than 0.1%), no leakage, no venting, no disassembly, no rupture and no fire, and the voltage retention is not less than 90%.

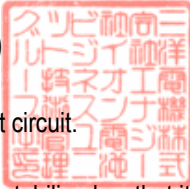
5. Test Date: 2007/12/17

6. Test Data

Battery No.	Mass(g)		Mass loss (%) (= < 0.1%)	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	32.67	32.67	0.00	4.10	4.10	100.0	0	PASS	PASS
	2	32.64	32.64	0.00	4.10	4.10	100.0	0	PASS	
	3	32.60	32.61	0.01	4.10	4.10	100.0	0	PASS	
	4	32.67	32.67	0.00	4.10	4.10	100.0	0	PASS	
	5	32.68	32.68	0.00	4.10	4.10	100.0	0	PASS	
	6	32.64	32.64	0.00	4.10	4.10	100.0	0	PASS	
	7	32.65	32.64	0.01	4.10	4.10	100.0	0	PASS	
	8	32.69	32.69	0.01	4.10	4.10	100.0	0	PASS	
	9	32.67	32.67	0.01	4.10	4.10	100.0	0	PASS	
	10	32.63	32.63	0.00	4.10	4.10	100.0	0	PASS	
At first cycle, in fully discharged states	11	32.64	32.64	0.00				0	PASS	
	12	32.65	32.64	0.01				0	PASS	
	13	32.59	32.59	0.00				0	PASS	
	14	32.61	32.60	0.00				0	PASS	
	15	32.58	32.58	0.00				0	PASS	
	16	32.57	32.57	0.01				0	PASS	
	17	32.59	32.59	0.00				0	PASS	
	18	32.61	32.61	0.00				0	PASS	
	19	32.61	32.61	0.00				0	PASS	
	20	32.63	32.63	0.01				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:NCR18500)



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 of this test.

5. **Test Date:** 2008/01/18

6. **Test Data**

Battery No.	Maximum temperature ($^{\circ}\text{C}$)	Other event	Result	Judgement	
At first cycle, in fully charged states	1	83	0	PASS	PASS
	2	84	0	PASS	
	3	83	0	PASS	
	4	81	0	PASS	
	5	83	0	PASS	
	6	85	0	PASS	
	7	80	0	PASS	
	8	82	0	PASS	
	9	85	0	PASS	
	10	82	0	PASS	
At first cycle, in fully discharged states	11	81	0	PASS	
	12	81	0	PASS	
	13	79	0	PASS	
	14	77	0	PASS	
	15	78	0	PASS	
	16	81	0	PASS	
	17	77	0	PASS	
	18	78	0	PASS	
	19	80	0	PASS	
	20	78	0	PASS	

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

UN Test Data (Model:NCR18500)



1. Test Item: Impact (T6)

2. Test Purpose: This test simulates an impact.

3. Test Procedure:

The test sample cell or component cell is to be placed on a flat surface. A 15.8mm diameter bar is to be placed across the center of the sample. A 9.1kg mass is to be dropped from a height of 61±2.5cm onto the sample.

A cylindrical or prismatic cell is to be impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the 15.8mm diameter curved surface lying across the centre of the test sample. A prismatic cell is also to be rotated 90 degrees around its longitudinal axis so that both the wide and narrow sides will be subjected to the impact. Each sample is to be subjected to only a single impact. Separate samples are to be used for each impact. A coin or button cell is to be impacted with the flat surface of the sample parallel to the flat surface and the 15.8mm diameter curved surface lying across its center.

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 of this test.

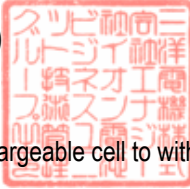
5. Test Date: 2008/01/30

6. Test Data:

Cell No.	Maximum Temperature(°C)	Other event	Result	Judgement	
At first cycle, 50% charged states	1	124	0	PASS	PASS
	2	123	0	PASS	
	3	122	0	PASS	
	4	107	0	PASS	
	5	124	0	PASS	
	6				
	7				
	8				
	9				
	10				
After 50 cycles ending, in fully discharged states	1	104	0	PASS	
	2	107	0	PASS	
	3	108	0	PASS	
	4	109	0	PASS	
	5	104	0	PASS	
	6				
	7				
	8				
	9				
	10				

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

UN Test Data (Model:NCR18500)



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 discharged 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 of the test.

5. Test Date: 2008/01/31

6. Test Data

Cell No.	Other event	Result	Judgement
At first cycle, in fully discharged states	1	0	PASS
	2	0	PASS
	3	0	PASS
	4	0	PASS
	5	0	PASS
	6	0	PASS
	7	0	PASS
	8	0	PASS
	9	0	PASS
	10	0	PASS
After 50 cycles ending, in fully discharged states	11	0	PASS
	12	0	PASS
	13	0	PASS
	14	0	PASS
	15	0	PASS
	16	0	PASS
	17	0	PASS
	18	0	PASS
	19	0	PASS
	20	0	PASS

PASS

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

UN Test Data (Model :  NCR18500)

1. Test Item: Drop Test

P.10/10

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	Six (one for each drop)	First drop: flat on the bottom Second drop: flat on the top Third drop: flat on the long side Fourth drop: flat on the short side Fifth drop: on an edge Sixth 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: 2008/11/13

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

- 6-1. No any package crack
- 6-2. No any cell damage and battery damage.
- 6-3. No any out side release of contents from shipping box
- 6-4. No any contact between battery and battery, cell and cell.

Packaging size:
284 * 304 * 174 mm
Packaging weight :
9.4 kg