

UN38.3 Test Report

Client Name Entel Philippines

Name of product INTRINSICALLY SAFE RECHARGEABLE BATTERY
PACK

Manufacturer Entel Philippines

Trade mark & model ENTEL/CNB950E V2

Test sort Safety Entrust Test



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CCIC Southern Electronic Product Testing (Shenzhen) CO., Ltd.					
TEST REPORT					
Name of sample	INTRINSICALLY SAFE RECHARGEABLE BATTERY PACK		Trade mark	ENTEL	
Manufacturer	Entel Philippines		Model/Type	CNB950E V2 (cell model:103449AR)	
Client	Entel Philippines		Sampling method	Sent by client	
Application date	2018/01/25		Completing Date	2018/02/08	
Quantity of samples	8Batteries,25Cells		Environment condition	15~35℃ 45~75%RH	
Nominal voltage (Cell /battery)	3.7V/7.4V	Limited Charge Voltage (Cell /battery)	4.2V/8.4V	Rate Energy/Capacity (Battery)	13.32Wh/1800mAh
Standard charge current (Cell /battery)	0.36A/0.36A	Max. Charge Current (Cell /battery)	1.8A/1.8A	End Charge Current (Cell)	0.036A
Cut-off Voltage (Cell /battery)	2.75V	Max.Discharge Current (Cell /battery)	3.6A/3.6A	Component cells Number	2PCS
<p>Test item:</p> <p>Test1: Altitude simulation</p> <p>Test2: Thermal Test</p> <p>Test3: Vibration</p> <p>Test4: Shock</p> <p>Test5: External short circuit</p> <p>Test6: Impact/Crush</p> <p>Test7: Overcharge</p> <p>Test8: Forced discharge</p>					
<p>Reference documents:</p> <p>《Recommendations on the Transport of Dangerous Goods,Manual of Test and Criteria》 (Sixth revised edition) section 38.3:Lithium metal and lithium ion batteries (ST/SG/AC.10/11/Rev.6).</p>					
<p>Summary:</p> <p>Each Cell/battery type is subjected to tests 1 to 8,Tests 1 to 5 are conducted in sequence on the same Cells/batteries,Tests 6 and 8 are conducted using not otherwise tested Cells/batteries,Test 7 using undamaged batteries previously used in Tests 1 to 5.</p> <p style="text-align: center;">$Mass\ loss\% = (M_1 - M_2) / M_1 \times 100$</p> <p>Where M_1 is the mass before the test and M_2 is the mass after the test. When mass loss does not exceed the values in Table 38.3.2.2, it shall be considered as "no mass loss".</p>					

Mass M of cell or battery	Mass loss limit
$M < 1g$	0.5%
$1g \leq M \leq 75g$	0.2%
$M > 75g$	0.1%

In test 1 to 4 batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test battery after testing is not less than 90% of its voltage immediately prior to this procedure.

The Lithium-ion Batteries submitted by manufacturer are single cell batteries, According to the standard, a single cell Battery is considered a "Cell" and shall be tested according to the testing requirements for "cell".

Remark:

- Batteries of B01#-B04# are fully charge at first cycle.
- Component cells of C9#-C13# at 50% of the design rated capacity at first cycle.
- Batteries of B05#-B08# are fully charge after 50 cycles.
- Component cells of C14#-C23# at first cycle in fully discharged states.
- Component cells of C24#-C33# are fully Discharge after 50 cycles.

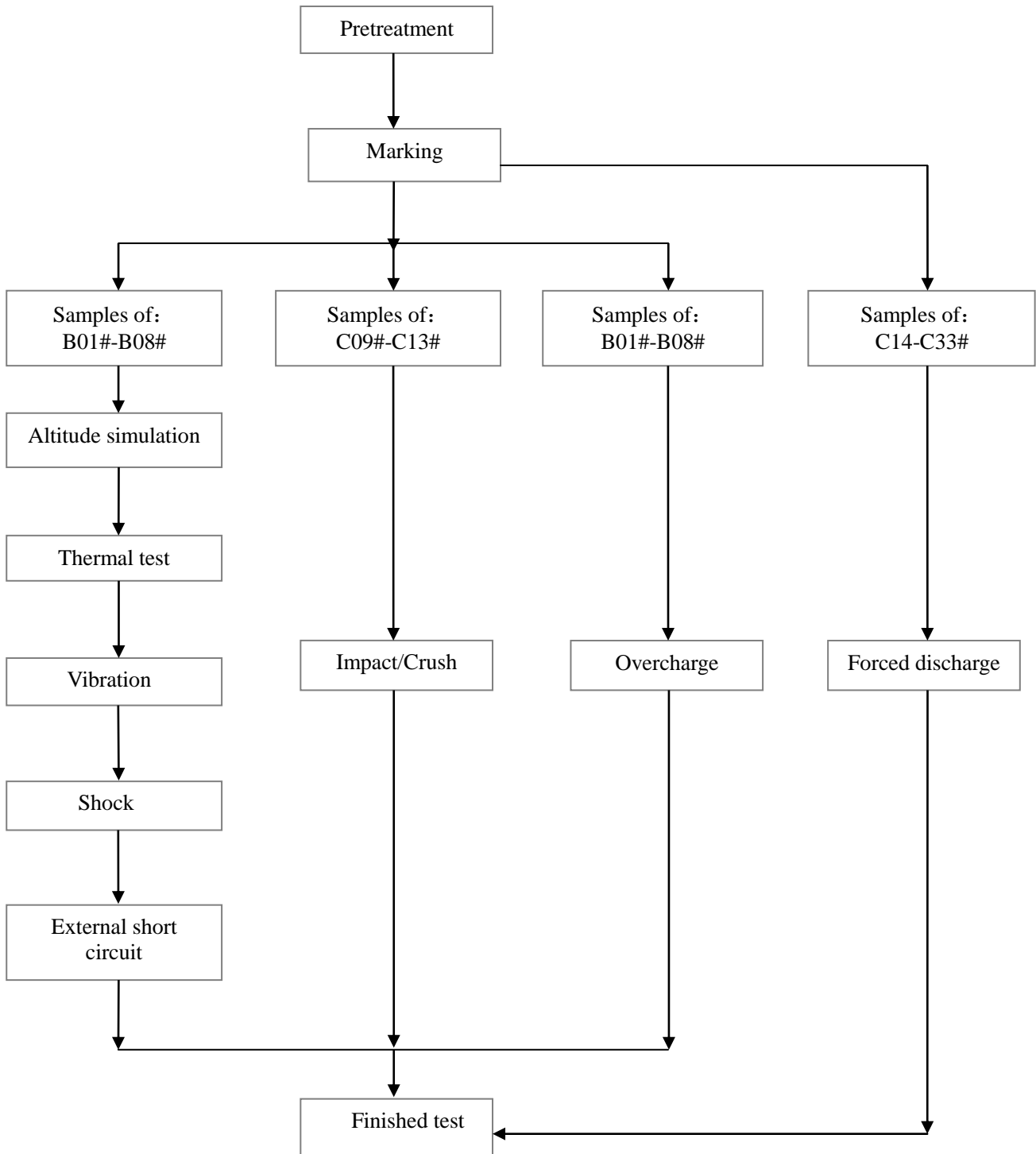
Test conclusion:

The test samples comply with section 38.3 of Recommendations on the Transport of Dangerous Goods, Manual of Test and Criteria.

(stamp)

Tested by <u> Aaron </u> Nov.05.2018	Reviewed by <u> Lu Jian </u> Nov.05.2018	Approved by <u> Billow </u> Nov.05.2018
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Test Procedure:



Test results:

Test T.1 Altitude situation

Test method;

Cells are stored at a pressure of 11.6 kPa or less for at least six hours at ambient temperature ($20 \pm 5^\circ\text{C}$).

Requirement;

Cells meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cells after testing is not less than 90% of its voltage immediately prior to this procedure.

Test Date showed in table below;

State of sample	No.	Pre-test		After test		Mass loss (%)	Voltage after test/Voltage pre-test(%)	Status
		Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
At first cycle in fully charged states	B01#	131.821	8.336	131.812	8.322	0.01	99.83	PASS
	B02#	131.345	8.334	131.333	8.324	0.01	99.88	PASS
	B03#	130.987	8.334	130.975	8.321	0.01	99.84	PASS
	B04#	130.993	8.335	130.982	8.323	0.01	99.86	PASS
After 50 cycles ending in fully charged states	B05#	131.457	8.336	131.446	8.325	0.01	99.87	PASS
	B06#	131.267	8.333	131.255	8.322	0.01	99.87	PASS
	B07#	131.455	8.329	131.443	8.319	0.01	99.88	PASS
	B08#	131.648	8.338	131.637	8.324	0.01	99.83	PASS

Notes:

After the test,the cells are no leakage,no venting, no disassembly, no rupture and no fire.

Ambient temperature:24.5°C.

Test T.2: Thermal test

Test method;

Cells are to be stored for at least six hours at a test temperature equal to 72 ± 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 are to be stored for 24 hours at ambient temperature (20 ± 5 °C).

Requirement;

Cells meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cells after testing is not less than 90% of its voltage immediately prior to this procedure.

Test Date showed in table below;

State of sample	No.	Pre-test		After test		Mass loss (%)	Voltage after test/Voltage pre-test(%)	Status
		Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
At first cycle in fully charged states	B01#	131.812	8.322	131.783	8.187	0.02	98.38	PASS
	B02#	131.333	8.324	131.313	8.194	0.02	98.44	PASS
	B03#	130.975	8.321	130.955	8.188	0.02	98.40	PASS
	B04#	130.982	8.323	130.961	8.192	0.02	98.43	PASS
After 50 cycles ending in fully charged states	B05#	131.446	8.325	131.423	8.184	0.02	98.31	PASS
	B06#	131.255	8.322	131.224	8.186	0.02	98.37	PASS
	B07#	131.443	8.319	131.421	8.185	0.02	98.39	PASS
	B08#	131.637	8.324	131.611	8.191	0.02	98.40	PASS

Notes:

After the test,the cells are no leakage,no venting, no disassembly, no rupture and no fire.
Ambient temperature:24.3°C.

Test T.3: Vibration

Test method;

Cells are firmly secured to the platform of the vibration machine. The vibration is 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 1g_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 50 Hz). A peak acceleration of 8 g_n is then maintained until the frequency is increased to 200 Hz.

Requirement;

Cells meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cells after testing is not less than 90% of its voltage immediately prior to this procedure.

Test Date showed in table below;

State of sample	No.	Pre-test		After test		Mass loss (%)	Voltage after test/Voltage pre-test(%)	Status
		Mass (g)	Voltage (V)	Mass (g)	Volta ge (V)			
At first cycle in fully charged states	B01#	131.783	8.187	131.783	8.187	0.00	100.0	PASS
	B02#	131.313	8.194	131.313	8.194	0.00	100.0	PASS
	B03#	130.955	8.188	130.955	8.188	0.00	100.0	PASS
	B04#	130.961	8.192	130.961	8.192	0.00	100.0	PASS
After 50 cycles ending in fully charged states	B05#	131.423	8.184	131.423	8.184	0.00	100.0	PASS
	B06#	131.224	8.186	131.224	8.186	0.00	100.0	PASS
	B07#	131.421	8.185	131.421	8.185	0.00	100.0	PASS
	B08#	131.611	8.191	131.611	8.191	0.00	100.0	PASS

Notes:

After the test, the cells are no leakage, no venting, no disassembly, no rupture and no fire.

Ambient temperature: 24.7°C.

Test T.4: Shock

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 shall be subjected to a half-sine shock of peak acceleration of 150 gn and pulse duration of 6 milliseconds. Alternatively, large cells may be subjected to a half-sine shock of peak acceleration of 50 gn 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.

Battery	Minimum peak acceleration	Pulse duration
Small batteries	150 gn or result of formula $Acceleration(g_n) = \sqrt{\left(\frac{100850}{mass^*}\right)}$ whichever is smaller	6 ms
Large batteries	50 gn or result of formula $Acceleration(g_n) = \sqrt{\left(\frac{30000}{mass^*}\right)}$ whichever is smaller	11 ms

* Mass is expressed in kilograms.

Each cell or battery shall be subjected to three shocks in the positive direction and to three shocks in the negative direction in each 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 and if the open circuit voltage of each test cells after testing 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.

Test Date showed in table below;

State of sample	No.	Pre-test		After test		Mass loss (%)	Voltage after test/Voltage pre-test(%)	Status
		Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
At first cycle in fully charged states	B01#	131.783	8.187	131.783	8.187	0.00	100.00	PASS
	B02#	131.313	8.194	131.313	8.194	0.00	100.00	PASS
	B03#	130.955	8.188	130.955	8.188	0.00	100.00	PASS
	B04#	130.961	8.192	130.961	8.192	0.00	100.00	PASS
After 50 cycles ending in fully charged states	B05#	131.423	8.184	131.423	8.184	0.00	100.00	PASS
	B06#	131.224	8.186	131.224	8.186	0.00	100.00	PASS
	B07#	131.421	8.185	131.421	8.185	0.00	100.00	PASS
	B08#	131.611	8.191	131.611	8.191	0.00	100.00	PASS

Notes:

After the test,the cells are no leakage,no venting, no disassembly, no rupture and no fire.
Ambient temperature:24.5°C.

Test T.5:External short circuit

Test method;

The cell or battery to be tested shall be heated for a period of time necessary to reach a homogeneous stabilized temperature of 57 ± 4 °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 ± 4 °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 ± 4 °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.

The short circuit and cooling down phases shall be conducted at least at ambient temperature.

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 within six hours after test.

Test Date showed in table below;

State of sample	No.	Highest temperature (°C)	Status
At first cycle in fully charged states	B01#	57.4	PASS
	B02#	57.4	PASS
	B03#	57.6	PASS
	B04#	57.5	PASS
After 50 cycles ending in fully charged states	B05#	57.5	PASS
	B06#	57.6	PASS
	B07#	57.6	PASS
	B08#	57.3	PASS

Notes:

After the test, the cells are no disassembly, no rupture and no fire within six hours.

Ambient temperature: 24.2°C.

Test T.6: Impact/Crush

Impact(applicable to cylindrical cells not less than 18mm in diameter)

Test method;

The sample cell or component cell is to be placed on a flat smooth surface. A 15.8 mm \pm 0.1mm diameter, at least 6 cm long, or the longest dimension of the cell, whichever is greater, Type 316 stainless steel bar is to be placed across the centre of the sample. A 9.1 kg \pm 0.1 kg mass is to be dropped from a height of 61 \pm 2.5 cm at the intersection of the bar and sample in a controlled manner using a near frictionless, vertical sliding track or channel with minimal drag on the falling mass. The vertical track or channel used to guide the falling mass shall be oriented 90 degrees from the horizontal supporting surface.

The test sample is to be impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the 15.8 mm \pm 0.1mm diameter curved surface lying across the centre of the test sample. Each sample is to be subjected to only a single impact.

Crush(applicable to prismatic, pouch, coin/button cells and cylindrical cells not more than 18 mm in diameter)

Test method;

Cells 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 kN \pm 0.78 kN;
- (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.

Requirement;

Cells or component cell 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 test.

Test Date showed in table below;

State of sample	Test item	No.	Status
At first cycle at 50% of the design rated capacity	Crush	C09#	PASS
		C10#	PASS
		C11#	PASS
		C12#	PASS
		C13#	PASS

Notes:

Cells or component cell are no disassembly and no fire during the test and within six hours after test.

Ambient temperature: 24.5 °C.

Test T.7:Overcharge

Test method;

The charge current is twice the manufacturer's recommended maximum continuous charge current. The voltage of the test is the lesser of two times the maximum charge voltage of the battery ,Tests are to be conducted at ambient temperature. The duration of the test is 24 hours.

Requirement;

Batteries meet this requirement if there is no disassembly and no fire during the test and within seven days after the test

Test Date showed in table below;

Overcharge current: 2×1.8=3.6A	Overcharge voltage : 2×8.4V=16.8V	Total time of charging: 24hours
State of sample	No.	Status
At first cycle in fully charged states	B01#	PASS
	B02#	PASS
	B03#	PASS
	B04#	PASS
After 50 cycles ending in fully charged states	B05#	PASS
	B06#	PASS
	B07#	PASS
	B08#	PASS

Notes:

Cells are no disassembly and no fire during the test and within seven days after the test
Ambient temperature:24.7°C.

Test T.8:Forced discharge

Test method;

Each cells is 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.

Requirement;

Recharged cells meet this requirement if there is no disassembly and no fire during the test and within seven days after the test.

Test Date showed in table below;

State of sample	No.	Status
At first cycle in fully discharged states	C14#	PASS
	C15#	PASS
	C16#	PASS
	C17#	PASS
	C18#	PASS
	C19#	PASS
	C20#	PASS
	C21#	PASS
	C22#	PASS
	C23#	PASS
After 50 cycles ending in fully discharged states	C24#	PASS
	C25#	PASS
	C26#	PASS
	C27#	PASS
	C28#	PASS
	C29#	PASS
	C30#	PASS
	C31#	PASS
	C32#	PASS
	C33#	PASS

Notes:

After the test,the recharged cells are no disassembly and no fire during the test and within seven days Ambient temperature:24.4°C.

Photo document



Photo 1

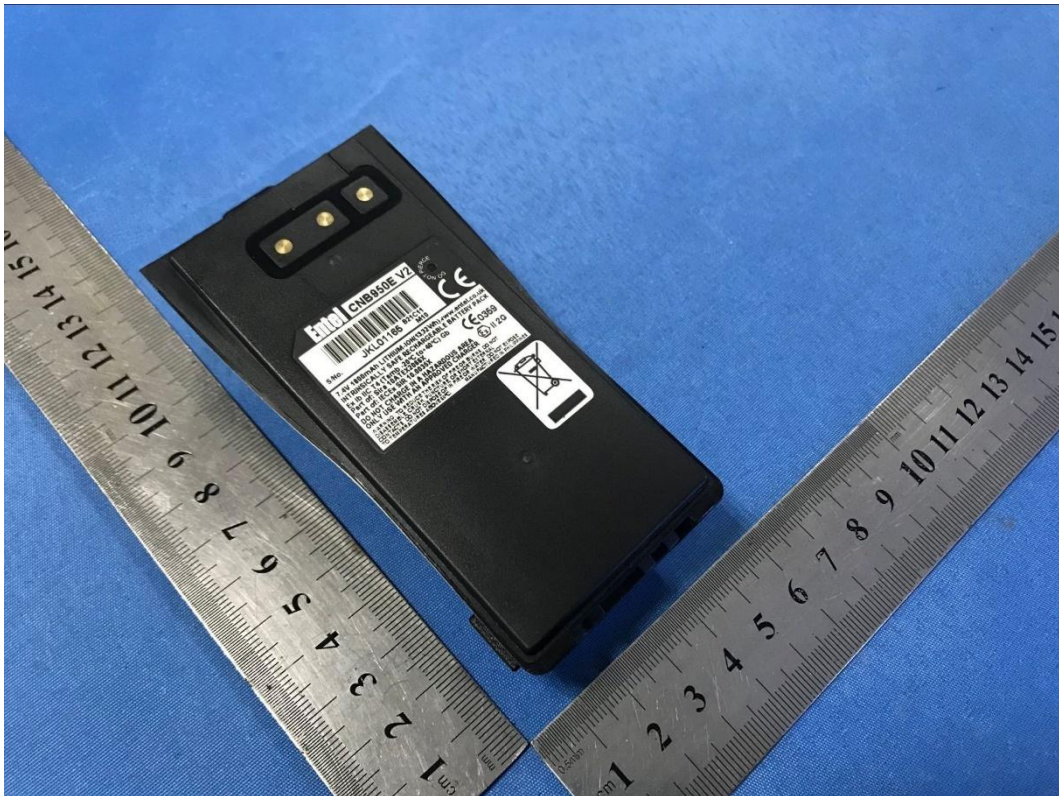


Photo 2

Photo document

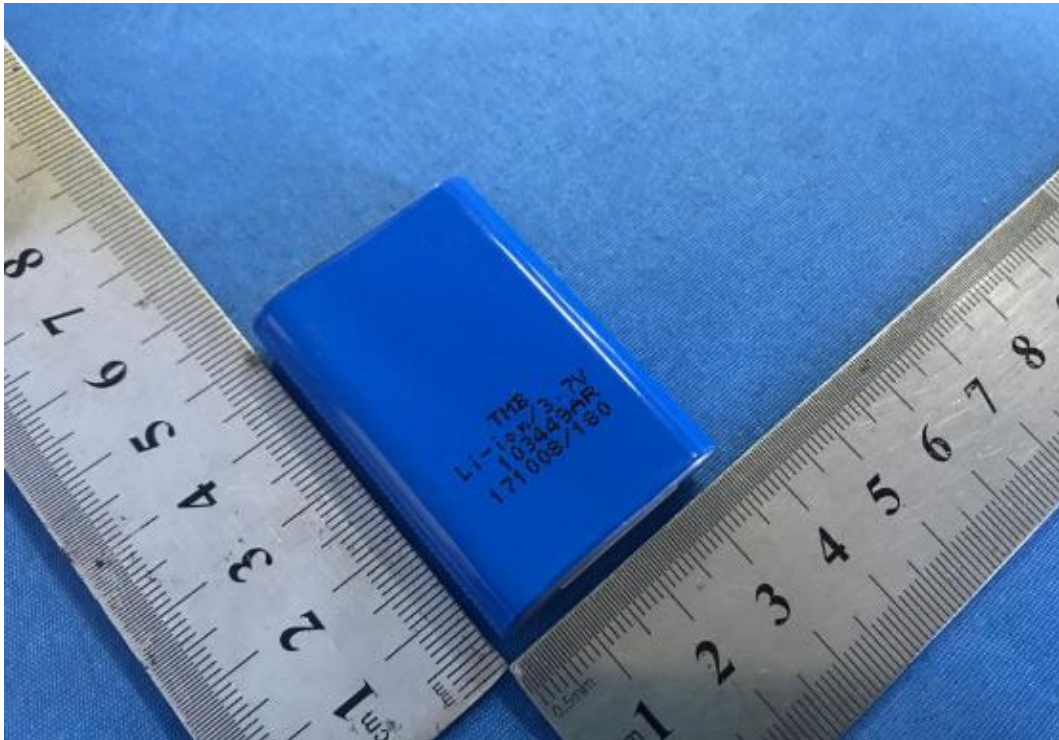


Photo 3



Photo 4

TESTING INSTRUMENTS

No.	NAME	Type	Serial No.	Effective date
1	Battery test system	BT2000	A0812588	2018/06/13
2	Battery charge&discharge test system	CHROMA 17011	R15100032	2018/10/25
3	DC Low Ohm Meter	YG2512	R160700400	2018/06/28
4	Digital Multimeter	GDM-8245	A13050135	2019/01/30
5	Vibration tester	ACT2000-S015L	YQ-242	2018/02/12
6	Electronic balance	BS 423S	R0509001	2018/07/24
7	Shock tester	CL-50	R141000242	2018/11/01
8	Ruler	CCIC-NF-02	C16080078	2018/11/20
9	High and low temperature test chamber	XSMS4-225C	R160700407	2018/07/26
10	LXI Data Acquisition/Switch Unit	34972A	R160527001	2018/07/06
11	20-Channel Armature Multiplexer	34901A	R160527003	2018/07/06
12	Vacuum chamber	RJD-DY-50	R150300294	2018/08/28
13	Crush tester	HY-JYDL-21	R1401193	2018/07/23

Notes: The above instrument is within the metering test cycle.

STATEMENT

1. The test report is invalid without stamp of laboratory.
2. The test report is invalid without signature of person(s) testing and authorizing.
3. The test report is invalid if erased and corrected.
4. Test results of the report is valid to the test samples if sampling by client.
5. “☆”item to be outside the scope of authorized by CNAS..
6. The test report shall not be reproduced except in full, without written approval of the laboratory.
7. If there is any objection to report, the client should inform issuing laboratory within 15 days from the date of receiving test report.

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