

TEST REPORT



CTK Co., Ltd.

(Ho-dong) 113, Yejik-ro, Cheoin-gu, Yongin-shi
Gyeonggi-do KOREA, REPUBLIC OF
Tel: +82-31-339-9970
Fax: +82-31-624-9501

Report No.:
CTK-2023-01886
Page(1) / (14)Pages

1. Report No.	CTK-2023-01886
2. Applicant	
Name	Aroot Co., Ltd.
Address	28-6, Gajangsaneopdong-ro, Osan-si, Gyeonggi-do, Republic of Korea
Date of Receipt	2023-07-06
3. Manufacturer	
Name	MPLUS Electronics Co., Ltd
Address	152-10, Muchon-ro, Bubal-eup, Icheon-si, Gyeonggi-do, Republic of Korea
4. Use of Report	UN Transport Test Report
5. Test sample / Model	Rechargeable Li-ion battery pack / LK-PB30
6. Date(s) of test	2023-07-17 to 2023-08-10
7. Test Standard (Method) used.....	ST/SG/AC.10/11/Rev.7/Amend.1 Recommendations on transport of dangerous goods / Manual of tests and criteria /Rev.7/Amend.1 Part III, subsection 38.3 Lithium metal and lithium ion batteries
8. Testing Environment.....	Temperature: (20.0 ± 5.0) °C
9. Results	Pass

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
This report shall not be reproduced except in full without the written approval of CTK

Approval	Tested by: JunHo, Choi (Signature)	Technical Manager: JungKyu, Yang (Signature)
----------	---------------------------------------	---

2023-09-04

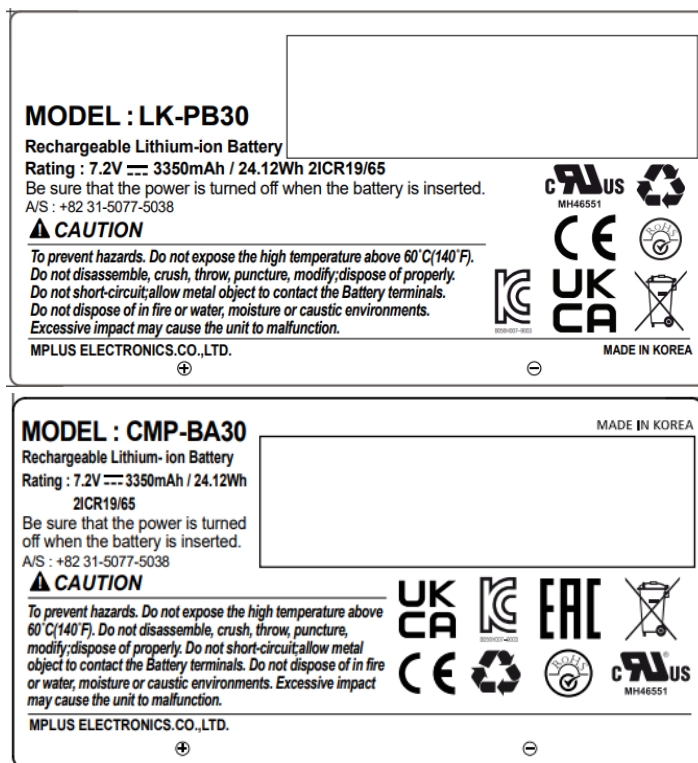
CTK Co., Ltd.

 CTK Co., Ltd. The Prime Leader of Global Regulatory Certification	CTK Co., Ltd. (Ho-dong) 113, Yejik-ro, Cheoin-gu, Yongin-shiGyeonggi-do KOREA, REPUBLIC OF Tel: +82-31-339-9970 Fax: +82-31-624-9501	Report No.: CTK-2023-01886 Page(2) / (14)Pages	
---	--	--	--

Test item description.....:	☐Lithium-ion Cell ☒Lithium-ion Battery ☐ Lithium-ion single cell battery
Trade Mark.....:	N/A
Model/Type reference.....:	1) LK-PB30 / 2INR19/66 2) CMP-BA30 / 2INR19/66
Rating	7.2 V, 3 350 mAh, 24.12 Wh
Mass (g)	Approx 123 g

List of Attachments (including a total number of pages in each attachment): Attachment 1 – 2 pages (Photographs) Attachment 2 – 1 page (Lithium cell or battery test summary)		
Summary of testing: <table border="1"> <tr> <td data-bbox="229 891 866 1176"> Tests performed (name of test and test clause): 38.3.4.1 Test T.1: Altitude simulation 38.3.4.2 Test T.2: Thermal test 38.3.4.3 Test T.3: Vibration 38.3.4.4 Test T.4: Shock 38.3.4.5 Test T.5: External short circuit 38.3.4.7 Test T.7: Overcharge </td> <td data-bbox="866 891 1509 1176"> Testing location: CTK Co., Ltd. (Ho-dong) 113, Yejik-ro, Cheoin-gu, Yongin-shiGyeonggi-do KOREA, REPUBLIC OF </td> </tr> </table>	Tests performed (name of test and test clause): 38.3.4.1 Test T.1: Altitude simulation 38.3.4.2 Test T.2: Thermal test 38.3.4.3 Test T.3: Vibration 38.3.4.4 Test T.4: Shock 38.3.4.5 Test T.5: External short circuit 38.3.4.7 Test T.7: Overcharge	Testing location: CTK Co., Ltd. (Ho-dong) 113, Yejik-ro, Cheoin-gu, Yongin-shiGyeonggi-do KOREA, REPUBLIC OF
Tests performed (name of test and test clause): 38.3.4.1 Test T.1: Altitude simulation 38.3.4.2 Test T.2: Thermal test 38.3.4.3 Test T.3: Vibration 38.3.4.4 Test T.4: Shock 38.3.4.5 Test T.5: External short circuit 38.3.4.7 Test T.7: Overcharge	Testing location: CTK Co., Ltd. (Ho-dong) 113, Yejik-ro, Cheoin-gu, Yongin-shiGyeonggi-do KOREA, REPUBLIC OF	
Model Differences: 1) Model CMP-BA30 is identical to Model LK-PB30 except for model name designation.		

Copy of marking plate



Possible test case verdicts:

- test case does not apply to the test object.....: N/A
- test object does meet the requirement: P (Pass)
- test object does not meet the requirement.....: F (Fail)

The state of cells or batteries:

Sample No.	States
B01– B04	at first cycle in fully charged states
B05–B08	after 25 cycles ending in fully charged states
B09– B12	at first cycle in fully charged states
B13– B16	after 25 cycles ending in fully charged states

 CTK Co., Ltd. The Prime Leader of Global Regulatory Certification	CTK Co., Ltd. (Ho-dong) 113, Yejik-ro, Cheoin-gu, Yongin-shi Gyeonggi-do KOREA, REPUBLIC OF Tel: +82-31-339-9970 Fax: +82-31-624-9501	Report No.: CTK-2023-01886 Page(4) / (14)Pages	
---	---	--	--

38.3 Lithium metal and lithium ion batteries

38.3.2 Scope

38.3.2.1 All cell types shall be subjected to tests T.1 to T.6 and T.8. All non-rechargeable battery types, including those composed of previously tested cells shall be subjected to tests T.1 to T.5.
All rechargeable battery types, including those composed of previously tested cells shall be subjected to tests T.1 to T.5 and T.7.

In addition, rechargeable single cell batteries with overcharge protection shall be subjected to test T.7.

A component cell that is not transported separately from the battery it is part of needs only to be tested according to tests T.6 and T.8.

A component cell that is transported separately from the battery shall be subjected to tests T.1 to T.6 and T.8.

38.3.2.2 Lithium metal and lithium ion cells and batteries shall be subjected to the tests, as required by special provisions 188 and 230 of Chapter 3.3 of the Model Regulations prior to the transport of a particular cell or battery type. Cells or batteries which differ from a tested type by:

- a) For primary cells and batteries, a change of more than 0.1 g or 20 % by mass, whichever is greater, to the cathode, to the anode, or to the electrolyte;
- b) For rechargeable cells and batteries, a change in nominal energy in Watt-hours of more than 20 % or an increase in nominal voltage of more than 20 %; or
- c) A change that would lead to failure of any of the tests,

shall be considered a new type and shall be subjected to the required tests.

NOTE: The type of change that might be considered to differ from a tested type, such that it might lead to failure of any of the test results, may include, but is not limited to:

- a) A change in the material of the anode, the cathode, the separator or the electrolyte;*
- b) A change of protective devices, including hardware and software;*
- c) A change of safety design in cells or batteries, such as a venting valve;*
- d) A change in the number of component cells;*
- e) A change in connecting mode of component cells; and*
- f) For batteries which are to be tested according to T.4 with a peak acceleration less than 150 g_n, a change in the mass which could adversely impact the result of the T.4 test and lead to a failure.*

In the event that a cell or battery type does not meet one or more of the test requirements, steps shall be taken to correct the deficiency or deficiencies that caused the failure before such cell or battery type is retested.

Mass loss means a loss of mass that exceeds the values in Table 38.3.2.2 below.

Table 38.3.1: Mass loss limit

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

NOTE: In order to quantify the mass loss, the following procedure is provided:

$$\text{Mass loss (\%)} = \frac{(M_1 - M_2)}{M_1} \times 100$$

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 38.3.1, it shall be considered as “no mass loss”

38.3.3 When a cell or battery type is to be tested under this sub-section, the number and condition of cells and batteries of each type to be tested are as follows:

- a) When testing primary cells and batteries under tests T.1 to T.5 the following shall be tested in the quantity indicated:
 - i) ten cells in undischarged states;
 - ii) ten cells in fully discharged states;
 - iii) four small batteries in undischarged states;
 - iv) four small batteries in fully discharged states;
 - v) four large batteries in undischarged states; and
 - vi) four large batteries in fully discharged states.
- b) When testing rechargeable cells and batteries under tests T.1 to T.5 the following shall be tested in the quantity indicated:
 - i) five cells at first cycle, in fully charged states;
 - ii) five cells after 25 cycles, in fully charged states;
 - iii) four small batteries at first cycle, in fully charged states;
 - iv) four small batteries after 25 cycles ending in fully charged states;
 - v) two large batteries at first cycle, in fully charged states; and
 - vi) two large batteries after 25 cycles ending in fully charged states.
- c) When testing primary and rechargeable cells under tests T.6, the following shall be tested in the quantity indicated:
 - i) for primary cells, five cells in undischarged states and five cells in fully discharged states;

 CTK Co., Ltd. The Prime Leader of Global Regulatory Certification	CTK Co., Ltd. (Ho-dong) 113, Yejik-ro, Cheoin-gu, Yongin-shiGyeonggi-do KOREA, REPUBLIC OF Tel: +82-31-339-9970 Fax: +82-31-624-9501	Report No.: CTK-2023-01886 Page(6) / (14)Pages	
---	--	--	--

- ii) for component cells of primary batteries, five cells in undischarged states and five cells in fully discharged states;
 - iii) for rechargeable cells, five cells at first cycle at 50 % of the design rated capacity and five cells after 25 cycles ending at 50% of the design rated capacity; and
 - iv) for component cells of rechargeable batteries, five cells at first cycle at 50 % of the design rated capacity and five cells after 25cycles ending at 50% of the design rated capacity.
- d) When testing rechargeable batteries or rechargeable single cell batteries under test T.7, the following shall be tested in the quantity indicated:
- i) four small batteries at first cycle, in fully charged states;
 - ii) four small batteries after 25 cycles ending in fully charged states;
 - iii) two large batteries at first cycle, in fully charged states; and
 - iv) two large batteries after 25 cycles ending in fully charged states.

Batteries or single cell batteries not equipped with battery overcharge protection that are designed for use only as a component in another battery, vehicle or in equipment, which affords such protection, are not subjected to the requirements of this test.

- e) When testing primary and rechargeable cells and component cells under tests T.8, the following shall be tested in the quantity indicated:
- i) ten primary cells in fully discharged states;
 - ii) ten primary component cells in fully discharged states;
 - iii) ten rechargeable cells, at first cycle in fully discharged states;
 - iv) ten rechargeable component cells, at first cycle in fully discharged states;
 - v) ten rechargeable cells after 25 cycles ending in fully discharged states; and
 - vi) ten rechargeable component cells after 25 cycles ending in fully discharged states.
- f) When testing a battery assembly in which the aggregate lithium content of all anodes, when fully charged, is not more than 500 g, or in the case of a lithium ion battery, with a Watt-hour rating of not more than 6200 Wh, that is assembled from batteries that have passed all applicable tests, one assembled battery in a fully charged state shall be tested under tests T.3, T.4 and T.5, and, in addition, test T.7 in the case of a rechargeable battery.
- g) When batteries that have passed all applicable tests are electrically connected to from a battery in which the aggregate lithium content of all anodes, when fully charged, is more than 500 g, or in the case of a lithium ion battery, with a Watt-hour rating of more than 6200 Wh, the assembled battery does not need to be tested if the assembled battery is of a type that has been verified as preventing:
- i) Overcharge;
 - ii) Short circuits; and
 - iii) Over discharge between the batteries.

 CTK Co., Ltd. The Prime Leader of Global Regulatory Certification	CTK Co., Ltd. (Ho-dong) 113, Yejik-ro, Cheoin-gu, Yongin-shi Gyeonggi-do KOREA, REPUBLIC OF Tel: +82-31-339-9970 Fax: +82-31-624-9501	Report No.: CTK-2023-01886 Page(7) / (14)Pages	
---	---	---	--

“For an assembled battery not equipped with overcharge protection that is designed for use only as a component in another battery, in equipment, or in a vehicle, which affords such protection:

- the overcharge protection shall be verified at the battery, equipment or vehicle level, as appropriate, and
- the use of charging systems without overcharge protection shall be prevented through a physical system or process controls.”

38.3.4 Procedure

Tests T.1 to T.5 shall be conducted in sequence on the same cell or battery.

Tests T.6 and T.8 shall be conducted using not otherwise tested cells or batteries.

Test T.7 may be conducted using undamaged batteries previously used in Tests T.1 to T.5 for purposes of testing on cycled batteries.

38.3.4.1 Test T.1: Altitude simulation

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 ± 5.0 °C).

Cells and batteries meet the requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery 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.

38.3.4.2 Test T.2: Thermal test

Test cells and batteries 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 until 10 total cycles are complete, 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.

Cells and batteries meet the requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery 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.

38.3.4.3 Test T.3: Vibration

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 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 shall differ for cells and batteries with a gross mass of not more than 12 kg (cells and small batteries), and for batteries with a gross mass of more than 12 kg (large batteries).

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 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.

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 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.

Cells and batteries meet the requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery 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.

38.3.4.4 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 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.

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

* Mass is expressed in kilograms

The relationship between minimum peak acceleration and mass is illustrated in Figure 38.3.4.1 for small batteries and Figure 38.3.4.2 for large batteries.

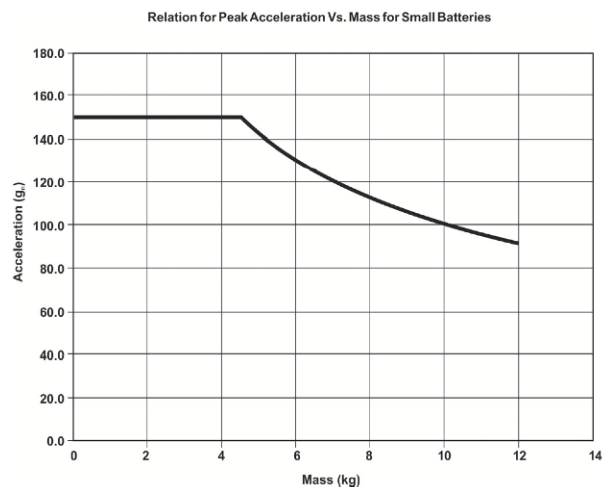


Figure 38.3.4.1: Relation between the Peak Acceleration and the Mass for small batteries (below 12.0 kg)

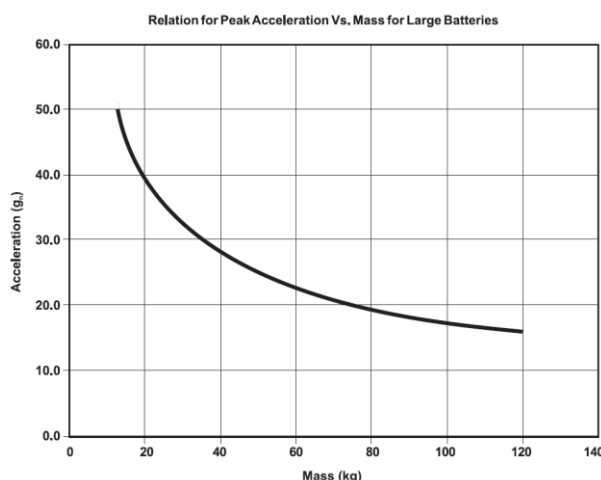


Figure 38.3.4.2: Relation between the Peak Acceleration and the Mass for large batteries (equal or above 12.0 kg)

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.

Cells and batteries meet the requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery 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.

38.3.4.5 Test T.5: External short circuit

The cell or battery to be tested shall be heated for a period of time necessary to reach a homogeneous stabilized 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.

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.

38.3.4.6 Test T.6: Impact/ Crush

38.3.4.6.2 Impact (applicable to cylindrical cells not less than 18.0 mm in diameter)

The test sample cell or component cell is to be placed on a flat smooth surface. A $15.8 \text{ mm} \pm 0.1 \text{ mm}$ 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 $9.1 \text{ kg} \pm 0.1 \text{ kg}$ mass is to be dropped from a height of $61 \pm 2.5 \text{ cm}$ 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

 CTK Co., Ltd. The Prime Leader of Global Regulatory Certification	CTK Co., Ltd. (Ho-dong) 113, Yejik-ro, Cheoin-gu, Yongin-shiGyeonggi-do KOREA, REPUBLIC OF Tel: +82-31-339-9970 Fax: +82-31-624-9501	Report No.: CTK-2023-01886 Page(10) / (14)Pages	
---	--	--	--

longitudinal axis of the 15.8 mm $\pm$ 0.1 mm diameter curved surface lying across the centre of the test sample.
Each sample is to be subjected to only a single impact.

38.3.4.6.3 Crush (applicable to prismatic, pouch, coin/button cells and cylindrical cells less than 18.0 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 kN $\pm$ 0.78 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 mV 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 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 cell or component cells that have not previously been subjected to other tests.

Cells and batteries 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 the test.

38.3.4.7 Test T.7: Overcharge

The charge current shall be twice the manufacturer's recommended maximum continuous charge current. The minimum voltage of the test shall be as follows:

- a) When the manufacturer's recommended charge voltage is not more than 18 V, the minimum voltage of the test shall be lesser of two times the maximum charge voltage of the battery or 22 V.
- b) When the manufacturer's recommended charge voltage is more than 18 V, the minimum voltage of the test shall be 1.2 times the maximum charge voltage.

Tests are to be conducted at ambient temperature. The duration of the test shall be 24 hours.

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

38.3.4.8 Test T.8: Forced discharge

Each cell shall be forced discharged at ambient temperature by connecting it in series with a 12 V D.C. power supply at 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).

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

38.3.4.1	TABLE: T.1 Altitude simulation						P
Model No.	Pre-test		After test		Voltage after test / pre-test (%)	Mass loss (%)	Results
	OCV (V)	Mass (g)	OCV (V)	Mass (g)			
B01	8.29	123.6	8.29	123.6	100.0	0.0	P
B02	8.28	123.7	8.28	123.7	100.0	0.0	P
B03	8.28	123.6	8.28	123.6	100.0	0.0	P
B04	8.28	123.7	8.28	123.7	100.0	0.0	P
B05	8.27	123.7	8.27	123.7	100.0	0.0	P
B06	8.27	123.3	8.27	123.3	100.0	0.0	P
B07	8.28	123.6	8.28	123.6	100.0	0.0	P
B08	8.27	123.3	8.27	123.3	100.0	0.0	P
Supplementary information: - at least six hours at ambient temperature (20 ± 5 °C) - Measuring mass before/after each test (If $M > 75g$, less than 0.1%, $1g \leq M \leq 75g$, less than 0.2%, $M < 1g$, less than 0.5%) - Measuring voltage before/after each test (more than 90%, only charged samples) - No leakage, no venting, no disassembly, no rupture, no fire							

38.3.4.2	TABLE: T.2 Thermal test						P
Model No.	Pre-test		After test		Voltage after test / pre-test (%)	Mass loss (%)	Results
	OCV (V)	Mass (g)	OCV (V)	Mass (g)			
B01	8.29	123.6	8.19	123.6	98.8	0.0	P
B02	8.28	123.7	8.19	123.7	98.9	0.0	P
B03	8.28	123.6	8.19	123.6	98.9	0.0	P
B04	8.28	123.7	8.19	123.7	98.9	0.0	P
B05	8.27	123.7	8.19	123.7	99.0	0.0	P
B06	8.27	123.3	8.19	123.3	99.0	0.0	P
B07	8.28	123.6	8.19	123.6	98.9	0.0	P
B08	8.27	123.3	8.20	123.3	99.2	0.0	P
Supplementary information: - after which all test cells and batteries are to be stored for 24 hours at ambient temperature (20 ± 5 °C) - Measuring mass before/after each test (If $M > 75g$, less than 0.1%, $1g \leq M \leq 75g$, less than 0.2%, $M < 1g$, less than 0.5%) - Measuring voltage before/after each test (more than 90%, only charged samples) - No leakage, no venting, no disassembly, no rupture, no fire							

38.3.4.3	TABLE: T.3 Vibration						P
Model No.	Pre-test		After test		Voltage after test / pre-test (%)	Mass loss (%)	Results
	OCV (V)	Mass (g)	OCV (V)	Mass (g)			
B01	8.19	123.6	8.19	123.6	100.0	0.0	P
B02	8.19	123.7	8.19	123.7	100.0	0.0	P
B03	8.19	123.6	8.19	123.6	100.0	0.0	P
B04	8.19	123.7	8.19	123.7	100.0	0.0	P
B05	8.19	123.7	8.19	123.7	100.0	0.0	P
B06	8.19	123.3	8.19	123.3	100.0	0.0	P
B07	8.19	123.6	8.19	123.6	100.0	0.0	P
B08	8.20	123.3	8.20	123.3	100.0	0.0	P
Supplementary information: - Measuring mass before/after each test (If $M > 75g$, less than 0.1%, $1g \leq M \leq 75g$, less than 0.2%, $M < 1g$, less than 0.5%) - Measuring voltage before/after each test (more than 90%, only charged samples) - No leakage, no venting, no disassembly, no rupture, no fire							

38.3.4.4	TABLE: T.4 Shock						P
Model No.	Pre-test		After test		Voltage after test / pre-test (%)	Mass loss (%)	Results
	OCV (V)	Mass (g)	OCV (V)	Mass (g)			
B01	8.19	123.6	8.19	123.6	100.0	0.0	P
B02	8.19	123.7	8.19	123.7	100.0	0.0	P
B03	8.19	123.6	8.19	123.6	100.0	0.0	P
B04	8.19	123.7	8.19	123.7	100.0	0.0	P
B05	8.19	123.7	8.19	123.7	100.0	0.0	P
B06	8.19	123.3	8.19	123.3	100.0	0.0	P
B07	8.19	123.6	8.19	123.6	100.0	0.0	P
B08	8.20	123.3	8.20	123.3	100.0	0.0	P
Supplementary information: - Measuring mass before/after each test (If $M > 75g$, less than 0.1%, $1g \leq M \leq 75g$, less than 0.2%, $M < 1g$, less than 0.5%) - Measuring voltage before/after each test (more than 90%, only charged samples) - No leakage, no venting, no disassembly, no rupture, no fire							

38.3.4.5	TABLE: T.5 External short circuit			P
Model No.	OCV at start of test (V)	Resistance of circuit (mΩ)	Peak Temperature on the external case (°C)	Results
B01	8.19	81.0	57.1	P
B02	8.19	83.0	57.2	P
B03	8.19	90.0	57.1	P
B04	8.19	85.0	57.0	P
B05	8.19	81.0	57.2	P
B06	8.19	84.0	57.1	P
B07	8.19	89.0	57.1	P
B08	8.20	85.0	57.2	P
Supplementary information: - Temperature < 170 °C - No disassembly, no rupture and no fire during test and within 6 hours after the test				

38.3.4.6	TABLE: T.6 Crush		N/A
Model No.	OCV at start of test (V)	Peak Temperature on the external case (°C)	Results
Supplementary information: ☐ cylindrical (> 18.0 mm in diameter) ☐ cylindrical (≤ 18.0 mm in diameter) ☐ prismatic ☐ pouch ☐ coin/button cells and - Φ=15.8mm bar, 9.1kg mass, (61±2.5) cm height - Temperature < 170 °C - No disassembly, no rupture and no fire during test and within 6 hours after the test			

 CTK Co., Ltd. The Prime Leader of Global Regulatory Certification	CTK Co., Ltd. (Ho-dong) 113, Yejik-ro, Cheoin-gu, Yongin-shi Gyeonggi-do KOREA, REPUBLIC OF Tel: +82-31-339-9970 Fax: +82-31-624-9501	Report No.: CTK-2023-01886 Page(14) / (14)Pages	
---	---	---	--

38.3.4.7	TABLE: T.7 Overcharge				P
Model No.	OCV at start of test (V)	Charge voltage (V)	Charge current (A)	Peak Temperature on the external case (°C)	Results
B09	8.28	16.8	5.2	23.5	P
B10	8.28			23.8	P
B11	8.28			23.6	P
B12	8.28			23.3	P
B13	8.29			24.0	P
B14	8.27			23.8	P
B15	8.27			23.9	P
B16	8.28			23.8	P
Supplementary information:					
- No disassembly, no fire during the test and within 7 days after the test					

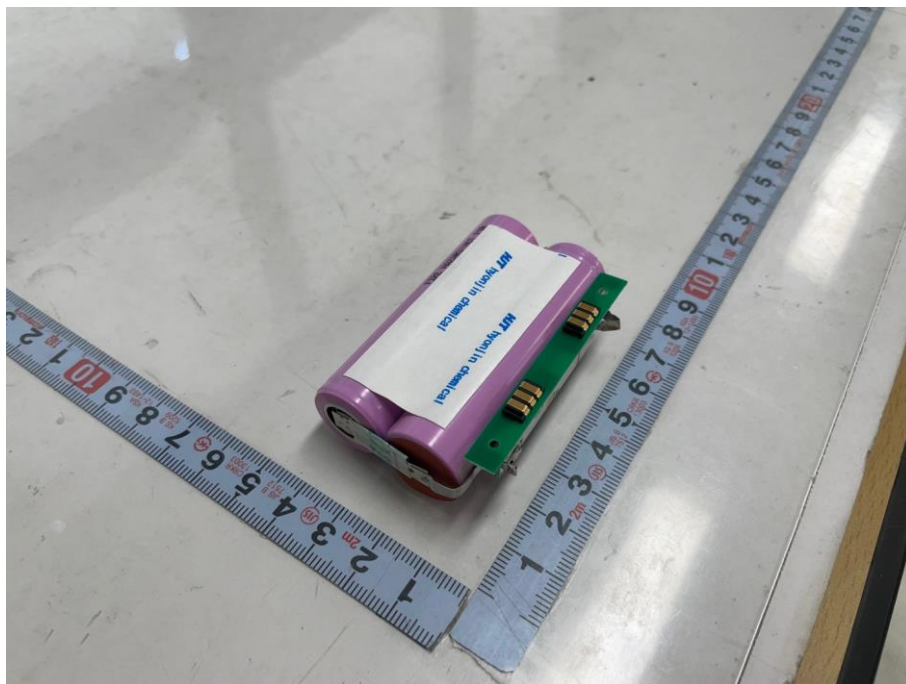
38.3.4.8	TABLE: T.8 Forced discharge				N/A
Model No.	OCV at start of test (V)	Discharge current (mA)	Test duration	Peak Temperature on the external case (°C)	Results
Supplementary information: - No disassembly and no fire during the test and within 7 days after the test					

Attachment 1 – Photographs

<Photo 1>Top side view

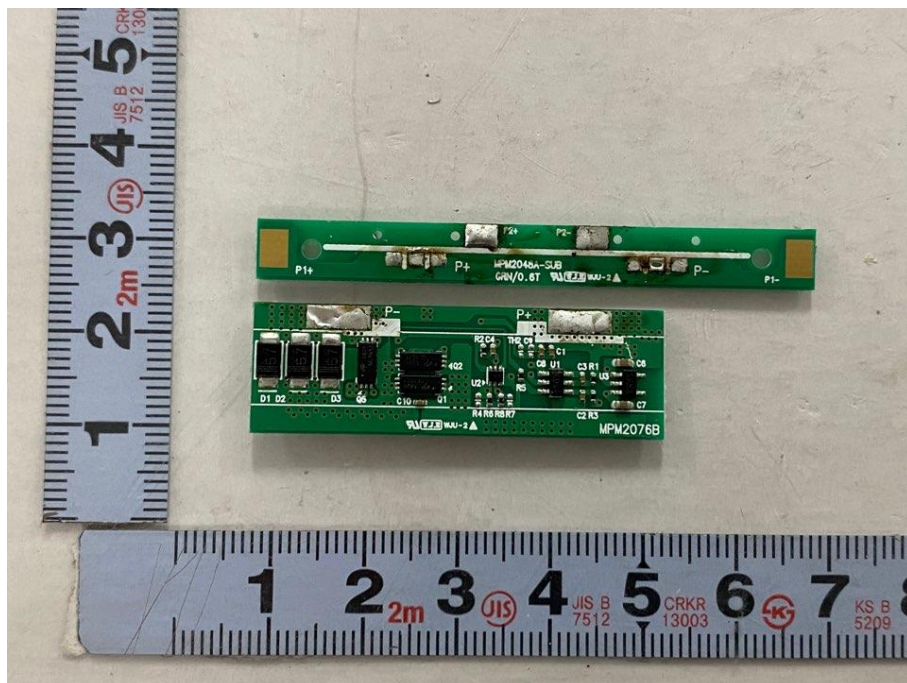


<Photo 2> Inside view

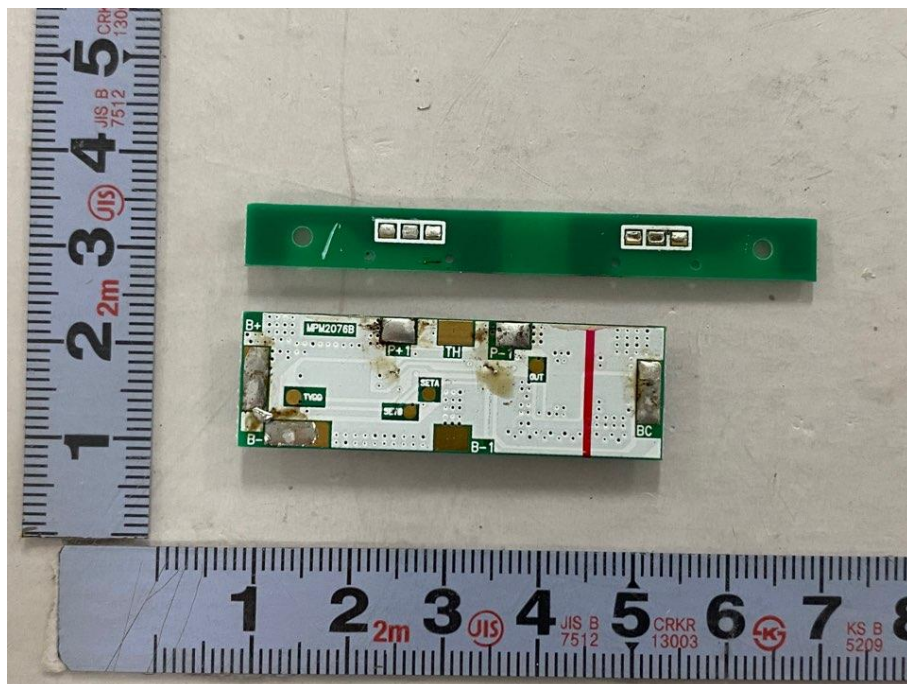


Attachment 1 – Photographs

<Photo 3>Component side view – PCM



<Photo 4>Solder side view – PCM



 CTK Co., Ltd. The Prime Leader of Global Regulatory Certification	CTK Co., Ltd. (Ho-dong) 113, Yejik-ro, Cheoin-gu, Yongin-shiGyeonggi-do KOREA, REPUBLIC OF Tel: +82-31-339-9970 Fax: +82-31-624-9501	Report No.: CTK-2023-01886 Page(1)/ (1) pages	
---	--	---	--

Attachment 2 – Lithium cell or battery test summary

Lithium cell or battery test summary in accordance with sub-section 38.3 of Manual of Tests and Criteria

a) Name of cell, battery, or product manufacturer, as applicable;

Cell manufacturer : SAMSUNG SDI Co., LTD.

Battery manufacturer : MPLUS Electronics Co., Ltd

b) Cell, battery, or product manufacturer's contact information to include address, phone number, email address and website for more information;

Battery manufacturer Address: 152-10, Muchon-ro, Bubal-eup, Icheon-si, Gyeonggi-do, Repulic of Korea

c) Name of the test laboratory to include address, phone number, email address and website for more information;

Test laboratory: CTK Co., Ltd.

Address: (Ho-dong) 113, Yejik-ro, Cheoin-gu, Yongin-shiGyeonggi-do KOREA, REPUBLIC OF

Tel: +82-31-339-9970, Fax: +82-31-624-9501

d) A unique test report identification number;

Report No.:CTK-2023-01886

e) Date of test report; 2023-09-04

f) Description of cell or battery to include at a minimum;

1) **Lithium ion or lithium metal cell or battery;** Rechargeable Li-ion battery pack

2) **Mass;** Approx 123 g

3) **Watt-hour rating, or lithium content;** 7.2 V, 3 350 mAh, 24.12 Wh

4) **Physical description of the battery;** Battery Size; 72.04 mm(L) X 56.49 mm(W) X 22.25 mm(T)
/ 2INR19/66

5) **Model numbers ;** LK-PB30, CMP-BA30

Model Differences: Model CMP-BA30 is identical to Model LK-PB30 except for model name designation

g) List of tests conducted and result (i.e., pass/fail);

T.1, T.2, T.3, T.4, T.5, and T.7. (Note that T.6 and T.8 are not applicable to batteries.)/ Pass

h) Reference to assembled battery testing requirements, if applicable (i.e. 38.3.3 (f) and 38.3.3(g));

Not Applicable

i) Reference to the revised edition of the Manual of Tests and Criteria used and to amendments thereto, if any; and ; ST/SG/AC.10/11/Rev.7/Amend.1

j) Name and title of responsible person as an indication of the validity of information provided. ;

Technical Manager: Jung Kyu Yang (Signature)