UN-20191107-02

Issue: November 7, 2019

FDK

Certificate of UN Test for Lithium Metal Cell

Specifications			
Model：ML621-TZ1　[Shape：Coin]			
Nominal voltage	3V	Product mass	0.3g
Nominal capacity	5.8mAh	Lithium equivalent content	0.002g

Manual of Tests and Criteria / Rev.6 Amendment 1 / 38.3 Lithium metal and lithium ion batteries

Test report number : D-C-105-06　Date of test report : November 7, 2019

No.	Test items	Test results	Note	Number of test cells	
T1	Altitude simulation	Pass		1st cycle, Fully charged 5 cells	25th cycle, Fully charged 5 cells
T2	Thermal test	Pass			
T3	Vibration	Pass			
T4	Shock	Pass			
T5	External short circuit	Pass			
T6	Crush	Pass		1st cycle, 50% charged 5 cells	25th cycle, 50% charged 5 cells
T7	Overcharge	—		—	
T8	Forced discharge	Pass		1st cycle, Fully discharged 10 cells	25th cycle, Fully discharged 10 Cells

Information		
Manufacturer / Seller	FDK CORPORATION Shinagawa Crystal Square Bldg.,1-6-41 Konan, Minato-ku, Tokyo 108-8212 Japan TEL: +81-3-5715-7400　E-mail: lithium_battery_info@fdk.co.jp Website: http://www.fdk.com/	
Test laboratory	FDK CORPORATION　(Tottori Plant) 28 Ohta, Iwami-cho, Iwami- gun,Tottori, 681-0063,Japan　TEL: +81-857-73-1771	

FDK CORPORATION
Technical Support Department
Lithium Battery Division

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UN Test Data (Model: ML621-TZ1)

1.Test Item: Altitude simulation (T1)

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

3.Test Procedure:

The 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).

FDK Internal Procedure:

As above.

4.Test Requirements:

No mass loss(less than 0.5% or 0.2% or 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 cells at fully discharged states.

5.Test Date: 2013/1/7

6.Test Data

Type of Lithium Battery: coin type rechargeable lithium cell							Lithium Content: 0.002 g			
Cell No.		Mass(g)		Mass loss (< 0.5%)	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	0.2184	0.2178	0.27	2.929	2.930	100.03	0	PASS	PASS
	2	0.2182	0.2183	-0.05	2.922	2.923	100.03	0	PASS	
	3	0.2183	0.2186	-0.14	2.927	2.928	100.03	0	PASS	
	4	0.2186	0.2188	-0.09	2.935	2.936	100.03	0	PASS	
	5	0.2167	0.2171	-0.18	2.934	2.935	100.03	0	PASS	
	6	0.2178	0.2181	-0.14	2.930	2.930	100.00	0	PASS	
	7	0.2183	0.2184	-0.05	2.926	2.927	100.03	0	PASS	
	8	0.2181	0.2183	-0.09	2.939	2.941	100.07	0	PASS	
	9	0.2172	0.2174	-0.09	2.938	2.939	100.03	0	PASS	
	10	0.2175	0.2173	0.09	2.925	2.926	100.03	0	PASS	
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Notes: L-Leakage, V-Venting, D-Disassembly, R-Rupture, F-Fire,
0-No leakage, no venting, no disassembly, no rupture & no fire

7.Test Requirement:

This UN test data meets test requirement of "UN Manual of Test and Criteria 6th revised edition part Ⅲ, sub-section 38.3".

UN Test Data (Model: ML621-TZ1)

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±2℃, followed by storage for at least six hours at temperature equal to -40±2℃.The maximum time internal 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 storedfor 24 hours at ambient temperature (20 ±5℃)For large cells and batteries the duration of exposure to the test temperature extremes should be at least 12 hours.

FDK Internal Procedure:

As above.

4.Test Requirements:

No mass loss(less than 0.5% or 0.2% or 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 cells at fully discharged states.

5.Test Date: 2013/1/8-2013/1/15

6.Test Data

Type of Lithium Battery: coin type rechargeable lithium cell							Lithium Content: 0.002 g			
Cell No.		Mass(g)		Mass loss (< 0.5%)	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	0.2178	0.2177	0.05	2.930	2.874	98.10	0	PASS	PASS
	2	0.2183	0.2184	-0.05	2.923	2.860	97.85	0	PASS	
	3	0.2186	0.2185	0.05	2.928	2.875	98.18	0	PASS	
	4	0.2188	0.2186	0.09	2.936	2.881	98.12	0	PASS	
	5	0.2171	0.2169	0.09	2.935	2.882	98.18	0	PASS	
	6	0.2181	0.2179	0.09	2.930	2.873	98.04	0	PASS	
	7	0.2184	0.2180	0.18	2.927	2.873	98.16	0	PASS	
	8	0.2183	0.2181	0.09	2.941	2.876	97.80	0	PASS	
	9	0.2174	0.2171	0.14	2.939	2.876	97.87	0	PASS	
	10	0.2173	0.2173	0.00	2.926	2.869	98.06	0	PASS	
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Notes: L-Leakage, V-Venting, D-Disassembly, R-Rupture, F-Fire,
0-No leakage, no venting, no disassembly, no rupture & no fire

7.Test Requirement:

This UN test data meets test requirement of "UN Manual of Test and Criteria 6th revised edition part Ⅲ, sub-section 38.3".

UN Test Data (Model: ML621-TZ1)

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 total of 3 hours for each of the 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 frequency increased until a peak acceleration of 8gn occurs (approximately 50Hz).A peak acceleration of 8 g_n is then maintained until the frequency is increased to 200Hz.

FDK Internal Procedure:

As above.

4.Test Requirements:

No mass loss(less than 0.5% or 0.2% or 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 cells at fully discharged states.

5.Test Date: 2013/1/16-2013/1/17

6.Test Data

Type of Lithium Battery: coin type rechargeable lithium cell							Lithium Content: 0.002 g			
Cell No.		Mass(g)		Mass loss (< 0.5%)	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	0.2177	0.2175	0.09	2.874	2.875	100.01	0	PASS	PASS
	2	0.2184	0.2182	0.09	2.860	2.861	100.01	0	PASS	
	3	0.2185	0.2182	0.14	2.875	2.875	100.02	0	PASS	
	4	0.2186	0.2184	0.09	2.881	2.881	100.02	0	PASS	
	5	0.2169	0.2167	0.09	2.882	2.882	100.01	0	PASS	
	6	0.2179	0.2180	-0.05	2.873	2.873	100.00	0	PASS	
	7	0.2180	0.2183	-0.14	2.873	2.874	100.02	0	PASS	
	8	0.2181	0.2180	0.05	2.876	2.877	100.01	0	PASS	
	9	0.2171	0.2171	0.00	2.876	2.876	100.00	0	PASS	
	10	0.2173	0.2173	0.00	2.869	2.870	100.01	0	PASS	
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Notes: L-Leakage, V-Venting, D-Disassembly, R-Rupture, F-Fire,
0-No leakage, no venting, no disassembly, no rupture & no fire

7.Test Requirement:

This UN test data meets test requirement of "UN Manual of Test and Criteria 6th revised edition part Ⅲ, sub-section 38.3".

UN Test Data (Model: ML621-TZ1)

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 pack 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 pulse duration of 11 milliseconds. Each cell or battery is subjected to three shocks in the positive direction followed by three shocks in thenegative direction of each of three mutually perpendicular mounting positions of the cell for a total of 18 shocks.

FDK Internal Procedure:

As above.

4.Test Requirements:

No mass loss(less than 0.5% or 0.2% or 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 cells at fully discharged states.

5.Test Date: 2013/1/18

6.Test Data

Type of Lithium Battery: coin type rechargeable lithium cell							Lithium Content: 0.002 g			
Cell No.		Mass(g)		Mass loss (< 0.5%)	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	0.2175	0.2177	-0.09	2.875	2.875	100.01	0	PASS	PASS
	2	0.2182	0.2183	-0.05	2.861	2.861	100.01	0	PASS	
	3	0.2182	0.2182	0.00	2.875	2.876	100.03	0	PASS	
	4	0.2184	0.2184	0.00	2.881	2.882	100.02	0	PASS	
	5	0.2167	0.2160	0.32	2.882	2.882	100.00	0	PASS	
	6	0.2180	0.2177	0.14	2.873	2.873	100.01	0	PASS	
	7	0.2183	0.2178	0.23	2.874	2.874	100.01	0	PASS	
	8	0.2180	0.2176	0.18	2.877	2.877	100.01	0	PASS	
	9	0.2171	0.2171	0.00	2.876	2.877	100.02	0	PASS	
	10	0.2173	0.2172	0.05	2.870	2.870	100.01	0	PASS	
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Notes: L-Leakage, V-Venting, D-Disassembly, R-Rupture, F-Fire,
0-No leakage, no venting, no disassembly, no rupture & no fire

7.Test Requirement:

This UN test data meets test requirement of "UN Manual of Test and Criteria 6th revised edition part Ⅲ, sub-section 38.3".

UN Test Data (Model: ML621-TZ1)

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±2℃ and then the cell or battery shall be subjected to a short condition with a total external resistance of less than 0.1ohm at 55±2℃.This short circuit condition is continued for at least one hour after the cell or battery external case temperature has returned to 55±2℃. The cell or battery must be observed for a further six hours for the test to be concluded.

FDK 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: 2013/1/21

6.Test Data

Type of Lithium Battery: coin type rechargeable lithium cell

Lithium Content: 0.002 g

Cell No.		Maximum Temperature (°C)	Other event	Result	Judgement
At first cycle,in fully charged states	1	56.4	0	PASS	PASS
	2	56.5	0	PASS	
	3	56.0	0	PASS	
	4	56.5	0	PASS	
	5	56.8	0	PASS	
	6	56.8	0	PASS	
	7	55.8	0	PASS	
	8	57.2	0	PASS	
	9	56.9	0	PASS	
	10	55.8	0	PASS	
	11				
	12				
	13				
	14				
	15				
	16				
	17				
	18				
	19				
	20				

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

7.Test Requirement:

This UN test data meets test requirement of "UN Manual of Test and Criteria 6th revised edition part Ⅲ, sub-section 38.3".

UN Test Data (Model: ML621-TZ1)

1.Test Item:Crush (T6)

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

3.Test Procedure: (applicable to prismatic, pouch, coin/button 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 kN±0.78 kN;

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

(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.

Each test cell or component cell is to be subjected to one crush only. The test sample shall be observed for a further 6h.

The test shall be conducted using test cells or component cells that have not previously been subjected to other tests.

FDK 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: 2013/1/15

6.Test Data

Type of Lithium Battery: coin type rechargeable lithium cell

Lithium Content: 0.002 g

Cell No.		Maximum Temperature (°C)	Other event	Result	Judgement
At first cycle,50% charged states	1	less than 160°C	0	PASS	PASS
	2	less than 160°C	0	PASS	
	3	less than 160°C	0	PASS	
	4	less than 160°C	0	PASS	
	5	less than 160°C	0	PASS	

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

7.Test Requirement:

This UN test data meets test requirement of "UN Manual of Test and Criteria 6th revised edition part Ⅲ, sub-section 38.3".

UN Test Data (Model: ML621-TZ1)

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).

FDK Internal Procedure:

As above.

4.Test Requirements:

There is no disassembly and no fire within seven days of this test.

5.Test Date: 2013/1/21-2013/1/28

6.Test Data

Type of Lithium Battery: coin type rechargeable lithium cell				
Lithium Content: 0.002 g				
Cell No.		Event	Result	Judgement
At first cycle,in fully discharged states	1	0	PASS	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	

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

7.Test Requirement:

This UN test data meets test requirement of "UN Manual of Test and Criteria 6th revised edition part Ⅲ, sub-section 38.3".