Product Specification

Flexible (Lithium-Ion) Cell

Model: F3920056

LiBEST Inc.

193, Munji-ro, Yuseong-gu, Daejeon, 34051, Republic of Korea

http://libest.co

Revision history

File version	Date	Description	Remarks
V0	2022.04.26	Original release	Tentative
V0.1	2023.08.23	Updated working temp.	

1. General Information

1-1. This product specification describes the requirements of lithium secondary cell with polymer jacket to be supplied to the customer by LiBEST Inc. Please using the test methods that recommend in this specification.

1-2. Product classification : Rechargeable Lithium-ion Cell (Pouch-type)

1-3. Designated name by IEC61960-3 : ICP4/20/56

1-4. Model / Part number : F3920056

1-5. Manufacturer : LiBEST Inc.

1-6. Manufacturing site : 193, Munji-ro, Yuseong-gu, Daejeon, 34051, Republic of Korea

2. Nominal Specification

Item		Specifications	Remarks
Discharge capacity		117mAh (C_{typ})	Based on standard charge / discharge (1C=110mA)
		110mAh (C_{min})	
Nominal voltage		3.80V	Average voltage @ standard discharge
Standard charge	Voltage	4.350±0.005V	Constant current & Constant voltage
	Current	0.5C	
	Cutoff	0.05C	
Max charge	Voltage	4.350±0.005V	10℃ ≤ Working temperature ≤ 45℃
	Current	1.0C	
	Cutoff	0.05C	
Standard discharge	Current	0.2C	Constant current
	Cutoff	3.0V	
Max discharge	Current	1.0C	0℃ ≤ Working temperature ≤ 60℃
		0.5C	-20℃ ≤ Working temperature < 0℃
	Cutoff	3.0V	-20℃ ≤ Working temperature ≤ 60℃
Cell voltage (Open Circuit)		3.78±0.05V	SoC 30% (Shipping state)
Impedance		≤ 600mΩ	AC 1kHz @ SoC 30% & 25℃
Weight		3.6 g	
Storage temperature	≤1month	-20 ~ 60℃	Recommended
	≤3month	-20 ~ 45℃	
	≤12month	-20 ~ 20℃	
Storage humidity		RH 65±20%	

3. Performance Specification

3.1. General test condition

3.1.1. Standard charge

"Standard charge" shall consist of charging at constant current of 0.5C. The cell shall then be charged at constant voltage of 4.35V while tapering the charge current. Charging shall be terminated when the charging current has tapered to 0.05C. For test purposes, charging shall be performed at 25±3℃.

3.1.2. Standard discharge

"Standard discharge" shall consist of discharging at a constant current of 0.2C to 3.0V. Discharging is to be performed at 25±3℃, unless otherwise noted.

3.1.3. Fast charge

"Fast charge" shall consist of charging at constant current of 0.7C. The cell shall then be charged at constant voltage of 4.35V while tapering the charge current. Charging shall be terminated when the charging current has tapered to 0.05C. Charging shall be performed at 25±3℃.

3.1.4. Fast discharge

"Fast discharge" shall consist of discharging at a constant current of 0.5C to 3.0V. Discharging is to be performed at 25±3℃, unless otherwise noted.

3.2. Electrical Specification

Item		Test condition	Spec.
3.2.1	Initial capacity (C_{ini})	Cell shall be charged per 3.1.1 and discharged per 3.1.2 within 1hr after standard charge completion.	≥ C_{min}
3.2.2	Initial AC impedance	Cell shall be discharged per 3.1.2 and charged per 3.1.1 for 0.5hrs. And then, the resistance of cell shall be measured at 1kHz at 25±3℃	≤ 600mΩ without protection circuit
3.2.3	Cycle life (25℃)	Cell shall be charged and discharged 500times per 3.1.3 and 3.1.4. During test, cell shall be rest for 10minutes after charging completion and discharging completion.	≥ 80% of 1st discharge capacity ≤ 10% of 1st cycle cell thickness
	Cycle life (45℃)	Cell shall be charged and discharged 400times per 3.1.3 and 3.1.4. During test, cell shall be rest for 10minutes after charging completion and discharging completion.	

3.3. Environmental Specification

Item		Test condition	Spec.
3.3.1	Storage Characteristics (I)	Cell shall be charged per 3.1.1 and stored in a temperature-controlled environment at 25±3℃ for 28 days. After storage, cell shall be discharged per 3.1.2 to obtain the remaining capacity.	≥ 90% of C_{ini} ≤ 5% of swelling
3.3.2	Storage Characteristics (II)	Cell shall be charged per 3.1.1 and stored in a temperature-controlled environment at 25±3℃ for 28days. After storage, cell shall be discharged per 3.1.2 and cycled per 3.1.1 and 3.1.2 to obtain discharge capacity. (Recovery capacity)	≥ 90% of C_{ini} ≤ 5% of swelling
3.3.3	Storage Characteristics (III)	Cell shall be charged per 3.1.1 and stored in a temperature-controlled environment at 45±3℃ for 28days. After storage, cell shall be discharged per 3.1.2 and cycled per 3.1.1 and 3.1.2 for 3 times to obtain discharge capacity. (Recovery capacity)	≥ 85% of C_{ini} ≤ 10% of swelling
3.3.4	Storage Characteristics (IV)	Cell shall be charged per 3.1.1 and stored in a temperature-controlled environment at 60±3℃ for 14days. After storage, cell shall be discharged per 3.1.2 and cycled per 3.1.1 and 3.1.2 for 3 times to obtain discharge capacity. (Recovery capacity)	≥ 85% of C_{ini} ≤ 10% of swelling
3.3.5	High Temperature and High Humidity Test	Cell shall be charged per 3.1.1 and stored at 60℃ (95% RH) for 168 hours. After test, cell shall be discharged per 3.1.2 and cycled per 3.1.1 and 3.1.2 for 3 times to obtain discharge capacity. (Recovery capacity)	≥ 80% of C_{ini}
3.3.6	Low Temperature Characteristics	Cell shall be charged per 3.1.1 and laying the cell 2hrs at -10℃, and then the cell shall be discharged by 0.2C current until the voltage is dropped to 2.75V.	≥ 60% of C_{min}

3.4. Mechanical Specification

Item		Test condition	Spec.
3.4.1	Vibration	Cells 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 shall differ for cells with a gross mass of not more than 12 kg. 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 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. (Refer to UN38.3)	No explosion No fire No leakage
3.4.2	Drop	Cell charged per 3.1.1 is dropped three times from a height of 1.0meter on to a concrete floor. The cells are dropped so as to obtain impacts in random orientations. Cells are examined 1 hour after dropping	
3.4.3	Bending (Curved state)	Cell shall be discharged per 3.1.2. And then, the cell is bended by R25mm curvature. (It is recommended to follow the specified bending direction as per 4.3) Cell shall be charged per 3.1.1 and discharged per 3.1.2 in a bent state.	≥ 90% of C_{min}
3.4.4	Cyclic bending	Cell shall be discharged per 3.1.2 and charged with 0.5C current for 1hr. And then cell shall be repeatedly bent and unfolded 3,000times with R25mm curvature and 25 times per minute velocity. After 3,000times bending, cell shall be discharged per 3.1.2. And then, the cell shall be charged per 3.1.1 and discharged per 3.1.2.	≥ 80% of C_{min}
3.4.5	Cyclic twist	Cell shall be discharged per 3.1.2 and charged with 0.5C current for 1hr. And then cell shall be repeatedly twisted 3,000times with +/-15° angle and 0.5Hz velocity. After 3,000times twist, cell shall be discharged per 3.1.2. And then, the cell shall be charged per 3.1.1 and discharged per 3.1.2.	≥ 80% of C_{min}

3.5. Safety Specification

Item		Test condition	Spec.
3.5.1	Over charge	Test cell is discharged per 3.1.1, and then charged at constant current of 3 times the max. charge condition and constant voltage of 4.35V while tapering the charge current. Charging is continued for 7 hours. (Refer to UL1642)	No explosion No fire
3.5.2	Over discharge	Tet cell shall be forced discharged at ambient temperature by connecting it in series with a 12V DC 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 road of the appropriate size and rating in series with the test cell. Test cell shall be forced discharged for a time interval (in hours) equal to its rated capacity divided by the initial test current (in ampere). (Refer to UN38.3)	No explosion No fire
3.5.3	External short-circuit	The cell 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. Then the cell at 57 ± 4 °C shall be subjected to one short circuit condition with a total external resistance of less than 0.1 ohm.	No explosion No fire Temp. ≤ 170℃
3.5.4	Thermal abuse (Heating)	Each fully charged cell by charging method 3.1.1, stabilized at room temperature, is placed in a gravity or circulating air-convection oven. The oven temperature is raised at a rate of 5 °C/min ± 2°C/min to a temperature of 130°C ± 2 °C. The cell remains at this temperature for 10 min before the test is discontinued.	No explosion No fire
3.5.5	Crush test	Test 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; 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. Test cell shall be crushed by applying the force to the widest side. The test sample shall be observed for a further 6 hrs. (Refer to UN38.3)	No explosion No fire Temp. ≤ 170℃

4. Appearance and Dimension

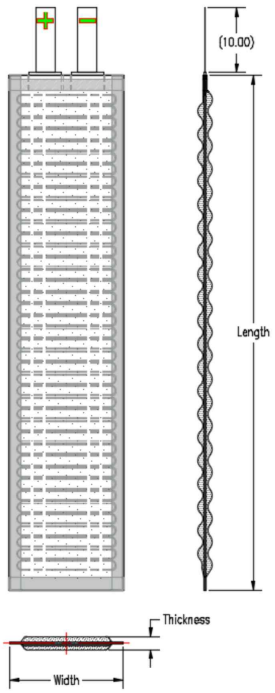
4.1. Appearance

There shall be no such defects as deep scratch, crack, rust, discoloration or leakage, which may adversely affect the commercial value of the cell.

4.2. Dimension

Item		Specification
Width		Max. 20mm
Length		Max. 56mm
Thickness	Shipping state (SoC 30%)	Max. 3.90mm
	Cycled(swelling) state	Max. 4.20mm

See the right cell drawing.



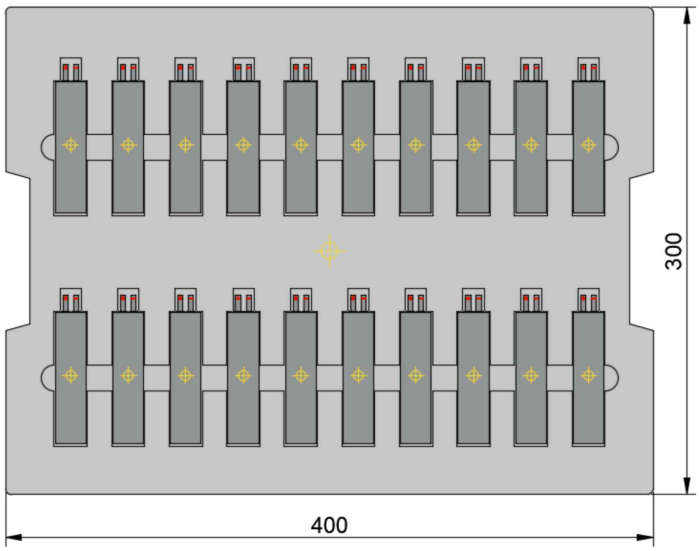
4.3. Bending(Curving) direction

The cell shall be bended recommended direction. See the below picture.

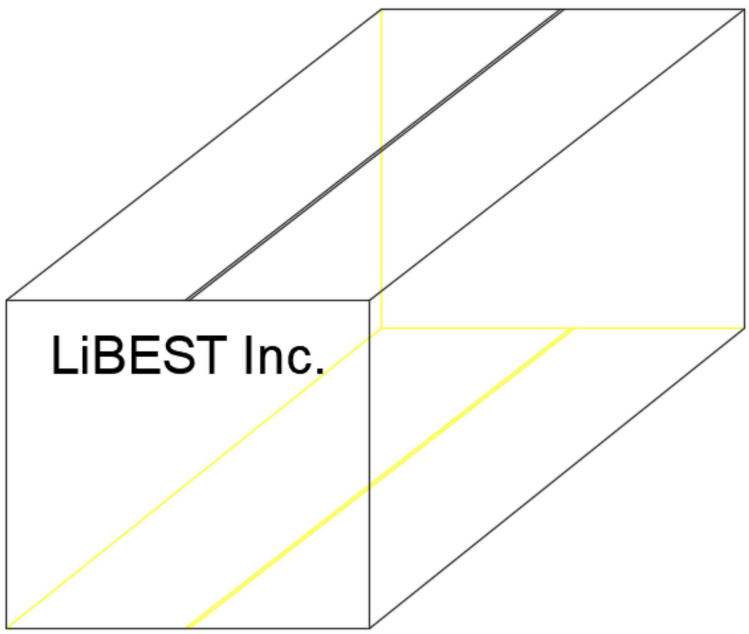
5. Packing

The cells are packed with inner trays and cotton box as follows.

5.1. Inner tray drawing (Tentative) : 20cells / Inner tray



5.2. Cotton box drawing (Tentative) : 15 inner trays / cotton box (max. 300cells / cotton box)
Box size : W410mm*L310mm*H280mm



6. Recycling & Disposal Instructions

This battery cell must be recycled or disposed of properly. The battery cell should be disposed of in accordance with the appropriate regulations or legislation. When discarding the battery cell, comply with local rules or regulations.

For safety reasons, do not dispose of battery cells in charged condition. It's best that battery cell be fully discharged before disposal (however if battery is physically damaged, it is not recommended to discharge it before disposal)

WARNING: DO NOT MUTILATE OR INCINERATE BATTERY CELLS.

- Lithium-Ion cells are subject to disposal and recycling regulations that vary by country and region. Always check and follow your applicable regulations before disposing of any battery cell. Contact Rechargeable Battery Recycling Corporation (www.rbrc.org) for U.S.A. and Canada, or your local battery recycling organization.
- Many countries prohibit the disposal of waste electronic equipment in standard waste receptacles.
- Place only discharged battery cells in a battery collection container. Use electrical tape or other approved covering over the battery cell connection points to prevent short circuits.

7. Cautions & Prohibitions

The battery cell must be careful of proceed the operation for its soft package.

7.1. Package material

The package material of cell is easily damaged by the sharp edge part, such as nickel-tabs.

-. Forbid to use the sharp part touching the battery cell;
-. Should cleaning working condition, avoiding the sharp edge part existence;
-. Forbid to pierce the battery with nail and other sharp items;
-. The battery was forbidden with metal, such as necklace, hairpin etc in transportation and storage.

7.2. Sealed edge

The Aluminum interlayer of package material has good electric performance. It's forbidden to connect with exterior component for preventing short-circuits and sealed edge has to be insulated if required.

7.3. Caution

When using the application equipped with the cell, refer to the user's manual before usage.
Please read the specific charger manual before charging.
Charge current should not be exceeded the value specified in the manual.
When the cell is not charged after long exposure to the charger, discontinue charging.
Cell must be charged at operating temperature range 0 ~ 45℃
Cell must be discharged at operating temperature range -20 ~ 60℃
Please check the positive (+) and negative (-) direction before packing.
When a lead plate or wire is connected to the cell for packing, check out insulation not to short-circuit.
Cell must be stored separately.
Cell must be stored in a dry area with low temperature for long-term storage.
Do not place the cell in direct sunlight or heat.

Do not use the cell in high static energy environment where the protection device can be damaged.
When rust or smell is detected on first use, please return the product to the seller immediately.
The cell must be away from children or pets
When cell life span shortens after long usage, please exchange to new cells.

7.4. Prohibitions

Do not use different charger. Do not use cigarette jacks (in cars) for charging.
Do not charge with constant current more than maximum charge current.
Do not disassemble or reconstruct the cell.
Do not throw or cause impact.
Do not pierce a hole in the cell with sharp things. (Such as nail, knife, pencil, drill)
Do not use with other cells or cells.
Do not solder on cell directly.
Do not press the cell with overload in manufacturing process, especially ultrasonic welding.
Do not use old and new cells together for packing.
Do not expose the cell to high heat. (Such as fire)
Do not put the cell into a microwave or high pressure container.
Do not use the cell reversed.
Do not connect positive (+) and negative (-) with conductive materials (such as metal, wire)
Do not allow the cell to be immerged in or wetted with water or sea-water