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|---|---|---|
| LGC MBD/MBDC | Roh, Sae Weon | Lithium Ion INR18650 MJ1 3500mAh |

# PRODUCT SPECIFICATION

## Rechargeable Lithium Ion Battery
## Model : INR18650 MJ1 3500mAh

LG Chem

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http://www.lgchem.com

## Revision History

| Revision | Date | Originator | Description |
|---|---|---|---|
| 0 | 2016-02-19 | Lee, Kwanhee | - Draft |
| 1 | 2016-06-30 | Lee, Kwan hee | - Some items of “5. Caution and prohibition in handling” were added. |
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## 1. General Information

1.1 Scope

This product specification defines the requirements of the rechargeable lithium ion battery of LG Chem.

1.2 Product classification

Cylindrical rechargeable lithium ion battery

1.3 Model name

INR18650 MJ1

## 2. Nominal Specification

| Item | Condition / Note | Specification |
|---|---|---|
| 2.1 Capacity | Std. charge / discharge | Nominal 3500 mAh<br>Minimum 3350 mAh |
| 2.2 Nominal Voltage | Average | 3.635V |
| 2.3 Standard Charge<br>(Refer to 4.1.1) | Constant current<br>Constant voltage<br>End current(Cut off) | 0.5C (1675mA)<br>4.2V<br>50mA |
| 2.4 Max. Charge Voltage | | 4.2 ± 0.05V |
| 2.5 Max. Charge Current | | 1.0 C (3350mA) |
| 2.6 Standard Discharge<br>(Refer to 4.1.2) | Constant current<br>End voltage(Cut off) | 0.2C (670mA)<br>2.5V |
| 2.7 Max. Discharge Current | | 10A |
| 2.8 Weight | Approx. | Max. 49.0 g |
| 2.9 Operating Temperature | Charge<br>Discharge | 0 ~ 45℃<br>-20 ~ 60℃ |
| 2.10 Storage Temperature<br>(for shipping state) | 1 month<br>3 month<br>1 year | -20 ~ 60℃<br>-20 ~ 45℃<br>-20 ~ 20℃ |

## 3. Appearance and Dimension

3.1 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.

3.2 Dimension

Diameter: 18.5 +0.15 / -0.3 mm (Max. 18.65mm)

Height: 65.1 ±0.2mm (Max. 65.3mm)

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## 4. Performance Specification

4.1 Standard Test Condition

4.1.1 Standard Charge

Unless otherwise specified, “Standard Charge” shall consist of charging at constant current of 0.5C. The cell shall then be charged at constant voltage of 4.20V while tapering the charge current. Charging shall be terminated when the charging current has tapered to 50mA. For test purposes, charging shall be performed at 25ºC ± 2ºC.

4.1.2 Standard Discharge

“Standard Discharge” shall consist of discharging at a constant current of 0.2C to 2.50V. Discharging is to be performed at 25 ºC ± 2 ºC unless otherwise noted (such as capacity versus temperature).

4.1.3 High Drain Discharge Condition

Cells shall be charged at constant current of 1,500mA to 4.20V with end current of 100mA. Cells shall be discharged at constant current of 4,000mA to 2.50V. Cells are to rest 10 minutes after charge and 20 minutes after discharge.

4.2 Electrical Specification

| Item | Condition | Specification |
|---|---|---|
| 4.2.1<br>Initial AC Impedance | Cell shall be measured at 1kHz after charge per 4.1.1. | ≤ 40 mΩ, without PTC |
| 4.2.2<br>Initial Capacity | Cells shall be charged per 4.1.1 and discharged per 4.1.2 within 1h after full charge. | ≥ 3350 mAh |
| 4.2.3<br>Cycle Life | Cells shall be charged and discharged per 4.1.3 400 cycles. A cycle is defined as one charge and one discharge. 401st discharge capacity shall be measured per 4.1.1 and 4.1.2 | ≥ 80 % (of $C_{min}$ in 2.1) |

4.3 Environmental Specification.

| Item | Condition | | Specification |
|---|---|---|---|
| 4.3.1<br>Storage Characteristics | Cells shall be charged per 4.1.1 and stored in a temperature-controlled environment at 25ºC ± 2ºC for 30 days. After storage, cells shall be discharged per 4.1.2 to obtain the remaining capacity*. | | Capacity remaining rate ≥ 90% ($C_{min}$ in 2.1) |
| 4.3.2<br>High Temperature Storage Test | Cells shall be charged per 4.1.1 and stored in a temperature-controlled environment at 60ºC for 1 week. After storage, cells shall be discharged per 4.1.2, and then cells shall be charged per 4.1.1, and then discharged per 4.1.2 for 3 cycles to obtain recovered capacity**. Cells are to rest 10 minutes after charge and 20 minutes after discharge. | | No leakage,<br>Capacity recovery rate ≥ 80% |
| 4.3.3<br>Thermal Shock Test | 65ºC (8h) ← 3hrs → -20ºC (8h) for 8 cycles with cells charged per 4.1.1 After test, cells are discharged per 4.1.2 and cycled per 4.1.3 for 3 cycles to obtain recovered capacity. | | No leakage<br>Capacity recovery rate ≥ 80% |
| 4.3.4<br>Temperature Dependency of Capacity | Cells shall be charged per 4.1.1 at 25ºC ± 2ºC and discharged per 4.1.2 at the following temperatures. | | |
| | Charge | Discharge | Capacity |
| | 23℃ | -10℃<br>0℃<br>23℃<br>60℃ | 70% of $C_{ini}$<br>80% of $C_{ini}$<br>100% of $C_{ini}$<br>95% of $C_{ini}$ |

* Remaining Capacity: After storage, cells shall be discharged with Std. condition (4.1.2) to measure the remaining capacity.
** Recovery Capacity: After storage, cells shall be discharged with Std. condition (4.1.2), and then cells shall be charged with Std. charge condition (4.1.1), and then discharged with Std. condition (4.1.2). This charge / discharge cycle shall be repeated three times to measure the recovery capacity.

4.4 Mechanical Specification

| Item | Condition | Specification |
|---|---|---|
| 4.4.1<br>Drop Test | Cells charged per 4.1.1 are dropped onto an wooden floor from 1.0 meter height for 1 cycle, 2 drops from each cell terminal and 1drop from the side of cell can (Total number of drops = 3). | No leakage<br>No temperature rising |
| 4.4.2<br>Vibration Test | Cells charged per 4.1.1 are vibrated for 90 minutes per each of the three mutually perpendicular axis (x, y, z) with total excursion of 0.8mm, frequency of 10Hz to 55Hz and sweep of 1Hz change per minute | No leakage |

4.5 Safety Specification

| Item | Condition | Specification |
|---|---|---|
| 4.5.1<br>Overcharge Test | Cells are discharged per 4.1.2, and then charged at constant current of 3 times the max. charge condition and constant voltage of 4.2V while tapering the charge current. Charging is continued for 7 hours (Per UL1642). | : No explode, No fire |
| 4.5.2<br>External Short - Circuiting Test | Cells are charged per 4.1.1, and the positive and negative terminal is connected by a 100mΩ-wire for 1 hour (Per UL1642). | : No explode, No fire |
| 4.5.3<br>Overdischarge Test | Cells are discharged at constant current of 0.2C to 250% of the minimum capacity. | : No explode, No fire |
| 4.5.4<br>Heating Test | Cells are charged per 4.1.1 and heated in a circulating air oven at a rate of 5ºC per minute to 130ºC. At 130ºC, oven is to remain for 10 minutes before test is discontinued (Per UL1642). | : No explode, No fire |
| 4.5.5<br>Crush Test | Cells charged per 4.1.1 are crushed with their longitudinal axis parallel to the flat surface of the crushing apparatus (Per UL1642). | : No explode, No fire |

## 5. Caution and Prohibition in Handling

Warning: Using the lithium ion rechargeable battery, mishandling of the battery may cause heat, fire and deterioration in performance. Be sure to observe the following.

### 5.1 Cautions for Using and Handling

- When using the application equipped with the battery, refer to the user's manual before usage.
- Please read the specific charger manual before charging.
- Charge time should not be longer than specified in the manual.
- When the cell is not charged after long exposure to the charger, discontinue charging.
- Battery must be charged at operating temperature range 0 ~ 45℃.
- Battery 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.
- Battery must be stored separately.
- Battery must be stored in a dry area with low temperature for long-term storage.
- Do not place the battery in direct sunlight or heat.
- Do not use the battery 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 battery must be away from children or pets
- When cell life span shortens after long usage, please exchange to new cells.
- Do insulate between the metal plate and cell or other components not to make a electrical short.
- The cells should be handled and used in Pack/System manufacturing companies only.
- The cells should be sold only to Battery Pack Maker(s) or System Integrator(s). The cells should not be handled by individual consumers and should not be sold to individual consumers by individual markets. (especially, the cells are strictly prohibited to be used for any kinds of E-cigarette devices)
- Be sure to request and confirm the most current product specifications in advance which explain the specifications in detail, before the final stage of your design, purchasing or use for any application.

### 5.2 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 battery.
- Do not throw or cause impact.
- Do not pierce a hole in the battery with sharp things. (such as nail, knife, pencil, drill)
- Do not use with other batteries or cells.
- Do not solder on battery directly.
- Do not press the battery with overload in manufacturing process, especially ultrasonic welding.

- Do not use old and new cells together for packing.
- Do not expose the battery to high heat. (such as fire)
- Do not put the battery into a microwave or high pressure container.
- Do not use the battery reversed.
- Do not connect positive(+) and negative(-) with conductive materials (such as metal, wire)
- Do not allow the battery to be immerged in or wetted with water or sea-water.
- Do not give immoderate heat and force to battery cell during a welding process of metal plates on it.

**5.3 Caution for the battery and the pack**

Pack shall meet under condition to maintain battery safety and last long performance of the lithium rechargeable cells.

5.3.1 Installing the battery into the pack

-. The cell should be inspected visually before battery assembly into the pack.

-. Damaged cell should not be used. (Damaged surface, can-distortion, electrolyte-smell)

-. Different Lot Number cells should not be packaged into the same pack.

-. Different types of cells, or same types but different cell maker's should not be used together.

5.3.2 Design of battery pack

-. The battery pack should not be connected easily to any charger other than the dedicated charger.

-. The battery pack has function not to cause external short cut easily.

5.3.3 Charge

-. Charging method is Constant Current-Constant Voltage (CC/CV).

-. Charging should be operating under maximum charge voltage and current which is specified in the product specification. (Article. 2.4, 2.5)

-. The battery should be charged under operating temperature specified in the product specification. (Article. 2.9)

5.3.4 Discharge

-. Discharging method is Constant Current (CC).

(In case of using the battery for mobile equipment, discharging mode could be Constant Power.)

-. Discharging should be operating under maximum discharge current which is specified in the product specification. (Article. 2.7)

-. Discharging should be done by cut off voltage which is specified in the product specification. (Article. 2.6)

-. The battery should be discharged under operating temperature specified in the product specification. (Article. 2.9)

5.3.5 Protection Circuit

- When battery packs for any applications are assembled with cells, following functions must be designed into the battery packs and/or in the charger or charging adapter. The detailed levels, values, conditions for each following functions should be referring to the contents specified in this Product Specification. If one or more than one function

is/are to be omitted, the Packer Company (and/or System integration company) must be informing to LG Chem's or to LG Chem's sales Agent company. Without informing to LGC, LGC will not be liable for any field quality issues happened due to exclusion of following functions.

(1) Over voltage protection circuit

(2) Under voltage protection circuit

(3) Over Charge current protection circuit

(4) Over Discharge current protection circuit

(5) Short circuit protection

(6) Over Temperature protection circuit

(7) 2nd over voltage protection

(8) FET failure protection (in case FET is out of order)

(9) Cell imbalance protection circuit (only for battery packs assembled with more than one cell)

(10) Cell Voltage balancing function (only for battery packs assembled with more than one cell)

**6. EXCLUSION OF LIABILITY**

THE WARRANTY SHALL NOT COVER DEFECTS CAUSED BY NORMAL WEAR AND TEAR, INADEQUATE MAINTENANCE, HANDLING, STORAGER FAULTY REPAIR, MODIFICATION TO THE BATTERY OR PACK BY A THIRD PARTY OTHER THAN LGC OR LGC'S AGENT APPROVED BY LGC, FAILURE TO OBSERVE THE PRODUCT SPECIFICATION PROVIDED HEREIN OR IMPROPER USE OR INSTALLATION, INCLUDING BUT NOT LIMITED TO, THE FOLLOWING:

-. DAMAGE DURING TRANSPORT OR STORAGE

-. INCORRECT INSTALLATION OF BATTERY INTO PACK OR MAINTENANCE

-. USE OF BATTERY OR PACK IN INAPPROPRIATE ENVIRONMENT

-. IMPROPER, INADEQUATE, OR INCORRECT CHARGE, DISCHARGE OR PRODUCTION CIRCUIT OTHER THAN STIPULATED HEREIN

-. INCORRECT USE OR INAPPROPRIATE USE

-. INSUFFICIENT VENTILATION

-. IGNORING APPLICABLE SAFETY WARNINGS AND INSTRUCTIONS

-. ALTERING OR ATTEMPTED REPAIRS BY UNAUTHORIZED PERSONNEL

-. IN CASE OF FORCE MAJEURE (LIGHTENING, STORM, FLOOD, FIRE, EARTHQUAKE, ETC.)

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