

|  |   |                           |                 |
|--|---|---------------------------|-----------------|
| <i>Prepared</i><br>LGCRP/BRI/BTC Yun, In Taeg    | <i>Document No.</i><br>LRB-PS-CY240           | <i>Date</i><br>2003-06-11 | <i>Rev</i><br>0 |
| <i>Approved</i><br>LGCRP/BRI/BTC Kim, Soo Ryoung | <i>Description</i><br>Lithium Ion ICR18650 A2 |                           |                 |

## PRODUCT SPECIFICATION

### Rechargeable Lithium Ion Battery

Model : ICR18650 A2

#### Revision History

| REVISION | DATE       | ORIGINATOR   | REASON FOR CHANGE |
|----------|------------|--------------|-------------------|
| 0        | 2003-06-11 | Yun, In Taeg | Original Release  |

| Prepared   | Reviewed  | Approved  |
|--|---|---|
| Yun, In Taeg<br><br>Date : '03. 06. 11. | Jung, Jae Han<br><br>Date : '03. 06. 11. | Kim, Soo Ryoung<br><br>Date : '03. 06. 11. |

|          |               |                 |              |                         |      |            |     |   |
|----------|---------------|-----------------|--------------|-------------------------|------|------------|-----|---|
| Prepared | LGCRP/BRI/BTC | Yun, In Taeg    | Document No. | LRB-PS-CY240            | Date | 2003-06-11 | Rev | 0 |
| Approved | LGCRP/BRI/BTC | Kim, Soo Ryoung | Description  | Lithium Ion ICR18650 A2 |      |            |     |   |

## 1. Scope

This product specification defines the requirements of the rechargeable lithium ion battery to be supplied to the customer by LG Chem, Ltd. Should there be any additional information required by the customer, customers are advised to contact LG Chem, Ltd. before selecting a solution.

## **2. Description and Model**

- 2.1 Description : Rechargeable Lithium Ion Battery  
2.2 Model : ICR18650 A2

### 3. Technical Information

- |     |                        |             |   |   |
|-----|------------------------|-------------|---|---|
| 3.1 | Capacity               | Nominal     | : | 2350 mAh (by standard charge and discharge)   |
|     |                        | Minimum     | : | 2300 mAh                                      |
| 3.2 | Nominal Voltage        |             | : | Average 3.7 V                                 |
| 3.3 | Standard Charge        |             | : | Constant Current and Constant Voltage (CC/CV) |
|     |                        | Current     | = | 1150 mA                                       |
|     |                        | Voltage     | = | 4.2 V   |
|     |                        | End Current | = | 50 mA   |
| 3.4 | Max. Charge Current    |             | : | 2300 mA                                       |
| 3.5 | Standard Discharge     |             | : | Constant Current (CC)                         |
|     |                        | Current     | = | 460 mA  |
|     |                        | End Voltage | = | 3.0 V   |
| 3.6 | Max. Discharge Current |             | : | 4600 mA (for continuous discharge)            |
| 3.7 | Weight                 |             | : | Approx. 46.5 g                                |
| 3.8 | Operating Temperature  | Charge      | : | 0 to 45 °C                                    |
|     |                        | Discharge   | : | -20 to 60 °C                                  |
| 3.9 | Storage Temperature    | 1 month     | : | -20 to 60 °C                                  |
|     |                        | 3 months    | : | -20 to 45 °C                                  |
|     |                        | 1 year      | : | -20 to 20 °C                                  |

|   |   |                           |                 |
|---|---|---------------------------|-----------------|
| <i>Prepared</i><br>LGCRP/BRI/BTC    Yun, In Taeg    | <i>Document No.</i><br>LRB-PS-CY240           | <i>Date</i><br>2003-06-11 | <i>Rev</i><br>0 |
| <i>Approved</i><br>LGCRP/BRI/BTC    Kim, Soo Ryoung | <i>Description</i><br>Lithium Ion ICR18650 A2 |                           |                 |

#### **4. Cell Dimensions**

Diameter        :         $18.3 \pm 0.1$  mm   ( Max. 18.4 mm )  
Height           :         $64.9 \pm 0.2$  mm   ( Max. 65.1 mm )

#### **5. Appearances**

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

#### **6. Characteristics**

##### 6.1 Standard Charge

Unless otherwise specified, “Standard Charge” shall consist of charging at constant current of 1150mA. The cell shall then be charged at constant voltage of 4.2V 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  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ .

##### 6.2 Standard Discharge

“Standard Discharge” shall consist of discharging at a constant current of 460mA to 3.0V. Discharging is to be performed at  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$  unless otherwise noted (such as capacity versus temperature).

##### 6.3 Initial Capacity

Cells shall be charged per 6.1 and discharged per 6.2 within 1 hour after full charge. Initial capacity shall meet the following requirement.

Initial Capacity                      2300 mAh

##### 6.4 Cycle Life

Cells shall be charged at constant current of 1150mA to 4.2V with end current of 50mA. Cells shall be discharged at constant current of 1150mA to 3.0V. Cells are to rest 10 minutes after charge and 20 minutes after discharge. A cycle is defined as one charge and one discharge. Discharge capacity shall be measured per 6.1 and 6.2 after 300 cycles.

Discharge capacity (301th Cycle)                      80 % (of minimum capacity in 3.1)

|   |  |                    |          |
|---|--|--------------------|----------|
| Prepared<br>LGCRP/BRI/BTC Yun, In Taeg    | Document No.<br>LRB-PS-CY240           | Date<br>2003-06-11 | Rev<br>0 |
| Approved<br>LGCRP/BRI/BTC Kim, Soo Ryoung | Description<br>Lithium Ion ICR18650 A2 |                    |          |

### 6.5 Initial AC Impedance

Initial AC impedance is measured at 1kHz after standard charge.

Initial AC Impedance            90 m    (with PTC)

### 6.6 Temperature Dependency of Capacity

Cells shall be charged per 6.1 at 23°C ± 2°C and discharged per 6.2 at the following temperatures.

Relative capacity at each temperature shall meet the following.

| Charge Temp. | Discharge Temperature |      |       |      |
|--------------|-----------------------|------|-------|------|
| 23°C         | -10°C                 | 0°C  | 23°C  | 60°C |
|              | 70 %                  | 90 % | 100 % | 95 % |

### 6.7 Storage Characteristics

Cells shall be charged per 6.1 and stored in a temperature-controlled environment at 23°C ± 2°C for 30 days. After storage, cells shall be discharged per 6.2 to obtain the remaining capacity.

Remaining capacity            90 % (of minimum capacity in 3.1)

### 6.8 Cell Voltage (as of shipment)

Voltage range    :   3.7 ~ 3.9 V

## **7. Mechanical Characteristics**

### 7.1 Drop Test

Test method        : Cells charged per 6.1 are dropped onto an wooden floor from 4 feet height for 3 cycles, where each cycle consists of 3 drops, 2 drops from each cell terminal and 1drop from the side of cell can (Total number of drops = 9). After test, cells are discharged per 6.2 and cycled per 6.1 and 6.2 for 3 cycles to obtain recovered capacity.

Criteria             : No leakage, Capacity recovery rate        80 %

### 7.2 Vibration Test

Test method        : Cells charged per 6.1 are vibrated for 90 minutes per each of the three mutually perpendicular axis (x, y, z) with an amplitude of 0.8mm, frequency of 10Hz to 55Hz and sweep of 1Hz change per minute. After test, cells are discharged per 6.2 and cycled per 6.1 and 6.2 for 3 cycles to obtain recovered capacity.

Criteria             : No leakage, Capacity recovery rate        80 %

|   |  |                    |          |
|---|--|--------------------|----------|
| Prepared<br>LGCRP/BRI/BTC Yun, In Taeg    | Document No.<br>LRB-PS-CY240           | Date<br>2003-06-11 | Rev<br>0 |
| Approved<br>LGCRP/BRI/BTC Kim, Soo Ryoung | Description<br>Lithium Ion ICR18650 A2 |                    |          |

## **8. Environmental Test**

### 8.1 High Temperature Storage Test

Test method : Cells are charged per 6.1 and stored in a temperature-controlled environment at 60°C for 1 week. After test, cells are discharged per 6.2 and cycled per 6.4 for 3 cycles to obtain recovered capacity.

Criteria : No leakage, Capacity recovery rate 80 %

### 8.2 High Temperature and High Humidity Test

Test method : Cells are charged per 6.1 and stored at 60°C (95% RH) for 168 hours. After test, cells are discharged per 6.2 and cycled per 6.4 for 3 cycles to obtain recovered capacity.

Criteria : No leakage, No rust, Capacity recovery rate 80 %

### 8.3 Thermal Shock Test

Test method : 65°C (8Hrs) 3hrs -20°C (8Hrs) for 8 cycles with cells charged per 6.1. After test, cells are discharged per 6.2 and cycled per 6.4 for 3 cycles to obtain recovered capacity.

Criteria : No leakage, Capacity recovery rate 80 %

## **9. Safety Test**

### 9.1 Abnormal Charge Test

Test method : Cells are discharged per 6.2, then charged at constant current of 6450mA and constant voltage of 4.2V while tapering the charge current. Charging is continued for 48 hours (Per UL1642).

Criteria : No rupture, No fire

### 9.2 External Short-circuiting Test

Test method : Cells are charged per 6.1, and the positive and negative terminal is connected by a 100m -wire for 1 hour (Per UL1642).

Criteria : No rupture, No fire

### 9.3 Overdischarge Test

Test method : Cells are discharged at constant current of 430mA to 250% of the minimum capacity (Per UL1642).

Criteria : No rupture, No fire

|   |  |                    |          |
|---|--|--------------------|----------|
| Prepared<br>LGCRP/BRI/BTC Yun, In Taeg    | Document No.<br>LRB-PS-CY240           | Date<br>2003-06-11 | Rev<br>0 |
| Approved<br>LGCRP/BRI/BTC Kim, Soo Ryoung | Description<br>Lithium Ion ICR18650 A2 |                    |          |

#### 9.4 Nail Test

Test method : A nail (diameter : 2.5~5mm) is penetrated vertically through the center of cells charged per 6.1 and left for 6 hours.

Criteria : No rupture, No fire

#### 9.5 Heating Test

Test method : Cells are charged per 6.1 and heated in a circulating air oven at a rate of 5°C per minute to 150°C. At 150°C, oven is to remain for 10 minutes before test is discontinued (Per UL1642).

Criteria : No rupture, No fire

#### 9.6 Impact Test

Test method : Cells charged per 6.1 are impacted with their longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the 15.8mm diameter bar (Per UL1642).

Criteria : No rupture, No fire

#### 9.7 Crush Test

Test method : Cells charged per 6.1 are crushed with their longitudinal axis parallel to the flat surface of the crushing apparatus (Per UL1642).

Criteria : No rupture, No fire

### **10. Standard Test Conditions**

Unless otherwise specified, all tests stated in this Product Specification are conducted at temperature  $23 \pm 2^{\circ}\text{C}$  and humidity  $65 \pm 20\% \text{RH}$ .

### **11. Product Liability**

The coverage of LG Chem, Ltd. is for the cell itself, while the customer assumes the liability of the product including the cell and its protection circuit.

### **12. Warranty**

As long as the cell is treated in accordance with this Product Specification and/or Proper Use and Handling, LG Chem, Ltd. warrants that the cell should be free from any defect for a period of 1 year

|   |   |                           |                 |
|---|---|---------------------------|-----------------|
| <i>Prepared</i><br>LGCRP/BRI/BTC    Yun, In Taeg    | <i>Document No.</i><br>LRB-PS-CY240           | <i>Date</i><br>2003-06-11 | <i>Rev</i><br>0 |
| <i>Approved</i><br>LGCRP/BRI/BTC    Kim, Soo Ryoung | <i>Description</i><br>Lithium Ion ICR18650 A2 |                           |                 |

from date of manufacturing.

The warranty set forth above or described in Proper Use and Handling excludes a defect which is not related to manufacturing on the cell.

### **13. Others**

Any matter not included in this specification shall be conferred between the both parties.

This document shall replace the document bearing a former revision index, and customers are kindly requested to destroy the former document in possession.

|   |   |                           |                 |
|---|---|---------------------------|-----------------|
| <i>Prepared</i><br>LGCRP/BRI/BTC    Yun, In Taeg    | <i>Document No.</i><br>LRB-PS-CY240           | <i>Date</i><br>2003-06-11 | <i>Rev</i><br>0 |
| <i>Approved</i><br>LGCRP/BRI/BTC    Kim, Soo Ryoung | <i>Description</i><br>Lithium Ion ICR18650 A2 |                           |                 |

Fig 1. Dimensional Drawing of ICR18650 A2

