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| Title: Coin Type Lithium ion Rechargeable Battery | Number: PD3555-04J18          |
| Model: <i>Powerdisc</i> 3555                      | Date: 2005. 01. 03    Rev : 1 |

**PRODUCT SPECIFICATIONS OF COIN TYPE LI-ION RECHARGEABLE BATTERY**

**MODEL: PD3555**

**PRESENTED TO:** \_\_\_\_\_

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| <b>Accepted by :</b><br><br><b>Date:</b> |
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*Korea PowerCell Inc.*

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| <b>Prepared by : Hyo-Seok Park</b> (       )    |
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| <b>Date : 2005. 01. 03</b>                      |



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### 1. Preface

This Product Specification describes the requirements of Coin Type Lithium-ion Rechargeable Battery ("Cell") to be supplied to customer by **Korea PowerCell Inc.**

### 2. Description

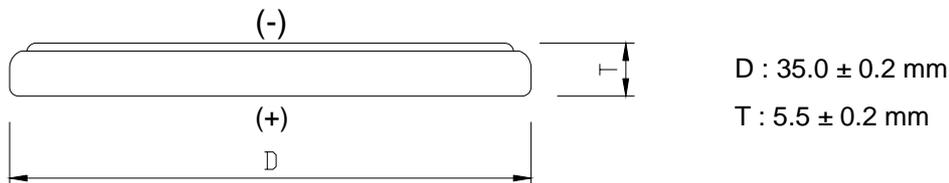
- 2.1 Product **Lithium-ion Rechargeable Battery**
- 2.2 Model (Type) **Powerdisc 3555 (PD3555)**

### 3. Specifications

| Item                           | Specification | Remark                              |
|--------------------------------|---------------|-------------------------------------|
| 3.1 Nominal Capacity           | 500 mAh       | 0.2C rate, 3.0V cut-off             |
| 3.2 Nominal Voltage            | 3.7 V         | From 4.20 V to 3.00V                |
| 3.3 Charging Method            | CC/CV         | Constant Current / Constant Voltage |
| 3.4 Charging Current (Std.)    | 0.5CA (250mA) | 0 ~ 45°C                            |
| 3.5 Charging Voltage           | 4.2 ± 0.03 V  |                                     |
| 3.6 Charging End Condition     | 45~15mA       | At CV mode                          |
| 3.7 Charging Time (Std.)       | > 3.0 hours   |                                     |
| 3.8 Discharge Current (Std.)   | 0.2CA (100mA) | - 20 ~ 60°C                         |
| 3.9 Discharge Current (Max)    | 0.5CA (250mA) | - 20 ~ 60°C                         |
| 3.10 Discharge Cut-off Voltage | 3.0 V         |                                     |
| 3.11 Cell Weight               | Approx. 14±1g |                                     |
| 3.12 Storage Temperature Range | -20 ~ 35      |                                     |

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#### 4. Dimensions (unit : mm)



#### 5. Standard Test Conditions

Unless otherwise specified, all tests stated in this Product Specification are conducted at temperature  $25 \pm 3$  and humidity  $65 \pm 20\%$  RH.

#### 6. Electrical Characteristics

##### 6.1 Standard Charge and Discharge Conditions

The "Standard Charge" means charging the Cell with initial charge current 250mA (0.5C) and with a constant voltage 4.20V ( $\pm 0.03$  V) and a cut off current 15mA at 25 for 3.0 hours.

The "Standard Discharge" means discharging the Cell with constant discharge current 100mA (0.2C) and with 3.0V cut-off voltage at 25 .

##### 6.2 Initial Discharge Capacity

The initial capacity measured under the standard test conditions stated in 6.1

Initial Discharge Capacity Typical 510mAh, Minimum 500mAh

##### 6.3 Initial Internal Impedance

Internal resistance measured at 1KHz after Standard Charge.

Initial Internal Impedance 200 m

##### 6.4 Cycle Life

Capacity after 500 cycles, measured under the test conditions stated in 6.1.

Capacity 400 mAh after 500cycles. (Std. Charge/Discharge condition)



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6.5 Temperature Dependence of Discharge Capacity

Relative capacity at each temperature, measured with constant discharge current 100mA (0.2C) with 2.75V cut-off after the Standard Charge shown below.

| Charge Temp. | Discharge Temp. |      |       |      |
|--------------|-----------------|------|-------|------|
| 25           | -20             | -10  | 25    | 60   |
|              | >40 %           | >70% | 100 % | >95% |

6.6 Discharge Characteristics on Current Load (C-Rate)

Relative capacity at each load, measured with constant discharge current 0.2C, 0.5C with 3.00V cut-off after Standard Charge shown below.

| Charge Current  | Discharge Current |        |
|-----------------|-------------------|--------|
| Standard Charge | 0.2 CA            | 0.5 CA |
|                 | 100 mA            | 250 mA |
|                 | 100 %             | >90 %  |

6.7 Storage characteristic

After stored at the following several conditions, the battery is measured at the standard charge and discharge condition stated in 6.1.

| Storage condition      | Charge state    | Capacity retention | Capacity recovery |
|------------------------|-----------------|--------------------|-------------------|
| 20 days at 60°C        | Shipping charge | -                  | > 85%             |
| 20 days at 60°C        | Full charge     | > 60%              | > 80%             |
| 60 days at 60°C        | Full charge     | > 30%              | > 50%             |
| 30 days at 60°C, 90%RH | Full charge     | > 30%              | > 50%             |

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## 7. Safety Test

| Test Item                              | Test Method  | Criteria   |
|--|--|--|
| 7.1 High Temperature                   | Storing a Cell at 90 for 4 hours after charged at 4.2 V  | No leakage   |
| 7.2 High Temperature and High Humidity | Storing a Cell at 60 ( 90 % RH ) for 1 week after charged at 4.2V.   | No leakage   |
| 7.3 Thermal Shock Test                 | Storing a fully charged Cell(4.2V) at 60 for 2hour and at -20 for 2hour (1 cycle). Total 10 cycles with the maximum transition time, 5 mins.   | No leakage   |
| 7.4 Hot Box Test                       | A cell is to be heated in a gravity convection oven. The temperature of the oven is to be raised at a rate of $5 \pm 2$ per minute to a temperature of $130 \pm 2$ and remain for 30 minutes at the temperature before the test is discontinued. | No explosion, No fire                                      |
| 7.5 Overcharge Test                    | Charging the Cell up to 250% of its Nominal capacity at 25 for 2.5 hours.  | No explosion, No fire                                      |
| 7.6 Impact Test                        | A test cell is to be placed on a flat surface. The bar of 9.1 kg weight and 15.8 mm diameter is dropped from a height of 610 mm onto the cell.   | No explosion, No fire                                      |
| 7.7 Short-Circuit Test                 | A Cell is to be short-circuited by connecting the positive and negative terminals of the battery with copper wire having a maximum resistance load of 100m .   | No fire or no explosion, until it is completely discharged |
| 7.8 Nail Test                          | A stainless steel nail having a diameter of 4.0 mm is punched through the cell until the nail has passed through the opposite side of the cell.  | No explosion, No fire                                      |
| 7.9 Applying Pressure                  | Giving Pressure on whole surface of a fully charged cell with 7kg <sub>f</sub> for 72 hours  | No leakage, No weight decrease                             |



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**8. Shipment**

The Cell shall be shipped in 25% charged state. (Cell voltage range: 3.7 ~ 3.8 V)

\*The remaining capacity before charging shall be changed depending on the storage time and conditions.

**9. Warranty**

The Warranty of battery is one year from the date of shipment. However, even though the problem occurs within this period, PowerCell won't replace a new battery for free as long as the problem is not due to the failure of PowerCell manufacturing process or is due to customer's abuse or misuse.

- PowerCell will not be responsible for trouble occurred by handling outside of the precautions in this specification.
- PowerCell will not be responsible for trouble occurred by matching electric circuit, battery pack and charger.
- PowerCell will be exempt from warrantee any defect cells during assembling after acceptance.

**10. Precautions and Safety Instructions**

Lithium-Ion rechargeable batteries subject to abusive conditions can cause damage to the battery and/or personal injury. Please read and observe the standard battery precautions below before using utilization.

**Note 1.** The customer is required to contact PowerCell in advance, if and when the customer needs other applications or operating conditions than those described in this document.

**Note 2.** PowerCell will take no responsibility for any accident when the cell is used under other conditions than those described in this Document.

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**10.1 Precautions and Safety Instructions:**

- a. Do not expose the battery to extreme heat or flame.
- b. Do not short circuit, over-charge or over-discharge the battery.
- c. Do not subject the battery to strong mechanical shocks.
- d. Do not immerse the battery in water or sea water, or get it wet..
- e. Do not reverse the polarity of the battery for any reason.
- f. Do not disassemble or modify the battery.
- g. Do not remove charge/discharge protection circuitry.
- h. Do not handle or store with metallic like necklaces, coins or hairpins, etc.
- i. Do not use the battery with conspicuous damage or deformation.
- j. Do not connect battery to the plug socket or car-cigarette-plug.
- k. Do not make the direct soldering onto a battery. Weld spot welding lead plate onto a battery.
- l. Do not touch a leaked battery directly.
- m. Do not use for other equipment.
- n. Do not use Lithium-ion battery in mixture.
- o. Do not use or leave the battery under the blazing sun (or in heated car by sunshine).
- p. Keep battery away from children.
- q. Do use the specified charger and observe charging requirement.
- r. Do not drive a nail into the battery, strike it by hammer or tread it.
- s. Do not give battery impact or fling it.

**10.2 Battery Operation Instruction:**A. Charging

- a. Charge the battery in a temperature range of 0°C to + 45°C.
- b. Charge the battery at a constant current of 0.5C until 4.20±0.03V per cell is attained. Charge rates greater than 0.5C are NOT recommended. (C : Rated Capacity of Battery)
- c. Maintain charge voltage at 4.20V per cell for 3.0 hours (recommended for maximum capacity).

\* Use a constant current, constant voltage (CC/CV) lithium-ion (Li+) battery charge controller.

\* Do not continue to charge battery over specified time.



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B. Discharging

- a. Recommended cut-off voltage to 3.0V. Recommended maximum discharge rate is 0.5C at constant current.
- b. For maximum performance, discharge the battery in a temperature range of -20°C to + 45°C.

C. Protection Circuit

A protection circuit is provided for protecting the battery against damage and/or performance deterioration.

- Over charge voltage protection : 4.28±0.05 V
- Over discharge voltage protection : 2.30±0.20 V
- Over current protection : 3.0±1.5 A
- Current consumption(leakage current) : I 7.0 uA

D. Storage Recommendations

- a. Storage Temperature and Humidity
  - Storage the battery at temperature range of -20 ~ +35°C, low humidity and no corrosive gas atmosphere.
  - No condensation on the battery
- b. Long Period Storage
  - In case of long period storage (more than 3 months), storage the battery at temperature range of -10 ~ +20°C, low humidity, no corrosive gas atmosphere.
  - No condensation on the battery

**11. Consultation**

As to the obscenity, contact the following.

**PowerCell Korea Inc.** Sales & Marketing Division

[sales@powercellkorea.com](mailto:sales@powercellkorea.com)

Tel : +82-42-864-0255

Fax : +82-42-864-4342

**12. Requirement for Safety Assurance**

For the sake of safety assurance, please discuss the equipment design, its system and protection circuit of Lithium-ion battery with PowerCell in advance.

And consult about the high rate current, rapid charge and special application in the same way.