



## Specification Approval Sheet

Name: Ni-Cd rechargeable battery

Model: 20305

SPEC: SC 2200mAh

| Approved By | Checkup | Make |
|-------------|---------|------|
|             |         |      |

| Customer Confirmation | Signature      | Date |
|-----------------------|----------------|------|
|                       |                |      |
|                       | Company Name : |      |
|                       | Stamp :        |      |

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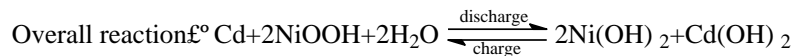
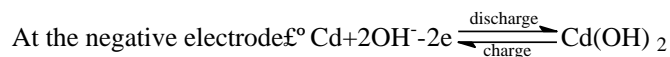
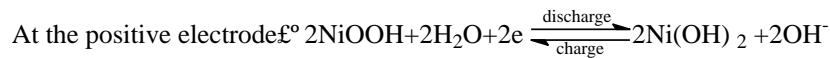
## 1. APPLICATION

The specification applies to the following sealed Ni-Cd rechargeable battery made by Tenergy Corporation.

APPLICATION: Electric tools, Electric toys, Etc

## 2. WORKING THEORY

The negative of Nickel-Cadmium cylindrical battery is metal of Cadmium, the positive is NiOOH, and the electrolyte is KOH of high purity. The electrochemical processes are represented by the following reactions:



During discharge, Cadmium of negative is oxidized to Cd(OH)<sub>2</sub>. The free electrons flow into the positive through the external circuit, NiOOH of positive receives the electrons and is deoxidized to Ni(OH)<sub>2</sub>. Charge process is just the opposition of discharge.

## 3. CELL TYPE AND RATINGS

|                           |                                     |
|---------------------------|-------------------------------------|
| Cell                      | Ni-Cd Sealed Cylindrical Cell       |
| Type                      | SC                                  |
| Typical Capacity          | 2200 mAh                            |
| Nominal cell voltage      | 1.2V                                |
| Weight of the single cell | 50g                                 |
| Diameter                  | 23.0 <sup>0</sup> <sub>1.0</sub> mm |
| Height                    | 43.0 <sup>0</sup> <sub>1.5</sub> mm |



#### 4. BEST EXPLOITATION CONDITIONS

|                                 |   |
|---------------------------------|---|
| Charge current                  | $400\text{mA} (0.2I_t \times 7.5\text{h}) \leq I \leq 800\text{mA} (0.4I_t \times 3.5\text{h})$ |
| Charge control method           | Time, TCO=45°C  |
| Temperature range for charge    | 15°C~25°C   |
| Humidity                        | 45%~85%   |
| Discharge current               | $200\text{mA} (0.1I_t \times A) \leq I \leq 10\text{A} (5I_t \times A)$                         |
| Temperature range for discharge | 15°C~25°C   |
| Temperature range for storage   | 0°C~25°C  |

#### 5. PERMISSION EXPLOITATION CONDITIONS

|                         |   |
|-------------------------|---|
| <b>Low rate charge</b>  |   |
| Current                 | $200\text{mA} (0.1I_t \times 16\text{h}) \leq I < 800\text{mA} (0.4I_t \times 3.5\text{h})$                                     |
| Control method          | Time, TCO=45°C  |
| Ambient temperature     | 10°C~30°C   |
| Humidity                | 45%~85%   |
| <b>High rate charge</b> |   |
| Current                 | $800\text{mA} (0.4I_t \times 3.5\text{h}) < I \leq 2000\text{mA} (1I_t \times 1.25\text{h})$                                    |
| Control method          | $-\Delta V = 10\text{mV}/\text{cell}$ , Time, $dT/dt = 1^\circ\text{C}/3\text{min} \sim 2^\circ\text{C}/3\text{min}$ , TCO=45°C |
| Ambient temperature     | 10°C~30°C   |
| Humidity                | 45%~85%   |



| <b>Discharge</b>                            |  |
|---|--|
| Can be recycled continues discharge current | 200mA (0.1I <sub>t</sub> A) ≤ I ≤ 20A (10I <sub>t</sub> A) |
| Cut-off voltage                             | 1.0V/cell (I ≤ 1I <sub>t</sub> A)                          |
|   | 0.9V/cell (1I <sub>t</sub> A < I ≤ 2I <sub>t</sub> A)      |
|   | 0.8V/cell (2I <sub>t</sub> A < I ≤ 5I <sub>t</sub> A)      |
|   | 0.7 V/cell (5I <sub>t</sub> A < I ≤ 10I <sub>t</sub> A)    |
| Ambient temperature                         | -20°C ~ 55°C (I ≤ 0.2I <sub>t</sub> A)                     |
|   | -10°C ~ 40°C (0.2I <sub>t</sub> A < I ≤ 1I <sub>t</sub> A) |
|   | 0°C ~ 30°C (1I <sub>t</sub> A < I ≤ 5I <sub>t</sub> A)     |
|   | 15°C ~ 25°C (5I <sub>t</sub> A < I ≤ 10I <sub>t</sub> A)   |
| Humidity                                    | 45%~85%  |
| <b>Storage</b>                              |  |
| Within a week                               | -20°C ~ 35°C   |
| Within six months                           | -20°C ~ 25°C   |
| Humidity                                    | 45%~85%  |

## 6. PERFORMANCE

### 6.1 TEST CONDITIONS

The test is carried out with new batteries (within one month after delivery). Before it is charged, the battery should be discharged at 0.2I<sub>t</sub>A to an end of voltage of 1.0V/cell under test conditions:

Temperature : 20°C ± 5°C

Relative Humidity : 45%~85%

Standard charge : 400mA (0.2I<sub>t</sub>A) × 7.5h

Standard discharge : 400mA (0.2I<sub>t</sub>A) to 1.0V/cell



**6.2 TEST METHOD & PERFORMANCE**

| Test                         | Unit             | Specification                              | Conditions  | Remarks                  |
|------------------------------|------------------|--|---|--------------------------|
| Shipment Voltage             | V                | $\geq 0.8$                                 |   | AQL=0.65%                |
| Open Circuit Voltage (OCV)   | V                | $\geq 1.3$                                 | In 1h after standard charge   |                          |
| Internal impedance           | m $\Omega$ /cell | $\leq 9$                                   | Upon fully charge (1KHz)  |                          |
| 1I <sub>r</sub> A Discharge  | min              | $\geq 54$                                  | Standard charge before discharge  | End Voltage is 1.0V/cell |
| 5I <sub>r</sub> A Discharge  | min              | $\geq 9$                                   | Standard charge before discharge  | End Voltage is 0.8V/cell |
| 10I <sub>r</sub> A Discharge | min              | $\geq 4$                                   | Standard charge before discharge  | End Voltage is 0.7V/cell |
| Over charge                  | min              | $\geq 300$<br>No leakage<br>No deformation | 0.1I <sub>r</sub> A charge 28d, and rest for 1h~4h, then discharge at 0.2I <sub>r</sub> A | End Voltage is 1.0V/cell |
| Charge retention             | mAh              | $\geq 1300$<br>(65%CN)                     | Standard charge, Storage of 28d, Standard discharge                                       | Temp. 20°C $\pm$ 2°C     |
| Cycle life                   | Cycle            | $\geq 500$                                 | IEC61951-1 (7.4.1. 1)   | Refer to <b>Note</b>     |
| Leakage                      |                  | No leakage<br>No deformation               | Fully charge at 0.4I <sub>r</sub> A, then storage of 14d                                  | Temp. 20°C $\pm$ 5°C     |



**Cycle life:**

Prior to the endurance in cycles test, the cell shall be discharged at a constant current of 0.2 I<sub>r</sub>A to a final voltage of 1.0 V/cell.

The following endurance test shall then be carried out, irrespective of cell designation, in an ambient temperature of 20 °C ± 5 °C. Precautions shall be taken to prevent the cell-case temperature from rising above 35 °C during the test, by providing a forced air draught if necessary.

**Note:** IEC61951-1 (7.4.1.1):

| Cycle number | Charge                           | Stand in charged condition | Discharge                                     |
|--------------|----------------------------------|----------------------------|---|
| 1            | 0.1I <sub>r</sub> A for 16h      | None                       | 0.25I <sub>r</sub> A for 2h20min <sup>a</sup> |
| 2-48         | 0.25I <sub>r</sub> A for 3h10min | Note                       | 0.25I <sub>r</sub> A for 2h20min <sup>a</sup> |
| 49           | 0.25I <sub>r</sub> A for 3h10min | Note                       | 0.25I <sub>r</sub> A to 1.0V                  |
| 50           | 0.1I <sub>r</sub> A for 16h      | 1h to 4h                   | 0.20I <sub>r</sub> A to 1.0V <sup>b</sup>     |

a. If the cell voltage drops below 1.0V, the discharge may be discontinued.

b. It is permissible to allow sufficient open-circuit rest time after the completion of discharge at cycle 50, so as to start cycle 51 at a convenient time. A similar procedure may be adopted at cycles 100, 150, 250, 300, 350, 400 and 450.

Cycles 1 to 50 shall be repeated until the discharge duration on any 50th cycle become less than 3 h. At this stage, a repeat capacity measurement as specified for cycle 50 shall be carried out.

The endurance test is considered complete when two such successive capacity cycles give a discharge duration of less than 3 h. The total number of cycles obtained when the test is completed shall be not less than 500.

**6.3 Storage:**

Prior to this test, the cell shall be discharge, at a constant current of 0.2I<sub>r</sub>A, to a final voltage of 1.0V. The cell shall then be stored on open circuit for 12 months.

After completion of the storage period, the cell shall be discharged at a constant current of 0.2I<sub>r</sub>A to a final voltage of 1.0V. Five cycles are permitted for this test, the capacity for 1I<sub>r</sub>A constant current shall be not less than 80%CN.



## 6.4 Vibration

The battery shall not cause damage to its performances when tested with the amplitude at 4mm (0.158 in) and the frequency at 1000Hz.

## 6.5 Drop test

The battery shall not cause damage to its performances when dropped to the wooden board at a height of 450mm(17.716 in).

## 6.6 Safety

### 6.6.1 Over-discharge device operation

Discharged for 24h with an load resistor ( $\text{Load}(m\Omega)=1.2V \times n \times 1000/2I_tA$ ), but no leakage nor deformation.

### 6.6.2 Safety valve performance

Test method: the batteries are discharged to 0V at 0.2I<sub>t</sub>A, then increase the current to 1I<sub>t</sub>A and maintain 1h, leakage and deformation are allowed, but no disrupt and no burst.

### 6.6.3 Short circuit

Test method: charge at 0.4I<sub>t</sub>A for 3.5h, short-circuit directly between positive pole and negative pole for 1h, no disrupt, no burst, but leakage and deformation are allowed.

## 7. USE AND MAINTENANCE

7.1 Battery can be charged at constant current and constant power, charge current and charge control design can refer to the provisions of 5, don't control the battery with  $-\Delta V$  for first 5min at the beginning of charge; and not advice charge the battery with constant voltage charger.

7.2 Too hot or too cool will reduce the capacity and life of the battery, please keep the battery at 15°C~25°C as much as possible.

7.3 Please refer to the provision of 5 to design discharge current and cut-off voltage, not advice to set discharge current more than the provision of 5.

7.4 Please contact with us when your charge/discharge current is higher than the provision of 5 or the combination quantity more than 15 pieces.

7.5 Short circuit, over-charge, over-discharge, reverse charge, mix using new battery with semi-used battery, excessive temperature or incinerate, strike or drop, incorrect charge method all can cause battery drop performance, seriously can cause battery to leakage, deform or explode.



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7.6 Please store the battery in a cool and dry place; long time storage can drop battery performance until lose effectiveness; The period of guaranteeing of our battery is 6 months after the day of purchase; please maintain the storing battery every 3 months; please charge/discharge the battery 3 times according to the provision of 5.

7.7 Battery can charge and discharge several hundred times, but can lose effectiveness at last. When battery's work hours shortened obviously, please buy new battery.

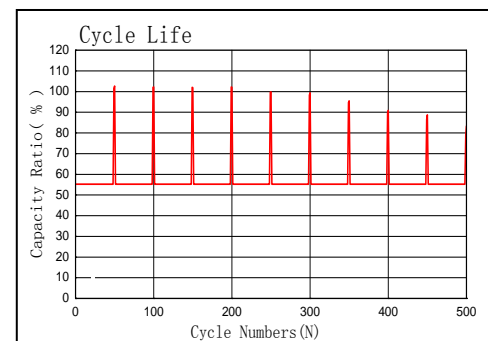
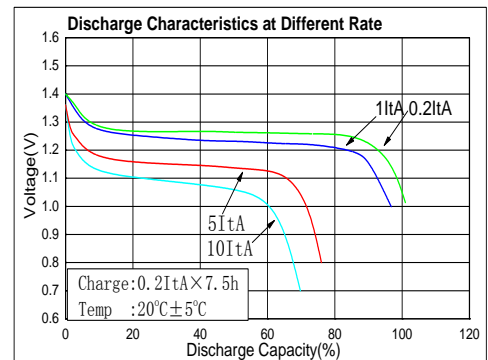
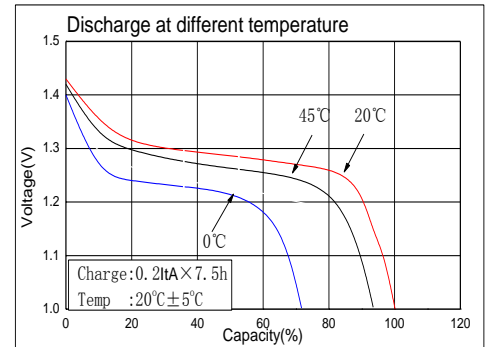
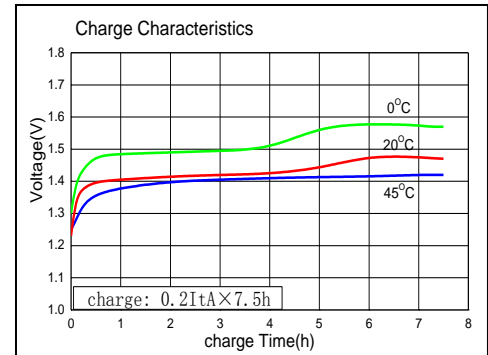




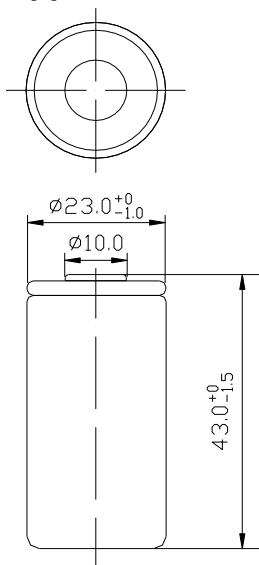
**Specifications**

|                              |                          |                                      |                       |
|------------------------------|--------------------------|--------------------------------------|-----------------------|
| Nominal voltage              |                          | 1.2V                                 |                       |
| Capacity (mAh)               |                          | 1C <sub>5</sub> Ah <sup>[1]</sup>    |                       |
|                              | Minimum                  | 1800                                 |                       |
| Diameter                     |                          | 23.0 <sup>0</sup> <sub>-1.0</sub> mm |                       |
| Height                       |                          | 43.0 <sup>0</sup> <sub>-1.5</sub> mm |                       |
| Weight <sup>[2]</sup>        |                          | About 50g                            |                       |
| Internal impedance (1000Hz.) |                          | ≤9mΩ (After charge)                  |                       |
| Charge                       | Standard                 |                                      | 0.2I <sub>t</sub> A   |
|                              | Rapid                    |                                      | 1I <sub>t</sub> A     |
|                              | Trickle                  | Max.                                 | 0.05I <sub>t</sub> A  |
|                              |                          | Min.                                 | 0.03I <sub>t</sub> A  |
| Ambient temperature          | Charge                   | Standard <sup>[3]</sup>              | 10°C~30°C 50°F~86°F   |
|                              |                          | Rapid <sup>[4]</sup>                 | 10°C~30°C 50°F~86°F   |
|                              | Discharge <sup>[5]</sup> |                                      | -20°C~55°C -4°F~131°F |
|                              | Storage                  |                                      | -20°C~25°C -4°F~78°F  |

**Typical Characteristics**



**Appearance** (Contain insulating packing)



**Note:**

[1] Charge 7.5h at 0.2I<sub>t</sub>A, rest 1h, then discharge at 1I<sub>t</sub>A, end at 1.0V/cell, 20°C.

[2] Weight is for reference.

[3] Charge 7.5h at 0.2I<sub>t</sub>A.

[4] Charge 1.25h at 1.0I<sub>t</sub>A, dT/dt=1°C/3min ~2°C/3min, TCO=45°C, -ΔV=10mV/cell.

[5] Discharge at 0.2I<sub>t</sub>A, end at 1.0V/cell.