Specification Approval Sheet

Name: Ni-Cd rechargeable battery

Model: 20300

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:

$$\text{At the positive electrode£º } 2NiOOH+2H_2O+2e \underset{\text{charge}}{\overset{\text{discharge}}{\rightleftharpoons}} 2Ni(OH)_2+2OH^-$$

$$\text{At the negative electrode£º } Cd+2OH^--2e \underset{\text{charge}}{\overset{\text{discharge}}{\rightleftharpoons}} Cd(OH)_2$$

$$\text{Overall reaction£º } Cd+2NiOOH+2H_2O \underset{\text{charge}}{\overset{\text{discharge}}{\rightleftharpoons}} 2Ni(OH)_2+Cd(OH)_2$$

During discharge, Cadmium of negative is oxidized to $Cd(OH)_2$, The free electrons flow into the positive through the external circuit, NiOOH of positive receives the electrons and is deoxidized to $Ni(OH)_2$. 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	$23.0^{0}_{-1.0}$mm
Height	$43.0^{0}_{-1.5}$mm

4. BEST EXPLOITATION CONDITIONS

Charge current	400mA (0.2I_tA×7.5h) ≤I≤800mA(0.4I_tA×3.5h)
Charge control method	Time、TCO=45℃
Temperature range for charge	15℃～25℃
Humidity	45%~85%
Discharge current	200mA（0.1I_tA）≤I≤10A（5I_tA）
Temperature range for discharge	15℃～25℃
Temperature range for storage	0℃～25℃

5. PERMISSION EXPLOITATION CONDITIONS

Low rate charge	
Current	200mA (0.1I_tA×16h)≤I＜800mA(0.4I_tA×3.5h)
Control method	Time, TCO=45℃
Ambient temperature	10℃～30℃
Humidity	45%~85%
High rate charge	
Current	800mA (0.4I_tA×3.5h)＜I≤2000mA(1I_tA×1.25h)
Control method	–ΔV=10mV/cell，Time，dT/dt=1℃/3min~2℃/3min，TCO=45℃
Ambient temperature	10℃～30℃
Humidity	45%~85%

Discharge	
Can be recycled continues discharge current	200mA（0.1I_tA）≤I≤20A（10I_tA）
Cut-off voltage	1.0V/cell（I≤1I_tA） 0.9V/cell（1I_tA＜I≤2I_tA） 0.8V/cell（2I_tA＜I≤5I_tA） 0.7 V/cell（5I_tA＜I≤10I_tA）
Ambient temperature	-20℃～55℃（I≤0.2I_tA） -10℃～40℃（0.2I_tA＜I≤1I_tA） 0℃～30℃（1I_tA＜I≤5I_tA） 15℃～25℃(5I_tA＜I≤10I_tA)
Humidity	45%~85%
Storage	
Within a week	-20℃～35℃
Within six months	-20℃～25℃
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_tA to an end of voltage of 1.0V/cell under test conditions：

Temperature ： 20℃±5℃

Relative Humidity ： 45%～85%

Standard charge ： 400mA (0.2I_tA) ×7.5h

Standard discharge ： 400mA (0.2I_tA) to 1.0V/cell

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6.2 TEST METHOD & PERFORMANCE

Test	Unit	Specification	Conditions	Remarks
Shipment Voltage	V	⩾0.8		AQL=0.65%
Open Circuit Voltage (OCV)	V	⩾1.3	In 1h after standard charge	
Internal impedance	mΩ/cell	⩽9	Upon fully charge (1KHz)	
$1I_tA$ Discharge	min	⩾54	Standard charge before discharge	End Voltage is 1.0V/cell
$5I_tA$ Discharge	min	⩾9	Standard charge before discharge	End Voltage is 0.8V/cell
$10I_tA$ Discharge	min	⩾4	Standard charge before discharge	End Voltage is 0.7V/cell
Over charge	min	⩾300 No leakage No deformation	$0.1I_tA$ charge 28d, and rest for 1h~4h, then discharge at $0.2I_tA$	End Voltage is 1.0V/cell
Charge retention	mAh	⩾1300 (65%CN)	Standard charge, Storage of 28d, Standard discharge	Temp. 20℃±2℃
Cycle life	Cycle	⩾500	IEC61951-1 (7.4.1. 1)	Refer to **Note**
Leakage		No leakage No deformation	Fully charge at $0.4I_tA$, then storage of 14d	Temp. 20℃±5℃

Cycle life：

Prior to the endurance in cycles test, the cell shall be discharged at a constant current of 0.2 I_tA 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_tA for 16h	None	0.25I_tA for 2h20min [a]
2-48	0.25I_tA for 3h10min	Note	0.25I_tA for 2h20min [a]
49	0.25I_tA for 3h10min	Note	0.25I_tA to 1.0V
50	0.1I_tA for 16h	1h to 4h	0.20I_tA to 1.0V [b]

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_tA, 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_tA to a final voltage of 1.0V. Five cycles are permitted for this test, the capacity for 1I_tA 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 (Load(mΩ)=1.2V×n×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_tA, then increase the current to 1I_tA 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_tA 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 –ΔV 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℃~25℃ as much as posible.

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.

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.

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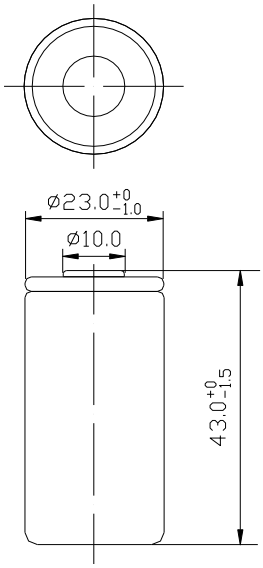
Specifications

Nominal voltage			1.2V	
Capacity (mAh)			$1C_5Ah$ [1]	
	Minimum		1800	
Diameter			$23.0^{0}_{-1.0}$mm	
Height			$43.0^{0}_{-1.5}$mm	
Weight[2]			About 50g	
Internal impedance (1000Hz.)			≤9mΩ (After charge)	
Charge	Standard		$0.2I_tA$	
	Rapid		$1I_tA$	
	Trickle	Max.	$0.05I_tA$	
		Min.	$0.03I_tA$	
Ambient temperature	Charge	Standard[3]	10℃~30℃	50°F~86°F
		Rapid[4]	10℃~30℃	50°F~86°F
	Discharge[5]		-20℃～55℃	-4°F~131°F
	Storage		-20℃~25℃	-4°F~78°F

Appearance (Contain insulating packing)



Note:

[1] Charge 7.5h at $0.2I_tA$, rest 1h, then discharge at $1I_tA$, end at 1.0V/cell, 20℃.

[2] Weight is for reference.

[3] Charge 7.5h at $0.2I_tA$.

[4] Charge 1.25h at $1.0I_tA$, dT/dt=1℃/3min ~2℃/3min , TCO=45℃,-ΔV=10mV/cell.

[5] Discharge at $0.2I_tA$, end at 1.0V/cell.

Typical Characteristics