DONG Guan NPP New Energy CO., LTD.

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MODEL: 18650-12V-80Ah

1 Scope

This specification is applied to the reference battery in this Specification and manufactured by DONG GUAN NPP Power Co., Ltd.

2 Product Specification

Cell	Model		18650-2.5Ah
	Capacity		2.5 Ah
	Rated Voltage		3.7 V
	Internal Resistance		≤60 mΩ
	Combination Standard		A. Capacity Difference≤1% B. Resistance()=1～5mΩ C. Current-maintaining Ability≥90% D. Voltage3.8～3.9V
	Combination Method		3S32P
Pile Index	Rated Capacity		80Ah
	Minimal Capacity （0.2C5A）		80Ah
	Nominal Voltage		11.1V
	Max. Charge Voltage		12.60V
	Discharge cut-off voltage		9.0V
	Charge Current		10A (Max)
	Working Current		15A (Max)
	Output and Input		P+(red) / P-(black)
	Weight		~4450g
	Dimension （L×W×H）		220×125×72mm 340*270*80mm
	Charge Method	Standard	8A×10hrs
		Quick	10A×8hrs.
	Operating Temperature	Charge	-10℃～55℃
		Discharge	-20℃～65℃

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3 Performance And Test Conditions

3.1 Standard Test Conditions

Test should be conducted with new batteries within one week after shipment from our factory and the cells shall not be cycled more than five times before the test. Unless otherwise specified, test and measurement shall be done under temperature of 20 ± 5 ℃ and relative humidity of 45~75%. If it is judged that the test results are not affected by such conditions, the tests may be conducted at temperature 15~30℃ and humidity 25~75%RH.

3.2 Measuring Instrument or Apparatus

3.2.1 Dimension Measuring Instrument

The dimension measurement shall be implemented by instruments with equal or more precision scale of 0.01mm.

3.2.2 Voltmeter

Standard class specified in the national standard or more sensitive class having inner impedance more than 10kΩ/V

3.2.3 Ammeter

Standard class specified in the national standard or more sensitive class. Total external resistance including ammeter and wire is less than 0.01Ω.

3.2.4 Impedance Meter

Impedance shall be measured by a sinusoidal alternating current method(1kHz LCR meter).

3.3 Standard Charge\Discharge

3.3.1 Standard charging: test process and standard as follows:

$0.1C_5A$

Charging shall consist of charging at a $0.1C_5A$ constant current rate until the cell reaches12.6V. The cell shall then be charged at constant voltage of 12.6V volts while tapering the charge current. Charging shall be terminated when the charging current has tapered to 0.01 C_5A . Charge time : Approx 5h, The cell shall demonstrate no permanent degradation when charged between 0 ºC and 45 ºC.

3.3.2 Standard Discharge

$0.1C_5A$

Cells shall be discharged at a constant current of $0.1C_5A$ to 8.25V @ 20º ± 5C

3.3.3 If no otherwise specified, the rest time between Chare and Discharge amount to 30min.

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3.4 Appearance

There shall be no such defect as flaw, crack, rust, leakage, which may adversely affect commercial value of battery.

3.5 Initial Performance Test

Table 2

Item	Test Method and Condition	Requirements
（1）Cell Voltage	As of shipment	≥11.1V
（2）Open-Circuit Voltage	The open-circuit voltage shall be measured within 24 hours after standard charge.	≥12.5V
（3）Internal impedance	Internal resistance measured at AC 1KHz after 50% charge.	≤180mΩ
（4）Minimal Rated Capacity	The capacity on $0.1C_5A$ discharge till the voltage tapered to8.25V shall be measured after rested for 30min then finish standard charge.	≥ 80Ah

3.6 Temperature Dependence of discharge capacity

Table 3

Discharge Temperature	-20℃	-10℃	0℃	23℃	60℃
Discharge Capacity （$0.2\ C_5A$）	30%	50%	80%	100%	92%

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3.7 Cycle Life and Leakage-Proof

Table 4

No.	Item	Criteria	Test Conditions
1	Cycle Life ($0.2C_5A$)	Higher than 60% of the Initial Capacities of the Cells	Carry out500cycle Charging/Discharging in the below condition. ◆Charge: Standard Charge, per 3.3.1 ◆Discharge: Standard discharge，per 3.3.2 ◆Rest Time between charge/discharge:30min. ◆Temperature:20±5℃

4. Mechanical characteristics and Safety Test

Table 5 (Mechanical characteristics)

No.	Items	Test Method and Condition	Criteria
1	Vibration Test	After standard charging, fixed the cell to vibration table and subjected to vibration cycling that the frequency is to be varied at the rate of 1Hz per minute between 10Hz an 55Hz, the excursion of the vibration is 1.6mm. The cell shall be vibrated for 30 minutes per axis of XYZ axes.	No leakage No fire
2	Drop Test	The cell is to be dropped from a height of 1 meter twice onto concrete ground.	No explosion, No fire,
3	Collisions	After the vibration test, according to X.Y.Z each battery average three vertical pulse peak acceleration, the setting for the 100m/s2, every minute, 40 ~ 80 collision frequency, pulse duration 16ms collision frequency ± 10 thousand.	No explosion, No fire, no leakage.

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Table 6

No.	Item	Battery Condition	Test Method	Requirements
4	Crush	Fresh, Fully charged	Crush between two flat plates. Applied force is about 13kN(1.72Mpa) for 30min.	No explosion, No fire
5	Short Circuit	Remove outer protective circuit	This test will be placed the battery electric dipole in the fume hood, short-circuit the anode (total resistance is not more than 50m lines Ω), monitor temperature changes, when the battery is low temperature dropped to about 10 degrees than peak, the end of experiment.	No explosion, No fire The Temperature of the surface of the Cells are lower than 150℃
6	Impact	Fresh, Fully charged	A 56mm diameter bar is inlayed into the bottom of a 10kg weight. And the weight is to be dropped from a height of 1m onto a sample battery and then the bar will be across the center of the sample.	No explosion, No fire
7	Thermal shock	Fresh, Fully charged	Batteries in hot box Temperature in 5℃±2℃/min，rising to 50℃±2℃ keep 30min.	No explosion, No fire
8	Forced Discharge	Fresh, Fully charged	Discharge at a current of 1 C_5A for 2.5h.	No explosion, No fire

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Table 6

No.	Item	Battery Condition	Test Method	Requirements
9	High temperature performance	Fresh, Fully charged	After charging Will a battery into 55±2℃ In the case of high temperature 2h Batteries in 55±2℃ 1C_5A discharge current to the termination voltage, discharge time should not below 51min,, Battery will in environmental temperature 20℃±5℃ place2h	No explosion, No fire
10	Low temperature performance	Fresh, Fully charged	After charging, will be a battery into - 20 ± 2 degrees Celsius in the box, then 16h constant 24h ~ 0.2C_5A with discharge current to the termination voltage, discharge time should not below 3h. After the experiment, the battery will in environmental temperature of 20 ± 5 ° c condition 2h aside	No deformation and burst
11	Charged	Fresh, Fully charged	A full battery, at ambient temperature 20 ±5 ℃ under the conditions of the battery will be open to 28d aside, 0.2C_5A to terminate discharge current voltage,	the discharge time not below 4.25 h.
12	Constant damp performance	Fresh, Fully charged	Standard after the battery, Will a battery into 40 ℃ ± 2 ℃ , Relative humidity90% ～ 95% At constant temperature and humidity box after 48h Battery will in environmental temperature20℃ ± 5 ℃ Aside 2h, 1C5A to terminate discharge current voltage,	No obvious deformation, hands rust, smoke, explosion, discharge time not less than 36 min

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5. Handling of Cells

5.1Prohibition short circuit

Never make short circuit cell. It generates very high current which causes heating of the cells and may cause electrolyte leakage, gassing or explosion that are very dangerous.

The LI tabs may be easily short-circuited by putting them on conductive surface.

Such outer short circuit may lead to heat generation and damage of the cell.

An appropriate circuitry with PCB shall be employed to protect accidental short circuit of the battery pack.

5.2.Mechanical shock

Falling, hitting, bending, etc. may cause degradation of LI characteristics.

5.3 Handling of tabs

The battery tabs are not so stubborn especially for aluminium tab.

Don't bend tab.

Do not bend tabs unnecessarily.

6.Notice for Designing Battery Pack

6.1 Pack toughness

Battery pack should have sufficient strength and the LI cell inside should be protected from mechanical shocks.

6.2 Cell fixing

The LI cell should be fixed to the battery pack by its large surface area.

No cell movement in the battery pack should be allowed.

6.3Inside design

No sharp edge components should be insides the pack containing the LI cell.

6.4Tab connection

Ultrasonic welding or spot welding is recommended for LI tab connection method.

Battery pack should be designed that shear force are not applied to the LI tabs.

If apply manual solder method to connect tab with PCM, below notice is very important to ensure battery performance:

- ■The solder iron should be temperature controlled and ESD safe;
- ■Soldering temperature should not exceed 350°C;
- ■Soldering time should not be longer than 3s;

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- Soldering times should not exceed 5 times, Keep battery tab cold down before next time soldering;
- Directly heat cell body is strictly prohibited, Battery may be damaged by heat above approx. 100°C

6.5 For mishaps

Battery pack should be designed not to generate heat even when leakage occurs due to mishaps.

1) Isolate PCB (Protection Circuit Module) from leaked electrolyte as perfectly as possible.
2) Avoid narrow spacing between bare circuit patterns with different voltage. (Including around connector)
3) LI battery should not have liquid from electrolyte, but in case If leaked electrolyte touch bare circuit patterns, higher potential terminal material may dissolve and precipitate at the lower potential terminal, and may cause short circuit. The design of the PCB must have this covered.

7. Notice for Assembling Battery Pack

Shocks, high temperature, or contacts of sharp edge components should not be allowed in battery pack assembling process.

8. Others

8.1.Cell connection

1) Direct soldering of wire leads or devices to the cell is strictly prohibited.
2) Lead tabs with pre-soldered wiring shall be spot welded to the cells. Direct soldering may cause damage of components, such as separator and insulator, by heat generation.

8.2.Prevention of short circuit within a battery pack

Enough insulation layers between wiring and the cells shall be used to maintain extra safety protection. The battery pack shall be structured with no short circuit within the battery pack, which may cause generation of smoke or firing.

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8.3.Prohibition of disassembly

1) Never disassemble the cells

The disassembling may generate internal short circuit in the cell, which may cause gassing, firing, explosion, or other problems.

2) Electrolyte is harmful

LI battery should not have liquid from electrolyte flowing, but in case the electrolyte come into contact with the skin, or eyes, physicians shall flush the electrolyte immediately with fresh water and medical advice is to be sought.

8.4Prohibition of dumping of cells into fire

Never incinerate nor dispose the cells in fire. These may cause explosion of the cells, which is very dangerous and is prohibited.

8.5Prohibition of cells immersion into liquid such as water

The cells shall never be soaked with liquids such as water, seawater, drinks such as soft drinks, juices, coffee or others.

8.6Battery cells replacement

The battery replacement shall be done only by either cells supplier or device supplier and never be done by the user.

8.7Prohibition of use of damaged cells

The cells might be damaged during shipping by shock. If any abnormal features of the cells are found such as damages in a plastic envelop of the cell, deformation of the cell package, smelling of an electrolyte, an electrolyte leakage and others, the cells shall never be used any more.

The Cells with a smell of the electrolyte or a leakage shall be placed away from fire to avoid firing or explosion.

9. Period of Warranty

The delivery period from battery date for 6 months If the battery is proved in manufacturing process Defect formation rather than the user abuse and error caused by use of this company is responsible for replacement battery.

10. Storing the Batteries

The batteries should be stored at room temperature, charged to about 30% to 50% of capacity. We recommend that batteries be charged about once per half 3 months to prevent over discharge.

11. Other The Chemical Reaction

Because batteries utilize a chemical reaction, battery performance will deteriorate over time even if stored for a long period of time without being used. In addition, if the various usage conditions such as charge, discharge, ambient temperature, etc. are not maintained within the specified ranges the life expectancy of the battery may be shortened or the device in which the battery is used may be damaged by electrolyte leakage. If the batteries cannot maintain a charge for long periods of time, even when they are charged correctly, this may indicate it is time to change the battery.

12.Note:

Any other items which are not covered in this specification shall be agreed by both parties.

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13.Protection circuit

13.1 PCB Standard

NAME	ITEM	value	Precision	unit
Over voltage	Ocv	4250	±25	mV
	Vcl	4100	±50	mV
	Delay Time	1	±0.5	S
Under Voltage	Vcu	2750	±100	mV
	Vcl	3000	±100	mV
	Delay Time	20	±50	mS
Charge Current	OC	≤15		A
	OC Delay Time	1000	±100	mS
Current	Continuous Output Discharging Current	≤15		A
Over Current	OC	20	±5	A
	OC Delay Time	10	±5	mS
Current Consumption	Normal Mode	≤30		uA
	Sleep Mode	≤0.1		uA
Short Circuit	Delay Time	≤600		uS
	Recovery Condition	Manual regulation		