From:
TO:_____

RECHARGEABLE FE BATTERY

SPECIFICATION FOR APPROVAL

Cell Model : FP1880100

Supplier

	Item	Prepared	Checked	Approved
BYD	Date	2009-07-22	2009-07-22	2009-07-22
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Customer

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Revision History

Edition	Edit date	Page	Item	Contents changed	Prepared
1.0	2009-7-22	10	14	First publish	Deng Yi

1.Scope

The specification describes the requirements for the Rechargeable Fe Battery supplied by BYD LITHIUM BATTERY CO.,LTD.

2.Kind of Products Specified

Name Fe Cell

Type FP1880100

Denomination F : Fe Cell P: Prismatic Cell

18 : Thickness 80: Width

100 : Height

3.Regulatory Requirements and Documents

UL1642,4th Edition	UL Standard for Safety for Lithium cell

4.Shape and Physical Dimensions

Refer to the attached drawing on page 10

5.Appearance

Defects, such as scratches, flaws, dirty spots, rust, deformation, discoloration, leakage, etc., which damage commercial values shall not be presented.

6.Basic Characteristics

Items		Characteristics	
Nominal Voltage		3.20V (at 0.5C discharge current)	
Capacity		10Ah (Typical)	9.8Ah (Minimum)
		(From 3.60V to 2.0V at 0.5C discharge current)	
Charge	Charge Method	CC / CV (Constant Current / Constant Voltage)	
	Charge Voltage	3.60±0.05V	
	Charge Current	2 A × 7hrs (Standard)	
		5A × 3hrs (Rapid)	
	Charge Cut-off current	200mA	
Discharge Current		5A (Normal Discharge Current)	
		30A (Maximum Continuous Discharge)	
Discharge Cut-off Voltage		2.00V / cell	
Operating Temperature		Standard Charge (2A)	10 ~ +60°C
		Max charge current(1A)	-10~+10°C
		Discharge	-20 ~ +60°C
Non-operating Temperature		-20 ~ +60°C	
Relative Humidity		Operating	10% ~ 90%
		Non-operating	5% ~ 95%
Weight		about 280g	
Dimensions		Thickness	18.0mm(max)
		Width	80.0mm(max)
		Height	103.0mm(max)
As Shipped Condition		3.25 ~ 3.35V (about 50%SOC)	

7.Specification and Test Method

7.1Electrical Characteristics

Items	Conditions				Criteria
7.1.1 Full Charge	"Complete charge" means charging the battery with 0.2C of constant current and 3.60V constant voltage for 7.0 hours.				≥98% capacity as the specification defined
7.1.2 Initial Capacity	Discharge the battery at 0.5C constant current till the voltage reduces to 2.00V within 2hour after full charge.				9.8Ah (Minimum)
					10Ah (Typical)
7.1.3 Internal Impedance	Measure the internal resistance at a current frequency of 1KHz after complete charge.				≤11mΩ
7.1.4 Temperature Effects on Discharge Capacity	Compare the capacity at each temperature. After full charge at 25°C/77°F,the capacity is measured with a constant discharge current 1.0C till the voltage reaches 2.00V. If the temperatures of two charge and discharge cycles are not the same, the interval between the cycles should be at least 6 hours. Compare the capacity with that at 25°C /77°F to get percentage as an index.				
	Discharge Temperature				
	-20°C/-4°F	-10°C/	0°C/32°F	25°C/77°F	60°C/140°F
	30%	60	70%	100%	100%
7.1.5 Temperature Effect on Charge Capacity	Relative capacity at each temperature, measured with discharge constant current 1.0C and 2.00V cut-off after the standard charge (at 25°C) is as follows.				
	Charge Temperature (°C)		-10	25	50
	Relative Capacity (%)		60	100	90
7.1.6 Discharge Rate Capabilities	Discharge capacity is measured with various currents as below and 2.00V cut-off after the standard charge.				
	Discharge Rate		0.5C	1.0C	3.0C
	Relative Capacity (%)		100	95	90
7.1.7 Charge Rate Capabilities	Discharge capacity is measured with constant current 1.0C and 2.00V cut-off after the cell is charged with 3.60V as follows.				
	Charge Condition				
	Current			0.5C	1.0C
	Cut-off			3.0hrs.	2.0hrs.
	Relative Capacity			100%	98%

.Items	Conditions			Criteria
7.1.8Cycle Life	Charge/discharge voltage is to be at 3.60V/2.0V. There shall be at least a 10 minute rest period between each charge and discharge cycle. The pass/fail criteria are summarized In the following table where the temperature is the ambient temperature.			
	Ambient Temperature	Charge/discharge current	Number of Cycles	Remaining Capacity/Design Capacity
	0°C	0.1C/0.1C	300	50%
	25°C	0.5C/0.5C	1000	80%
	45°C	0.5C/0.5C	1000	80%
7.1.9Storage Performance	Cell shall be capable of being stored for 6 months at 25°C in an as shipped condition without discharging below 20% RSOC.			
	Retention / Recovery Capacity			
	Capacity after 28days storage at 25°C (full charged cell)			≥ 90% / 95%
	Capacity after 7 days storage at 60°C (full charged cell)			≥ 85% / 90%
7.1.10Self Discharge	Cell OCV drop after 28days storage at 25°C (as shipped condition) shall not exceed 10mV.			

7.2 Safety Characteristics

Items	Conditions and Criteria
7.2.1 Overcharge	Discharged cells are to be charged at 15A constant current till the voltage reaches 10.0V.
	No explosion, no smoke and no fire.
7.2.2 Short Circuit	The cell is to be short-circuited by connecting the positive and negative terminals of the cell with copper wire having a resistance about 0.1Ω on the room temp.
	No explosion, no smoke and no fire.
7.2.3Overdischarge Test	Discharge at 0.5C to 250% of Capacity after standard discharge.
	No leakage, explosion, smoke or catch fire. Cell shall be observed for operation of any protective devices, venting, case expansion or other terminating event.
7.2.4Heating Test	A fully charged cell shall be raised at a rate of 5°C /min to 150°C and kept 150°C storage for 1h r.
	No explosion, smoke or catch fire. Cell shall be observed for operation of any protective devices, venting, case expansion or other terminating event.

Items	Conditions and Criteria
7.2.5 Thermal shock	1) Raising the chamber-temperature to 70 ±3°C (158 ±5°F) within 30 minutes and maintaining this temperature for 4 hours. 2) Reducing the chamber temperature to 20 ±3°C (68 ±5°F) within 30 minutes and maintaining this temperature for 2 hours. 3) Reducing the chamber temperature to minus 40 ±3°C (minus 40 ±5°F) within 30 minutes and maintaining this temperature for 4 hours. 4) Raising the chamber temperature to 20 ±3°C (68 ±5°F) within 30 minutes. 5) Repeating the sequence for a further 9 cycles. 6) After the 10th cycle, storing the batteries for a minimum of 24 hours, at a temperature of 20±5°C (68 ±9°F) prior to examination.
	No leakage, explosion, smoke or catch fire. Without operation of any protective devices, venting, case expansion or other terminating event.
7.2.6Low Pressure	A fully charged cell shall be stored at 11.6 kPa for 6 hrs.
	Without any change.
7.2.7Immersion in Water	A fully charged cell shall be dipped in water for 7 days.
	No explosion, smoke or catch fire. Only leakage is Permitted. Cell shall be observed for operation of any protective devices, venting, case expansion or other terminating event.

7.3Mechanical Abuse Specifications

7.3.1 Nail penetration	Fully charged cells are to be punctured with a nail (Nail Diameter 3.0±0.3mm; Nail Velocity 200±20mm/sec; Nail shall be aligned in the center of the target cell length and diameter).
	No explosion, smoke or catch fire. Only leakage is permitted. Cell shall be observed for operation of any protective devices, venting, case expansion or other terminating event.
7.3.2 Impact	Fully charged cells are to be placed on a flat surface (concrete). A 15.9mm diameter bar (no sharp edges or projections preferably Iron) shall be placed across the center of the cell(s). A 9.1kg weight is dropped from a height of 610±25mm onto the sample, striking the bar.
	No explosion, smoke or catch fire. Cell shall be observed for operation of any protective devices, venting, case expansion or other terminating event.
7.3.3 Crush	Fully charged cell shall be crushed between two flat surfaces. The crush is to be continued until a pressure reading of 17.2 Mpa is reached. The press shall be actuated until the temperature of the cell starts to rise, at which point the press shall be stopped. The temperature rise shall be measured until the cell returns to ambient temperature.
	No explosion, smoke or catch fire. Cell shall be observed for operation of any protective devices, venting, case expansion or other terminating event.
7.3.4 Vibration	Sweep rate: 0.25 oct/min on each of the 3 perpendicular axes. Peak displacement: 3mm, Freq range: 2 to 9Hz
	Sweep rate: 0.25 oct/min on each of the 3 perpendicular axes. Amplitude: 10m/s² pk, Freq range: 9 to 200Hz
	No explosion, smoke or catch fire. Cell shall be observed for operation of any protective devices, venting, case expansion or other terminating event.

8.Standard Environmental Test Condition

Temperature: 25±2°C/77°F Relative Humidity: 65±20% (unless otherwise specified)

9. Appearance

Defects, such as scratches, flaws, dirty spots, rust, deformation, discoloration, leakage, etc., which damage commercial values shall not be presented.

10.Warranty period

Warranty period of this product is 12 months from manufacture code, which the battery should be used in accordance with this specification.

11.Required Protection Functions

To insure the safety, charger and the protection circuit shall be satisfied following items. As safety device, please use in combination with the temperature fuse or poly-switch. The standard charge method is CC / CV (Constant current / Constant voltage).

Charger

No.	Items	Condition
1	Charge Termination Voltage	3.60±0.05 V

Protection function (for reference)

2	Excess Charge Detection Voltage	3.80V~4.05 V
3	Excess Charge Release Voltage	3.70V~3.90 V
4	Discharge Termination Voltage	2.0V
5	Excess Discharge Detection Voltage	1.60V-1.80 V
6	Excess Discharge Release Voltage	1.80V-2.00 V

12. Other Product Liability

You are kindly requested to use the battery which is delivered from BYD LITHIUM BATTERY CO.,LTD in strict accordance with the specification and remarks include at the end of the document.

Due to improper usage of the battery, an accident or a fire may occur. BYD LITHIUM BATTERY CO.,LTD will not guarantee against any accidents occurring due to use beyond the content of this specification.

Prior Notice of Change

In case specification, materials, production process, and control system for the products are changed, the notice of change in writing together with quality and reliability data is to be informed in advance to the buyer.

Indications on Battery Pack

The following warnings should be indicated on the battery packs.

*Use a specified charger by (the manufacturer).

*Do not throw the battery in fire, or heat it up.

*Do not short-circuit the battery terminals.

*Do not disassemble, alter, or solder the battery.

13.Warning, Notice and Caution

Please read and follow the handling instructions for the battery before use. Improper use of the battery may cause heat, fire, rupture, damage or capacity deterioration of the battery.

⚠ WARNING

Do not put the battery into a fire, or heat the battery, do not store the battery in high temperature environment.
Do not connect the battery reversed in positive (+) and negative (-) terminals in the charger or equipment.
Do not let the battery terminals (+ and -) contact a wire or any metal (like a metal necklace or a hairpin) with which it carried or stored together, may cause short-circuit.
Do not drive a nail in, hit with a hammer, or stamp on the battery, do not strike the battery in other ways.
Do not disassemble or alter the batteries' outside structure.
Do not submerge the battery in water, do not wet the battery when store the battery.

⚠ NOTICE

Battery should be charged and discharged with proper charger, in compliance with correct operation contents.
Do not use the battery with other maker's batteries, different types and /or models of batteries such as dry batteries, nickel-metal hydride batteries, or nickel-cadmium batteries, or new and old lithium batteries together.
Do not leave the battery in a charger or equipment if it generates an older and/or heat, changes color and/or shape, leaks electrolyte, or cause any other abnormality.
Do not discharge the battery continuously when it is not charged

⚠ Caution

1.In case young children use the battery, instruct them on the contents of the instructions and ensure the battery is correctly used by them at all times.
2.The battery was inspected carefully by QA before shipment to confirm with the specifications. However, in the case any abnormality of bad smell or heat, etc, arise after purchase, bring it and communicate with us.
For long-term storage, please charge at 0.5C for about one hour in advance.
3.Do not use the battery in other than the following conditions, otherwise, the battery might cause heat generation, damage, or deterioration of its performance.
Operating environment:

Charge:	-10℃ ~ +60℃/40~140°F
Discharge:	-20℃ ~ +60℃/-4~140°F
Store less than 1 month:	-20℃ ~ +60℃/-4~140°F
Store less than 3 months:	-20℃ ~ +45℃/-4~113°F
Store less than 1 year:	-20℃ ~ +25℃/-4~77°F

14.FP1880100 dimensions