

# PRODUCT SPECIFICATION

Cylindrical Lithium-ion Cell

**LR2170SF**

<b>Customer Approval</b>	<b>Signature</b>	<b>Date</b>
	<b>Company Name : celltechchina</b>	
	<b>Company Stamp :</b>	

<b>Prepared By</b>	<b>Checked By</b>	<b>QA</b>	<b>Approved By</b>



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## Product Specification

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## History of revision

[illegible]

## Product Specification

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### 1 SCOPE

The product specification describes the requirements of the Cylindrical Lithium-ion Cell to be supplied to the customer by Tianjin Lishen Battery J/S Co.,Ltd.. Should there be any additional information required by the customer, customer are advised to contact Tianjin Lishen Battery J/S Co.,Ltd..

### 2 DESCRIPTION AND MODEL

2.1	Description	Cylindrical Lithium Ion Cell
2.2	Model	LR2170SF

### 3 GENERAL SPECIFICATIONS

3.1	Nominal Capacity	4500mAh (at 0.2C Discharge)
	Minimum Capacity	4000mAh (at 0.2C Discharge)
	Nominal capacity is measured by the discharge at 1.0C to 2.5V end voltage after standard fully charged according to specification at 25°C.	
3.2	Maximum Charge Voltage	4.20V±0.03V
3.3	Average working Voltage	3.60V@0.2C
3.4	Standard Charge Method(25°C±2°C)	Constant Current and Constant Voltage (CC/CV)
	Current	0.5C (2250mA)
	Voltage	4.2V
	End Current	90mA±5mA
3.5	Maximum Charge Current	0°C ≤ T ≤ 5°C 0.1C(450mA)
		5°C < T ≤ 15°C 0.2C(900mA)
		15°C < T ≤ 60°C 0.5C(2250mA)
3.6	Standard Discharge	Constant Current (CC)
	Current	0.2C (900mA)
	End Voltage	2.5V
3.7	Maximum Discharge Current	-20°C ≤ T ≤ 5°C 1.0C(4500mA)
		5°C < T ≤ 25°C 2.0C(9000mA)
		25°C < T ≤ 45°C 3.0C(13500mA)
3.8	Cycle Life	
	500th cycle ≥80% of 1 <sup>st</sup> Capacity (25°C±2°C, 0.5C/0.5C)	
	If discharged at high rate and high temperature frequently, cell cycle life will be shorten.	
3.9	Weight of Bare Cell	Avg. 72g±4g
3.10	Operating Enviromental Temperature	Charge 0°C ~ 45°C
		Discharge -20°C ~ 60°C
3.11	Storage Temperature	1 month -20°C ~ 50°C
	(For shipping state)	3 months -20°C ~ 40°C
		12 months -20°C ~ 20°C



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### 4 OUTLINE DIMENSION (UNIT: mm)

Dimension: Diameter  $21.7\text{mm} \pm 0.2\text{mm}$ , Height  $70.9\text{mm} \pm 0.2\text{mm}$ . Refer to the attached drawing 1.

### 5 APPEARANCE

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

### 6 TEST CONDITION AND DEFINITIONS

#### 6.1 Measuring Equipment

##### 6.1.1 Voltmeter

Inner impedance  $> 1000\Omega/V$ .

##### 6.1.2 Ampere-meter

Total external resistance (ammeter and wire)  $< 0.01\Omega$ .

##### 6.1.3 Slide caliper

The slide caliper should have a scale of  $0.02\text{mm}$ .

##### 6.1.4 Impedance meter

The impedance meter should be operated at AC  $1\text{kHz}$ .

#### 6.2 Unless otherwise specified, all tests shall be performed at $25 \pm 2^\circ\text{C}$ and humidity of $65 \pm 20\%$ RH.

The cells used for the test mentioned should be new ones delivered a week before at most.

#### 6.3 Definitions :

C Rate ("C"): The rate (milliamperes) at which a fully charged cell is discharged to its end voltage in one (1) hour.

### 7 CHARACTERISTICS

#### 7.1 Charge method

7.1.1 Charging shall consist of charging at a  $0.5C$  constant current rate until the cell voltage reaches  $4.2V$ . The cell shall then be charged at constant voltage of  $4.2V$  while tapering the charge current. Charging shall be terminated when the charging current has tapered to  $0.02C$ .

7.1.2 Charging shall consist of charging at a  $0.5C$  constant current rate until the cell voltage reaches  $4.2V$ . The cell shall then be charged at constant voltage of  $4.2V$  while tapering the charge current. Charging shall be terminated when the charging current has tapered to  $0.05C$ .

#### 7.2 Discharge method :

7.2.1 Cells shall be discharged at a constant current of  $0.2C$  to  $2.5$  volts

7.2.2 Cells shall be discharged at a constant current of  $0.5C$  to  $2.5$  volts

7.2.3 Cells shall be discharged at a constant current of  $1.0C$  to  $2.5$  volts

7.2.4 Cells shall be discharged at a constant current of  $2.0C$  to  $2.5$  volts

7.2.5 Cells shall be discharged at a constant current of  $3.0C$  to  $2.5$  volts

#### 7.3 Internal Impedance

The impedance shall be measured by 6.1.4

Initial Internal Impedance  $\leq 20\text{m}\Omega$ .

#### 7.4 Discharge Rate characteristics

Cells shall be charged per standard charge method at  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$  and discharged per 7.2.1(1.0C), 7.2.2 (2.0C), 7.2.3 (3.0C). The discharge capacity of each cell at respective discharge rate shall be compared with the discharge capacity at 1.0C and the percentage shall be calculated. Each cell shall meet or exceed the requirements of Table 1.

Table 1

0.2C	0.5C	1.0C	2.0C	3.0C
100%	$\geq 96\%$	$\geq 94\%$	$\geq 92\%$	$\geq 90\%$

#### 7.5 Cycle Life

Charge cells per 7.1.2. Rest 15 minutes. Discharge per 7.2.2. Rest 15 minutes before recharge. The test environmental temperature is  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ . A cycle is defined as one charge and one discharge. Discharge capacity shall be measured after 500 cycles.

Discharge capacity (500th Cycle)  $\geq 80\%$  of 1<sup>st</sup> Cycle Capacity

#### 7.6 Storage Characteristics

After charge as per 7.1.1, store the testing cells at  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$  for 28 days. Then discharge as per 7.2.1.

The recovery discharge capacity  $\geq 90\%$  of Initial capacity.

#### 7.7 Temperature Characteristics

Cells shall be charged per standard charge method and discharged per 7.2.1. Cells, full charged, shall be stored for 3 hours at the test temperature prior to discharging and then shall be discharged at the test temperature. The capacity of a cell at each temperature shall be compared to the capacity achieved at  $25^{\circ}\text{C}$  and the percentage shall be calculated. Each cell shall meet or exceed the requirements of Table 2.

Table 2

$-10^{\circ}\text{C}$	$0^{\circ}\text{C}$	$25^{\circ}\text{C}$	$45^{\circ}\text{C}$	$60^{\circ}\text{C}$
$\geq 70\%$	$\geq 80\%$	$\geq 100\%$	$\geq 95\%$	$\geq 90\%$

### 8 SAFETY

#### 8.1 External Short-circuiting Test at $25^{\circ}\text{C}$

Cell, charged per standard charge method, is to be short circuited by connecting the positive (+) and negative (-) terminals with a total external resistance of less than 50mohm. Stop the test when the cell voltage falls below 0.1V and the cell case temperature has returned to a value within  $10^{\circ}\text{C}$  of the original testing temperature.

Criteria: No Fire, No Explosion

#### 8.2 Overcharge Test

Cell, charged per standard charge method, is to be overcharged with 1C to 6.3V while tapering the charge current. Monitoring change of cell temperature during testing. Stop the test when cell temperature decays to room temperature.

Criteria: No Fire, No Explosion

#### 8.3 Heating Test



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Cell, charged per standard charge method, is to be placed in the hot oven. Store the testing cells connecting with thermocouple in constant temperature box, heating the cells and box (speed of ascending temperature is  $5^{\circ}\text{C} \pm 2^{\circ}\text{C}$  per min) together at room temperature simultaneously, monitor the temperature change of the box, keep for 60 minutes after the box temperature reaches  $130^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , then stop the test.

Criteria: No Fire, No Explosion

### 8.4 Overdischarge Test

Cell, charged per standard charge method, is discharged at constant current of 1C for 90min.

Criteria: No Fire, No Explosion

### 8.5 Crush Test

Cell, charged per standard charge method, is to be crushed between two flat surfaces and with cell longitudinal axis parallel to the flat surfaces of the crushing apparatus. The force for the crushing is to be applied by a hydraulic ram with a 1.25 inch (32 mm) diameter piston. The crushing is to be continued until a pressure reading of 2500 psig (17.2 MPa) is reached on the hydraulic ram, applied force of 3000 pounds (13 kN). Once the maximum pressure has been obtained it is to be released.

Criteria: No Fire, No Explosion

## 9 GUARANTEE

Cells are guaranteed to be free from defects in workmanship and materials for a period of half a year provided that the manufacturer can confirm such defects are coming from manufacturing abnormality and not from abusive usage, or else manufacturer will solve the quality problem. Lishen won't replace a new cell for free if the defects are not due to the failure of manufacturing process or is due to customer's abuse or misuse.

9.1 Lishen will not be responsible for trouble occurred by handling outside of the precautions in instructions.

9.2 Lishen requires batteries can not to be used in electric vehicles.

9.3 Lishen will not be responsible for trouble occurred by matching electric circuit, cell pack and charger.

9.4 Lishen will be exempt from warranty any defect cells during assembling after acceptance.

## 10 PACKAGING

Loading 64 cells per box, 2 boxes per case for a total of 128 cells. Sketch map refer to attached drawing 2.

## 11 OTHERS

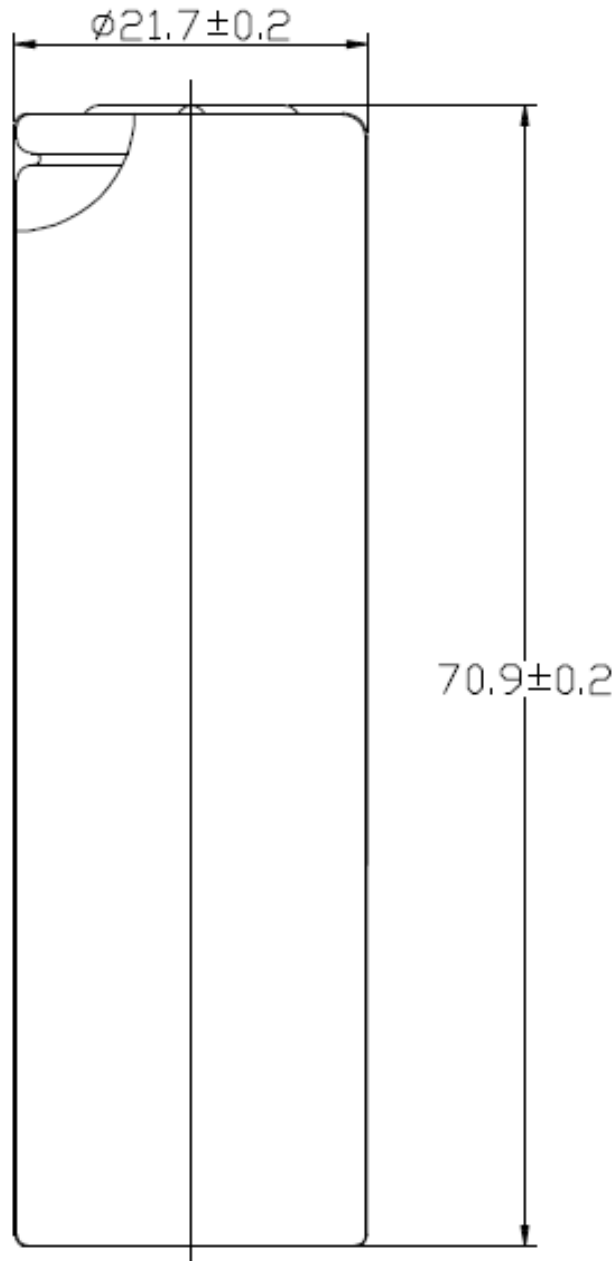
Any matter not included in this specification shall be conferred between the both parties.

## 12 SHIPPING

The capacity of delivery cell is under 10% SOC. It is not specified more than 10% capacity remain at customer, because of self-discharge. During transportation, keep the cell from acutely vibration, impacting, solarization, drenching.

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### Attached 1: LR2170SF Cell Size Drawing



## Attached 2: LR2170SF Packaging Sketch map Drawing

