PRODUCT SPECIFICATION

Cylindrical Lithium-ion Cell

LR1865SK

Customer Approval	**Signature**	**Date**
	Company Name：	
	Company Stamp：	

Prepared By	Checked By	QA	Approved By

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History of revision

Revision	Date	Originator	Reason of Revision
0	20200604	Yu Yang	Original Release

1 SCOPE

The product specification has been prepared to specific the technical requirements, test methods and precautions for the Cylindrical Lithium-ion Cell supplied by Lishen Battery (Suzhou) Co., Ltd. For technical requirements other than this specification, please contact with Lishen Battery (Suzhou) Co., Ltd. for related matters.

2 DESCRIPTION AND MODEL

2.1	Description	Cylindrical Lithium Ion Cell
2.2	Model	LR1865SK

3 GENERAL SPECIFICATIONS

3.1	Typical Capacity	2600mAh (at 0.2C discharge)	
	Minimum Capacity	2500mAh (at 0.2C discharge)	
3.2	Charging Voltage	4.20 ± 0.03V	
3.3	Operating Voltage	3.65V@0.2C	
3.4	Standard Charging method(25±2℃)	Constant Current and Constant Voltage	
		Current	0.5C (1300mA)
		Voltage	4.20V
		End Current	0.02C (52mA)
3.5	Maximum Charging Current	0℃ ≤ T ≤ 5℃	0.1C (260mA)
		5℃ < T ≤ 15℃	0.2C (520mA)
		15℃< T ≤ 45℃	0.5C (1300mA)
3.6	Standard Discharging method	Constant Current	
		Current	0.2C (520mA)
		End Voltage	2.75V
3.7	Maximum Discharging Current	-20℃≤ T ≤ 5℃	0.5C (1300mA)
		5℃ < T ≤ 45℃	2.0C (5200mA)
		45℃< T ≤ 60℃	1.5C (3900mA)
3.8	Cell Weight	Avg.	45 ± 2g
3.9	Operating Temperature Range	Charge	0℃ ~ 45℃
		Discharge	-20℃ ~ 60℃
3.10	Storage Temperature Range	1 month	-20℃ ~ 60℃
	（For ex-factory status）	3 months	-20℃ ~ 40℃
		12 months	-20℃ ~ 20℃

4 OUTLINE DIMENSION

Dimension: Diameter 18.3 ± 0.2mm, Height 64.9 ± 0.3mm. Refer to attached drawing 1.

5 APPEARANCE

There shall be no such defect as breakage of tube and deep scratch, flaw, crack, rust, leakage, etc., which may adversely affect performance of the cell.

6 TEST CONDITION AND DEFINITIONS

6.1 Measuring Equipment

6.1.1 Voltmeter

Inner impedance>1000Ω/V.

6.1.2 Ammeter

Total external resistance(ammeter and wire)<0.01Ω.

6.1.3 Slide caliper

The slide caliper should have 0.02mm scale.

6.1.4 Impedance meter

The impedance meter with AC 1kHz should be used.

6.2 Environmental Conditions

Unless otherwise specified, all tests in this specification are conducted at 25±2℃ and humidity under 65%±20%RH.

The cell used for testing should be a new one received within one week.

6.3 Definitions:

C Rate (“C”): The current value(milliamperes) used to discharged a fully charged cell to the end voltage within 1 hour.

7 CHARACTERISTICS

7.1 Charging method

7.1.1 The cell shall be charged at 0.5C constant current to 4.20V, then charge at 4.20V constant voltage until the current decays to 0.02C.

7.1.2 The cell shall be charged at 0.5C constant current to 4.20V, then charge at 4.20V constant voltage until the current decays to 0.05C.

7.2 Discharging method

7.2.1 The cell shall be discharged at 0.2C constant current to 2.75V.

7.2.2 The cell shall be discharged at 0.5C constant current to 2.75V.

7.2.3 The cell shall be discharged at 1.0C constant current to 2.75V.

7.2.4 The cell shall be discharged at 2.0C constant current to 2.75V.

7.2.5 The cell shall be discharged at 1.0C constant current to 3.0V.

7.3 Internal Impedance

The impedance measured as per 6.1.4 at 25℃.

Internal Impedance ≤ 35mΩ.

7.4 Discharge Rate Capabilities

The cells are charged as per 7.1.1 and then discharged as per 7.2.1(0.2C), 7.2.2 (0.5C), 7.2.3 (1.0C), 7.2.4 (2.0C) respectively at 25℃. The discharge capacity at the various currents is compared with the

discharge capacity at 0.2C and the percentage is calculated. Each cell shall meet the requirements of Table 1.

Table 1

Current	0.2C	0.5C	1C	2C
Relative Capacity	100%	≥95%	≥93%	≥90%

7.5 Cycle Life

The cell is charged as per 7.1.2, rested 15 minutes then discharged as per 7.2.5, and rested 15 minutes before recharged. The test enviromental temperature is 25±2℃. A cycle is defined as one charge and one discharge. The discharge capacity is tested after 500 cycles.

Capacity recovery ≥ 80% of initial capacity.

7.6 Recovery Characteristics

7.6.1 The cell is stored for 28 days at 25±2℃ after charging as per 7.1.1, then discharge as per 7.2.1 and record the cell capacity.

Capacity recovery≥ 90% of initial capacity.

7.6.2 The cell is stored for 7 days at 55±2℃ after charging as per 7.1.1, then discharge as per 7.2.1 and record the cell capacity.

Capacity recovery≥ 90% of initial capacity.

7.7 Temperature Characteristics of Discharge Capacity

The cells are fully charged as per 7.1.1 and then discharged as per 7.2.2 after 3 hours stay at the test temperature. The discharge capacity at the various temperatures is compared with the discharge capacity at 25℃ and the percentage is calculated. Each cell shall meet the requirements of Table 2.

Table 2

Temperature	-10℃	0℃	25℃	45℃	60℃
Relative Capacity	≥70%	≥80%	100%	≥95%	≥90%

8 SAFETY

8.1 External Short-circuiting Test at 25±2℃

Fully charged cell as per 7.1.1 is to be short-circuited by connecting the positive (+) and negative (-) terminals of the cell using the external circuit with external resistance is 80±20mΩ. Stop the test when the cell voltage has droped to 0.1V, or the cell case temperature has droped to within 10ºC of the test temperature.

Criteria: No Fire, No Explosion.

8.2 Overcharge Test

The cells are discharged to 2.75V as per 7.2.2 and then charged to 12V at 1.5C. And then charged at 12V for 7h to gradually decrease the current. Monitoring change of the cell temperature during testing. Stop the test when the cell temperature has droped to room temperature.

Criteria: No Fire, No Explosion.

8.3 Heating Test

Fully charged cell as per 7.1.1 is to be placed in the constant temperature heating box. Store the testing cells connecting with thermocouple in the box with heating rate 5±2 ℃/min. Monitoring change of the box temperature during testing. Stop the test when the box temperature reaches to 130±2℃ for 60 minutes.

Criteria: No Fire, No Explosion .

8.4 Overdischarge Test

Fully charged cell as per 7.1.1 is to be discharged at 1.0C for 90 minutes.

Criteria: No Fire, No Explosion, No Leakage.

8.5 Crush Test

Fully charged cell as per 7.1.1 is to be crushed between two horizontal flat plates of the crushing apparatus, and the cell longitudinal axis is parallel to the flat plates. The hydraulic equipment using a piston pump with a 1.25 inch (32mm) of diameter as the power supply continuously pressurizes the two plates until the hydraulic pressure reaches to 2500 psig (17.2MPa). Stop the test when the squeezing force between the two plates reaches to 3000 pounds (13kN).

Criteria: No Fire, No Explosion

8.6 Drop Test

Fully charged cell as per 7.1.1 is to be dropped from a height of 1.5m onto the concrete ground 3 times(one time on the top, one time the bottom, one time on the side).

Criteria: No Fire, No Explosion.

8.7 Vibration Test

Fully charged cell as per 7.1.1 is to be vibrated in three mutually perpendicular axes(x,y,z) with an amplitude of 0.8mm for 90min in each direction. The vibration frequency increases by 1HZ per minute from 10HZ to 50 HZ.

Criteria: No Fire, No Explosion, No Leakage.

9 PACKAGE

Loading 100 cells per box, 2 boxes per case for a total of 200 cells. Refer to attached drawing 2.

10 OTHERS

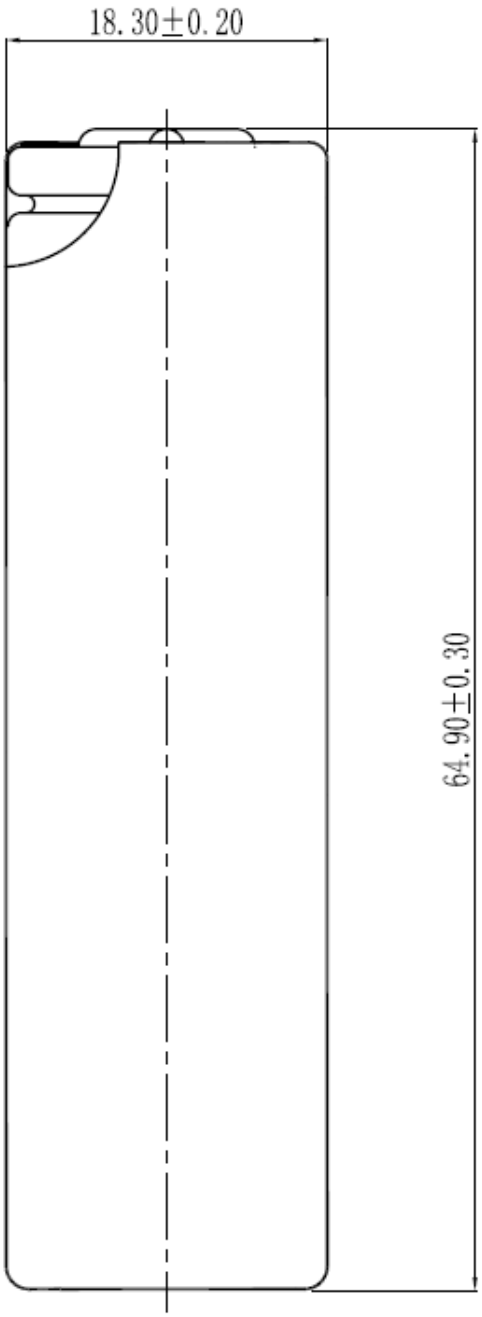
Any matters that specifications does not have, should be conferred with between the both parties.

Not included in this specification shall be resolveded by mutual consultation.

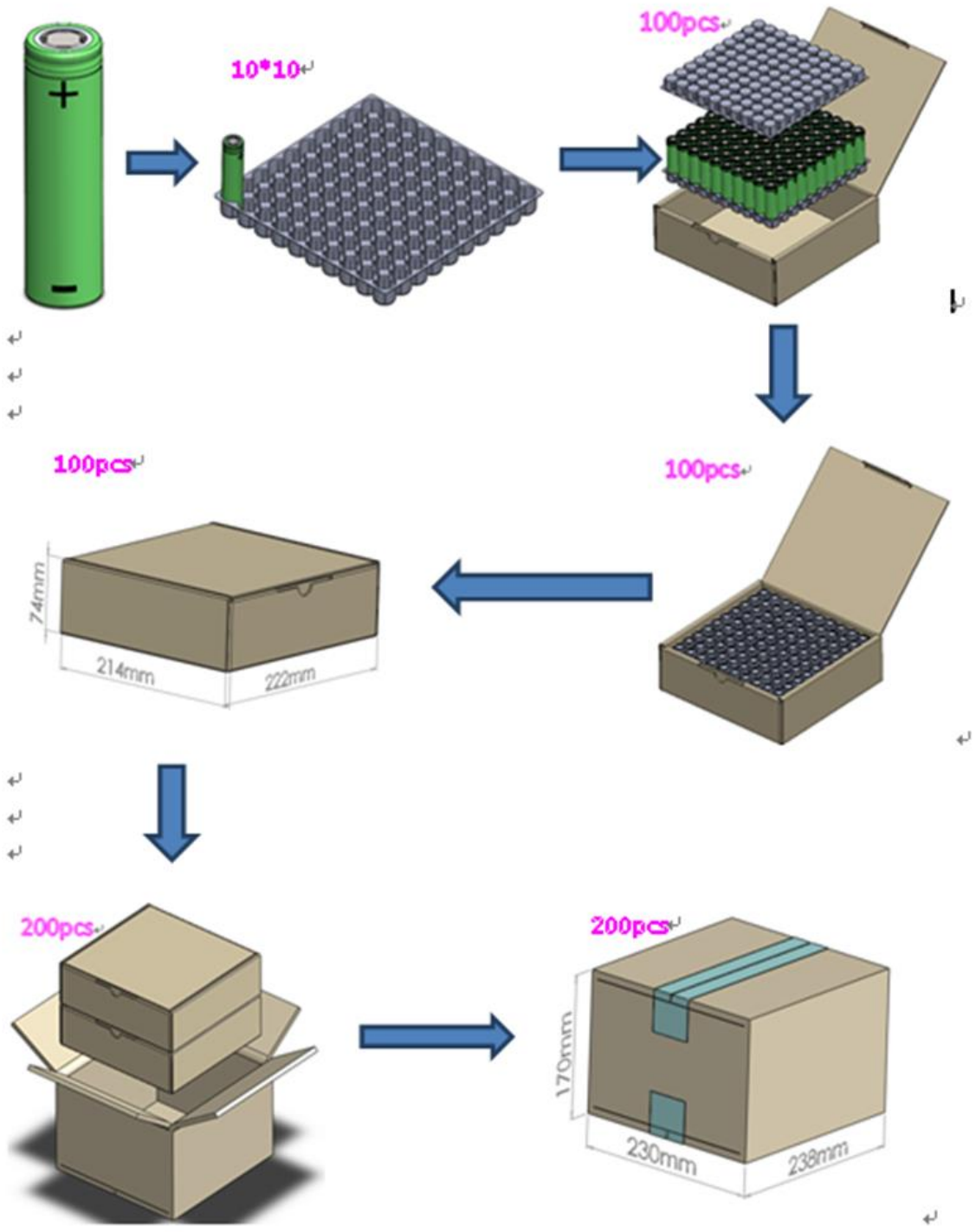
11 SHIPMENT

The capacity of shipping cell is 30%~40%SOC. The violent vibration, impaction, solarization, drenching should be avoided during transportation.

Attached drawing 1



Attached drawing 2



The following precaution and warning should appear in manuals and/or instructions for users, especially at the point of use.

HANDLING INSTRUCTIONS
FOR
LITHIUM ION RECHARGEABLE CELL

1 DESIGN CONSIDERATIONS FOR ELECTRIC CAR, CHARGER AND BATTERY PACK

1.1 Charging

1.1.1 Cell should be charged with constant current-constant voltage method. The charging voltage cannot above 4.20 V/cell and the charging cut-off current is greater or equal to 1/20C. Considering the control deviation of the charger, the charging voltage must be less than 4.20V. Even under abnormal conditions, the charging voltage should not above 4.23V to avoid overcharging. The cell cycle life will be shortened by charging voltage above 4.20V.

1.1.2 Charger should be equipped with a complete charging detection device, which can through the timer, current or open circuit voltage to detect the charged state of the cell. When it is detected the cell is fully charged, the charging circuit should be cut off at time. Avoid trickle charging.

1.1.3 The cell should be charged within a temperature range of 0℃~ 45℃ at the specified current. When the cell temperature exceeds this range, it should be rest until the temperature reaches the above range before recharging.

1.2 Discharging

1.2.1 Discharging end voltage must be over 2.75V.

1.2.2 Discharging current must be below 5.2A/cell.

1.2.3 Discharge temperature range of the cell is -20℃~60℃ at specified current (as per 3.7 in the specification). If surface temperature of the cell exceeds 70℃, the discharge must be stopped.

1.3 Over-discharging

If the voltage is less than 2.75V/cell, the cell is considered to be over-discharged and cannot to be used.

1.4 Storage

The cell should be stored in the following specified range: low humidity (less than 70%RH), no corrosive gases, no pressure and condensation on the cell, best temperature range is -20℃~20℃, best SOC is 10%-35%, and the voltage should be detected before use.

Stored within 1 month: -20℃ ~ 60℃

Stored within 3 months: -20℃ ~ 40℃

Stored within 12 months: -20℃ ~ 20℃

1.5 Battery pack design

1.5.1 Battery pack shape, mechanism and material

The battery pack should be designed to ensure that it cannot be charged by an unauthorized charger.

The battery pack should be designed to ensure that it cannot be connected with unauthorized equipment.

The positive and negative terminals of the battery pack should be designed to avoid short circuits or reverse connection.

The battery pack should have a device with over-current protection function to avoid external short-circuiting.

The positive and negative connection wires of the battery should no overlap.

The battery pack should be designed with anti-static function and can prevent the intrusion of dust, liquid, etc.

The battery pack should be designed to ensure that the electrolyte cannot reach the protection circuit board, even if the battery leaks.

The battery pack should be designed to ensure that the cell is fixed in the battery pack, cannot move.

The structure of the battery pack should be designed to ensure that the dent, deformation and other mechanical stresses of the battery cannot be caused after the foreseeable fall.

The materials of battery pack such as double-sided tape and rubber should be verified for flammability.

The welding mold should be sealed with glue; if ultrasonic welding is used to seal the welding mold, Lishen will not bear any responsibility.

1.5.2 Battery pack structure (battery pack limits the number of batteries used)

The number of parallel connections is unlimited, but the battery pack must pass the overcharge test (the charging current of the overcharge test is the product of the maximum charging current of the charger and the product of the parallel quantity).

The number of series connections is unlimited and the fuse is required.

The battery should be positioned away from the heating electronic components to avoid the deterioration of battery performance.

Between the PCBA and the battery pack should be insulated by the insulation material (such as plastic barrier to provide air isolation or non-conducting thermal insulation material).

The battery pack should be used with cooling device. (Note: often charging and discharging at high temperature (≥35℃) and high rate or high voltage will shorten the battery cycle life; often charging and discharging at high temperature (≥65℃) may have potential safety problems.)

1.5.3 Protection Circuit

The following protection circuit should be installed in the battery pack:

Overcharge protection. For safety and in order not to shorten the cycle life, the maximum overcharge protection voltage for the single cells within each module should be less than 4.23V (including tolerances).

Over-discharge protection. If the single cell voltage reaches 2.75V, the over-discharge protection should cut off the discharge current, and the current consumption of the circuit should be set as small as possible.

Overcurrent protection. If the discharge current of the single cell exceeds about 5.2A, the overcurrent protection should cut off the discharge current circuit. To avoid over discharge in long-term storage, the current consumption of the battery pack protection circuit should be set as small as possible. When it has not been used for a long time, it is necessary to regularly check the remaining state of power and ensure that the single cell in the battery pack cannot reach the over-discharge state.

1.5.4 Cell connection

The cell should not be soldered directly with other cells. Namely, the cell should be welded with leads on its terminal and then be soldered with wire or leads to solder.

1.6 Cell usage

1.6.1 When cells are used in series and parallel connection, they need to use the same gear, the same batch and the same state of charge. This information can be obtained from the inside and outside box labels. Before using the cell, the voltage and internal resistance need to be detected and the cells should be assembled according to its purpose. Lishen recommends that the cell voltage difference is within 20mV and the internal resistance difference is within 6mΩ at least.

1.6.2 Check the voltage, internal resistance, protection circuit function, thermistor and thermal fuse of the battery pack before shipment.

1.6.3 During the transfer of the cells to the assembly factory, special attention should be paid to prohibiting causing damage from external forces during transportation. Lishen recommends that the same transportation packaging is used during the transfer process, even if there is a process of opening the package.

1.6.4 Don't use damaged or leaked cells due to transport damage, drop, short circuit or other reasons.

2 SAFETY INSTRUCTIONS

The cell contains flammable substances such as organic solvents. Improper use may present the cell to generate heat or fire, causing damage of the cell or personal injury. Please pay attention to the use of prohibited items, while the protection device should be added to avoid cells accident by the abnormal use of equipment. Before using lithium-ion rechargeable cells, please read the following safety instructions carefully. In addition, Lishen strongly recommends that these instructions are added to the user manual.

2.1 Dangerous matter

2.1.1 Don't use or store the cell in high temperature environment (above 70℃). Don't put it into fire, water or make it moisture. Don't repair or disassemble cells, there is a risk of causing fire, heat generation, leakage or explosion.

2.1.2 Don't place the cell in a chaotic manner, and keep away from conductive materials such as metal to avoid short-circuit, and don't reverse the positive (+) and negative (-) poles to use.

2.1.3 Don't use non-specified charger and violate charging instructions. Charging under non-specified conditions will cause the cell to overcharge or abnormal chemical reactions, causing heat generation, smoke, rupture or fire.

2.1.4 Don't connect the battery to an AC plug (outlet) or a car plug. The battery needs a specific charger. If the battery is directly connected to the plug, the battery may fire, smoke, explode, or generate heat.

2.1.5 Don't overcharge, over-discharge, puncture, hammer or step on the cell.

2.1.6 Don't hit or throw the cell. If the cell falls, please dispose it as a waste product and don't continue to use it.

2.1.7 Don't disassemble the cell. Otherwise, the battery will no longer be protected. The battery may fire, smoke, explode or generate heat.

2.1.8 Don't charge near high temperatures. If the battery is charged near a high temperature, the battery cannot be recharged due to the protection circuit. In this case, the protection circuit may be interrupted, the battery may fire, smoke, explode or generate heat.

2.1.9 Don't use obviously damaged or deformed batteries, which may generate heat, smoke, rupture or fire.

2.1.10 Don't solder on the cell directly. Overheat will cause deformation of the cell components such as insulating gaskets, the cell may deform, leak, explode or fire.

2.1.11 Don't reverse charge. The battery is reverse charged will occur abnormal chemical reaction. In addition, there is an unpredictable high current may flow during discharge. The battery may generate heat, smoke, rupture or fire.

2.2 Warning

2.2.1 Keep the battery away from babies and children. In case of swallowing the battery, please seek medical immediately.

2.2.2 Don't put the battery in a microwave oven or other cooking utensils. Due to the heating and electrical shock of the microwave oven, the battery may fire, smoke, explode or generate heat.

2.2.3 Don't mix use other batteries. The battery cannot be mixed used from different capacities, chemical systems or manufacturers. Otherwise, the battery may fire, smoke, explode or generate heat.

2.2.4 Don't use an abnormal battery. If there are obvious abnormalities, such as peculiar odor, heat generation, deformity or discoloration, stop using the battery. Such batteries may be defective and if used, they may cause fire, smoke, heat generation or explosion.

2.2.5 If the charging process cannot be ended, stop charging. If the battery cannot complete the charging process within the specified time, stop the charging step. The battery may fire, smoke, explode or generate heat.

2.2.6 Don't use leaking batteries near flames. If the battery or the leaking battery produces a pungent odor, keep the battery away from flames. The battery may be ignited or explode.

2.2.7 Don't touch the leaking battery. If the liquid leaks from the battery gets into the eyes, it will cause serious damage. If the leaked liquid gets into your eyes, flush your eyes with clean water and go to see a doctor immediately. If the liquid is left in the eyes, it will cause serious damage.

2.2.8 To avoid short circuit or damage, please put the battery into a box or carton tightly.

2.2.9 Don't store the battery together with metallic objects, such as keys, necklaces, hairpins, coins or screws.

2.3 Precautions

2.3.1 Before using the battery, be sure to read the instruction. Please keep this instruction for future reference.

2.3.2 Don't use or store batteries in high temperature environments, such as in a car under direct sunlight. Otherwise, the battery may fire, smoke, explode or generate heat. At the same time, it may cause degradation in battery performance and cycle life.

2.3.3 The battery pack has protection circuit. Don't use batteries in a place where static electricity (over 100V) is generated, it may damage the protective circuit. If the protection circuit of the battery pack is damaged, the battery may fire, smoke, explode or generate heat.

2.3.4 The specified temperature range is 0℃~45℃. Don't charge the battery outside the specified temperature range. Otherwise, it may cause heat generation, leakage, or serious damage. In addition, it may cause degradation in battery performance and cycle life.

2.3.5 Before charging, be sure to read the charging method in the charger instruction.

2.3.6 In the first use, if the battery has an abnormal smell, heat generation or rust, please contact with the supplier.

2.3.7 During charging and discharging, please keep away from flammable materials. Otherwise, it may cause fire, smoke, explosion or heat generation.

2.3.8 If the electrolyte leaks from the battery and leaks onto clothes or skin, wash with water immediately. Otherwise, it may irritate the skin.

2.3.9 If wires or metallic objects are abnormally connected to the battery, please completely seal and insulate them. Otherwise, the battery may short circuit, fire, smoke, explode, or generate heat.

2.3.10 After use, please recycle the battery according to local laws and regulations.

3 DIDCLAIMER

3.1 Lishen is not responsible for any loss caused by breach of precautions in the specification.

3.2 Lishen is not responsible for any problems caused by design and mix of battery packs, electric cars and chargers.

3.3 Lishen does not accept abnormal batteries caused by improper assembly.

3.4 Lishen is not responsible for any problems caused by using charging or discharging methods and environment that are incorrect or inappropriate with the specifications.

3.5 Lishen is not responsible for any problems caused by force majeure (such as lightning, storm, flood, fire, earthquake, etc.).

3.6 In order to standardize the use of sample batteries, the rights, obligations and responsibilities of each customer and Lishen are clarified. Before using the battery, please read and understand the specifications thoroughly. To ensure the safety of the battery, please contact Lishen for the design and application. If there are special usage conditions (such as high current load, fast charging method, low temperature and high temperature use), please contact with Lishen.

If you choose to use this cell, your use will be considered as an endorsement of the entire contents of this instruction.

The right to modify, update and interpret this statement belongs to Lishen.

4 CONSULTATION

If you have any questions, please consult as follows:

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