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# SPECIFICATION OF PRODUCT

## Lithium-ion Rechargeable Cell

**Model: EVE-INR21700/50E**

<b>Draft</b>	<b>Checked</b>	<b>Approved</b>
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<b>Company name:</b>
<b>Approved by:</b>
<b>Signature date:</b>

**March, 2021**

**EVE Energy CO., LTD**

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## Revision history

Revision No.	Date	Page	Item	Description	Author
A	2021-3-2	/	/	First Edition	Milo Liu

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## 1.0. Scope

This product specification has been prepared to specify the rechargeable lithium-ion cell to be supplied to Customer by EVE Energy CO., LTD.

## 2.0. Description and Model

2.1 Description	Lithium-ion rechargeable cell
2.2 Model name	EVE-INR21700/50E

## 3.0. Nominal Specification

Item	Specification	
3.1 Typical Capacity	5000 mAh Charge: 1000 mA (0.2C), 4.20V, CCCV 100 mA cut-off, Discharge: 1000 mA (0.2C), 2.50 V DC cut-off.	
3.2 Min. Capacity	4900 mAh Charge: 1000 mA (0.2C), 4.20 V, CCCV 100 mA cut-off, Discharge: 1000 mA (0.2C), 2.50 V DC cut-off.	
3.3 Typical Voltage	3.65 V	
3.4 Standard Charge	CCCV, 1000 mA (0.2 C), 4.20 V, 100 mA cut-off	
3.5 Rate Charge	CCCV, 2500 mA (0.5 C), 4.15 V, 100 mA cut-off	
3.6 Max. Continuous Charge	CCCV, 5000 mA (1 C), 4.10 V, 100 mA cut-off	
3.7 Standard Discharge	DC, 1000 mA (0.2 C), 2.50 V cut-off	
3.8 Max. Continuous Discharge	DC, 15000 mA (3 C), 2.50 V cut-off	
3.9 Standard Charge/Discharge Voltage Range	4.20~2.50 V	
3.10 Cell Weight	69.0±2.0 g	
3.11 Cell Dimension	Height: 70.15±0.15 mm Diameter: 21.15±0.10 mm	
3.12 Operation Temperature (Cell Surface Temperature, cut-off temperature 70°C)	Charge: 0 to 15 °C	≤ 0.2C (1000mA)
	Charge: 15 to 45 °C	≤ 1.0C (5000mA)

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		Charge: 45 to 55 °C		≤ 0.2C (1000mA)	
		Discharge: -20 to 60°C (cut-off temperature 70°C)			
3.13 Storage Temperature (At Shipping SOC)		1 month		0~60 °C	
		3 months		0~45 °C	
		1 year		0~25 °C	
3.14 Storage Humidity		≤65% RH			

Remark: The recovery capacity is more than 90% of Min. capacity after storage at the condition of 3.13.

## 4.0. Outline Dimensions

See the attachment (Fig. 1).

## 5.0. Appearance

There shall be no such defects as rust, discoloration, leakage which may adversely affect commercial value of the cell.

## 6.0. Standard Test Condition

### 6.1 Environment Condition

Unless otherwise specified, all tests stated in this specification are conducted at temperature  $25 \pm 2$  °C and humidity under 65% RH.

### 6.2 Measuring Equipment

#### (1) Amp-meter and volt-meter

The amp-meter and volt-meter should have an accuracy of the grade 0.5 mA and 0.5 mV or higher.

#### (2) Slide caliper

The slide caliper should have 0.01 mm scale.

#### (3) Impedance meter

The impedance meter with AC 1 kHz should be used.

## 7.0. Characteristics

### 7.1 Standard Charge

Standard Charge means charging the cell CCCV with charge current 1000 mA (0.2C), constant voltage 4.20 V and 100 mA cut-off in CV mode at 25 °C for capacity.

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## 7.2 Standard Discharge Capacity

The Standard Discharge Capacity is the initial discharge capacity of the cell, which is measured with discharge current of 1000 mA (0.2C) with 2.50 V cut-off at 25 °C within after the standard charge.

Standard Discharge Capacity  $\geq$  4900 mAh

## 7.3 Initial Internal Impedance

Initial Internal Impedance is measured at AC 1kHz at shipping SOC

Initial Internal Impedance  $\leq$  20 m $\Omega$

## 7.4 Discharge Rate Capabilities

Discharge capacity is measured with the various currents in the following table and 2.50 V cut-off after the standard charge, rest 30 min between charge and discharge.

Item	Discharge Condition				
Current	1000 mA	2500 mA	5000 mA	10000 mA	15000 mA
Rate	0.2C	0.5C	1C	2C	3C
Relative Capacity	100%	$\geq$ 97%	$\geq$ 95%	$\geq$ 93%	$\geq$ 90%

## 7.5 Temperature dependence of discharge capacity

Capacity comparison at each temperature, measured with discharge constant current 1000 mA and 2.50 V cut-off after the standard charge at 25°C

Item	Discharge temperature		
	-20 °C	25 °C	55 °C
Rest time	4 H	4 H	4 H
Relative Capacity	$\geq$ 70 %	100 %	$\geq$ 95 %

## 7.6 Cycle Life

Charge: standard charge (1000 mA, 4.20 V, 250 mA cut-off)

Discharge: Standard discharge (1000 mA, 3.00 V cut-off)

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Rest time: 10 min between charge and discharge

Capacity after 1000 cycles

Capacity  $\geq 70\% C_i$

( $C_i$ : the first discharge capacity of cycle life test at  $25 \pm 2^\circ \text{C}$ )

## 7.7 Storage Characteristics

Test method: Each fully charged cell is stored in corresponding oven, and after the end of the storage, retention capacity and recovery capacity are measured.

Initial Capacity: Standard discharge capacity.

Retention Capacity: The standard discharge capacity after fully standard charged storage at condition in the following table.

Recovery Capacity: The standard discharge capacity of three times cycle after fully standard charged storage at condition in the following table.

Retention Ratio = Retention Capacity / Initial Capacity \* 100 %

Recovery Ratio = Recovery Capacity / Initial Capacity \* 100 %

Item	Retention Ratio	Recovery Ratio
25 °C 28 Days	$\geq 85\%$	$\geq 90\%$
55 °C 7 Days	$\geq 85\%$	$\geq 90\%$
45 °C 28 Days	/	$\geq 90\%$

## 7.8 Status of the cell as of ex-factory

The cell should be shipped in 3.45 V to 3.60 V charging voltage range.

## 8.0. Mechanical Characteristics

### 8.1 Free fall test

Test method: Each fully standard charged cell is dropped three times from a height of 1.0m onto a flat concrete floor at  $20 \pm 5^\circ \text{C}$ . The cells are dropped so as to obtain impacts in random orientations. After the test, the cells shall be put on rest for a minimum of 1h and then a visual inspection shall be performed.

Criteria: No fire, no explosion.

### 8.2 Vibration test

Test method: The vibration shall be a sinusoidal waveform with a logarithmic sweep

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between 7Hz and 200Hz and back to 7Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of 3 hours for each of three mutually perpendicular mounting positions of the cell. One of the directions of vibration must be perpendicular to the terminal face. The logarithmic frequency sweep is increased from 7 Hz a peak acceleration of 1 gn is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1.6 mm total excursion) and the frequency increased until a peak acceleration of 8 gn occurs. A peak acceleration of 8 gn is then maintained until the frequency is increased to 200 Hz.

Criteria: No fire, no explosion, no leakage, with less than 10% of OCV drop.

## 9.0. Safety

### 9.1 Overcharge test

Test method: Fully standard charged cell is charged with 5000 mA to 6.3 V or until charging time up to 1 h.

Criteria: No fire, no explosion.

### 9.2 External Short-circuit test

Test method: Fully standard charged cell is to be short-circuited by connecting the positive and negative terminals of the cell with a circuit load having a resistance load  $80 \pm 2 \text{ m}\Omega$ . Until the test time is lasting to 10 min.

Criteria: No fire, no explosion.

### 9.3 Forced Discharge test

Test method: A fully standard discharged cell is subjected to forced discharge at 5000 mA (1C) for 90 min.

Criteria: No fire, no explosion.

### 9.4 Heating test

Test method: To heat up the standard charged cell at heating rate  $5 \text{ }^{\circ}\text{C} \pm 2 \text{ }^{\circ}\text{C}$  per minute up to  $130 \text{ }^{\circ}\text{C} \pm 2 \text{ }^{\circ}\text{C}$  and keep the cell in oven for 10 minutes.

Criteria: No fire, no explosion.

### 9.5 Altitude Simulation test

Test method: Fully standard charged cell is to be stored at a pressure of 11.6 kPa or less for at least six hours at ambient temperature ( $20 \pm 5 \text{ }^{\circ}\text{C}$ ).

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Criteria: No fire, no explosion and no leakage with less than 10 % of OCV drop.

#### 9.6 Thermal test

Test method: Fully standard charged cell is to be stored for at least 90 minutes at a test temperature equal to  $-40\pm 2$  °C, followed by storage for at least 110 minutes at a test temperature equal to  $85\pm 2$  °C. The time interval from  $25\pm 2$  °C to  $-40\pm 2$  °C is 60 minutes, from  $-40\pm 2$  °C to  $25\pm 2$  °C is 60 minutes, from  $25\pm 2$  °C to  $85\pm 2$  °C is 90 minutes, from  $85\pm 2$  °C to  $25\pm 2$  °C is 70 minutes, respectively. This procedure is to be repeated until 5 total cycles are complete.

Criteria: No fire, no explosion.

#### 9.7 Crush Test

Test method: A fully standard charged cell is to be crushed between two flat surfaces. The force for the crushing is to be applied by a hydraulic ram or similar force mechanism. The flat surfaces are to be brought in contact with the cells and the crushing is to be continued until an applied force of  $13\pm 1$  kN is reached. Once the maximum force has been obtained is to be released. The cell is to be crushed with its longitudinal axis parallel to the flat surfaces of the crushing apparatus.

Criteria: No fire, no explosion.

### 10.0. Warranty

The warranty period of cell is made according to business contract. However, even though the problem occurs within this period, EVE won't replace a new cell for free as long as the problem is not due to the failure of EVE manufacturing process or is due to customer's abuse or misuse.

EVE will not be responsible for trouble occurred by handling outside of the precautions in instructions

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

EVE will be exempt from warrantee any defect cells during assembling after acceptance.

### 11.0. Precautions and Safety Instructions

Lithium-Ion rechargeable batteries subject to abusive conditions can cause damage to the cell and/or personal injury. Please read and observe the standard cell precautions below before



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using utilization.

Note 1. The customer is required to contact EVE in advance, if the customer needs other applications or operating conditions than those described in this document.

Note 2. EVE will take no responsibility for any accident when the cell is used under other conditions than those described in this Document.

Note 3. For the sake of safety assurance, please discuss the equipment design, its system and protection circuit of Lithium-ion cell with EVE in advance. And consult about the high rate current, rapid charge and special application in the same way.

## **12.0. Others**

### **12.1 Storage for a long time**

If the cell is kept for a long time (3 months or more), it is strongly recommended that the cell is performed one cycle and preserved at dry and low-temperature.

### **12.2 Others**

Any matters not involved in this specifications, should be conferred with the both parties.

## **13.0. Guide for the use of Lithium-ion cells**

### **13.1 General**

This chapter has been prepared to describe the appropriate cautions and prohibitions, which the customer should take or employ when the customer uses and handles the lithium ion cell to be manufactured and supplied by EVE Energy CO., LTD., in order to obtain optimal performance and safety.

### **13.2 Charging**

#### **13.2.1 Charging current**

Charging current shall be less than maximum charge current specified in the specification.

#### **13.2.2 Charging voltage**

Charging shall be done by voltage less than that specified in the specification.

#### **13.2.3 Charging temperature**

The cell shall be charged within a range of specified temperatures in the specification.

#### **13.2.4 Reverse charging**

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The cell shall be connected, confirming that its pole are correctly aligned. Inverse charging shall be strictly prohibited. If the cell is connected improperly, it may be damaged.

### 13.3 Discharging

#### 13.3.1 Discharging current

The cell shall be discharged continuously at less than maximum discharging current specified in the specification. In case of the higher discharging current should be set, it shall be discussed with EVE.

#### 13.3.2 Discharging temperature

The cell shall be discharged within a range of temperatures specified in the specification. Otherwise, it may cause loss of performance characteristics.

#### 13.3.3 Over-discharging

The system should equip with a device to prevent further discharging exceeding discharging cut-off voltage specified in the specification.

Over-discharging may cause loss of performance characteristics of battery.

Over-discharging may occur by self-discharging if the battery is left for a very long time without any use.

The charger should equip with a device to detect voltage of cell box and to determine recharging procedures.

### 13.4 Storage

#### 13.4.1 Storage conditions

The cell should be stored within a range of temperatures specified in the specification. Otherwise, it may cause loss of performance characteristics, leakage and/or rust.

#### 13.4.2 Long term storage

The cell should be used within a short period after charging because long-term storage may cause loss of capacity by self-discharging. If long-term storage is necessary, the cell should be stored at lower voltage within a range specified in the specification, because storage with higher voltage may cause more loss of performance characteristics.

### 13.5 Cycle life

13.5.1 The cell can be charged & discharged repeatedly up to times with a certain level of capacity specified in specification.

13.5.2 Cycle life may be determined by conditions of charging, discharging, operating

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temperature and/or storage.

### 13.6 Design of system

#### 13.6.1 Connection between the cell and the battery

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.

Otherwise, it may cause damage of component, such as separator and insulator, by heat generation.

#### 13.6.2 Positioning the battery in the system

The battery should be positioned as possible as far from heat sources and high temperature components. Otherwise, it may cause loss of characteristics. The recommended spacing between the cells is more than 1mm.

#### 13.6.3 Mechanical shock protection of the battery

The battery should be equipped with appropriate shock absorbers in the pack in order to minimize shock, which can damage the cells. Otherwise, it may cause shape distortion, leakage, heat generation and/or rupture and/or open circuit.

#### 13.6.4 Short-circuit protection of the cell

The cell equips with an insulating sleeve to protect short-circuit which may occur during transportation, battery assembly and/or system operation. If the cell sleeve is damaged by some cause such as outside impact, it may cause short-circuit with some wiring inside the battery.

#### 13.6.5 Connection between the battery and charger/system

The battery should be designed to be connected only to the specified charger and system. A reverse connection of the battery, even in the specified system, should be avoided by employing special battery design such as a special terminal.

#### 13.6.6 Pack design

The current consumption of the battery pack should be under 10uA at sleep mode.

The system should be equipped with a device to monitor each voltage of cell block to avoid cell imbalance which can cause damage to the cells.

The battery pack or system should have warning system such as over temperature, over voltage, over current, and so on.

### 13.7 Battery pack assembly

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#### 13.7.1 Prohibition of usage of damaged cell

The cell should be inspected visually before battery assembly.

The cell should not be used if sleeve-damage, can-distortion and/or electrolyte-smell is detected.

#### 13.7.2 Terminals handling

Excessive force on the negative terminal should be avoided when external strip terminal is welded.

#### 13.7.3 Transportation

If the cell is necessary to be transported to such as the battery manufacturer, careful precautions should be taken to avoid damage of cell.

### 13.8 Others

#### 13.8.1 Disassembly

The cell should not be dismantled from the battery pack.

Internal short-circuit caused by disassembly may lead to heat generation and/or venting.

When the electrolyte with fresh water and seek medical advice.

#### 13.8.2 Short-circuiting

Short-circuit results in very high current which leads to heat generation.

An appropriate circuitry should be employed to protect accidental short-circuiting.

#### 13.8.3 Incineration

Incinerating and disposing of the cell in fire are strictly prohibited, because it may cause rupture and explosion.

#### 13.8.4 Immersion

Soaking the cell in water is strictly prohibited, because it may cause corrosion and leakage of components to be damaged to functions.

#### 13.8.5 Mixing use

Different types of cell, or same types but different cell manufacturer shall not be used, which may lead to cell imbalance, cell rupture or damage to system due to the different characteristics of cell.

#### 13.8.6 Battery exchange

Although the cell contains no environmentally hazardous component, such as lead or cadmium, the battery shall be disposed according to the local

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regulations when it is disposed.

The cell should be disposed with a discharged state to avoid heat generation by an inadvertent short-circuit.

#### 13.8.7 Caution

The battery used in this device may present a risk of fire or chemical burn if mistreated.

Do not disassemble, expose to heat above 100°C or incinerate it.

Do not expose the cell to extreme heat or flame.

Do not short circuit, over-charge or over-discharge the cell.

Do not subject the cell to strong mechanical shocks.

Do not immerse the cell in water or sea water, or get it wet.

Do not reverse the polarity of the cell for any reason.

Do not disassemble or modify the cell.

Do not handle or store with metallic like necklaces, coins or hairpins, etc.

Do not use the cell with conspicuous damage or deformation.

Do not connect cell to the plug socket or car-cigarette-plug.

Do not make the direct soldering onto a cell.

Do not touch a leaked cell directly.

Do not use for other equipment.

Do not use Lithium-ion cell in mixture.

Do not use or leave the cell under the blazing sun (or in heated car by sunshine).

Keep cell away from children.

Do not drive a nail into the cell, strike it by hammer or tread it.

Replace battery with those of EVE only.

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## 14.0. Others

### 14.1 Storage for a long time

If the cell is kept for a long time (3 months or more), the environment should be low-temperature (normally 0~25 °C), dry and no corrosive gas.

### 14.2 Sorting

Item	Spec.	Remark
Nominal Capacity	$\geq 4900\text{mAh}$	Charge: 1000 mA, 4.20 V, CCCV 100mA cut-off Discharge: 1000 mA, 2.5 V DC cut-off
Shipping Voltage	3.45V to 3.60V	20~30% SOC
Variation of Capacity	$\leq 40\text{mAh}$	/
Variation of Voltage	$\leq 10\text{mV}$	This refers to the shipment voltage
Variation of AC Impedance	$\leq 3\text{m}\Omega$	This refers to shipment AC impedance

### 14.3 Others

Any matters not involved in this specifications, should be conferred with the both parties.

## 15.0. Consultation

15.1 Address: Huizhou EVE Energy Co., Ltd.-EVE Industrial Park on No.38, Huifeng 7th Road, Zhongkai Hi-Tech Zone, Huizhou.

15.2 Tel No.: 86-755-3270571

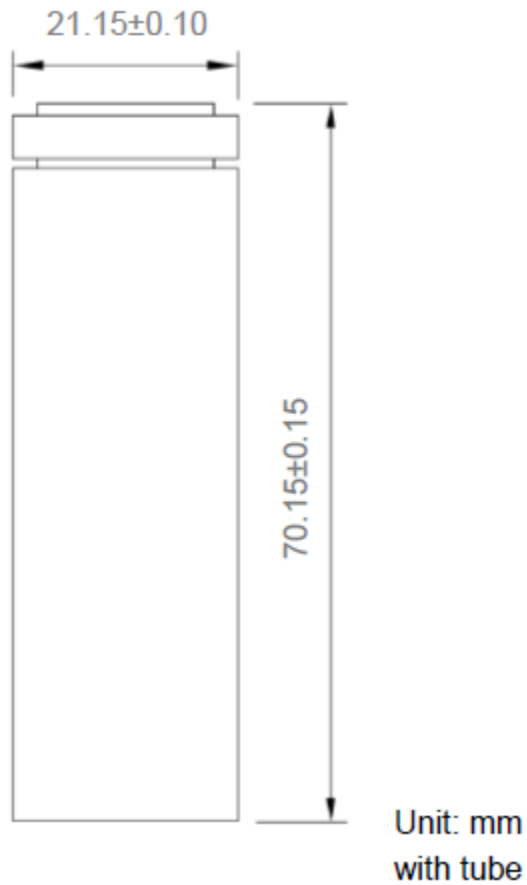
15.3 Fax No.: 86-752-2606033

15.4 Website: [Http://www.evebattery.com.cn](http://www.evebattery.com.cn)

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**Attachment:**

**Fig 1:**



**Fig. 1. Outline Dimension of INR21700/50E**