TERRA E®

Cell Specification

INR 21700 50E2

Powerful for you.
Fast for everyone.


E-Mobility


Industrial


Medical


Power- and Gardentools


Drive System


Energy Storage Systems

www.terrae.com

INR 21700 50E2
Cylindrical Lithium Ion Cell

1. Scope

The product specification describes the requirements of the Cylindrical Lithium-ion Cell to be supplied to the customer by TerraE. Should there be any additional information required by the customer, customer are advised to contact TerraE.

2. Description and Model

2.1	**Description**	Cylindrical Lithium Ion Cell
2.2	**Model**	INR_21700_50E2

3. General Specifications

3.1	**Nominal Capacity**	5000mAh (at 0.2C Discharge)
	Minimum Capacity	4900mAh (at 0.2C Discharge)

Nominal capacity is measured by the discharge at 0.2C to 2.5V end voltage after standard fully charged according to specification at 25°C.

3.2	**Maximum Charge Voltage**	4.20V
3.3	**Average Working Voltage**	3.60V
3.4	**Standard Charge Method (25°C ± 2°C)**	
	Constant Current to 4.2V	0.5C (2500mA)
3.5	**Maximum Charge Current**	1C (at 25°C, not ideal for cycle life)

Recommended charge rates

0°C ≤ T ≤ 5°C	0.1C (500mA)
5°C < T ≤ 10°C	0.2C (1000mA)
10°C < T ≤ 15°C	0.3C (1500mA)
15°C < T ≤ 25°C	0.4C (2000mA)
25°C < T ≤ 45°C	0.7C (35000mA)

3.6	**Standard Discharge**	Constant Current (CC) 0.2C (5500mA)
		Current 2.5V
		End Voltage
3.7	**Maximum Discharge Current**	3C (at 25°C, not ideal for cycle life)

Recommended discharge rates

-20°C ≤ T ≤ 25°C	1.0C (5000mA)
25°C < T ≤ 40°C	3.0C (15000mA)
40°C < T ≤ 55°C	1.0C (5000mA)

INR 21700 50E2
Cylindrical Lithium Ion Cell

3.8	**Cycle Life**	80% SOH after 800 cycles at 25°C with 0.5C/1C	
3.9	**Weight of Bare Cell**	≤72g	
3.10	**Operating Enviromental Temperature**	Charge	0°C ~ 45°C
		Discharge	-20°C ~ 60°C
3.11	**Storage Temperature (For Shipping State)**	1 month	-20°C ~ 60°C
		3 months	-20°C ~ 45°C
		12 months	- 20°C ~ 25°C

4. Outline Dimension (Unit: mm)

Dimension: Diameter max 21.40mm, Height max 70.75mm. 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	**Electronical Balance**	Parameter mileage 0.01g-160g,accuracy 1mg
6.1.2	**Manual Voltage-Impedance Tester**	Impedance: Parameter mileage 0-3.1kΩ, accuracy 0.1μΩ, The impedance meter should be operated at AC 1kHz
6.1.3	**Digital Caliper**	Parameter mileage 0-150mm, accuracy ± 0.02mm, resolution ratio 0.01mm

6.2 Unless otherwise specified, all tests shall be performed at 25°C ± 2°C and humidity of 65%RH ± 20%RH. The cells used for the test mentioned should be new ones delivered a week before at most.

6.3 Definition

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 0.2C 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.

INR 21700 50E2
Cylindrical Lithium Ion Cell

7.2 Discharge Method

7.2.1 Charging shall consist of charging at a 0.3C 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.

7.1.3 Charging shall consist of charging at a 1.0C constant current rate until the cell voltage reaches 3.80V ,0.8C constant current rate until the cell voltage reaches 4.00V, 0.6C constant current rate until the cell voltage reaches 4.10V, 0.4C constant current rate until the cell voltage reaches 4.19V, 0.2C constant current rate until the cell voltage reaches 4.195V, 0.05C constant current rate until the cell voltage reaches 4.20V.

7.3 Internal Impedance

The impedance shall be measured by 6.1.2
Initial Internal Impedance ≤ 30mΩ

7.4 Discharge Rate Characteristics

Cells shall be charged per standard charge method at 25°C ±2°C and discharged per 7.2.1 (0.2C), 7.2.2 (0.5C), 7.2.3 (1C), 7.2.4 (2C), 7.2.5 (3C). The discharge capacity of each cell at respective discharge rate shall be compared with the discharge capacity at 0.2C and the percentage shall be calculated. Each cell shall meet or exceed the requirements of Table 1.

Discharge Current	Available Capacity
0.2C	100%
0.5C	≥97%
1.0C	≥95%
2.0C	≥90%
3.0C	≥85%

7.5 Cycle Life

Charge 0.5C constant current charge to 4.20V followed by 4.20V constant voltage charge to cut-off current ≤ 0.05.C (250mA). Discharge: 1C constant current discharge to cut-off voltage ≤ 2.75V. Discharge capacity (801th Cycle) ≥80% of 1st Cycle Capacity. Charge 0.5C constant current charge to 4.15V followed by 4.15V constant voltage charge to cut-off current ≤ 0.05.C (250mA). Discharge: 1C constant current discharge to cut-off voltage ≤ 3.00V. Discharge capacity (1001th Cycle) ≥80% of 1st Cycle Capacity.

INR 21700 50E2
Cylindrical Lithium Ion Cell

7.6 Storage Characteristics

7.6.1 After charge as per stardard charge method 7.1.1, store the testing cells at 25°C ± 2°C for 28 days. Then discharge as per 7.2.3. Then the same cell is fully charged as per 7.1.1 again and discharged a second time and measured as per 7.2.3 The recovery discharge capacity (2nd discharge capacity) ≥90% of Initial capacity.

7.6.2 After charge as per stardard charge method 7.1.1, store the testing cells at 55°C ± 2°C for 7 days. Then discharge as per 7.2.3. Then the same cell is fully charged as per 7.1.1 again and discharged a second time and measured as per 7.2.3. The recovery discharge capacity (2nd discharge capacity) ≥90% of Initial capacity.

7.7 Temperature Characteristics

Cells shall be charged with 0.5C and discharged with 0.2C.

Temperature	Available Capacity
-20°C	≥65%
-10°C	≥75%
0°C	≥85%
10°C	≥90%
45°C	≥97%
60°C	≥98%
25 ° C	100%

8. Safety

8.1 External Short-Circuiting Test at 25°C

Cell, charged per stardard charge method, is to be short circuited by connecting the positive (+) and negative (-) terminals with a total external resistance of 80 mΩ ± 20mΩ. Stop the test when the cell voltage falls below 0.1V and the cell case temperature has returned to a value within 10°C of the original testing temperature.

Criteria: No Fire, No Explosion

8.2 Overcharge Test

Cell, charged per stardard 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

INR 21700 50E2
Cylindrical Lithium Ion Cell

8.3 Overdischarge Test

Cell, charged per stardard charge method, is discharged at constant current of 1C for 90min.
Criteria: No Fire, No Explosion

8.4 Heating Test

Cell, charged per stardard 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°C ± 2°C per min) together at room temperature simultaneity, monitor the temperature change of the box, keep for 30 minutes after the box temperature reaches 130°C ± 2°C, then stop the test.
Criteria: No Fire, No Explosion

8.5 Drop Test

Cell, charged per stardard 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 pressurereading 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. Packaging

Loading 130 cells per box, refer to attachment 2.

10. Others

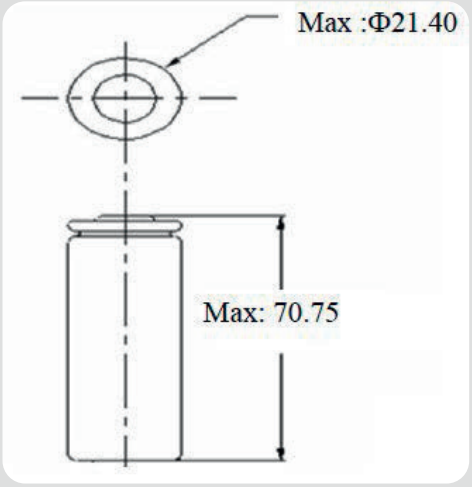
Any matter not included in this specification shall be conferred between the both parties.

11. Shipping

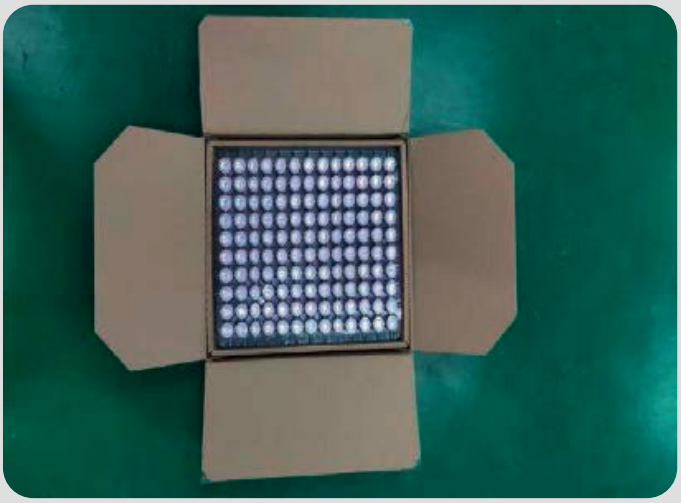
The cell voltage in delivery is between 3.50V – 3.80V, or in accordance with customers' requirement. The remaining capacity before charging shall be changed depending on the storage time and conditions.

INR 21700 50E2
Cylindrical Lithium Ion Cell

Attached 1: Cell Size Drawing



Attached 2: Packaging per box



INR 21700 50E2
Cylindrical Lithium Ion Cell

The following caution 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. Charging Electric Car, Charger and Battery Pack Design Considerations

1.1 Charging

1.1.1 Cell must be charged with constant current-constant voltage method. Charging voltage must below 4.20V/cell and the charging cut-off current is greater than or equal to 1/20C. Even if the charge could be out of order, charge voltage of charger should not be above 4.23V/cell to avoid over-charging. Cell life will be shorten by charging voltage above 4.20V.

1.1.2 Charger should be equipped with a pre-charging system, and the function should be used to prevent the abnormal large multiplier charging after the deep discharge. In case of cell voltage is below 2.5V(and higher than 2.0V), cell should be charged with pre-charge that current is below 0.5A (0.1C). Then cell voltage reach over 2.5V, standard charge starts. And if cell voltage never reaches to 2.5V in 30 minutes, charger will stop charging. Don't charge if the voltage is lower than 2.0V.

1.1.3 Charger should be equipped with a complete charging detection device including the timer inspection, current and open circuit voltage to detect the current state of charge. When one of the detection such as timer, current and voltage detected the full charge, charge should be completely cut off the charging circuit, avoid produce turbulence.

1.1.4 Charger should start charging at temperature range 0°C ~45°C (see spec 3.5). When the cell temperature exceeds 60°C, it should be placed in the battery temperature to reach the above range before recharging.

1.1.5 For cycle life, use the normal charging or trickle charging method and minimize the fast charge.

INR 21700 50E2
Cylindrical Lithium Ion Cell

1.2 Discharging

1.2.1 Discharge end voltage must be over 2.5V.

1.2.2 Discharge temperature range should be -20°C ~ 60°C (see spec 3.7). If surface temperature exceeds 60 degrees, it should be placed in the battery temperature to reach the above range before recharging.

1.3 Storage

Any storage, cell should be in low humidity (less than 70%RH), no corrosive gas atmosphere area. And there is no press and condensation on the cell. Best temperature range -20°C ~ 20°C. For long storage, the soc of the cell must between 25% ~ 35% SOC, and the voltage of the cell must be checked before used.

When stored within 1 month:	-20°C ~ 60°C
When stored within 3 months:	-20°C ~ 45°C
When stored within 12 months:	-20°C ~ 25°C

1.4 Precautions on Battery Pack Design

1.4.1 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 to unauthorized equipment and equipment; both ends of the battery pack should be designed to avoid short circuits or positive and negative The battery pack design should have anti-static function and can prevent the dust, The battery should be designed so that even if the battery leakage occurs, the electrolyte cannot reach the protection circuit board; battery design should ensure that the battery is fixed in the battery pack, cannot move; battery pack in the structure should ensure that The use of materials such as double-sided tape and rubber should verify its flammability; welding mold should be sealed with glue; if the welding die in the sealed when the welding of the mold cannot be used, The use of ultrasonic welding method, for the emergence of any defects, God does not bear anything Either.

1.4.2 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 maximum charge current of the charger and the product of the parallel quantity); the number of series is unlimited and the fuse is required; the battery should be away from the heat Device to avoid deterioration of battery performance; PCBA circuit board and battery pack should be insulated between the insulation material (such as plastic barrier to provide air isolation or non-conducting thermal insulation material). If charged and discharged at high rate and high temperature (≥35°C) frequently, cell cycle life will be shorten. If charged and discharged at high temperature (≥60°C) frequently, cell safety may be occurred.

INR 21700 50E2
Cylindrical Lithium Ion Cell

1.4.3 Protection Circuit insure safety of battery
The following protection circuit should be installed in the battery pack:

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

Over discharge protection
If the single cell voltage reaches 2.5V, we recommend that the discharge protection should cut off the discharge current, the circuit current consumption should be as small as possible;

Overcurrent protection
If the discharge current of the single cell exceeds about 10A, the overcurrent protection should cut off the discharge current circuit.

External short protection
The battery pack has function not to cause external short cut.

Over temperature protection
Set the temperature protection of pack according to the cell use condition in SPEC. Battery pack should have cell voltage balancing function and cell imbalance protection circuit. Battery pack should have function to avoid thermal propagation when the cell is failure. Weld spot welding lead plate onto cell, and solder lead wire or lead plate. the battery pack in the discharge, the internal cell temperature difference should be less than or equal to 5°C. In order to avoid long-term storage over discharge mode, battery pack protection circuit current consumption should be set as small as possible. Long-term use, to regularly check the remaining state of electricity, to ensure that the battery within the single cell cannot achieve over-discharge state.

1.4.4 Cell connection
Do not solder onto a cell in order to avoid a damage on the cell. The battery pack should be equipped with appropriate shock absorbers in the pack in order to minimize shock, which can damage the cells.

INR 21700 50E2
Cylindrical Lithium Ion Cell

1.5 Cell Usage

1.5.1 When using batteries for serial and use, use the same gear, the same batch and the same state of charge batteries, you can get this information from the inside and outside the box label. Batteries need to be used before the detection of voltage resistance, and in accordance with its use for the combination. It is recommended at least to ensure that the use of batteries within 30mV voltage within the internal resistance within 6mΩ.

1.5.2 Battery pack before shipment Check the voltage, internal resistance, protection line function, thermistor, thermal fuse.

1.5.3 Transfer the batteries to the assembly process to pay special attention to prohibit the transport process caused by external damage, the transport process is recommended to use the same transport packaging, even if there is a process of opening the package.

1.5.4 Do not use damaged or leaked batteries due to transport damage, drop, short circuit or other reasons.

2. Safety Instructions

Batteries containing organic solvents and other flammable substances, such as improper use may cause the core heat or fire, resulting in damage to the battery or personal injury. Please pay attention to the use of prohibited items, while the protection device should be added to avoid the use of equipment caused by abnormal batteries accident. Before using lithium-ion rechargeable batteries, please read the following safety guidelines carefully. In addition it is strongly recommended to add these instructions to the user manual.

2.1 Dangerous Matter

2.1.1 Don't use or place batteries in high temperature (above 60°C) environment. Do not put it into fire, water or make it moisture. Do not repair or disassemble batteries, there is a risk of causing the batteries to ignite, overheat, leak or explode.

2.1.2 Don't place the batteries in a chaotic manner, away from metal and other conductive materials to avoid positive (+) negative (-) short circuit, do not reverse the positive (+) negative (-) pole

2.1.3 Don't use non-specified charging equipment and violate charging requirements. Non-specified conditions charge will cause the battery to overcharge or abnormal chemical reactions, heat generation, smoke, rupture or fire.

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

2.1.5 Don't overcharge, over-discharge, drive nail into the cell, strike it by hammer or tread and step on it.

2.1.6 Don't hit or throw batteries. If the batteries appear to fall, please treat the waste, cannot continue to use.

2.1.7 Don't dissect the battery. If the protection line is damaged, the battery will no longer be protected. Then, the battery may fire, smoke, explode or cause heat.

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

2.1.9 Don't use batteries that are clearly damaged or deformed. May cause fever, smoke, rupture or burning.

2.1.10 Don't direct soldering of batteries, overheating will lead to insulation gaskets and other parts of the deformation, causing cell deformation, leakage, explosion or fire.

2.1.11 Don't reverse polarity charge. In the case of charging, the battery is reverse charging will be abnormal chemical reaction. In addition, there is an unpredictable high current through the discharge. These may cause heat, smoke, rupture or burning.

2.2 Warning

2.2.1 Batteries should be kept away from infants and young children. In case of swallowing the battery, please seek medical attention immediately.

2.2.2 Don't place the battery in a microwave oven or other cooking utensils. Due the heating and electrical shock of the microwave oven, the battery may ignite, smoke, explode or cause heat.

2.2.3 Don't mix with other batteries. The battery cannot be mixed with other different capacities, chemical systems, or manufacturers' batteries. Do not connect other batteries or mix other batteries. The battery may catch fire, smoke, explode or cause heat.

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

2.2.5 If the charging process does not end, stop charging. If the battery cannot complete the charging process for a specified period of time, stop the charging step. The battery may catch fire, smoke, explode or cause heat.

2.2.6 Don't use a leaky battery near a flame. If the battery or liquid out of the battery produces a pungent odor, the battery should remain away from the flame. The battery may be ignited or exploded.

2.2.7 Don't touch the leaky battery. If the liquid leaking from the battery into the eyes, will cause serious damage. If you come from your leaked liquid into your eyes, rinse your eyes with water immediately. Please consult a doctor immediately. If the liquid is left in the eyes, it will cause serious damage.

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

2.2.9 Don't store the cell in a pocket or a bag together with metallic objects such as keys, necklaces, hairpins, coins, or screws.

2.3 Precautions

2.3.1 Don't use or place batteries in high temperature environments, such as in direct sunlight. The battery may catch fire, smoke, explode or cause heat. At the same time, may cause battery performance and life degradation.

2.3.2 Battery pack has a protective line. Do not use batteries in places where static electricity (over 100V) is generated,which may damage the protection circuit. If the protective line of the battery is damaged, the battery may catch fire, smoke, explode or cause heat. Do not use Lithium ion cell with the primary batteries or secondary batteries whose capacity or kinds or maker is different. If do that, the cell will be discharged or charged excessively in use. And it may cause the generating heat, smoke, rupture or flame because of the abnormal chemical reaction in cells.

2.3.3 Specified the charging temperature range. Do not charge the battery outside the specified temperature range. Failure to do so may result in heat, leakage, or serious damage. In addition, battery performance and life degradation may occur.

2.3.4 Please read the manual before use. Please keep this manual for future reference.

2.3.5 Please read the charging method of the charger manual.

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

2.3.7 Keep away from flammable materials during charging and discharging. May cause fire, smoke, explode or cause heat.

2.3.8 If the electrolyte leaks from the battery, gets on the clothes or on the skin, rinse it immediately with water. Otherwise it may irritate the skin.

2.3.9 If wires or metal objects come out of the battery, completely seal and insulate them. Otherwise, the battery may cause a short circuit, fire, smoke, explosion, or cause heat.

2.3.10 After use, please carry out battery recycling according to local laws and regulations.

INR 21700 50E2
Cylindrical Lithium Ion Cell

3. Exclusion Liability

3.1 TerraE is not liable for any loss caused by breach of notice in the specification

3.2 TerraE is not responsible for any problems caused by design defects in battery packs, electric cars and chargers

3.3 TerraE does not accept abnormal batteries caused by improper assembly

3.4 TerraE is not liable for any loss caused by incorrect or incongruent with the SPEC charge and discharge method and inappropriate environment

3.5 TerraE is not liable for any force majeure (ex. Lightening, storm, flood, fire, earthquake, etc)

3.6 In order to standardize the use of sample batteries, the rights, obligations and responsibilities of every customer and TerraE are clarified. Before using the battery, please read carefully and thoroughly understand the contents of the specification. In order to ensure the safety of the battery, please contact TerraE to discuss design of the application. Also, if there are special usage conditions (for example: a large current load, a quick charge method, or a special usage pattern), please consult TerraE before finalizing the product specification. If you choose to use this battery, your use will be regarded as an endorsement of all the contents of this statement. The amendment, renewal and final interpretation of this statement are belong to TerraE.

Any questions?

Contact us, we will be pleased to advise you.

A full load of advantages

Customized cells tailored to your individual requirements with the best choice in Li-Ion technology for the coming development.

- One-Stop Shop
- Customized
- High Quality
- More Power
- High Energy

Headquarter Germany

TerraE GmbH
Zeche Gustav 1
63791 Karlstein am Main

+49(0) 6188-9956-0
info@terrae.com
www.terrae.com

Power – the result of a better battery