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CHAM BATTERY TECHNOLOGY CO.,LTD

Lithium-ion Rechargeable Cell Specification

High Energy Cylindrical Cell

CMINR18650F9E

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Revision History

Edition	Modified Content	Draftsman	Reviser	Date
A0	/	Liang.Zhang	/	2021-10-14
A1	3.7: Modify the description of the max. discharge current; 3.8: Reduce the weight; 3.12: Raise the storage temperature in one month; 4.1/4.2: Supplement the definition of standard charge and standard discharge; 5.1.4: Raise the max. rate current of rate character; 5.1.6: Raise the max temperature of the temperature dependency of capacity; 5.1.8: Modify the relative humidity of storage; 5.4.3: Extend the testing time of heating test; 10: Modify the delivered voltage and capacity.		Liang.Zhang	2021-11-05

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1. Scope

This specification describes technical parameters and test standards for the lithium-ion rechargeable cell CMINR18650F9E, manufactured and supplied by Cham Battery Technology Co., Ltd. These parameters and standards mainly refer to GB 31241-2014 and UL1642.

2. Product Specification

2.1 Type: Cylindrical Lithium Ion Rechargeable Cell

2.2 Model: CMINR18650F9E

3. Basic Characteristics

Technical Parameters	Specification		Condition/Note
3.1 Capacity	Typical	3450mAh	Standard charge/discharge (Refer to 4.1 and 4.2)
	Minimum	3350mAh	
3.2 Nominal Voltage	3.6V		
3.3 Internal Impedance	$\leq 40\text{m}\Omega$		AC 1kHz
3.4 Standard Charge (Refer to 4.1)	0.5C(1675mA) 4.2V 50mA		Constant current Constant voltage End condition(Cut off)
3.5 Rapid Charge	1.0C(3350mA) 4.2V 50mA		Constant current Constant voltage End condition(Cut off)
3.6 Standard Discharge	0.2C(670mA) 2.5V		Constant current End condition(Cut off)
3.7 Max. Discharge Current	10000mA		
3.8 Weight	Max. 50.0 g		
3.9 Dimension	Diameter (Φ)	Max. 18.6mm	
	Height (H)	Max. 65.2mm	

3.10 Operating Temperature (Charge)	Temperature	Max. Continuous Charge Current	
	$0^{\circ}\text{C} \leq T \leq 15^{\circ}\text{C}$	670mA (0.2C)	
	$15^{\circ}\text{C} < T \leq 25^{\circ}\text{C}$	1675mA (0.5C)	
	$25^{\circ}\text{C} < T \leq 45^{\circ}\text{C}$	3350mA (1.0C)	
3.11 Operating Temperature (Discharge)	$-20^{\circ}\text{C} \sim 60^{\circ}\text{C}$		
3.12 Storage Temperature (for Shipping State)	one month	$-20^{\circ}\text{C} \sim 60^{\circ}\text{C}$	$\geq 2680(3350*80\%) \text{ mAh}$
	three months	$-20^{\circ}\text{C} \sim 45^{\circ}\text{C}$	$\geq 2680(3350*80\%) \text{ mAh}$
	one year	$-20^{\circ}\text{C} \sim 25^{\circ}\text{C}$	$\geq 2513(3350*75\%) \text{ mAh}$
3.13 Overheat Protection Temperature	70°C		Stop discharging when cell surface temperature $\geq 70^{\circ}\text{C}$

4. Standard Conditions for Test

1. Without stating specifically, all the electrical characteristics are obtained under the following conditions: Ambient temperature: $25 \pm 3^{\circ}\text{C}$; Relative humidity: $\leq 75\%$.

2. Without stating specifically, all the safety tests are conducted under the following conditions: Ambient temperature: $20 \pm 5^{\circ}\text{C}$; Relative humidity: $\leq 75\%$.

4.1 Standard Charge	0.5C(1675mA), CC-CV(constant current to constant voltage charge) to 4.2V, 50mA cut off
4.2 Standard Discharge	0.2C(670mA), CC(constant current discharge) to 2.5V
4.3 Rate Discharge	Charge with constant current of 0.5C(1675mA) to 4.2V with end current of 50mA, and discharge with constant current of 0.2C(670mA) to 2.5V. Cells are to rest 10 minutes after charge and 20 minutes after discharge.

5. Characteristics

5.1 Electrical Characteristics

Items	Test Procedure	Requirements	
5.1.1 Nominal Voltage	Charge as described in 4.1, and discharge as described in 4.2. Calculate the average working voltage during discharge process.	3.6V	
5.1.2 Discharge Character	Charge under the condition of 4.1, and discharge under the condition of 4.2.	$\geq 3350\text{mAh}$	
5.1.3 Cycle Life	Charge with constant current of 1005mA (0.3C) to 4.2V with end current of 100mA and rest for 10min, and then discharge with constant current of 3350mA (1.0C) to 2.75V at $25\pm 2^{\circ}\text{C}$. Record the discharge capacity and then rest for 20min. Repeat cycling for 500 times.	Discharge Capacity $\geq 2010(3350*60\%) \text{mAh}$	
5.1.4 Rate Character	Charge as described in 4.1, rest for 10min, and discharge with different constant currents and cut off at 2.5V. Record the discharge capacity.	670 mA	≥ 3350 $(3350*100\%) \text{mAh}$
		3350 mA	≥ 3183 $(3350*95\%) \text{mAh}$
		6700 mA	≥ 3116 $(3350*93\%) \text{mAh}$
		10000 mA	≥ 3015 $(3350*90\%) \text{mAh}$
5.1.5 High Temperature Storage Test	Charge as described in 4.1, rest for 7 day in the environment with temperature of $60^{\circ}\text{C} \pm 2^{\circ}\text{C}$, After storage, cells shall be discharged per 4.2 and cycled per 4.3 for three cycles to obtain recovered capacity.	Recovered capacity $\geq 2680(3350*80\%) \text{mAh}$	
5.1.6 Temperature Dependency of Capacity	Charge as described in 4.1, and discharge as described in 4.2 with different temperature. Record the discharge capacity.	-10°C	≥ 2345 $(3350*70\%) \text{mAh}$
		0°C	≥ 2680 $(3350*80\%) \text{mAh}$
		25°C	≥ 3350 $(3350*100\%) \text{mAh}$

		55°C	≥3183 (3350*95%) mAh
5.1.7 Storage Characteristics	Charge as described in 4.1, store for 30 days, and discharge as described in 4.2 to obtain the remaining capacity.	Remaining capacity ≥ 3015(3350*90%) mAh	
5.1.8 Storage	Charge the cell (After manufactured within 3 months) as described in 4.1 until the capacity reaches 40-50% and store in the environment with ambient temperature of 25±2°C, relative humidity ≤75% for 12 months. Then fully charged as described in 4.1 and discharge as described in 4.2 to obtain the remaining capacity.	Remaining capacity ≥ 2680(3350* 80%) mAh	

5.2 Safety performances

Items	Test Procedure	Requirements
5.2.1 External short Circuit	The sample cell should be fully charged as described in 4.1 rest for 30min, and then short-circuited by connecting positive and negative terminals with a circuit load having a resistance of $80 \pm 20\text{m}\Omega$ at $20 \pm 5^\circ\text{C}$. The temperature of the case should be measured during the test. The cell should remain on test for 24 hours or until the temperature of the case declines by 20% of the maximum temperature.	No fire , no explosion.
5.2.2 Over-charge	The sample cell should be discharged as described in 4.2, and subjected to the charging process to 4.6V with the current of the greater one between the 10050mA (3.0C) and three times of the charging current recommended by the manufacturer. The temperature of the case should be measured during the test. The test should be continued until the charging time reaches 7 hours or the temperature of the case declines by 20% of	No fire , no explosion.

	the maximum temperature.	
5.2.3 Over-discharge	The sample cell should be discharged as described in 4.2, and subjected to the forced discharge process with the reverse current of 3350mA (1.0C). The test time is 90min.	No fire , no explosion.

5.3 Mechanical Performance

Items	Test Procedure	Requirements
5.3.1 Vibration	The sample cell should be fully charged as described in 4.1, and firmly secured to the platform of the vibration machine. Test conditions are: a) Scanning mode: sinusoidal waveform with the logarithmic scanning mode; b) Frequency range: 7Hz~200Hz; c) Specific mode: start at the frequency of 7Hz, and maintain the peak acceleration of 1g_n until the frequency is increased to 18Hz; maintain the amplitude of 0.8mm (1.6mm total excursion) and increase frequency to 50Hz; maintain the peak acceleration of 8g_n until the frequency is increased to 200Hz; back to 7Hz; d) Scanning time of each cycle: 15min. The above process should be conducted at both axial and radical directions (three mutually perpendicular directions for prismatic and pouch cell). The test should be repeated 12 times for 3 hours in each direction.	No fire, no explosion, and no leakage.
5.3.2 Drop	The sample cell should be fully charged as described in 4.1, and dropped onto a flat concrete floor from 1m height. The positive and negative electrode side should be dropped once, respectively, and the cylindrical surface twice. Each cell should be dropped four times.	No fire, no explosion.
5.3.3 Crush	The sample cell should be fully charged as	No fire,

	described in 4.1, and then put into two planes, which is axially parallel to the plate. Crush the cell in the direction perpendicular to the plate with a crushing force of $13.0 \pm 0.2\text{kN}$. When the crushing force reaches the maximum value, the test is completed.	no explosion.
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5.4 Environmental Tests

Items	Test Procedure	Requirements
5.4.1 Temperature Cycling	The sample cell should be fully charged as described in 4.1, and stored in a test chamber. Test conditions are: a) Raise the chamber temperature to $72 \pm 2^\circ\text{C}$ and maintain this temperature for at least 6 hours; b) Reduce the chamber temperature to $-40 \pm 2^\circ\text{C}$ and maintain this temperature for at least 6 hours; c) Repeat above steps 10 times. The time interval between two test temperatures should be less than 30 minutes.	No fire, no explosion, and no leakage
5.4.2 Low Pressure	The sample cell should be fully charged as described in 4.1, and stored for 6 hours at an absolute pressure of 11.6kPa (1.68psi) and a temperature of $20 \pm 5^\circ\text{C}$, followed by 1 hour's observation.	No fire, no explosion, and no leakage
5.4.3 Heating	The sample cell should be fully charged as described in 4.1, and placed in a gravity or circulating air convection oven with an initial temperature of $20 \pm 5^\circ\text{C}$. Raise the oven temperature at a rate of $5 \pm 2^\circ\text{C}/\text{min}$ to the test temperature $130 \pm 2^\circ\text{C}$ and remain at this temperature for 30 minutes.	No fire, No explosion.

6. Outline Dimensions

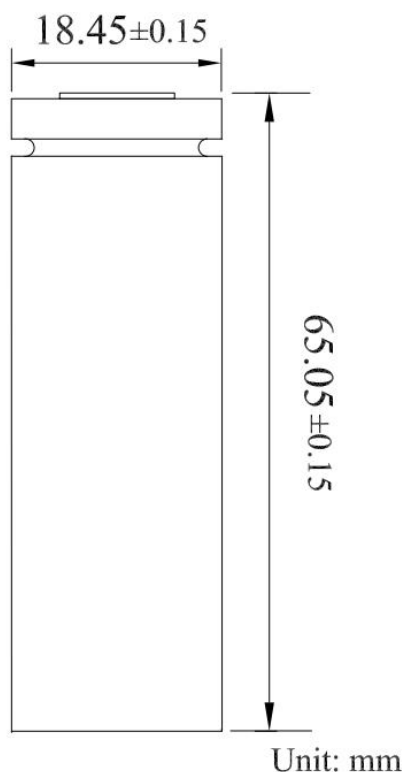


Fig.1 Outline Dimensions of CMINRF9E(with tube)

7. Cautions

Please read this specification carefully before testing or using the cells since improper handling of the Li-ion cells may lead to efficiency loss, heating, electrolyte leakage, ignition or even explosion.

7.1 Caution in Use

7.1.1 Abnormal operations such as overcharge (voltage > 4.2V), over discharge (voltage < 2.5V) and overcurrent charge-discharge (maximum current allowed at current temperature) should be prohibited during cell using. It is strictly prohibited to use the cell in the environment easily causing problems, such as static electricity and poor sealing (water and dust entering).

7.1.2 More than 1675mA(0.5C) current charging, use in high-temperature/low-temperature environment, use in vibration environment, not match well cells and use in humid environment will reduce the cycle life of the cell.

7.1.3 The cell shall not be used in the environment of high frequency microwave or ultrasonic wave. When using in series and parallel, it is recommended to coat the high-voltage wire with electromagnetic insulation cover to prevent the electromagnetic wave from damaging adjacent devices and human body.

7.1.4 Avoid overlapping or contact between the positive and negative terminal wires of the battery to reduce the risk of short circuit.

7.1.5 The battery should be charged and discharged in strict accordance with this specification to

ensure the battery's cycle life and safety.

7.1.6 When the batteries are assembled in a module for use, the cells with the same capacity, internal resistance, batch and charged state shall be used. The packing standard of the batteries should be strictly in accordance with the technical agreement. The temperature difference inside the battery pack should be less than 5°C when the pack is working.

7.1.7 Do not charge the battery when temperature is less than 0°C. Please store it in the environment with temperature more than 0°C for a period of time before charging. Recommended store time as follows:

Outside Temperature	$-5^{\circ}\text{C} \leq T \leq 0^{\circ}\text{C}$	$-10^{\circ}\text{C} \leq T \leq -5^{\circ}\text{C}$	$-15^{\circ}\text{C} \leq T \leq -10^{\circ}\text{C}$	$-20^{\circ}\text{C} \leq T \leq -15^{\circ}\text{C}$
Time	2h	5h	8h	10h

7.2 Safety Caution

7.2.1 The battery should be placed away from babies and children. If there is any emergency such as deglutition, scald or explosion, please go to the hospital immediately.

7.2.2 When charging or discharging the battery, please use professional test equipment designed for Li-ion batteries. Do not use ordinary constant current or constant voltage (CC/CV) power chargers without limitation of current or voltage. These chargers do not protect the battery from being overcharged and over-discharged, and may lead to function failure and be dangerous.

7.2.3 When charging, discharging, or assembling the battery, avoid reversing the positive and negative terminals. Or it would lead to overcharge and over-discharge of the battery, causing serious failure, or even explosion.

7.2.4 Do not solder the battery directly. Do not disassemble the battery.

7.2.5 Do not put the battery in pockets or bags with metal objects, such as necklaces, hairpins, coins, screws, etc. Neither store the battery without proper isolation, nor connect the positive and negative electrodes directly with conductive materials. Or the battery may be short-circuited.

7.2.6 Do not hammer, throw or trample the battery. Do not put the battery into washing machines or high-pressure containers.

7.2.7 Keep the battery away from heat sources, such as fires, heaters, etc. Do not use or store the battery in direct sunlight or at places where temperature could exceed 60°C. Or the battery may generate excessive heat, ignite and fail.

7.2.8 Do not get the battery wet or throw it into water. When not in use, place the battery in a dry environment with relatively low temperature.

7.2.9 When in use, testing or storing, if the battery becomes abnormally hot, give out smell, change color, deform or show any other abnormalities, please stop using or testing immediately. Attempt to isolate the battery and stay away.

7.2.10 If electrolyte leaking from the battery gets into your eyes, do not rub your eyes. Rinse the

eyes with clean water and seek medical attention if problems remain. If electrolyte gets onto the skin or clothing, wash with clean water immediately.

8. Packing

Cells need to be at half-charged state when packed. The surface of the packing boxes shall contain the following information: product name, type, nominal voltage, quantity, gross weight, date, capacity and impedance.

9. Transportation

During transportation, do not subject the cells or the boxes to violent shaking, bumps, rain or direct sunlight. Keep the cells at half-charged state (50% SOC).

10. Long-term Storage

When delivered, cells are charged to the voltage of 3.45V ~ 3.70V. Storing cells at/more than 2680(3350*80%)mAh for a long time will lead to capacity loss and cycle life loss, please keep cells into use within 90 days when the capacity is more than 2680(3350*80%)mAh.

Cells may have lower capacity than they're expected due to the self-discharge when cells are to be delivered at 670(3350*20%)mAh.

Do not use or store the cells when the voltage is less than 2.5V.

11. Warranty

The warranty period of this product is 12 months from the ex-factory date. This warranty will be void if the cells are used outside these specifications.

12. Exclusion of Liability

The company is not responsible for any problems arising from the use of electrical circuits, battery packs and chargers.

The company does not guarantee the quality of the defective batteries caused by customers in the battery assembly process after shipment.

13. Statements

The information in this specification is subject to change without prior notice.

For those applications not described here, please consult your nearest CHAM Sales Office or Distributors.