

Document: SPEC-RD-C-001

Rev: A0

Type: **Product Specification of 314Ah Cell**

Product Specification of 314Ah Cell

Cell Model: **CSI314**Cell Capacity: **314Ah**

Customer Confirmation	Signature	Date
	Customer Code:	
	Company Seal:	

AMENDMENT RECORDS

Rev.	ECN No.	Effective Date	Author	Description of Revision
A0		2025.01.06	Karl Zhang	New Release

Content

0	Definitions	4
1.	Scope of Application	5
2.	Electrical Specification	5
2.1.	General	5
2.2.	Charging/Parameter	6
2.3.	Discharging/Parameter	7
2.4.	High/Low Temperature Capacity	8
2.5.	Cell Temperature Rise	8
2.6.	Safety and Reliability	8
3.	Product End of Life Management	10
4.	Application Conditions.....	10
5.	Safety Precautions	13
6.	Disclaimer	14
7.	Risk Warning	14
8.	Mechanical Drawing	15

0 Definitions

Terms	Definition
Product	Means the 314Ah 3.2V rechargeable lithium-ion cells produced by CSE
Customer	Means the customer in the «CSE product sales contract»
CSE	Means Canadian Solar Energy Storage Technology Co. Limited
PN	Means the unique part number provided by CSE to identify the product supplied by CSE.
Ambient Temperature	Means the ambient temperature of the environment which the products are exposed to.
Battery Management System(BMS)	Means an active tracking and control system to be developed and implemented by CSE to monitor and record the operating parameters, including but not limited to voltage, current and temperature, of each product in its entire service life, and to control the operation of each product to ensure a safe operation of product.
Cell Temperature	Means the temperature of the cell measured by the temperature sensor connected to the main part of cell, The temperature can be calculated from the collected temperature.
Fresh State	Means the state within 15 days after customer received the product (domestic only) with less than 5 cycles of charge and discharge .
C-Rate	The ratio of charging power to the energy of batteries measured repeatedly by BMS. For example, when the battery energy is 1008Wh and the charging power is 252W, the charging rate is 0.25P; when the battery energy fades to 806.4Wh and the charging power is 252W, the charging rate is 0.25P.
D-Rate	The ratio of discharging power to the energy of batteries measured repeatedly by BMS. For example, when the battery energy is 1008Wh and the discharging power is 252W, the discharging rate is 0.25P.
Cycle	Means a state when a total of charge and discharge according to rules from a cell as recorded by BMS and it may consist of a summation of a few segments of partial charge and discharges.
Production Date	Means the production date of the cell marking on the top of the cell by date code.
State of Charge (SOC)	Means the ratio of the actual battery charge to the full charge, characterizing the state of charge of the battery. The state of charge of 100% SOC indicates that the battery is fully charged to 3.65V, and the state of charge of 0% SOC indicates that the battery is completely discharged to 2.5V.
Temperature Rise	Means the temperature of the cell rises during the conditions specified in this document, such as the charging process or the discharging process.

Terms	Definition
Units of Measurement	“V” (Volt), Voltage Unit “A” (Ampere), Current Unit “W”(Watt), Power Unit “Ah” (Ampere-Hour), Capacity Unit “Wh” (Watt-Hour), Energy Unit “Ω” (Ohm) , Resistance Unit “mΩ” (Milli Ohm), Resistance Unit “°C” (Degree Celsius), Temperature Unit “mm” (Millimeter), Length Unit “s” (Second), Time Unit “Hz” (Hertz), Frequency Unit

1. Scope of Application

The purpose of this document is to specify the specifications of 314Ah 3.2V lithium iron cells for energy storage system with CSE (“Product”) to be supplied by CSE.

2. Electrical Specification

2.1 General

No.	Parameter	Specification	Condition
2.1.1	Typical Capacity	314 Ah	Fresh cell Refer to 2.2&2.3 standard charge and discharge procedure
2.1.2	Typical Energy	1004.8 Wh	Fresh cell Refer to 2.2&2.3 standard charge and discharge procedure
2.1.3	Rated energy	602.88Wh (EOL 60%SOH)	Fresh cell Refer to 2.2&2.3 standard charge and discharge procedure (Energy that needs to be met throughout the entire lifecycle)
2.1.4	Operating Voltage	2.5~3.65V 2.0~3.65V	Cell temperature T>0°C Cell temperature T≤0°C
2.1.5	Impedance (1KHz)	≤0.25mΩ	Fresh cell (~25%SOC)
2.1.6	Shipping Capacity	78.5±1Ah	25%SOC
2.1.7	Energy Efficiency	≥93% (0.5P) ≥90% (1P)	Fresh cell, 25°C

2.1.8	Self-discharge Rate	Per month $\leq 3.0\%$, After First Month	Full cell, 25%SOC, $25\pm 2^{\circ}\text{C}$ storage
2.1.9	Energy retention and recovery	Retention: $\geq 95\%$ Recovery: $\geq 95\%$	45°C , 100%SOC, 30days
2.1.10	Storage	Energy Recovery: $\geq 96.5\%$	50°C , 50%SOC, 30days
2.1.11	Operating Temperature (charging)	$0\sim 60^{\circ}\text{C}$	Reference to paragraph 2.2
2.1.12	Operating Temperature (discharge)	$-20\sim 60^{\circ}\text{C}$	Reference to paragraph 2.3
2.1.13	Cell Weight	$5.7\pm 0.2\text{Kg}$	N.A.
2.1.14	Storage Temp.	$-20\sim 45^{\circ}\text{C}$	Storage ambient humidity $\leq 85\%$ ROH, no condensation
2.1.15	Typical Dimension (W*H*T)	Width: $173.9\pm 0.5\text{mm}$ Shoulder Height: $204.8\pm 0.5\text{mm}$ Thickness: $71.7\pm 0.7\text{mm}$	Thickness with compression force($300\pm 20\text{kgf}$), Height with Terminal, BOL (Reference to item 8)
2.1.16	Rest SOC	$\geq 8\%$	The cell needs to be charged when SOC is less than 8%
2.1.17	Altitude	$< 5000\text{m}$	N.A.
2.1.18	Cycle Performance	12000 Cycles@60%SOH	The temperature is maintained at $25\pm 2^{\circ}\text{C}$, cycle test by the standard charge and discharge method under $300\pm 20\text{Kgf}$ preload, Fading to 60% of standard capacity.

2.2 Charging/Parameter

No.	Parameter	Specification	Condition
2.2.1	Standard Charge Power	0.5P	$25\pm 2^{\circ}\text{C}$
2.2.2	Maximum Sustainable Charging Power	0.5P	$25\pm 2^{\circ}\text{C}$
2.2.3	Standard Charge Voltage	Cell max voltage 3.65V	N.A.
2.2.4	Standard Charge Method	The average temperature of cell is maintained at $25\pm 2^{\circ}\text{C}$, 0.5P constant power charge to 3.65 V, rest 10min	

2.2.5	Standard Charge Temperature	25±2°C	Cell Temperature
2.2.6	Charging Temperature (Cell Temperature)	0~60°C	No matter what charge mode the battery is in, stop charging once the cell temperature exceeds absolute charge temperature range.
2.2.7	Charging Upper Limit Voltage	Max 3.65V	No matter what charge mode the battery is in, stop charging once the cell voltage exceeds absolute charge voltage.

2.2.8 Other Charge Condition (C-Rate) (The following are estimated values to be tested in practice)

Cell Temperature/°C		0	5	10	15	20	25	45	50	55	60
Max Charge Power(P)	0%~<100% SOC	0.04	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0

2.3 Discharging/Parameter

No.	Parameter	Specification	Condition
2.3.1	Standard Discharge Power	0.5P	25±2°C
2.3.2	Standard Discharge Method	The average temperature of cell is maintained at 25±2°C ,0.5P constant power discharge to 2.5 V, rest 10min	
2.3.3	Maximum Discharge Power (Continuous)	0.5P	N.A.
2.3.4	Discharge Cut-off Voltage	2.5V 2.0V	T>0°C T≤0°C
2.3.5	Standard Discharge Temperature	25±2°C	Cell temperature
2.3.6	Absolute Discharge Temperature	-20~60°C	Stop discharging once cell temperature is outside this range regardless of whether continuous or pulse current is adopted.

2.3.7 Other Discharge Condition (D-Rate)

Cell Temperature/°C		-20	0	5	10	15	20	25	45	50	55	60
Max Discharge Power(P)	0%~<100% SOC	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0

2.4. High/Low Temperature Capacity

No.	Parameter	Specification	Condition
2.4.1	Capacity@55°C	≥314Ah	Fresh cell, 55°C, 0.5P, 2.5V~3.65V
2.4.2	Capacity@5°C	≥288Ah	Fresh cell, 5°C, 0.5P, 2.5V~3.65V
2.4.3	Capacity@-20°C	≥220Ah	Fresh cell, -20°C, 0.5P, 2.0V~3.65V

2.5 Cell Temperature Rise

The temperature rise refers to the surface temperature of the cell after discharge minus the surface temperature of the cell before discharge. For each cell temperature measurement, a calibrated temperature sensor that records time data should be selected.

No.	Parameter	Specification	Condition
2.5.1	Continuous discharge temperature rise	≤10°C	The cell is discharged in the standard discharge method, refer to 2.3.2

2.6 Safety and Reliability

2.6.1 Description of service conditions

safety test、cycle life test and pack design need to add preload force, and the range of preload force of fresh cell is 500N~5000N, the recommended preload tolerance is ±200N.

The cell will generate swelling force during attenuation. The swelling force of the cell at 60% SOH under the test condition of 15mm steel plate with a swelling space of 0mm, which is about 60000N. The customer needs to consider the reliability of structural strength in the product design process. It is suggested that 2.0~2.5 mm Gap (which would provide space for swelling while the using of cell) be reserved for the cell assembly module.

2.6.2 Safety Performance Test

No	Items	Test method and condition	Criteria
2.6.1	Over Charge Test	After standard charging, the cell shall be charged in the constant current until 1.5 times of the termination voltage or the time reaches 1h, and then observe for 1h. The charging current shall be the smaller value between 0.5C and the maximum continuous charging current of the product.	No explosion, no fire

2.6.2	Over Discharge Test	After standard discharging, the cell shall be discharged until the time reaches 60min or the voltage reaches 0V, and then observe for 1h. The discharge current is the smaller value between 0.5C and the maximum continuous discharge current of the product.	No leakage, no smoke, no explosion, no fire
2.6.3	Overload Performance Test	After standard discharging, the cell should be charged to cut-off voltage with 2P constant power, rest 10min, then discharged the cell to cut-off voltage with 2P constant power, and stop the test after observing for 1h.	No leakage, no smoke, no explosion, no fire
2.6.4	Short Circuit Test	After standard charging, the cell is shorted circuit for 10 min by connecting the positive and negative terminals with a total external resistance less than 1mΩ and observe for 1h.	No explosion, no fire
2.6.5	Crush Test	After standard charging, the cell shall be placed on a semi-cylinder bar with a diameter of 75mm. The battery is pressed at a rate of (5±1) mm/s, until the voltage reaches 0V or the extrusion force reaches 50kN. Holding for 10min, and then stop the test after observing for 1h.	No leakage, no smoke, no explosion, no fire
2.6.6	Drop Test	After standard charging, the cell, which is turned the positive or negative terminal down, is dropped from a height of 1.5m to the cement floor once and observe for 1h.	No smoke, no explosion, no fire
2.6.7	Thermal Runaway Test	After standard charging, the cell is charged with 0.5C constant current, and then start the heating device to heat the cell continuously. When thermal runaway occurs or the temperature of the monitoring point reaches 300°C or charging 4 hours, turn off the heating device and observe for 1h. (Thermal runaway: Temperature Rise Rate $\geq 3^{\circ}\text{C/s}$, explosion, or fire)	No explosion, no fire
2.6.8	Thermal Runaway Test after Cycle	The cell that has completed the cycle performance test is tested for thermal runaway performance according to 2.6.7.	No explosion, no fire
2.6.9	Nail Penetration Test	25°C, 25±5 mm/s with $\phi(5\sim 8)\text{mm}$ nail, left the nail in the cell and observe for 1 hour	No explosion, no fire

3. Product End of Life Management

3.1. This cell is designed to service with a finite lifetime. The customer shall develop and implement an active tracking system to monitor and record impedance of each Product in its entire service life. CSE and its customer shall come into agreement about internal resistance and capacity measurement methods, CSE and/or its customer shall stop using any of the products when its resistance exceeds 200% of its internal resistance or its capacity fading to 60% of typical capacity at 25°C. Failure to comply with this requirement shall render CSE's warranties under the Contract inapplicable, thereby releasing CSE from any liability in connection therewith.

3.2. The cell life determination conditions can refer to paragraph 2.1.18 cycle life.

4. Application Conditions

Customer shall ensure that the following application conditions in connection with the products are strictly observed:

4.1. Customer shall procure that each product shall be used under the strict monitor, control, and protection by the BMS incorporated by CSE. When the cell is first used, it must be fully charged and discharged for activating it and giving fully capacity.

4.2. Customer shall provide detailed information of the BMS, including but not limited to its design, features, setting, and data file format to CSE for design review and record keeping.

4.3. Once the detailed information of the BMS has been reviewed and agreed by CSE, customer shall not modify or change the design, features, setting or data file format of the BMS without the prior written agreement by CSE.

4.4. Customer shall keep relevant records of the BMS monitoring data throughout the entire service life of each product, including keeping record of number of occurrences of rush charge, which could be used in the determination and judgment of any product warranty and liability claim entitlement. No warranty or liability claim should be considered without BMS diagnosis records (at a regular basis, esp. during maintenance) of the relevant product.

4.5. The BMS shall include the following monitoring and control features as a minimum requirement.

No.	Parameter	Specification	Action
4.5.1	Stop charging	3.65V	Stop charging when cell voltage reaches 3.65 V.
4.5.2	First overcharge protection	$\geq 3.70\text{V}$	Stop charging when cell voltage reaches 3.70 V.
4.5.3	Second overcharge protection	$\geq 3.85\text{V}$	When the battery voltage reaches 3.85V, the BMS is forced to terminate charging, and the BMS should be locked until technicians solve the problem.

4.5.4	Stop discharge	Minimum 2.5V($T > 0^{\circ}\text{C}$) 2.0V($T \leq 0^{\circ}\text{C}$)	Minimize the discharging current when cell voltage reaches 2.5V($T > 0^{\circ}\text{C}$), 2.0V($T \leq 0^{\circ}\text{C}$).
4.5.5	First over discharge protection	Minimum 2.4V($T > 0^{\circ}\text{C}$) 1.8V($T \leq 0^{\circ}\text{C}$)	Stop discharging when cell voltage reaches 2.4V.
4.5.6	Second over discharge protection	Minimum 2.0V ($T > 0^{\circ}\text{C}$) 1.6V($T \leq 0^{\circ}\text{C}$)	When the cell voltage is less than 2.0V, the cell should be charged back to 50% SOC at 0.1C in time, and the BMS should be locked until technicians solve the problem.
4.5.7	Short circuit protection	No short circuit allowed	When a short circuit occurs, the battery (cell) is disconnected by the overcurrent protection device.
4.5.8	Over current protection	Reference 2.2&2.3	Control discharge current by BMS to values within specification.
4.5.9	Over temperature protection	Reference 2.2&2.3	Stop charging and discharging when temperature exceeds specification.
4.5.10	Charging upper limit capacity	Charging capacity <352.8Ah	Charging capacity protection, charging capacity must be less than 112% of the nominal capacity.

Note: The above No. 4.5.2, 4.5.3, 4.5.5, 4.5.6 are the warning clause, draw the attention of customers: When the battery reaches any of the terms described in the above, means that the battery has been used beyond the specifications, the customer shall take protective measures on the battery in accordance with the "protection action" and other relevant provisions of this specification. At the same time, the CSE shall not take any responsibility for the damage in connection therewith.

4.6. Prevent draining any product down to over discharge state. A product may be permanently damaged internally when the cell voltage is lower than 2.0 V and which shall be strictly prohibited, failing what CSE's warranties under the contract shall cease to apply, thereby releasing the CSE from any liability in connection therewith. After discharge cut-off in accordance with paragraph 2.3.4, internal power consumption of the system should be reduced to a minimum to prolong the idle time before recharge. Customer undertakes to educate the users of the products or other parties who may come to handle the products to recharge the cells at minimum time intervals to prevent reaching the over-discharge state.

4.7. For cell, the recommend period to recharge is 6 months at $-20\sim 30^{\circ}\text{C}$; the recommend period to recharge is 3 months at $30\sim 45^{\circ}\text{C}$. The recharge period is for reference, and the SOC cannot be less than 8% for storage. The storage considers the self-discharge of cells only.

4.8. Batteries should avoid charging at low temperatures prohibited by this Technical Agreement (including standard charging, fast charging, and emergency charging), otherwise accidental capacity reduction may occur. Battery management system should be controlled according to the minimum charging temperature. It is forbidden to charge under the temperature stipulated in this technical agreement. Otherwise, CSE will not undertake the responsibility of quality assurance.

4.9. The design of the electric box must fully consider the heat dissipation problem of the cell. CSE does not take the responsibility due to the overheating of the cell or batteries caused by the thermal design problem of the electric box.

4.10. The design of the electric box must fully consider the waterproof and dustproof problems of the cells. The electric box must meet the waterproof and dustproof grade stipulated by the relevant national standards. The CSE does not take the responsibility due to damage to the cell or batteries (such as corrosion, rust, etc.) caused by water and dust.

4.11. It is forbidden to mix different PN batteries in the same battery system, otherwise, CSE will not be responsible for quality assurance.

4.12. External interface parameters of cell

No.	Parameter	Specification
4.12.1	Terminal Diameter	18±0.2mm
4.12.2	Center to Center Distance of Terminals	123±0.3mm
4.12.3	Boundary of Terminal Welding Area	Weldable area: $\phi 2.8\text{mm} \sim \phi 14.0\text{mm}$ Maximum melting depth: 2.2mm Welding temperature 150°C, time $\leq 5\text{s}$ The change in compression of the sealing ring before and after welding $\leq 10\%$, $\sigma \leq 0.05$ Melting of terminal plastic is not allowed during the welding process
4.12.4	Terminals Positioning Holes	Cylindrical hole with diameter 2.0±0.2mm & Conical bore with diameter 2.0±0.2mm
4.12.5	Requirements for Terminal Withstand Extrusion Force	+Z direction: $\geq 500\text{N}$ -Z direction: $\geq 500\text{N}$
4.12.6	Requirements for Terminal to Withstand Shear Force	X Y direction: $\geq 1000\text{N}$

4.12.7	Requirements for Terminal to Withstand Torque Force	$\geq 6 \text{ Nm}$
4.12.8	Pre-Tightening Force Specifications When Welding the Battery Cell Busbar	The pressure specification that the top cover of the cell can withstand is $\geq 500 \text{ N}$
4.12.9	Assembly Pre-tightening Force	500N~5000N, Uniform force on the cell, avoid shell deformation
4.12.10	Cell Swelling Force (Within the Lifespan)	Max Swelling Force $\leq 30\text{KN}$, Fading to 80%SOH Max Swelling Force $\leq 40\text{KN}$, Fading to 70%SOH Max Swelling Force $\leq 60\text{KN}$, Fading to 60%SOH
4.12.11	The Maximum Swelling Force that the Cell Can Withstand	64KN
4.12.12	Cell QR Code Level	$\geq \text{C Class}$

5. Safety Precautions

5.1. Do not immerse cells into water.

5.2. Do not drop cells into fire or expose them to any high temperature environment exceeding operation temperature as set out in paragraphs 2.1.11、2.1.12&2.1.14, otherwise it may cause fire. At all use times, cell temperature should not exceed 60°C , shut down system by BMS when it occurs.

5.3. Do not short circuit cell terminals, otherwise high current and temperature may cause body injury or fire hazards. Metallic cell terminals exposed from plastic packaging and ample safety precautions should be implemented to avoid short circuiting them during system integration or connections.

5.4. Always connect cell terminals according to its label(s) in right polarity. Reverse charging is strictly prohibited.

5.5. It is extremely dangerous to overcharge a cell which may cause overheating and fire hazards. Multiple level of fail-safe overcharge protection should be implemented by hardware and software. See paragraph 4.5.1、4.5.2、4.5.3、4.5.9 for minimum requirement to be adopted by the BMS for protection.

5.6. After charging according to article 4.5.9 of this technical agreement, normal charging shall be terminated. When the continuous charging time exceeds the reasonable time limit, the battery will overheat, which may cause thermal runaway and fire. A timer should be implemented in the charger circuit and set up properly. In case charging does not terminate normally within charging time out limit, ensure that the timer will intervene and stop the charging. See also paragraph 5.11.

5.7. Products should be securely fixed to solid platform, and power cables should be securely attached by fastener to avoid intermittent contact which may cause arcing and sparks.

- 5.8. Do not service cells and electrical connections within plastic package of cell. Improper electrical connection within a cell may cause overheating in service.
- 5.9. When the electrolyte leaks, skin and eye contact with the electrolyte should be avoided. In case of contact, a large amount of clean water should be used to clean the contact area and seek help from the doctor. It is forbidden for any person or animal to swallow any part or substance contained in the battery.
- 5.10. Protect cells from mechanical shock, impact, and pressure. Internal electrical circuit may short circuit to generate high temperature and fire hazards.
- 5.11. When cells charging is terminated improperly for reasons such as exceeding allowable charging time, cut-off due to exceeding charging voltage or cut-off due to exceeding charging current, all these events are defined as “improper charge termination”. Such event may indicate that there is current leaking within a cell system, or some components have started to malfunction and subsequent charging of such cell system without finding and fixing root cause of problem may cause potential overheating, or fire hazards. When such event occurs, the BMS should lock itself up to prevent subsequent charging and notice should be given to the user to return the battery to dealer for servicing. Subsequent charging should only be resumed after the system has been thoroughly checked by qualified technician who can identify, and fix root cause attributed to the “improper charge termination”.
- 5.12. Battery fire or explosion may be caused by improper operation during abuse test. The test can only be carried out in a professional laboratory by professionals equipped with appropriate protective equipment. Otherwise, it may lead to serious personal injury and property loss.

6. Disclaimer

- 6.1. If the product demand unit does not use the product according to the provisions of this specification, causing social impact and affecting the reputation of CSE, CSE will investigate the responsibility of the product demand unit. According to the degree of impact on CSE, the product demander should provide compensation to CSE.
- 6.2. CSE reserves the right to modify the specifications and performance parameters of the product. Before ordering CSE products, the buyer needs to confirm the latest status of the products in advance with CSE.

7. Risk Warning

7.1. Waring Statement

- 7.1.1 Cell are potentially dangerous and proper precautions must be observed in handling and maintenance.
- 7.1.2 Running tests on the cells improperly may result in severe personal body injury or property damages.
- 7.1.3 Work on cells must be performed only with proper tools and protective equipment must be Used.
- 7.1.4 Cell maintenance must be carried out by personnel knowledgeable of cells and trained in the safety precautions involved.
- 7.1.5 Failure to observe the above may cause various hazards.

7.2. Types of Hazards

Customer acknowledges the following potential hazards in connection with the usage and handling of the Products:

7.2.1 Working with battery can expose the handler to chemical, shock and/or arcing hazards. Although a person's body might react to contact with direct current voltage differently than from contact with alternate current voltage, Customer shall take a conservative position and consider the risk of shock or electrocution to be the same for both alternate current and direct current exposures greater than 50 V.

7.2.2 Cells expose its handler to chemical hazards associated with the electrolyte used in the cell.

7.2.3 When selecting work practices and personal protective equipment, customer and its employees should consider potential exposure to these hazards and therefore prevent accidental short-circuit that can result in electrical arcing, explosion, and/or "thermal runaway" of the cells.

7.3. Alarm temperature:

The first level alarm temperature of the cells is 65 °C.

The second level alarm temperature of the cells is 64 °C.

The third level alarm temperature of the cells is 62 °C.

8. Mechanical Drawing

