Technical Specification

280Ah LFP lithium battery cell for energy storage

Type：LFP71173207/280Ah

Version：1.0

Shenzhen Zhongtong Battery CO.,LTD

Content

1. Definitions

Hithium	Xia Men Hithium New Energy Technology Co., Ltd.
Client	Purchaser of batteries in sales contract.
Product	Unless specified, the product refers to the cell purchased by the customer from Hithium.
Ambient temperature	The ambient temperature where the cells are exposed to the temperature tolerance is ±2℃.
PN	The unique part number provided by Hithium to identify the product supplied by Hithium.
Cell	Shipping capacity 27% SOC, insulated by blue film before delivery
Battery Management System （BMS）	An effective tracking and control system to monitor and record the operating parameters of the product throughout the service life. Its tracking and recording parameters include but not limited to voltage, current, temperature, etc., to control the operation of the product and to ensure that the product operating environment and operating conditions meet the requirements of this specification.
Cell temperature	The temperature of the cell measured by the temperature sensor connected to the main part of cell.
Fresh cell	Fresh cells are charged and discharged less than 5 times within 15 days after the customer receives the goods (for domestic transportation only) .
C-Rate	The ratio of charging/discharging power to the energy of batteries measured repeatedly by BMS. For example, when the cell energy is 896Wh and the charging/discharging power is 448W, the charging/discharging rate is 0.5P; when the energy fades to 627.2Wh and the charging/dischargingpower is 313.6W, the charging/discharging rate is 0.5P.
Cycle	A state when a total of charge and discharge from a cell according to rules as recorded by BMS and it may consist of a summation of a few segments of partial charge and discharges.
Production date	The production date of the cell marked on the top of the cell by

	date code.
OCV	The open circuit voltage without any load connected.
Standard charge	At room temperature (25±2℃), charge with 0.5P constant power to the end voltage 3.65V, stop charging，shelving for 30 min.
Standard discharge	At room temperature (25±2℃), discharge with constant 0.5P to a end voltage of 2.5V, stop the discharge，shelving for 30 min.
State of charge (SOC)	The ratio of the actual lithium battery cell charge volume to the full charge volume, 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 discharge to 2.5V.
Temperature rise	The temperature of the cell rises during the conditions specified in this document, such as the charging process or discharging process.
Units of measure	"V" (Volt), the unit of voltage "A" (Ampere), the unit of current "W" (Watt), power unit "Ah" (Ampere-Hour), a unit of capacity "Wh" (Watt-Hour), energy unit "mΩ" (milliOhm), internal resistance unit "℃" (degree Celsius), temperature unit "mm" (millimeter), the unit of length "s" (second), time unit "Hz" (Hertz), frequency unit "kg" (kilogram), a unit of mass "N" (Newton), a unit of force

2. Scope of application

The purpose of this specification is to specify the performance requirement, test method, transportation, storage and risk warning etc.

3. Normative reference document

There are the references in this document. The edition of references is valid edition.

GB/T 36276-2018 Electrical performance and test methods for Lithium

ion battery of electrical energy storage

GB/T 31485-2015 Safety requirement and test methods for traction battery of electric vehicle.

4. Test conditions

4.1 The test object is fresh cell (except for self-discharge test). Unless otherwise specified, the experiment and measurement should be carried out under the conditions of temperature 25±2℃and standard humidity (55±20)% and large surface fixture of (3000±200)N.

4.2 Test equipment and accuracy

1) Test equipment accuracy： ±0.1%

2) Current measurement accuracy: ≥0.5 level,

Voltage measurement accuracy: ≥0.5 level

3) Temperature measurement accuracy: ±0.5℃

4) Time measurement accuracy: ±0.1%

5) Dimensional measurement accuracy: ±0.1%

6) Weight measurement accuracy: ±0.1%

4.3 Standard charge/discharge method

If not particularly indicated, both charge and discharge modes should be standard charge/discharge modes.

4.4 Welding parameters of pole and Busbar

Table 1

No	Item	Standard
1	Depth of fusion	≤2.0mm
2	Drawing force	≤1000N
3	The temperature of the plastic part of the pole	200℃ lasting less than 30s
4	Overwhelming force of the pole	≤1000N

5. Technical parameter

5.1 General

Table 2 technical parameter

Parameter	Specification	Condition
Type	LFP	N.A.
Model	LFP71173207/280Ah	N.A.
Dimension	Refer to drawings	Refer to chapter.10 drawing
Weight	5.43±0.20kg	Including blue film
Impedance （1KHz）	0.18±0.05mΩ	27%SOC，1kHz
Typical capacity	280Ah	(25±2)℃，standard charge and discharge
Typical voltage	3.2V	(25±2)℃，standard charge and discharge
Typical energy	896Wh	(25±2)℃，standard charge and discharge
Operating voltage	2.5-3.65V 2.0-3.65V	Cell temperature T＞0℃ Cell temperature T≤0℃
Shipping voltage	3.28-3.30V	(25±2),OCV,27%SOC
Energy density	≥160Wh/kg	(25±2)℃，standard charge and discharge
Recommended SOC interval	SOC:10%～90%	N.A
Residual capacity loss	≤3.0%	Fresh cell after 3 months,25±2℃，27%SOC
Max continuous charging power	1P	25±2℃
Max continuous discharge power	1P	25±2℃
Operating temperature(discharging)	-30~60℃	N.A.
Operating temperature(charging)	0-60℃	N.A.

5.2 Performance parameter

Table 3 performance parameter

Parameter	Specification	Test method
-20℃ discharge capacity	≥70% nominal capacity	-20℃±2，shelving for 24 hrs, discharge with 0.5P to 2.0V and record capacity.
55℃ discharge capacity	≥95% nominal capacity	55℃±2，shelving for 5 hrs, discharge with 0.5P to2.5V and record capacity.
Continuous charge/discharge temperature rise	≤10℃	(25±2)℃, standard charging and discharging, the temperature sensing wire is attached to the large surface of the cell (the cell is tested without a fixture), tested in a high and low temperature box, the cell starts to charge (discharge) until the charge (discharge) is completed. Temperature rise is recorded as continuous charging (discharging) temperature rise.
Pulse discharge temperature rise	≤5℃	50%-80% SOC,25±2℃, 500A pulse discharge for 10s, tested in incubator, the temperature sensor wire attached to the large surface of the cell (without fixture), temperature rises from the cell starting to charge/discharge to finishing charge/discharge.
Retention and recovery ability at room temperature	Retention≥95% Recovery≥97%	After standard charging of cell, shelving for 28 days in an open circuit at room temperature for; discharge at 0.5P to 2.5V, and the discharged capacity is recorded as the remaining capacity; after standard charging again,

		discharge at 0.5P to 2.5V, and the discharged capacity is recorded as the recovery capacity.
Charge retention and recovery ability at high temperature	Retention≥95% Recovery ≥97%	After standard charging of the battery cell, leave it in an open circuit at a high temperature of 55 ±2℃ for 7 days; after leaving it at room temperature for 5 hours, discharge to 2.5V at 0.5P, and the discharged capacity is recorded as the remaining capacity; after standard charging again, discharge at 0.5P to 2.5 V, the released capacity is recorded as the restored capacity.
Safety performance	GB/T36276-2018 and GB/T31485-2015(nail penetration test)	Refer to GB/T 36276-2018, GB/T 31485-2015, 6.2.8 requirements.

5.3 cell cycle life Product end of life management

Table 4

Item	Parameters	Testing method
Cycle life at room temperature	≥10000 cls	(25±2)℃, the cell covered with 15mm aluminum plate, the fixture force is (3000±200)N, tested in a high and low temperature box, charged to 3.65V with a constant power of 0.5P, shelving for 30min, with 0.5P discharge to 2.5V at constant power, shelving for 30 minutes, and repeat the above standard charge and discharge until the capacity fades to 70% of the nominal capacity.

6. Requirements for identification, appearance and packaging

6.1 The engraving code on the top cover of the cell complies with Hithium 《Battery Product Coding Rules》;

6.2 The cell identification shall be implemented in accordance with standards agreed by the customer and Hithium;

6.3 The packing box and packing size shall be implemented in accordance with the agreement between the customer and Hithium;

6.4 The cell shipment report contains the size, capacity, voltage, internal resistance, and size data of the battery cell;

6.5 When the product is stored, it should be placed in a warehouse with good ventilation, relative humidity less than 80%, and room temperature less than 35℃, waterproof, anticorrosive, dustproof, and the battery is charged at 20-50% SOC.

6.6 The packaging box should be marked with words such as handle with care, waterproof, anti-upside down, available number of stackable layers, etc.;

6.7 The packing box should be handled with care during transportation to avoid collision and knocking, strictly forbidden to put it together with corrosive materials such as acid and alkali;

6.8 The card board of the cell carton shall not be allowed to be inclined or collapsed during normal consignment or placement.

7. Application conditions

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

7.1 After receiving the delivered batteries, the client should complete the warehousing inspection within 15 days. Refer to the inspection specifications negotiated by both parties for details.

7.2 Operating environment temperature range. charge: 0～60℃; discharge: -30～60℃;

7.3 Short-term storage temperature range (within 1 month): -20～45℃;

7.4 Altitude: ≤4500m;

7.5 Relative humidity: ≤85%RH;

7.6 The group design of the system requires a certain pre-tightening force to be applied to the batteries. The pre-tightening force range of fresh cell is 500～3000N, and the recommended pre-tightening force tolerance is 3000±200N.

7.7 The product will generate expansion force during use. When the cell is attenuated to 70% under the test condition of 15mm steel plate, the expansion force is about 25000N. Customers need to consider the reliability of the structural strength of the system that the cells use for.

7.8 Customer shall procure that each product shall be used under the strict monitor, control and protection by BMS;

7.9 Customer shall provide detailed information of the BMS, including but not limited to its design, features, setting and data file format to Hithium for design review and recording keeping. If the customer does not adopt the Hithium evaluation suggestion, and a direct causal quality problem or quality accident occurs, Hithium shall be exempt from responsibility.

7.10 Customer shall keep relevant records of the BMS monitoring data throughout the entire service life of each product, including keeping record of number of occurrence 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 of the relevant product.

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

Table 5

No.	Parameter	Specification	Action
7.11.1	Stop charging	3.65V	Stop charging when cell voltage reaches 3.65V
7.11.2	First overcharge protection	≥3.7V	Stop charging when cell voltage reaches 3.7V
7.11.3	second overcharge protection	≥3.8V	when the battery voltage reaches 3.8V, the BMS is forced to terminate charging and the BMS should be locked until technicians solve the problem.
7.11.4	Stop discharge	Minimum 2.5V(T>0℃)	Minimize the discharge voltage when cell

		2.0V(T≤0℃)	voltage 2.5V(T>0℃) or 2.0V(T≤0℃)
7.11.5	First over discharge protection	Minimum 2.4V(T>0℃) 1.8V(T≤0℃)	Stop discharging when cell voltage reaches 2.4V(T>0℃) or 1.8V(T≤0℃)
7.11.6	Second over discharge protection	Minimum 2.0V(T>0℃) 1.6V(T≤0℃)	When the cell voltage is less than 2.0V(T>0℃) or 1.6V(T≤0℃) , the cell should be charge back to 50% SOC at 0.1C in time, and the BMS should locked until technicians solve the problem.
7.11.7	Short circuit protection	No short circuit allowed	When a short circuit occurs, the cell is disconnected by the overcurrent protection device.
7.11.8	Overcurrent protection	Current≤358.4A	BMS controls the charge and discharge current to meet the specifications
7.11.9	Overheating protection	Cell temperature≤60℃	Stop charging and discharging when temperature exceeds specification
7.11.10	Low temperature protection	Charging: T>0℃; Discharge: T≥-30℃	Stop charging and discharging when temperature exceeds specification

Note: the above No. 7.11.2、7.11.3、7.11.5、7.11.6 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 specification 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, Hithium shall not take any responsibility for the damage in connection therewith.

7.12 Prevent draining any product down to over discharge state. A product may be permanently damaged internally when the cell voltage is lower than 2.0V and which shall be strictly prohibited, failing what Hithium warranties under the contract shall ceases to apply, thereby releasing the Hithium from any liability in connection therewith. After discharge cut-off in accordance with paragraph 5.1, 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.

7.13 The storage SOC of the cell should be kept within the range of 20-50%. If the customer expects to store the cells for over 1 month and less than 6 months, they should do a charge and discharge in advance and adjust the SOC to 20%-50%. If the SOC of cell exceeds the range of 20-50% or if it is stored for more than 6 months without charging and discharging maintenance, Hithium will not be liable for the capacity loss or other losses caused by the battery cell.

7.14 Batteries should avoid charging at low temperature prohibited by this Technical Specification (including standard charging, fast charging and emergency charging), otherwise accident 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 specification. Otherwise, Hithium will not undertake the responsibility of quality assurance.

7.15 The design of the module or pack must fully consider the heat dissipation problem of the cell. Hithium does not take the responsibility due to the overheating of the cell or battery caused by the thermal design problem of the module or pack.

7.16 The design of the module or pack must fully consider the waterproof and dustproof problems of the cells. The module or pack must meet the waterproof and dustproof grade stipulated by relevant national standards. Hithium does not

take the responsibility due to damage to the cell or batteries (such as corrosion, rust, etc.) caused by water and dust.

7.17 It is forbidden to mix different P/N batteries in the same battery system, otherwise, Hithium will not be responsible for quality assurance.

7.18 The service life of batteries is limited. Customers should establish an effective tracking system to monitor and record the internal resistance and capacity of the batteries during service life. The internal resistance and capacity measurement methods and calculation methods require the customer and Hithium to discuss and agree between the two parties. If the two parties do not reach an agreement, the Hithium standard will be implemented. When the internal resistance of the cell in use exceeds 200% of the initial internal resistance of the cell or the capacity is less than or equal to 70% of the nominal capacity (25°C), the cell should be stopped.

8. Safety precautions

8.1 Do not immerse cells into water.

8.2 Incorrect use and storage of the battery cells may result in the risk of fire, explosion and burns. Do not disassemble, crush, incinerate, heat or throw the battery cells into a fire.

8.3 Do not drop cells into fire or expose them to any high temperature environment exceeding operation temperature, otherwise it may cause fire. At all use time, cell temperature should not exceed 60℃, shut down system by BMS when it occurs.

8.4 Keep the battery cells out of reach of children, do not remove the original packaging of the battery cells before use, and dispose of used batteries in a timely manner in accordance with local recycling or waste regulations.

8.5 Do not disassemble or repair the battery cell in any way without authorization.

8.6 Do not mix different types and brands of cells.

8.7 If the cell occurs peculiar smell, heat, deformation, discoloration or any other abnormal phenomenon, do not use it and move the cell to a safe location.

8.8 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.

8.9 Always connect cell terminals according to its labels in right polarity. Reverse charging is strictly prohibited.

8.10 It is forbidden to overcharge the battery cell, otherwise, it may cause cell to overheat and fire accidents. In the battery installation and use, the hardware and software need to implement multiple level of overcharge-failure safety protection. See paragraph 7.11.3 and 7.11.6.

8.11 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 systems without finding and fixing root cause of problem may cause potential overheat or fire hazards. When such event occurs, the BMS should lock itself up to prevent subsequent charging and notice should only be given to user after the system has been thoroughly checked by qualified technician who can identify and fix root cause attributed to the “improper charge termination”.

8.12 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.

8.13 Do not service cells and electrical connections within plastic package of cell. Improper electrical connection within a cell may cause overheating in service.

8.14 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.

8.15 Protect cells from mechanical shock, impact and pressure. Internal electrical circuit may short circuit to generate high temperature and fire hazards. The cell is potentially dangerous, and appropriate protective measures must be taken during operation and maintenance; improper operation of the test experiment described paragraph 5.2, may cause the battery cell to catch fire or explode. 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. Failure to comply with the above

warnings can cause a variety of disasters.

8.16 Customer acknowledges the following potential hazards in connection with the usage and handling of products: Working with battery can expose the handler to chemical, shock and 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 50V. When selecting work practices and personal protective equipment, customer and its employees should consider potential exposure to these hazard and therefore prevent accidental short-circuit that can result in electrical arcing, explosion, and/or "thermal runaway"of the cells.

9. Other agreements

9.1 After the production of the battery cell is completed, it will be shipped with 27% SOC. Hithium can provide the data of capacity, voltage, internal resistance and size.

9.2 The quality assurance requirements shall be subject to the agreement between the customer and Hithium. If the two parties have not agreed, please refer to paragraph 5.3 for the cycle life requirements.

9.3 When Hithium technical support is required during the installation and use of the battery, Hithium is obliged to provide service and technical support. During the warranty period, if the problem is not caused from manufacturing procedure and quality of Hithium, instead the battery cell problem caused by the user's misuse, Hithium can provide technical guidance and does not promise free replacement services.

9.4 The customer shall use the battery in strict accordance with the battery usage requirements in this specification. Hithium shall not be responsible for the failure and loss caused by the violation of the battery usage requirements.

9.5 When the internal resistance in use exceeds 200% of the initial internal resistance or the capacity is less than or equal to 70% of the nominal capacity (25℃), the customer should stop using the cell, otherwise the parameters will not correct, Hithium shall not be liable for quality problems, failures and any losses.

9.6 Other product-related documents involved in this specification must meet the requirements of this specification. If it violates this specification, the content of this specification shall prevail.

9.7 The customer is obliged to keep the content of this specification confidential, and the customer shall not disclose it to any third party without authorization. For details, please refer to the confidentiality agreement signed by both parties.

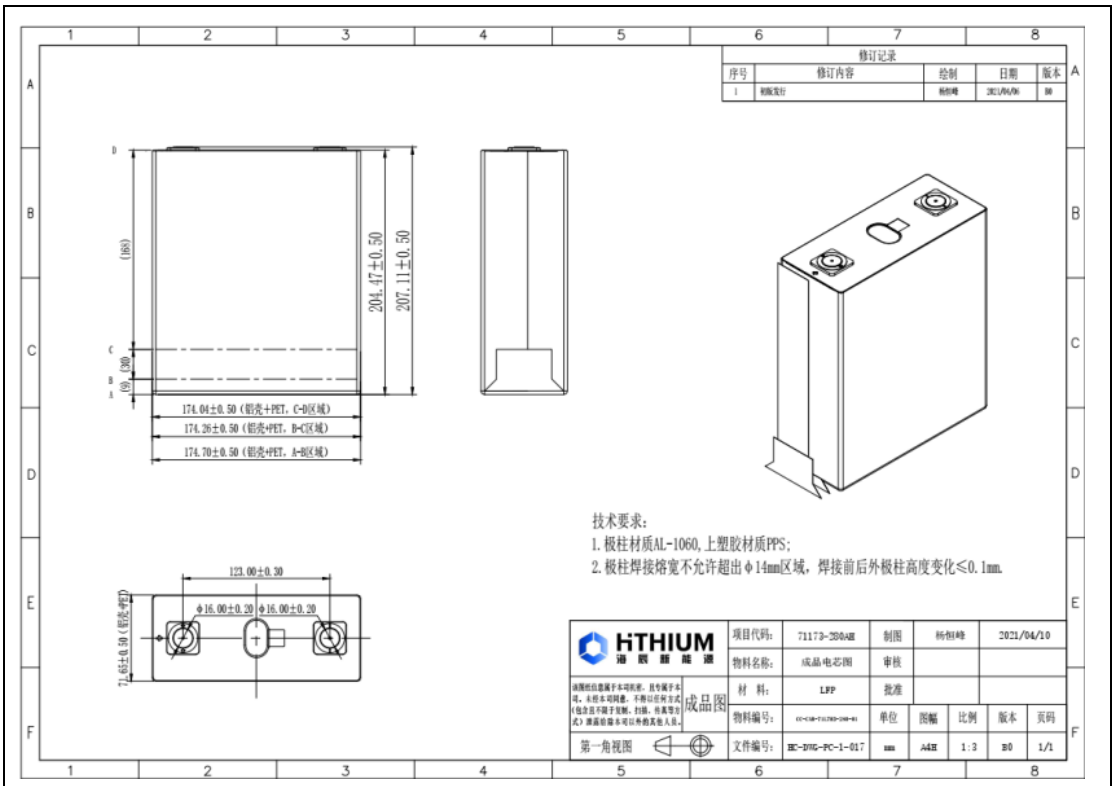
9.8 Without the consent of Hithium, customers, product users and any related parties shall not synthesize, separate or modify the technical solutions of the cell under any circumstances. It is also not allowed to disassemble cell and dismantling as a competitor etc.

9.9 Hithium reserves the right to modify the specifications and performance of the product. Before ordering Hithium products, the buyer needs to confirm the latest status of the products in advance with Hithium.

9.10 The sample is still in development stage. The cell is only used for announcement, testing, etc. the specific test items need to be negotiated with Hithium and prohibited from being sold to the customer.

9.11 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 Hithium, Hithium will investigate the responsibility of the product demand unit. According to the degree of impact on Hithium, the product demander should provide compensation to Hithium.

10. Mechanical drawing



Item	Standard	tolerance
Height (excluding pole)	204.47mm（With insulating film, with outer gasket）	±0.5mm
Height (including pole)	207.11mm（with insulation film）	±0.5mm
Thickness	71.65mm（with insulation film）	±0.5mm
Width	174.70mm（with insulation film）	±0.5mm
Pole welding area	Φ16mm(Excluding the plastic outside the pole)	±0.2mm
anode (cathod) pole center distance	123mm	±0.3mm

Note: Requirement Description (The size test is the mechanical splint test on the large surface of the battery, the initial preload is 3000N±200N)