

ISO9001 IATF 16949 ISO14001 ISO45001



INSTALLATION & OPERATING INSTRUCTIONS

Leoch VRLA Lead Acid / Gel Battery

LB-VA-2022-08

Read this manual carefully before installing and
using batteries



SAFETY AND WARNING LABEL

	<ul style="list-style-type: none"> • Please follow the instructions and put them near the battery for reference. Only professional personnel can operate the battery and pay attention to the precautions in the manual.
	<ul style="list-style-type: none"> • No smoking. • Stay away from any fire or heat source.
	<ul style="list-style-type: none"> • Please wear protective clothes and glasses when handle the battery. • Please be careful to follow the accident prevention protocol.
	<ul style="list-style-type: none"> • Please wash with plenty of water and go to hospital if acid splash into skin or eyes. • Please wash with water if acid splash on clothes.
	<ul style="list-style-type: none"> • Warning! The metal part of the battery is electrically charged, do not place objects on the battery. • Avoid heat, fire or explosion caused by short circuit.
	<ul style="list-style-type: none"> • Electrolyte is corrosive, and cannot be contacted under normal working conditions, but if the battery is damaged, do not touch the spilled electrolyte.
	<ul style="list-style-type: none"> • The batteries are very heavy, please use suitable tools for transportation. • Shockproof! Handle with care.
Please do not violate the operation instruction, AGM valve regulated sealed lead - acid battery do not need add water, the safety valve has sealed function, do not open it.	
	<p>Battery disposal</p> <p>Batteries marked with recycling marks shall be recycled by formal recycling agencies, or can be returned to manufacturer for recycling.</p> <p>Batteries should not be placed with industrial waste.</p>



SAFETY PRECAUTIONS

“**Danger**” indicates high danger and vigilance; “**Warning**” indicates moderate danger to on alert; “**Caution**” indicates mild risk needs attention.

Danger—Please do not use the battery outside the designated purpose. If it is used outside the designated purpose, it may cause liquid leakage, heating, fire and explosion.

Danger—It is forbidden to disassemble, transform, damage, strongly impact or throw the battery, as it may leads to liquid leakage, heating, fire or explosion.

Danger—It is forbidden to put the battery into the fire or heat it, as it may leads to fire or explosion.

Danger—It is forbidden to connect the battery in short circuit, otherwise the battery will be heated and ignited.

Warning—If total voltage of battery pack exceeds 45V, safety measures such as insulated gloves shall be used before work. If safety measures are not taken during work, there is risk of electric shock.

Warning—Keep and use the batteries out of the reach of children.

Warning—Sulfuric acid solution is adsorbed on the plates and separators inside the battery. If the battery is mechanically damaged, prevent the sulfuric acid from contact the skin and clothes, and splash into the eyes. If this happens wash it immediately with plenty of water and go to hospital for serious cases.

Warning—When installing wiring, wrap the handle of metal installation tool with insulating tape.

Notice—It is forbidden to discard batteries at will, as batteries and leakage can pollute the environment.

Notice—It is forbidden to wipe the battery with organic solvents such as petrol or alcohol.

Notice—It is forbidden to store or use the batteries upside down.

Notice—When measuring for maintenance, the face should not be directly on top of the battery and should be kept at an angle or distance.

Notice— The limit temperature range allowed for batteries: Charging 0 to 40°C, discharging -20 to 55°C, storage -15 to 50°C, but use at 20 to 30°C is more conducive to battery life.

Notice—If the battery is used in a way that is not described in this manual, or if there is any inconsistency with other product information, please seek help from your supplier.

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1. BATTERY SHIPMENT

1.1 Receiving inspection

When receiving, examine for possible damage caused in transit. Damaged packing material could indicate rough handling. Make a descriptive notation on the delivery receipt before signing. If cell damage is found, request an inspection by the carrier and file a damage claim immediately. Any battery with terminal or seal damage should be replaced.

1.2 Visible External

Immediately upon delivery (while the carrier representative is still on-site), inventory all materials against the Bill of Lading and inspect for visible external damage.

Check material quantities received against the Bill of Lading, including the number of battery pallets and the number of accessory boxes.

Notice:

Damage to packing material.

Wetness or stains, indicating electrolyte leakage.

If damage is noted:

- Make a descriptive notation on the delivery receipt before signing.
- Request an inspection by the carrier.
- File a damage report.

1.3 Concealed Damage

Within 15 days of receipt, unpack the cells/batteries and check for concealed damage. Remember, you are handling a LIVE battery. Take precaution against a shock hazard. Follow the safety precautions in this manual.

Notice:

Damage to packing material.

Wetness or stains, indicating electrolyte leakage.

If damage is noted:

a. Request an inspection by the carrier.

b. File a concealed-damage claim.

Check the received materials against the detailed packing list to verify receipt of all materials in the quantities specified. For export, the cells may be packed in wooden boxes which must be opened completely and carefully, and the cells then handled as described hereafter. See 3.3 for unpacking and handling.

Delay in notifying the carrier may result in loss of your right to reimbursement of damages. Refer to the Bill of Lading, when perform the parts inventory, you are unsure about the appearance of a part.

If you have any questions concern about potential damages, please contact the supplier.

2. BATTERY STORAGE

1) Store batteries indoors in a clean, dry and cool location. Storage at higher temperatures will result in accelerated rates of self-discharge and possible deterioration of battery performance and life.

2) Do NOT stack pallets. Damage may occur and the warranty may be voided.

3) The maximum storage time from shipment to initial charge is 6 months for batteries stored at ambient temperatures no warmer than 25°C. For storage temperatures higher than 25°C, the battery must be recharged 1 month sooner for every 3°C. See Table 1.

Table 1: Storage temperature and time

Storage Temperature	Storage Time
20°C or less	9 months
20°C~30°C	6 months
30°C~40°C	3 months

If storage time exceeds the storage time recommended in Table 1, give the battery a freshening charge before the end of the recommended storage interval. See Section 4 for charging information. Leoch VRLA DDM, DDS and DDV batteries must be charged in the horizontal position. Charging in the vertical position could void the warranty.

4) Repeat the freshening charge for each additional storage interval until the battery is installed. Storage at higher temperatures will result in accelerated rates of self-discharge and possible deterioration of battery performance and life. Storage times exceed the above may result in plate sulfating, which may adversely affect electrical performance and expected life.

5) Maximum total storage time prior to installation is 1 years from date of shipment from the factory to the customer. Freshening charges are required before the end of the storage time period, or more frequently, as noted in Table 1.

6) Failure to charge as noted will void the battery's warranty.

3. INSTALLATION CONSIDERATIONS

3.1 Use Circumstances

No fire, flame and heat supply near the battery;

Avoid the heat supply and direct sunshine place;

Avoid the humid and soggy place;

After storage for a long time, please charge the batteries before use.

3.2 Use Conditions

Parallel connection: recommend within 4 groups;

Multi-layer assembly: temperature among layers should be controlled within 3°C;

Heat dispersing: keep around 20mm inter Cell;

Ventilation: ensure the volume concentration of released hydrogen smaller than 0.8%.

Environment temperature range: charge 0 ~ 40°C, discharge -20 ~ 55°C, storage -15 ~ 50°C.

The battery can operate in above temperature range, but the standard data is measured at 25°C. The ideal temperature range for charge and discharge is 20 ~ 25°C for best battery performance and life. Use at lower temperatures will

shorten discharge times, while use at higher temperature will shorten life and increase potential for thermal runaway.

Different specifications, different years, different brands, different performance of the battery cannot be mixed, if you need to mix, please contact us for technical guidance.

3.3 Open Box and Check

Handling: Forbid the force on the terminal, avoid the effect to the sealed part;

Avoid the upside down, throw or impact of battery, absolutely avoid metal wire such as steel rope etc., to prevent the short circuit.

Inspection: packaging, appearance of battery no damage.

Count check: battery quantity, spare parts full.

Reference: catalogu, assembly drawing, notice.

3.4 Notice before Installation

After checking that the battery is normal, install it in a designated place such as battery room.

If the battery is placed in the battery room, it should be placed in the lowest place of the battery room as far as possible.

Do not install the battery near the heat source (such as a transformer).

As battery may cause flammable gas during storage, avoid closing with the unit which produce flame such as fuse when assemble.

Before connecting, clear the terminals to give them a metallic sheen.

Be careful with conductive material shorting battery positive and negative terminals.

When multi batteries are used together, ensure that the batteries are properly connected before connecting the batteries to power supplier or loads. In this case, the positive terminal of the battery should be connected to the positive terminal of the power supply device or load, and the negative terminal should be connected to the negative terminal. If the battery isn't connected to the power supply equipment correctly, the power supply equipment will be damaged, so make sure that the connection is correct.

Don't give extreme force on the terminals when connecting, every connecting nut and screw should be tightening, (including the adapter) please refer to the torque as Table 2.

Table 2: Suggested torque table

Range	M5	M6	M8
Torque	3.1 ~ 4.2N·m	3.9 ~ 5.4N·m	11 ~ 14.7N·m

3.5 Installation

Ensure that the racks, cabinets, or shelves are stable before installing the cells/batteries, do not use grease on the racks and ensure that the batteries are installed in the approved orientation. Avoid open flames electrostatic discharge sparks and short circuits with clothing jewelry, wristwatches and tools when installing and operating the batteries. (Remove jewelry and wristwatches.)

Never lay tools on other metallic objects on batteries.

Do not reach or lean across batteries on step racks.

Remember, dangerous voltages exist.

Be aware of what you are touching at all times.

If the units need cleaning, only use a water damp cloth, do not use chemicals, solvents or sprays.

Maintain a gap of 20mm between individual units.

Do not try to remove the vents and add water to PG batteries, this would present a safety hazard and void the warranty.

Check unit polarity and voltage before making inter unit connections and only use specified cables and accessories.

Install the inter-tier cabling again checking unit polarity. Attach the inter-tier cabling to the wall or the rack so that the weight of the cable is not on the battery terminal. If using a stiff cable, pre-bend the cable so no 'spring' force is placed on the battery terminals. Failure to support the cable weight could result in a premature battery failure and loss of battery integrity.

Within a string check that all connections are properly made (positive to negative) and measure the total string voltage. Tighten the interconnections on to the terminals to the following recommended torque values.

For parallel strings, connect batteries in parallel with cables of similar resistance and only at the end terminals of the strings.

Affix no. stickers to each unit starting with no.1 at the positive end of the battery.

Make sure the settings of the charger or rectifier are set to the correct float voltage. Power down the charger/rectifier. Finally connect the main positive terminal of the battery with the positive terminal of the charger/ rectifier. Monitor the battery to ensure the operation is proceeding normally i. e. the charge acceptance of the battery is reducing, the batteries are not overheating and are within 3 degrees of each other and the ambient.

4. INITIAL AND/OR FRESHENING CHARGE

During the delivery and storage, the battery will lose part of the capacity due to self-discharge, so please supplement charge before use. If stop using temporarily during use, please supplement charge termly. Supplementary charge according to the table below before use. The time interval of supplementary charge and storage temperature.

Table 3: Battery storage temperature and time interval for recharging

Storage temperature	Time interval of supplementing charge	Supplementing charge way
20°C or less	Every 9 months	a) Charging at a constant voltage of 2.25V/cell and an initial current less than 0.1C for 2-3 days.
20°C~30°C	Every 6 months	b) Charging at a Limited current of 0.1 and a constant voltage of 2.35V/cell for 12 hours.
30°C~40°C	Every 3 months	c) Fully charge with the matching smart charger. 3 options for choice.

Notice:

Current value C is rated capacity of battery.

For example: rated capacity of 12V100AH battery is 100AH.

$$0.1C=0.1*100=10A.$$

Charge voltage: 12V battery is $2.25*6=13.5V$, 6V battery is $2.25*3=6.75V$.

5. OPERATION

5.1 General

The sealed design of the VRLA batteries make it impossible to measure specific gravity as a state-of charge indicator. The state-of-charge can be identified to some degree by the amount of charging current of the battery.

5.2 Determining the State-of-charge

The following method can be used to determine the state-of-charge of the battery.

1) Place the battery on charge/recharge following a discharge.

Read the ammeter.

The charging current will be a combination of the load current plus the required current to charge the battery.

2) The battery becomes fully charged when the current of the battery starts to decrease and stabilize.

3) When the current level remains constant for three consecutive hours, the state-of-charge is approximately 95 to 98%. Full charge can be assumed.

For most requirements, the battery is ready for use.

5.3 Float Operation

5.3.1 Float Charge

◆Charge parameter

Charge voltage: 2.23~2.27V/Cell (25°C, recommend 2.25V/Cell)

The maximum charge current: 0.3CA

Temperature compensation coefficient: $-3\text{mV}/^{\circ}\text{C}\cdot\text{Cell}$ (taking 25°C as base point)

Total variation range of charge voltage: $\pm 0.02\text{V}/\text{Cell}$

Table 4: Recommended charge voltages for different Temperature

Temperature	Float Use (V)
-0°C (32°F)	2.30-2.35
10°C (50°F)	2.28-2.33
20°C (68°F)	2.26-2.31
25°C (77°F)	2.25-2.30
30°C (86°F)	2.24-2.29

Notice:

a) Every batteries voltages of a battery group have a little difference at the beginning of use, half a year later they will become consistent.

b) The impact of too high or too low floating voltage on batteries is as follows:
Too high for a long time (overcharging): shortened life;

Too low for a long time (insufficient charge): cannot meet the load or make the battery voltages inconsistent, thus making the battery group capacity decline, life is shortened.

5.3.2 Equalizing Charge

Due to their sealed maintenance free designs, LEOCH batteries do not normally require equalization charges. However, environmental condition or charger variations may cause voltage imbalances in battery systems. This imbalance can be resolved by a short term equalization charge. An equalization charge is accomplished by raising the charging voltage for certain amount of time. For LEOCH batteries, the following table should be used for equalization charge. (25°C)

◆Charge parameter

Charge voltage: $2.35\sim 2.40\text{V}/\text{Cell}$ (25°C , recommend $2.35\text{V}/\text{Cell}$)

The maximum charge current: 0.3CA

Temperature compensation coefficient: $-4\text{mV}/^{\circ}\text{C}\cdot\text{Cell}$ (taking 25°C as base point)

Total variation range of charge voltage: $\pm 0.02\text{V}/\text{Cell}$

Condition of dropping out the equalizing charge: Reference data of dropping out of the equalizing charge is usually set as $0.01\sim 0.02\text{CA}$.

Multiplied the group number of the battery when it's parallel connection.

Notice:

This step is may be omitted when it is normal float charging, in case of the below condition is emergent, equalizing charge can be considered, do not exceed 2.37 volts per cell(VPC), or safety valve may release excess gas into the atmosphere. It is not recommended to use an equalizing charge on a regular basis.

Capacity released exceed 20% of the rated capacity.

Storage period is more than 3 months.

There is single cell with float voltage below than $2.18\text{V}/\text{cell}$.

Float charging for 3-6months or there is battery laggard in voltage.

Operating more than 1 year under float charging.

Supplementary charge the battery after installation and before using.

Equalizing charge, the battery before and after the capacity test.

5.3.3 Cycle use Charge

◆Charge parameter

Charge voltage: $2.40\sim 2.50\text{V}/\text{Cell}$ (25°C , recommend $2.45\text{V}/\text{Cell}$)

The maximum charge current: 0.3CA

Temperature compensation coefficient: $-5\text{mV}/\text{Cell}$ (taking 25°C as base point)

Total variation range of charge voltage: $\pm 0.02\text{V}/\text{Cell}$

Supplementary charge capacity is $110\%\sim 130\%$ of discharge capacity, ambient temperature is below Table 5, if do not know how much discharge capacity there is, please refer to the following table for supplementary charging:

Table 5: Supplementary Charge

Ambient temperature (°C)	Charge voltage(v/cell)	Charge time(h)
5	2.31	7
	2.46	4
20	2.25	7
	2.40	4
35	2.21	7
	2.34	4

Notice:

Charging is the time when terminal voltage to reach the value shown in the table shows above at constant charging 0.3CA and below.

If the charging time is over the using time of the batteries; and the charge time is less than the time as above table, the batteries will cannot meet the normal capacity.

5.4 Notes during Charging

Charging current at the end of charging is over 0.05CA, which may result in permanent damage on battery appearance and battery life, please pay more attention to charging voltage.

The used charger should have degressive and automatic constant voltage device, please contact us if use other kind of charger.

If the ambient temperature is not 25°C, temperature supplementary should be applied on the voltage, formula is $U=U_{25^{\circ}C}-K*(T-25)$.

T—ambient temperature

K—temperature supplementary modulus

Judgment on charge end point, usually, if the battery charge can meet any one of the below listed condition, it can be regarded as the end of charging.

a) Charged value is not less than 1.2 times of the released value.

b) The current is less than 0.005CA (C10 rated capacity of the battery) during the final period of charging.

6. BATTERY CAPACITY TESTING

Since discharge or load testing gives the only real measure of battery capacity, therefore, it is recommended that capacity checks are carried out on an annual basis. There are two discharge tests that can be carried out:

1) A ratings test discharge - the intention here is to determine the percent of battery capacity as compared to the rated capacity. This is typically an 8 hour discharge test.

2) A service test discharge - this testing is to determine the battery standby time under the actual load conditions of intended battery usage.

6.1 Test Procedure

The battery test procedure for either test is below:

Ensure the battery is fully charged before capacity testing and that all connections are clean and tight.

◆Prepare the load bank or test load system. Ensure all temporary cable connections are secure and connect to the proper polarity, and have sufficient current carrying capacity.

◆Determine the battery temperature by measuring and recording the temperature of each bloc. Average the readings to determine average battery temperature. Measure the battery temperature in the middle of the side (preferably) or the end wall of the container.

◆If a ratings test is being performed, the load current or power must be temperature corrected if the battery temperature is significantly different from 25°C. Use the following formula for calculating temperature corrected load.

◆Just prior to starting the discharge test, measure and record the individual bloc voltages, the string voltage and float current (if available).

◆Remove or disconnect the charger from the battery string.

◆Connect the load to the battery and start a timer. Monitor the string voltage and record the lowest voltage reached and the time reached.

◆Record the load current, string and individual cell voltages on a regular basis. A minimum of three sets of readings should be taken.

The time interval between sets of readings will vary based on the expected test time. For example, take readings every hour for the first 4 hours of an 8-hour rating test. For the following 3 hours take readings every 1/2 hour. For the last hour, take readings every 15 minutes. For a 15 minute UPS discharge, readings every 5 minutes would be desirable.

◆Continue the discharge until the string voltage drops below the end-point voltage per cell times the number of cells in the string.

◆Stop the timer and remove the load from the battery.

◆Recharge the battery using the existing charger or an external charger. An equalize voltage may be used to reduce charge time.

◆Record the discharge time and calculate % capacity if a ratings test was performed.

◆Keep a copy of all the test data with the battery records.

Discharge Test Notes:

◆The PG series batteries/cells full capacity will be obtained after several cycles.

◆String voltage should be measured at the battery terminals, not at the load connections.

◆ Accurate meters are essential for correct test results. Ensure all meters, shunts, etc. are properly calibrated before use.

6.2 Discharge

To maximize life, it is preferable not to discharge a battery past a certain point called a final discharge voltage. The acceptable final discharge voltage varies with the rate of discharge during the cycle. As a rule of thumb, at high discharge rate and short run time each tolerate a lower final discharge rate. Because less total capacity is taken from the battery than a lower amp discharge over a longer period.

◆Final discharge protective voltage as below:

Table 6: Termination voltmeters with different discharge currents

Discharge current	Final discharge voltage (V/cell)	Remark
$I < 0.2CA$	1.80	1) Current value C is rated capacity. 2) Current discharge rate should be not less than 0.05CA.
$0.2CA \leq I < 0.5CA$	1.75	
$0.5CA \leq I < 1.0CA$	1.70	
$1.0CA \leq I$	1.60	

◆The maximum allowable discharge current does not exceed the value below.

a) 12V series batteries allow 3CA continuous discharge.

b) 2V series batteries allow 3CA discharge ≤ 3 min.

c) For specific data, please refer to the product specification.

Noted:

a) Do not let terminal voltage drop to the above specified value;

b) Do not storage after discharge, please supplementary charge immediately.

6.3 Off-system Test Method

a) Keep the battery group for 1 hour from the system after full charge, adopt the outer fake load connect method and proceed the discharge test at 10hours discharging rate under the ambient temperature $25^{\circ}C \pm 5$.

b) Terminal voltage, ambient temperature and time should be tested before discharging.

c) Terminal voltage, discharging current, room temperature should be tested and recorded during the discharging period. Testing interval is 1 hour, discharging current must not exceed 1% of the stipulated data. They should be tested at any moment at the final discharging period, so that to make sure the time to reach the discharging end point voltage.

d) Discharging current multiplied by the discharging time makes the capacity of the battery. When battery discharge at 10 hour discharging rate, if the temperature is not $25^{\circ}C$, then it should be calculated according to the below formula on the base of the capacity obtained in the test.

$$Ce = Cr / \{1 + K(t - 25)\} \text{-----(A)}$$

In this formula, t- refers to the temperature; K-refers to the temperature modulus (K=0.006/ °C when discharging at 10H discharging rate, K=0.008/°C when discharging rate is 3H. K=0 .01/ °C when discharging rate is 1H.

◆Temperature corrected load = load at 25°CxCF, where CF is the capacity correction factor for temperature.

Table 7: Temperature Coefficient

Test Temperature (°C)	Correction Factor(CF)
0	0.78
5	0.84
10	0.89
15	0.94
20	0.97
25	1.00
30	1.03
35	1.05

If the service test is being performed, no temperature correction is necessary.

e) Battery should be recharged by 1.2 times of the original after finish discharge.

6.4 On-system Test Method

a) In the direct current power system, adjust the out-put voltage of the inverter to protection voltage (e. g .46V), battery supply the power to the load, then find out and test the battery which the lowest voltage and worst capacity.

b) Open the inverter and charge the battery, then keep 1 hour after full charge.

c) Proceed test at 10 hour discharging rate on the worst battery found out in a). Terminal voltage, temperature, discharging time, and room temperature should be tested and recorded before and after the testing. Take note at the interval of 1 hour. Notes should be taken at any moment when the discharge is near the termination voltage, it should be measured and recorded at any time to accurately record the discharge time.

d) Discharging current *discharging time = capacity of the battery group. If the room temperature is not 25°C , the capacity should be calculated according to the formula in (A) .

e) After finishing the test, charge the battery in a supplementary way so that to recover its capacity.

f) Draw the discharge curve according to the test data.

6.5 Check-aimed Discharge Test Method

In order to control the estimated capacity of the battery group at any time, it is necessary to proceed on the check-aimed discharge test.

In DC power supply system, adjust the output voltage of the rectifier to protection voltage (for example 47V), and the battery supply electricity to communication load. Terminal voltage, temperature, room temperature and discharge time of the single battery should be tested and recorded before and after the battery discharging, until 30-40% of the rated capacity is released.

b) Supplementary charge the battery after finish discharging, the charged value should be 1.2times of the discharged value.

Draw discharge curve according to the notes, and keep record for comparing with future test.

Notice:

1) Off-system test method is not recommended for UPS system battery group.

2) When operate the on- system test method and check-aimed capacity test, if the tested UPS equipment equipped with discharge performance itself, the test performance of discharging should be opened. If it is without discharge test performance, its AC input should be cut off before process the discharge test.

3) The above mentioned capacity test are the most frequently used in daily maintenance, whatever method is used, it is very important to keep proceeding the system during the test period. Therefore, before processing the test, we should investigate whether there has a plan to stop electricity and the standby generator should be ready to work at any time.

4) Apply multi meter, inner-resistant instrument, conductance instrument to make a defend test before the capacity discharge test.

5) In order to make sure that accuracy of the capacity test, professional on-system test instrument and fake load should be adopted.

6.6 Judgment on Laggard Battery

Terminal voltage of the laggard battery is lower, so it should be tested under the discharge condition. If the terminal voltage is lower on the average during the three consecutive discharge cycle test, it can be judged as the laggard battery of the group. Equalization charge should be proceeded when laggard battery is available.

7. BATTERY MAINTENANCE

7.1 Cleanness

- ◆Keep the battery surface and its working circumstance clean and dry.
- ◆Keep battery clean and avoid static condition.
- ◆Clean battery with wet cloth, no organic solvent such as gasoline, alcohol etc. or clothes with such substance is used to clean battery.

7.2 Inspection and Maintenance

To better understand the operation of battery and equipment to prevent battery damage during inspection, please periodically inspect the battery and record it.

7.2.1 Inspection items of each month:

Items	Content	Standard	Maintenance
Total float charging Voltage of battery Group.	Use a multi meter to measure the positive and negative output voltage of the battery.	The measured value is consistent with the floating charging voltage displayed on the power supply device. The deviation range is not more than $\pm 0.5\%$, and the measurement value meets the setting standard of the floating charging voltage at the current temperature.	1. If data attained by testing is various from the standard, the tested data is prevailing. 2. For those adjusted by monitor module and still can't reach the allowed error range after module adjustment, repair is to be applied or send them back to factory.
Appearance of the battery.	Visually check the battery case and cover without leakage,	Normal	Find out the reasons if exist abnormal appearance.

	deformation, cracks and damage. Inspect if there is dust or stain.	Clean.	Clean the rust and stain with wet cloth.
	Visually check whether the shelf cabinet and bolts supporting the battery are rusty.	Without rustiness.	Clean the rust, change the harness and paste antirust.
Temperature of the battery	Use an infrared thermometer to measure the temperature of the terminal of the cell and surface of the battery case.	Under 35°C	If the temperature is higher than the standard value, investigate the cause and handle it accordingly, or consult the manufacture.
	Check there is any loosen bolt/ screw by spanner or not.	Fastness (Please refer to the table for torque).	Tighten the loosen bolt/screw in time.
Connection	Visually check whether the connection bar and pool terminal are corroded.	Without appearance of erosion.	Slight corrosion can be removed from the connection strip, soak in water to remove rot, each connection point with a steel brush clean after reconnecting and tightening; If severe corrosion occurs, replace the connection bar or battery.

7.2.2 Inspection item per quarterly:

In addition to checking maintenance items every month, add the following items.

Items	Content	Standard	Maintenance
Float voltage of each battery.	Use a multi meter to measure and record the float charging voltage of a single battery at the current temperature.	The floating charging differential pressure of a single battery in a battery pack should not exceed the following standards: 90mV for the 2V series and 480mV for the 12V series.	If it exceeds the reference value, charge 2.35V/cell evenly for 8-10h or discharge 10% first and then charge evenly. After switching to floating charge, observe for 2-3 months. If it still deviates from the reference value, replace the single battery with low voltage
lag battery repair.	1. Charging repair: 2.4V/cell forced equal charging 12-20h,	The floating charging difference of a single battery in the battery pack	A single still cannot be repaired, it should be replaced.

	serious to 2-3 cycles of charging and discharging; 2. Single online repair: correct the activator or charger. Negative to negative connect to both ends of the backward battery and repair a single battery.	should meet the above standards.	
The whole group of activation charge and discharge.	Perform a cycle of charge and discharge operations on the battery pack.	30% to 40% of the rated capacity can be released during discharge.	Perform this operation for floating charging batteries that have not been discharged for more than 6 months.

7.2.3 Inspection item per year:

In addition to checking maintenance items quarterly, add the following items.

Items	Content	Standard	Maintenance
Checking discharge test	Online discharge or offline intelligent load discharge, Discharge 30 to 40% of the rated battery capacity	Battery voltage should be over 1.95V/Cell after discharging .	When it is lower than the reference value, the second discharge will be carried out after 5-10h of charging. If it still deviates from the reference value, replace the Single backward battery.
Capacity test	Online discharge or offline intelligent load discharge, Discharge 60 to 80% of the rated battery capacity	More than 80% of the capacity is reserved	All the parameters in the discharge test were recorded and stored, and the single backward electric pool was equalized charged, repaired or replaced online.

7.3 Basic requirement on maintenance

7.3.1 Principle find out the hidden trouble and insure the safety should be complied when make test on the battery.

7.3.2 Daily maintenance and performance analysis should be carried out strictly according to the processing plan.

7.3.3 Battery parameter setting and operation should be strictly complied with the maintenance rules and related requirement.

7.3.4 Always wear insulated gloves when handling the batteries to avoid electric shock. Make sure the metal instrument is insulated.

7.3.5 Use instrument and meters which meet the test requirement.

7.3.6 Physical articles

a) Check whether the post and connection is clear or not, whether there is any appearance of oxidation or erosion. In case it is serious, please clear it and reduce the resistance.

b) Check there is any loosen connection, if have, please tighten them up.

c) Check there is any appearance of acid climbing, leakage of liquid, and whether there is liquid overflow around the safety valve.

d) Check there is any damage, leakage and distortion on the battery case and the post without any damage and distortion.

e) Check there is any abnormally temperature increase on the battery and its connection.

7.3.7 Check and adjust the set of related parameters.

a) Check the float voltage, equalization voltage, float charging current is normal or not on the base of technical parameters and site environment. If not, please process it on time.

b) Check whether the limited charge current set is correct or not. If not, please adjusted it on time.

c) Check the alarm voltage (below voltage and over voltage alarm) of the battery set is correct or not. If not, please adjust it on time.

d) If there is off-load set, please check the off-load voltage is correct or not. If not, please adjust it on time.

8. REPLACEMENT AND RECYCLING

8.1 Replacement judgment

If the discharge capacity is lower than 80% (floating use) or 50% (cycle use), or after inspection, the performance cannot meet the needs of use, you should consider replacing the battery.

8.2 Replacement Time

Batteries are consumables and have a certain life cycle. Considering the influence of factors such as use conditions and ambient temperature, before reaching the designed service life of the battery, replace it with a new battery to fully ensure the safety of the power supply system.

8.3 Battery recycling

The battery is marked with recycling symbol, and the scrapped battery should be recycled by a formal recycling organization, or it can be returned to the supplier for unified recycling. Do not throw it into the trash can or discard it at will, it will cause environmental pollution.

9. CAUTIONS

- ◆Keep batteries in the place, which the children could not touch.
- ◆Do not use batteries for application other than those specified in its specification.
- ◆Do not attempt to disassemble, modify, damage, impact, or dispose of battery, otherwise the battery will leak, heat, explode.
- ◆Do not dispose of the battery in water, fire, and do not heating the batteries.
- ◆Do not short circuit batteries.
- ◆If the voltage of battery back is above 45V, please be sure wear the insulated glove in working, otherwise, it may be get an electronic shock.
- ◆Do not face to the top of battery in a short distance, please keep a certain distance when you measuring and repairing.
- ◆There are sulfuric acid in the battery, do not contact with sulfuric acid in skin, cloths, especially in eyes. If eyes contact with sulfuric acid, please wash with a lot of clean water, and consult a physician immediately.

10. BATTERY MAINTENANCE REPORT

Battery/Cell Type: _____

Installation Date: _____

Battery Location: _____

No. of Strings Per Battery: _____

No. of Cells Per String: _____

Battery Float

Date: _____

Battery overall Voltage (volts) : _____

Battery Discharged

Date: _____

Discharge Current (Amps) : _____

Discharge Time: _____

Discharge Capacity (Ah): _____

Battery Equalized

Date: _____

Duration: _____

Ambient Temperature (°C): _____