



Valve-Regulated Sealed Lead Acid Battery Maintenance Manual



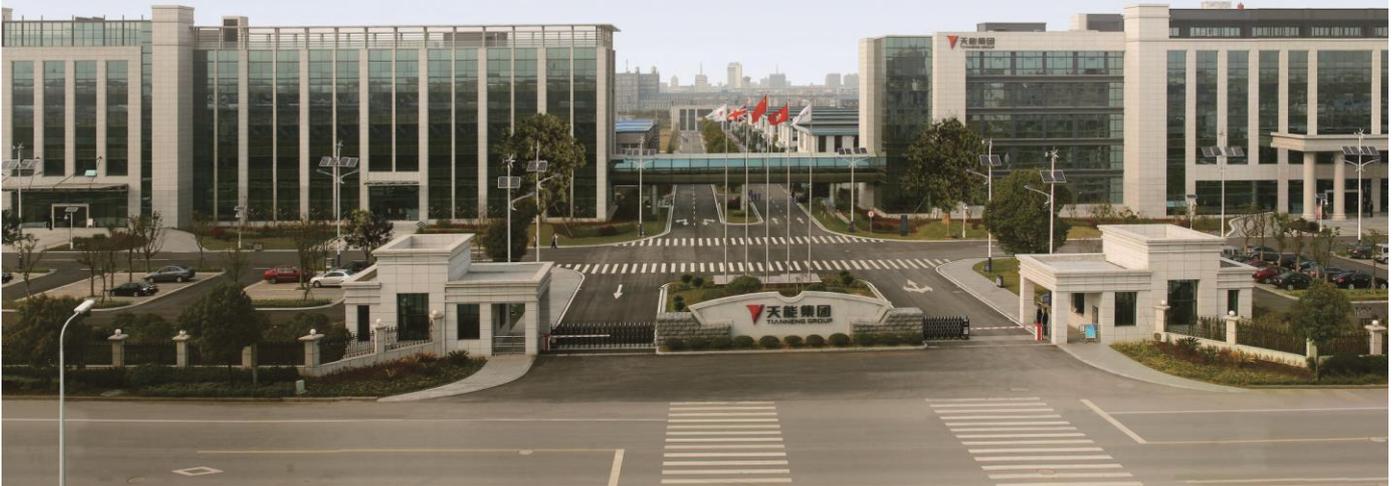
Tianneng Group
(2019 Edition)

About Tianneng Group

Tianneng Group is a leading enterprise in China's new energy motive battery industry. Founded in 1986 and after more than 30 years of development, Tianneng has become a large-scale industrial group focus on environmentally friendly motive battery manufacturing for electric vehicle, integrating research and development, production and sales of new energy vehicle lithium batteries, automobile start-stop batteries, and wind energy solar energy storage batteries, as well as reuse and recycling of used batteries, urban intelligent micro-grid construction, and green intellectual industrial park construction into one entity.

In 2007, Tianneng Power successfully listed on the Main Board in Hong Kong as China's first motive battery share. The group now has more than 40 domestic and foreign subsidiaries, 10 production bases in Zhejiang, Jiangsu, Anhui, Henan and Guizhou provinces. The Group's comprehensive strength ranks among the World's Top 500 New Energy Company, the Top 500 Chinese enterprises, the China's Top 500 Private Enterprise, and the top 10 enterprises in China's battery industry.

Our Vision : To be the most respected world-class new energy enterprise.



Content

1、 Safety Notes.....	4
2、 Battery Application	4
3、 Transportation and Storage.....	6
4、 Battery Usage	6
5、 Battery Management.....	8
6、 Battery Maintenance	11
7、 Battery Replacement	12
Attached: Battery Inspection Record.....	14

1、 Safety Notes



Please read the instruction manual before application.



Recycling is needed for batteries after use. Disposing is not allowed.



The electrolyte acid in the battery is strong corrosive, if there's accidental contact with skin or splashed into your eyes or clothes, please wash off immediately with plenty of free water and contact a doctor if necessary.



Danger



anti-corrosion

危险 腐蚀性材料 请佩戴手部保护设备
Danger corrosive materials Use hand protection



Eye protection is needed



Cautions



Live danger



No smoking

◆ Precautions

- ◇ The battery should be placed out of the reach of children;
- ◇ Explosive gas can be produced during the application of the battery, close to open flame or high temperature is not allowed. Do not throw the battery into the fire. Do not keep the battery under direct exposure to the sun in high temperature season;
- ◇ There is still electricity exist in abandoned battery, beware of short circuit and spark, otherwise it may cause ignition and explosion;
- ◇ Do not connect the battery directly to the AC power source;
- ◇ Do not repair, disassemble or rebuild the battery by yourself, otherwise the toxic substances inside the battery will cause harm to people and the environment;
- ◇ Please use the appropriate wire and connect the terminal bolts firmly, otherwise it will heat up;
- ◇ Battery case can not be cleaned with organic solvent, the battery fire accident can not be put out with a carbon dioxide fire extinguisher but a special dry powder fire extinguisher.

2、 Battery Application

Application Field

The valve-regulated sealed lead acid battery of Tianneng Group in accordance with market demand is divided into two categories: reserve batteries and energy storage batteries

Product Category	Reserve Battery	Energy Storage Batteries
Application	Uninterrupted Power Supply (UPS), Emergency Power Supply (EPS), Data center, Communication base station, Cable TV, Rail transit, Oil pipeline transportation, Electricity supply, Emergency lighting equipment, Security system, Robot and automation equipment, Portable measuring instruments, electronic tools and toys, Baby carriage, etc.	New energy storage, Oil and electricity hybrid program, Power peak adjustment, Industrial park energy storage, etc.

Service Environment of the Battery

- ✧ Recommended ambient temperature: Charging: 0°C~+40°C, Discharging: -15°C~+50°C, Storage: -15°C~+50°C.
- ✧ Keep away from heat, spark, and open flame;
- ✧ Avoid direct sunlight and heat sources;
- ✧ Avoid wet, possibly flooding places;
- ✧ Avoid completely enclosed space.

Battery Service Condition

- ✧ Series connection: recommended system voltage is less than 450V, if yours are exceed 450V, please keep an record in our company in order to get correct guidance from our professional staff. In principle, if the voltage is more than 380V, it is recommended to use the middle line connection;
- ✧ Parallel connection: recommended number of unit is no more than 5, if the numbers are up, please keep an record in our company in order to get correct guidance from our professional staff.
- ✧ Multi-layer installation: inter-layer temperature difference should no more than 3 °C

- ✧ The battery can be used upright or side standing, 2V series can not be suspending during side standing usage;
- ✧ Heat extraction condition: the batteries should at least remain 20mm apart;
- ✧ Ventilation condition: Make ensure that the concentration of hydrogen volume released is less than 0.8%;
- ✧ Floating use condition (25 °C): constant voltage 2.23 ~ 2.30V /cell (recommended to set to 2.25V / cell), current limit ≤ 0.30C10 A;
- ✧ Equalizing use condition (25°C): constant voltage 2.30 ~ 2.40V / cell (recommended to set to 2.35V / cell), current limit ≤ 0.30C10 A, charging within 12 hours;
- ✧ Cycle use condition (25°C): constant voltage 2.40 ~ 2.50V / cell, current limit ≤ 0.30C10 A, charging with no more than 16 hours;
- ✧ The use of the battery in the range of 25±5°C is more beneficial to the life of the battery, and the life expectancy of the battery is reduced by half when the temperature is increased by 10°C at the temperature of 25°C;
- ✧ When the battery charge is below 0°C or above the temperature of 40°C, it is necessary to carry out the temperature compensation correction. If the

temperature exceeds the temperature of 25°C, it should be converted according to the standard capacity conversion formula;

- ✧ Battery mixture: it is not recommended to blend batteries with different specifications, life expectancy, manufactures, capacity and performance into one system, if mixture is required, please keep us in contact to receive optimum solutions.

3、Transportation and Storage

The battery is fully charged in the state of delivery, so in the transportation and storage process, please pay attention to the following matters:

- ✧ In the course of transportation, the battery shall not be subject to strong mechanical crash and exposure to rain or sun, please do not invert the product;
- ✧ In the course of loading and unloading, the battery should be lightly handled, and it is strictly prohibited to break, throw and roll. No weight on the top. In the course of placing, please make sure the mark on the outer box face up to avoid the pressure on the vulnerable surface;
- ✧ In the course of storage, the battery should be placed in somewhere dry, clean and well ventilated with a temperature of 0 to 25°C. The product should not lay idle for more than 6 months, and please charge the battery every 6 months. The maximum storage time should not exceed 18 months. Batteries once used should be fully charged before storage, and should be stored in accordance with requirements (see more details in "Battery Management");
- ✧ The battery should carefully avoid direct sunlight, and should be kept away from heat resource (heating, heater, etc.) for 2 meters and above;
- ✧ Avoid contact with any harmful gases and organic solvents;

- ✧ Inventory management is necessary, and stick to implementation of first-in first-out and reasonable inventory in case of long-term backlog reduce life expectancy of the product.

4、Battery Usage

Unpack and check

The battery has go through scrutiny before delivery, but you need check all the following details the moment you receive it:

- ✧ Inspect the battery and packaging box for evidence of physical damage;
- ✧ Check the number of batteries and its accessories;
- ✧ Take a thorough look at the instruction manual, installation drawing and precautions;
- ✧ Please do not stress on the terminal parts in case of terminal damage and crack on sealed parts;
- ✧ Please do not invert, throw, break and crush the battery;
- ✧ Do not wire the battery with mental, such as steel, in case of short circuit;
- ✧ The battery is heavy enough for you to pay great attention to safety during handling process, and be cautions about excessive bending on the plastic handle in case of fracture problem.

Battery Cabinet Installation

➤ Installation Space

- ✧ Select the installation area and maintenance and inspection channel as required
- ✧ Load-bearing requirements should be designed based on building condition, and installation quantity and layout mode should also be checked on the same time;

➤ Precautions

- ✧ Batteries should be kept away from heat resources and places where sparks are easily produced, the

- ◇ safety distance should no less than 0.5 meters;
- ◇ Direct sunlight should be avoided, no place in sealed space, and the ambient environment should be clean and free of radioactive, infrared and ultraviolet radiation, organic solvent and corrosive gas are also forbidden;
- ◇ It is for the best to install the battery on the bottom if it is installed in the device in case of temperature rise, and it is important that there's no protrusion or burr inside the device to prevent shell damage;
- ◇ The battery compartment should have regular lighting and accident lighting, and its lighting fixtures should be placed above the aisle
- ◇ The floor in the battery compartment should have sufficient bearing capacity, and the civil design should be warned about the load requirements when the products need to be fixed upstairs. It is better to place the battery in separate space, and kept reserved space around the pack for ventilation and maintenance;
- ◇ Seismic fortification intensity of 7 degrees and above should be strengthened by foundation bolts or reinforced channel.

➤ **Installation Procedure**

- ◇ Connect the horizontal frame and the crosspiece with the Phillips screw and tighten them, then tighten the nut (Do not spin too tight);
- ◇ Measure the four diagonal of the battery holder with a tapeline to ensure it is smooth and no tilt, and then use bolts to secure the baffle and side frame;
- ◇ Mark 4 anchor holes in the installation area for the battery cabinet, and drill them vertically at a depth of about 55mm. Then place the 4 M8X70 foot bolts and reinforce with a wrench, then place the holder on top and fix it with nut.

Battery Installation

➤ **Installation Procedure**

- ◇ According to the wiring diagram, installation should

- start from the bottom (Please pay attention to the polarity and dimension of the products, and strictly keep the installation process in tune with the wiring diagram and dimension specification offered; Do not touch the terminal with wrench or other mental in case of short circuit culpable of fire problems), the location is favorable for the heat dissipation of the battery, and each layer should be fixed with a baffle plate after the installation of the battery;
- ◇ According to the wiring diagram, connect the wire, copper bar and other accessories;
- ◇ Tight connection is required during wiring process, the plug-in terminal must be tightly connected with bolts or nuts, each connection bolt or nut must be tightened, but not too hard to damage to the terminal, it is recommended to tighten the torque according to the table below:

Tightening torque proposal				
Application scope	M5	M6	M8	M10
Tightening torque (N·m)	2.0~3.0	3.9~5.4	9.8~14.7	14.7~19.6

Remarks: The standard wire or copper bar of our company has a certain bearing capacity:

- ◇ For wire or copper bar of 70mm², the maximum load flow should not exceed 280A of each cable during long-term running;
- ◇ For wire or copper bar of 50mm², the maximum load flow should not exceed 200A of each cable during long-term running;
- ◇ For wire or copper bar of 35mm², the maximum load flow should not exceed 140A of each cable during long-term running;

In the use of our wire or bar, please pay attention not to exceed the rated value above, if you have special needs, please contact us.

- **If there is a junction box, please follow the**

drawings provided

- ✧ Secure the two high voltage electric porcelain to the middle of the connecting plate with hexagonal bolts (M10x25);
- ✧ Place the connecting plate and the connecting copper bar in parallel with the high voltage electric porcelain. Place the 2 holes in the middle of the copper strip with hexagonal bolts and fix the strip on the high voltage electric porcelain plate;
- ✧ Place two cover holders vertically near the connection plate;
- ✧ Secure the terminal box to the other side of the battery cabinet with hexagonal bolts;
- ✧ After wiring is completed, P / N is affixed to the middle of the glass cover and the cover is inserted into the groove of the other side of the guard bracket.

◆ Precautions

- ✧ Before installing the battery, make sure that the frame and cabinet are stable, the installing location should well ventilated , away from heat, direct sunlight and transformers;
- ✧ Battery will produce explosive gas during storage, it should be kept away from device which could produce sparks (such as fuse);
- ✧ Do not lean on, tilt or trample the cabinet;
- ✧ When the battery series is over 450V, the bottom of the battery needs to be covered with insulation pads;
- ✧ Polish the battery terminals before connecting to render the metal bright;
- ✧ Check whether the valve is firmly connected, if not, tighten it immediately;
- ✧ It is recommended to measure and select batteries with same or similar open circuit voltage to be in group application, and the difference between voltages shall less than 0.01V/cell;
- ✧ Due to the high voltage of the battery pack, the risk

of electric shock should be under concern, tools during wiring should be wrapped with insulating tape. Insulating gloves, aprons and protective glasses are required when battery is installed or carried. Do not wrench the terminal and valve during delivery, and crash and shock should also be well prohibited. Do not put tools, debris, and other conductive materials on the battery;

- ✧ Each column of batteries is required to be kept 20mm and above from each other for better heat dissipation condition. During multiple parallel, the principle is that series connection always finished before parallel connection;
- ✧ The wire should be fixed on wall or shelf to avoid weight gained on the terminal;
- ✧ During connection between battery and charger or load, make sure one terminal is isolated from others in battery pack, and the switch of the charge or load should remain in "OFF" position in case of short circuit, meanwhile, ensure the connection is correct, the positive pole of battery connect that of charge, and the negative pole runs the same connection;
- ✧ After finishing installation, check the voltage of the battery group before loading. Make sure the floating voltage of charge or rectifier is correctly set.

5、 Battery Management

Charge State of the Battery

In order to facilitate daily inspection and judgment as well as estimate battery charge state, you can check the state through measuring open circuit voltage after you charge the battery for 24h in accordance with the recommended method of usage and maintenance, the following table shows the comparison of open circuit voltage and charge state (for reference only):

Reference voltage for every series of battery (V/cell)			charge state (%)
2V	6V/12V	6V/8V/12V	
2.14	2.16	2.18	100
2.10	2.12	2.14	80
2.07	2.09	2.11	60
2.04	2.06	2.08	40
2.00	2.02	2.04	20

◇ The battery will suffer a capacity loss due to its self discharge during transportation and storage, so please recharge the battery before take it into

application (the charging current should be determined by both nominal charging current of the product and the charging current of the charger);

- ◇ The current gradually falls and tend to be stable as the battery approaches full state of charge;
- ◇ If the current stay the same for nearly 3h, it means the charging state is close to 95~98%; Battery could be straight into application in general;
- ◇ If there is a pause during application, please charge the battery regularly. The battery needs to be charged according to the situation indicated as follows before any application:

Battery Storage Temperature and Charge Time Interval		
Storage Temperature	Charge Time Interval	Charge Methods
less than 20°C	every 9 months	a) constant voltage 2.23 ~ 2.30V/cell, constant current 0.30C (A) charge for 2~3 days;
20°C ~ 30°C	every 6 months	b) constant voltage 2.30 ~ 2.40V/cell, constant current 0.30C (A) charge for 10~16 hours;
30°C ~ 40°C	every 3 months	c) constant current 0.1C (A) charge for 8~10 hours;
40°C~60°C	every 1 months	d) charge the product with a intelligent charger and do not cut the current until the light turn green;
You are free to take anyone above		

Notes: the "C" in current value means the nominal capacity of the battery.

Examples: the nominal capacity of the "12V 100Ah" battery is 100Ah, 0.1C (A) =0.1 x 100=10A ;

Charging voltage: since 12V battery consists of 6 cell series, its floating voltage would be 2.25V x 6=13.50V; as for 6V battery, consists of 3 cell series, its floating voltage would be 2.25V x 3=6.75V

Battery Discharge

The temperature should be controlled in -15~+50°C during discharge at common application, check the real capacity at meantime; It can reflects the issues and deficiencies during battery maintenance.

■ Battery Discharge Termination

In general, the fixed valve-regulated sealed acid battery (batteries with relatively large capacity) could set its discharge termination voltage according to the factors in the following table or the discharge curve of the

battery. One of the following three conditions can be regarded as discharge termination.

Discharge Rate	Discharge Current (A)	Discharge Termination Voltage	Capacity Inspection Standard
10h	1.0I ₁₀	1.80	≥1.00C ₁₀
5h	1.6I ₁₀	1.80	≥0.80C ₁₀
3h	2.5I ₁₀	1.75	≥0.75C ₁₀
1h	5.5I ₁₀	1.75	≥0.55C ₁₀

◆ Precautions

- ✧ The performance of the battery was tested by multimeter, internal resistance meter and conductivity meter before the discharge test for battery capacity;
- ✧ The terminal voltage of the battery are not allowed to be lower than the specific value above;
- ✧ The maximum discharge current should be controlled in the range below:
 - ✓ discharge current $I \leq 1C10A$, continuous discharge;
 - ✓ discharge current $I = 3C10A$, discharge time $T \leq 2min$;
 - ✓ discharge current $I = 6C10A$, discharge time $T \leq 10s$.
- ✧ The terminal voltage, temperature, room temperature and discharge time should be kept in record before and after battery discharge;
- ✧ The battery needs immediate charge after it finished discharge process, and the charge electricity should be 1.05~1.1 times more than that of discharged;
- ✧ Record the measurements to conceive the discharge curve;

■ Battery Nominal Capacity Conversion

The discharge current multiplied by the discharge time is the capacity of the battery pack. If the temperature is not 25°C, the actual measured capacity C_t shall be converted to the capacity C_e at 25°C according to the following formula, t symbolize the temperature when the battery is discharged at different times.

$$C_e = C_t / (1 + K (t - 25^\circ C))$$

Notes:

t —the ambient temperature when battery is discharged
 K —temperature coefficient ($K=0.006/^\circ C$ when discharge rate is 10H; $K=0.008/^\circ C$ when discharge rate is 3H; $K=0.01/^\circ C$ when discharge rate is 1H)

■ Determination of Lagging Battery

The lagging battery should be measured under discharging state due to its poor performance in terminal voltage while discharging. If the terminal voltage runs the lowest in three discharging cycle test, the battery are determined to be a lagging battery. Equalize charging

process is needed for the battery group once a lagging battery is found.

Battery Charge

- Floating Charge
 - ✧ Charge voltage: 2.23 ~ 2.30V/cell (25°C) (the recommend setting is 2.25V/cell);
 - ✧ Maximum charge current: 0.30C10A;
 - ✧ Temperature compensation coefficient: $-3mV/(^\circ C * cell)$, on the basis of 25°C, every time the ambient temperature increased by 1°C, there should be a reduction with floating voltage at 0.003V/cell and every time the temperature dropped by 1°C, the floating voltage should increase by 0.003V/cell;
 - ✧ Since temperature have considerable impact on the floating voltage of the battery system, the charging voltage needs instant modification according to the ambient temperature change;
 - ✧ The product can be modified 2~4 times in general circumstance, the range reference are following:

Floating Voltage with Different Temperature	
Temperature	Floating Voltage (V/cell)
-40°C (-40°F)	2.38-2.43
-20°C (-4°F)	2.34-2.39
-10°C (-14°F)	2.32-2.37
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
40°C (104°F)	2.22-2.27
50°C (122°F)	2.20-2.25

◆ Precautions

- ✧ The batteries in same group would suffer from a difference on voltage value in early application, but they will be consistent after six months.
- ✧ The floating voltage, if runs too high in long term

(overcharge) would cause life deduction; if runs too long term (undercharge) would be unable to satisfy load and cause confusion in batteries' voltage, subsequently damage the life expectancy.

- ✧ Equalize Charge
- ✧ Charge voltage: 2.30 ~ 2.40V/cell (25°C)
(recommended setting: 2.35V/cell);
- ✧ Maximum charge current: 0.3C10A;
- ✧ Temperature compensation coefficient: -3mV/(°C*cell) (on basis of 25°C);
- ✧ The charging voltage fluctuates from $\pm 0.02V/cell$;
- ✧ The current reference value of the battery charging termination is 0.01C10A, it should multiply unit number when battery is used in parallel connection.

■ Cycle Charge

- ✧ Charge voltage: 2.40 ~ 2.50V/cell (25°C)
(recommended setting: 2.45V/cell);
- ✧ Maximum charge current: 0.3C10A;
- ✧ Temperature compensation coefficient: -5mV/(°C*cell) (on basis of 25°C);
- ✧ The charging voltage fluctuates from $\pm 0.02V/cell$;
- ✧ The electricity charged should be 1.05~1.1 times more compared to that of discharged, but if the temperature is lower than 5°C, the number should be 1.1~1.2.

Battery Charge Reference

Ambient Temperature (°C)	Charging Voltage (V/cell)	Charging Time (hour)
5	2.31	6
	2.46	4
25	2.25	6
	2.40	4
35	2.21	6
	2.34	4

◆ Precautions

- ✧ Charging time is the internal time when battery is charged with constant current of 0.30C10A or below

and the terminal voltage of the battery reach to the voltage in the above table;

- ✧ If the charging time exceed time mark in above table, the continuous charging will result in overcharge and a reduction of battery life;
- ✧ During Cycle usage, it is recommended to install the timer or set automatic transition from full-charged to trickle charge. If there is imparity between 25°C and the real ambient temperature, the voltage should be set to temperature compensation, the formula is following:

$$U_{corrected} = U_{25^{\circ}C} + K \times (T_{real} - 25)$$

(T_{real} —ambient temperature , K —Temperature compensation coefficient)

6、 Battery Maintenance

Inspection and Maintenance

- There might be some trouble in battery application:
 - ✧ The float voltage is set too low
 - ✓ Due to long-term under-charging state, the active material in the depth of plate are unable to participate in chemical reaction, which will contribute to the formation of high resistance layer between active material and the separator, increase internal resistance, decrease battery capacity.
 - ✧ The float voltage is set too high
 - ✓ Due to long-term over-charging state, the internal gas continuously increased, and the valve should be constantly open, Which cause a serious loss of water in the battery, increase the electrolyte concentration, accelerate the battery internal corrosion, capacity failure and so on.
 - ✓ Due to the excessive discharge of the battery, lead sulfate in the interior are over-produced, so that the volume of the plate material increases, causing its bending, expansion, and will lead to the battery tank crack;

- ✓ If the ambient temperature runs too high, the water loss inside the battery will increase, exacerbating the plate corrosion and causing a reduction in battery life. The life expectancy of the battery is reduced by half every time the temperature is increased by 10°C
- Valve-regulated sealed lead acid battery maintenance
 - ◇ The battery should be kept clean in case of electricity leakage;
 - ◇ When cleaning the battery, it must be wiped with a damp cloth. Do not scrub or coat with oil or organic solvents (such as gasoline and thinner). Cloth soaked with these materials is also forbidden. It is not allowed to wipe the product with a fluffy brush and a dry cloth to in case of static electricity and fire problem caused;
 - ◇ The battery should be stored in space that is clean, well-ventilated and dry. There should be no direct sunlight, high temperature and heat resource during both application and storage. The ambient temperature would better to be 15~20°C;
 - ◇ During charging process, the charge is recommended to be device that have function of limiting current and constant voltage, and the constant voltage should be kept in the range of $\pm 1\%$;
 - ◇ Please maintain complete battery operating record.
- when installing the system;
- ◇ Do not use any organic solvents to clean the battery;
- ◇ Do not disassemble the valve or add material in the battery;
- ◇ No smoking or fire near the battery group;
- ◇ The battery should be charged in 24h after usage, and make sure it is full-charged otherwise the capacity could suffer from certain damage;
- ◇ Valve check: whether it is tightened (Do not disassemble the valve);
- ◇ The battery could go through a performance decaying during storage, so please bring it into service as soon as possible;
- ◇ It is highly recommended to exert maintenance plan monthly, annually and quarterly according to both the condition of the battery and application requirements in order to make sure the system is running properly and safely.

Maintenance and Inspection Requirements

- ◇ Make sure you have necessary tools, include isolated tools, rubber gloves and apron, protective eyeglasses and facial protection, all the mental tools are required to be well-insulated;
- ◇ Tools and instruments used should meet the requirements of inspection. No metal tools can be placed on the battery;
- ◇ The voltage of the multi-cell battery is rather high, so the AC and DC circuits should be disconnected
- when installing the system;
- ◇ Do not use any organic solvents to clean the battery;
- ◇ Do not disassemble the valve or add material in the battery;
- ◇ No smoking or fire near the battery group;
- ◇ The battery should be charged in 24h after usage, and make sure it is full-charged otherwise the capacity could suffer from certain damage;
- ◇ Valve check: whether it is tightened (Do not disassemble the valve);
- ◇ The battery could go through a performance decaying during storage, so please bring it into service as soon as possible;
- ◇ It is highly recommended to exert maintenance plan monthly, annually and quarterly according to both the condition of the battery and application requirements in order to make sure the system is running properly and safely.

7、 Battery Replacement

Common Faults Type

- ◇ The floating voltage is too low: It should be under your concern if the floating voltage of one battery is 50mV (for 2V batteries) or 300mV (for 12V batteries) lower than average voltage that of the same group
- ◇ The capacity is not enough: It may caused because of the active material being inactive (muddy effect or vulcanization) or over-loss of water
- ◇ Internal short: It may caused because of grid corrosion, creep, over discharge dendrite short circuit and so on
- ◇ The shell broke: It may caused because of thermal runaway or collision rupture
- ◇ Terminal corrosion: It may caused because of leakage around the terminal parts or outside corrosion

Precautions

- ◇ If problems, such as shell broke, terminal corrosion and internal short, are found, please replace the battery immediately in case of safety accident;
- ◇ If the capacity is not qualified for the requirement after discharge test, please take replacement into consideration;
- ◇ If a single battery in group use calls for replacement, please measure the open circuit voltage of both the new battery and the old one and make sure the disparity between them is no more than 0.02V/cell before the replacement finally into action;
- ◇ If the system are not allowed to take a pause in

parallel condition, please turn down the charge voltage and safely remove one battery group before any next move.

Replacement Period

Batteries are consumables with a certain life cycle. Taking into account the use of conditions, ambient temperature and other factors, the old one should be replaced with a good before the final designed life. Make sure the battery system runs in a safe and reliable condition.

Attached: Battery Inspection Record

Battery Maintenance Record

Battery Model _____
Installation Time _____
Installation Site _____
Number of Parallel Batteries (unit) _____
Number of Serial Batteries (unit) _____
 Floating Charge _____ Discharge _____ Equalize charge _____
 Date: _____ Date: _____ Date: _____
 Time: _____ Discharge Capacity (Ah): _____ Real Value (V): _____
 Total Voltage (V): _____ Charge Current (A): _____ Temperature (°C): _____

Monthly Record

Single Battery Record

Number	Floating Voltage (V)	Number	Floating Voltage (V)
1		21	
2		22	
3		23	
4		24	
5		25	
6		26	
7		27	
8		28	
9		29	
10		30	
11		31	
12		32	
13		33	
14		34	
15		35	
16		36	
17		37	
18		38	
19		39	
20		40	

Test Point Record

Date	Test Point Floating Voltage (V)	Total Voltage Floating Voltage (V)	Temperature (°C)

Remarks:

Recorder: _____

Battery Test Record

Site Name: _____

Test Time: _____

Battery Model:				Battery Number:				Group Number:							
Production Date:				Installation Date:				Environment Temperature :							
Battery Group ()				Floating Voltage <input type="checkbox"/>				Equalize Voltage <input type="checkbox"/>				Discharge <input type="checkbox"/>			
Total Voltage (V)				Operating Current (A)											
Number	Single Battery Voltage											remarks			
	0	1h	2h	3h	4h	5h	6h	7h	8h	9h	10h				
1															
2															
3															
4															
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Inspector: _____

Confirmor: _____



Responsibility for the Soul Cooperation for the Win-win



Tianneng Battery Group Co., Ltd.
Tianneng Power Energy Technology Co., Ltd.
Tianneng Group Wan Yang Green Energy Co., Ltd.
Tianneng Group (Henan) Energy Technology Co., Ltd.

Zhejiang Tianneng Battery (Jiangsu) Co., Ltd.
Tianneng Battery (Wuhu) Co., Ltd.
Tianneng Battery Group (Anhui) Co., Ltd.
Tianneng Power (Hong Kong) Co., Ltd.

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