SEALED LEAD-ACID BATTERY
OPERATION MANUAL

Content

1. Introduction

1.1、Leading Technology and Broad Product Range

CSPOWER Battery Tech. Co.Ltd. was set up in 2003 with over 10 years of experiences.. We use advanced technology and equipment from USA and Japan to produce our specialty valve sealed lead acid storage batteries. Our products comprise eight series (2V, 4V, 6V, 8V, 10V, 12V,24V,36V) with over 280 models. Our battery capacities range from 0.5AH to 3000Ah. Our products are certified by UL, CE,VDS, China Information Industry Ministry , Railway Ministry, and Electronics Ministry. In addition to the manufacture of common seal lead acid batteries, we also manufacture GEL, Deep cycles,High rate discharge,Front terminal, solar power, long-life, and Electrical toy batteries. All of our SLA battery use the very latest technology.

1.2、The Most Experienced People to Support You

We has more than 40 senior engineers, who are graduated from leading Chinese Universities. They each have more than 10 years experiences in the battery field and have published theories on battery science. We have about 1200 experienced and responsible workers.

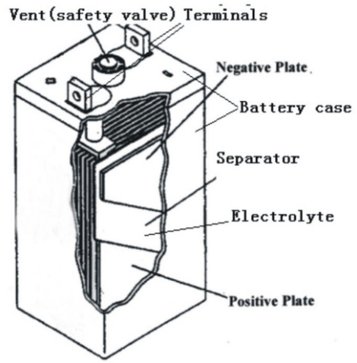
1.3、The Newest Products

Our company takes great stock in developing new products. We annually invest more than 3M RMB in our special research department and cooperate regularly with Haerbin Industry University, Wuhan University and Huanan Science University to research raw materials. Our R&D department has developed more than 10 patents on battery technology and production techniques. New products include GEL, Deep cycles,High rate discharge,Front terminal, solar power, long-life, and Electrical toy batteries, The principal advantages of these SLA battery are long life design, optimize design, colloid design, and so on. By constantly innovating and producing the right products we help you meet your customer needs – all the time.

1.4、 SLA battery market

About our market, 20% is domestic market, 80% of the SLA batteries are exported to over 35 countries, such as: USA, Brazil,UK,Italy,Spain,Germany,Sweden,Holand,Iran,Korea,Thailand,South Africa,etc, the main customers are Amerson, Tyco, Delta, Europa, steren,SAMSUNG
,China mobile,China telecom,China unicom,China railway.etc, We produce over 30 million pcs various kinds of SLA batteries and the total export value is over 70 million USD dollars in 2007 year and we have confident,make our 2008 yearly export values 30~50% more than that in 2007 year.

2、GENERAL INFORMATION ON VRLA-BATTERIES



2.1、Battery Construction

• Positive plates

Positive plates are plate electrodes of which a grid frame of lead-calcium alloy holds porous lead dioxide as the active material.

• Negative plates

Negative plates are plate electrodes of which a grid frame of lead-calcium alloy holds spongy lead as the active material.

• Electrolyte

Diluted sulfuric acid is used as the medium for conducting ions in the electrochemical reaction in the battery.

• Separator

Separators, which retain electrolyte and prevent shorting between positive and negative plates, adopt a non-woven fabric of fine glass fibers which is chemically stable in the diluted sulfuric acid electrolyte. Being highly porous, separators retain electrolyte for the reaction of active materials in the plates.

• Vent (one way valve)

The vent is comprised of a one-way valve made of material such as neoprene. When gas is generated in erroneous charging, charger malfunctions or other abnormalities, the valve opens to release excessive pressure in the battery and maintain the gas pressure within specific range (0.07-0.44 bar).

During ordinary use of the battery, the valve is closed to shut out outside air and prevent oxygen in the air from reacting with the active material in the negative electrodes.

• Positive and negative electrode terminals

Positive and negative electrode terminals may be fasten tab type, bolt fastening type, threaded post type, or lead wire type, depending on the type of the battery. Sealing of the terminal is achieved by a structure which secures long adhesive-embedded paths and by the adoption of strong epoxy adhesives.

• Battery case

Materials of the body and cover of the battery case are ABS resins, unless otherwise specified.

2.2、Electrochemical Reactions on Electrodes

The electrochemical reaction processes of the sealed lead-acid battery (negative electrode recombination type) are described below.

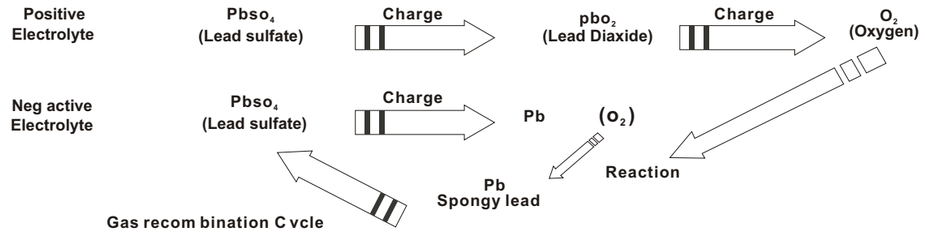
Where “charge” is the operation of supplying the rechargeable battery with direct current from an external power source to change the active material in the negative plates chemically, and hence to store in the battery electric energy in the form of chemical energy. “Discharge” is the operation of drawing out electric energy from the battery to operate external equipment.

$$PbO_2 + 2H_2SO_4 + Pb \underset{Charge}{\overset{Discharge}{\rightleftharpoons}} PbSO_4 + 2H_2O + PbSO_4$$

(Lead dioxide)	(Sulphuric acid)	(Spongy lead)	(Lead sulphate)	(Water)	(Lead sulphate)
Positive Active Material	Electrolyte	Negative Active Material	Positive Active Material	Electrolyte	Negative Active Material

2.3、Oxygen cycle

In the final stage of charging, an oxygen-generating reaction occurs at the positive plates. This oxygen transfers inside the battery, then is absorbed into the surface of the negative plates and consumed. These electrochemical reaction processes are expressed as follows.



2.4、Battery Applications

(1) Cycle Use:

Portable VTR/TV, tape recorders, radios, and etc. Power tools, lawn mowers and vacuum cleaners, Cameras and photographic equipment, Portable personal computers, word processors, portable terminals and etc. Portable measuring equipment, Portable telephone sets, Various power toys and recreational equipment Lighting equipment

(2) Standby Use:

Communications and electric equipment, Emergency lighting equipment, Fire alarms and security systems, Various telemeter equipment, Office computers, processors and other office automation equipment Robots, control equipment and other factory automation equipment, UPS power supplies, Emergency power supplies in power generation plants and substations Telecommunications

(3) Solar Cell Power Generation:

Street lighting, Water pumping stations, Portable handheld power supplies, Small town power systems

2.5、Features

Safety

Patent design to prevent the battery burning, exploding and leakage.

Easy maintenance

unlike the conventional batteries in which electrolyte can flow freely, VRLA batteries do not need the specific-gravity check of the electrolyte nor the watering structurally; this makes the battery function fully and makes maintenance easy.

Long Life Design

The use of heavy-duty lead-calcium alloy grids with anti-corrosive construction enable the CSPOWER AGM battery to remain in float service for 10-15 years and the CSPOWER Gel battery to remain in float service for 15-20 years.

High Reliability and Stability

Advanced AGM and GEL production technology and strictly quality control systems ensure battery stability and reliable performance. The voltage, capacity and seals are 100% tested during production.

Safety and Quality certification

Have Passed VdsUL and CE tests (Certification # MH26669, # G4M20104-0409-E-16). The production quality control system has passed the SGS ISO9000 Certification.

Energy-Saving:

High charging efficiency and low floating charging current, can save much energy for customers during the battery life.

2.6、International Certification and standard

All CSPOWER batteries are tested and certified according to UL 924, section 38 (Emergency Lights and Power Equipment). Section 38 requires that the battery is free from the hazard of bursting, that is, when the battery is overcharged the vent valve opens to release internal pressure. The battery types commonly used in security applications are further certified by Vds, the German insurance underwriters association. We are also ISO 9001 certified as well as CE recognized.

- **UL certIfication (MH 26669)**

Our VRLA batteries fall into UL 2003（MH26669） It requires that the battery is free from the hazard of bursting, that is, when the battery is overcharge the vent valve opens to release internal pressure. UL recognized types of VRLA batteries to date are listed in the following table. A number of the recognized battery types are in use for such applications as emergency lights.

- **VdS certIfication**

The types of VRLA batteries which have acquired VdS (Germany) recognition。

- **JIS and IEC standard**

Our sealed lead-acid batteries comply with JIS C 8702, and JIS C 8707. IEC 60896—2004 standard

- **ISO14001:2004 and ISO9001.2000:**

After an evaluation by the SGS CERT CERTICATION Body of SGS NORD CERT GmbH & Co. KG, in accordance with SGS CERT procedures that our company has established and applies the quality and environrnent a management system for production,distribution and service of lead-acid batteries. Registered certification number: CN08/31054

3、SAFETY

3.1、SAFETY DESIGN

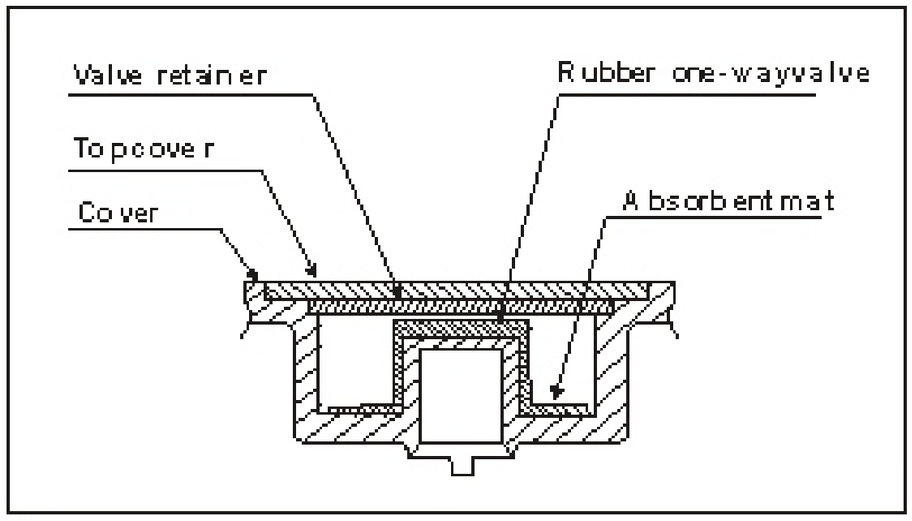
・Vent (one way valve)

If the internal pressure of the battery is raised to an abnormal level, the rubber one way valve opens to release excessive pressure; thus the valve protects the battery from danger of bursting. Since the rubber valve is instantly resealable, the valve can perform its function repeatedly whenever required.

Example of valve construction

・leakage-proof:

The elctrolyte is absorbed in the plates and seperators, no extra electrolyte inside the battery, the case and terminal are sealed by epoxy glue. The acid cannot be out.



3.2、VRLA battery safety test items

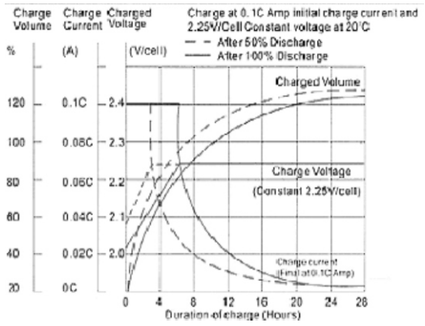
Item	Test method	Check point
1.shock test(drop test)	A fully charged battery is allowed to drop in the upright position from the height of 20 cm onto a hard board having a thickness of 10 mm or more. Test is repeated three time.	The battery should be free from notice able breskage or leak, and its terminal voltage should be held higher than the nominal voltage.
2.Vibration test	A vibration frequency of 1000 time/minutes and amplitude of 4 mm is applied to the x-. y-and z-axis directions of a fully charged battery for 60 minutes respectively.	No battery part should be broken, the battery should be free from leak , and its terminal voltagge should be held higher than the nominal voltage.
3.oven test	A fully charged battery is left standing in a atmosphere of 70℃ for 10 hours.	The battery case shouldn’ tbe deformed, the battery should be free from leak.
4. coldproof test	A fully charged battery is connected to a resistor equivalent to 60 hour rate discharge and left for 4 days, then the battery is left standing in an atmosphere of -℃ for 24 hours	No crack should develop in the battery case, the battery should be free from leaks.
5. heat cycle test	A fully charged battery is exposed to 10 cycles of 2 hours at 40℃ and 2 hours at 65℃	No crack should develop in the battery case, the battery should be free from leaks.
6.short circuot test	A fully charged battery connected with a small resistor of 10 ohms or less os allowed to discharge.	The battery must not burn-nor burst
7.Large current discharge test	A fully charged battery is allowed to discharge at 3C A to 4.8V/6V battery level.(this test is not applicable to batteries having built-in thermostat.)	The battery must not burn nor burst, and it should be free fom battery case deformation, leaks and any irregularity in the internal connections
8.vent valve function test	A fully charged battery is submerged in liquid paraffin in a container,then overcharged at 0.4C A(UL 1989)	Release of gas from the vent should be observed. No irregularity should be notices in the
9. overcharge test	A fully charged battery is overcharged at 0.1C A for 48 hours, left standing for one hour, and allowed to discharge at 0.05C A to 5.25V/6V battery level.	battery appearance, the battery should retain 95% or more of the initial capacity.

4、CHARACTERISTICS

4.1 charging

Charging characteristics (constant voltage-constant current charging) of VRLA batteries are exemplified below.

Example of constant-voltage charge characteristics by current

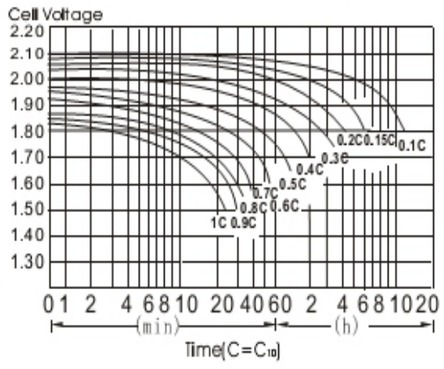


4.2、Discharging

a) Discharge current and discharge cut-off voltage

Recommended cut-off voltages for 2V batteries consistent with discharge rates are given in the figure below. With smaller discharge currents, there-fore discharge cut-off voltages are set to the higher side for controlling over discharge. For larger discharge currents, on the contrary, cut-off voltages are set to the lower side.

(Note) Discharge cut-off voltage given are recommended values.



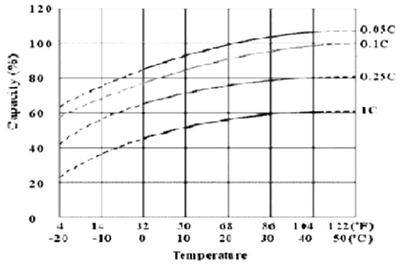
B） discharge temperature

(1) control the ambient temperature during discharge within the range from －15℃ to 50℃ for the reason described below.

(2) Batteries operate on electrochemical reaction which converts chemical energy to electric energy. The electrochemical reaction is reduced as the temperature lowers, thus, available discharge capacity is greatly reduced at temperatures as low as 15℃. For the high temperature side, on the other hand, the discharge temperature should not exceed 50℃ in order to prevent deformation of resin materials which house the battery or deterioration of service life.

c） effect of temperature on discharge characteristics

Available discharge capacity of the battery varies with ambient temperature and discharge current as shown in the figure below.Discharge capacity by temperature and by discharge current.



d） Discharge current

Discharge capability of batteries of expressed by the 20 hour rate (rated capacity). Select the battery for specific equipment so that the discharge current during use of the equipment talls within the range between 1/20 of the 20 hour rate value and 3 times that (1/20 C A to 3C A): discharging beyond this range may result in a marked decrease of discharge capacity or reduction in the number of times of repeatable discharge. When discharging the battery beyond said range, please consult Sunnway in advance.

e） Depth of discharge

Depth of discharge is the state of discharge of batteries expressed by the ration of amount of capacity discharged to the rated capacity.

4.3、Storage（self discharge）

Storage condition

Observe the following condition when the battery needs to be stored.

1) Ambient temperature: -15℃ to 40℃ (preferably below 30℃)

2) Relative humidity: 25 to 85%

3) Storage place free from vibration, dust, direct sunlight, and moisture.

a) Self discharge and refresh charge

During storage, batteries gradually lose their capacity due to self-discharge, therefore the capacity after storage is lower than the initial capacity. For the recovery of capacity, repeat charge/discharge several times for the battery in cycle use; for the battery in trickle use, continue charging the battery as loaded in the equipment for 48 to 72 hours.

b) Refresh charge (Auxiliary charge)

When it is unavoidable to store the battery for 3 moths or longer, periodically recharge the battery at the intervals recommended in the table below depending on ambient temperature. Avoid the battery for more than 12 months.

storage temperature	interval of auxiliary charge(refresh charge)
Below20°C	9month
20℃ to 40°C	6month
20℃ to 40°C	3month

C) Residual capacity after storage

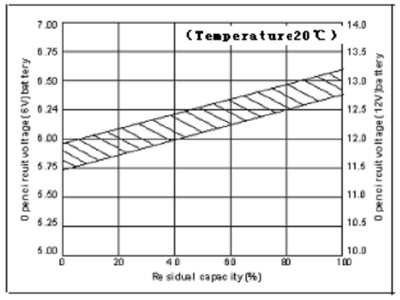
The result of testing the residual capacity of the battery which, after fully charged, has been left standing in the open-circuit state for a specific period at a specific ambient temperature is shown in the figure below. The self-discharge rate is very much dependent on the ambient temperature of storage. The higher the ambient temperature, the less the residual capacity after storage for a specific period. Self discharge rate almost double by each 10℃ rise of storage temperature.

Residual capacity test result

d) Open-circuit voltage vs. residual capacity

Residual capacity of the battery can be roughly estimated by measuring the open circuit voltage as shown in the Figure.

Open circuit voltage vs. Residual capacity (20℃)



4.4、Temperature conditions

Recommended temperature ranges for charging, discharging and storing the battery are tabulated below.

Charge	0^0C-40^0C
discharge	-15^0C-50^0C
storage	15^0C-40^0C

4.5、Battery life

a) Cycle life

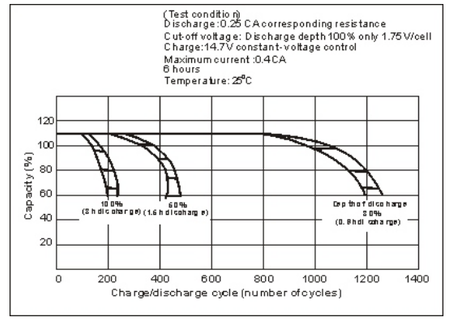
Cycle life (number of cycles) of the battery is dependent on the depth of discharge in each cycle. The deeper the discharge is, the shorter the cycle life (smaller number of cycles), providing the same discharge current. The cycle life (number of cycles) of the battery is also related to such factors as the type of the battery, charge method, ambient temperature, and rest period between charge and discharge. Typical cycle-life characteristics of the battery by different charge/discharge conditions are shown by the below figures.

This date is typical and tested at a well-equipped laboratory.

Cycle times are different for each battery model.

Cycle times are also different from this data when using batteries under real conditions.

Cycle life vs. Depth of discharge

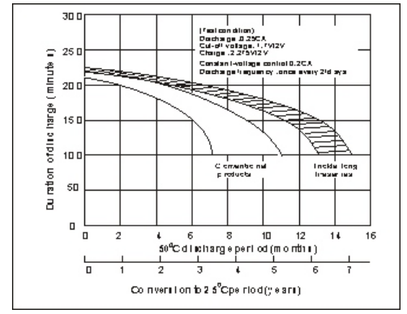


B) Float life

Trickle life of the battery is largely dependent on the temperature condition of the equipment in which the battery is used, and also related to the type of the battery, charge voltage and discharge current. The respective Figures show the influence of temperature on trickle life of the battery, an example of trickle (float) life characteristics of the battery, and the test result of the battery life in an emergency lamp.

Influence of Temperature on Trickle life

Trickle life characteristic at 50℃



5、CHARGING METHODS

5．1、Methods of charging the Valve regulated lead-acid battery

For charging the valve regulated lead-acid battery, a well matched charger should be used because the capacity or life of the battery is influenced by ambient temperature, charge and other parameters.

Charging methods are dependent on battery applications, and the applications are roughly classified into main power application(cycle use) and stand-by/back-up power applications(trickle use).

- Classification by application
  - (1)Main power source(cycle use)
    - (a)standard charging (normal charging)
    - (b)rapld charging
  - (2)stand-by power source(trickle use)
    - (a)trickle charging
    - (b)float charging

5.1.1main power cycle use

cycle use is to use the battery by repeated charging and discharging in turn.

a) standard charging (Normal charging)

For float applications of the battery, the constant voltage charge method is advantageous as it allows the battery to exert full performance.

- **Constant voltage charging method**

  This method is to charge the battery by applying a constant voltage between the terminals.

  When the battery is charged by applying a voltage of 2.45V per cell (unit battery) at a room temperature of 20℃ to 25℃, charging is complete when the charge current continues to be stable for three hours. Valve regulated lead-acid batteries can be overcharged without constant voltage control. When the battery is overcharged without constant voltage control. When the battery is overcharged, the water in the electrolyte is decomposed by electrolysis to generate more oxygen gas than what can be absorbed by the negative electrode. The electrolyte is reduced, the chemical reactions of charge and discharge become inefficient and hence the battery performance is severely deteriorated. Therefore, exact voltage control and proper charging time in constant voltage charging are essential for securing the expected life of the battery.

- **Constant-voltage and constant-current charging method**

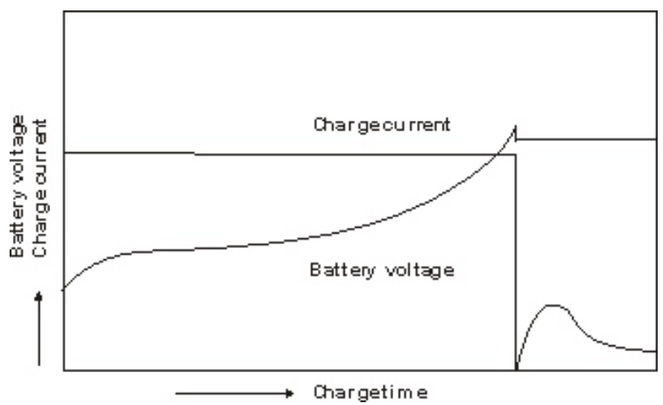
  This method is to charge the battery by controlling the current at 0.4CA and controlling the voltage at 2.45V/per cell (unit battery) at a room temperature of 20℃ to 25℃.Proper charging time is 6 to 12 hours depending on discharge rate.

  constant-voltage and constant-current charge characteristic

b） Rapid charging

when rapidly charging the battery, a large charge current is required in a short time for replenishing the energy which has been discharged. Therefore, some adequate measures such as the control of charge current is required to prevent overcharging when the rapid charging is complete.Basic requirements for rapid charging are as follows:

Sufficient charging should be made in a short time for fully replenishing the amount discharged.



Charge current should be automatically controlled to avoid overcharge even on prolonged charging The battery should be charged adequately in the ambient temperature range of 0℃ to 40℃。

Reasonable cycle life of charge/discharge should be secured.

Typical methods to control charging so as to satisfy the above requirements follow.

· Two-Step Constant Voltage Charging

Two-step constant voltage charge control method uses two constant-voltage devices. At the initial stage, the battery is charged by the first constant voltage device of high setup voltage (setup for cycle charge voltage). When the charge current, the value of which is detected by the current-detection circuit, has reduced to the preset value, the device is switched over to switch over to the second low setup voltage(setup for trickle charge voltage). This method has the advantage to allow trickle use application to charge the battery in a comparatively short time for the next discharge.

charging characteristics of the two-step constant voltage control charger

5．1.2 Stand-by/back-up use (trickle use)

the application load is supplied with power from AC sources in normal state. State-by/back-up use is to maintain the battery system at all times so that it can supply power to the load in case the AC input is disrupted (such as a power failure). There are two methods of charging for this use.

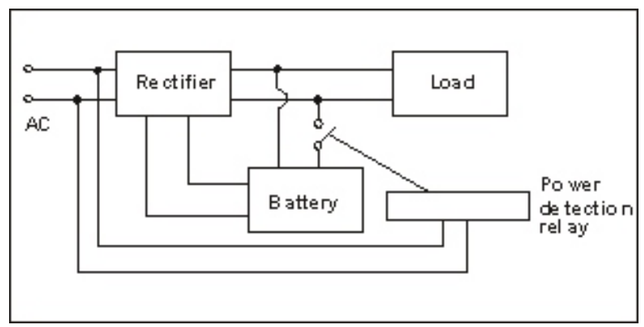
a）trickle charge (compensating charge)

Trickle charge

In this charge system, the battery is disconnected from the load and kept charged with small current only for compensating self discharge while AC power is alive. In case of power failure, the battery is automatically connected to the load and battery power is supplied. This system is applied mainly as a spare power source for emergency equipment. In this use, if rapid recovery of the battery after discharge is required, it is necessary to consider the recovery charge with a comparatively large current followed by trickle charge, or alternative measures.

While the type and capacity of the battery is determined by the back-up time and the load (current consumption) during power failure, some reserve power should be taken into account considering such factors as ambient temperature, capability of the charger and depth of discharge.

Trickle charge system model



• **equalization charging**

As a team batteries continues to be charged over a long period(e.g. 3 months), or 90mV difference in a charging team voltage has been discovered. which may result in a significant difference in the battery life. Therefore, equalization charging should be adopted。 Which should controll a narrow range chargeing voltage with initial current of approx 0.1C A.

• **Float Charge**

Float system is the system in which the battery and the load are connected in parallel to the rectifier, which supplies a constant-voltage current. In the float system, capacity of the constant-voltage power source should be more than sufficient against the load. Usually, the rectifier capacity is set at the sum of the normal load current plus the current needed in order to charge the battery.

5.2、charging condition

a) Temperature Compensation of Charge Voltage

Charge voltage of the battery should be compensated to the ambient temperature around the battery, as shown in figure 27. Main reasons for the temperature compensation of charge voltage are to prevent the thermal runaway of the battery when it is used in high temperature conditions and to secure sufficient charging of the battery when it is used in low temperature conditions. Prolongation of service life of the battery by the above-described temperature compensation is expected as follows

At 30℃: prolonged by appros. 5%

At 35℃: prolonged by appros. 10%

At 40℃: prolonged by appros. 15%

In low temperature zones below 20℃ , no substantial prolongation of the battery life can be expected by the temperature compensation of charge voltage.

b) Charge Time

Time required to complete charging depends on factors such as depth of discharge of the battery, characteristics of the charger and ambient temperature. For cycle charge, charging time can be estimated as follows:

(1). When charge current is 0.25C A or greater:

Tch = Cdis/I+(3 to 5) (2) . When charge current is below 0.25C A

Tch = Cdis/I + (6 to 10)

Where: Tch = Charge Time

Cdis = Amount of discharge before this charging (AH)

I = Initial charge current (A)

Time required for trickle charge ranges from 24 to 48 hours.

Summary

C) Charging temperature

(1) charge the battery at an ambient temperature in the range from 0℃ to 40℃。

(2) optimum temperature range for charging is 5℃ to 30℃。

(3) charge at o℃ or below and 40℃ or higher is not recommended: at low temperatures, the battery may not be charged adequately; at high temperatures, the battery may become deformed.

(4) For temperature compensation values, see a).

d) Reverse charging

Never charge the battery in reverse, as it may cause leakage, heating or bursting of the battery.

e) Overcharging

Overcharge is an additional charge after the battery is fully charged. Continued overcharging shortens the battery life. Select a charge method which is specified or approved for each application.

f) Charging before use

Recharge the battery before use to compensate for capacity loss due to self-discharge during storage.

5.3 Charging parameters

5.3.1 normal charging

MIdels	Capacity	Current(A)	Voltage(V)	Time(h)
2V	50AH-3000A h	≤0.2C_{10}	2.35-2.40	12-15
6V	0.5AH-200A h	≤0.4C	7.20-7.50	12-15
12V	0.8AH-280A h	≤0.4C	14.40-15.0	12-15

5.3.2 floating charging&equalization charging

MIdels	Capacity	Current(A)	Floating charging voltage(v)	Equalization charging voltage(v)	Equalization charging time(h)
2V	50AH-3000A h	≤0.2C	2.23-2.27	2.33-2.38	20-24
6V	0.5AH-200A h	≤0.2C	6.75-6.90	7.10-7.30	20-24
12V	0.8AH-280A h	≤0.2C	13.50-13.80	14.20-14.60	20-24

5.3.3 Complementarity charging:

When the battery store for a long time.

As following conditions or the battery before use.The battery must be charged.

Store temeparature(℃)	Store time	Charging
≤20	Every 9 months	One time
20-30	Every 6 months	One time
30-40	Every 3 months	One time

Charging parameters

Charging voltage	2.33-2.38V/cell
Charging current	≤0.2C
Charging time	5-12h

5.4、Precautions

1) When adoption charging methods and charging conditions other than those described in the specifications or the brochures, thoroughly check charging/discharging characteristics and life characteristics of the battery in advance. Selection of appropriate methods and conditions of charging is essential for safe use of the battery and for fully utilizing its discharge characteristics.
2) In cyclic use of the battery, use a charger equipped with a charging timer or charger in which charging time or charge amount is controlled by other means; otherwise, it will be difficult to judge the completion of the charge. Use of a charger as described above is recommended to prevent undercharge or overcharge which may cause deterioration of the battery characteristic.
3) Continue charging the battery for the specified time or until the charge completion lamp, if equipped, indicates completion of charging interruption of charging may cause a shortening of service life.
4) Do not recharge the fully charged battery repeatedly, as overcharge may accelerate deterioration of the battery.
5) In cyclic use of the battery, do not continue charging for 24 hours or longer, as it may accelerate deterioration of the battery.
6) In cyclic service of the battery, avoid charging or more batteries connected in parallel simultaneously, Imbalance of charge/discharge amount among the batteries may shorten the life of batteries.

6、Battery selection

6.1、MODEL NUMBERS OF VRLA-BATTERIES

All series batteries of CSPOWER are set out below.

General battery ——CS ×××××

Gel battery ——CG×××××

Electric vehicle battery ——EV ×××××

Photovoltaic & wind power battery ——CL ××××××

Golf car battery ——CL ××××××

Front terminal battery ——FT ××××××

Tubular OPzv battery —— ×OPZv×××

Tubular OPzs battery —— ×OPzs×××

DIN width 198 series tractor ×Pzs×××

DIN width 158 series tractor ×VBS×××

6.2、method of battery selection(Estimation of that discharge time)

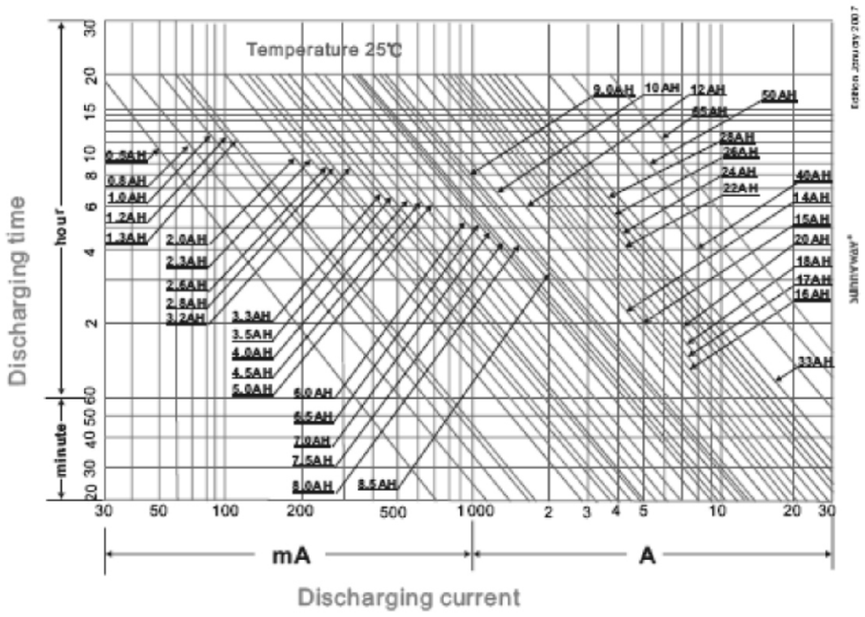
(1) determine discharge current.

(2) determine duration of discharge required.

(3) select batteries from the selection chart below.

Then, select a battery which meets the specfication of the equipment in which the battery is loaded such as voltage. Dimenstons and mas.

(Note) date given are the average values obtained with in three cycles of charge/discharge. not the minimum values.



7、The Installation and operation

7.1、 Mode of Installation

CSPOWER small batteries usually come with lead wires or connectors, they can be used independently in actual use, or used in UPS system by plug-in or soldering the terminals.

7.1．1 Installed on the ground

For commodious battery room, the batteries can be installed on the ground or table-board in single column or more columns. (Connection layout attached). 7.1.2 Installed in Battery Chest

For incapacious places, in order to decrease the floor area of batteries and to keep them uniform with equipments, batteries can be installed in battery chest (connection layout attached).

7.1.3 Installed in Battery Rack

This mode can decrease the floor area of batteries as well as apply to different arrange of battery voltage. According to different voltage and capacity required, the batteries can be separated into monolayer single column or multiplayer multi-columns. The batteries can be lying horizontally or vertically according to their laying orientations.

- Installation Instance. series installed in battery rack:

The Sketch Map of Installation in Battery Rack

（1）In virtue of attachment plate <4>, connect the bracket<6> at the left of battery carrier with the horizontal baffle of the rear <7> with a M8×20 bolt <5>, and need not to fasten it closely.

（2）In the same way, connect the bracket on the right with horizontal baffle of rear well, and does not fasten it closely.

（3）Aim the bulge of the orientation sheath of bottom splint<2> at the recession of the active rack part, then insert one M10×25 hexagonal socket bolt <3> into the orientation sheath, connect them with a spanner, but don’t fasten up closely. Finally connect other battery splints well.

（4） Adjust all connections among the parts, and if there is no misplacing, fasten every bolt tightly.

（5）Move battery rack into battery room, put the side without transverse baffle towards outside, make marks on the points which are corresponding to the feet of battery rack.

（6）Move battery rack away, bore a hole where a mark is made with an electric hammer, then clear up the installing site.

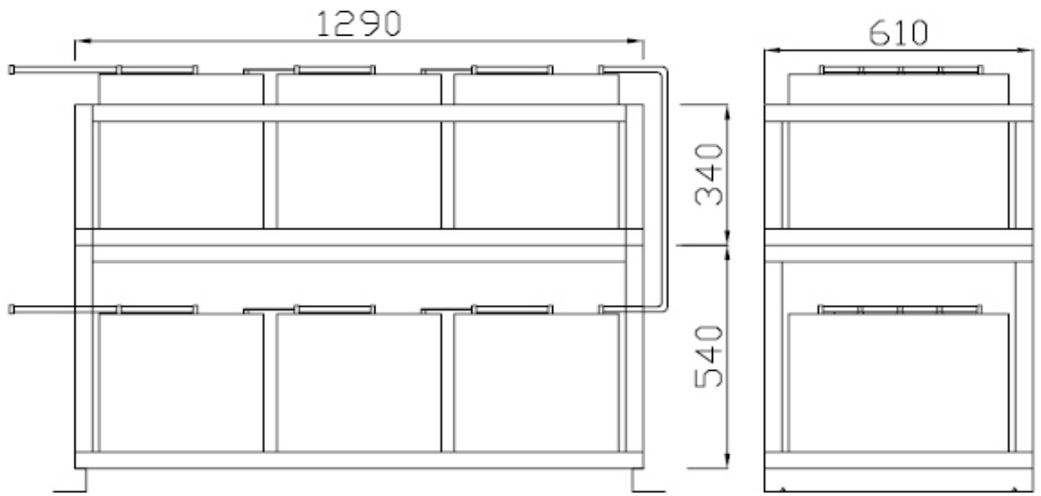
（7）Put the expanded bolt<1> into the hole, then move battery rack back, and fasten it well.

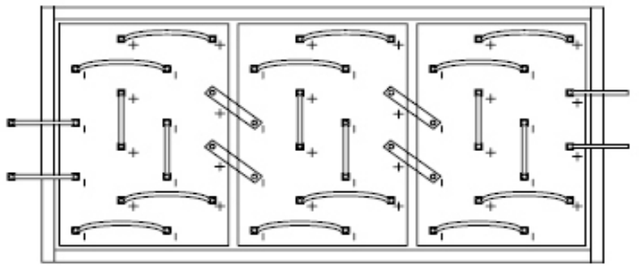
（8）Put battery into battery rack, and connect battery line well according to their layout.

（9）Install other two horizontal baffles to the battery rack, and connect them firmly.

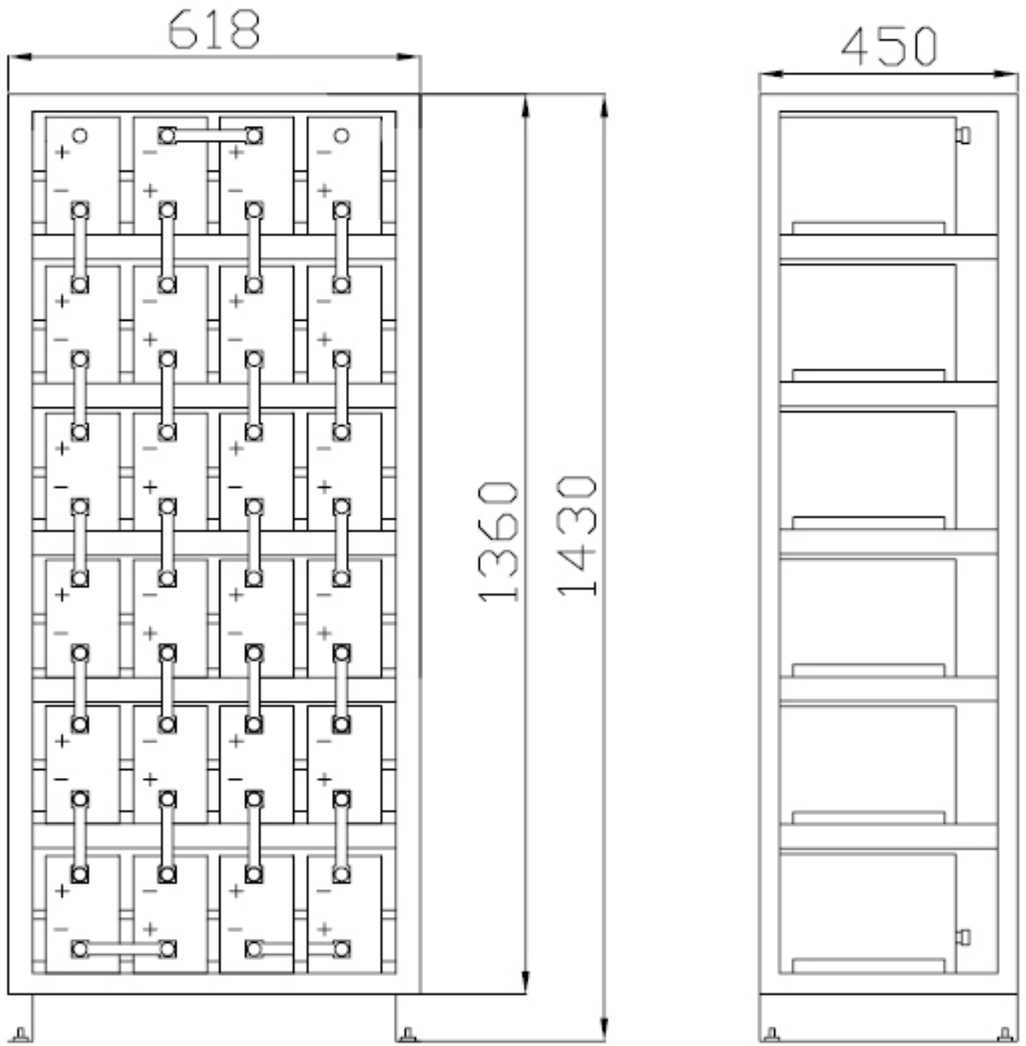
(10) after installation put some oil on the surface of bolt and connector to protect corrosion

For 48V200AH and 12V2000Ah batteries the installation as shown below:





12V2000AH rack installation



7.2、Precautions for handling VRLA-Batteries

This document should be read in its entirety and its contents fully understood before handling or using CSPOWER rechargeable sealed Lead-Acid batteries. If there are any questions, please contact us. Please keep this document available for reference. Due to the potential energy stored in the batteries, improper handling or use of the batteries without understanding this document may result in injury caused by electrolyte leakage, heat generation, or explosion.

*All description are subject to modification without notice.

7.2.1 Degree of danger

1） WARNING

When the batteries are handled or used improperly, death or severe injury may occur, and slight injury or loss of products often occurs.

2） CAUTION

When the batteries are handled or used improperly, slight injury may occur and damage to the batteries and equipment may occur.

3） REQUEST

When the batteries are handled or used improperly, damage to their quality or performance may occur.

Note (1): Improper handling and use of the batteries may cause dangerous conditions to arise. All precautions should be taken to prevent any harmful effects from the use of the batteries.

Note (2): “Severe injury” as a result of improper handling or use of the batteries may include but are not limited to loss of eyesight, injury / burn / electric shock / fracture of a bone / poisoning with after effect, or injury that requires long-term medical treatment. “Slight injury” covers such conditions as burns or electric shock that do not require long-term medical treatment. Damage to products is defined as extensive damage to a house, a house hold effects, a livestock, or pets.

Note (3): “Request” are meant to prevent a decrease in the quality or the performance of the batteries.

7.2.2、Safety precautions

Environment and condition

WARNING

(1) DO NOT put batteries into airtight containers. The batteries tend to generate inflammable gas upon excess charge which may cause explosion if enclosed in an airtight container.

(2) DO NOT place the batteries near open fire or near a device that may cause sparks (such as a switch or fuse). Since batteries may generate an inflammable gas when charged excessively that may ignite upon contact with a spark or they may burn or explode due to sparks or fire.

(3) Always charge the batteries using the specified charger and maintain the charge conditions recommended by CSPOWER Battery Tech.CO,LTD . If the batteries are charged under conditions other than those specified by CSPOWER, they may leak, gas, generate excessive heat, or explode.

(4 When using the batteries in medical equipment, incorporate a back-up system other than the main battery in the event of power failure.

(5) Insert insulation that is resistant to heat and sulfuric acid between the batteries and any metallic housing. Failure to do so may cause the batteries to smoke or burn in case of electrolyte leakage.

CAUTION

(1) DO NOT allow the batteries to be exposed to rain or sea water. If the battery terminals should get wet, they may corrode.

(2) DO NOT use or store the batteries in a car or under direct sunlight. To do so may cause the batteries to lead, gas, generate excessive heat or explode.

(3) DO NOT placing batteries near a heat-generating device (e.g. a transformer) which may cause the batteries to generate excessive heat, leak or explode.

(4) Use of store the batteries in the temperature range specified below:
Discharge (operating an application): -15° C~ 50° C Charge: 0° C to 40° C Storage: -15° C to 40° C Temperature above or below those recommended could result in damage or deformity or the batteries.

(5) If more than one battery is required, first connect the batteries together before connect the batteries to the charger or the load. Be careful to connect the (+) terminal of the batteries to the (+) terminal of either the charger or the load. Improperly connecting the batteries, charger, or load may cause an explosion or fire to occur. In some cases, bodily injury may occur.

(6) When handling the batteries, wear steel-tipped shoes to prevent possible injury to the feet if the batteries are accidentally dropped.

REQUEST

(1) Dropping a battery may cause a strong physical shock that may damage the performance of the battery.

(2) Confirm the life of the batteries using the real load and charge. Differences in the charging and the discharging condition may cause a big difference in the life of the batteries.

7.3. PRECAUTION FOR INSTALLATION

WARNING

(1) DO NOT install the batteries in a room without proper ventilation. Excessive charging of the batteries may cause the batteries to generate inflammable gas resulting in an explosion or fire.

(2) Tools such as wrenches used to install the batteries should be insulated. The use of bare metal tools may cause short circuit accident to occur resulting in body injury, damage to the battery, explosion or fire.

(3) DO NOT use organic solvents, such as thinner, gasoline, lamp oil, benzene, acetone or liquid detergent to clean the batteries. The use of organic solvents may cause the ABS container to crack. Furthermore, avoid the use of plastic or resin (*) of unknown nature with the batteries. Cracked batteries, in the worst case scenario, may cause the batteries to catch fire. Need to make sure the use of material will not cause the containers and /or the covers (ABS resin) of the batteries to crack due to the migration of plasticizer within the material by asking the manufacturer of the material if necessary.

*Examples for plastic or resin which should be avoided using: Vinyl chloride, Oily rubber.

*Examples for plastic or resin which is proper for the use: Polyolefin resin such as polypropylene, polyethylene.

(4) DO NOT install the batteries in areas where they may have a chance to come in contact with water. If the batteries come in contact with water, an electric shock or fire may occur.

(5) ALWAYS wear rubber gloves when handling batteries with voltages higher than 45 volts in order to prevent severe bodily injury from occurring.

CAUTION

(1) DO NOT carry the batteries by picking them up by their terminals or lead wires. To do so may irreversibly damage the batteries.

(2) During unpacking, handle the batteries carefully and check for cracks, breakage, or leakage. Failure to handle the batteries carefully may result in damage.

(3) DO NOT cover the batteries with plastic sheet as static electricity from the sheet may cause a fire or an explosion.

(4) DO NOT remove the insulating covers that come with the batteries until it is ready to connect. (5) ALWAYS consider installing the batteries for easy checking, maintenance and replacement. The VRLA batteries are designed for use in almost any position, but avoid charging the batteries in the upside-down position. The charging of the batteries in the upside-down position may cause the batteries to leak. (6) Shock and jolt to the batteries may result in damaging the batteries.

(7) Be aware all lead acid batteries are relatively heavy. Improper handling may cause bodily injury.

(8) for heavy battery, please using a lifter

(9) Fasten the bolts and nuts with the torque accordingly. The biggest torque is 11.3N?M. Not to do so may cause the battery terminals to spark and/or break.

(10) Please consult us prior to using the batteries in applications such as a motor bicycle, a engine driven lawn mower, etc. which may generate severe vibration.

REQUEST

If at all possible, one should ask a certified technician or a person who is familiar with the batteries to install the batteries.

7.4、 PREPARATION PRIOR TO OPERATION

WARNING

ALWAYS use well insulated connecting plates between the batteries and the load or charger. Insufficient insulation may cause an electric shock also heat generating from a short circuit resulting in an injuring, burn, smoke or fire.

CAUTION

(1) DO NOT plug the batteries directly into the outlet or the cigarette receptacle of a car without inserting a proper charger between the batteries and the outlet or the receptacle. To do so may cause electrolyte leakage, heat generation, or explosion of the battery.

(2) Turn off the circuit switch when connecting the batteries to the charger/load.

(3) ALWAYS check for abnormalities, such as: rust on the terminals, cracks, or other external damages before using the batteries. Using a damaged battery may cause electrolyte leakage, heat generation, or explosion.

REQUEST

It is normal for the batteries to lose part of their capacity due to self-discharge during shipment and storage. Full capacity can be restored by recharging the batteries. Check for the following conditions before to recharge (see the follow table).

7.4.1. Unspecified Use

CAUTION

Do not place the batteries in an unspecified use or they may leak, generate heat, or explode.

7.4.2.HANDLING

WARNING

(1) DO NOT short-circuit the positive and negative terminals of the batteries. Only insulated tools should be used. Be careful while using a metal tool such as a wrench on the batteries. Short-circuiting the battery's terminals may cause heat generation, and explosion or a fire.

(2) Never dispose of the batteries in a fire as it may cause them to explode or generate a toxic gas.

(3) DO NOT attempt to disassemble the batteries as it could cause leakage of sulfuric acid that could resulting in bodily injury.

CAUTION

(1) To prevent accidents from happening, change any battery that is found to have an abnormality such as a crack, a deformity, or leakage.

(2) It is a good practice to keep the batteries clean and free from dirt.

(3) In the event the batteries show any abnormality of the charge voltage or the discharge voltage replace the batteries with now ones immediately.

(4) Charging the batteries with an inverse polarity connection between the batteries and the charger could cause electrolyte leakage, heat generation, or a fire.

(5) AVOID the use of the batteries of different capacities, type, made, and history of use (charge/discharge operation). These differences could cause electrolyte leakage or heat generation.

(6) DO NOT subject the batteries to any strong physical shocks or jolts while moving them. Treating the batteries roughly could cause leaks, heat generation, or a explosions

(7) DO NOT charge the batteries beyond the amount of the time indicated in the specification. Stop charging the batteries when the charge indication lamp indicates a full charge. Over-charging the batteries can cause leakage, heat generation, or explosions.

(8) DO NOT allow young children to handle or to perform any battery operations, such as charging the battery.

(9) Keep the batteries out of the reach of small children at all times.

REQUEST

(1) The cut-off voltage during discharge should vary depending on the discharge current. Do not discharge the batteries lower than the recommended cut-off voltage as shown inthe CSPOWER specifications or CSPOWER technical handbook. Recharging a battery which was once discharged below the recommended cut-off voltage may damage the batteries. Over-discharging a battery may impair performance. Always recharge the

batteries immediately after discharge even if the batteries were not discharged to the recommended cut-off voltage. Prolong leaving the batteries in a state of discharge cause the batteries to 'sulfate'.

Note: The cut-off device should be effectively cut off all discharge current including any weak current.

(2) Thoroughly study and understand the Charging Methods as recommended by theCSPOWER technical handbook and the conditions of the batteries before adopting other charge methods. The use of different charging may cause the batteries not to perform proper and for safety reasons.

(3) When the batteries are used in a cyclic application, it is important to charge the batteries for the proper amount of time. A timer should be incorporated into the charging circuit that will disconnect the charging current to prevent overcharging.

(4) Avoid parallel charging of the batteries in cycle used. This may shorten the life of the batteries by causing an imbalance in the charge/discharge operation of the batteries.

(5) When charging the batteries in series, measure the total voltage of the batteries during trickle charge (or float charge), using a voltage meter with the accuracy of Class 0.5 (JIS). If the total voltage of the batteries deviates from the specified voltage range, be sure to investigate the cause. If the total voltage is lower than that specified, the batteries may be undercharged charged. However, prolong overcharging, i.e. keeping the total voltage higher than that specified, may cause the batteries to lose their capacity or more seriously may cause the batteries to 'thermal run-away' and other accidents.

(6) Always switch off the equipment after use. Over discharging the batteries will shorten battery life.

(7) Always store the batteries by disconnecting them from the equipment or charger to prevent over-discharge and loss of capacity. DO NOT store the batteries in a highl humid place to prevent rusting or unnecessary oxidation of the terminals

8、Inspections and maintenance

8.1Preparation for VRLA Battery Periodic Inspections & Maintenance

For optimum reliability, it is recommended that the battery system be monitored quarterly. If the battery system incorporates an automatic monitoring system to gather the electrical and environmental data, the quarterly checks are limited to the evaluation of the recorded data and a visual inspection of the battery.

In general the types of inspections to be made during periodic maintenance include:

• Visual battery inspection • Battery system capacity test • Battery system voltage inspection • Ambient temperature • Individual battery float voltage inspection • High rate load test • Electrical resistance and tightness of inter-unit connections A test of the individual unit resistance, impedance or conductance, while optional, is also recommended on a periodic basis. This data and its trends can be a valuable aid in troubleshooting the system and predicting the need for a system capacity test.

Prior to starting the periodic maintenance activity assure that all the required maintenance tools and equipment is available and functional. Notify anyone who will be affected by the intended maintenance or troubleshooting activity. All, all units in the battery should be numbered so as to facilitate the recording and analysis of data unique to each unit.

8.2.Tools and Equipment Required for Inspections & Maintenance

At a minimum, the following tools and equipment are required to maintain and troubleshoot our VRLA Battery.

1. Digital voltmeter
2. Current clamp
3. Impedance tester
4. System load bank
5. Recorder
6. Insulated socket wrenches
7. Insulated box end wrenches
8. Torque wrench
9. Screw driver
10. Rubber gloves
11. Face shield or goggles
12. Portable eyewash
13. Fire extinguisher

8.3.Quarterly VRLA Battery Inspection

The following inspection should be completed quarterly.

1. Assure the battery room is clean, free of debris and with proper lighting.
2. Assure that all facility safety equipment is available and functional.
3. Measure and record the air temperature within the battery room.
4. Visually inspect the battery for: (a).cleanliness (b).terminal damage or evidence of heating (c).container or cover damage
5. Measure the DC voltage from each polarity of the battery to ground and detect any ground faults.
6. Measure and record the individual unit DC float charging voltage, and current.

7. Measure and record the system equalization voltage, and current.
8. Measure and record the temperature of the battery cabinet inspections.

8.4.Semiannual VRLA Battery Inspection

The following inspection should be completed semiannually.

1. Repeat the quarterly inspection.
2. Randomly measure and record the resistance/conductance of the individual units to trend the condition of the individual units over time and to detect dramatic differences between individual units and the norm.

8.5.Annual VRLA Battery Inspection

The following inspection should be completed annually.

1. Repeat the semiannual inspection.
2. Re-torque all of the inter-unit connecting hardware. This can be omitted if the connection resistance is measured and found to have not increased more than 20% from the value recorded at installation.
3. The battery should be capacity tested every two years at the service load or at the battery rating related to the service requirements. Ideally, this will be the same rate at which it was acceptable when tests were run upon installation.

Note:

If more than 24 units of batteries, another form should be attached.

For multi-cell batteries, the voltage of each cell should be recorded.

Caution;

If problems are found in each process, corrections should be taken immediately,

1. Equalized charging
2. Contact our customer service staff for replacement of batteries.

Or else it will affect the capacity and life of the batteries.

8.6.Data Analysis and Corrective Actions

The data accumulated during the periodic maintenance activities should be recorded on a form. Following is an explanation of how the data would be interpreted and the corrective action to be taken. However, it must be recognized that this explanation is not all inclusive and the analysis and corrective decision must be made by personnel familiar with VRLA batteries and their operation and failure modes.

VRLA Battery Relular Maintenace Record

Type					Place				
Status					Number of battery				
Total voltage (V)					Current (A)				
Number	Voltage(V)				Number	Voltage(V)			
1	Cell-1	IR(MΩ)	Cell-2	IR(MΩ)	13	Cell-1	IR(MΩ)	Cell-2	IR(MΩ)
2					14				
3					15				
4					16				
5					17				
6					18				
7					19				
8					20				
9					21				
10					22				
11					23				
12					24				
Check by sight					Temperature				
Result:									
Tester:					Date:				

8.7、 MAINTENANCE

WARNING

(1) When cleaning the batteries, use a soft damp cloth. A dry cloth may cause static electricity that could result in a fire or explosion.

(2) ALWAYS replace the batteries with the new ones before the end of their useful life (50% state of their initial discharge duration time) as determined in the specifications. As the batteries near the end of their life their discharge time will be shorten dramatically. Finally the batteries will lose their available capacity by either drying out their electrolyte (causing increase in their internal resistance) or an internal short-circuit. When that happens, if the batteries were to go on charging, thermal runaway and/or leakage of electrolyte may occur. Therefore, the batteries should be replaced before becoming in these states.

The expected life of the batteries (in trickle or float use) will decrease to half (50%) with each 10° C rise in temperature above 25° C. In particular, the life of the batteries will be shortened remarkably at approximately 40° C accordingly. Therefore, precautions are required to prevent using batteries in a high temperature environment.

CAUTION

Avoid using organic solvents such as thinner, gasoline, lamp oil or benzene and liquid detergent to clean the batteries. These substances may cause the battery containers to crack or leak.

REQUEST

ALWAYS make sure the battery terminals are clean to prevent the development of unnecessarily high resistance. High resistance will impair battery performance.

8.8、 Treatment at Emergency

WARNING

The batteries have toxic liquid-dilute sulfuric acid solution in them. If the acid comes into contact with skin or clothes, wash skin or cloth with lots of clean water to prevent scalding from occurring. If the acid should come into contact with the eyes, consult a physician immediately to prevent possible loss of sight.

CAUTION

Check the batteries visually for any sign of irregularities in appearance. If any damage exists such as crack, deformation, leakage of electrolyte, or corrosion, the batteries must be replaced with the new ones. Irregularities in the batteries could result in bodily injury, electrolyte leakage, excessive heat generation or explosion, if used. Furthermore, make sure the batteries are clean and free from dirt and dust.

8.9STORAGE

CAUTION

(1) ALWAYS Store the batteries in a safe place away from metal or other conductive materials.

(2) ALWAYS keep the batteries from water that could cause corrosion on the terminals of the batteries.

(3) ALWAYS keep the batteries right-side-up during transportation. AVOID letting rough handling of the batteries, e.g. strong shock and/or jolt. Moving the batteries in other than the up-right position may impair battery performance

.(4) When storing the batteries, be sure to remove them from the equipment or disconnect them from the charger and the load. ALWAYS store them at room temperature (20° C (68° F) - 25° C (77° F) or lower temperature. DO NOT store the batteries under direct sunlight, higher temperature or high humidity. To do so will shorten battery life, impair performance, and terminal corrosion.

REQUEST

(1) Charge the batteries at least once every six months if they are stored at 25° C (77° F). Use the Charge Method as specified in 'Preparation Prior to Use - Recommendation'. The interval of this charge should be reduced to 50% by each 10° C (18° F) rise in temperature above 25° C (77° F). It is important to remember the self-discharge rate doubles for each 10° C (18° F) rise in temperature. AVOID storing the batteries for a long time in a discharged state for their capacity may not recover even after charge. If the batteries are stored for more than a year at room temperature, the life of the batteries may be shortened.

(2) To prevent the shortening the battery life ALWAYS tore the batteries in a fully charged state.

(3) ALWAYS rotate the stock of the batteries by the simple rule of thumb 'FIRST IN FIRST OUT'. For battery user put the battery into use as soon as possible after receiving them as they gradually deteriorate even under proper storage conditions.

8.10、DISPOSALS & RECYCLING

CAUTION

(1) Please write the information about battery recycling on the equipment, the package, the carton, the instruction manual etc. in countries where legal or voluntary regulations on battery recycling are applicable.

(2) Design the equipment such that exchange and disposal of the batteries can be undertaken easily.

(3) Used batteries should be recycled. When returning used batteries, insulate their terminals using adhesive tape, etc. Even used batteries still have electrical charge and an explosion or a fire may occur, if proper insulation is not given on the terminals of the used batteries.

9.Trouble shooting

Check Category/symptom	Required tools	Possiboe cause	Possible end result	Remedial action
Extermal	Visual, touch smell			
Plastic container distortion, Swelling and /or cracks	Visual	1.battery is being over-charges 2.intemal short 3.poor grounding 4.gas buildup due to the continuous use of an expended battery 5.the combination of all of the above causing the battery to experience the rmal runaway	1.release of Hydrogen Sulfide-rotten egg smell 2.may cause battery to catch fire 3.loss of capacity 4.battery may explode causing equipment or bodily damage.	1.replace the battery immediately. 2.perform voltage balance between batteries. 3.Correct all the possible causes.
Terminal corrosion	Ditto	1.residual acid due to manufacturing 2.terminal leak	Increase terminal imperance causin gterminal overheat and unexpected higher voltage drop	1.clean and retighten cable to terminal 2.replace battery if acid on terminal is due to internal leakage.
Rotten Egg smell (Hydrogen Sulfide-H2S)	Smell	Ditto	The rmal runaway.	Ditto
Overheated terminal	Touch	Loose screw on cable and terminal	Will eventually damage terminal	Tighten screw or nut on cable and terminal

Precautions for handling VRLA-Batteries

Capacity check to be performed at 250c (770F)	Multimeter			
Capacity lost with apparent steadily decline of system voltage	Discharge chart	Normal aging	1.system will eventually fail 2.negligence at this point may lead to internal shorts	Charge the batteries
Capacity lost with apparent voltage decline in step function	Ditto	Unbalanced voltage between batteries Possible cause	Reverse polarity may happen during discharge causingpremature system failure Possible end result	Remove and replace the under-preform unit
Check category/symptom	Required tools			Reme disl action
Excessive initial voltage decline-decline exceeds the recommended lower oimit in the 1 st few second of descharge		1.very lowbattery tempreature 2.very high cable impedance-cable size too small 3.excessively high resistance at its connection 4.batterycapacity too low for the designed system 5.internal short	1.large voltage drop 2.unit will heat up causing thermal run-away and may lead to explosion	1.warm up the battery. 2.increase size of the connecting cable 3.clean to remove dirt on cables and terminals. 4 re-match battery capacity to system. 5 replace battery
DC Voltage check this should be performed at 25	Multimeter internal Resistance Measuring meter			
System float charge average cell voltage>2.3V/Cell		Erroneous charger set-point	Overcharging may cause the electrolyte to enaporate leading to thermal run-away	Adjust charger unit to match recommended charging current

10 sec Rate Discharge Load Test	Multimeter			
Terminal voltage slightly<1.7V/Cell	1.reduction in working time 2.possible thermal runaway 3.will not be able to support load		1.battery discharged 2.possible internal corrosion shedding of a active materials or depleting electrolyte 3.possible internal short 4.possible internal open circuit	1.recharge battery 2.replace battery
Impedance& conductivity check	Internal impedance multimeter			
Impedance measurement is 50% of specification		1.battery is in the state of discharge 2.internal short 3.internal open circuit	1.reduction in working time 2.possible thermal runaway 3.will not be able to support load	Ditto
Connectivity check	Multimeter			
Connectivity impedance shows only 20% of its original value		1.extreme temperature factor causing loosening of cable to terminal 2.dirt or corrosion at the terminal	1.prolong overheat may cause permanent damage to permanent 2.fall to sustain high rate discharge causing premature shut down of instrument May cause terminal to overheat	1.tighten connecting screw and nut 2.clean termminal to remove dirt and corroded material and apply grease to prevent further corrosion
Connection between terminal and cable register smaller torque value than the recommended		Higher impedance		Tighten screw&nut to the recommended torque

Average float charge voltage<2.25/cell		Erroneous charger set-point	Under charging may shorten battery working time. Prolong negligence will result in cell sulfation which is the main ause of permanent capacity loss.	1.adjust charger float voltage to match recommended value. 2.charge battery system between 48to 72 hours. 3.perform capacity check. 4.replace battery if capacity loss proved to be irreersible.
Over all system constant voltage >2.4V/Cell		Erroneous constamt voltage setting	Overcharging may cause the electrolyte to evaporate leading to thermal runaway	Adjust charger unit to match recommended charging current.
Over all system constant voltage >2.4V/Cell		Ditto	System indicator will continue to flash indecating battery system is not functioning properly	Adjust charger unit to match recommended charging current
Individual battery showing average cell voltage is <2.2V	Internal resistance multimeter	Possible internal short	1.short dischage time 2.increase in float charge voltage. 3.overheating will occur when discharge 4.possible thermal runaway	Cahrnge battery
Chacks category/ symptom	Required tools	Possible cause	Possible end result	Remedial action
Individual battery showing average cell voltage is <2.2V	Ditto	Possible internal open circuit	Will not be able to sustain load.	Change the battery

10.Battery specfications

10.1Stationary battery

Model	V	C_{10}/Ah (1.80V/cell)	External Dimension(mm)								Weight Approxt	
			Length		Width		Height		Total Height			
			mm	inch	mm	inch	mm	inch	mm	inch	kg	pound
2V200AH	2	200	172	6.8	111	4.4	330	13	365	14.4	13.5	30
2V200AH	2	200	206	8.1	103	4.1	355	14	386	15.2	13.5	30
2V250AH	2	250	171	6.7	151	5.9	330	13	356	14	16.5	36
2V250AH	2	250	206	8.1	125	4.9	355	14	386	15.2	16.5	36
2V300AH	2	300	171	6.7	151	5.9	330	13	356	14	19.5	43
2V300AH	2	300	206	8.1	145	5.7	355	14	386	15.2	19.5	43
2V350AH	2	350	211	8.3	176	6.9	330	13	356	14	24.5	54
2V350AH	2	350	206	8.1	125	4.9	471	18.5	501	19.7	25	55
2V400AH	2	400	211	8.3	176	6.9	330	13	366	14.4	27.5	61
2V420AH	2	420	206	8.1	145	5.7	471	18.5	501	19.7	28	62
2V450AH	2	450	223	8.8	187	7.4	351	13.8	373	14.7	29.5	65
2V500AH	2	500	242	9.5	172	6.8	331	13	366	14.4	31	68
2V600AH	2	600	301	11.9	175	6.9	331	13	356	14	35	77
2V600AH	2	600	206	8.1	145	5.7	645	25.4	675	26.6	36	79
2V800AH	2	800	411	16.2	175	6.9	330	13	366	14.4	53	117
2V1000AH	2	1000	475	18.7	175	6.9	330	13	356	14	63	139
2V1500AH	2	1500	401	15.8	351	13.8	342	13.5	369	14.5	101	222
2V2000AH	2	2000	491	19.3	351	13.8	344	13.5	383	15.1	132	291
2V3000AH	2	3000	712	28.0	353	13.9	343	13.5	383	15.1	196	432
6V33AH	6	33	159	6.3	85	3.35	165	6.50	180	7.09	5.8	12.8
6V42AH	6	42	162	6.4	88	3.46	164	6.46	177	6.97	6.5	14.3
6V105AH	6	105	208	8.2	128	5.04	203	7.99	225	8.86	18.5	40.7
6V200AH	6	200	323	12.7	178	7.01	224	8.82	229	9.02	32	70.5
12V33AH	12	33	196	7.7	131	5.16	155	6.10	180	7.09	10.5	23.1
12V40AH	12	40	196	7.7	166	6.54	171	6.73	171	6.73	13	28.6
12V40AH	12	40	255	10	97	3.82	203	7.99	203	7.99	13.5	29.7
12V50AH	12	50	218	8.6	180	7.09	189	7.44	189	7.44	17	37.4

Model	V	C_{10}/Ah (1.80V/cell)	External Dimension(mm)								Weight Approxt	
			Length		Width		Height		Total Height			
			mm	inch	mm	inch	mm	inch	mm	inch	kg	pound
12V55AH	12	55	230	9.1	138	5.43	208	8.19	226	8.90	18	39.6
12V65AH	12	65	350	13.8	166	6.54	179	7.05	179	7.05	21	46.3
12V70AH	12	70	260	10.2	169	6.65	211	8.31	229	9.02	22.5	49.6
12V90AH	12	90	307	12.1	169	6.65	211	8.31	229	9.02	27.5	60.6
12V100AH	12	100	331	13	173	6.81	213	8.39	233	9.17	30	66.1
12V120AH	12	120	407	16	174	6.85	209	8.23	233	9.17	38	83.7
12V134AH	12	134	341	13.4	173	6.81	281	11.06	287	11.30	41	90.3
12V150AH	12	150	484	19.1	171	6.73	241	9.49	241	9.49	44	96.9
12V180AH	12	180	530	20.9	209	8.23	214	8.43	234	9.21	53	116.7
12V200AH	12	200	522	20.6	240	9.45	216	8.50	242	9.53	58	127.6
12V250AH	12	250	522	20.6	240	9.45	216	8.50	242	9.53	64	140.8

10.2、Front terminal battery

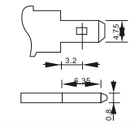
Model	V	C_{10}/Ah (1.80V/cell)	External Dimension(mm)								Weight Approxt	
			Length		Width		Height		Total Height			
			mm	inch	mm	inch	mm	inch	mm	inch	kg	pound
12V55AH	12	55	277	10.9	106	4.17	222	8.74	222	8.74	19	42
12V75AH	12	75	562	22.1	114	4.49	188	7.4	188	7.4	28	62
12V80AH	12	80	562	22.1	114	4.49	188	7.4	188	7.4	28	62
12V100AH	12	100	394	15.5	109	4.29	285	11.2	285	11.2	34	75
12V100AH	12	100	394	15.5	109	4.29	285	11.2	285	11.2	38	84
12V105AH	12	105	507	20	109	4.29	223	8.78	238	9.37	35	77
12V110AH	12	110	394	15.5	109	4.29	285	11.2	285	11.2	36	79
12V120AH	12	120	551	21.7	109	4.29	239	9.41	239	9.41	38	84
12V125AH	12	125	437	17.2	108	4.25	317	12.48	317	12.48	39	86
12V150AH	12	150	551	21.7	109	4.29	287	11.3	287	11.3	50	110
12V150AH	12	150	551	21.7	105	4.13	288	11.34	288	11.34	49	108
12V155AH	12	155	547	21.5	125	4.92	317	12.48	317	12.48	47	104
12V160AH	12	160	551	21.7	109	4.29	287	11.3	287	11.3	50	110
12V180AH	12	180	560	22.1	125	4.92	316	12.44	316	12.44	55	121

10.3、Photovoltaic & wind power battery

Model	V	C_{10}/Ah (1.75V/Cell) (AH)	External Dimension(mm)								Weight Approxt		Terminal Typel
			Length		Width		Height		Total Height				
			mm	inch	mm	inch	mm	inch	mm	inch	kg	pound	
2V100AH	2	100	171	6.7	72	2.83	207	8.15	227	8.94	5.8	12.8	T16
2V150AH	2	150	172	6.8	102	4.02	206	8.11	227	8.94	8.5	18.7	T75
2V170AH	2	170	173	6.8	85	3.35	361	14.21	370	14.57	14	30.8	T36
2V200AH	2	200	172	6.8	111	4.4	330	13.0	365	14.4	14	31	T20
2V200AH	2	200	206	8.1	103	4.1	355	14.0	386	15.2	14	31	T20
2V250AH	2	250	171	6.7	151	5.9	330	13.0	356	14.0	17	37	T20
2V250AH	2	250	206	8.1	125	4.9	355	14.0	386	15.2	17	37	T37
2V300AH	2	300	171	6.7	151	5.9	330	13.0	356	14.0	20	44	T20
2V300AH	2	300	206	8.1	145	5.7	355	14.0	386	15.2	20	44	T37
2V350AH	2	350	211	8.3	176	6.9	330	13.0	356	14.0	25	55	T20
2V350AH	2	350	206	8.1	125	4.9	471	18.5	501	19.7	25	55	T37
2V400AH	2	400	211	8.3	176	6.9	330	13.0	366	14.4	28	62	T20
2V420AH	2	420	206	8.1	145	5.7	471	18.5	501	19.7	28	62	T37
2V450AH	2	450	223	8.8	187	7.4	351	13.8	373	14.7	30	66	T20
2V500AH	2	500	242	9.5	172	6.8	331	13.0	366	14.4	32	70	T20
2V600AH	2	600	301	11.9	175	6.9	331	13.0	356	14.0	36	79	T20
2V600AH	2	600	206	8.1	145	5.7	645	25.4	675	26.6	36	79	T37
2V800AH	2	800	411	16.2	175	6.9	330	13.0	366	14.4	56	123	T20
2V1000AH	2	1000	475	18.7	175	6.9	330	13.0	356	14.0	65	143	T20
2V1500AH	2	1500	401	15.8	351	13.8	342	13.5	369	14.5	99	218	T20
2V2000AH	2	2000	491	19.3	351	13.8	344	13.5	383	15.1	132	291	T20
2V3000AH	2	3000	712	28.0	353	13.9	343	13.5	383	15.1	198	436	T20
6V33AH	6	33	159	6.3	85	3.35	165	6.50	180	7.09	5.81	12.8	T3
6V42AH	6	42	162	6.4	88	3.46	164	6.46	177	6.97	6.5	14.3	T16
6V65AH	6	65	184	7.2	112	4.41	205	8.07	205	8.07	11.3	24.9	T8
6V105AH	6	105	208	8.2	128	5.04	203	7.99	225	8.86	19	41.9	T10
6V120AH	6	120	195	7.7	170	6.69	207	8.15	212	8.35	22	48.5	T16
6V160AH	6	160	298	11.7	172	6.77	227	8.94	247	9.72	24.5	54.0	T10.T19
6V180AH	6	180	260	10.2	182	7.17	247	9.72	250	9.84	27	59.5	T19
6V190AH	6	190	243	9.6	187	7.36	275	10.83	275	10.83	28	61.7	T19
6V190AH	6	190	306	12.0	169	6.65	220	8.66	227	8.94	28	61.7	T19
6V200AH	6	200	323	12.7	178	7.01	224	8.82	229	9.02	32	70.5	T19
8V180AH	8	180	260	10.2	182	7.17	295	11.61	295	11.61	38	83.7	T18
12V7AH	12	7.0	151	5.9	65	2.56	94	3.70	100	3.94	2.3	5.07	T1、T2
12V7.3AH	12	7.3	140	5.5	48	1.89	124	4.88	130	5.12	2.4	5.29	T1、T2
12V7.5AH	12	7.5	151	5.9	65	2.56	94	3.70	100	3.94			T1、T2
12V8AH	12	8.0	151	5.9	65	2.56	94	3.70	100	3.94	2.55	5.62	T1、T2
12V9AH	12	9.0	151	5.9	65	2.56	94	3.70	100	3.94	2.6	5.73	T1、T2
12V10AH	12	10	151	5.9	65	2.56	111	4.37	124	4.88	3.1	6.83	T2、T3
12V12AH	12	12	151	5.9	98	3.86	94	3.70	100	3.94	3.6	7.93	T2、T3
12V14AH	12	14	151	5.9	98	3.86	94	3.70	100	3.94	4.4	9.69	T2、T3
12V15AH	12	15	181	7.1	77	3.03	167	6.57	167	6.57	5.3	11.69	T3
12V16AH	12	16	151	5.9	122	4.80	95	3.74	101	3.98	5.2	11.45	T1、T2
12V18AH	12	18	181	7.1	77	3.03	167	6.57	167	6.57	5.6	12.33	T3、T14
12V18AH	12	18	180	7.1	167	6.57	77	3.03	82	3.23	6.1	13.44	T47
12V20AH	12	20	181	7.1	77	3.03	167	6.57	167	6.57	5.8	12.78	T3、T14
12V20AH	12	20	302	11.9	65	2.56	102	4.02	102	4.02	6	13.22	T21
12V22AH	12	22	181	7.1	77.5	3.05	173	6.81	173	6.81	5.8	12.78	T3A
12V24AH	12	24	175	6.9	166	6.54	125	4.92	125	4.92	8	17.62	T4、T13
12V24AH	12	24	166	6.5	125	4.92	175	6.89	182	7.17	8	17.62	T28、T32
12V26AH	12	26	302	11.9	65	2.56	142	5.59	154	6.06	8	17.62	T4、T13
12V28AH	12	28	166	6.5	175	6.89	125	4.92	125	4.92	9	19.82	T4、T13
12V28AH	12	28	165	6.5	126	4.96	175	6.89	182	7.17	9	19.82	T28、T32
12V33AH	12	33	196	7.7	131	5.16	155	6.10	180	7.09	10.5	23.1	T9、T16
12V40AH	12	40	196	7.7	166	6.54	171	6.73	171	6.73	13.5	29.7	T9、T16
12V40AH	12	40	255	10.0	97	3.82	203	7.99	203	7.99	13.5	29.7	T9、T16
12V50AH	12	50	218	8.6	180	7.09	189	7.44	189	7.44	17	37.4	T16
12V55AH	12	55	230	9.1	138	5.43	208	8.19	226	8.90	18	39.6	T9、T16
12V55AH	12	55	277	10.9	106	4.17	223	8.78	223	8.78	18	39.6	T16
12V65AH	12	65	350	13.8	166	6.54	179	7.05	179	7.05	22	48.5	T9、T16
12V70AH	12	70	260	10.2	169	6.65	211	8.31	229	9.02	23	50.7	T12、T16
12V80AH	12	80	260	10.2	169	6.65	211	8.31	229	9.02	24	52.9	T33、T16
12V90AH	12	90	307	12.1	169	6.65	211	8.31	229	9.02	28	61.7	T10、T16
12V100AH	12	100	331	13.0	173	6.81	213	8.39	233	9.17	31	68.3	T10、T16
12V120AH	12	120	407	16.0	174	6.85	209	8.23	233	9.17	38	83.7	T11、T16
12V120AH	12	120	409	16.1	177	6.97	225	8.86	225	8.86	38	83.7	T10、T19
12V134AH	12	134	341	13.4	173	6.81	281	11.06	287	11.30	41	90.3	T19
12V150AH	12	150	484	19.1	171	6.73	241	9.49	241	9.49	45	99.1	T12、T50
12V150AH	12	150	500	19.7	208	8.19	212	8.35	239	9.41	45	99.1	T12、T19
12V180AH	12	180	530	20.9	209	8.23	214	8.43	234	9.21	55	121.1	T11、T16
12V200AH	12	200	522	20.6	240	9.45	216	8.50	242	9.53	58	127.6	T11、T19
12V250AH	12	250	522	20.6	240	9.45	216	8.50	242	9.53	64	140.8	T11、T19

● TERMINAL TYPE

T0



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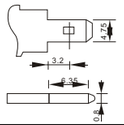

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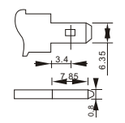

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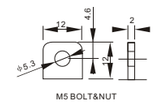

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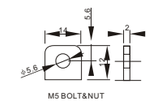

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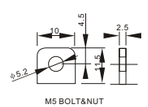

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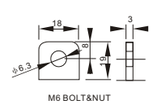

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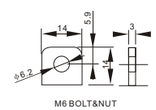

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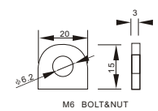

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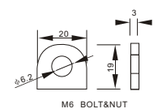

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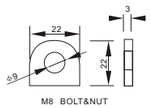

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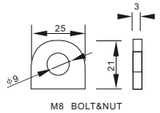

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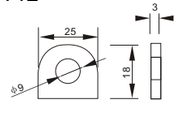

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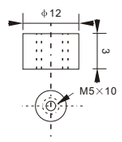

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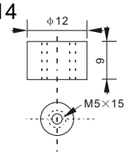

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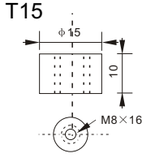

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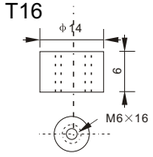

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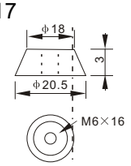

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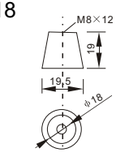

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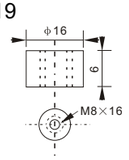

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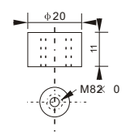

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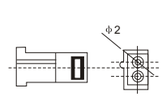

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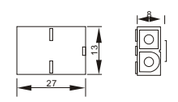

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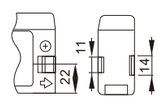

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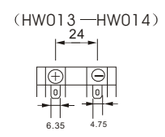

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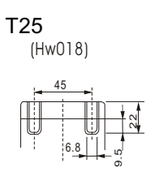

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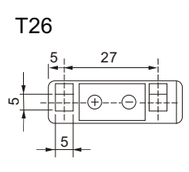

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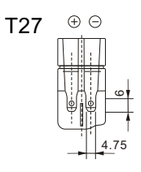

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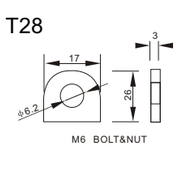

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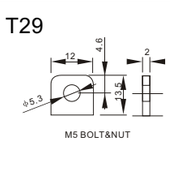

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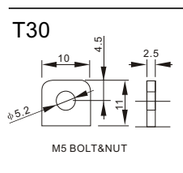

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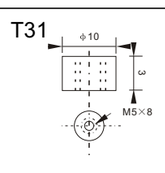

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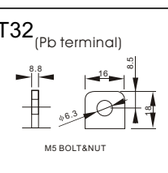

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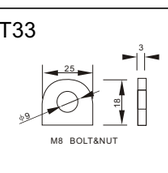

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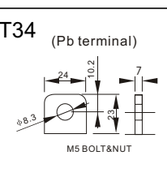

11、Glossary of main battery terms

ABS RESIN

A plastic material largely used for the case and cover of batteries

ACTIVE MATERIAL

The substance which electrochemically reacts in the electrode of batteries Lead-acid batteries adopt lead dioxide for the positive electrode and spongy lead for the negative electrode.

AMBIENT TEMPERATUER

Average temperature in the vicinity of the battery

AVAILABLE CAPACITY

The capacity actually available from a cell/battery. The available capacity is the capacity of a battery when it discharges at a specified hour rate, and expressed in hour rate and Ah.

BOLT FASTENING TERMINAL

A type of battery terminals, to which lead wires are connected wieh bolts.

CAPACITY

The electric capability of a battery. It usually means ampere-hour capacity expressed in Ah or C (coulomb).

CELL

The minimum battery unit which composes a storage battery. Nominal voltage of the cell of the lead-acid battery is 2V.

CHARGE

The operation of supplying a battery with a DC current from an external power source to have the electrode active materials conduct chemical reactions then to store electric energy as chemical energy in the battery.

CHARGE ACCEPTNCE TEST

Test of batteries to check whether or not they are adequately recharged after discharge.

CHARGING EFFICIENCY

General term for ampere-hour efficiency and watt-hour efficiency. In many cases, however, it means the ampere-hour efficiency.

CONSTANT CURRENT CHARGE

A method of charging: to charge a battery with a constant current.

CONSTANT VOLTAGE CHARGE

A method of charging: to charge a battery by applying a constant voltage to the terminals.

C-RATE

A charge or discharge current rate expressed in A or mA. It is numerically the same as the hour rate capacity of a battery expressed in Ah of the rated capacity

CUT-OFF VOLTAGE OF DISCHARGE

The terminal voltage of a battery at which discharging should be discontinued. This voltage depends on discharge current, type of electrodes and construction of battery.

CYCLE LIFF

The number of charge/discharge/rest cycles a cell/battery can provide. Cycle life is usually expressed by the number of cycles available before duration of discharge decreases to a half of the initial value.

DEPTH OF DISCHARGE

A value to express the state of discharge of a battery. The depth of discharge is generally expressed by the ratio of discharge amount to rated capacity of the battery.

DISCHARGE

To draw off the electric energy stored in a cell/battery.

DISCHARGE RATE

The term to express the magnitude of discharge current. When assuming discharge current and time to discharge cut-off voltage t hours, this discharge is called t hour rate (t HR) discharge, and the current is called t-hour rate discharge current. When time t is minutes instead of hours, t MR is used.

DUTY CYCLE TEST

Test of batteries in ordinary use including charge, discharge and rest.

ELECTROLYETE

The medium which serves to conduct ions in the electrochemical reactions in batteries. The lead-acid battery adopts diluted sulfuric acid as the electrolyte.

ENERGY DENSITY

Energy available per unit Approx. mass or unit volume of a cell/battery. Energy density is expressed in Wh/kg or Wh/l

FLOAT CHARGE

The system in which a constant voltage is continuously applied to a battery connected to a rectifier in parallel with a load to maintain the battery in charged state: on occurrence of power failure or load variation, the battery supplies power to the load without any short break.

GAS RECOMBINATION ABILITY

Capability of a battery to recombine (or absorb) internally generated oxygen gas at the negative plate. The greater this capability is, the larger the available charge current.

HIGH RATE DISCHARGE

A very rapid discharge of a battery. (In many cases it means discharging at approx. 1 C A or higher rate.)

INTERNAL TRESSURE

The ptressure within a sealed battery. Internal pressure of a battery is increased by oxygen gas which is generated from the positive plate at the end of charging.

INTERNAL RESISTANCE

The resistance within a battery: it is the total of individual resistances of the electrolyte and the positive and negative plates. Internal resistance is simply measured with the current four-terminal method (1000 Hz) and expressed in the composite value of resistance component and capacitor component.

INTERNAL SHORT-CIRCUIT

Touching of the positive and negative plates within a cell.

LIFF

The time period until a cell/battery loses its expected characteristics.

LOW MAINTENANCE

Low maintenance means that no watering or equalizing charge is required in operating batteries.

LOW-VOLTAGE CUT-OFF

A circuitry designed to discontinue discharge of a battery at a predetermined voltage level.

MALE TAB

The metallic pieces which are attached to a SLA battery as the terminals.

MEMORY EFFECT

A phenomenon where a temporary drop of discharge voltage is observed during deep discharge of an alkaline rechargeable battery which has been subjected to shallow charge/discharge. Cycles or trickle charging over long time.

NEGATIVE PLATE

The battery electrode into which a current from the external circuit flows during discharging. The negative plate has lower electric potential than the positive plate to the electrolyte. The negative plate is incorporated with connection parts such as the electrode pole.

RATED CAPACITY

A nominal value of capacity of a cell/battery, which is a measure of electric capability. Rated capacity is rather approximate compared with rated capacity.

NOMINAL VOLTAGE

A nominal value to indicate the voltage of a cell battery. Generally, nominal voltage value of a battery is somewhat lower than its electromotive force. Nominal voltage of the lead-acid battery is 2.0 V per unit cell.

OPEN CIRCUIT VOLTAGE

Measured voltage of a cell/battery, which is electrically disconnected from the external circuit.

OVERCHARGE

Continued charging of a fully charged cell/battery. With batteries which require watering, overcharge causes electrolysis of water, resulting in rapid decrease of electrolyte. Generally, overcharge adversely influences battery life.

OVRDISCHARGE

Discharge of a battery to a voltage below a predetermined cut-off voltage.

PARALLEL CHARGE

Simultaneous charging of two or more batteries connected in parallel. In cyclic use of batteries, specifically, the parallel charge tends to cause an imbalance in charge state among the batteries, which may shorten their service life.

POLYPROPYLENE RESIN

A plastic material which is often used for the case and cover of batteries.

POSITIVE PLATE

The battery electrode from which a current flows to the external circuit during discharging. The positive plate has higher electric potential than the negative plate to the electrolyte. The positive plate is incorporated with connection parts such as the electrode pole.

QUICK CHARGE (RAPID CHARGE)

Charging in a short time with a large current.

RATED CAPACITY

The stated capacity of a battery; namely, the ampere-hour amount which can be drawn from the battery in fully charged state at a specified temperature, at a specified discharge rate, and to a specified cut-off voltage. The symbol Cn may be used to express the rated capacity of n-hour rate.

RECHARGEABLE BATTERY

The rechargeable battery is a system comprising two different electrodes and an ion-conductive medium, which is capable of converting chemical energy to electric energy, and vice versa. It is also called a secondary battery.

REFRESH CHARGE (AUXILIARY CHARGE)

Charging of a battery mainly to compensate for its self discharge.

RESIDUAL CAPACITY

Residual capacity of a battery after partial discharge of after storage for long time.

RETAINER TYPE

A method to control flowing electrolyte in a battery with the retainer mat, etc…

SELF DISCHARGE

Reduction in capacity of a battery while no current is drawn by the external circuit. Self discharge depends on temperature: amount of discharge approximately doubles by each (10℃) rise of ambient temperature.

VALVE REGULATED LEAD-ACID BATTERY (VRLA-BATTERY)

Valve regulated lead-acid battery.

SEPARATOR

A porous or microporous liquid-absorbent material which is installed between the battery electrodes for preventing short-circuit, securing the separation of the electrodes and retaining electrolyte. The separator should be resistant to oxidation and chemicals; it should excel in electric insulation and liquid-retention; and it should not disturb diffusion of the electrolyte and ionic conduction.

STANDBY USE

General term of constant stand-by battery systems. Batteries are kept charged by trickle/float method at all times in preparation for unforeseen power disruptions.

TEMPERATURE COMPENSATION

Compensation of charge voltage for temperature variation of a cell/battery or in its vicinity. Qualitatively, charge voltage should be corrected to higher side for low temperatures and to lower side for high temperatures.

TERMINAL VOLTAGE AT DISCHARGE

The voltage of a battery during discharging

THERMAL RUNAWAY

Such phenomena as excessively high set-up voltage in constant-voltage charging of a battery and a very high battery temperature cause charge current to increase, which then raises the temperature further: this vicious cycle is called thermal runaway, which may, in the worst case, result in breakage of the battery due to heat.

TRICKLE C HARGE

To charge a battery in the state of disconnection from the load to compensate for its self discharge.

TRICKLE LIFE

The service life of a battery in the trickle use. Usually, the trickle life is the time expressed in years before the dischargeable time of the battery decreases to a half of the initial value.

UL

Abbreviation of Underwriters Laboratories Inc. in USA. The UL establishes various safety standards, and performs official recognition of materials, parts and products.

UPS (Uninterruptible power supply)

Equipment or system which is automatically connected to the load to supply power if the main power fails.

VENT **(ONE WAY VALVE)**

A valve on each battery which automatically releases gas from the battery when internal pressure of the battery exceeds a predetermined value: it prevents breakage of the battery due to excessive internal pressure caused by the gas generated by charging or other reasons. The valve also serves to prevent outside air from entering batteries.