Technical Manual

Gelled Electrolyte (GEL) and Absorbed Glass Mat (AGM) Batteries

Quality System Certified to ISO 9001

Introduction

Valve-regulated lead-acid (VRLA) technology encompasses both GEL electrolyte(GEL) and absorbed glass mat (AGM) batteries. Both types are valve-regulated and have significant advantages over flooded lead-acid products.
More than a 15 years ago, We began building VRLA batteries using latest AGM technology come from USA. Our's professional technology have created a product that is recognized as the **highest quality, longest lived VRLA battery available from any source.**
Our's GEL and AGM batteries are manufactured to tough quality standards. Our manufactures high power GEL and AGM batteries with excellent performance and life.

Applications

VRLA batteries can be substituted in virtually any flooded lead-acid battery application, as well as applications where traditional flooded batteries cannot be used.
VRLA batteries are particularly well suited applications such as the fllowing areas:

1.Industial
2.Automotive
3.Traction

For example:

Deep Cycle, Deep Discharge Applications

- Marine Trolling
- Electronics • Sailboats
- Electric Vehicles
- Wheelchairs • Golf Cars
- Portable Power
- Floor Scrubbers
- Personnel Carriers
- Marine & RV House Power

Standby and Emergency Backup Applications

- UPS (Uninterrupted Power Systems)
- Cable TV
- Emergency Lighting
- Computer Backup
- Telephone Switching
- Village Power

Unusual and Demanding Applications

- Street & garden lighting
- Air-transported Equipment
- Off-road Vehicles
- Wet Environments
- Marine & RV Starting
- Diesel & I.C.E. Starting
- Solar Power

General Features about STANDHBS Battery

STANDHBS Professional

We build VRLA batteries to the highest standards. Our manufacturing process features improved controls using state-of-the art computers and the latest manufacturing technology and equipment.
All batteries produced by STANDHBS consistently meet the highest quality performance and life standards.

Ultrapremium Sealing Valve

Not only must the valve keep the cell pressurized and safely release excessive pressure and gas due to overcharging, but it must also keep the cell from being contaminated by the atmosphere.
Our valves are 100% tested after manufacturing.

Spillproof and Leakproof

All VRLA batteries are not created equal in their degree of non-spillability.STANDHBS unique construction and sealing technique guarantee no leakage.

Exclusive GEL Formula

Our GEL led electrolyte contains sulfuric acid, fumed silica, pure demineralized, deionized water, and a

phosphoric acid additive. Fumed silica is come from Japan.
So our batteries deliver **dramatically longer cycle life**.

Exclusive Electrolyte

Our electrolyte contains high purity sulfuric acid and absolutely pure water to increase battery performance. Since the designs are "acid-starved" to protect the plates from deep discharge.

Multi-Staged Filling/Vacuuming Operation

Our process fills and vacuums each cell several times. This multi-step process assures complete evacuation of air and **complete GEL-to plate interface.** Our computerized process also weighs every battery before and after filling as a check for proper GEL levels.
The system assures that the maximum retainable electrolyte quantity is held within the battery separators, without leaving any unabsorbed liquid to spill or leak.

Exclusive Plates and Formula Design

We uses tank formation to activate the battery plates. This process **guarantees a fully formed and voltage matched plate.** Extra deep cycle paste formula also ensures long cycle life.

Low Selfdischarge

Self-discharge to less than 3% per month:

Exclusive Pb —Ca —Sn Alloy Grids

This exclusive alloy provides **longer shelf life, more powerper- pound and superior corrosion resistance. Performance and life dramatically improved.**

Acid Stratification Prevention

Because the immobilized GEL will not "float" or "sink" within itself when a non-uniform concentration exists, it cannot stratify. Therefore, **no high-voltage equalizing charge is necessary.** This means **longer life and consistent performance** in stationary and standby applications.
Electrolyte in an AGM battery is strongly held by the capillary forces between the glass mat fibers, but not completely immobilized.

Compact Design

STANDHBS battery high energy density result in superior power/volume and power/weight ratios.

Design Flexibility

Dozens of Terminal Options Available. Our batteries are delivered with the most popular type of terminal and shapes**.** This gives you total flexibility to specify the **special requirements for your application**… without making compromises.

Proprietary Case, Cover

Cases, vents and covers in our on-site, state-of the-art plastics molding facility. We choose the best supplier in china.
This provides **ultimate control** of our high performance designs,

Environment and Worker Protection

It's nice to know that every possible safeguard was designed into our process to **protect our co-workers and the environment**… special safeguards that are exclusive to STANDHBS.

Quality Assurance Checks Accord With the ISO9001 System

Authenticate by TUV ISO9001. Hundreds of quality checks are performed to assure total confidence in the performance and life of our batteries.

How does a VRLA battery work? --Working Principle

The charge/discharge reaction of the VRLA battery can be expressed by the following equation:

Anode		Electrolyte		Cathode		Anode		Electrolyte		Cathode
PbO_2	+	$2H_2SO_4$	+	Pb	$\underset{\text{Charge}}{\overset{\text{Discharge}}{\rightleftharpoons}}$	$PbSO_4$	+	$2H_2O$	+	$PbSO_4$
Lead dioxide		**Sulfuric acid**		**Sponge lead**		**Lead sulfate**		**Water**		**Lead sulfate**

A VRLA battery is a "recombinant" battery. This means that the oxygen normally produced on the positive plates of all lead-acid batteries is absorbed by the negative plate and recombined into H_2O. This suppresses the production of hydrogen at the negative plate. Water (H_2O) is produced instead, retaining the moisture within the battery. It is completely maintenance-free in service life.
Reaction at positive plate in the last period of charge or overcharge:

$$2H_2O \longrightarrow O_2 + 4H^+ + 4e^-$$

O_2 generated from the PAM then reacts with the charged lead of the negative plate and turns into lead monoxide. Then lead monoxide in turn reacts with sulfuric acid in the electrolyte to turn into lead sulfate, allowing the negative plate to discharge. As a result, the negative plate never generates H_2. This completely prevents loss of water.Meanwhile sealing principle may be expressed as a reaction equation.

Negative plate(charged) generated from the positive plate Negative plate

Pb + 1/2 O_2 → PbO

Sponge lead Oxygen gas Lead oxide

Recombinant

Negative plate(discharged) Electrolyte

H_2O + $PbSO_4$ ← H_2SO_4 + PbO

Water Lead sulfate Sulfuric acid

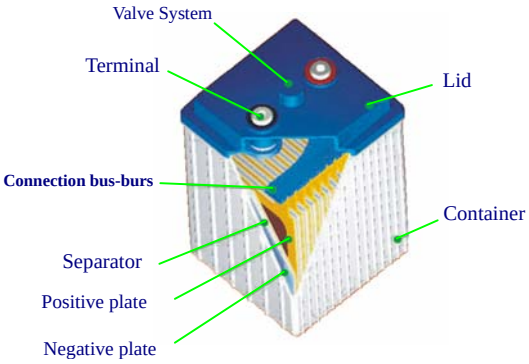
In case of the open-vented type, overcharge after completion of charge causes electrolysis of the water content of the electrolyte, which generates O_2 gas at the positive plate and H_2 at the negative plate. These gases are escaped from the inside of the battery, Since a drop in electrolyte level results, adding the water is occasionally needed – called **maintenance**.

It never needs watering, and should never be opened as this would "poison" the battery with additional oxygen from the air and other impurity.

Cell Construction

Construction an Material

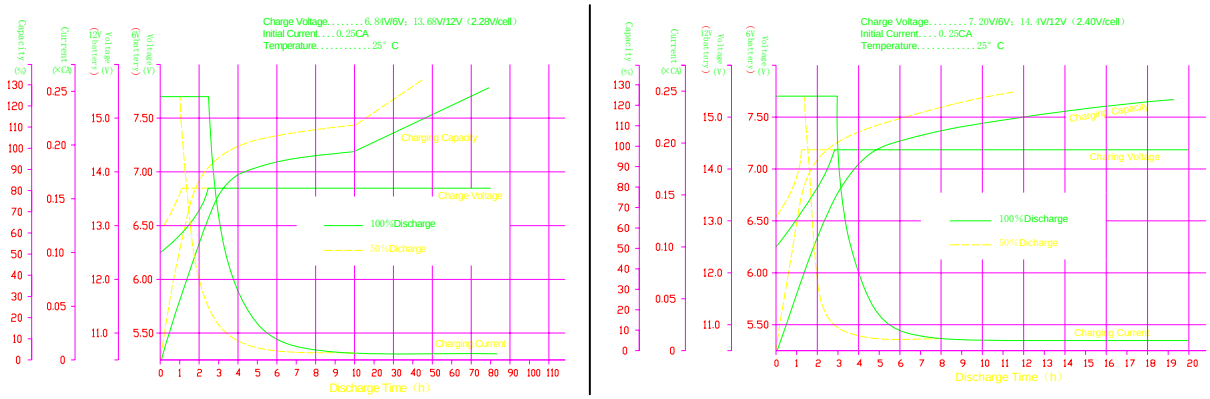
- **Component…..Raw material**
- **Positive……..Lead dioxide**
- **Negative……..Lead**
- **Containter……ABS**
- **Cover/Lid…….ABS**
- **Sealant…….Epoxy Resin or Polyester**
- **Safety valve…EPDM**
- **Terminal……..Copper or Pb**
- **Separator……AGM or PE**
- **Electrolyte….Sulfuric acid or Thixotropic Gel**



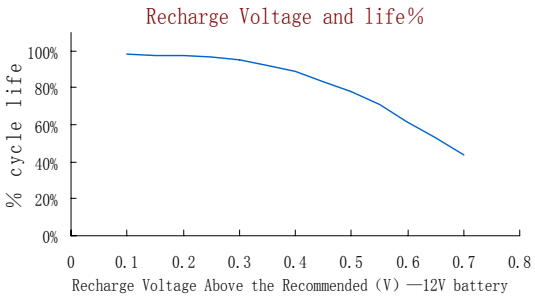
CHARACTERISTICS

Charging Current and Voltage vs.Charging Time

Shown is the current needed to charge a battery from 0% to 100% state of charge in a given time. Or time required to change a battery from 0% to 100% state of charge by a given charing voltage. For example, to charge an CJ12-5 to 100% in 18 hours(at 2.275/cell,); at 2.4V/cell, it only take 9 hours.



Charging voltage shows great influence upon the battery life(high voltage result in overcharge). This chart shows the effect on life of overcharging a GEL battery.



The charging efficiency varies depending upon the state of charge of the battery, temperature, and charging rate.

Fig

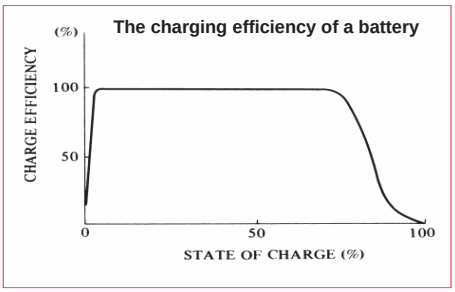
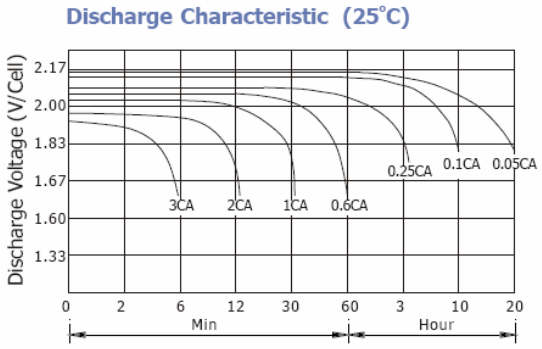


Figure 13. Charging Efficiency vs. State of Charge

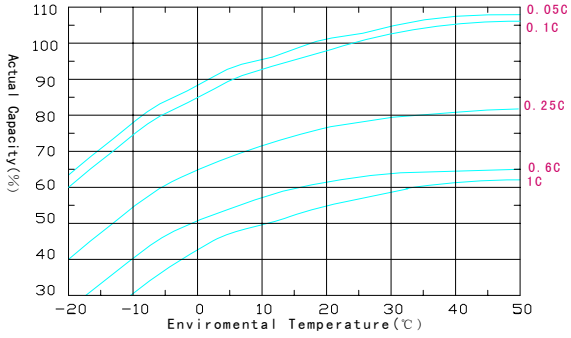
Application	Charging Voltage(V/cell)			Max.charge current	Temperature Cmpensation coefficient
	Temperature	Set point	Allowable range		
Cycle use	20℃（68°F）	2.45	2.40~2.50	0.3C(＜24Ah)	-5mV/cell
Standby use		2.275	2.25~2.30	0.25C(≥24Ah)	-3.3mV/cell

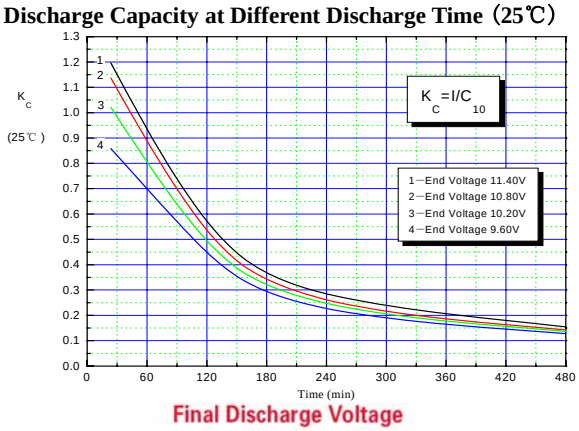
Discharge Characteristics

Battery capcacity varies largely depending on the discharge current(discharge rate) and the temperature. Fig. shows the battery voltage-time characterics and the relation between the discharge current and the capacity when discharged.



capacity is related with temperature



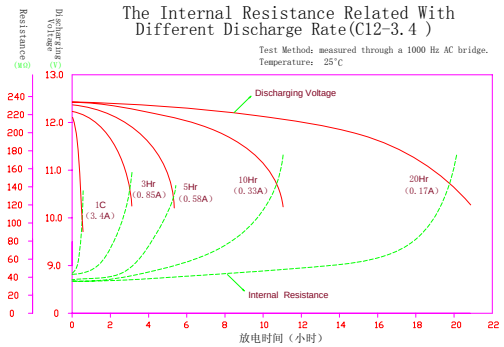


Final Discharge Voltage

Discharge Current	Final Discharge (V/Cell)
0.1 C or below, or Intermittent discharge	1.75
0.1 7C or current close to it	1.70
0.26C or current close to it	1.67
0.6C or current close to it	1.60
From 0.6C to 3C	1.50
Current in excess of 3C	1.30

Impedance

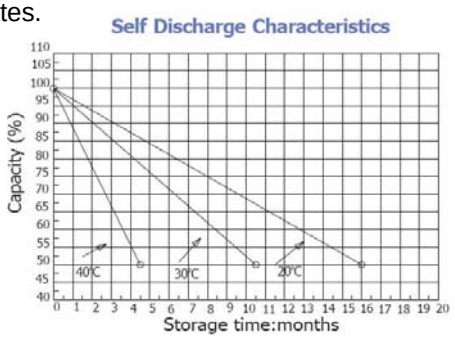
The internal resistance (impedance) of a battery is lowest when the battery is in a fully charged state. The internal resistance increases gradually during discharge, Figure 7 shows the internal resistance of an CJ12-3.4 battery measured through a 1,000 Hz AC bridge.



Storage

Lead to self-discharge and passivation of the plates. Self-discharge reactions are presented for the two kinds of plates. The capacity loss during storage is reversed upon charge of the battery. The passivation phenomena are determined by the structure of the two kinds of plates.

Storage temperature	**Remcommended supplementary charge interval**	Supplementary charge method
Below 20℃（68^{0}F）	Every 6 months	More than 24 hours with a constant voltage 0f2.275V/cell
20~30℃（68 to 86^{0}F）	Every 3 months	6 to 12hours with a constant voltage 0f2. 40V/cell
Over 30℃（86^{0}F）	Storage to be avoided	6 to 12hours with a constant current 0f 0.05C



a) separators. In the case of partially wet-charged batteries, $PbSO_4$ crystals form in the separators during storage. When the battery is subjected to charge and overcharge they transform into Pb and PbO_2 and may cause short circuits between the plates and the failure of the battery.

b) positive plates. The passivation of the positive plate manifests itself by an abrupt fall of its discharge potential with out changing substantially the discharge time. This is due to the formation of a nonstoichiometric oxide PbO_n (n<1.5) following a reaction between the grid and the PbO_2 of the corrosion layer. This oxide has a high electric resistivity. Upon charge it is oxidized to PbO_2 by the O atoms and the O radicals which have first formed upon high anodic polarization. They penetrate through the corrosion layer and oxidize the PbO_n layer to PbO_2. The plate is depassivated with a sharp rise of its discharge potential.

c) negative plates. The passivation of the negative plate brings about the shortening of the discharge time without changing substantially the discharge potential. The passivation is caused by the formation of PbO (or $PbSO_4$) film at the interface between the skeleton and energetic structures of the lead active mass. These films interrupt the electric contact between skeleton and energetic structure and thus decreasing the plate capacity. Upon charge the PbO (or $PbSO_4$) film is reduced to lead and the electronic contact between the two structures is restored. The negative plate depassivate and the capacity increases.

※ Precautions Against Over Self-Discharge

a. The batteries should be stored in a cool ,dry place.

b. The batteries should not be stored in a direct sunlight.

c. The batteries should not be subjected to an external heat source.

d. The voltage of batteries in stock should be regularly checked.

General Concepts About Lead-Acid Battery （Flooded versus AGM and Gel）

What is a battery?

A battery is an electric storage device which can changes the chemical potential into electricity .It can be found in any number of shapes, size, voltages and capacities. such as nickel-iron battery,nickel-cadmium battery, silver-zinc battery etc.

What is a GEL battery?

A GEL battery is a lead-acid electric storage battery that:
• is sealed using special pressure valves and should never be opened(like VRLA).
• is completely maintenance-free.
• uses thixotropic GEL electrolyte.
• uses a recombination reaction to prevent the escape of hydrogen and oxygen gases.

• more electrolyte(15~20% more than VRLA)ensure long life.
• is non-spillable, and therefore can be operated in virtually any position. However, upside-down installation is not recommended.

What is an AGM battery?

An AGM battery is a lead-acid electric storage battery that:
• is sealed using special pressure valves and should never be opened.
• is completely maintenance-free.*
• Electrolyte absorbed in separator's(70~80%) and plate's((20~30%)) micropore.
• uses a recombination reaction to prevent the escape of hydrogen and oxygen gases normally lost in a flooded lead-acid battery (particularly in deep cycle applications).
• is non-spillable, and therefore can be operated in virtually any position. However, upside-down installation is not recommended.

What are the differences between GEL and AGM batteries?

Both are recombinant batteries. Both are sealed VRLA battery. AGM batteries and GEL batteries are both considered "acid-starved". In a AGM and GEL battery, the electrolyte does not flow like a normal liquid. In a GEL battery, the electrolyte has the consistency and appearance of jelly. Like gelled electrolyte batteries, absorbed electrolyte batteries are also considered non-spillable –all of the liquid electrolyte is trapped in the sponge-like matted glass fiber separator material.
The "acid-starved" condition of GEL and AGM batteries protects the plates during heavy deep-discharges. The GEL battery is more starved, giving more protection to the plate; therefore, it is better suited for super-deep discharge applications.
Due to the physical properties of the gelled electrolyte, GEL battery power declines faster than an AGM battery's as the temperature drops below 32ºF. AGM batteries excel for high current, high power applications and in extremely cold environments.

What is the difference between VRLA batteries and traditional wet batteries?

Wet batteries do not have special pressurized sealing vents, as they do not work on the recombination principle. They contain liquid electrolyte that can spill and cause corrosion if tipped or punctured. Therefore, they are not air transportable without special containers.
They cannot be shipped via UPS or Parcel Post or used near sensitive electronic equipment. They can only be installed "upright."
Wet batteries lose capacity and become permanently damaged if:
• continually over-discharged, due to active material shedding, especially in automotive starting types.
• GEL and AGM are completely maintenance-free in service life, whereas maintenance is needed in wet battery
Our GEL cells have superior deep cycle life, due to our unique design. The shelf life of a VRLA battery is six times higher than the shelf life of a deep cycle antimony battery.

VRLA batterie's recharge and precautions

While our VRLA batteries accept a charge extremely well due to their low internal resistance, **any** battery will be damaged by continual under-or overcharging. Capacity is reduced and life is shortened.
Overcharging is especially harmful to any VRLA battery because of the sealed design. Overcharging dries out the electrolyte by driving the oxygen and hydrogen out of the battery through the pressure relief valves. Performance and life are reduced.
If a battery is continually undercharged, a power-robbing layer of sulfate will build up on the negative and positive plates, which acts as a barrier to recharging. Overdischarge and Premature plate shedding can also occur. thus performance is reduced and life is shortened.

WARNING-Never leave a VRLA battery in a discharged state. Because of the sulphation:
When a battery is left in a discharged state for prolonged periods of storage lead sulphate crystals begin to form acting as a barrier to recharge an will prevent normal battery operation. Depending on the degree of sulphate, a battery may be recovered from the condition by constant current charging at a higher voltage with the current limited to one tenth of the battery capacity for 12h or longer.In extreme circumstances a battery may never fully recover from sulphate and must be replaced**.**
Thus the charger must be temperature-compensated to prevent under or overcharging due to ambient temperature changes.

Another is because **thermal runaway**（especially in AGM）.

⚠ **Constant current chargers should never be used on VRLA batteries.**

Can VRLA batteries be installed in sealed battery boxes?

NO! Never install any type of battery in a completely sealed container.
Although most of the normal gasses (oxygen and hydrogen) produced in a VRLA battery will be recombined as described above, and not escape, **oxygen and hydrogen will escape from the battery in an overcharge condition** (as is typical of any type battery).When the pressure in boxes exceed the bond, explosion may caused.
For safety's sake, these potentially explosive gasses **must** be allowed to vent to the atmosphere and **must never be trapped in a sealed battery box or tightly enclosed space!**

Can STANDHBS VRLA batteries be used as starting batteries as well?

Our VRLA batteries will work in SLI (Starting, Lighting and Ignition) applications as long as the charging voltage is regulated to the appropriate values.
Many vehicle regulators are set too high for VRLA batteries; therefore, the charging system may require adjustment to properly recharge a VRLA battery for best performance and life. yet the price is higher than flooded.
AGM batteries excel in low temperature, high current applications such as cold weather starting.

Rate of Discharge

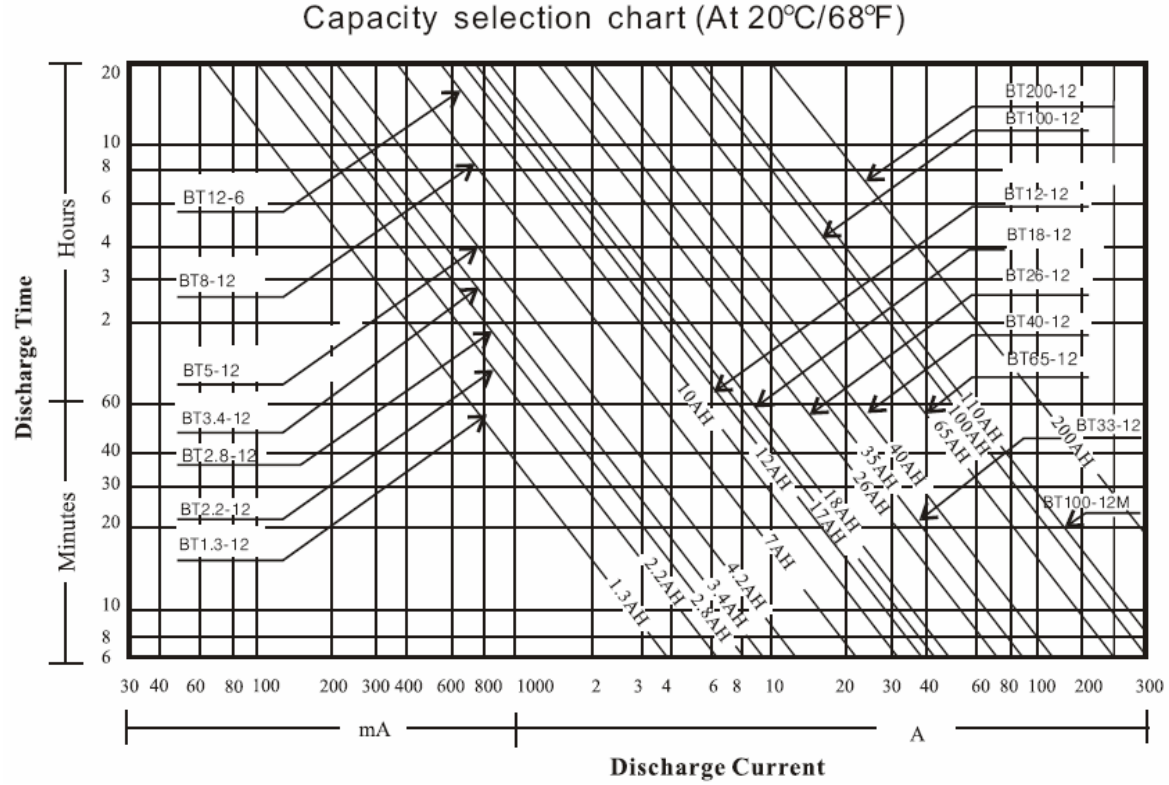
Minutes discharged at 50, 25, 15, 8 and 5 Amperes
Minutes discharged is the time in minutes that a new, fully charged battery will deliver at various currents and maintain at least 1.75 volts per cell. These are nominal or average ratings.
Ampere Hour Capacity ： C_{20}, C_3, C_1 etc
These are nominal or average ratings.
Amper Hour Capacity is An expression describing rate of discharge. The number indicates the number of hours to completely discharge the battery at a constant current. So C/20 is the current draw at which the battery will last for 20 hours(C_{20}), C/1 is the current at which the battery will last 1 hour(C_1). The useful capacity of a battery changes depending on the discharge rate, so battery capacities are stated with respect to a particular rate. For instance, a particular model of Our battery CJ12-40 is rated at 40 amp-hours at the C/10 rate of 4.0 amps, but only 26 Ah at the C/1 rate of 26A.
EXAMPLE
10 amperes for 20 hours (10 x 20) = 200 Ah @ the 20-hour rate(C_{20})
8 amperes for 3 hours (8 x 3) = 24 Ah @ the 3-hour rate(C_3)
30 amperes for 1 hour (30 x 1) = 30 Ah @ the 1-hour rate(C_1)
Therefore, if you have an application that requires a draw of 17 amperes for 3 hours, you would need a 51Ah battery (@ the 3 hour rate)…(17 x 3 = 51). However, this is 100% of the capacity of this 51 Ah battery

Battery Life

We say the end-of-life of a battery when it can no longer hold a proper charge (for example, a cell has shorted) or when the available battery capacity is 80% or less than what the battery was rated for. The life of Lead Acid batteries is usually limited by several factors：
Cycle Life is a measure of how many charge and discharge cycles a battery can take before its lead-plate grids/plates are expected to collapse and short out. The greater the average depth-of-discharge, the shorter the cycle life.
Age also affects batteries as the chemistry inside them attacks the lead plates. The healthier the "living conditions" of the batteries, the longer they will serve you. Lead-Acid batteries like to be kept at a full charge in a cool place. Only buy recently manufactured batteries. The longer the battery has sat in a store, the less time it will serve you! Since lead-acid batteries will not freeze if fully charged, you can store them in the cold during winter to maximize their life.
Sulphation is a constant threat to batteries that are not fully re-charged. A layer of lead sulphate can form in these cells and inhibit the electro-chemical reaction that allows you to charge/discharge batteries. Many batteries can be saved from the recycling heap if they are *Equalize.*

HOW TO CHOOSE THE CORRECT SIZE OF BATTERY

To find the size of battery you require your generally need three pieces of information **battery load** ,**back-up times** and the **ambient temperature**.(Note: other factor may also have an effect)
By using the selection chart(see below), You can know how to choose the size of battery your need.



You may notice that the chosen capacity in Amp Hours is often higher than the value of Amp×Hours used, in our example using 10 Amp3Hours=30AH(D.O.D=75%) and chosen option being 40AH(10×3/75%=40). This is because the capacity "AH" of each our battery is stated at the C_{10} or C_{20} hours discharge rate. you will only get full capacity if discharged over the length of time.

Most system designs will specify a battery that will deliver a minimum of twice the capacity required. This means the battery will discharge to 50% of its capacity. Using a 50% depth of discharge (versus 80% or 100%) will dramatically extend the life of any battery. Therefore, when helping to specify a battery for a system, choose a battery with at least **twice** the capacity required for best performance. If 50 Ah is required, specify at least a 100 Ah battery.

Back-up Times

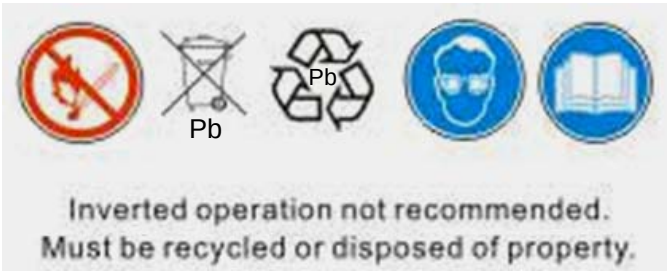
Reserve Minutes are a measure of how long your battery can sustain a load before it's available capacity has been completely used up. This measure is especially useful for folks who want to run inverters, fridges, and other large loads.
Always choose a suitable sized battery from the ranges appropriate to your application.

Disposal/Recycle

Finally,when a battery has reached the end-of-life it must be returned to the point of sale or to a licensed battery dealer for recycling.

Caution:

Do not throw batteries in a bin at end-of-life.
VRLA batteries contain substances harmful to the environment.



Answers to some Questions

Why can't VRLA batteries be opened?

VRLA (Valve-Regulated Lead-Acid) batteries work on a recombination principle. Oxygen gas is produced at the positive plates during charge. The charged negative plates react first with this oxygen and subsequently with the electrolyte.
Water is produced and the negative plates are very slightly discharged. Additional charging recharges the negative plates instead of producing hydrogen gas. Since very little hydrogen and oxygen is lost and the water (H_2O) is retained, we say that the gasses have recombined. To work properly, the oxygen produced must be retained in the battery until the reaction is completed.
If any VRLA (gelled or absorbed electrolyte) battery is overcharged, gas will be vented from the valves. Hydrogen as well as oxygen will be released. If continued, the electrolyte will eventually dry out and the battery will fail prematurely. This is why charging limits are so critical.
In a sealed battery a balance is maintained between the hydrogen, oxygen and charge. If a VRLA battery is opened, or leaks, the negative plates are exposed to extra oxygen from the atmosphere. This excess oxygen upsets the balance. The negative plates become discharged. The positive plates may be subsequently severely overcharged. The battery ***will*** fail prematurely, and the **warranty will be voided.**

Why does STANDHBS use calcium grids in VRLA batteries for deep cycle applications?

When deeply discharged, the plates release all their available power, eventually causing plate shedding and active material fall-out. In contrast, with flooded antimony batteries, the antimony helps lock the active material onto the grid. Therefore, the plate does not shed as easily, which extends the deep cycle life of the battery when compared to flooded calcium.
Our VRLA calcium alloy battery is also very efficient with low resistance. However, when deeply discharged, the electrolyte is used up before the plates are totally discharged because the battery is "acid-starved."
This feature:

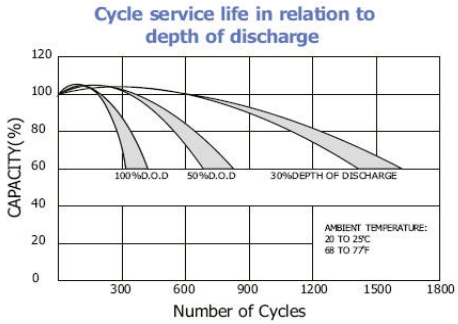
Shelf life

Our calcium/tin lead alloy premium separators and demineralized electrolyte are **ultra-pure.** Impurities in the lead alloy, separators and electrolyte is very low. **The purer the components, the longer the shelf life.**

Does depth of discharge affect cycle life?

Yes! The harder any battery has to work, the sooner it will fail.

This is a typical graphic shows the number of cycles relation to the D.O.D（GEL）



As you can see, **the shallower the D.O.D(depth of discharge), the longer the life.** This is why it's important to size a battery system to deliver at least twice the average power required, to assure shallow discharges ,therefore prolong the cycle life. Please:
• Avoid ultra-deep discharges.
• Don't leave a battery at a low stage of charge for an extended length of time. Charge a battery as soon as possible after discharged.
• Don't cycle a battery at a low state of charge without regularly recharging fully.
Ultra-deep discharging is what causes life-shortening plate shedding and accelerated positive grid corrosion which can destroy a battery.

Why does temperature have such a dramatic effect on batteries?

Temperature is a major factor in battery performance, shelf life, charging and voltage control. At higher temperatures there is dramatically more chemical activity inside a battery than at lower temperatures.

Acid stratification in VRLA batteries

Acid stratification can occur in conventional wet cells. During charge, acid is released at the plate surfaces. During discharge, acid is consumed at the plate surfaces. Since the concentration is not uniform, diffusion (spontaneous mixing by random molecular motions) begins. If this mixing occurred rapidly, stratification would not occur, but it is relatively slow, allowing lighter parts of electrolyte to "float" toward the surface and heavier parts to "sink" toward the bottom.

The top portion of the plates do not perform as well in contact with lower concentration electrolyte. The bottom portion of the plates do not perform as well with the higher concentration, and will corrode prematurely. High voltage "equalization" charging is sometimes used in wet batteries to make gas bubbles that re-mix the electrolyte.

Can a battery be recharge for long periods of time?

It is extremely important not to charge batteries for long periods of time at rates which cause them to gas(overcharge) because they use water, which in sealed valve regulated batteries cannot be replaced. Of course, no battery should be overcharged for a long period of time…even at low rates using so-called "trickle charges."

How critical is recharge voltage?

All lead-acid batteries give off hydrogen from the negative plate and oxygen from the positive plate during charging.

Voltage is electrical pressure. Charge (ampere-hours) is a quantity of electricity. Current (amperes) is electrical flow (charging speed).

A battery can only store a certain quantity of electricity. The closer it gets to being fully charged, the slower it must be charged.

Temperature also affects charging. Temperature arise reactions other than the charging reaction occur to transport this current through the battery—mainly gassing. Hydrogen and oxygen are given off faster than the recombination reaction. This raises the pressure until the pressure relief valve opens. The gas lost ed.

Any VRLA battery will dry out and fail prematurely if it experiences excessive overcharge.

Charging voltage must be carefully regulated and temperature compensated to the values.

How long does it take to recharge a fully discharged VRLA battery?

A **specific time is difficult to determine** because recharging depends on so many variables:

- Depth of discharge
- Temperature
- Size and efficiency of the charger
- Age and condition of the battery
- Charging voltage and initial current

Charging Guides for an estimated time based upon the initial charge current the battery accepts.

Typical Charging Time vs % State of Charge(SOC)

It will take about 60% of the charge time to bring a VRLA battery from 0% charged to 90% charged. It will take the remaining 40% of the total charging time to put the last 10% of the charge back into the battery. (0% SOC is defined as the depth of discharge giving a terminal voltage of 10.50 Volts – measured under a steady load at the 20-hour rate at 80ºF).

Typically, the charge that must be returned to a VRLA battery to achieve a 100% state of charge is from 105% to 115% of the charge removed.

How can continual undercharging harm a battery?

In many respects, **undercharging is as harmful as overcharging.**

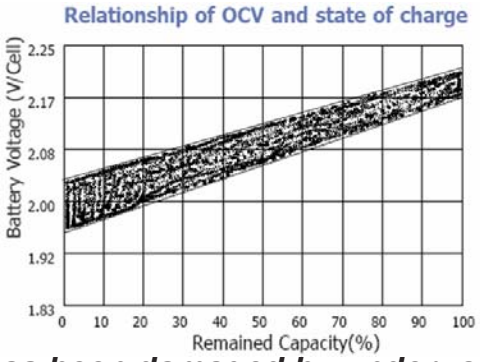
Keeping a battery in an undercharged condition allows the positive grids to corrode and the plates to shed, dramatically shortening life.

Also, an undercharged battery must work harder than a fully charged battery, which contributes to short life as well.

An undercharged battery has a greatly reduced capacity. It may easily be inadvertently over-discharged and eventually damaged.

How can you tell if an VRLA battery is fully charged?

By using a voltmeter and the Fig. you can identify the SOC(state of charge) approximately.



How can you tell if a VRLA battery has been damaged by under- or overcharging?

The only way is **with a load test.** Use the same procedure you would use with a wet cell battery:
a. Recharge if the open circuit voltage is below 75%.
b. If adjustable, set the load at 1⁄2 the CCA rating or three times the 20 hour rate.
c. Apply the load for 15 seconds. The voltage should stabilize above 9.6 volts while on load.
d. If below 9.6 volts, recharge and repeat test.
e. If below 9.6 volts a second time, replace the battery.

Do VRLA batteries have a "memory" like ni-cad batteries?

One of the major disadvantages of nickel-cadmium (ni-cad) batteries is that after shallow discharge cycles, the unused portions of the electrodes "remember" the previous cycles and are unable to sustain the required discharge voltage beyond the depth of the previous cycles. The capacity is lost and can only be restored by slowly discharging completely (generally outside the application), and properly recharging. **VRLA batteries do not exhibit this "use it" or "lose it" capacity robbing effect known as memory.**

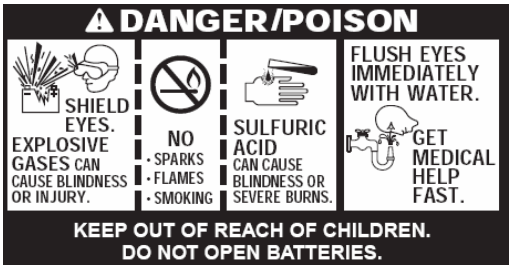
Battery's internal pressure

To prevent the permanent loss of gases so that recombination has time to take place, each cell can hold up to about 1.5 psi without venting.
The valves only let gas out, never in. A partial vacuum can form within a sealed battery under various circumstances. Battery temperature and ambient pressure play a role, but predominantly the recombination and discharge reactions are responsible. After charging ends, the recombination reaction continues until most of the oxygen in the battery headspace is consumed. The total volume of the battery components decreases slightly during a discharge.
If a battery bulges severely on charge, this is not normal. It is an indication of a blocked valve or an overcharge situation. Such a battery should be removed from service.
A sucked-in appearance can also be normal. A sucked-in battery should be charged, but if it remains sucked-in after charging, the appearance can safely be ignored; however, if only a single cell displays or lacks this appearance a load test would be prudent.

How safe are VRLA batteries? Can they explode?

VRLA batteries are very safe, unless abused. However, as with any type battery, certain safety precautions must be taken.

ALWAYS WEAR SAFETY GLASSES
WHEN WORKING AROUND BATTERIES!



Batteries, battery posts, terminals and related accessories contain lead and lead compounds and other chemicals can cause cancer and birth defects or other reproductive harm. **Wash hands after handling.**
Because VRLA batteries normally emit very little to no hydrogen gas, they are safe near sensitive electronic equipment. They do not cause corrosion of surrounding metals. No hydrogen gas means no dangerous explosions… UNLESS SEVERELY OVERCHARGED!

Do not install any lead-acid battery in a sealed container or enclosure.
Hydrogen gas from overcharging must be allowed to escape.
DO NOT CHARGE IN EXCESS OF 15.0V @ 68°F - one Cells

What to installation?

Wiring and Waterproofing **ALWAYS WEAR SAFETY GLASSES WHEN WORKING AROUND BATTERIES!**
a. Cabling of the approved gauge should be tinned copper.
If using untinned copper, allow plenty of spray silicone to “wick” along the strands.
b. Install heat-shrink tubing with a silicone interior; the silicone forms an excellent moisture barrier. Cut the tubing long enough to cover the terminal lug and plenty of the insulated portion of the cable. Slip tubing onto the cable.
c. Crimp on the appropriate terminal.
d. Position the heat-shrink tubing. Heat and inspect.
e. Clean battery terminals and connect. Be sure perfect metalto- metal contact is made, with no dirt, corrosion, grease or foreign material to interfere with current flow.
f. Always attach the cable connected to the solenoid or starter first. Attach the ground cable last! Tighten snugly, BUT DO NOT OVERTIGHTEN, which will damage the terminals or crack the battery cover.
g. Spray exposed terminals and connectors with several coats of battery terminal corrosion protection spray. (Mask surrounding areas to protect against overspray.)
h. For batteries which may be exposed to very wet environments total encasement of the exposed terminals and connectors is necessary. However, do not block or cover the vents. **Allow ventilation.**
A battery terminal boot should be used. Install the boot on the cable before crimping the terminal. Fill the boot with petroleum jelly and fit over the sprayed connectors (as in “g” above).
i. Battery charging in a boat requires a charger specifically designed for marine applications. In addition to battery gases, bilges often contain potentially dangerous fuel fumes.

⚠ The room where the battery is installed must be ventilated so that the maximum hydrogen concentration is not more than 0.8%.Storage batteries generate hydrogen gas which may explosion.

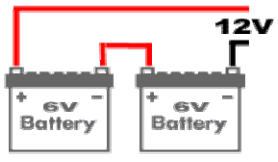
Battery Connection

Note: In a multi-battery installation, it is often best to replace the entire set of batteries when one battery is weak or has failed.

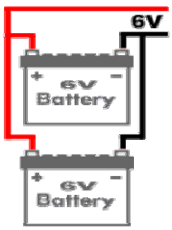
Series
A “series” system increases the voltage, but keeps the battery capacity (cranking amps, amp hours, reserve minutes, and minutes running time) the same. Therefore, two 12-volt batteries connected in series (POS to NEG, NEG to POS) will deliver 24 volts at the same rating as one battery:
During recharge, each battery receives the same amount of current; e.g. if the charger is putting out 10 amps, both batteries are getting 10 amps.

Parallel
A “parallel” system increases the capacity available, but keeps the voltage the same. Therefore, two 12-volt 100 Ah will deliver 12 volts 200Ah.
During recharge, the current (amps) is split between the batteries. The battery that is discharged the most will receive more current than the other until both are brought up to full charge.

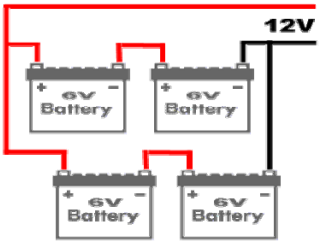
Series/Parallel
A “series/parallel” system provides a combination of voltage and capacity for special applications.
Note: Never mix different types and sizes of batteries in the same bank.
eg: each battery=6V100Ah



=12V100 Ah
series



=6V200 Ah
parallel



=12V100 Ah
series/parallel

Appendix

Glossary of Terms

Abbreviations	Definitions
Active Material	The active electro-chemical materials used in the manufacture of positive and negative electrodes.
Ambient Temperature	The average temperature seen by the battery.
Ambient Capacity	The capacity from the battery based on its state of charge, rate of discharge, and ambient temperature.
Battery	Two or more cells, series connected together. A single cell is some times referred to as a battery.
CA	Ampere; the C-rate of a battery measured in amperes.
Cell	The minimum unit of which a storage battery is composed. Note:The nominal voltage of a single lead acid cell is about 2.0 volts.
Cutoff Voltage	The final voltage of a cell or battery at the end of charge or discharge.
Cycle	A single charge and discharge of a cell or battery.
Discharge Rate	Current taken from a cell or battery and expressed as a fraction of C (Ampere-hour rating of the cell or battery).
End-of-Charge Voltage	The voltage reached by the cell of battery at the end-of-charge,while the charger is still attached.
Electrolyte	Conducts ions in the cell. Lead acid batteries use a sulfuric acid solution.
Energy Density	Ratio of cell or battery energy to unit weight (pound or kilogram) or unit volume (cubic inch or cubic meter)
Gas Absorption	The ability of the negative plate to absorb oxygen gas generated within the battery; the greater this ability, the greater the chargecurrent capability.
High-Rate Discharge	A very rapid discharge of the battery. Normally in multiples of C(Ampere-hour rating of the cell or battery).
Internal Impedance（Resistance）	The resistive value of the battery to an AC current, expressed in ohms. Normally measured at 1 khz at full charge.
Low Voltage Cutoff	A sensing device designed to end discharge at a predetermined voltage level.
Nominal Capacity	The nominal value of rated capacity. In sealed lead acid batteries,nominal capacity is usually measured at the 20 hour rate.
Nominal Voltage	The nominal value of rated voltage. In lead acid batteries, nominal voltage is 2 volts per cell.
Open Circuit Voltage	The measured voltage of the cell or battery without a load attached.
Overcharge	The continuous charging of a cell after it achieves 100% of capacity. Battery life is reduced by prolonged over charging.
Parallel Connection	Connection of a group of batteries by inter-connecting all terminals of the same polarity, thereby increasing the capacity of the battery group. (Note: Differing brands and/or capacities should not be connected together).
Primary Cell	A cell which can be discharged only once. Example: Manganese zinc and alkaline.
Rated Capacity	The capacity of the cell expressed in ampere hours. Commonly, aconstant current for a designated number of hours to a specified depth of discharge at room temperature.
Safety Vent System	The safety device built into the cell to allow the release of excess gases and prevent case rupture.
Secondary Battery	A battery which can be charged and discharged repeatedly. Example: Lead acid and nickel cadmium batteries.

Appendix (continued)

Self Discharge	The loss of capacity of a battery while in stored or unused condition without external drain.
Separator	The materials which separate the electrodes. In a sealed lead acid battery, they are usually constructed of micro-porous glass fiber and additionally serve to retain the electrolyte.
Service Life	Expected life of a battery expressed in the number of total cycles or years of standby service to a designated remaining percentage of original capacity.
Shelf Life	The maximum period of time a battery can be stored under specific conditions, without supplementary charging.
Standby Use	A general term for an application in which the battery is maintained in a fully charged condition by trickle or float charging and always ready for use.
Trickle Charge	Continuous charging by means of a small current designed to compensate for self discharge in an unloaded battery.
Voltage Cutoff	A sensing device used to terminate a charge or discharge when the battery reaches a predetermined voltage level.
Thermal Runaway	In a AGM battery，this is a very dangerous condition. If batteries are charged too fast. One of the byproducts of *Gassing* are Oxygen and Hydrogen. As the battery heats up, the gassing rate increases as well and it becomes increasingly likely that the Hydrogen around it will bulge or even explode. The danger posed by high Hydrogen concentrations is one of the reasons .So it is requires that batteries be installed in a well-ventilated area. Without a recombination reaction, flooded batteries convert most excess charging energy to gas, not heat. This makes them almost immune from the thermal runaway. GEL batteries are much less susceptible to thermal runaway than AGM batteries GEL Batteries become more susceptible with increasing age.

香港翰和實業有限公司
HONGKONG H&H INDUSTRY LIMITED
Rooms 1318-20,13/F,Hollywood Plaza,610 Nathan Road,Mongkok,Kowloom.Hong Kong
Tel: 00852-27108200 EXT.970 Fax: 00852-27108266
http://www.standbattery.com