

General Description of VRLA Battery

1. Battery Features

(1) Maintenance free

Gas, generated from water electrolysis by overcharge, is absorbed and reduced to an electrolyte by the electrode thus making the battery maintenance free.

(2) Can be installed and operated in any position except of upside down

There is no liquid electrolyte because the electrolyte is firmly retained by a retainer and electrodes. However, gas generated from overcharge is absorbed by the electrodes and not expelled outside the battery under normal operations. With this feature, the battery can be used in any position for home & office applications.

(3) Safety measures

Excessive overcharge or an incorrect charging method may produce an extremely large volume of gas. Our battery is equipped with a safety valve which detects rising internal pressure, and allows gas to be expelled to the outside.

(4) Ready for use when charged even after extended storage

Using a lead calcium alloy grid structure allows the self discharging quantity to be 1/3 to 1/4 less than the conventional lead antimony grid structure battery. This greatly extends the storage period prolonging battery life.

(5) High performance lead-acid battery

With efficient discharge characteristics and little internal resistance, this battery can be applied to many applications. Principal applications include cycle service with repeated charges and discharges, as well as stand-by use in which the battery is normally maintained in a charged state and discharged only as required.

(6) Economy

Our batteries can be used for 260 or more cycles at 100% discharge in cycle service and three to five years in stand-by service. The battery is maintenance free and has a low running cost making it very economical. Its compactness, lightweight and high performances contribute to reducing the overall cost of a power supply system as a whole. (Ambient temperature: 25°C (77°F)).

2. Battery Applications

Recently, electronic products are showing remarkable developments. Various communications systems (i.e. VAN, LAN and INS) are quickly advancing to connect portable equipment, OA equipment, and FA equipment.

A power generation system with solar cells utilizing solar energy is also being brought into



service. Our battery is the most suitable lead-acid battery for main and emergency power supply as well as being an energy storage means. Our products are designed for cycle and stand-by applications.

Specific 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

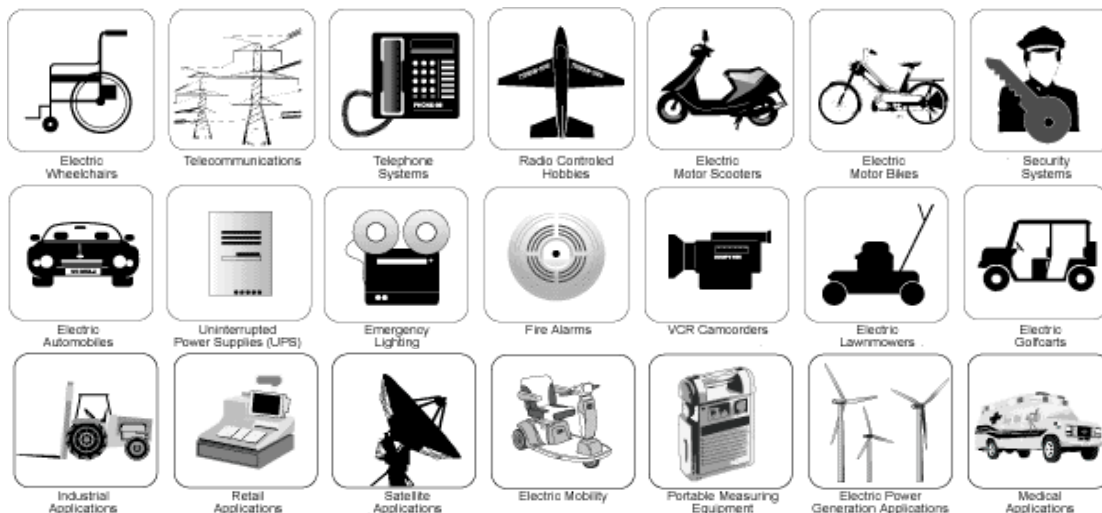
(2) Standby Use:

- ✓ 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

Product Applications:



3. Battery Constructions

The construction of a CSB VRLA battery is shown Figure 1. The following is a description of the different parts that make up our batteries.

(1) Positive and negative plates

Positive and negative plates consist of active mass and a lead-calcium alloy grid structure.

(2) Retainer, adjusting plate

Unwoven glass fiber cloth, with a high oxidation and heat resistance, is used to offer superior electrolyte absorption and retaining ability and satisfactory ion conductivity.

(3) Safety valve

The safety valve opens when there is an abnormal increase in internal pressure caused by overcharging or misuse. Gas is released from the battery to return the pressure back to normal.

(4) Container and covers

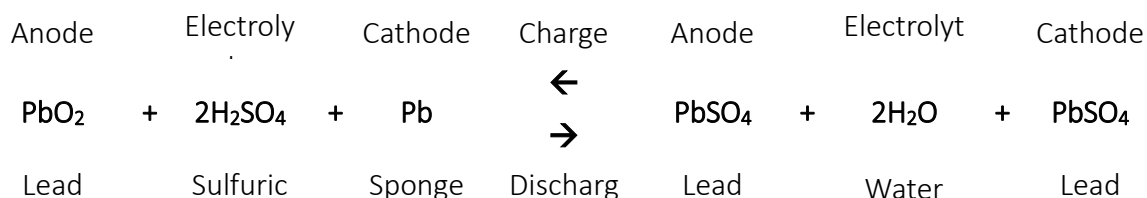
Container and covers are made of ABS or PP resin, with superior strength and acid resistance characteristics. The container and covers are sealed to prevent electrolyte and gas leakage.



Figure 1: Construction of VRLA battery

4. Sealing Principle

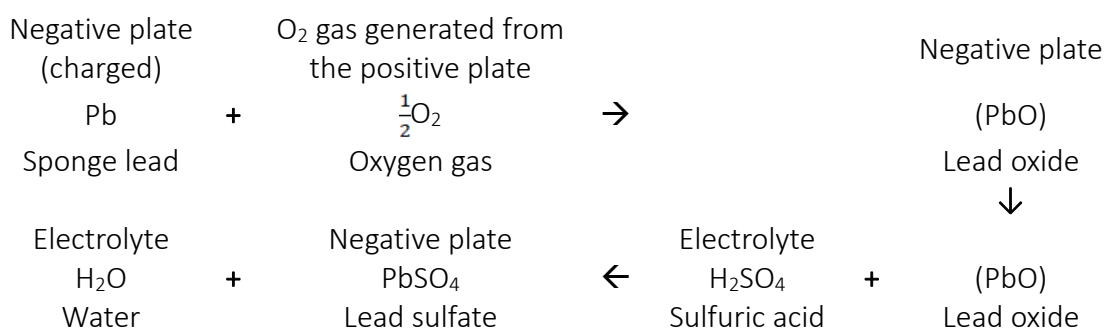
The charge/discharge reaction of the VRLA battery can be expressed by the following reaction:



Overcharging causes electrolysis of the water content of the electrolyte, which generates O_2 gas at the positive plate and H_2 gas at the negative plate. These gasses are then discharged to the outside. Since a drop in the electrolyte levels results, adding water is occasionally needed.

The VRLA battery is designed so that the negative plate does not have to be fully charged even when the positive plate is fully charged. Furthermore, no H_2 gas is generated from the negative plate although O_2 gas is being generated from the overcharged positive plate. O_2 generated from the positive plate then reacts with the charged sponge lead (Pb) of the negative plate and turns into lead monoxide (PbO). The lead monoxide, in turn, reacts with sulfuric acid (H_2SO_4) in the electrolyte to turn into lead sulfate ($PbSO_4$), allowing the negative plate to discharge. In other words, O_2 from the positive plate is absorbed by the negative plate without being expelled to the outside. Since the negative plate develops discharging with the help of O_2 , there always exists a portion free from discharging. As a result, the negative plate never generates H_2 . This completely prevents the loss of water.

The sealing principle of a VRLA battery may be expressed by the following equation (See Figure 2 for illustration):



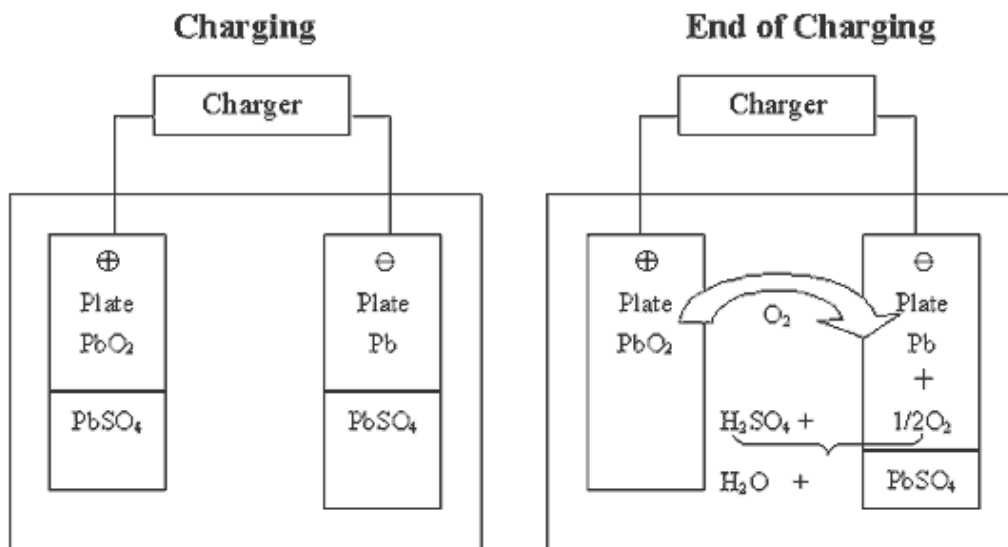


Figure 2: Illustration of Sealing Principles