

Battery Tutorial

You have most likely heard the term K.I.S.S. (Keep It Simple, Stupid). I am going to attempt to explain how lead acid batteries work and what they need without burying you with a bunch of needless technical data. Actually battery manufacturer's data will vary somewhat.

The commercial use of the lead acid battery is over 100 years old. The same chemical principal is being used to create energy that our Great, Great, Grandparents may have used.

If you can grasp the basics you will have fewer battery problems and will gain greater battery performance, reliability, and longevity.

A battery is like a piggy bank. If you keep taking out and putting nothing back you soon will have nothing.

A Few Basics

The Lead Acid battery is made up of plates, lead, and lead oxide (various other elements are used to change density, hardness, porosity, etc.) with a 35% sulfuric acid and 65% water solution. This solution is called electrolyte which causes a chemical reaction that produce electrons.

Safety

We must think *safety* when we are working around and with batteries. Remove all jewelry. After all you don't want to melt your watchband while you are wearing the watch. Wear junk clothes or Polyester but Polyester is so out of style. When doing electrical work just remember you are messing with maybe a 100+ amps of current.

Types of batteries

Basically there are **two types of batteries**; starting (cranking), and deep cycle (marine/golf cart). The **starting battery** is designed to deliver quick bursts of energy (such as starting engines) and have a greater plate count. The plates will also be thinner and have somewhat different material composition. The **deep cycle battery** has less instant energy but greater long-term energy delivery. Deep cycle batteries have thicker plates and can survive a number of discharge cycles. Starting batteries should not be used for deep cycle applications. The so-called **Dual Purpose Battery** is only a compromise between the 2 types of batteries.

Wet Cell (flooded), **Gel Cell**, and **Absorbed Glass Mat (AGM)** are various versions of the lead acid battery. The **wet cell** comes in 2 styles; serviceable, and maintenance free. Both are filled with electrolyte and I prefer one that I can add water to and check the specific gravity of the electrolyte with a hydrometer. The **Gel Cell** and the **AGM** batteries store very well and do not tend to sulfate or degrade as easily as wet cell. There is little chance of a hydrogen gas explosion or corrosion when using these batteries; these are the safest lead acid batteries you can use. Gel Cell and some AGM batteries may require a special charging rate. Careful consideration should be given to the AGM battery technology for applications such as Solar and Stand-By Power just to name a few. Gel Cell batteries still are being sold but the AGM batteries are replacing them in most applications. There is a little confusion about AGM batteries because different manufactures call them different names. In most cases AGM batteries will give greater life span and greater cycle life than a wet cell battery.

SPECIAL NOTE about Gel Batteries: It is very common for individuals to use the term GEL CELL when referring to sealed, maintenance free batteries. Be careful.

AGM: The Absorbed Glass Matt construction allows the electrolyte to be suspended in close proximity with the plates active material. In theory, this enhances both the discharge and recharge efficiency. The AGM batteries are typically good deep cycle batteries and they deliver best life performance if recharged before the battery drops below the 50 percent discharge rate. If these AGM batteries are discharged to a rate of 100 percent the cycle life will be 300 plus cycles and this is true of most AGM batteries rated as deep cycle batteries.

GEL: The gel cell is similar to the AGM style because the electrolyte is suspended, but different because technically the AGM battery is still considered to be a wet cell. The electrolyte in a GEL cell has a silica additive that causes it to set up or stiffen. The recharge voltages on this type of cell are lower than the other styles of lead acid battery. This is probably the most sensitive cell in terms of adverse reactions to over-voltage charging. Gel Batteries are best used in VERY DEEP cycle application and may last a bit longer in hot weather applications. If the incorrect battery charger is used on a Gel Cell battery poor performance and premature failure is certain.

An amp hour (AH) is a rating usually found on deep cycle batteries. If a battery is rated at 100 amp hours it should deliver 5

amps for 20 hours, 20 amps for 5 hours, etc.

Battery Maintenance is an important issue. The battery should be cleaned using a baking soda and water mix; a couple of table spoons to a pint of water. Cable connection needs to be clean and tightened. Many battery problems are caused by dirty and loose connections. To **prevent corrosion** coat the washer with high temperature grease or petroleum jelly (Vaseline), then place cable on the post and tighten. Coat the exposed cable end with the grease.

Digital Voltmeters should read as the voltage is shown in this document. The sealed AGM and Gel-Cell battery voltage (full charged) will be slightly higher in the 12.8 to 12.9 ranges. If you have voltage readings in the 10.5 volts range on a charged battery, that indicates a shorted cell.

When in doubt about battery testing, call the battery manufacturer. Many batteries sold today have a toll free number to call for help.

Selecting a Battery - When **buying a new battery** I suggest you purchase a battery with the greatest reserve capacity or amp hour rating possible. Of course the physical size, cable hook up, and terminal type must be a consideration. You may want to consider a Gel Cell or an Absorbed Glass Mat (AGM) rather than a Wet Cell if the application is in a harsher environment or the battery is not going to receive regular maintenance and charging.

Be sure to purchase the correct type of battery for the job it must do. Remember an engine starting battery and deep cycle batteries are different. **Freshness** of a new battery is very important. The longer a battery sits and is not re-charged the more damaging sulfation build up there may be on the plates. Most batteries have a date of manufacture code on them.

Battery life and performance - 80% of all battery failure is related to sulfation build-up. This build up occurs when the sulfur molecules in the electrolyte (battery acid) become so deeply discharged that they begin to coat the battery's lead plates. Before long the plates become so coated that the battery dies. The causes of sulfation are numerous. Let me list some for you.

- Batteries sit too long between charges.
- Battery is stored without some type of energy input.

- "Deep cycling" an engine starting battery. Remember these batteries can't stand deep discharge.
- Undercharging of a battery.
- Heat, A new fully charged battery left sitting 24 hours a day at 110 degrees F for 30 days is most likely dead.
- Incorrect charging levels and settings. Most cheap battery chargers can do more harm than good.
- Cold weather is also hard on the battery. A deeply discharged battery can freeze solid in sub zero weather.

Battery Charging - Remember you must put back the energy you use immediately. If you don't the battery sulfates and that affects performance and longevity. Batteries like to be charged in a certain way, especially when they have been deeply discharged. This type of charging is called 3 step regulated charging. Please note that only special [SMART CHARGERS](#) using computer technology can perform 3 step charging techniques. You don't find these types of chargers in parts stores and Wal-Marts. The first step is **bulk charging** where up to 80% of the battery energy capacity is replaced by the charger at the maximum voltage and current amp rating of the charger. When the battery voltage reaches 14.4 volts this begins the **absorption charge** step. This is where the voltage is held at a constant 14.4 volts and the current (amps) declines until the battery is 98% charged. Next comes the **Float Step**. This is a regulated voltage of not more than 13.4 volts and usually less than 1 amp of current. This in time will bring the battery to 100% charged or close to it. The float charge will not boil or heat batteries but will maintain the batteries at 100% readiness and prevent cycling during long term inactivity. Some gel cell and AGM batteries may require special settings or chargers.

Battery Do's

- Think Safety First.
- Do read entire tutorial
- Do regular inspection and maintenance especially in hot weather.
- Do recharge batteries immediately after discharge.
- Do buy the highest RC reserve capacity or AH amp hour battery that will fit your configuration.

Battery Don'ts

- Don't forget safety first.
- Don't add new electrolyte (acid).

- Don't use unregulated high output battery chargers to charge batteries.
- Don't place batteries into storage without some type of device to keep the battery charged.
- Don't put off recharging batteries.
- Don't discharge a battery any deeper than you possibly have to.
- Don't let a battery get hot to the touch and boil violently when charging.
- Don't mix size and types of batteries.