

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 produces electrons. When you test a battery with a hydrometer, you are measuring the amount of sulfuric acid in the electrolyte. If your reading is low, that means the chemistry that makes electrons is lacking. So where did the sulfur go? It's resting on the battery plates so that when you recharge the battery, the sulfur returns to the electrolyte.

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1. You must think safety when you're working around, and with, batteries. Remove all jewelry. (After all, you wouldn't want to melt your watchband while you're wearing it!) The hydrogen gas that batteries make when charging is very explosive. We have seen several instances of batteries blowing up and drenching everything in sulfuric acid. That was no fun, and would have been a good time to use those safety goggles hanging on the wall. Heck, you could even break out your disco outfit. Polyester isn't affected by sulfuric acid, but anything with cotton will be eaten up. If you don't feel the need to make a fashion statement, just wear junk clothes—after all, polyester is still out of style.

When doing electrical work on vehicles, it's best to disconnect the ground cable. Just remember that you're messing with corrosive acid, explosive gases and hundreds of amps of electrical current.

2. Basically, there are **two types of lead acid batteries** (along with three sub categories). The two main types are starting (cranking), and deep cycle (marine/golf cart). The **starting battery (SLI starting lights ignition)** is designed to deliver quick bursts of energy (such as starting engines) and therefore has a greater plate count. The plates are 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 because the thinner plates are more prone to warping and pitting when discharged. The so-called **Dual Purpose Battery** is a compromise between the two types of batteries, though it is better to be more specific if possible.

3. Wet cell (flooded), **gel cell**, and **absorbed glass mat (AGM)** are various versions of the lead acid battery. The wet cell comes in two styles; serviceable and maintenance free. Both are filled with electrolyte and are basically the same. 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 are specialty batteries that typically cost twice as much as a premium wet cell. However, they 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; they are the safest lead acid batteries you can use. Gel cell and some AGM batteries may require a special charging rate. If you want the best, most versatile type, consideration should be given to the AGM battery for applications such as Marine, RV, Solar, Audio, Power Sports and Stand-By Power just to name a few.

If you don't use or operate your equipment daily, AGM batteries will hold their charge better than other types. If you must depend on top-notch battery performance, spend the extra money. Gel Cell batteries still are being sold, but AGM batteries are replacing them in most applications.

There is a some common confusion regarding AGM batteries because different manufactures call them by different names. Some of the more common names are "sealed regulated valve," "dry cell," "non-spillable," and "valve-regulated lead acid" batteries. In most cases, AGM batteries will give greater life span and greater cycle life than a wet cell battery.

SPECIAL NOTE: It's common for individuals to use the term "gel cell" as a generic term when referring to sealed, maintenance-free batteries, much like one would use Kleenex when referring to facial tissue. As a result, be careful when specifying a gel cell battery charger, as many times we're told by a customer that they need a charger for a gel cell battery when in fact it isn't a gel cell at all.



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. Common manufacturer applications include high-performance engine starting, power sports, deep cycle, solar and storage battery. The larger AGM batteries we sell are typically good deep cycle batteries and they deliver their best life performance if recharged before allowed to drop below the 50% discharge rate. The Scorpion motorcycle batteries we carry are a nice upgrade from your stock flooded battery, and Odyssey branded batteries are fantastic for holding their static charge over long periods of non use. When deep cycle AGM batteries are discharged to a rate of no less than 60%, the cycle life will be 300 plus cycles.

GEL: The gel cell is similar to the AGM style because the electrolyte is suspended, but it's 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 voltage on this type of cell is 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.

4. CCA, CA, AH and RC. These are the standards that most battery companies use to rate the output and capacity of a battery.

Cold cranking amps (**CCA**) is a measurement of the number of amps a battery can deliver at 0°F for 30 seconds and not drop below 7.2 volts. So a high CCA battery rating is especially important in starting battery applications, and in cold weather. This measurement is not particularly important in deep cycle batteries, though it is the most commonly "known" battery measurement.

CA is cranking amps measured at 32°F. This rating is also called marine cranking amps (**MCA**). Hot cranking amps (**HCA**) is seldom used any longer but is measured at 80°F.

Reserve Capacity (**RC**) is a very important rating. This is the number of minutes a fully charged battery at 80°F will discharge 25 amps until the battery drops below 10.5 volts.

An amp hour (**AH**) is a rating usually found on deep cycle batteries. The standard rating is an amp rating taken for 20 hours. What this means for a 100 AH rated battery is this: Draw from the battery for 20 hours, and it will provide a total of 100 amp hours. That translates to about 5 amps an hour. ($5 \times 20 = 100$). However, it's very important to know that the total time of discharge and load applied is not a linear relationship. As your load increases, your realized capacity decreases. This means if you discharged that same 100 AH battery by a 100 amp load, it **will not** give you one hour of runtime. On the contrary, the perceived capacity of the battery will be that of 64 amp hours.

5. Battery Maintenance: A properly maintained battery is important for the ultimate in service life. Consider these points on a regular basis:

- The battery should be cleaned using a baking soda and water solution; a couple of tablespoons to a pint of water.
- Cable connections need to be cleaned and tightened as battery problems are often caused by dirty and loose connections.
- A serviceable battery needs to have the fluid level checked. Use only mineral-free water; distilled is best as all impurities have been removed and there is nothing left that could contaminate your cells.
- Don't overfill battery cells, especially in warmer weather because the natural fluid expansion in hot weather can push excess electrolytes from the battery.
- To prevent corrosion of cables on top-post batteries, use a small bead of silicone sealer at the base of the post and place a felt battery washer over it. 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. The gases from the battery condensing on metal parts causes most corrosion.

6. Battery Testing: This can be done in more than one way. The most accurate method is measurement of specific gravity and battery voltage. To measure specific gravity, buy a temperature-compensating hydrometer. To measure voltage, use a digital D.C. Voltmeter. A quality load tester may be a good purchase if you need to test sealed batteries.

For any of these methods, you must first fully charge the battery and then remove the surface charge. If the battery has been sitting at least several hours (I prefer at least 12 hours), you may begin testing. To remove surface charge, the battery must be discharged for several minutes. Using a headlight (high beam) will do the trick. After turning off the light, you're ready to test the battery.

State of Charge	Specific Gravity	Voltage	
		12V	6V
100%	1.265	12.7	6.3
75%	1.225	12.4	6.2
50%	1.190	12.2	6.1
25%	1.155	12.0	6.0
Discharged	1.120	11.9	6.0

Load testing is yet another way of testing a battery. Load test removes amps from a battery much like starting an engine would. A load tester can be purchased at most auto parts stores. Some battery companies label their battery with the amp load for testing. This number is usually half of the CCA rating. For instance, a 500 CCA battery would load test at 250 amps for 15 seconds. A load test can only be performed if the battery is near or at full charge.

The results of your testing should be as follows:

- Hydrometer readings should not vary more than .05 differences between cells.
- Digital volt meters should read as the voltage as shown in this document. The sealed AGM and gel cell battery voltage (fully charged) will be slightly higher in the 12.8 to 12.9 range. If you have voltage readings in the 10.5 volt range on a charged battery, that typically indicates a shorted cell.
- If you have a maintenance-free wet cell, the only ways to test are volt meter and load test. Any of the maintenance-free batteries that have a built in hydrometer (black/green window) will tell you the condition of 1 cell of 6. You may get a good reading from 1 cell but have a problem with other cells in the battery.
- When in doubt about battery testing, call the battery manufacturer. Many batteries sold today have a toll-free number to call for help.

7. 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 that engine starting batteries and deep cycle batteries are different. **Freshness** of a new battery is very important. The longer a battery sits and not recharged the more damaging sulfation build up there may be on the plates. Most batteries have a date of manufacture code on them. The month is indicated by a letter with "A" being January and a number "4" corresponding with the year 2004. C4 would tell us the battery was manufactured in March

2004. Remember the fresher the better. The letter "I" is not used because it can be confused with the number 1.

Battery Warranties are figured in the favor of battery manufacturers. Let's say you buy a 60-month warranty battery, and it lives 41 months. The warranty is pro-rated, so when taking the months used against the full retail price of the battery you end up paying about the same money as if you purchased the battery at the sale price. This makes the manufacturer happy. What makes me happy is to exceed the warranty. Let me assure you it can be done.

8. Battery Life and Performance: Average battery life has become shorter as energy requirements have increased. Two phrases I hear most often are "**my battery won't take a charge,**" and "**my battery won't hold a charge.**" Only 30% of batteries sold today reach the 48-month mark. In fact 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:

- Batteries sit too long between charges. As little as 24 hours in hot weather and several days in cooler weather.
- 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 to only 90% of capacity will allow sulfation of the battery using the 10% of battery chemistry not reactivated by the incompleting charging cycle.
- Heat of over 100°F increases internal discharge. As temperatures increase so does internal discharge. A new fully charged battery left sitting 24 hours a day at 110°F for 30 days would most likely not start an engine.
- Low electrolyte level. Battery plates exposed to air will immediately sulfate.
- Incorrect charging levels and settings. Most cheap battery chargers can do more harm than good. See the section on battery charging.
- Cold weather is also hard on the battery. The chemistry does not make the same amount of energy as a warm battery. A deeply discharged battery can freeze solid in sub zero weather.
- Parasitic drain is a load put on a battery with the key off. More info to follow on parasitic drain.

There are ways to greatly increase battery life and performance. All the products we sell are targeted to improve performance and battery life.



An example: Let's say you have "toys" such as **an ATV, classic car, antique car, boat, Harley, etc.** You most likely don't use these toys 365 days a year as

you do your car. Many of these toys are seasonal, so they are stored. What happens to the batteries? Most batteries that supply energy to power our toys only last 2 seasons. You must keep these batteries from sulfating or buy new ones. We sell [products to prevent and reverse sulfation](#). The [PulseTech](#) products are patented electronic devices that reverse and prevent sulfation. Also [Battery Equaliser](#), a chemical battery additive, has proven itself very effective in improving battery life and performance. Other devices such as [solar trickle chargers](#) are a great option for battery maintenance.

Parasitic drain Most vehicles have clocks, engine management computers, alarm systems, etc. In the case of a boat, you may have an automatic bilge pump, radio, GPS, etc. These devices may all be operating without the engine running. You may have parasitic loads caused by a short in the electrical system. If you are always having dead battery problems, most likely the parasitic drain is excessive. The constant low or dead battery caused by excessive parasitic energy drain will dramatically shorten battery life. If this is a problem you are having, check out [PriorityStart! battery switches](#) to prevent dead batteries before they happen. This special computer switch will turn off your engine start battery before all the starting energy is drained. This technology will prevent you from deep cycling your starting battery.



9. Battery Charging: Remember, you must put back the energy you use immediately. If you don't, the battery sulfates, which will affect performance and longevity. The alternator is a battery charger. It works well if the battery is not deeply discharged. The alternator tends to overcharge batteries that are very low and the overcharge can damage batteries. In fact, an engine-starting battery on average has only about 10 deep cycles available when recharged by an alternator. 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 battery chargers using computer technology can perform 3-step charging techniques. You don't find these types of chargers in parts stores or big box stores.

1. 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.
2. 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.
3. 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 it will maintain the batteries at 100% readiness and prevent cycling during long term inactivity. Note: Some gel cell and AGM batteries may require special settings or chargers.

10. Battery Dos

- 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.

11. *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 your equipment and toys into storage without some type of device to keep the battery charged.
- Don't disconnect battery cables while the engine is running (your battery acts as a filter).
- Don't put off recharging batteries.
- Don't add tap water as it may contain minerals that will contaminate the electrolyte.
- 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