BATTERY & CHARGING

A word of caution.

Batteries contain a sulphuric acid electrolyte, which is a highly corrosive poison, that will produce gases when recharged and explode if ignited. This can result into serious injuries. When working with batteries, you must have plenty of ventilation, remove jewellery and wristwatch, wear protective eyewear, keep a water bucket handy and exercise caution. Whenever possible, please follow the manufacturer's instructions for testing, installing and charging. This write up assumes a six-cell battery commonly used for 12 volt systems.

General

Deep-cycle batteries are different from automotive batteries. Deep-cycle batteries are used to power motors, lights or other load in absence of continuous charging current. In engine driven vehicles a dynamo or alternator continuously charges the battery and the battery is never heavily discharged. They are built differently than the battery used to start a car, which has only to deliver short bursts of energy until the alternator takes over, providing the electricity to run the car and recharge the slightly discharged battery. A deep cycle battery goes through many deep discharges. Often, the battery is drained to nearly zero before it is recharged. Deep cycle batteries are specifically designed to handle hundreds of deep discharges. Even the best automotive batteries won't last more than about 50 deep cycles, and of those, only the first 15 or so will recharge fully.

"Deep Cycle" Batteries

Deep cycle batteries are specially designed with denser active material and thicker plates to withstand deep discharge-recharge service. They are also reinforced by envelope and glass mat separators to reduce shedding of the active material. Car batteries, on the other hand, use porous active material and thin plates so that high-amp energy can be quickly delivered for maximum starting power. Repeated cycling weakens the positive plates and makes the active material fall from the grids.

Charging and Maintenance

The BEST method of recharging a battery is to SLOWLY charge it using an external constant voltage (or tapered current charger) because the electrolyte has more time to penetrate the plates. A constant voltage "automatic" charger applies regulated voltage at approximately 14.4 volts

When you are recharging VR (SMF or gel cell) batteries, charging voltages can be very critical and you need special recharging equipment. In most cases standard car type chargers can not be used..

The battery on the Electric Bicycle is a VR type or a sealed flooded type. Do not recharge with current above 15% of the battery's rating. Always use the charger originally supplied with the Electric Bike

Thinly coat the terminal and terminal clamps with a high temperature grease or petroleum jelly (Vaseline) to prevent corrosion.

Use the battery so that the negative cable will connect to the negative terminal. Reversing the polarity of the electrical system will severely damage or destroy it.

Perform preventative maintenance, especially during warm weather. This consists of visually inspecting for obvious problems like damaged case and leaks, corroded terminals, loose holding clamps and cable terminals.

Gel Batteries

Gel batteries are sensitive to high voltage charging (14.4 volts or more). The design permits rapid

Gel batteries are sensitive to high voltage charging (14.4 volts or more). The design permits rapid charging even at low charge voltages. Alternators and Battery chargers with high charging voltages can damage gel batteries.

Valve Regulated (VR) batteries are divided into two groups, gel cell and Absorbent Glass Mat (AGM). VR batteries are spill proof, so they can be used in closed areas, are totally maintenance free, and have a longer shelf life. Their greatest disadvantage is the high initial cost, but could have an overall lower cost due to a longer lifetime

Overcharge

Overcharging a battery occurs when the battery remains on charge after it has reached full charge. Overcharging causes excess heat that can cause the plates within the cells to buckle and shed their active material. Also, the battery will react to the overcharge by producing excess hydrogen and oxygen as the water within the electrolyte breaks down. The water that is lost due to overcharging can be replaced in a non-sealed battery; in a sealed battery the water loss is permanent and will negatively effect the battery's service life.

Life

Effect of extreme heat on a battery.

Extreme heat causes the water in the battery to evaporate faster than under normal temperatures. The heat also causes the grids that make up the positive plates to corrode more rapidly. These two factors are detrimental to the long-term life of the battery.

Which is more detrimental to a battery, heat or cold?

Both extremes create battery problems. Extreme heat will allow the battery to increase its performance level for a short term. However, internally it accelerates corrosion and other deterioration factors, which lead to an overall short battery life. Extreme cold temperatures within the battery result in a reduction of battery efficiency level, which reduces short-term performance.

Life of the battery is considerably reduced by heat, overcharging and by keeping the battery in discharged condition.

Tips

- Recharge batteries as soon as possible after use.
- Allowing batteries to sit in a discharged state for a prolonged period of time is damaging to the future capacity of the battery.
- Limit the discharge of the batteries to about 75% of the capacity available. Shallower the average discharge, the longer the battery life.
- Use a charger that it will recharge over a 6 to 8 hour period at 13.8 to 14.6 volts
- Buy the freshest and best quality battery. Only the rich can afford a cheap battery.
- A Digital Voltmeter is not expensive nowadays. And it will help you get the most from your battery.
- Avoid parking in direct sunlight.

Knowing The State-Of-Charge

- Use the following table to determine the battery's state-of-charge. The best way to measure the state-of-charge is to check the specific gravity in each cell with a hydrometer. But this is not possible with a sealed battery. So the possible procedure is to measure the battery's voltage with a good quality digital voltmeter with an accuracy of 0.5% or better.

State Of Charge	No Load Voltage
100%	12.75
75%	12.45
50%	12.25
25%	12.05
5%	11.85

- If the temperature of the electrolyte is below 21 degrees C, then add 0.021 volts (21 millivolts) per degree below 21 degrees C to the reading. A 100% state-of-charge for an AGM (absorbent glass mat) battery will be approximately 12.75 VDC and 12.85 VDC for a gel cell.

- During charging and up to 24 hours after charging, the surface charge effect can provide a higher voltage reading which is nor the correct value. If you are checking a sealed battery, you will have voltage as your only indicator of state of charge, so remove the surface charge before testing. If you have just recharged your battery, then eliminate any surface charge by applying some load for 2 minutes (using the bike for two minutes) and then wait for ten minutes.

Winter

Effect of extreme cold on a battery.

The amount of power a battery can produce is greatly reduced in the cold. At 17°Celsius, a battery will deliver only about 40 percent of the power it would at 27°Celsius. The slowing effect that cold temperatures have on a fully charged battery is not permanent. Using the battery itself warms up the battery to some extent. If a battery is not fully charged, however, the electrolyte can freeze and damage the plates or crack the container. Batteries at usable states of charge will not freeze at temperatures above 20°C. As long as the battery do es not actually freeze up; there is no permanent damage.

Storage

Batteries left undercharged will tend to sulphate, a process whereby deposits form on the battery's plates, leading to premature failure. A battery has internal electrical leakage that will cause it to become fully discharged and sulphated over time. Prior to storing a battery, it should be fully charged and recharged when it reaches 80% state-of-charge or six months, whichever occurs first. If a battery is not fully charged during winter storage, the electrolyte can freeze and damage the plates or crack the container.

THE MOST COMMON CAUSES OF BATTERY FAILURES

- Loss of electrolyte due to leakage, heat or overcharging,
- Sulfation in storage,
- Undercharging with voltages less than 13.8 volt
- Old age
- Vibration
- Freezing
- Corrosion and breakage of terminals

When to Replace the battery.

Replace the battery, if one or more of the following conditions occur:

- If the battery will not recharge to a 75% or more state-of-charge level (12.4 volts)
- If digital voltmeter indicates 0 volts (you have an 'open' cell)

- If the digital voltmeter indicates 10.45 to 10.65 volts at no load, you have a shorted cell. A shorted cell is caused by plates touching, sediment build-up or "treeing" between plates.

Normally a battery "ages" as the active plate material sheds (or flakes off) due to the expansion and contraction that occurs during the discharge and recharge cycles. Heat and vibration accelerate this "ageing" process. Eventually, the sediment builds up and can short the cell completely. Another major cause of faulty batteries is sulfation. When batteries are stored discharged for over six months, lead sulphate makes the plates very hard and dense and the battery less capable or unable to be recharged. When the active material in the plates can no longer sustain a discharge current and the battery "dies".

Using a new battery

There is a misconception that a battery must be fully discharged and charged 4 - 5 times during initial periods. This is not true. A deep cycle battery does not require a deep discharge at any time in its service life. In fact, for best results, it is recommended to shallow or moderately discharge the first 5 to 10 cycles.

Batteries and 'Memory'

Lead-acid batteries do not develop a memory. This is peculiar with Ni-Cd batteries used in cordless phones and computers. Lead-acid batteries have the ability to cycle to various amounts of depth of discharge anytime during their service life without a memory developing inside the battery. So ignore this aspect.