Recommendation: Find a good source for Golf cart batteries 6 volt batteries they usually give a good price per value. And if one cell goes out it can usually be jumper over to short it so the other two can be used in series to build a 12 volt battery. For example 3 – 6volt batteries each with one shorted cell can be put in series to make a usable 12 volt battery. These in this way are more economical in the long run than a bunch of 12 volt batteries in parallel connection.

Other names for same thing: fork lift (**Trojan** L-16 or =) or golf cart (**"Trojan"** 105, 125, 145 or =) -- assuming you have a place to put them. **"Exide"** and **"Interstate"** also manufacture good golf cart batteries

The state of charge of a lead acid battery can be checked in several ways. The first, and arguably easiest method is to measure the voltage of the battery bank. A fully charged 12 volt battery will read about 12.7 volts (2.06v/cell) at 70 degrees Fahrenheit. (double this for 24 volt systems) By the time the voltage reads 12.2, it is 50% discharged, and at 11.9 it is considered empty. The problem with measuring charge in this way is that if there has been any recent activity (charging or discharging) in the batteries, the readings will be highly inaccurate, and temperature can also adversely affect the reading. The second method to determine the state of charge is to use a hydrometer. By measuring the specific gravity of the battery bank, the hydrometer can give you an accurate indication of remaining energy. For example, a fully charged battery may read 1.270, at 50% read 1.190, and at 1.100 be discharged. Hydrometer readings should be adjusted for temperature, and should be performed with the batteries at rest for at least ½ hour. The third and most convenient way to measure battery capacity is with an amp hour meter. These totalizing meters measure energy flow into and out of the battery and keep a running total of available energy at any given instant. Although they may require occasional resynchronization, these meters are very accurate and provide at a glance insight into the state of your system.

See http://www.solaralaska.com/primer/battery.htm

HOME POWER BATTERIES

THE BATTERY IN THE HOME POWER SYSTEM

The battery bank in a home power system serves two purposes. It acts as a voltage stabilizer for the system, moderating the high voltages that can occur during battery charging and minimizing the low voltages common in high demand situations. It also acts as a power reservoir, supplying the power needed when the load demand exceeds the capabilities of the power (charging) source. For instance, if you have a solar panel that produces 51 watts of power and want it to power a light bulb that requires 100 watts, the additional 49 watts of power required by the light bulb will be supplied by the battery. The power used by the battery is then replaced when the light bulb is not in use.

RV/MARINE BATTERIES

RV and marine batteries are available in a variety of sizes to 100 amp hour and are normally 12 volt. They may be of the standard, serviceable type or the sealed, "maintenance-free" style. They are common in small home power and portable power systems.

- Advantages: These batteries are small, compact and easy to handle and install. Their initial cost is relatively low. The sealed types have the added advantage of being nonspillable and low gassing which makes them attractive for indoor applications.
- Disadvantages: These batteries are not designed for heavy cycling so they may have a shorter life span than other types, depending on how heavily they are cycled. To obtain more than 100 amp hours capacity more than one battery must be connected in parallel. The sealed types have the added disadvantage of having limited cycling capability and sensitive charging characteristics. They can easily be overcharged.

GOLF CART BATTERIES

These batteries are available in 220 to 300 amp hour capacities and are normally 6 volts per battery. They are a good choice for small to medium home systems.

- Advantages: Since these batteries are designed for deep cycling they will give better performance and longer life than the RV/marine batteries. They are still relatively light in weight and easy to handle and have lower per-amp-hour costs than the RV/marine batteries. They are also less susceptible to damage from overcharge and can handle higher charging currents.
- Disadvantages: Since they normally are 6 volt and most home power systems are 12 volt, these batteries require a series-parallel connection which is a little more complicated. They will give off more gas during charging and should be stored in a ventilated area. There will be some water loss which will require replacement water periodically. Their 6 volt configuration limits the amp hour capacity so they are not good batteries for large systems.

INDUSTRIAL/STATIONARY BATTERIES

These batteries, which are normally manufactured as individual 2 volt units, are available in a broad range of capacities to 3000 amp hours. Six 2 volt units are connected in series for 12 volt systems. They are an excellent choice for medium to large capacity home power systems.

- Advantages: These batteries have the advantage of long life under deep cycling conditions. Since the desired system capacity can be achieved in one six-cell configuration, charge/discharge characteristics are excellent. Maintenance and cycling specifications will vary but are well suited to home power applications.

- Disadvantages: The initial set-up costs will be higher, because of the additional amp hour capacity. Also, these batteries are quite heavy (to 350 lb. per 2 volt cell) and will require a well-supported area and special handling and transportation assistance.

NICKEL CADMIUM/NICKEL IRON BATTERIES

The batteries previously discussed are called "lead-acid" batteries in that they consist of lead plates in a sulfuric acid solution and are the most common batteries utilized in home power applications. Nickel cadmium and nickel iron batteries consist of nickel alloy plates in an alkaline solution which dramatically alters the operating characteristics of the battery. These batteries are also good choices for home power systems but involve special considerations.

Advantages:

- 1) They are longer life. The best lead-acid batteries may achieve 20 years whereas the nickel alloys can have a 50 year life.
- 2) Maintenance is lower due to higher voltage characteristics and their ability to sit partially or totally discharged for extended periods of time without failure.
- 3) Battery voltage on the nickel alloy batteries does not follow the basically linear pattern of the lead-acid batteries during discharge so much more of the rated amp hour capacity is actually available at the practical level. In addition, the nickel alloy batteries can be repeatedly completely discharged without damage or loss of battery life.
- 4) The nickel alloy batteries are not easily damaged by severe cold and retain higher discharge potential than the lead-acid in colder temperatures.
- 5) Nickel alloy batteries have lower internal resistance so matching batteries of differing ages and sizes in a home power system battery bank is much easier than with lead-acid batteries.

Disadvantages:

- 1) The initial cost of purchasing a nickel alloy battery bank is very high compared to lead-acid, even with the reconditioned batteries (which are most prevalent in home power systems). This is the major deterrent to most people.
- 2) the broad charging voltage range creates some compatibility problems which have to be addressed when matching the nickel alloy batteries to other home power equipment such as inverters or chargers.
- 3) Their non-linear discharge rate makes the charge state of the nickel alloy batteries more difficult to monitor.
- 4) The nickel alloy batteries are often not as easily disposed of as lead-acid batteries when their useful life has ended.

Lead - Acid batteries

Batteries serve as a storage device for electrical energy. Although the general idea is simple, batteries must be carefully selected and maintained to have a reliable power system. If batteries are poorly selected or maintained, they can degrade at a rapid pace and require frequent or premature replacement, often at considerable expense.

Cycling

The normal use of a battery is known as cycling. Cycling is the process of removing electricity from and replacing it to a battery system. When electricity has been consumed and then replaced, it can be said that the battery has been cycled. The extent of the cycling or the depth of discharge is usually expressed as a percentage of the total battery capacity. Thus, if 50 amp hours is consumed from a 100 amp hour battery , it is said to be 50% discharged. A cycle exceeding about 20% of a batteries capacity is said to be a deep cycle, while a discharge and replacement of less than 20% is referred to as a shallow cycle.

Efficiency

Not all the energy that is put into a battery can be taken back out. Some 10 to 20 percent will be lost ultimately to heat through the electrochemical charging process. As such, 110 - 120 amp hours must be imparted to a battery to provide 100 amp hours of usable energy.

In addition to the losses incurred during charging, another source of energy loss is self-discharge. The "typical" lead acid battery will lose 10 - 20% of its energy in a month, more at high temperatures, less at lower temperatures. Lead calcium batteries have lower self discharge rates than lead antimony types, but perform poorly as true deep cycle batteries.

Temperature

As well as affecting self discharge rates, temperature affects battery performance in other ways. The optimum performance temperature range for batteries is 60 - 80 degrees Fahrenheit. At these temperatures, the battery will perform at 100% of its rated capacity. As temperatures drop, battery longevity increases, but performance drops. The battery goes into a state of partial "suspended animation" and only some of it’s potential power is available. You may have experienced this while starting your car in cold weather. (unless you are fortunate enough to live where there is no such thing as cold weather.) For example, at freezing (32 degrees Fahrenheit) some 65% of battery capacity can be utilized, but at zero only 40 percent is available.

Freezing

Freezing of batteries is a major concern of northern climate inhabitants. A fully charged battery typically will not freeze down to 70 to 90 degrees below zero, while a fully discharged battery is susceptible to freezing at +32 degrees. This is because of the chemical process which creates electricity in a battery. As a battery becomes discharged, the sulfuric acid in the electrolyte gradually bonds to the lead oxide in the battery plates. As this process continues, the electrolyte becomes less and less concentrated, until finally it is (theoretically but I wouldn't drink it) pure water. Since water freezes at +32 F, the dead battery will then freeze at this temperature. Damage caused by freezing is mostly mechanical, I.E. the bursting of cases, plate breakage, separator failure, mechanical shorting, plate material delamination and many other woes too hideous to mention. Although batteries can sometimes survive even a severe freeze-up, there is always damage done, and reduced life can be expected.

Maintenance

A properly maintained battery bank can last 10, 20, or even 30 years in rare instances. A poorly maintained bank of the same quality can be ruined in a matter of months (or even days at the hands of an expert). This is why battery maintenance is so important. Here are the basic do's & don'ts:

DO:

- Water batteries after charging , but only to the indicated full mark.
- Keep the batteries from freezing, especially when discharged
- Use only distilled water to water batteries
- Periodically check the specific gravity of each cell with a hydrometer - Wide (<.020) variations indicate the need for an equalize charge and can indicate a failing cell.
- Perform an equalization charge every 3 months or so, regardless of specific gravity variation, to remove any sulfation and mix the electrolyte. This is energy well spent.
- Wear goggles when dealing with batteries. Gloves and a rubber apron are a good idea as well.
- Keep a supply of fresh water on hand when working around batteries. This can be used to rinse hands, eyes, or clothing to remove battery acid.
- Keep batteries stored at a full state of charge. Long term discharge causes batteries to sulfate, and will eventually render them useless.
- Educate yourself in the care and maintenance of the batteries you are using.

DONT:

- Use tap water

- Work on batteries with metal tools immediately after or during charging, they could cause a spark and subsequent explosion
- Overcharge your batteries
- Allow connections to get so corroded that you can barely see them for the gooky stuff, or at all, when possible.
- Work with batteries without proper safety equipment and procedures.
- Drop batteries, especially on your toe.

GOOD IDEAS:

- Keep a log of specific gravity readings and voltages
- Contact us if you have any questions
- Keep safety stuff in the battery area for easy access

Equalizing

An equalization charge is merely a controlled overcharging of the battery bank. This can be accomplished by using a generator and battery charger or other power sources with the voltage regulation equipment turned off. The object is to bring battery voltage to 15 - 16 volts and hold it there until hydrometer readings in all cells are equal or have stopped increasing, or until all sulfation (white flecks on the plates) has been removed, or both. 15 -16 volts is too high for some electronic equipment, so you should check maximum ratings and disconnect these items as necessary. At these charging voltages, water loss will be significant and water should be replaced as needed. Take care that the batteries do not get hot to the touch (warm is OK) and if necessary reduce charging current or voltage.

Gassing

Gassing is a normal process that batteries undergo while charging. During the charging process, hydrogen and oxygen are released into the air through the vents on the battery tops, usually along with some water vapor. This can often form a damp surface on the battery that is conductive, leading to corrosion. Remove this film by rinsing with hot water. Water loss through gassing can be reduced through the use of hydrocaps, little catalyst do - dads that recombine the hydrogen & oxygen into water, which drains back into the battery.

Caution

Because gassing produces hydrogen (very flammable) and oxygen (which makes things even more flammable) great care should be taken not to inadvertently ignite this (flammable) mixture. Although the quantities produced are small, in a tightly confined space (like in the tops of the batteries) a flame or spark can cause a violent explosion, shattering batteries and sending acid and debris flying about at ridiculous speeds. It is good practice to give batteries the same consideration you would afford to a fuel can or tank in this respect. (unless you are one of those folks who puts out cigarettes in gas cans just to prove that it won't light)(this is a very, very, bad idea)

Corrosion

Through the gassing process, some corrosion can be expected to accumulate on battery terminals or metal in the vicinity of the batteries. This can easily be removed with HOT water and a scrub brush. Be sure to rinse clean, and as always when working with batteries, wear eye protection. If left unchecked, corrosion can destroy battery posts and terminals, eat through enclosures, and even create dangerous sparks if connections fail. While sometimes fun to watch, corrosion is generally a bad thing and should be held in check through regular cleaning and maintenance. (kind of like teeth)

Enclosures

Batteries should be placed in a vented enclosure that will maintain a temperature of 50-80 degrees Fahrenheit. Sometimes this is simply not possible, but you should do the best that you can. Proper venting of the battery compartment helps to remove the hydrogen and is easily accomplished. Merely venting the highest part of the battery box to the outside is often all that is required. Small battery banks may not require venting, but should be protected from sparks & open flame.

Determining the state of charge

The state of charge of a lead acid battery can be checked in several ways. The first, and arguably easiest method is to measure the voltage of the battery bank. A fully charged 12 volt battery will read about 12.7 volts at 70 degrees Fahrenheit. (double this for 24 volt systems) By the time the voltage reads 12.2, it is 50% discharged, and at 11.9 it is considered empty. The problem with measuring charge in this way is that if there has been any recent activity (charging or discharging) in the batteries, the readings will be highly inaccurate, and temperature can also adversely affect the reading. The second method to determine the state of charge is to use a hydrometer. By measuring the specific gravity of the battery bank, the hydrometer can give you an accurate indication of remaining energy. For example, a fully charged battery may read 1.270, at 50% read 1.190, and at 1.100 be discharged. Hydrometer readings should be adjusted for temperature, and should be performed with the batteries at rest for at least ½ hour. The third and most convenient way to measure battery capacity is with an amp hour meter. These totalizing meters measure energy flow into and out of the battery and keep a running total of available energy at any given instant. Although they may require occasional resynchronization, these meters are very accurate and provide at a glance insight into the state of your system.