SOME BATTERY SYSTEM TIPS

- A flooded battery will freeze if it is discharged and left out in the winter
- A deep cycle is going below 80% of the batteries capacity
- You should try to always maintain a battery at the 50% or above capacity level for maximum life
- A battery will lose up to 30% of its capacity in cold weather
- A good quality flooded type deep cycle battery can last 4 or 5 years with proper charging and maintenance
- Before buying a battery check the number of deep cycles provided
- Check the water level at least once per month and before/after every trip
- As batteries age they provide less amp/hours under load and are more susceptible to cold temperatures
- A good battery with a proper charger should only require water 2 to 4 times per year
- A battery may test good but can actually become a lower amp/ hour unit due to aging or poor care
- After a deep cycle a battery must be fully charged to avoid serious damage
- Most automotive charging systems do not put out suffcient voltage/current to restore an RV battery in a deep cycle unless a special hook up has been provided
- Most of the poorer charging systems cannot restore a battery from a deep cycle or conversely, if they can they usually overcharge the battery if left on charge for long time periods
- Keep batteries/terminals clean and coat connections with silicon dielectric
- Take off the ground terminal frst
- Purchase a Digital Multimeter to take care of your batteries and provide a troubleshooting capability for your RV
- Learn how to use Ohm's law to size and check out your battery requirements
- If you need more amp-hours increase the size and/or number of batteries in parallel

CHARGERS

The best chargers provide four stages of computer chip controlled charge current. This type of charger will provide the best battery performance and the longest useful life. They usually have switches and sensors to optimize charge parameters for different types of deep cell batteries and the ambient temperature. This allows you to keep the batteries on continuous charge. If you have a source of shore power your batteries can be left in the RV during the winter months with no danger of freezing. Once I changed to a computer chip controller, I have kept my batteries on charge, continuously, since 1989. They are always charged and ready to go on one of my winter camping trips.

1. The **BULK** stage brings the battery up to about 80% of a full charge and essentially provides whatever current the battery will accept. The charge current is constant and should not exceed about 20% of the amp/hour capacity of the battery bank. Typically this is about 20 amps per battery, which results in a charger capacity minimum of 40 amps for the trailers with Group 27 batteries. The voltage is in the range of 14.2 to 15 volts.
2. The **ABSORPTION** stage where the charger voltage is constant and the current decreases until the battery is fully charged. This represents a voltage of around 14.1 to 14.8 volts that provides the last 20% of recharge.
3. The **FLOAT** (trickle charge) stage is used to keep the battery in a fully charged condition in order to overcome the self-discharge rate. This is typically in the 13 to 13.6 volt range.

4. The **EQUALIZE** stage is a controlled overcharge designed to mix the acid evenly in the cells and remove sulfate crystals that have built up on the plates. This is typically in the 15.5 volt range of charge voltage. It can last for 6 hours and should be done every 2 or 3 months. This can bring a seemingly dead battery back to life. Before using this stage the battery should be fully charged and the water levels should be checked (before and after).

These chargers also have sensors, attached to the battery terminals, which change the various stage parameters as a function of the battery temperature. They also have switches which optimize the charge parameters based on the kind of battery being charged (Flooded, Gel, AGM). Yes they are more expensive, but that is how you get the best performance and longest life out of a set of batteries. Reference 3, (http://batterytender.com/resources/battery-basics.htm) provides more details on the charging algorithms.

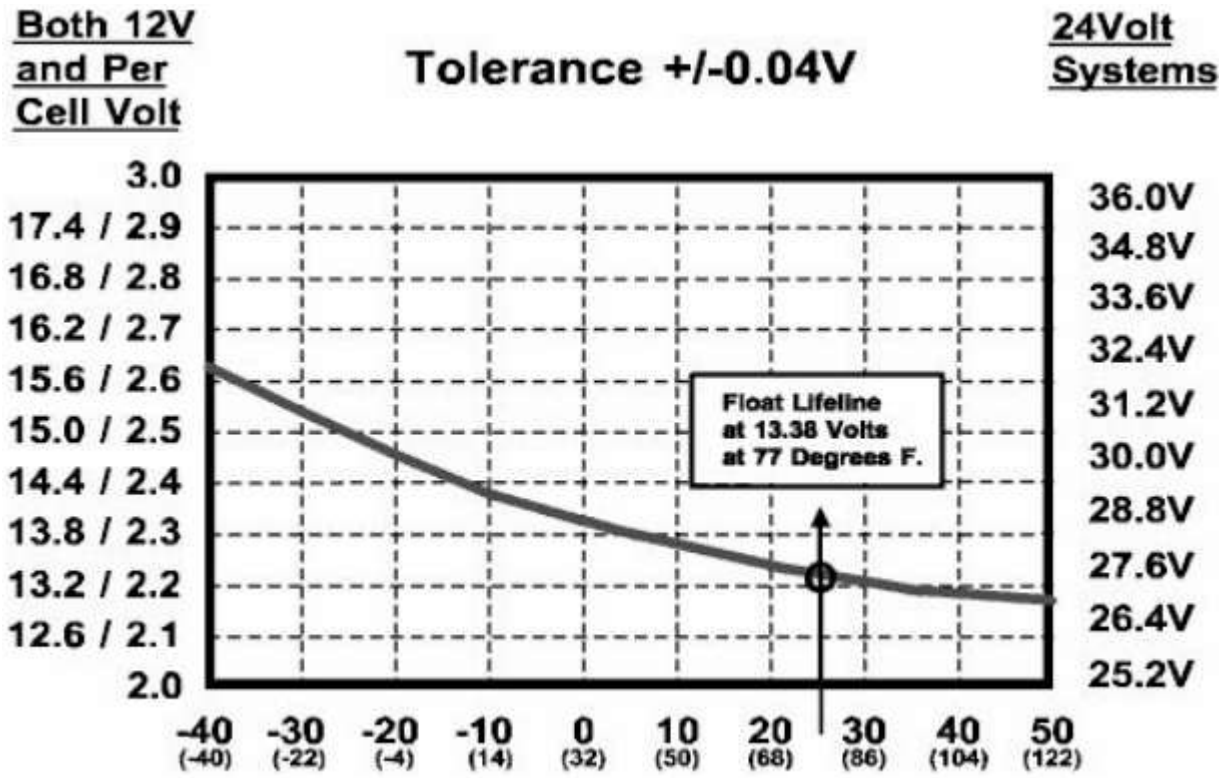

Figure 4. Optimum Charge Voltage versus Temperature

Figure 4, illustrates how the float volt- age (trickle charge) varies as a function of temperature. As you can see there is a wide range of charging voltage as the battery temperature changes. All of the quality chargers, that provide four stage computer controlled voltage, include a battery temperature sensor to modify the output charge voltage. The sensor is bolted to the battery ground terminal with output wires that couple the voltage to the charger. The charge voltage must be significantly increased at lower temperatures in order to get a good charge.

My first Airstream motorhome had a transformer type charger similar to the early Univolts. Batteries seemed to last 2 or 3 years, after 2 years they constantly needed

water, I had to bring them in the house during the winter, because the charger would boil out the water. I finally had enough and purchased a fac- tory rebuilt marine type Statpower (now named Xantrex) charger. This was one of the first available computer controlled chargers. It even had two complete channels so that two sets of batteries could be charged independently. I hooked up one of the channels to the engine start battery and the other channel to the two deep cycle batteries. It included a temperature sensor and an equalize stage that I used once every two months. Now my batteries typically lasted for 5 years and were always fully charged, since I kept the Coach plugged into shore power during the winter months. Twenty years later the charger still worked fine and it is now running around the countryside in England. Remember; **a quality charger can turn a cheap battery into a win- ner while a cheap charger will turn a quality battery into a piece of junk.**

To fully charge a battery that is in a deep cycle will take about 8 hours. You will need a charger that can supply at least 20 amps to get the charging started. Let's assume your tow vehicle can supply this current level, as long as your starter battery is almost fully charged and you are not using any high current options in the tow vehicle. So, after a night of dry camping you should be able to bring the batteries back up as you drive to the next stop. Not likely, since most tow vehicles do not have either a high enough output voltage or the proper size wire run to deliver that level of current to the Coach batteries. To check this, after a night of dry camping, hookup the trailer and have a friend run the engine at about 2500 rpm while you take your new digital voltmeter and measure the voltage on the deep cycle batteries. You should be getting around 14 volts in order to bring the battery out of a deep cycle.

I am not saying you should throw out your current charger and buy a new one. More recent trailer models have multistage chargers that provide a reduced trickle charge, when needed, and work fne for most applications. Some of the older trailers, however, have way too high a voltage that can lead to battery overcharging, boiling and water loss. If you have to replace the charger, for whatever reason, then you should defnitely consider a computer controlled unit. Prices vary from 230-360 dollars for 45 to 80 amps.

INVERTERS

The Converters (chargers) described in the last section essentially convert 120 VAC to 12 plus volts DC. An inverter is just the opposite it converts, 12 volts DC from a battery to 120 VAC to run appliances in your RV. It draws amp/hours from the battery system to power the things we would like when we do not have shore power. Some of our appliances work directly from the batteries i.e. water heater, furnace, refrigerator, lights, radio, etc. (some of them with a little help from the propane). Things we would like to have that cannot be run from DC include, hair dryer, coffee maker, toaster, microwave, TV, Hi-f stereo, computer, vacuum cleaner, satellite TV, small battery chargers for phones and I-pods. Large motorhomes usually include combination Converter/Inverter units that provide several kilowatts of AC power as well as a computer controlled charger. Some of these include multiple large 4D or 8D batteries that can easily power large microwave units. These are built in with all the needed wiring and control circuits available. Several of the appliances are already connected to the Inverter through multiple use receptacles, that are also shore powered, when it is available. Adding this capability to a trailer or motorhome, after the fact, would be an extremely diffcult and expensive undertaking, which I do not usually recommend.

If you are almost never going to dry camp (boondock) and are always going to stay in campgrounds with electric then you have no need for an Inverter. Even if most of the

time you overnight in a campground but you occasionally do a Wal-Mart or a Cracker Barrel then an inverter could be handy.

Most inverters under 300 watts can be plugged into a cigarette lighter, have a single AC output receptacle and a cooling fan (for the higher rated units), which only operates when the unit gets too hot. When you get above 400 watts you are going to be drawing currents in excess of 30 amps which cannot be reliably handled by a cigar lighter plug. In this case you will have to run suitable size wires (Reference 1) directly from the battery to the Inverter.

Typical costs for non-sinewave inverters are as follows:

300 watts ($40-$60): For household appliances, TVs (up to 27”), VCR, desktop computers, other mobile offce equipment. Most of these connect via a 12-Volt cigar lighter plug.

600 watts ($100-$120): For household appliances, large screen TVs, 5-amp power tools, computers, and printers. Most such inverters are connected directly to the 12-volt battery and have three or more grounded outlets for powering several products at the same time.

1750 watts ($199-$380): For household appliances, larger power tools, microwave ovens, toasters, and hair dryers. All of these inverters are designed for direct connection to the battery network and can generally supply 1500 watts of continuous power.

3000 watts ($395-$750): With output power generally rated at 2500 watts for continuous load, these inverters can power virtually all household appliances and offce equipment. For loads of this magnitude, special wiring and battery banks will be required.

Usually Inverters provide a modifed sine wave output voltage will work fne with most TVs, computers and small heat type appliances. True sine wave inverters can cost two to fve times as much as the square wave units. These could be required for fax machines, laser printers, equipment with variable speed motors, plasma displays, some gaming systems and high end audio/video systems. Carefully check out what you want to run before making an inverter purchase.

Because of the wiring problems and multiple locations of the 120 volt AC appliances you might want to run, I usually recommend several small inverters located near the 12 volt sources. Be sure and check your wire sizes for the current capability required. If the appliance is 10 to 20 feet from a DC voltage source make the 12 volt feed lines short and run an extension cord for the 110 volt AC lines (they only have to handle 1/10 of the current). You can easily replace a 12 volt cigarette lighter with a cover plate and binding posts for connecting the larger inverters (if the existing wire is large enough). The larger units come with multiple AC sockets so you can set one up in the front of the rig to run a computer and the TV. A good location would be under the front couch where you will have a very short wire run to the batteries.