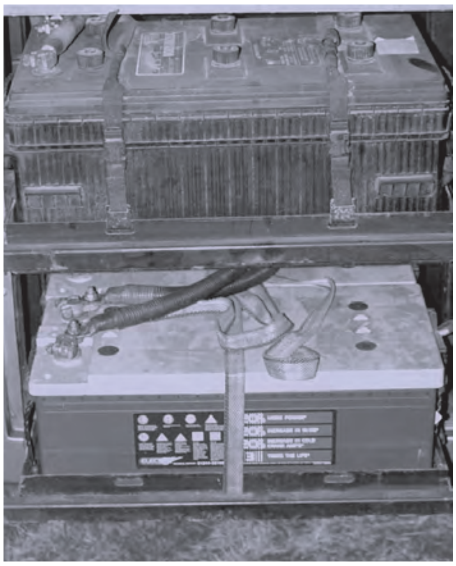
Batteries and related matters

This three-part article has been published in earlier editions of ARVM but because of the number of battery problems experienced by RV owners we have decided to rreprint for the benefit of those new to American RVs and to others who mislaid the article.

PART 1

This article starts with the basics then gradually gets more advanced, with more e xtensive tests and interpretations. Some topics are mentioned se veral times, usually with more details and e xplanation, sometimes for emphasis. Even experienced RVers should star t with the basics as there are a lot of misconceptions when it comes to batteries.



THE BASICS

First things first. A 12-volt battery is not a 12-volt battery. Twelve volts is just a nominal, convenient term used to distinguish one battery from another. A fully-charged 12-volt battery, allowed to "rest" for a few hours (or days) with no load being drawn from it (or charge going to it), will balance out its charge and measure about 12.6 volts between terminals.

When a battery reads only 12 volts under the above conditions, it's almost fully depleted. Actually, if a battery's resting voltage is only 12.0 to 12.1 it means only 20 to 25% of its useful energy remains. It's either a goner or it has been deep cycled, and a battery can only be deep-cycled a limited number of times before it is indeed dead.

12-volt batteries supply useful energy only through a limited range – from over 14 volts (when fully charged and unrested) down to 10.5 volts in use/under load (when lights dim, pumps groan and TV pictures get small). No 12-volt battery will remain at over 14 volts for more than seconds unless it's being charged. The lowest limit is 10.5 volts (used in testing) and obviously unsatisfactory in practical use. Experienced RVers try to use no more than 20% to 50% of the energy available in a battery before recharging. That means they never let resting voltage get below 12.5. They never use more than 50% before recharging (resting volts of 12.3) except in an emergency. They know that, if resting voltage ever reaches 12.1, they have deep-discharged one cycle and that a battery is good for only so many cycles (from as low as 20 in an automotive battery to 180 in a golf cart battery, with the typical RV/marine battery good for no more than 30).

RESTING VOLTAGE IMPORTANT TO UNDERSTAND

Resting voltage causes some confusion, although it shouldn't. It means with no charging and nothing drawing electricity. No night lights, clocks (to include microwave), radio or TV memories (some have circuits that remain "on" even with the unit turned "off" to recall preset channels, etc. – so-called "phantom loads."). And don't forget the LP gas detector/auto shut-off – a real energy user. No refrigerator on (the "brain" in a three-way uses 12 volts even when running on AC). Needless to say, testing voltage this way can be a rather tedious job. There is an easier way to do it: If you have two or more house batteries, disconnect one of them and charge it fully with a reliable manual charger. The other(s) will run your RV while the disconnected one "rests." Overnight is OK. A day or two is better. Then check the resting battery's voltage, reconnect it and repeat the test on another one. You only need to make this test once or twice a year. (It's a good time to clean your batteries and connections as well.) (More later on converters, manual chargers, meters and correct voltage.)

MANAGEMENT

You need to know what you can get out of your battery without dropping it below an acceptable voltage, but it's not a daily exercise. Done a time or two (or three) with notes taken, you'll soon know how many hours you can run lights, TV, etc., before recharging is needed. This is how experienced RVers calculate how many days they can rally or wild camp before cranking up a generator. It's a mix of conservation, intelligent charging and battery care.

It's best to practice this while you're on an electrical hookup so you can recharge faster when finished:

Switch the refrigerator to LP and turn off unnecessary 12V appliances.

Fully charge battery(s).

Record the time.

Shut off converter or battery charger, or unplug your RV if there no way to switch it off.

Run off 12 volts for 24 hours (or some convenient time) using appliances and lights as you would normally.

Occasionally check with a digital volt meter (see later) and record time when meter drops to each % Of Charge. Don't, though, go below the 50% level in this test.

Simultaneously record the appliances you have running and how many minutes they run (that's each appliance, including number and type of lights, if you really want to do this right).

When you reach the voltage that approximates 50% Of Charge, turn your battery charger back on. You now know how long you can run the coach, in "normal" use, without charging, before chancing a "deep cycle." Do some simple maths (below) to refine this and calculate where you can conserve electrical use to extend your time.

NOTE: When measuring above, that when the battery is under load, but not being charged, volt meter will read lower than actual battery state. For example: If TV and lights are on, the meter might read 12.3. Don't panic. Turn heavy loads like those off. Watch meter. If batteries aren't substandard, it will increase volt reading then stabilize. That's the point where you take your reading. (An easy, quick way to observe this is to watch the meter while you run enough water to make the pump start. You'll see a drastic drop in voltage. Shut water off. When pump stops you'll see meter reading start to creep back up.)

SOME SIMPLE MATHS – Either before or after the 8-step test above you need to calculate the amp hours you use:

Quick way: After the test above you found you could run (x) hours of lights, (y) hours of TV, (z) hours of etc., before reaching the point where you were about to deep-discharge the battery.

Proper way: Highly recommended that you do this at least once.

Record actual minutes any given appliance was running.

Convert to Amp Hours as follows: 2a) Read label on appliance for amp draw. Can't find it? Look for Watts or VA (same thing for our purposes). Watts = Volts x Amps, so 60W = 12V x ?A and 60 divided by 12 = 5A. (If this doesn't make sense you didn't pay attention in school.)

If your appliance draws 5 Amps and it was running an hour, that's 5 AH (Amp Hours) because AH = Amps x Time (in hours). And if it didn't run an even hour? Then use minutes divided by minutes in an hour (e.g. 60 minutes divided by 60 minutes [the minutes in an hour] =1, so if the appliance was on 12 minutes and it was drawing 5 amps, then AH = 5 x 12/60 or 1AH (or 5 amps for 1 hr 15 min = 5 x 75/60 = 1.25AH).

TIPS: Almost any appliance will have a label or the same info in its booklet. The circuit boards on some refrigerators, water heaters and furnaces use 12 volts also. It's only a small amount, but should be considered because it's being consumed 24 hours a day and the total can amount to a few amps. (On the other hand, the 12 volt fan on a furnace uses an enormous amount of electricity – don't miss that one.) Doing it the proper way allows you to predict in advance how many Amp Hours you'll use. Don't be alarmed if your 105AH battery, when voltage indicates it's at 50% of capacity, has given you a lot less than the 50AH you expect. Most batteries are seriously overrated by the manufacturer, seldom yielding 80% of their stated rating. (See more on battery capacity later.)

CHARGING VOLTAGE

Charging voltage is different. **Some more basics:** If you read articles on how electricity flows, you will see comparisons as to how water flows. This is okay up to a point, but water also flows by gravity. Electricity doesn't, it has to be "pushed" (just as water has to sometimes be pumped).

You have to have more "juice" at one end of a wire than you need at the output or electricity won't flow. The wire you pump electricity through and the connections in the lines resist the flow. You have to overpower it. Similarly, batteries have an inherent resistance to take a charge because of their chemical makeup. It's like "making a blivet" (a blivet is 10 pounds of poop in a 5 pound bag). You have to force more electricity into a battery than it would like to accept or it won't be fully charged. To charge a 12-volt battery, you have to bring it up to above 14 volts (amount varies with the type of battery).

The typical wet-cell battery (a tub of lead plates in a mixture of sulphuric acid and water) needs to be charged up to about 14+ volts in order to adequately distribute those funny little things called electrons through the plates. Once that's done, the battery can rest. As it does, the electrons distribute themselves and eventually balance out at 12.6 volts (more or less, depending on the type of battery and its condition). This is your starting point. Doesn't sound like much, does it?

MORE AMPS AND VOLTS

I mentioned earlier that you should only draw a battery down to about 12.3 volts before recharging. Obviously, there's more to it than that. Amperes are the measure of actual power available. They're usually converted to amp(ere) hours (AH). Think of it as the amount of (nominal) 12-volt power you can draw out of a battery for a certain amount of time. It's not just three-tenths of a volt. It's 12 (nominal) volts for a certain amount of time. The three-tenths stuff is nothing more than a difference in measurement – like the difference between three-fourths of a tank of gas and a half tank.

Look at voltage as two things: First, a force that pushes electrons – Second, as a handy measurement.

Look at amperes as two things: First, a quantity of energy (like you would a gallon of gas) – Second, as a handy measurement. From a (nominal again, don't forget) 12-volt tub of energy, you can extract just so many amperes of power.

Keep in mind that the laws of physics prevent you from getting more out of something than you put into it! Keep in mind that waste (those wires, battery chemicals and such) prevents you from taking out as much as you put in. Keep in mind that you're going to have to put in about 10% more electrical power than you use (high school physics). A battery bank is like a "money" bank or checking account – if you repeatedly take more out than you put in, you'll eventually be in trouble.

MORE ON CHARGING

Not all batteries are the same. Standard wet-cell batteries can be charged to 14+ volts (usually 14.3 but depends on the manufacturer). Gel-cell batteries and other sealed batteries should never be charged to more than about 14.1 volts (again, may vary depending on manufacturer). And these figures only pertain when the charger will be disconnected as those levels are reached (as with a generator, solar system, portable charger, or engine alternator). As the volts drop (usually down to about 12.6 to 13.3), charging begins again, either manually or through an automatic regulator. Note also: The maximum charging voltage quoted for gels by the manufacturer is as a sustained voltage, not an intermittent one. That means brief over voltages before a regulator shuts off are OK.

Sustained charging, where the batteries are "floated" at a constant charge (as in the RV converter or with an automatic portable charger) should not be done at more than 13.8 volts (and 13.65 makes batteries last longer). It's supposed to keep the batteries "up" to a reasonable level without undercharging or overcharging them (the assumption being you'll "top them off" by driving). Unfortunately, many cheap chargers and RV converters don't regulate very well. Overcharging destroys batteries quickly. Undercharging destroys batteries too, but more subtly as the battery stratifies and will no longer maintain a charge. In effect, the 100 amp/hour RV battery becomes a 10 amp/hour battery after consistent undercharge. It will read full voltage, but as soon as a small load is placed on it, it drops to nothing. RVers who remain plugged into commercial power for long periods often never know this has happened until they unplug, because the converter's transformer also supplies power directly to the RV circuits while it's charging the battery – or trying to. (More later.)

EQUALIZING

Sometimes an equalizing charge can correct the above situation. BUT, don't ever try to equalize a really sealed wet battery or gel-celled or AGM battery! You've got to be really careful when doing this! The battery is going to "gas" (bubbles in the cells, hydrogen gas escaping). It shouldn't be violent, spewing acid an over the place, just gentle to rapid bubbling but it requires caution. It's usually done by hooking up a manual charger, then bringing the voltage up to 14.1 or 14.3 and, instead of stopping as usual, keeping it there, at about a 5-amp charge, for three to six hours (until voltage reaches 14.5 to 15). Do this with the caps off of a standard battery so you can see what's going on. About three hours is usually normal for one of these equalizing charges.

Follow safety precautions, use safety goggles, plenty of ventilation, etc. This procedure may recover the battery but if not, buy a new battery (as you should have in the first place).

Some battery people recommend equalizing in this manner every three months (or after 5 deep cycles). I think the wear and tear on a 12V battery from equalizing this often does more damage than it's worth.

Batteries held at 13.8 or so for long periods get lazy and like it there. They need some "equalizing" also. Not as drastic as above, fortunately. If you drive occasionally, your engine alternator should do it (assuming the regulator is set properly). So will a solar electric system or a good, well-regulated independent battery charger. If nothing else, use the manual charger once in a while when parked and plugged in, but just bring volts up to 14+ (whatever's appropriate) and stop there.

Six volt heavy-duty batteries (like golf carts, etc.) differ. Their heavy plates and other construction features allow periodic equalizing. I recommend the same 5 amp charge rate, for three to six hours (until voltage reaches a maximum of 16.5) every three to six months. It varies, with some people doing it monthly (which might mean another problem).

CHARGE/DISCHARGE RATE

You'll see references in battery books to the proper charge rate. C/10, C/20, etc. Sometimes it can be confusing. What you need to know is that it means the "time" it takes to fully charge a "dead" battery at a certain amp rate. For example: A 105AH battery will fully recharge (from dead) in about 10 hours at about 10 amps of charge C/10 or about 20 hours at 5 amps of charge C/20. Faster charge rates, like C/5 or C/8 shouldn't be used with most batteries because the high amperage required for such a fast charge damages the battery. C/5 on a dead 105AH battery requires pounding in over twenty amps. (This is sufficient reason to stay away from fast-chargers in service stations where a gigantic amount of amps are pummeling your battery when they "charge" (destroy) it in 20 minutes. And when you buy a battery off the shelf, don't let the guy "put it on a charger for just a few minutes" or it will be damaged before you ever use it.

Now, for real life: You'll seldom be charging a "dead" battery. The C/20 rate of 5 amps will charge your partially discharged battery just fine in a lot less than 20 hours. And, since your typical RV converter only puts out a low amp charge anyhow (only 3 or 4 or so), you're about at the safe C/20 rate all the time. If you're in a hurry, plug in your manual charger as well and just keep an eye on things.

TROUBLESHOOTING AND TESTING

Don't just replace batteries and keep on trucking! Find out what went wrong first. Is the converter working? Voltage too high? Too low? Is it connected to the battery? Fuse blown? Wire broken? Contacts cruddy? Kill switch on motor home on or off (whichever is appropriate — and the wrong position a common fault among motor homers)? How many times have you deep-cycled? Short in the system? Been hooked up a long time? Automotive regulator/alternator OK? (More later.)

Measuring, metering, testing and troubleshooting require only a few tools and basic knowledge. Much of it is common sense, requiring no tools. Do not ever depend on the red/yellow/green idiot meter installed in most RV's. Get a digital meter. You need a digital meter to accurately read battery voltage to tenths of a volt. You should have an Analog (needle face) meter also. You can't tell the difference between battery voltages with an analog with great accuracy, but they are better in some ways (because it's easier to see rapid changes) than digital meters for reading fluctuations. (Much more later.)

Get a 12-volt troubleshooting light/test lamp from any auto store cheap or make your own. (Meters will indicate voltage even if there's only one strand left in a wire. Test lamps won't light if there's not enough wire to carry the load.)

Get a decent hydrometer if you have wet-cell batteries and can remove the caps. Don't get a cheapie with colored, floating balls. Learn how to read a hydrometer. (See more later.)

MAINTENANCE

Maintenance is all-important. Crud on top of a battery provides a path between poles. It's a "short." One most people never notice, but it uses energy constantly.You don't need to slop baking soda all over. Often just a spray 'n wipe with household cleaner is all that's needed.

Corrosion will build up. Some-times you can't even see it. Take contacts apart and clean them. (Now is when you might use baking soda, but don't let it get in the cells.) Done once or twice a year, it's fast and easy.

Before putting things back together, coat all surfaces (thinly) with silicone dielectric grease. That's before, not after. You won't accomplish a thing by smearing grease on top of corrosion.

Never use red battery spray. It just makes things worse. The red/green felt, noncorrosive washers are okay.

Label or colour-code cable and wire ends. Make a diagram. If you don't, you'll just hook things up wrong. (More on maintenance later.)