

## The proper charging of Receiver and Transmitter packs.

By Larry Sribnick

In Volume R1 of *R/C Techniques* I covered the testing and evaluating of receiver and transmitter packs. This time, I'm going to cover how to properly charge a nickel cadmium battery pack so that you'll get the longest life and highest reliability from your packs.

- *How long should I charge my receiver and transmitter packs?*

That all depends on the rate at which you're charging. The basic rule is that you charge at 10% of your pack's capacity for 14 to 16 hours. In other words, if you have a 500mah pack, your charge rate would be 50ma, 10% of 500, for 14 to 16 hours.

Charging at 10% of the pack's capacity is called *slow charging*. You'll sometimes see it referred to as "1/10<sup>th</sup> C" or the "C over 10" charge rate. You might see it written as "C/10." No matter what it's called, these are just different ways of saying the same thing, charge at 10% of the pack's capacity. No matter how large or how small a nickel cadmium pack is, charging it at 10% of its capacity will always work properly and will give you the longest life and highest reliability from your packs. All other charging systems or techniques are a compromise where you trade off some pack life or reliability in order to gain a faster charge time or a pack that's ready to go at a moment's notice.

- *You said 10% for 14 to 16 hours. Why isn't it 10% for 10 hours? Isn't that 100%?*

It does sound like it should be 10% for 10 hours but that's assuming that all of the energy that goes into the pack stays in the pack. In fact, only about 60% of what you put in stays in. For that reason we give the pack an extra four to six hours of charge to make up for these losses.

- *What does "ma" and "mah" mean?*

Current flow (a charge going into your pack or a

discharge coming out of your pack) is measured in amps. Each amp is broken down into 1000 parts or *milliamps* to make it easier to measure small amounts of current. 500 milliamps or 500*ma* is ½ amp. If a current of 500ma flows out of a pack for 1 hour we refer to the amount of energy taken out of the pack as 500*mah* or 500 milliamp *hours*.

By the way *ma* or *mah* is not pronounced like a baby calling for its mother, ma ma. We say the letters M, A or M, A, H.

- *At what rate does the standard charger that came with my radio charge?*

For many years radio systems came with 500mah battery packs as standard so the chargers were 50ma chargers. In recent years, advancements in nickel cadmium technology have made the 600mah cell the standard "AA" size cell. However, "AA" size nickel cadmium cells can have a capacity as high as 900mah or more. As long as the charger charges at 10% of the pack's capacity, it's a slow charger and it's the right charger for your system.

- *All of this is fine for 500ma chargers but my radio didn't come with a 500mah pack, it came with a 700mah pack.*

No problem, just charge a little longer than 14 to 16 hours. Within limits, which I'll discuss in a moment, you can either raise the charge rate or lengthen the charge time if you'd like to charge a larger pack. For a 700mah pack being charged with a 50ma charger, charge for 18 to 20 hours and everything will be fine..

- *How large a pack can be charged with the standard 50ma charger that came with my radio system?*

If you extend your charging time to 24 hours, packs with capacities as high as 1000mah can be safely charged with a 50ma charger. It all depends on how efficient the cells are. Remember I said that 60% of what goes into a cell stays in? Well, that 60% is only a guideline. Some cells are more efficient and some cells are less efficient. Before deviating from the 10% for 14

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to 16 hour rule, check with the maker of your cells as to what they recommend. In our SR cells, our 300mah, 575mah, 650mah, 900mah, 950mah, and 1100mah cells can all be safely charged with a 50ma charger by varying the charge time from seven to 24 hours.

- *What about a 1500mah pack? Can it be charged at 50ma too by lengthening the charge time to 36 hours or more?*

**Under no circumstances should you charge any brand of 1200mah to 1500mah pack at 50ma regardless of how long you charge.** A charge rate of 100ma is the lowest charge rate you should use for a 1200mah to 1500mah pack and you should really use the 10% rule and use a charge rate of 120ma to 150ma for 14 to 16 hours. I can't begin to tell you how many aircraft have been lost because someone said you could charge a 1200mah pack or larger at 50ma as long as you charge for 36 hours or more.

- *Why doesn't lengthening the charge time work?*

The charging of a pack is really a chemical process. It takes a certain amount of energy per square unit of plate area to get the charging process going. If there isn't enough energy to get the process going, it's like trying to charge a piece of wood!

- *How critical is the timing? What if I forget and charge for longer than 14 to 16 hours?*

No problem. The beauty of using the slow, 10% charge rate is that it isn't very critical. If you were to forget that the pack was on charge and didn't remember for a day or two no damage would be done.

- *Does that mean that I can leave a pack on charge at the 10% rate all the time?*

No! An occasional overcharge at the 10% rate won't hurt anything but leaving the pack on charge all the time at the 10% charge rate will eventually damage the pack.

- *With trickle charging the pack is on charge all the time. Why doesn't that hurt the pack?*

First, let me define trickle charging. Trickle charging is a continuous charging of the pack. It is generally done at 1% to 2% of the pack's capacity. That means that for a 500ma pack, the trickle charge rate would be

5ma to 10ma.

The thing to keep in mind when trickle charging is that it is designed to maintain the charge level already in the pack, not to bring the pack up to a full charge. For this reason, you should always charge the pack at the normal slow rate of 10% for 14 to 16 hours first and then put the pack on trickle charge. If you put a partially charged pack on trickle charge, there is a good chance it will still only have a partial charge when you go to use the pack.

- *How long can I leave a pack on trickle charge and will it do any damage?*

Just about as long as you like. I have a few ships that I leave on charge all the time so they will always be ready to go. The only problem you might experience is that if you leave a pack on trickle charge without using it for 6 months or more you might find that the pack's capacity is down by 15% to 20% when you go to use it. However, as soon as you start using the pack and put it through a few normal 10% charges and discharges, the capacity of the pack should come right back to normal.

- *Can a partially charged pack be trickle charged?*

There's no problem putting a partially charged pack on trickle charge. However, if your trickle charger is working properly it won't charge the pack up. Instead, it will just maintain the pack in a partially charged state. For that reason you should always fully charge a pack before you put it on trickle charge. In that way the pack should have close to a full charge when you go to use it.

- *Trickle charging sounds great. Where can I get a trickle charger?*

One way is to buy an attachment for the charger you already own. When you flip a switch the charge rate changes from 50ma to about 5ma.

Another way is to buy an adjustable charge rate charger. This type of charger allows you to dial in almost any charge rate you'd like.

A third type, is a dual rate charger that at the flip of a switch, changes from a slow to a trickle rate charge. Some even change rates automatically. Your best bet is to give us a call so that we can go over your needs and help you pick the right charger.

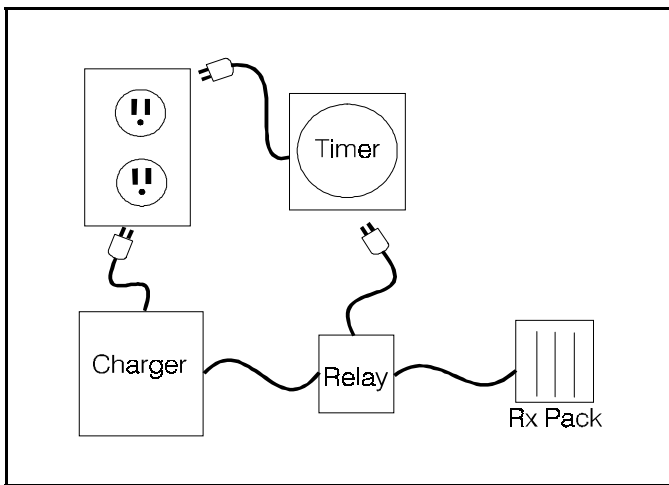
- *What about a pulsed or timed charge instead of a trickle charge?*

A pulsed or timed charge will keep your packs fully charged and ready to go just as a trickle charger will. The idea behind a pulse charger is rather than having a continuous charging current flow, the charge is pulsed on and off. If the charge is pulsed on for only 10% of the time (10 seconds out of 100 seconds or 1 second out of 10 seconds) it's the same thing as reducing the charge rate from 50ma to 5ma.

You can also do the same thing with a timer so that out of 24 hours in the day, the charger is charging for only two to three hours and is off the rest of the time.

- *Can I just plug my charger into a timer?*

I wouldn't recommend it. The problem is that some chargers will start to discharge the pack if they are connected to the pack but not connected to the wall socket. You could end up with a situation where you're charging for two hours and discharging for 22 hours.



Here's the right way to do it. Go to Radio Shack and buy a 110v relay. Wire the relay between the pack and the charger so that when the timer turns on, it closes the relay and allows the charge current to flow. The charger itself is plugged in and on all the time. Please see the illustration for details.

- *Can I charge a pack in less than 14 to 16 hours?*

Sure, just increase the charge rate. If you have a 500ma pack and you double the charge rate from 50ma to 100ma you cut the charging time in half, 7 hours. If you double it again to 200ma you cut the charge time in half again to 3½ hours.

- *I notice that you cut 14 hours in half to get 7 hours rather than cutting 16 hours in half. Is there any reason you chose 7 hours?*

Yes! Slow charging is very forgiving and it's almost impossible to mess up a pack if you slow charge it at the 10% rate. However, fast or quick charging can be very critical. To do it right every time, you should consider the state of charge of the pack, the temperature of the pack, the internal impedance of the cells, the type of charger being used, and the type of vents used in the cells. For this reason, I only recommend fast charging when there is a specific reason to fast charge, not for everyday charging.

- *What about fast field charging?*

Fast field chargers work fine as long as they're the right type. As I've said, fast charging can be very critical so a good fast charger should be very conservative in design. It shouldn't try to fully charge the pack because that's when you can get in trouble. Instead, it should only try to give the pack about a 75% charge. If you need more, you can always put the plane back on charge after the next flight. Fast charging doesn't damage a pack. Overcharging in the fast charge mode is what does the damage.

- *What is "peak detection" charging and do you recommend it for receiver and transmitter packs?*

Peak detection is based on the idea that as the pack charges, its voltage goes up. When the pack reaches a full charge, its voltage stops going up. And, when the pack starts to go into over charge, its voltage goes down. The charger simply has to take a voltage reading of the pack and "remember" it. So many seconds or milliseconds later, the charger takes a second reading and compares this new reading to the last voltage reading taken. As long as the second voltage reading is the same or higher than the first, the charger keeps on charging. If the second reading is lower than the first, the charger stops charging. Sounds simple, doesn't it?

Well, in life, nothing is simple. Nickel-cadmium cells show very strange voltage readings at times, particularly when you first start a charge. A good charger has to avoid these "false peaks" in order to charge the pack properly. In addition, if some of the cells in the pack aren't working properly, you might not get a peak at all in which case the pack will be ruined. For this

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reason, the ideal charger should be peak detecting with a temperature sensing backup system just in case.

This brings me to a controversial question. Should a peak detection charger be used for charging receiver and transmitter packs? I believe the answer is, NO! I'm not singling out a particular brand or model charger. I believe that peak detection chargers in general, shouldn't be used for charging receiver and transmitter packs.

As I've already said, as a cell charges, its voltage rises until the cell reaches a full charge. The problem is that the charger doesn't *see* the voltages of the individual cells, it sees the *average* voltage of the entire pack. Normally, the cells in a receiver or transmitter pack aren't perfectly matched and as a result, the cells reach a full charge one at a time. If you're slow charging, there isn't any problem because the cells that arrive at a full charge early simply wait for the other cells catch up. The beauty of slow charging is that even moderate overcharging won't damage the cells so the cells that arrive early, aren't damaged.

When you are fast charging it's a very different story. There's a very good chance that any cells which arrive at a full state of charge early, *will* be damaged because of the high charge rates used. In new packs, with well matched cells, this isn't a problem because all of the cells arrive at a full charge at about the same time. But, as the pack ages, or, if it has been primarily fast charged, the cells will go out of balance and a peak detection charger will damage any cell which arrives at a full charge too early.

Normally, I don't worry about this with Electric Flight packs. The worst that will happen, if you've damaged some cells in the pack, is that you will get a short motor run and you'll know that there is a prob-

lem with the pack. However, with a receiver or transmitter pack, the way you find out that the pack has been damaged is by a crash! When it comes to receiver and transmitter packs, I don't take any chances!

- *I hear a lot about using a five cell receiver pack. What's are the advantages of a five cell receiver pack?*

If you use a five cell receiver pack rather than a four cell pack, your servos will be much faster and more powerful. A five cell pack will also give you some peace of mind because if one cell fails in the pack, you still have a four cell pack left and you won't crash. If you're flying with a four cell pack and one cell fails, that's it, instant kit.

Like everything in life there is bad news that goes along with the good news. Many people think that by adding a cell they are also increasing the flying time available from the pack. In reality, it's the opposite. You will get as much as 15% less flying time from a five cell pack than a four cell pack. The reason is, there's no free lunch. If the servos are faster and more powerful, they're also drawing more current. If they draw more current, they use up the receiver pack more quickly.

- *Can I use the charger that came with my radio system to charge a five cell pack?*

Probably not. As I've explained before, charging is like a syphon. If the difference in voltage between the charger and the pack isn't great enough, no charging will take place. The charger that came with your radio system was designed for a four cell pack and you should really buy a new charger if you want to use five cell packs.