

The Technical Side - Care and Feeding of Rechargeable Batteries

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In this instalment of *The Technical Side* we will be covering proper care of rechargeable batteries. With their wide use with electronic survey instruments, the surveyor is faced with some of the problems in keeping batteries operating at their maximum capacity. We will focus on NiCad batteries because they are the most commonly used rechargeable batteries.

We will start off by giving some background information and explaining some of the terms we will be using. All batteries produce electrons from a chemical reaction. Different combinations are used, such as carbon-zinc, lead-acid, nickel-cadmium, along with lithium and nickel hydrate. In some of these batteries this reaction can be reversed or the battery charged by applying voltage across the battery. The chemical reaction can occur again, producing more electrons. The amount of electrons produced, or the capacity, depends on the amount of chemicals in the reaction. This capacity is measured in amp hours, the amount of time the battery will provide a given amount of current. For example, a 2.8 amp hour battery should provide one amp of current for 2.8 hours or 2.8 amps for one hour. Some batteries are designed to be discharged at a lower rate and will only give the rated capacity when discharged over a longer period of time.

Our first concern with a NiCad battery is charging it. There are two methods for recharging a battery, constant current and constant voltage. A constant current charger maintains a constant amount of current through the battery for a certain amount of time. The amount of current depends on the battery capacity and the charge time. Generally, these are designed to be a 12 or 16 hour charge so the battery can be charged overnight. The little black box "wall wart" transformer-type chargers are usually constant current. Constant voltage chargers maintain a certain

voltage across the battery. This voltage depends on the number of cells in the battery. When a dead battery is first connected to the charger, it draws a large amount of current. As it charges, this current tapers off to finally reach a maintenance current when the charge cycle is done. This cycle is usually complete in two to four hours. These are often referred to as quick chargers because the battery has most of a full charge after an hour or two.

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The next thing we do with a NiCad battery is discharge it. This part is easy, we just go use our total station, EDM, data collector, or radio. But what happens when the battery doesn't perform like it was supposed to? Rechargeable batteries are famous for having problems. They get overcharged, undercharged, take memory sets, cells short, blow fuses, and all sorts of other problems. We will address each of these problems and some solutions that are available.

Heat is one of the biggest enemies of batteries. Storing batteries in a warm area greatly reduces the service life of the battery. A battery also loses its charge faster than one stored in cooler temperatures. Charging a battery in high temperatures will cause problems. At temperatures over 100 degrees F., the battery starts drawing more current than it is supposed to. This raises its temperature, which causes it to draw even more current. This turns into a cycle called thermal runaway that will, at the very least, blow the

thermal fuse in the battery. If the battery doesn't have thermal protection, it will destroy the battery. Heat also affects the capacity of the battery. If the battery is charged in a warm area or used in high temperatures, the capacity can be as much as a third lower than it should be.

Cold temperatures cause problems too. When using batteries in low temperatures, their capacity is lowered. Batteries do store well at cold temperatures, retaining their charge and keeping their service life. You are probably wondering exactly what we mean by cold and warm temperatures. Well, NiCad batteries happen to like the same temperatures we do. You will get the best performance at room temperature. Capacity diminishes above or below 68 degrees F.

Overcharging batteries shortens their life. This happens because overcharging raises the battery temperature and causes the problems described above. Leaving a constant current charger on the battery for too long can overcharge it. A constant voltage charger that has too high of an output will also overcharge a battery. However, overcharging batteries happens less than most people think. Depending on the battery capacity and the amount of use, some batteries should actually stay on the charger anytime they are not in use. The smaller batteries used in some data collectors are a prime example. One of our customers left one on the charger for a year and a half. The data collector is being used now and shows no signs of battery problems. If leaving the battery on the charger makes you uncomfortable, think of your cordless phone or Dustbuster. My cordless phone sits on the charger quite a bit longer than the 10 hour charge time listed in the manual. I've had the thing for almost two years and haven't had any problems. Undercharging a battery does pretty much what com-

mon sense would tell you, it shortens the battery life. Repeated undercharging will shorten the battery's service life but doing it occasionally won't hurt. It's all right to charge the battery for half an hour so you can get the day's work done. We most commonly see problems with undercharged batteries when the cells have been replaced with higher capacity cells. The user charges it for the normal amount of time and finds out the battery has less life than it did before. If your battery normally gets an overnight charge and you get high capacity cells installed, you will probably need to extend the charge time to a day and a half or longer.

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Memory set is probably one of the most commonly known NiCad battery problems. If the battery is not completely discharged before charging it back up for several charge cycles, it starts to "remember" how much it gets used and the capacity decreases accordingly. Memory set problems have decreased because of improvements in battery components and charger design. Again, think of your cordless phone. Mine often gets used for no more than 10 minutes before it goes back on the charger but, when I do have two hour conversations, I don't run the batteries down. But what can you do if you think your batteries have taken a


memory set? The first thing to try would be using the battery until it is dead, fully charging it, and running it down again. Several cycles of "exercising" the cells like this might do the trick. Discharging the batteries at a higher current works sometimes. We use automotive light bulbs to do this for two reasons. One, to have a visual indication that the battery is completely discharged and, two, the bulb discharges the battery at a high current rate without blowing the fuses. If you are using a constant current charger and consistently have problems, a constant voltage charger will probably help. The high current initially supplied to the battery serves the same purpose as discharging it at a high current. Some people think that shorting the cells and then recharging them will cure memory set problems. This should never be done. Shorting a high capacity cell will produce a lot of heat and the possibility of explosion exists. Cells that have been shorted can actually reverse, resulting in negative voltage. If you try to short a cell pack that has fuses or thermal protection built in, you will destroy these and have a useless cell pack. NiCad cells should never be taken below about 1 volt per cell. Taking them below this can cause all sorts of problems.

NiCad cells short out or lose their capacity to generate electrons at the end of their service life. If one cell in a pack shorts out, it causes problems for the rest of the cells. In the charge cycle, the other cells often get overcharged. In use, the battery has a very short life or none at all. These cells can sometimes be made usable again but since it usually indicates the cells are at the end of their service life, we recommend re-

placement. Battery packs that blow fuses usually have some mechanical problem that lets a short circuit develop. This has to be fixed to prevent damage to the cells.

So how long should NiCads last? Manufacturers often list 300 to 500 cycles. This is with the best of care and is a little higher than normally experienced. We typically see two to three years with proper care. If the pack is less than a year old and you get shortened life, look for something else as the cause of the problem.

We have mentioned exercising or replacing cells to repair a NiCad battery pack. Unless you have the correct tools and the electrical and mechanical knowledge to properly replace the cells, you should leave the job to a competent repair technician. Look for someone who will test the battery before replacing the cells in case the battery still has some usable life. If the cells have to be replaced, the new cell pack should have all the thermal and short circuit protection that the original had. The replacement cells should be tested and have a guarantee that they won't fail in the first year.

We hope this information helps you extend the usable life of your NiCad batteries. This information came from fifteen years experience we have in building chargers and maintaining batteries. We would like to hear your opinions and experiences, or any questions you might have about your rechargeable batteries. We might even mention your name in an upcoming article. Write us at THE TECHNICAL SIDE, 1562 Linda Way, Sparks, N.V. 89431, or fax it to  (702) 359-6693.

Japanese Cat Burglar Uses Satellite To Aid Getaway

TOKYO (Reuter) -- A Japanese thief arrested for allegedly breaking into some 300 Tokyo homes used a hi-tech satellite positioning system to aid his getaways, a Japanese daily reported today.

The Mainichi Shimbun said police found the \$14,785 tracking system in-

stalled in his car. It displays a detailed map on a colour television screen with a pointer showing the car's position.

Takayuki Okamoto, 41, a construction worker, was charged with the theft of \$616,450 in the burglaries.

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?? Technical Questions ??

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