

Consider the Complete Battery Management Process

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"There's nothing worse than picking your radio up when you need it and it's dead," says Dennis Granger, Communications for Grant Park, Illinois Sheriff's Department and EMT Ambulance. It's happened to everyone. Fast moment, life-or-death communications. All contact lost, because the radio goes dead, or all you hear is static. How can radios, which are the lifeline of work be so unpredictable? It's not the radio – it's the battery, and how you manage it every day of the year that often determines the dependability of the radio.

Unfortunately for most public safety and emergency professionals, operating a "Battery Maintenance Program" is low on the list of priorities in day-to-day operations. Bigger operations employ a Communications Officer to help manage equipment and channels. But taking care of the battery is usually the responsibility of the individual, which isn't so hard to do once you understand batteries.

There are three types of batteries currently being used for portable communications: Nickel Cadmium (NiCd), Nickel Metal Hydride (NiMH) and Lithium Ion (Li Ion). For years, NiCd has been the workhorse of rechargeables. It gives the best value for the money, costs less and provides more charge/discharge cycles than its counterparts. But it is heavier, and can demonstrate problems such as memory effect, which reduces charge capacity and cycle life. NiMH and Li Ion are lighter and have higher capacity than NiCd, but each chemistry has its own drawbacks: high costs, short cycle life and limited power capabilities. And, NiMH also has a memory effect.

Naturally, given the lower cost and longer life, NiCd is the battery of choice for most public safety operations. When misused, NiCd batteries can create frustration and "burn out" early, causing communications breakdown and frustration. However, when properly handled, **NiCd batteries do the job dependably and save money.**

When a battery is frequently charged before it is fully discharged, it begins to "remember" the level at which it was last charged, and it begins to think that that is the maximum level of capacity. Gradually, the usable time between charges is reduced, until a battery capable of lasting 12 hours can be reduced to only two or three hours. This is "memory effect," which also reduces the life of the battery. Two-way radio NiCd batteries should last about 500-700 charge/discharge cycles, but that's not the case in operations where no concern for battery chemistry is applied to daily usage. Memory effect is cumulative, so it builds up over time. Inconsistent battery care will usually result in a degree of memory effect, which cannot be undone, even if methods are improved.

John E. McGuire, Operations Liaison at the Unified Port District in San Diego understands how memory effect can shorten battery life. "Batteries have been a very sore subject around here for a long time," he explains. "Even after we got the OEM upgrade charger, we thought we were just out of luck with batteries, and that we would continue to replace them every six months until we got the **ACT**ivator chargers."

"I have to change our batteries about every year because of the memory effect. Batteries aren't lasting long like they are supposed to," echoes Dennis Granger of Grant Park, Illinois.

It's no great secret. The key to battery success lies in the charging. You can use or abuse your battery, but if you charge (and discharge) it properly, it will serve you well for a long, long time. And a maintenance program does not have to be labor intensive or costly. At Gwinnett County Police Department (GA), batteries last up to four years, because officers are trained in proper usage and charging practices.

“Each officer has two batteries and a trickle charger at home,” explains Lamar Martin, Radio System Coordinator. “They work six days on and three off. They use one battery one week, another battery the next. At the end of six days, they leave radio on until it runs down to full discharge. Others charge and discharge every day they work. The batteries are lasting a 10-hour shift at a time, and often, into a second shift for a part-time job. I condition the batteries regularly, too. But the act of just ‘killing’ it frequently helps to erase any memory.”

There is a variety of equipment on the market for battery maintenance -- chargers, conditioners, analyzers, and the new **ACT**ivator conditioning charger. **Chargers** replenish the energy storage capacity of the battery. Three main types are available: the constant-current trickle charge (commonly referred to as “roasters and toasters”); the constant high-current fast charger, which is often self-terminating; and the pulse charger, which combines steady positive current with brief negative currents. The **ACT**ivator chargers by Advanced Charger Technology, Inc., (**ACT**) incorporate the patented enrev™ battery operating system technology. Enrev, the newest technology on the market, is generations beyond pulse charging. Using an intelligent microchip that reads the chemistry of the battery, enrev responds with very high positive current charging interspersed with variable and brief (microseconds) deep discharging currents and rest periods, which combine to condition the battery as it charges. (for a detailed comparison of charger types, see sidebar)

Conditioners “exercise” the battery by discharging it very deeply -- usually to about 1v/cell. This “cleans” the battery and helps undo the damage of memory effect. **Analyzers** measure the capacity of the battery and sometimes measure changes in capacity. Some analyzers can also determine the cause of a bad battery, i.e. external damage, bad condition or bad cell. Most analyzers discharge the battery fully and then recharge it to measure capacity.

Many people mistakenly think that battery management needs to be a labor-intensive process that can only be done by large operations with communications professionals. Myth. Every single person with a radio can be proactive in making his/her battery last longer – between charges and for cycle life – and the steps are simple.

- 1) **Drain your battery before charging** – as much as possible. It sounds simple, but few people actually do it. In an ideal world, every user would have a spare battery that is always ready to go while the other is discharged and recharged.
 - a) Drain the battery by leaving the radio turned on until the battery can no longer power the radio at all (You can accelerate the process by using the radio). If the length of your shift and access to a charger doesn’t permit you to run the battery down before recharging it daily, do it at least once every 7-14 days.
 - b) Don’t drop the battery/radio in the charger throughout your shift when it isn’t in use. Let it run down a full shift!
- 2) **Charge the battery fully** – Most devices indicate that a battery is charged when it has only reached 80-90% capacity. If you consider that most batteries will no longer operate a cell phone or lap top when they go below 60% capacity, you can imagine how much battery life you are sacrificing if you terminate charging too early. In addition, frequently terminating charging too soon will ultimately contribute to shortened capacity between charges.
- 3) **Terminate charging** – don’t leave the battery on a trickle or fast-current charger indefinitely. If your charger is not self-terminating, buy an inexpensive outlet timer. If your charger takes eight hours to charge your battery – have the timer stop at eight hours – don’t allow the current to over charge your battery by running all night or weekend.

“It’s great when a charger stops when it’s finished. The **ACT**ivator keeps them from cooking. The guys all leave their batteries in the charger overnight and they’re just cooking slowly the whole time

– it’s so bad for the batteries,” explains Paul Smith of the San Bernardino County Radio Operations Group. “On the other hand,” he adds “they’ll warm your hands on a cold morning!”

- 4) **Condition your battery** – NiCd batteries perform best if they are periodically “exercised.” A good conditioner will fully discharge the battery – bringing the voltage down as low as possible (below 1V/cell), far lower than the discharge achieved from running down the radio. This helps to erase any memory-effect. Label the batteries and establish a chart which will remind everyone when a battery is due for conditioning.
- 5) **Invest in a good charger** – many departments buy the best radios, and then take the basic, inexpensive OEM “trickle chargers” as an afterthought. Likewise, the manufacturers spend their resources making the best radios for you, then often stick their name on a low-tech, inexpensive charger to bundle with the radio and keep the bid low. The real cost in any durable equipment is O&M- operations and maintenance. An investment in a good charger can bring the long-term costs of your communication system down significantly. A good charger is one with an intelligent chip to charge your battery only as much as it needs and that will terminate when the battery is fully charged. Some form of pulse charging, rather than constant current, is also preferable. It is worth the investment in doing some research and asking more than one dealer to recommend chargers. A service-oriented dealer should be happy to help you research a number of charger options before making a recommendation.
- 6) **Monitor your batteries** – label all batteries with the date that they are put into service, and keep track of how frequently they are conditioned. A simple chart is sufficient. Look for patterns in problems. Is it possible that battery problems are more prevalent in one department or a certain shift? Can you track quality problems to a particular batch of batteries based on supply date?
- 7) **Format your battery properly the first time** – the life of a battery can be severely shortened in its first day. Follow the manufacturer’s directions to fully charge your battery the first time it comes out of the box. If you put it into service prematurely, you have already begun the memory effect problem.
- 8) **Condition your back-up batteries regularly** -- Avoid a crisis of bad back-up batteries by taking a pro-active approach to maintaining them. Do Not leave emergency batteries sitting in non-terminating trickle-chargers or they could fail when you need them most. Again, you can incorporate inexpensive outlet timers to help manage termination and recharging. It is true that left off of charge, some energy will drain -- but temporary capacity loss is safer than permanent memory effect. If possible, use an intelligent conditioning charger like **ACT's** Maintainor, which cycles your batteries regularly without user intervention. If that is not an option, rotate the batteries into service regularly, or condition them. At least once a month, batteries which are being charged regularly without being used need to be fully discharged before recharging.

Recently, during severe flash-flooding off the cape of South Africa, Mossel-Bay township emergency workers found themselves out of radio communications quickly when constant talk-time wore the batteries down quickly and back-up batteries and chargers failed to return the radios to service in a timely fashion. Thanks to the initiative of Graeme Wells, **ACT** Pty. Ltd., who drove 3.5 hours to Mossel Bay to help out, **ACT**ivators incorporating enrev technology were used to fast charge the batteries and get the radios back into service. Wells’ experience in Mossel Bay and with a similar fire catastrophe weeks before illustrated how maintenance of emergency batteries can take a back-seat to daily operations and result in a natural disaster becoming a communications disaster. Similar concerns have been echoed by fire safety officers in the United States, prompting the introduction of the Maintainor, which maintains back-up batteries to deliver peak performance in emergency situation.