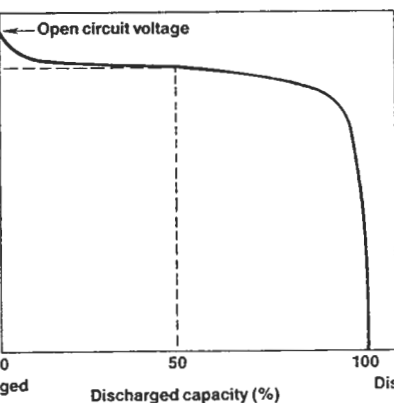


How to Keep Rechargeables Rolling



Too many designers waste battery capacity and limit operating time through ignorance of a few simple guidelines.

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Discharge curve for a nickel-cadmium cell at room temperature and constant load current. The discharge is extremely flat with a midpoint voltage of 1.2 V.

FORGET THE MEMORY EFFECT

The infamous label "memory effect" has haunted nickel-cadmium cells since the mid 1960s. It was originated to describe a phenomenon observed in the power system of a U.S. satellite. The memory effect implies that a nickel-cadmium (Ni-Cd) cell can forget how to deliver all of its charge if continually partially discharged to the same level. In other words, if a rechargeable 2-h battery runs 5 min each day, it will turn into a 5-min battery.

Memory effect seems to be brought on by certain conditions. First, the battery must be designed with cell cutoffs above 1 V. Second, it must be repetitively discharged to about the same shallow level. Third, it must receive no overcharge. If the three conditions are satisfied, then there is a remote chance of permanent loss of some capacity.

Since the mid 1960s, memory effect has been the "cause" of almost every conceivable rechargeable-product malfunction. To avoid it, fearful users have vigilantly enforced complete discharge of the battery on each cycle. But in reality, memory effect has been officially diagnosed in only that one instance in outer space. The overuse of the term may be a case of confusing memory with a similar phenomenon called "voltage depression."

Voltage depression refers to a drop in Ni-Cd discharge voltage. It is caused by a combination of poor design and product misuse which lowers anode oxidation efficiency during discharge. Again, cutoff voltage must be above 1 V. In this case however, the battery must excessively overcharge for extended periods of time. When these conditions coincide, products may experience voltage depression which, like a high cutoff, reduces runtime.

Voltage depression was somewhat of a problem with early Ni-Cd cell technology of the late 1960s. It was common with improperly applied batteries made with primitive electrode technologies of that time. Modern electrode technology, however, has nearly eliminated the problem.

The ability to prevent voltage depression is in the hands of designers. Keep the cutoffs below 1 V, and the effect will not be noticed. Users could help by varying the depth of discharge or runtime occasionally. But voltage depression is practically a nonissue because it is completely reversed after the first duty cycle. If it does occur, it shortens only the first run.