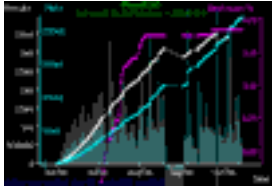


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Laboratory Evaluation

Ever-Charge Advanced 'Eco' Battery Re-charger by Ben Duncan* [*BDR Labs UK, July 2006](#)

Appearance-wise, The 'Ever Charge' charger is superficially like any regular NiCad (rechargeable battery) charger. Except that it has switchable settings for the newer & vastly better Nickel Hydride (strictly, Nickel Metal Hydride, NiMH) cells and layer batteries. And also, central to this report, a third setting - to 'recharge' Alkaline cells and batteries. These are colloquially known by various trade names. The use of the word 'charge' in the context of Alkaline cells & batteries, may cause justifiable concern for some readers. Instead, one may say 'rejuvenate' or 'reconstitute'. See 'Terminology' (later) for a further discussion.

Our Tests - The following text is essentially factually identical to the report issued to the distributor & maker, with changes being limited mainly to enhancements in the English (language) style, added descriptions and background information, and refined emphases.

Test methodology The nominal (published) capacities were used to designate (very) approximately commensurate integer loads for the 3 cell sizes, of 1, 2 and 4 times the current, for AAA, AA and D respectively. The cells & batteries, obtained 'fresh' from a retail outlet,

"The Ever Charge shows that up to 90% of the chemical content of discarded alkaline batteries was not really finished. But, that is now history."

The reconditioning or 'recharging' of alkaline cells has been possible for many years, but without fairly detailed microprocessor control, it was hitherto not

had the usual unknown capacity loss ('pre-discharge') due to storage. They were then discharged using the above-designated loads. The duration, to a given endpoint, established a 'spot' capacity, taken to be 100%. Due to the unknown degree of pre-discharge*¹, circa 5% max, a recharge to above 100% of this capacity is not unfeasible.

*¹As any primary battery loses some of its charge or chemical potential, as soon as it is manufactured.

Conditions Ambient temperatures happened to range between 23 & 29 C (span of 6 C) during the tests and recharges; But by no more than 3 C during any one test.

Equipment It was not necessary to use the most modern equipment to make the tests. The following equipment, while dating from 1964 to 1984, is highly regarded, all British made & designed, and has been fully restored, regularly maintained and calibration checked.

A Farnell L30-BT bench power supply powered an op-amp based comparator, operating an alarm & record system.

A Solartron AS1412.2 lab psu provided a digitally- set, endpoint comparison voltage, of 1.10 or 1.00v, for cells, and 6.60 and 6.00v, for '9 volt' layer batteries.

Three Datron 1041, 4.75 digit system DMMs were used to monitor cell terminal voltage, supply lines, and comparison voltage.

Additionally, a Datron 1061 was available for peak-hold 'data capture'.

Battery holders were arranged with 4mm sockets, so that lamp sets (fitted with dual-circuit 4mm plugs) could be interchangeably connected. Connectors were high quality, Hirschmann and MC (Germany).

Battery wiring was with silicone-rubber insulated tinned copper stranded flex wires,

necessarily safe outside of the technically minded and alert operator. Some cells would get hot, and unless monitored with alarms, this might happen at any time, with sealed cells either exploding, or leaking their contents. This is the basis that battery makers may correctly warn users from using chargers. But, the Ever-Charge system identifies bad, such as short circuited, cells (as 'BAD'), and will not charge/ recondition them. Making the charging process very safe."

It is additionally recommended that the manual is in any event generally rewritten, in quality international English. The product is rather unnecessarily let down by the 'Chinglish' pidgin.

Test Conclusions Overall, it is confirmed that the charger does re-charge or re-condition alkaline cells, such that they are substantially able to re-perform up to their initial discharge capacity. And, this need only happen once to be extremely useful. We can also confirm that with alkaline cells, subsequent re-charges to a significant percentage of the original capacity, were also recorded - provided the discharging just beforehand was adequate. There are some minor problems with the manual and the PP3 alkaline management; otherwise, the unit is a highly workable eco-aid. And will quickly pay for itself in many businesses and households.

Why Rejuvenate? The high cost of non-rechargeable batteries has been complained about since they were first used en-masse, in the 1880s, for phone exchanges and doorbells. Even at today's high prices, mains electricity remains vastly cheaper - by a factor of at least a hundred times.

Rechargeable NiCad cells and batteries that would fit

arranged with properly crimped ring terminals and 'professional-grade' fixing hardware - such as stainless steel screws, and wavy washers - for assuredly stable connective DCRs.

1 - Alkaline Cells Three of the four de facto standard sizes were tested - D, AA & AAA.

What was found was interesting. Initially cells were discharged to 1.10 volts - on a load approximately commensurate to capacity. This is the end-point indicated on a typical cell condition test meter, where the needle is lying between the yellow & red sections. This was initially felt to meet the manual's instruction "... alkaline batteries should be completely drained before recharging with ..."

Discharge to this endpoint, resulted in a useful recharge, if of only about 50% of the initial capacity.

However, if the endpoint of the discharge was lowered 'just a tad', to 1.00 volt or below - and probably any lesser voltage, it was found that the recharged capacity was raised, far closer towards 100%.

Also, if the cells were allowed to trickle charge, for some hours after the point where the charger indicated that charging was completed ('ok'), then the recovered capacity more closely approached, or could even be slightly above, 100%. The latter sounds unlikely, but is logical enough, as explained above, *1.

Conversely, some cells that had been drained for a long time (say over 30 days - but more work would be needed to establish the range of the transition period), were found to be not rechargeable.

Users need to 'take care' that such cells will appear to charge, the charger also saying later that they are charged ('ok'). It appears to be fooled! But when loaded, the cell is not charged much at all, and the terminal voltage

in the place of regular cells and batteries have been 'around' - for the public - for some 35 years.

Originally, their use was limited to 'professional' users - like the military. They originally required careful recharging, and were quite costly. NiCad and now NiMH rechargeable cells have since become more worthwhile, with prices (per amount of energy stored) that are far lower in real terms than 10 or 20 years ago. But NiCad cells and batteries have some awkward habits. They self-discharge quickly. Within 30 days, they are "on the way down". Thus they are utterly useless for emergency and other low-use equipment. Particularly in clocks, but also in torches and motor-driven items, that dare demand both current and an undiminished voltage (low resistance).

NiMH cells self-discharge less, but still drain their contents over several months, far faster than alkaline cells.

'Memory effect' is (or should be) well known. NiCad cells are quick to be lazy. They can immediately loose capacity if not deep (fully) discharged, before recharge. The loss can be permanent, the first time an undercharge is performed. Simply re-charging Ni-CAD cells or batteries with no idea as to their condition, is all you have to do. Some makes of cell, and generally cells of newer design, are claimed to be developed to suffer less from this, although to do so is unprofitable for makers.

NiCad and NiMH cells and batteries also exhibit 'limited cycling'. Meaning that rechargeables don't last for ever. Recharge-ability is never eternal. Depending on the charger and the care of the user, and also the 'endpoint' decided upon, where the cell is no longer worth using (as the capacity loss is gradual), the number of cycles is between 200 and 1000 at best. PP3 type batteries typically have shorter lives, sometimes as few as 50 cycles. If alkaline cells and batteries are able to be rejuvenated, the above now provides a useful context, and helps us to see how the picture changes First, alkaline cells are not as expensive initially. If they can be rejuvenated only 1/3rd as many times as NiCad versions, then they will cost about the same.

can actually be lower, than before the charging started.

As most users will recognise long-discharged cells (and a torch found switched on... last used mmm ... most will at least be able to readily recall whether likely under a day ago, or above 7 days), and as there is no harm in trying to rekindle them, this is not considered a big deal.

2 - Alkaline Battery (PP3 size) Also known as a 'Layer Cell'. This type requires time and care to discharge fully.

When well-loaded (say 120mA interim'ly) and then deep discharged (to below 1.1v per cell = 6.6v overall), one cell typically reverses, or may be similarly "not altogether happy" - which then prevents the remainder from discharging so readily. This means that more time is needed to get an adequately deep discharge. A slower discharge would seem safer.

The increased internal resistance that an 'out-of-line' cell creates, also means that while the battery appears to charge, and appears to have a high enough terminal voltage at the end of charging, when loaded at all appreciably (eg. an approx 1 watt load, relative to 8.5v, amounts to a relatively heavy loading of about 120mA), the terminal voltage sinks to 7v or less. In many instances this won't be observed, nor matter - because PP3 battery loads are typically appreciably lower, and equipment designed to use NiCad-based PP3 layer batteries, must anyway be prepared to work at a lower, fully-charged 'start out' voltage, of a mere 7.2v, at best.

The fact that the Ever-Charge unit is not giving such a clear (LCD-based) indication, nor such an accurate indication, of charging conditions, for the PP3 charging position, as it does for the cell positions, is the main point. It will help readers to realise that that PP3 batteries fits into a solo, 5th position, that is not presently

Second, alkaline cells and batteries have a great energy saving benefit. As they have low self-discharge. They also don't leave a mess, if they should fully discharge (other primary and secondary cells can 'leak' corrosive chemicals)

Thirdly, alkaline cells have the highest terminal voltage when fresh and loaded. It's only with alkaline cells (or batteries) fitted, that many lamp- or -motor-based items, operate to their full potential.

For example, fully charged and lightly loaded NiCad cell voltages are typically 1.20v each, so '9v' is actually 7.2v or so, at best.

But an alkaline cell's voltage under the same conditions - of comparable capacity - is typically 1.55v, hence '9v' is 9.3v. The just under 22% difference reduces an ordinary incandescent lamp's output, by some 300% (three fold).

Alkaline cells' benefits, added to the opportunity for reducing the gross level of "premature disposance" that they've suffered from beforehand, may paradoxically see them used more widely, while far fewer are still disposed of, per unit time.

"It is said, that at this time, 15,000 million alkaline cells are disposed of annually, across the world."

Terminology

Recharge vs. Reconstitute The use of the word 'recharge' is at the heart of any problems felt to exist by scientific pedants, and the most likely cause of upset by those who know (just) a little about chemistry and physics. The reason is simply that any alkaline cell is a primary type. In primary cells, the chemical reactions which generate EMF, are not reversible. To do work, the cell must "eat itself", or at least gradually neutralise its active constituents. So, the sort of reversible chemical action that goes on in secondary cells (such as in NiCad and NiMH types, and car batteries), when they are charged, is not strictly what is going on when alkaline cells are 'recharged'.

included in the charge monitoring, on the LCD screen. There is just a LED indication. But, do not take this situation for granted, since the maker might update the design, in part as a result of this observation. It is clearly fixable 'with a revision step'. Maybe a key, embedded chip lacked the capacity. Or the programming budget ran out. Watch the maker's space.

Moving on, full, deep (near 100%) discharge, to below 0.1 volt, was then carried out, by leaving the already discharged and partially recharged alkaline PP3 battery connected to the discharging load, for over 3 days (above 72 hours). After recharge, the charge capacity was improved - on a heavy load to some 35%, which while not as good as the cells managed, is still 'plenty useful'. Imagine a clock, where the battery has already lasted 4 years; the load will be light, so the effective recharge will probably amount to nearer 50%, so another two years could be had. At the same time, this is rather inferior to the recharging performance of the single cells (A thro' D). But it needs emphasising that this is believed to be down to one cell not charging fully, or even entering or remaining, in reverse or shorted modes.

However, putting matters into context, such problems of charging (or re-conditioning) series cells, are typical with, and in common to, all battery systems that employ cells in series. And the problems of 'serised' cells gets worse with higher currents (relative to cell size). Also when there are only a few cells in series, a disproportionate part of the voltage can be lost. And things are bad when there are not adequately conceived control mechanisms, that more specialist operations can afford. For example, if PP3 packs were made of separable cells, a bad one could be changed. Saving needless landfill.

However, our tests clearly showed that alkaline cells and batteries (see sidebar) were able to do extra work - and stay working - as a result of using the charger. The bottom line - of using the same energy supply device more than once, if not many times, before needing to spend money on a replacement - is identical. Also, in everyday parlance, it's not unreasonable to call such a process 'recharging', considering the term is also viably used by tired humans having a quick sleep, who are also not secondary cells! To satisfy the gravitas of a technical article, and in order to emphasise that the mechanism of energy-delivering recovery is different - than in secondary, rechargeables, terms like 'rejuvenate' and 'reconstitute', may be substituted.

Cells vs. Batteries Sizes AAA, A, C and D 'batteries' are strictly, cells. A basic 'power unit' of around 1.2v to 1.5v, depending on the chemistry employed. The PP3 'mini power pack' is truly a battery, but is also known as a 'layer cell' or 'stack' - as it comprises 'a battery of' 6 cells, in a special flat format, stacked in layers.

Primary & Secondary Cells (and Batteries) Primary cells & batteries are everyday non-rechargeables. Mostly, they are either low cost, basic zinc-carbon types (which have been around for over 100 years), and the higher-tech (manganese-) alkaline replacements (which began use 50 years ago), or later, mainly incremental developments of these.

Some 3W-borne Background Information
- considered to be authoritative

A well written US site, on battery history:
<http://electrochem.cwru.edu/ed/encycl/art-b02-batt-nonr.htm>

Alkaline battery chemistry, from a foremost British science centre:
<http://www.msm.cam.ac.uk/doitpoms/tlplib/batteries/>

NiCad PP3s and electric tool NiCad packs are just two examples of batteries made short lived by this situation. The problem - that just one cell can by itself, disrupt the whole show - occurs with all forms of battery power, where voltages above the (generally) 1.2 to 3v per single cell, are required. It is equally inevitable at the end of life, that one cell fails before the others. A Ben Duncan recommendation is that to be 'better rechargeable', the traditional layer battery really needs redesigning with diodes and related electronic content, to control cell voltage sharing. A part that would ideally be pluggable, so it could be re-used when such batteries reached end of their chemical (but not electronic) life.

batteries_alkaline_mno.php

Alkaline battery patents & history from the Austrian genius who invented the technology:
<http://chem.ch.huji.ac.il/~eugeniik/history/kordesch.html>

Some Historic Background Reading

A.S.Henderson, Nickel-Cadmium secondary cells, Wireless World, March 1982.
R.W. Hallows, Recharging Primary Cells, P.194-5, Wireless World, London, April 1958.
W.R. Cooper, Primary Batteries, 2nd edition, 1916, Benn Bros Ltd, London, published for 'The Electrician' journal.

Reviewer's Recommendations * Changes to manual to clarify need to discharge quite adequately & fully.

* It would be preferable to see changes to the charger to provide for discharge, and indication of deep-enough discharge. For both cells, and PP3 batteries. An incandescent lamp is suggested, as its operation can be seen, and the deep enough discharge will involve lamp filaments that are not visibly illuminated in daylight. This is a good measure. "Discharge until the lamp's glow is no longer visible in daylight."

Whether integral lamp discharging is provided in future, or the user provides their own, for PP3 batteries, use a 12v lamp. For cells, use a 2.4 or 2.5v lamp. These values are cited for long life, so that the discharge lamp will not in practice, likely fail, during the charger's lifespan (which might be 25 years, with care). The 12v lamp wattage needs to be well below 1w relative to 8v, so PP3 discharging current is not too high.

The Author

Ben Duncan has reviewed and consulted on over 300 advanced and refined electronic products over 25 years, mainly for the professional, and high-end domestic, audio industries, with publication of his lab results to over 150,000 readers of some 20 British and American technical journals & magazines. Products have ranged from competing integrated circuit chips, that had to be expertly assembled into a measurable form and arranged to be evaluated on a level playing field, to loudspeakers, with quite different, yet hard-to-measure sonic qualities.

The archives at BDR contain many folders with letters and faxes from UK & international makers, distributors and users alike, grateful for the quality of detail, and the integrity and accuracy, of the assessment work. In the 'old' days of undertaking reviewing, in the early '80s, BD also performed evaluatory work for the world renowned (UK) Consumers' Association, on a panel judging loudspeakers. In 1987, work was undertaken for the Guinness' Book of Records.

BDR test methods may be purposefully independent of

* Changes to the charger, such that PP3 battery charging is better able to be monitored.

* It occurs to us that the charger (in the version we tested) may not in fact be principally designed to recharge alkaline PP3 cells, and that the charging via the PP3 'clips' is primarily optimised for NiCads, with the usual constant current method. This may need checking. (and clarifying in the manual)

The following addition, or similar, to the Manual's text, is recommended:

"The Ever-Charge can 'replenish' most, if not all types, of alkaline (and related manganese alkaline) cells, provided they have been preferably freshly and quite fully discharged. Intelligent control of the charge current (up to 130mA) enables alkaline cells to be safely 'recharged', initially up to nearly 100% of their first use capacity. And then up to 30 more times, with (naturally enough) gradually reducing capacity.

It's helpful to realise that batteries & cells are 'chemical activity centres' somewhat like living objects, and those that are have been left fully ('deep') discharged for above a few days, or aged 'surplus' stock (maybe kept in bad conditions - you may need to ask why they are being sold as a 'bargain'), or cells of lesser quality, may not 'recharge' at all; or so deeply, nor so often, before they are incapable of giving much more usable service life. Deep discharge can be checked - the cells will not light a torch lamp visibly; or the light is so feeble it can only be seen as a dull orange'ish glow in a dark place. The Ever-Charge system does not recharge alkaline cells in the same way as NiCads or car batteries. It refurbishes or reconditions chemicals, so that the valuable

various world standards that (however well meaning), can act to limit the overall, holistic accuracy of information, and also, hinder creative development. Technically cognoscent readers may recognise that self-perpetuating bodies are not the sole source of mindful experimental design. Over 800 3rd party websites & forum pages and also over 900 published articles, papers, reviews, projects and 10 books and compendia, mention or contain parts of, Ben Duncan's works in high-quality audio equipment-, electronic product- & electrical engineering, music technology, eco-power, CAD, data security, and other fields.

Testing and review was independently performed, and Ben Duncan Research is in no way affiliated or has interest in, the Ever Charge system. In being ecologically aware however, we cannot fail to approve of the initiative taken.

Other than demonstrating product review & investigative capacities, this text may be seen by the many former readers, as resting in place of a hypothetical, technical product review in the former and foremost worldwide, British-published electronics technology podium, Wireless World, more recently known as 'EW+WW'. RIP.

BD - 22nd Sept 2006

content is not wasted, and can be fully utilised. Once used, it is used. But, on a keymost environmental note, even just one 'recharge' halves the amount (per unit time), of alkaline battery waste, that is going into landfill. Sad to realise that most of it has, before now, been quite needless - as the Ever Charge shows that up to 90% of the chemical content of discarded alkaline batteries was not really finished. But, that is now history. Like cars that easily rusted.

www.benduncanresearch.org

related:

alkaline battery life extension, alkaline battery recharge, alkaline battery recycling, alkaline cell life extension, alkaline cell recharge, alkaline cell recycling, battery landfill reduction, battery life extension, battery recycling, battery usage reduction, battery waste crisis agenda, battery waste crisis reduction, BBC Radio 4 news, BBC, Costing The Earth programme, Costing The Earth, easing landfill crisis, eco energy knowledge, eco energy research, Electronics & Wireless World, Electronics World magazine, extending alkaline battery life, extending battery life, extension of alkaline battery life, extension of battery life, Friends of the Earth, green battery solution, green energy research, greener battery use, Greenpeace, lab test of cell recovery, lab testing battery chargers, lab testing rechargeable cells, lab testing services, landfill agenda, landfill battery reduction, landfill crisis agenda, landfill crisis solution, landfill reduction capacity, landfill reduction, landfill solution, landfill solutions, lengthening alkaline battery life, lengthening alkaline cells' lifespan lengthening battery life, local authority requirement, local authority waste agenda, manganese alkaline battery life extension, manganese alkaline battery recharge, manganese alkaline battery reconditioning, manganese alkaline battery recycling, manganese alkaline cell life extension, manganese alkaline cell recharge, manganese alkaline cell reconditioning, manganese alkaline cell recycling, primary alkaline battery rejuvenation, primary battery charging, primary battery rejuvenation, primary battery reuse, reduced landfill, reducing battery cost, reducing battery wastage, reducing landfill crisis, reducing landfill, reducing waste chemicals, UK landfill reduction assistance, UK landfill reduction help, UK landfill reduction technology, UK landfill solution, waste crisis agenda, Wireless World article citations. Wireless World article tradition,