

Waste Prevention World

Rechargeable Battery and Charger Sources

Note—There is a new type of rechargeable battery technology now being introduced to the market that will most likely alter some of your decisions about which type of rechargeable AAA and AA batteries to buy. The new technology is Low Self Discharge (LSD) Nickel-Metal Hydride (NiMH) batteries. They are only available in AAA and AA sizes. They are different than other rechargeable AAA and AA batteries because they lose significantly less charge when not in use. According to manufactures, they lose only 15% per **year**, compared to 4% per **day** for ordinary NiMH. See [AAA and AA Rechargeable Batteries Compared](#). LSD batteries can be charged with ordinary NiMH chargers.

This page contains a list of distributors of Nickel-Cadmium (NiCd) batteries, Nickel-Metal Hydride (NiMH) batteries, Low Self Discharge Nickel-Metal Hydride (LSD) batteries, and the chargers needed to maintain these batteries. This table only lists distributors of rechargeable batteries and chargers designed to be used as substitutes for disposable batteries of the sizes AAA, AA, C, D, and 9 Volt. Not all distributors listed carry all sizes of batteries. Not all distributors listed carry chargers for all sizes of batteries.

The number of vendors that carry LSD batteries seems to be rapidly increasing. So, do not assume that if a vendor is not identified on this list as a supplier of LSD batteries, that they do not sell them. Most of the vendors below and others may carry LSD batteries by the time you read this.

Brands of LSD batteries include the following. Please [let us know](#) if you learn of others:

- Accupower Acculoop—Not available yet in the United States.
- [Greenbatteries.com](#)—Available in 2,000 mAh capacity AA size, and 800 mAh AAA size. Bulk discounts are available.
- [Nexcell energyON](#)—Available in 2,000 mAh capacity AA size, and 750 mAh capacity AAA size.
- [Rayovac Hybrid](#)—Available in 2,000 mAh capacity AA size, and 800 mAh AAA size.
- [Sayno Eneloop](#) (Canadian Site)—Available in 2,000 mAh capacity AA size, and 800 mAh AAA size.
- [Uniross Hybrio](#)—Available in 2,000 mAh capacity AA size, and 800 mAh AAA size.

For more information about selecting and using NiCd, NiMH, and LSD batteries and chargers, see [Rechargeable Batteries](#).

Please [recycle your rechargeable batteries](#) when they are worn out. For information on the recycling and disposal of batteries in California, see the Waste Prevention Information Exchange's [battery page](#).

To add to the following list, or to make modifications, contact the [Waste Prevention Information Exchange](#).

NiCd = Nickel-Cadmium NiMH = Nickel-Metal Hydride LSD = Low Self Discharge Nickel-Metal Hydride
 LSD batteries can be charged with ordinary NiMH chargers.

Distributor Name	Battery Types	Battery Charger Types	Battery Chargers with the Ability to Discharge (Recondition) Batteries
Amazon.com	NiCd, NiMH, LSD	NiCd & NiMH	NiCd & NiMH AAA, AA, C, and D
Batteries.com	NiMH	NiCd & NiMH	
Battery Mart.com	NiCd & NiMH	NiCd & NiMH	
BatteryPrice	NiCd & NiMH	NiCd & NiMH	NiCd & NiMH AAA, AA, C, and D
Batteryweb.com	NiCd & NiMH		
CompUSA	NiMH	NiMH	
GoodHumans	NiMH	NiCd & NiMH	
Green Batteries	NiMH & LSD	NiCd, NiMH, & LSD	NiCd & NiMH AAA, AA, C, and D
Only Batteries	NiCd & NiMH	NiCd & NiMH	NiCd & NiMH AAA, AA, C, and D
Radio Shack	NiCd & NiMH	NiCd & NiMH	NiCd & NiMH AAA, AA, C, and D
Real Goods	NiMH	Solar Powered	
Sundance Solar	NiCd & NiMH	NiCd & NiMH Solar Powered	
Sun Star		Solar Powered	
Thomas Distributing	NiMH, LSD	NiCd, NiMH, & LSD	NiCd & NiMH AAA, AA, C, and D. Also carries reconditioning travel chargers for AA and AAA.
Walmart	NiMH	NiMH	

The inclusion of a company on this list does not constitute an endorsement of that company's product.

This list is only intended to give an extremely brief description of these companies products, and might not accurately represent the companies or their products. [Other disclaimers](#) apply. To add other companies, which manufacture recycling containers, to this list, or to request removal from this list, contact the staff listed at the bottom of this page. Additions are subject to the discretion of the California Integrated Waste Management Board.

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Rechargeable Batteries and Chargers: A Personal Perspective

This page is a personal perspective of a CIWMB staff person who is an avid user of rechargeable batteries.

The following insight addresses rechargeable replacements for single-use batteries of the sizes AAA, AA, C, D, and 9 Volt. For a brief description of other types of rechargeable batteries, see [Electrical Storage, Present, Past and Future](#). To learn where to buy rechargeable batteries and chargers, see [Rechargeable Battery and Charger Sources](#).

There are three types of rechargeable batteries, as described below. They are Nickel-Cadmium (NiCd), which are the oldest type; Nickel-Metal Hydride (NiMH), which were developed around the same time that low-cost digital cameras were invented; and a new type of NiMH battery, called Low Self Discharge (LSD). The characteristics of the three types of rechargeable batteries are described below. Battery chargers come with a variety of characteristics, as well. This page will help you and your entire household almost completely avoid single use batteries.

If you are in a hurry to just buy some rechargeable batteries and a charger, and you don't want to make a formal study of the subject as I do, skip the following introduction and just read the section entitled, [What to Do, in Brief](#).

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Introduction

I hate throwing batteries away when they die. Single use (ordinary) batteries, sometimes called primary batteries by the manufacturers, have gotten so expensive that I feel am throwing away cash when I buy them. I also hate not knowing when my batteries are going to conk out. There is an ease and a freedom that come with rechargeable batteries. I pay for them once every five or more years, and if for any reason I want fresh batteries in an electrical device, I just pop out the batteries and charge them, or swap them for some others that I have already charged. I have not had a battery go dead on me in the middle of an important task since I made the switch to rechargeables. Furthermore, I don't need to concern myself with completely using up batteries to avoid wasting money or natural resources, not to mention the energy needed to manufacture and ship both the batteries and the materials to make the batteries.

I made the switch to rechargeable batteries over three years ago. I now use rechargeable batteries for almost everything in my home that uses batteries of the sizes, AAA, AA, C, D, and 9 Volt. I am pleased with the change, but I had a rough start. My first foray into the world of rechargeables was neither happy nor cost effective. The purpose of this page is to help you avoid the mistakes I made, and to achieve the dramatic long-term reductions in both cost and waste generation that rechargeable batteries can provide.

Rechargeable batteries are much better than they used to be. The higher capacity rechargeable batteries today have nearly three times the capacity of what was readily available a few years ago. Their capacity equals or exceeds ordinary single use Alkaline batteries, and the new Low Self Discharge (LSD) rechargeable batteries, explained in the following paragraph, provide a charged shelf life that is as practical as the shelf life of ordinary single use batteries. If you take care of your rechargeable batteries, as described in [What to Do, in Brief](#), they will, according to the manufactures, last for between 500 and 1,000 charge/discharge cycles. Once in a while I find a battery that stops holding a complete charge and goes out much sooner. In my experience, this happens more frequently with some of the cheapest brands, but by no means with all of the cheapest brands. However, most of my rechargeable batteries are going strong after three years, with no sign of weakening. I recharge about half of my non-LSD batteries every couple of months. Most of the rest are recharged every three to five months. The new LSD batteries will probably alter this picture considerably.

The new Low Self Discharge (LSD) batteries have entered the market in sizes AAA and AA. If the manufacturers' claims are true, they will outlast alkaline batteries, but not the new extra long lived single-use lithium batteries. Yet the greatest advantage of LSD batteries is not the capacity, but the shelf-life. LSD batteries are a new version of the Nickel-Metal Hydride (NiMH) batteries, which became popular a few years ago with the advent of digital cameras. The problem with rechargeable batteries, especially traditional NiMH batteries, has been that they loose a significant amount of charge with time, even when not in use. According to the manufacturers, the new LSD NiMH batteries loose much less. (See [AAA and AA Rechargeable Batteries Compared](#), below.)

So far, there are only three instances where I have not let go of single use batteries. My smoke detectors is one. I am not confident that 9 Volt NiMH or

NiCD batteries will last a full year or more in a smoke detector as single-use batteries will. Another instance is in my headlamp and flashlight that I take backpacking. There prefer the new lithium single use batteries because they last the longer than anything in AAA size, and because warm temperatures do not cause them to loose a significant amount of charge. The last instance where I still use throw-away batteries is, somewhat ironically, in my digital multi meter that I use to test battery strength, because it is hard to replace the battery in this particular device. If LSD 9 Volt batteries are ever made, I might use them in the smoke detectors and multi-meter.

What to Do, in Brief

If you want to cut to the chase and keep it simple, then do these three things:

1. Buy a battery charger that has these five features (In order of importance.):

(a) Charges Nickel-Metal Hydride (NiMH) batteries, or better still, charges both Nickel-Metal Hydride batteries and Nickel-Cadmium (NiCd) batteries. Almost all chargers sold today charge NiMH batteries, but check to make sure, especially if you are buying a used charger. All chargers designed to charge NiMH batteries are perfectly compatible with the new Low Self Discharge (LSD) NiMH batteries, described in the introduction.

(b) Has an optional discharge cycle, more commonly called a reconditioning cycle. For reasons why, see [#3 below](#).

(c) Switches to a trickle charge or shuts off or automatically after the batteries are charged. This prevents you from over cooking your batteries and dramatically shortening their life.

(d) Charges each battery individually. Many chargers only charge batteries in pairs. That works OK if you use batteries only in pairs. But wall clocks and some remote controls use only one battery, and some flashlights use one, three, or five. Additionally, you will find in time that supposedly identical rechargeable batteries differ slightly in their capacity. Allowing each battery to recondition and recharge individually assures that each battery will last as long as it can. More importantly, if a rechargeable battery goes bad, and if your charger charges each battery individually, it can tell you precisely which battery is the bad one.

(e) Automatically switches from recondition mode to recharge mode, without requiring you to go to the charger to flip a switch half-way through the process. This is a tremendous convenience. Without this feature you will find yourself either repeatedly going to the charger to see when you can start the charging process, or you will forget to switch to the charging process and not have charged batteries when you want them. Worse still, you may get frustrated by the reconditioning cycle, stop reconditioning your batteries, and thus shorten the life of your batteries.

Your best bet might be to make your first charger one that charges/discharges (typically four) AAA, AA, C and D batteries. Some of these also charge 9 Volt batteries. Alternately, if you don't think that C and D rechargeable batteries will be in your future soon, get a charger that charges about 10 AAA and AA batteries. You may think you will never want to charge that many, but if you start to replace all the AAA and AA batteries in your home with rechargeables, you will most likely find smaller capacity chargers to be limiting. If you buy two or more smaller capacity chargers, then you may spend more on all your small chargers than if you had just bought the big in the first place. You might also have trouble finding a place to plug in all of them. Another benefit of the larger chargers is that they tend to be more sophisticated, and thus usually possess all the characteristics listed above, although a few of the smaller chargers have all the characteristics too.

To find vendors that sell such chargers, see [Rechargeable Battery and Charger Sources](#).

Note—It is recommended by some who regularly use rechargeable batteries to plug your chargers into a surge protector to not only protect the charger, but to reduce the chances of a an electrical surge acting to confuse your charger during a charge cycle, and thus not properly charge your battery. Any ordinary surge protector will suffice, including strip surge protectors commonly sold in computer stores, or wall-outlet surge protectors sold in hardware and electronic stores.

Note—It is recommended by some who regularly use rechargeable batteries to place your charger on a noncombustible surface to insulate the charger from the table or counter on which is rests. This is because in a few instances chargers have been reported to have become quite hot as a result of some sort of malfunction. Such instances are reportedly rare. This measure is only precautionary. Examples of a noncombustible insulators include a kitchen trivet or an inverted pie plate. I use left-over ceramic bathroom tile. Of course, this precaution does not apply if your charger is of a type where the entire charging unit plugs into

the wall socket, and does not draw power through a wire connected to a transformer (power brick).

2. Buy Nickel-Metal Hydride (NiMH) batteries, or Low Self Discharge (LSD) Nickel-Metal Hydride batteries of the highest or nearly the highest capacity (mAh) that you can find.

(a) When buying AAA and AA sizes, buy Low Self Discharge (LSD) Nickel-Metal Hydride batteries (NiMH). The only exception would be for electronic devices that you or your children use so intensively that you recharge the batteries more than every three weeks or so when you use them. Such might be the case with digital cameras and motorized toys. If you generally run your batteries down in about three weeks, consider buying ordinary **high capacity** Nickel-Metal Hydride batteries (NiMH) batteries, because they hold a little more charge than the LSD batteries. Check the mAh rating on the batteries before you buy. [See AAA and AA Rechargeable Batteries Compared](#), below.

(b) When buying C, D and 9 Volt batteries, buy ordinary high capacity Nickel-Metal Hydride batteries (NiMH). LSD batteries are not yet available in these sizes. ([Let us know if you ever find them.](#)) The only exceptions might be with devices that you use only lightly **and** in which you need the battery to stay charged a long time in very warm temperatures. In these cases, the old Nickel-Cadmium (NiCd) batteries might be a little better. I say "might" because it depends on whom you want to believe. It has been traditionally stated that the advantage of NiCd batteries is that they self discharge (lose their charge when not in use) at a rate of only about 1% per day, compared to the 4% per day of NiMH batteries, and that these rates of self discharge are greater in warm temperatures. This has been my personal experience. Others would argue. However, makers of ordinary NiMH batteries have apparently been trying to reduce the NiMH self discharge rate. See [Technical Information About Rechargeable Batteries](#), below.

Ordinary NiMH batteries and NiCd batteries are available in drastically different capacities. Check the mAh rating on the batteries before you buy. Also, be aware that the best NiCd batteries have half or less of the capacity of the best NiMH

batteries.

Note—Single use lithium batteries outlast all rechargeable batteries.

Test the water. I have found that batteries of some manufactures seem to provide electricity for longer durations than others. For example, I have some 2,600 mAh AA NiMH batteries that last only about as long as some 1,600 mAh AA NiMH batteries of another brand. In this case the 2,600 mAh batteries are underperforming, not the 1,600 mAh batteries over performing. I have also found instances where some samples of a particular brand of AA NiMH batteries were too wide to fit in some samples of one popular brand of AA flashlight, and also were too long to fit in one of my two wall clocks. I do not know if the battery manufacturer, the flashlight manufacturer, the clock manufacturer, or all the manufacturers had built some of their products outside some sort of standard specifications of diameter and length.

3. Send your Nickel-Metal Hydride batteries (NiMH) and your Low Self Discharge (LSD) Nickel-Metal Hydride batteries through a reconditioning (discharge) cycle about every fourth time you charge them. Send your Nickel-Cadmium batteries (NiCd) through more frequent reconditioning cycles). You may have heard that NiCd batteries develop discharge memory and that NiMH batteries do not. This is not quite true. Both NiCd and NiMH develop discharge memory, the NiCd just do it more readily. Discharge memory refers to the behavior of batteries whereby if a battery is discharged, for example, only half way every time it is used; eventually the battery can only be discharged half way before it dies. So, for example, a 1,000 mAh battery begins to behave something like a 500 mAh battery.

I recondition my batteries every time I charge them unless I am in a hurry. With over 75 rechargeable NiCd and NiMH batteries at my home, it is hard to remember which ones were reconditioned when. (You could easily have over 75 batteries in your home too.) It is far simpler to just recondition them almost every time, and if your charger automatically switches from recondition mode to recharge mode without requiring you to go to the charger to flip a switch half way though the process, then it is not an inconvenience to recondition them most times.

Examples of NiMH Battery Capacity:

- **AAA**—High capacity AAA batteries would have 1,000 or 950 mAh capacity. They can come with as little as 400 mAh capacity or with no capacity listed. As of the date of this writing, Low Self Discharge AAA batteries have a capacity of 750 or 800 mAh.

- **AA**—High capacity AA batteries would have 2,700 or 2,650 mAh capacity. They can come with as little as 600 mAh capacity or with no capacity listed. As of the date of this writing, Low Self Discharge AA batteries have a capacities around 2,000 mAh.
- **C**—High capacity C batteries would have 5,500 or 5,000 mAh capacity. They can come with as little as 1,000 mAh capacity or with no capacity listed. As of the date of this writing, there are no Low Self Discharge C size batteries. [Let us know if you ever find them.](#)
- **D**—High capacity D batteries would have 12,000 or 10,000 mAh capacity. They can come with as little as 1,000 mAh capacity or with no capacity listed. As of the date of this writing, there are no Low Self Discharge D size batteries. [Let us know if you ever find them.](#)
- **9 Volt**—High capacity 9 Volt batteries would have 275 or 250 mAh capacity. They can come with as little as 120 mAh capacity or with no capacity listed. As of the date of this writing, there are no Low Self Discharge 9 Volt batteries. [Let us know if you ever find them.](#)

Note: If you cannot find the higher capacity batteries, or the Low Self Discharge batteries near where you live, check vendors listed in [Rechargeable Battery and Charger Sources](#). For my own purposes, I find better batteries on the Web than I do in stores where I live.

AAA and AA Rechargeable Batteries Compared

Battery Type	Total Capacity	Self-Discharge Rate	Use Characteristics
Nickel-Metal Hydride (NiMH)	Up to 1,000, AAA. Up to 2,700 mAh, AA. Available capacities vary widely. Check the mAh rating before you buy.	Does not hold charge well over long periods. Loses 4% per day ¹ , much more in warm temperatures.	Works well in devices that require sudden high amperage discharge, such as digital cameras. Also works well in most other devices.

Low Self Discharge Nickel-Metal Hydride (LSD NiMH)	Up to 800, AAA. Up to 2,000, AA Almost all LSD batteries sold have close to these capacities.	Holds charge well over long periods. Loses 15 % per year ² , very slightly more in warm temperatures.	Works well in devices that require sudden high amperage discharge, such as digital cameras. Also works well in most other devices.
Nickel-Cadmium (NiCd)	Up to 350 mAh, AAA. Up to 1,000 mAh, AA. Available capacities vary widely. Check the mAh rating before you buy.	Loses 1% per day ³ , slightly more in warm temperatures.	Does not work well in devices that require sudden high amperage discharges. Does not work well in digital cameras, but does work well in most other devices.

Footnotes

1. [NiMH lose 4% of their charge per day](#), according to [Sundance Solar](#), a battery distributor. According to [Green Batteries](#), another distributor, NiMH batteries [can lose up to 40 percent](#) of their charge in a month when stored at 70 degrees F.
2. [LSD NiMH lose 15% per year](#), according to Sanyo, which makes [Enloop](#).
3. [NiCd lose 1 percent per day](#), according to [Sundance Solar](#).

[See Technical Information About Rechargeable Batteries](#), below.

AAA and AA Single-Use Batteries Compared

Battery Type	Total Capacity	Self-Discharge Rate	Discharge Characteristics

Lithium (Very High Capacity Single- Use Batteries)	Up to 1,250 mAh, AAA. Up to 3,000 mAh, AA.	Holds charge very well over long periods and in warm temperatures. Other data not available.	Works well in devices that require sudden high amperage discharge, such as digital cameras. Also works well in most other devices.
Alkaline (High Capacity Single-Use Batteries)	Data not available.	Holds charge very well over long periods and in warm temperatures. Other data not available.	Works well in devices that require sudden high amperage discharge, such as digital cameras. Also works well in most other devices.

Additional Quirks

The battery strength of NiCd batteries starts out strong, and then tapers off gradually during the discharge cycle. NiMH batteries start out strong and stay strong until the batteries conk out. They quit with little or no warning. I have not yet heard anything that would lead me to think that LSD NiMH batteries would behave any differently in this regard than ordinary NiMH batteries.

The duration of future discharge cycles and battery life can easily be shortened if NiCd batteries are not fully discharged between charges. By contrast, the duration of future discharge cycles and battery life of NiMH batteries are not shortened as easily as NiCd batteries if the battery is not fully discharged between charges. However, NiMH batteries do benefit from being fully discharged once in a while. (See [Notes and Tips](#), below.)

NiCd batteries seem to work a little bit better than NiMH as temperatures dip below 40 degrees Fahrenheit, but low temperature NiMH batteries are available.

It is sometimes said that NiCd batteries are not environmentally friendly, and that NiMH batteries are. This is usually said in reference to federal standards, which in many other states allow NiMH batteries to be disposed in the trash, but which require NiCd batteries to be disposed or recycled as hazardous waste. However **in California, all batteries, including NiMH, LSD, NiCd and ordinary single use batteries, must be disposed or recycled as hazardous waste.** It is illegal to place them in the trash. So, if you dispose of batteries as you should in California, there is little difference in the environmental risks of disposing the various types of batteries.

Consider This

If you keep your charger or chargers handy and at the ready, it will be much more convenient to charge batteries in a hurry, than if the chargers are stashed in a drawer. Consider installing a simple shelf especially for the chargers, perhaps in your kitchen, laundry room, or garage. Perhaps buy a surge protecting power strip as used on computers so that you can more easily plug in two or three chargers. I built a simple plywood cabinet in my garage with four electrical outlets on the back wall of the cabinet. Power to the outlets runs through a lighted switch on the outside of the cabinet, so that when the cabinet door is closed I am reminded that there are batteries charging inside the cabinet. The closed cabinet keeps out dust and debris from my occasional woodworking and other garage projects. The cabinet has vents at the top and bottom to allow enough air circulation to keep the chargers and transformers (power bricks) cool on hot summer days. Batteries get warm when they are charged, especially D size.

Note—It is recommended by some who regularly use rechargeable batteries to plug your chargers into a surge protector to not only protect the charger, but to reduce the chances of an electrical surge acting to confuse your charger during a charge cycle, and thus not properly charge your battery. Any ordinary surge protector will suffice, including strip surge protectors commonly sold in computer stores, or wall-outlet surge protectors sold in hardware and electronic stores.

Note—It is recommended by some who regularly use rechargeable batteries to place your charger on a noncombustible surface to insulate the charger from the table or counter on which it rests. This is because in a few instances chargers have been reported to have become quite hot as a result of some sort of malfunction. Such instances are reportedly rare. This measure is only precautionary. Examples of noncombustible insulators include a kitchen trivet or an inverted pie plate. I use left-over ceramic bathroom tile. Of course, this precaution does not apply if your charger is of a type where the entire charging unit plugs into the wall socket, and does not draw power through a wire connected to a transformer (power brick).

An Example of What Not to Do

My first attempt using rechargeable batteries involved Nickel-Metal Hydride (NiMH) batteries for the head light and tail light on my bicycle. At first I thought I had the perfect solution. I bought two sets of batteries, one set to keep at the ready in the quick chargers, and one set to keep inside the lights on the bicycle. I just swapped the batteries every few days to assure they would not go dead during commutes, and all seemed well with the world. But after a few months I noticed the batteries weren't holding a charge. My quick chargers were a type that neither turned off nor switched to trickle charge when the batteries were fully charged. Thus, I had overcharged my batteries by not removing them as soon as they were charged. I may have also created some battery memory. Because I did not want the batteries conking out during my commute, I did not let the batteries fully discharge. However, these batteries had only experienced about 50 charging cycles. So, over-charging was most likely the problem. If I had used chargers that either shut themselves off or switched to trickle charge when the batteries were fully recharged, then I would have been much better

off.

It may seem like not overcharging batteries would be simple, just go unplug the charger. However, if the charger does not shut off or switch to trickle charge, you have no way of knowing when they are fully charged. Timing the charging, and remembering to remove the batteries promptly and continually for batteries that you are recharging once every week or two, time after time, gets to be annoying. Even if you only need to charge batteries once a month, if you are dealing with a household, let alone a business or grammar school, with lots of rechargeable batteries, such diligence can be daunting to impossible. That is why I suggest using the type of chargers [described above](#). Pay a little more and buy battery chargers that do all the work for you. To find such chargers, see [Rechargeable Battery and Charger Sources](#).

Other Types of Rechargeable Batteries

There is another type of rechargeable replacement for batteries in sizes AAA, AA, C, D, and 9 volt, reusable alkaline. This page does not address reusable alkaline batteries because they are capable of only about a half dozen charge/discharge cycles, and thus do not provide anywhere near as much potential for waste prevention as NiCd, NiMH, or LSD batteries.

Of course, some electrical gadgets come with their own custom made rechargeable batteries. Cell phones, cordless phones, cordless power tools, some types of cordless shavers and digital cameras, and other gadgets use batteries made in special shapes and sizes. These batteries might be NiCd, NiMH, or Lithium. This article does not address these batteries except to say two things:

1. To make these batteries last as long as they can, remember to run them through full discharge cycles before every third or fourth time you charge the battery. (More frequent full discharge cycles are better.) This is most important with Nickel-Cadmium batteries, but even Nickel Metal Hydride and rechargeable Lithium batteries benefit from this according to anecdotal reports from users, and according to some instructions supplied with both some of these devices and with some of their replacement batteries.
2. None of these batteries, or any other batteries, are allowed in the trash in California. See the [Waste Prevention Information Exchange's battery page](#), for more information on battery recycling and disposal.

Battery Capacity

When comparing two different NiCd batteries or two different NiMH batteries, look for the mAh rating. (Explained in the following section.) The higher numbers generally correlate to more hours or minutes of use between charges.

When buying rechargeable batteries, it pays to pay attention to the mAh rating. These ratings vary drastically in ordinary NiMH and NiCd batteries. At the

time of this writing, all LSD batteries seem to be manufactured with nearly the same mAh rating. Ordinary NiMH batteries are manufactured with capacities both above and below LSD batteries. Don't expect to find NiCd batteries with as much capacity as NiMH batteries. Typically, the highest capacity NiCd batteries hold half or less than half the capacity of best NiMH batteries. However this does not automatically mean that NiCd batteries are not as good. When factoring cost, the type of use, and sometimes temperature, NiCd can be the better choice if the new Low Self Discharge batteries are not available. At the time of this writing, LSD batteries were only available in AAA and AA sizes.

Manufacturers sometimes sell batteries of the same brand name and in the same packaging, but with different mAh ratings, in some cases very different. Batteries that look nearly identical can have very different capacities. This is not an intentionally deceptive practice. These manufactures are just giving you a choice in how much you spend. It is up to you to read the mAh rating that manufacturers usually print for you both on the packaging and on the battery. Of course, if the mAh capacity is not listed on a rechargeable battery, then beware. Unfortunately, for some reason the capacity is not usually printed on single-use batteries.

What's a mAh?

The capacity of NiCd and NiMH batteries is rated in milliampere hours. One milliampere hour (mAh) is one thousandth of an ampere delivered for a duration of one hour. In the case of AAA, AA, C, and D batteries, this energy is delivered at somewhere around 1.5 Volts.

If a one of these 1.5 Volt batteries had the potential to provide one thousandth of an amp for one hour we would say that it has a capacity, of 1 mAh. If it could provide 2,000 milliamps for one hour, or 1 milliamp for 2,000 hours, it would be called a 2,000 mAh battery.

Amperes (often called Amps) can be thought of as the amount of electricity in motion, or an amount being delivered at any instant. Voltage, or Volts can be thought of as force." The Voltage coming from the battery is roughly constant. It stays in the neighborhood of 1.5 Volts. However, the amperage utilized or drawn by any particular electrical device can vary from device to device. For example, wall clocks and remote controls use just a tiny amount, digital cameras use a comparatively large amount, although in both cases only tiny fractions of an ampere are used, hence the measurement of thousandths of Amps.

Strictly speaking, mAh is not a measurement of an amount of electrical energy. It is only a measurement of milliamperes over time. To make it a measurement of an amount of electrical energy, we would need to factor the Voltage. This is impractical because:

1. The actual Voltage of AAA, AA, C, and D (and 9 Volt) batteries weakens as the batteries are drained of charge.
2. Different types of batteries start out with different maximum Voltages. NiMH batteries, in the sizes AAA, AA, C, and D, provide a maximum

Voltage of about 1.40 to 1.45 Volts. A single use battery will actually generate a maximum voltage a little over 1.5 Volts when it is new, I have measured them as high as 1.7 Volts.

Battery powered devices are designed to handle the range of Voltage that their batteries generate.

Notes and Tips

Battery manufactures have warned that discharging rechargeable batteries so thoroughly that they hold no charge at all can damage or destroy batteries. On this page, the term "fully discharge" refers to the practices of using batteries until the device that they power does not operate normally, or using the batteries until the device that they power tells the user to replace the batteries, or discharging batteries to their lowest safe level in a "reconditioning" battery charger. Many modern devices with sophisticated electronic circuitry turn themselves off when batteries are low. However, a simple device, such as a flashlight, might, if left on, discharge batteries so thoroughly that they become damaged.

NiCd and NiMH batteries can also be damaged by over charging. Once a battery has been recharged, it is recommended that users do not try to add additional charge to the battery by sending it through another recharge cycle before using the battery. This is especially true when using chargers that charge for a specific period of time every time that the charger is turned on. If you use a charger that either stops charging or switches to trickle charge when a battery is fully charged, you greatly reduce the risk of overcharging, although the conventional wisdom is that batteries should not be left in trickle charge mode indefinitely.

You might find it useful to write the purchase date on each battery with permanent ink as you collect them. This will help you keep track of which ones are old, and thus perhaps getting ready to fail. It could also help you determine if you are using and charging your batteries in a manner that allows them to last as long as you think they should.

You may eventually find it most convenient to have more than one charger. I have three, and I sometimes use all three simultaneously. One of my chargers individually reconditions and charges up to ten batteries, but only of sizes AAA and AA, and at a fairly slow rate of charge. The other two individually recondition and charge up to four batteries of sizes AAA, AA, C, and D, and at a fairly high rate. These two chargers also each charge two 9 Volt batteries, but they do not recondition the 9 Volt batteries. I have not found a charger that reconditions 9 Volt batteries. However, the lack of a recondition cycle for 9 Volt batteries has not been a problem for me, because I usually discharge my 9 Volt batteries completely in the electrical devices that use them. All three chargers automatically and individually switch each battery from discharge to charge at the appropriate time, and all three of my chargers individually switch each battery to trickle charge when they are charged.

To find both batteries and chargers, see [Rechargeable Battery and Charger Sources](#).

Alternatives to Batteries

Let's go back to square one for a moment. Do you need batteries? Interestingly enough, in two cases the answer is sometimes no. To learn more about the possibilities, see [Alternative Power Products](#).

Don't forget to [recycle your rechargeable batteries, or dispose of them as hazardous waste](#), when they are worn out.

More Information

- [Batteries Digest](#)—Batteries, fuel cells, and photovoltaics.
- [Batteries in a Portable World. A handbook on rechargeable batteries for non-engineers](#)—By Isidor Buchmann.
 - [Frequently Asked Questions about Rechargeable Batteries](#)
- [Batteryweb.com](#)—Frequently Asked Questions
- [Conscious Consumer - Buy Better Batteries](#)—From the Conscious Consumer Project of Center for a New American Dream
- [Electrical Storage, Present, Past and Future](#)—From Waste Prevention World.
- [Rechargeable Battery Information](#)—From Steve's Digicams
- [Battery and Cell Phone Drop-Off Locator](#)—Find where to recycle used rechargeable batteries from the [Rechargeable Battery Recycling Corporation \(RBRC\) Web site](#).
- [Waste Prevention Information Exchange, Batteries](#)
- [Waste Source Reduction Hospital Case Study](#)—This study from the Minnesota Office of Environmental Assistance addresses several common hospital waste streams, one of which is batteries. This study documents significant cost and waste reductions achieved by switching from single use to rechargeable batteries for flashlights. Portable Document Format (PDF), 136 KB.
- **Technical Information about Rechargeable Batteries**—Some of this information supports, and some if this information contradicts, the statements made on this page about self discharge rates. It is posted so that you can come to your own conclusions:
 - [Candle Power Forums, Enloop Self Discharge Study](#)
 - [Duracell, Ni-MH Rechargeable Batteries](#) (Adobe PDF, 504 KB)
 - [Panasonic, Nickel Metal Hydride Batteries](#) (Adobe PDF, 76 KB)
 - [PG Batteries, NIMH Rechargeable Batteries](#) (Adobe PDF, 648 KB)
 - [Quest Batteries, Nickel Metal Hydride](#) (Adobe PDF, 152 KB)
 - [Sanyo Twicell Batteries](#) (Adobe PDF, 448 KB)

For information about how to recycle or reuse other electronic equipment, see the CIWMB [Electronic Product Directory](#).

The reference of or link to a company on this page does not constitute an endorsement of that company or its product. [Other disclaimers](#) apply.

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Waste Prevention World <http://www.ciwmb.ca.gov/WPW/>

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