# Batteries

by J. Moldovan Sr.

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Electric batteries (a source of electrical power storage) are not created equally. Two-way radio batteries, application, output and storage capacity are critical in operations where a generated power source is not readily available. Batteries and on-hand serviceable (charged) spares are used to power many two-way radios and electronic devices. Without a power source these devices are typically non-operative for intended purposes be it routine operations or more critical when needed in "EMERGENCY" situations. Keep it simple!

Hurricane Helene (2024) may have exposed some real vulnerabilities of our fragile infrastructure. However, two-way radio communications functioned where even the best cell phones and networks did not or were very limited. The irony is that some two-way radio operators were down simply because they did not have spare serviceable or charged batteries on-hand and failed to fully consider real" EMERGENCY" situations. The Boy Scouts of America motto is "Be Prepared" which has greater implications beyond batteries! Are you prepared? U.S. Navy Seals have a saying that "Two is one and one is none". This idea suggests that having "one" item is like having none and experience reveals that when "one" fails (equipment or plan) it's when you least expect it and often at the worst possible time. If possible, at least three serviceable/charged sets of battery spares for each critical device, is ideal. Don't forget redundancy in critical equipment, specialized batteries, charging sources, dedicated connectivity (wiring/plugs) & schedule routine upkeep.


Courtesy: TheEngineersPost.com

**Batteries 101 -** Batteries use internal electro-chemical conversions and special metallic composition to store energy, extend their useful life and may often provide increased energy output. Batteries typically provide a direct current (DC) power source.

- Batteries come in different voltages (electrical potential) and amperage (current flow)
- Batteries come in various physical sizes AA, AAA, C, D, Button Cell/Coin and more
- Battery packs are (specialized self-contained batteries often specific to a device)
- Batteries used for general purposes (may or may not be interchangeable)
- Batteries come in non-rechargeable (one time use) & rechargeable (multiple use)
- Beyond cost there are "Pro's & Con's" to consider in selection including critical device requirements. **Be sure to refer to original equipment manufacturer specifications.**

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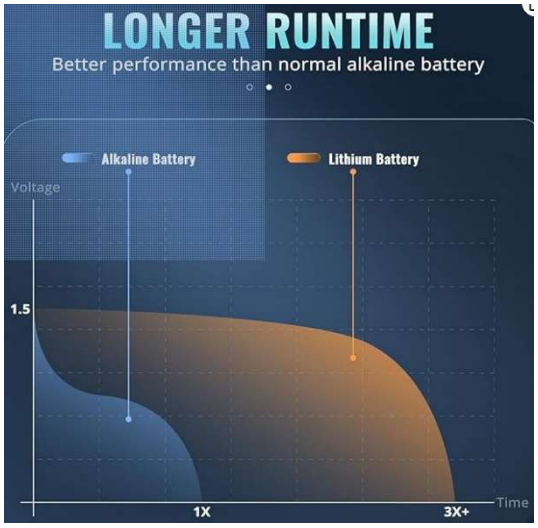
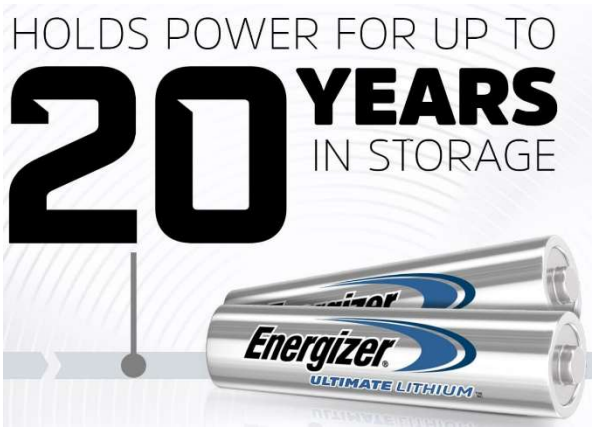
## What batteries are typically used with Two-way Handheld (HT) Radios & Radio Base Station (Back-up)?

***Tech-Tip! Think of batteries as the "Engine" for your battery powered electronic devices. Carefully consider your selection (1) Life (Useful-Shelf), (2) Capacity (Energy Density), (3) Operating Temperature Range Above or Below* (0ºC /32 ºF)*, (4) Charge cycle (If Rechargeable), (4) Serviceable Spares and (5) Cost.***

1. ***Many Modern radios typically use Li-ion batteries***
2. ***Many Legacy radios typically use NiCad and NiMH batteries (Undesirable "memory effect"***
3. ***Many Base Station battery back-up use Lithium-iron phosphate* (LiFePO$_4$), Sealed Lead Acid (SLA) and Absorbent Glass Mat (AGM) batteries.**

**1. Lithium-ion batteries (Li-ion) $$$$ (Most Common and Most Expensive)** Li-ion batteries are 25-30% lighter than others but provide a high energy to weight ratio. Typically, at 3.6 to 3.7VDC circuitry reduced in some applications down to 1.5VDC. Considered by many as environmentally friendly and do not experience the "memory effect".




a. **Lithium polymer battery** $$ Rechargeable


b. **Lithium-iron-phosphate (LiFePO$_4$) $$$S** Rechargeable, charging at or below freezing will damage the battery **(0ºC /32 ºF). <u>Many (high end) but Not All</u>** have protective charging/discharging/heater circuits. Typically, 3.6–3.8 V (charged) to 1.8–2.0 V (discharged) May be circuitry reduced to 1.5VDC

**2. Nickel-cadmium batteries (Ni-Cd) $$$** Rechargeable-Often used in older battery packs. Can hold a charge and maintain nominal voltage typically 1.4/1.2 VDC. Nickel Cadmium (NiCd) batteries are ideal for high performance (watt-hours) in extreme temperatures ranging from -30C to +50C. Ni-Cd suffer from "memory effect".

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**3. Nickel-metal hybrid hydroxide batteries (Ni-MH) $$$** Rechargeable- They typically offer 35-40% longer operation time than Ni-Cd but are not an extreme temperature battery. Overcharging can cause premature damage. However, like Ni-Cd but on a lesser scale they suffer from "memory effect".



**4. Alkaline batteries $$** Technically Rechargeable- **<u>But Dangerous/Explosive to do so, not recommended also requiring a special charger.</u>** Typically last longer than Zinc- Carbon batteries. High Energy Density, Long Shelf Life, Lower Temperature Operation (performance significantly dropping at **(0ºC /32 ºF)**. Typically, 1.50-1.65VDC

**5. Zinc-carbon batteries (Dry Cells) $** Not rechargeable, Throw-away, low cost, typically 1.5 VDC but perhaps the lowest all-round performance of all.

**Battery Packs-** Two-way radio manufacturers offer a (proprietary) selection of rechargeable battery packs for their radios (HT). Battery packs in general terms are groups of battery cells oriented/connected in such a way to provide the appropriate voltage/current necessary for the device to function properly. Many manufacturers offer a custom fit battery case designed to hold AA size Alkaline (type) cells but can often accommodate aftermarket spares like (1) nickel cadmium (NiCad), (2) nickel metal hydride (NiMH), and (3) lithium-ion (Li-ion). The user should consider their unique operational requirements. A good option to replace dead or damaged cells and great for emergencies.





**<u>Buy Two Way Radios</u>**

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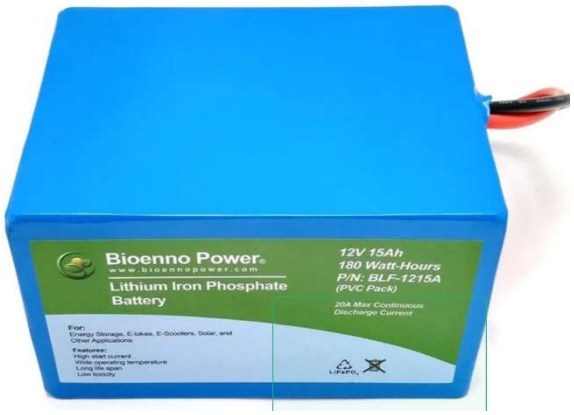
**Base station-backup Lithium-iron-phosphate ($LiFePO_4$) $$$S** (Has become very popular) Rechargeable, charging at or below freezing will damage the battery **(0ºC /32 ºF). Many (high end) but Not All** have protective charging/discharging/heater circuits. Base stations run at 12-volt, moderate to high current output (depending on battery selection). Individual cells grouped and configured to provide necessary voltage, amperage and overall capacity. Typically, cells individually are 3.6–3.8 V (charged) to 1.8–2.0 V (discharged) May be circuitry reduced to 1.5VDC. **Bioenno Power**





**Base station back-up Lead-acid batteries (Typically Automotive Type) $** Rechargeable, function/charge in both low and high temperature extremes. Danger with charging (Gas out) & acid. Requires servicing and service life is about 3-5 years (Many options)

**Base station back-up Sealed Lead-acid batteries (SLA) $$** Rechargeable, function/charge in both low and high temperature extremes. Danger with charging (Gas out). Does not require servicing and service life is about 4-7 years. (Many options)

**Base station back-up Absorbent Glass Mat Lead-acid batteries (AGM) $$$** Rechargeable, function/charge in both low and high temperature extremes. Danger with charging (Gas out) is reduced. Does not require servicing and service life is about 5-8 years. (Many options)

**Coin cell batteries** Can be Alkaline **$** or Lithium Manganese Dioxide **$$** Typically 1.5 or 3.0 VDC-Used in special applications. (Many options)

| **AA-Cells** | **Li-ion** | **NiMH** | **NiCad** | **Alkaline** | **Zinc-Carbon** |
|---|---|---|---|---|---|
| Full-Charge | 4.1 V | 1.4 V | 1.4 V | >1.5 V | 1.5 V |
| Nominal | 3.6 V | 1.2 V | 1.2 V | 1.5 V | ---------- |
| Discharged | 2.6 V | 1.0 V | 1.0 V | 1.0 V | ---------- |
| **Capacity** | | | | | |
| Maximum | 2700 mAh | 2500 mAh | 1000 mAh | 2700 mAh | 400-900 mAh |
| Average | 2000 mAh | 1500 mAh | 600 mAh | 1500 mAh | ---------- |
| Minimum | 1800 mAh | 1000 mAh | 300 mAh | 600 mAh | ---------- |

**Approximate Values