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Battery Types Used in Wind and Solar Electric Systems

A brief overview of the different types of batteries that may be used in solar electric and backup power systems.

LEAD ACID

The common automobile batteries in which the electrodes are grids of metallic lead-containing lead oxides that change in composition during charging and discharging. The electrolyte is diluted sulfuric acid.

The new AGM Battery technology has made a huge impact on lead-acid batteries, making it one of the best batteries to use in solar electric systems.

Industrial-type batteries can last as long as 20 years with moderate care, and even standard deep cycle batteries, such as the golf car type, should last 3-5 years. Intermediate batteries, should last 7 to 12 years.

LITHIUM

Lithium batteries have many advantages over traditional battery types. They have an extremely long cycle life and high discharge and recharge rates.

NICAD (NICKEL CADMIUM)

Alkaline storage batteries in which the positive active material is nickel oxide and the negative contains cadmium.

Downsides:

1. Very expensive
2. Very expensive to dispose of - Cadmium is considered VERY hazardous.
3. Low efficiency (65-80%)
4. Non-standard voltage and charging curves may make it difficult to use some equipment, such as standard inverters and chargers.

My impression of traditional pocket plate NiCads--this is a turn of the century technology--is that they have many good points--low self-discharge, non-freezing, and so on--but their CYCLE LIFE IS NO BETTER THAN, IF AS GOOD AS properly chosen

lead-acids. To put it another way, they have a long life in *chronological terms,* but not in *cycle* terms. This makes them good for emergency/standby systems, but not for systems with a daily cycle. Not recommended for most solar or backup power systems.

NIFE (NICKEL IRON)

Energy storage density = 55 watts per kilogram

Alkaline-type electric cells using potassium hydroxide as the electrolyte and anodes of steel wool substrate with active iron material and cathodes of nickel plated steel wool substrate with active nickel material. This is the original "Edison Cell". Very long life.

..."Our experience with customers using alkaline batteries in stand-alone AE systems suggests that they may have as many drawbacks as advantages when compared to lead-acid type batteries. We suggest that potential alkaline users evaluate the economics and performance claims carefully to determine the suitability of any battery being considered..."

Doug E. Combs

Downsides:

1. Low efficiency - may be as low as 50%, typically 60-65%. Very high rate of self-discharge
2. high gassing/water consumption
3. high internal resistance means you can get large voltage drops across series cells.
4. high specific weight/volume
5. can reduce the overall efficiency of the solar system as much as 25%

This also means that the output voltage varies with load and charge much more than other batteries. If you are using an inverter, the inverter needs to be designed with these voltage swings in mind. You may not be able to use NiFe's if your system depends on a stable voltage, for example, if you are running certain common DC appliances such as a refrigerator directly off the batteries. Also when using NiFe's to power DC lighting, you will notice the light intensity fluctuates. One could always use a voltage regulator to feed those appliances that need it, but that would decrease the efficiency even more.

Previously, it appears that the only source for new NiFe batteries was from Hungary, and we heard mixed reports on them. In short, we did not recommend them unless they were nearly free. The high losses in charging and discharging would have added an extra 25-40% to the size of the solar panels you needed for the same energy usage.

In short, due to our past experience, and despite all the hype about long life and thousands of cycles, we felt that overall these batteries were a very poor choice for all solar applications.

Times are changing and manufacturing technology is advancing every day. We now have a range of Nife batteries that will perform well in most suitable solar/wind systems, if you so choose to use them.

We still feel that going for the more advanced technology batteries is the only way to go.

A valve-regulated lead-acid battery sometimes called sealed lead-acid or maintenance free battery. There are three primary types of VRLA batteries, sealed VR wet cell, absorbent glass mat (AGM) and gel cell. Gel cells add silica dust to the electrolyte, forming a thick putty-like gel. These are sometimes referred to as "silicone batteries". AGM batteries feature fiberglass mesh between the battery plates which serves to contain the electrolyte. Both designs offer advantages and disadvantages compared to conventional batteries and sealed VR wet cells, as well as each other.

NOTE: Charging with an existing lead acid charger or inverter charger that bulk charges at 13.6 volts is acceptable, however it will take longer than a specialized li-ion charging system. These batteries perform best at 14.4 volts bulk and absorption charge.

You’ve reached it: the pinnacle of deep cycle, lithium ion battery technology.

Our batteries are the height of lithium ion technology. We only use LiFePO4 (Lithium Iron Phosphate) in our packs, this is the safest and most reliable chemistry of lithium ion available. They outperform and outlast all other batteries in their class and below their class (lookin’ at you, lead acid batteries). The best part? They’re easy on the planet and your wallet.

Cornerstone’s bestselling battery weighing in at a sleek 30 lbs, 100 amp hour, 12 volt dances circles around the competition. This also requires no new hardware to run in your boat, RV, trailer, or golf cart. Just pull out that grungy old lead acid battery (use two hands, those suckers are heavy), drop in this elegant upgrade, and get yourself out there.

Specifications:

- Usable Capacity: 100 Amp-hours
- Voltage: 12 Volts
- Continuous Output: 100 Amps
- Maximum Output: 200 Amps for 30 seconds
- Lifetime Cycles: 3000- 5000 Cycles
- Dimensions: (L x W x H): 10.32" x 6.86" x 11.0"
- Weight: 30 pounds
- Cell Type: LiFeP04
- Warranty: 10 years

High Capacity AGM Battery Bank 24VDC 1378 Amp-hour

24 Volts DC, 1,378 Ah at 20 Hr rate. The high capacity battery family offers an ideal solution for large capacity Valve Regulated Lead Acid (VRLA) battery requirements. The high capacity battery's steel can (module) design concept, with its integral racking system, provides a cost effective battery system with a compact, quick and simple installation process. Its AGM technology incorporates an enhanced cell design with a superior racking system. The enhanced cell incorporates thicker positive plates for longer life. The welded/epoxy dual post seal design provides the highest integrity seal in the industry. The large copper post design also enhances the high rate performance.

The high capacity battery provides excellent performance and service life in grid-tied, grid-interactive and off-grid renewable energy and UPS solutions.

Specifications:

- Nominal Voltage Per Cell: 2 VDC
- Total Voltage: 24 VDC
- Optimal Temperature Range: 73.4°F - 78.8°F
- Float Voltage Per Cell: 2.25 VDC (77°F)
- Equalization Voltage Per Cell: 2.32 VDC (69.8°F - 89.6°F)
- Maximum Charging Current: 300 Amps
- Internal Resistance: 225 microOhms (0.000225 Ohms)
- Terminal Hardware: M8 bolt, lock washer and flat washer
- Total Weight: 2,577 lbs.

- Dimensions H x W x D inches: 43.44 x 33.32 x 26.25
- Amp-hour Capacity @20 Hr rate: 1,378 Ah