

Par Caddy LiFePO₄ Battery

Important information - please read it

Charge your new battery completely before using it.
Protect your battery from impact, weather, and excessive vibration.

Introduction

Your battery is built using the latest Lithium Iron Phosphate (LiFePO₄) technologies. LiFePO₄ is a battery chemistry ideally suited for electric golf carts, with properties that combine: light weight, stability, safety, and long life. If treated properly (more on that below), LiFePO₄ batteries can last for many years and for 1,000 charge/discharge cycles or more.

The battery is actually composed of individual LiFePO₄ cells. Each cell is about 3.2 volts, which means that for a nominal "12V" battery, there are 4 cells, giving a typical operating voltage of 12.8V.

Your lithium battery and charger are equipped with BMS, or "battery management system." This typically performs two functions:

- 1. Monitoring and protection for over-discharge of each cell and is built right onto the battery and monitoring every single cell.*
- 2. Balancing the cell voltages during charging. With all lithium-ion based batteries, balancing is required for proper battery function, otherwise, some cells will end up "full" with others only "part-full".*

This is the reason why you must use only the charger supplied with your lithium battery.

Specifications

Battery Type: LiFePO₄ (Lithium Iron Phosphate)

Nominal Voltage: 12.8V

Capacity: 20AH (amp hours) (equivalent to approx 40AH in a lead acid battery)

Max continuous discharge current: 40A

Max pulse discharge current: 60A

Size: 7 1/4 x 3 x 6 1/2 inches (185 x 75 x 165 mm)

Weight: < 3 kg (about 6 1/2 pounds)

Storage Temperature: 5°C - 35°C

Operating Temperature: -20°C - 60°C

Battery life: Approx 1000-1500 charge / discharge cycles

Battery Charger Included: Output 14.6V-5A

Battery Bag Included: Black fabric padded bag

Warranty: Two years pro-rated

Using your battery

Using the battery is straightforward. When you plug the battery in, there may be a small spark. This is because most controllers have one or more capacitors, which are like little reservoirs for electricity. When you first plug it in, the electricity rushes in from the battery to fill up these reservoirs, and that is the source of the spark you see. Some battery packs have an integrated on/off switch which prevents that spark, provided the switch is in the "off" position when you connect the battery to the controller. Best to plug the battery in first, then power on the golf cart.

When mounting the battery on your golf cart, please make sure the wires are not pinched or overly bent. Some bending is ok, but a sharp 90-degree bend may damage them. You should mount the battery securely, using vibration-dampening material between the battery and the battery platform. The battery and wires must be protected from impact and moisture. Best to lay the battery on its back on the Par Caddy battery platform, then secure it down with the velcro strap. See the pic at the bottom of this bulletin.

Break in period

LiFePO4 batteries are new enough in the market that there is not a lot of good information available on how to maximize their lifespan. Our own experience indicates that a gentle break-in period for your battery will help make it happy and long lived. For the first 20 charge/discharge cycles, it is important to avoid over-discharging the battery (below 1/2 of its capacity), and to avoid prolonged, high currents (> 15 amps). This is just like breaking in a car. Just use it gently at first, and try to avoid sudden starts with it, or climbing long, steep hills at full throttle, until it has been broken in a bit.

Charging your battery

Ensure that your charger connections are tight and that the correct LED lights are on.

When the charger is plugged in and NOT connected to the battery LED 2 (left one) should be Green and LED 1 (right one) should be Red.

When you connect a partially discharged LI battery to the charger, both LED's should be Red and the charger fan should be running.

When the LI battery reaches full charge LED 2 will turn from red to green and the charger fan should stop running.

If your charger does not operate as described above, check the connections, check the charger fuse then call Par Caddy. Do not operate the battery unless it has been properly recharged with a correctly working charger.

Even though you can probably get 36 holes or more from a fully charged battery, to prolong battery life, we recommend recharging your lithium battery after every 18 holes. The reason is because the lower the depth of discharge, the more charge/discharge cycles you will get over the life of the battery. Please see the chart below. We estimate that 18 holes of golf will take the battery to between 25 – 50% depth of discharge (DoD) – this of course depends on a variety of factors including terrain, weight of equipment, operating temperature, etc etc.

100% DoD – 300-500 cycles

50% DoD – 1200-1500 cycles

25% DoD – 2000-2500 cycles

10% DoD – 3750-4700 cycles

Precautions: *while LiFePO4 is a reliable and stable battery chemistry, it needs to be charged in a location without flammables immediately nearby. If something were to go wrong during charging, parts may get very hot. Avoid leaving the battery unattended. If there are any signs of problems, please promptly unplug from the wall and contact us for further instructions.*

The charger included with your battery is fully automatic. It will detect when all cells are balanced and charged, then turn itself off.

First, carefully plug the battery into the charger (leaving charger unplugged from the wall outlet). Make sure that the splines on the multi-prong connector are aligned, and plug it in straight. If you plug it in at an angle, you may short one or more pins and get a big spark (possibly damaging something too). If it won't plug in, don't force it - you may bend a pin, which is bad news. Just make sure everything is straight and aligned. If by chance you notice a pin that is bent and you want to straighten it, do not use a metal tool to do so! Use a plastic or wood tool instead. Otherwise you may short something out, and possibly start a fire. Always keep the charging pins for your battery covered when not in use.

After plugging the battery into the charger, plug the charger into the wall. The "power" LED should come on, and also the red "charge" LED. You may hear the fan blowing to keep the charger cool. After several hours (depending on how much charging the battery needs), the green "charging" light will come on, and after a bit, charging will automatically stop. However, the battery is not necessarily at its fully charged and balanced state the first time the charging light turns green.

The battery's BMS will turn the charger on and off several times, as it evens out the voltages on the individual cells. Therefore, you should leave the battery plugged into the charger as long as possible to ensure a full charge (overnight is best). It is safe to leave the battery plugged into the charger after a full charge, since the BMS will prevent over-charging. When you are ready to use the battery, you must first disconnect the charger from the wall outlet, then disconnect the charger from your battery (the reverse of the charging procedure).

Care and Maintenance

The charging and discharging connectors need to be kept clean and protected.

Storage during the off-season

Store your battery in a cool dry place - ideal storage temperature is 5°C or just above freezing.

If you need to store the battery for long periods, start by fully charging it up, and then make sure to charge it every 4-6 weeks to keep it topped up. These batteries will discharge themselves slightly during storage, since the BMS draws a small amount of power to maintain cell balance. If you don't occasionally charge them, one or more cells may fall below the 2.0V per cell critical threshold, permanently damaging the battery and voiding the warranty.

Please inspect all wires and connections before and after every use for any signs of damage or wear. *If there are any signs of damage to any of the wires, please discontinue use immediately and contact us for repair.*

To maximize your battery's life, please treat it gently. The most damaging thing you can do to the battery is over-discharge, allowing any cell in your battery to fall below 2.0 volts. Some cells may become discharged to that point slightly before others. So you can't just wait until the overall battery voltage drops to 8V (for a 12V battery - 2.0V x 4 cells = 8V), since by the time the battery is that low, some cells are below 2.0V. It is better to play it cautiously. We recommend you don't let the battery fall below an average of 2.5v/cell, which for a 4-cell battery is 10 volts.

If you have an accurate voltage monitor, this is easy to tell. If you don't, you will still notice a substantial drop off in the battery's power at that time. The discharge curve of the battery's voltage is pretty flat until the battery starts running out, then it drops rapidly. So, if you feel like the battery is suddenly losing steam, then it is time to discontinue use and get it charged.

Do not ever short-circuit the charge or discharge terminals. Do not ever damage the insulation on the wires. Do not puncture or incinerate battery. Fire may result.

Troubleshooting

1. There is no power from the battery. *First, check to make sure that the discharge connectors (usually Anderson Powerpoles) are clean and in good shape. Second, check the fuse (if applicable) to make sure it has not blown. Check the fuse on your charger as well, in case the battery has simply not been getting charged. Third, check the rest of your system to make sure there is not a problem somewhere else (e.g. controller). If you have access to a voltmeter, measure the discharge terminal voltage. For a fully charged 12V battery, it should be about 14 volts. For a discharged battery it should be around 10-11V.*

2. Charging won't start. *First, reset the charger. Unplug the battery and the AC cord, and wait 60 seconds. Then, plug the battery back in, and plug the charger into the wall. Make sure that the battery is plugged in correctly and securely to the charger. Make sure your outlet is supplying power. If these steps fail, please contact us.*

3. Cell going bad. *This doesn't happen often, but occasionally one cell in a battery may fail prematurely. You may notice that the battery seems to be losing steam early (not full capacity). If this is happening, please contact us to explore repair/replacement options.*

Warranty

Batteries and battery chargers have traditionally been the largest source of warranty support. The manufacturer's warranty period is 2 years **pro-rated** from the date of purchase, and it covers things like:

- Faulty BMS circuits that trips below rated current or cause premature pack cutout
- Pack that delivers less than 80% of its nominal capacity at a 1C discharge rate
- Internal cell tab weld coming loose

Warranty does not cover:

- Batteries that have self discharged below 2V/cell from being left on the shelf for an extended period of time
- Cells that have been over discharged below 2V/cell, either by cycling the power system (turning the battery off and then back on when it stops providing power), or by removing or bypassing the BMS
- Water damage, which can lead to unreliable BMS circuit behavior, including burned leads/components, damaged cells, or complete battery failure
- Damage from the battery being dropped, punctured, or subjected to impact, whether accidental or intentional
- Use of the battery outside the specified parameters
- Modification of the battery or charger
- Battery damage as a side-effect of damage to other parts of the golf cart system

Lithium batteries are liable to self-discharge over time because the BMS circuit itself draws current from the battery pack. Although the amount of current is usually small (<1mA typically) it is still enough to kill a battery in 1-2 months, especially if it is stored in an initially flat state. If you plan to store a lithium battery, be sure to top it up with a charger at least every 4-6 weeks.

Further, the battery manufacturer and Par Caddy Canada Inc. will not be responsible for any damages to anything beyond the battery itself. Before using the battery, you are acknowledging your understanding that the battery carries a large amount of energy that may cause sparks or fires. You will carefully monitor battery during both charge and discharge for any signs of deformation, heating, or other damage, and immediately discontinue use if you observe a problem. The battery carries a large amount of energy so it must be treated with great respect. Par Caddy Canada Inc. will not be held liable for any damages arising from misuse, intentional or otherwise.

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Orientation on battery platform.