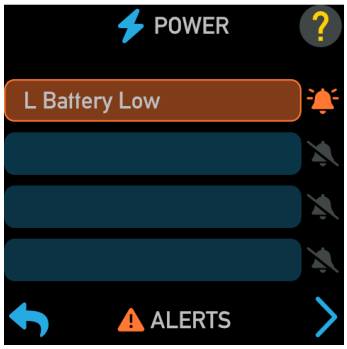
Important care information for Sargent lithium batteries

Protection systems for Sargent lithium batteries

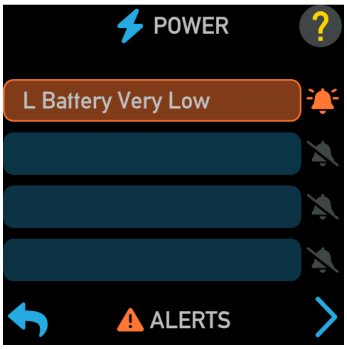
In order to protect lithium batteries against damage due to over discharge, there are a number of safety systems in place within the battery and the Sargent control system.

Sargent Control System protection

Within the Sargent control system there are warnings and protection to reduce the chances of a battery becoming over discharged.
Should the control system detect the batteries State of Charge (SoC) has fallen to 15%, it will first issue an alert on the control panel screen to warn the user the battery requires re-charging.
If the battery is still not re-charged and the charge reduces further to 5%, the control system alert again, then power off all switched circuits, to avoid further discharge.
It should be noted however that any circuits powered directly from the battery will still be active and consuming current from the battery.



15% alert



5% Alert

Protection within the Sargent lithium battery

Within the lithium battery there are further protection methods controlled by the Battery Management System (BMS) which will activate should the battery continue to discharge.

If the lithium battery detects its State of Charge (SoC) has reduced to 0%, the battery will enter a Deep Sleep mode (DSLP) and switch off its output until re-charged. If the battery enters this mode, it is important to re-charge it as soon as possible to avoid reducing lifespan and performance.

If for any reason the internal voltage of the battery cells drop below the critical voltage of 2.5 volts per cell (or voltage across the battery terminals falls below 10 volts) the battery will enter its Under Voltage Protection mode (UVP) and switch off power from the cells. This is a last resort protection in order to avoid damage and any potential safety issues.

WARNING

In this situation it is crucial that the battery is re-charged immediately, as leaving the battery in this state can lead to permanent damage of the cells.

Recovering a deeply discharged battery

Recovering a battery in deep discharge may not be possible with the integrated charger fitted to the vehicle. Many smart chargers require the presence of a battery voltage in order to start charging, however a lithium battery in deep discharge will have no voltage at the terminals, so the charger may not be able to recognise the presence of a battery.

If the battery has only entered Deep Sleep mode, the 'lithium wakeup' feature of the Sargent PX310 charger may be able to wake the battery and start charging as normal. However if the battery has entered Under Voltage Protection mode, it may be necessary to attach a fixed voltage charger, in order to recover the battery cells to a point where they can switch back on. For the Sargent lithium battery this point is at 2.8 volts per cell i.e. 11.2 volts in total for four cells with the battery.

Deeply discharged lithium batteries may become damaged

If lithium cells enter their Under Voltage Protection mode (UVP) and are not recharged quickly, they may become permanently damaged. A batteries UVP protection is the last safety cutoff to prevent a deep discharge from destroying the cells. A prolonged deep discharge can cause irreparable chemical changes that affect the battery's performance and safety.

How deep discharge damages lithium cells

Even after UVP cuts power to connected circuits, the lithium cell continues to self-discharge at a low rate. If left in this state for too long, several damaging chemical reactions can occur:

- **Anode damage**: The copper current collector on the anode can dissolve when the cell voltage drops too low. This can cause lithium plating and the formation of dendrites, which can grow and puncture the separator between the anode and cathode.
- **Internal short circuits**: If dendrites cause a short circuit, it can trigger thermal runaway, a dangerous, self-sustaining reaction that can cause the battery to catch fire or explode.
- **Increased internal resistance**: The breakdown of the electrolyte at very low voltages creates an insulating layer (SEI layer) on the electrodes, increasing the battery's internal resistance. This reduces the battery's efficiency and can cause it to overheat during use.
- **Irreversible capacity loss**: The internal damage from deep discharge can cause a permanent loss of capacity, meaning the battery will no longer hold as much charge as it did previously.
- **Chemical instability**: In addition to performance loss, the chemical instability introduced by deep discharge poses a significant safety risk upon attempted recharging.

Why recharging quickly is crucial

A timely recharge after a UVP event can prevent the most severe damage. However, waiting too long allows the battery's voltage to drop to a critically low level, at which point the battery management system (BMS) may permanently lock the cell to prevent it from being charged again.

- **Temporary vs. permanent shutdown:** When UVP is triggered, the battery's protection circuit temporarily disconnects the battery from its load. If the battery is recharged soon after, its voltage rises and the circuit reconnects. If left to self-discharge below the critical threshold, the protection becomes permanent.
- **The "sleep mode" trap**: Lithium cells left uncharged for months can enter a "sleep mode" that prevents normal charging. While some chargers have a recovery feature that attempts a low-current charge to revive the cell, the damage may already be done.

The takeaway

Do not rely on the Under Voltage Protection UVP as a signal for when to charge a battery. While it's a critical last-resort safety measure, triggering it and waiting to recharge can permanently damage the battery and compromise its safety. The best practice for extending the lifespan of a lithium battery is to avoid frequent deep discharges and maintain a partial state of charge, ideally between 40% and 80%.