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Tech Notes
Maximize battery life - GUPS2400 series

PURPOSE

Present ways to extend battery life.

BACKGROUND

The batteries used in the GUPS2400 series units are a spiral wound, lead acid, valve regulated cell design. These batteries are the Cyclon series produced by EnerSys (e.g., Hawker / Gates Energy Products) http://www.enersysreservepower.com/, and are used in demanding applications in many different products with a very high success rate. We used data provided by EnerSys to present estimated storage time vs. temperature, as well as the effects of temperatures, self-discharge and sulfation.

FACTORS THAT DIMINISH BATTERY LIFE

The primary factor impacting battery life is sulfation, which is part of the natural electrochemical reactions in lead acid batteries. Other factors include: non-operational discharge, cell impedance, storage duration, the temperatures at which the battery is used and in which the battery is stored, the number and depth of discharges, and charger characteristics.

Sulfation

Sulfation is where the sulfuric acid electrolyte and the lead plates in a battery forms lead sulfate crystals that collectively behave like insulation, which hinders the battery's ability to accept a charge. Sulfation also causes an increase in cell impedance. Furthermore, the rate of sulfation increases when the battery is exposed to higher temperatures, when the battery is stored for a long time without a recharge, and when the battery is stored in a discharged state.

Non-Operational Discharge and Storage

The GUPS2400 Series units, while powered down and turned off, draw a small current (300-500uA). Even when the battery drawer is removed from the GUPS chassis, batteries continue to self discharge when not in use, so storage duration is a concern. Also, if the GUPS is stored without being recharged after the battery is used, the additional self-discharge causes damage to the battery by removing more of the charge than the manufacturer recommends. (The GUPS is designed to shut down while in operation, before the battery is discharged below the recommended level, but self-discharge continues during storage). Self-discharge increases with sulfation.

Cell Impedance

Cell impedance causes a reduction of loaded voltage to eventually fall below the minimum input limits for a powering device (such as the GUPS series). Imagine an increasing resistor value in series with the load: the voltage drop across this resistor continues to drop even further as sulfation increases. Cell impedance increases with sulfation.

Temperatures

Storage and operational temperatures impact battery life by impacting the sulfation rate: higher temperatures increase sulfation rates.

Number and Depth of Discharges and Charger Characteristics

The depths of discharge and charger characteristics allowed in the GUPS designs, are based on the EnerSys published guides for UPS applications. To summarize, at higher temperatures the charge voltage must be temperature-compensated by reducing the voltage to avoid an over voltage. At lower temperatures the charge voltage must be temperature-compensated by increasing the charge voltage to prevent undercharging. Although these charger related parameters are outside an end user's control, they are taken into account in the GUPS system design.

WAYS TO MAXIMIZE BATTERY LIFE

While you cannot eliminate sulfation or self-discharge, you the user can control some factors that impact their effects on battery life. To mitigate loss of battery life due to sulfation or self-discharge:

- recharge a discharged battery before storing it
- store the battery at a cool temperature
- after the battery has been in long-term and/or high-temperature storage, charge it for 72 hours prior to using it (install it in a GUPS with AC input power to recharge).

Refer to the Battery Storage Times table in the Battery Information, Care and Handling section of your GUPS manual, for storage temperatures and durations.

Another condition that can be controlled is operational temperatures, which have the same impact on sulfation

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that storage conditions do: higher temperatures lead to increased sulfation rates. When and where possible, reduce the operational temperatures.

When there can be no significant control of the number and depth of discharges, e.g., the application involves repeated full discharges, a more reliable source of power may be a better choice if available, in order to maintain or extend expected battery life.

SUMMARY OF KEY POINTS

- Keep the battery charged and cool.
- Remove the battery drawer from the GUPS chassis if storage duration exceeds 30 days.
- Do not store the battery drawer in a discharged state; whether left in or removed from the chassis; recharge the battery after use/before storing.
- Store at lower temperatures. A fully charged battery drawer can be stored for 10 months at 10º C, but at 40º C this is reduced to 1.5 months. (Refer to table in the Battery Information, Care and Handling section of your GUPS manual, for storage temperatures and durations).
- Before use after long-term storage, charge the batteries in the chassis for 72 hours. This gives the battery an equalization charge, which minimizes the chance of cells having a partial charge due to differences in cell impedance.

RECOMMENDATION

Consider placing the GUPS2400 batteries on a cyclic life-extension maintenance schedule where the chassis-in-use is swapped out with a stored battery drawer, at intervals frequent enough to minimize the effects of long-term storage, storage at high temperatures, and self-discharge.

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