PowerSafe® SBS XC

Operating Guide
for Unreliable Grid Applications

The EnerSys® PowerSafe® SBS® XC range of valve regulated lead acid cells and monoblocs are designed to meet the challenging demands of unreliable grid applications.

SBS XC benefits from EnerSys' state-of-the art Thin Plate Pure Lead (TPPL) technology platform. The fast recharge and high reliability of PowerSafe SBS XC make it the perfect solution for challenging operating conditions in a network of poor grid stability where there is high risk of uncontrolled partial state of charge (PSoC) operation. It also has the benefit of resistance against deep discharge.

The high cyclability of SBS XC and it's ability to operate in uncontrolled PSoC conditions, where ambient temperature can often be warm, provides the operator benefits in terms of total cost of ownership (TCO).

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PowerSafe® SBS XC

1. Applications

Table 1 below outlines the demands of the battery, such as unreliable grid applications where the grid is unstable with frequent power outages and typically where the battery is operated in warm ambient temperature with uncontrolled cyclic use.

Application	Battery Demands
Unreliable grid	• Poor grid stability • Frequent power outages - scheduled & unscheduled • Poor temperature control • High cyclic use • Cycles can be shallow or deep • High risk of uncontrolled partial state of charge

Table 1

Table 2 provides a summary of the operating parameters (charging) that will deliver optimum service life and performance.

Application	Charge Parameters for Optimised Life and Performance
Unreliable grid	✓ Boost voltage equivalent to 2.35Vpc to 2.40Vpc @ 20°C to fast charge ✓ Charge current of $0.1C_{10}$ Amps minimum. Maximum is unlimited ✓ Followed by float voltage with temperature compensation applied as required

Table 2

2. Operating Temperature Range

The recommended operating temperature range for optimum life and performance is between 20°C to 25°C. Note, operation of batteries at higher temperatures will reduce life expectancy. PowerSafe® SBS® XC monoblocs/cells can be operated in the temperature range -40°C to +50°C. In order to maintain mechanical integrity of the plastic components, the battery temperature in operation should not exceed +50°C.

3. Storage

Monoblocs and cells lose capacity when standing on open-circuit because of parasitic chemical reactions. The high purity of the materials used in the construction of PowerSafe SBS XC batteries results in a very low rate of self-discharge, delivering up to 2 years shelf life at 20°C before refresh charge is required. Batteries should be stored in a cool, dry area. Note that high temperature increases the rate of self-discharge and reduces storage life. The maximum storage times before a freshening charge is required and recommended open circuit voltage audit intervals are illustrated in **Table 3**.

Temperature (°C / °F)	Storage Time (Months)	OCV Audit Interval (Months)
+10 / +50	48	12
+20 / +68	24	12
+30 / +86	12	6
+40 / +104	6	3

Table 3

Monoblocs/cells must be given a freshening charge when the OCV approaches the equivalent of 2.10Vpc or when the maximum storage time is reached, whichever occurs first.

4. Freshening Charge

Charge the monoblocs or cells at a constant voltage equivalent to 2.40Vpc with minimum $0.1C_{10}$ Amps current for a period of 24 hours.

5. Commissioning Charge

Before conducting a capacity discharge or commencing cycling, the battery must be given a commissioning charge as detailed in the Installation, Operation & Maintenance Manual.

6. Operation

The high charge acceptance of PowerSafe® SBS® XC monoblocs and cells enables the use of fast charge techniques. This allows the battery to be brought to full state of charge (SoC) quicker and having greater battery capacity available in the event of further power outages. Where power outages are frequent, PowerSafe SBS XC can be operated in partial state of charge conditions. It is very important to ensure that the battery is periodically returned to full SoC to ensure that the battery does not suffer from reduced performance due to the build-up of irreversible sulphation.

Once the battery is brought to full SoC, the voltage setting should revert to float voltage with temperature compensation applied, in order to prevent prolonged periods of overcharge.

6.1. Float Operation

The recommended float voltage setting is 2.29Vpc at +20°C/+77°F. Therefore the system voltage setting equals the number of cells in series x 2.29V.

The recommended float voltage temperature compensation is:

- 2.29Vpc +3mV per cell per °C below 20°C
- 2.29Vpc -3mV per cell per °C above 20°C

(see Figure 1)

Temperature compensation is capped at +46°C/+115°F. At this temperature the compensated charge voltage approaches the natural open circuit voltage of the battery, and there is insufficient overvoltage to keep the battery in a fully charged condition.

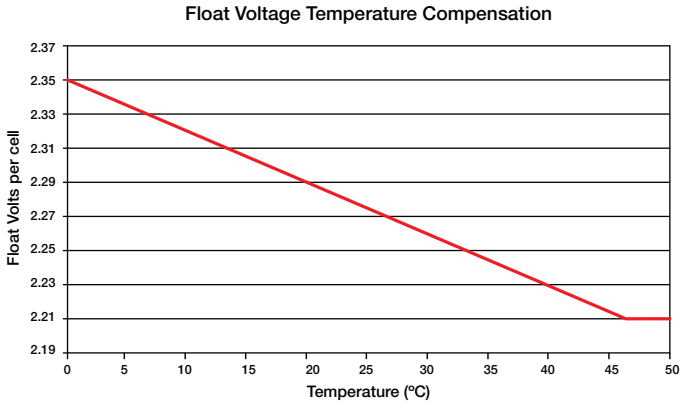

Figure 1

6.2. Fast Charge Operation

The inherently high charge acceptance of TPPL technology used in the PowerSafe SBS XC is suited for applications which require a short time to repeat duty, in such applications the rectifier voltage should be set at 2.35Vpc to 2.40Vpc at 20°C.

Once fully charged the voltage can be changed to float voltage, with temperature compensation as required. There are a number of methods that can be utilised to control the recharge and determine, when using fast charge, that full SoC is obtained:

6.2.1. Current Absorption Rate: Recharge can be stopped when current being absorbed by the battery reaches $0.1C_{10}$ A. At this point a timer is activated to deliver an additional 1 hour of charge.

6.2.2. Time Base: It is possible to estimate time to full state of charge when using a recharge voltage of 2.40Vpc at 20°C by using the calculation:

Recharge time (hrs) = (2 x ((0.8 x discharged Ah) / current limit)) + 1

When time is being used as a trigger for the end of fast recharge then temperature compensation for voltage is applicable. The profile below **(Figure 2)** gives the recommended compensation to charge voltage for temperature.

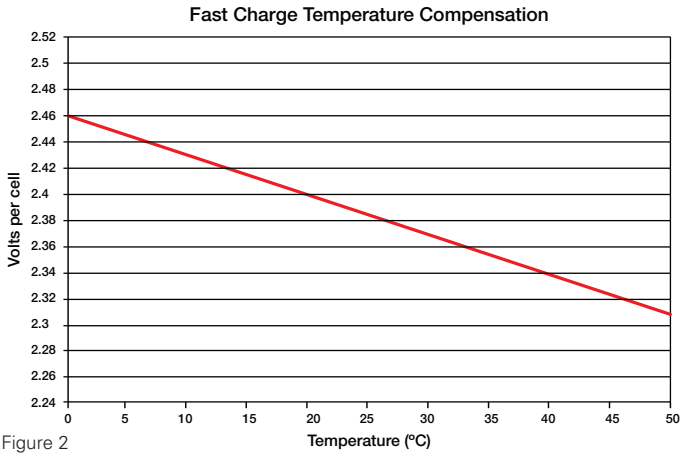

Figure 2

6.2.3. Ampere Hour Counting: Controlled recharge can be achieved by Ah counting (i.e.103% of discharged Ah is returned/115% in terms of Wh returned) using a device with accuracy ± 1% of the expected current range. However, inaccuracies associated with equipment calibration and/or controller algorithm accuracy can lead to drift in determining the true SoC. This means that periodic equalisation charge and recalibration of SoC is required.

Where Current Absorption Rate or Ah counting is used to control the recharge, the battery voltage can be maintained at a constant of 2.35Vpc to 2.40Vpc, provided that the battery temperature is controlled at or below +50°C.

Where rectifier voltage cannot be adjusted to values >2.40Vpc, to compensate for temperatures below 20°C, the time to full SoC will be increased.

For additional information and guidance on this subject, please contact your EnerSys® representative.

6.3. Fast Charge Current Limit

In addition to the influence of charge voltage, the available charge current will impact on the time to repeat duty. **Figure 3** illustrates the typical time to full SoC as a function of available charge current from varying depths of discharge based on recharge at 2.40Vpc at 20°C.

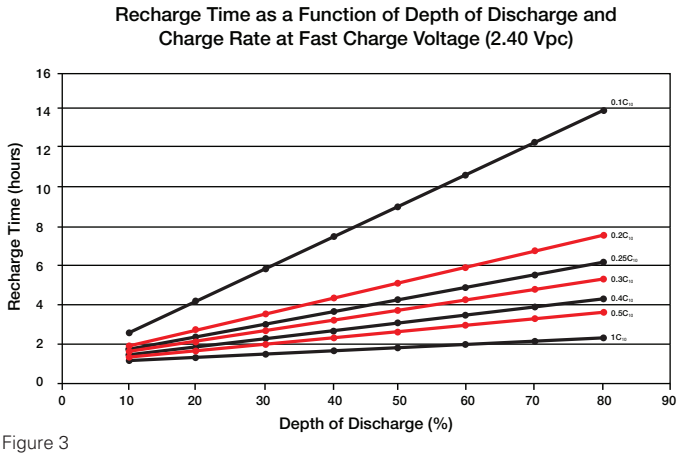

Figure 3

6.4. Discharge

Batteries must not be left in a discharged condition after supplying the load but must immediately be returned to recharge mode.

A low voltage disconnect of 1.93Vpc (80% DoD) should be applied to protect the battery from abusive over-discharge. An abusive deep discharge can severely impact battery performance.

7. Cyclic Performance

The performance characteristics of the PowerSafe® SBS® XC range has been optimised with the added capability to deliver high performance in unreliable grid applications. In particular where, due to the frequency of power outages, there is a risk of uncontrolled partial state of charge operation.

Figure 4 indicates the cyclic capability in a typical unreliable grid application. Note, actual life obtained is dependent on site conditions.

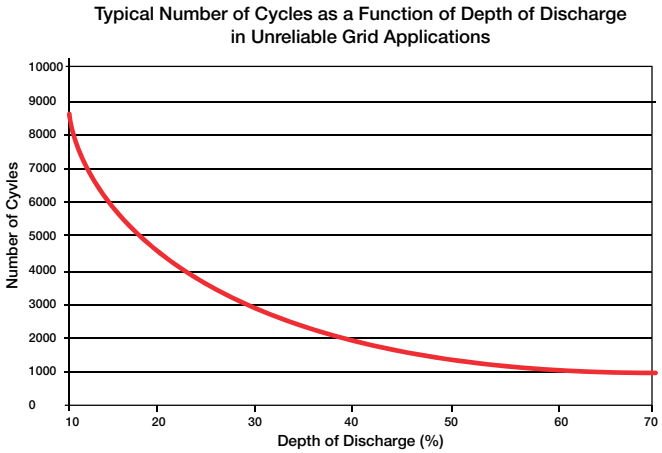

Figure 4

8. Data Recording

It is recommended that, as a minimum, the following information is recorded by means of regular data logging, which the user must make available to EnerSys® to validate any warranty claim.

1) Records of the commission charge.
2) The number of cycles performed and the depth of discharge (DoD) of each cycle.
3) The duration of each charge and discharge cycle, and the Ah in and Ah out, or Wh in and Wh out.
4) Full details of the recharge voltage/current profile for the last 50 cycles.
5) A full history of the ambient and battery surface temperatures, recorded at regular intervals throughout battery operation and life.
6) The time and date of each event. An event is defined as the start/stop of the battery discharge, the start/stop of the battery recharge, the start/stop of any generator input power or other input power source, etc.

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