

Operation Guide

for Renewable Energy Applications



Important

Please read this manual immediately on receipt of the battery before unpacking and installing. Failure to comply with these instructions will render any warranties null and void.

Care for your safety



No smoking, no naked flames, no sparks



Shield eyes



Read instructions



Electrical hazard



Electrolyte is corrosive



Danger



Clean all acid splash in eyes or on skin with plenty of clean water. Then seek medical help. Acid on clothing is to be washed with water



Warning: Risk of fire, explosion, or burns. Do not disassemble, heat above 60°C (140°F), or incinerate. Metallic parts under voltage are present on the battery, avoid short circuit. Do not place tools or items on top of the battery.



Recycle scrap batteries. Contains lead

1. Specific Attributes

The specific attributes of this type of battery, for renewable energy applications, are as follows:

- High cycling (one “cycle” consists of a discharge, of any depth, followed by a recharge)
- Fast recharge capability
- Deep discharge recovery
- Low rate of self-discharge
- No addition of water required during service life

PowerSafe® SBS® XC are designed for renewable energy applications where the battery must undergo repeated cycling with daily depths of discharge of up to 35% of capacity C_{120} (such as rural settlements, communications systems and lighting systems).

2. Monobloc/Cell Design

The PowerSafe SBS XC monoblocs and cells consist of:

- Positive plates - Thin Plate Pure Lead (TPPL) grid technology for long cycle life and efficient recharging
- Negative plates - provide a perfect balance with the positive plates to ensure optimum recombination efficiency
- Separators – low resistance microporous glass fibre mat separator with high absorption and stability
- Containers and lids - in UL94 V-0 rated flame-retardant PC/ABS material, highly resistant to shock and vibration
- Electrolyte - high grade dilute sulphuric acid fully absorbed into separator material to prevent spillage in case of accidental damage
- Dual-seal terminal design to prevent leakage over the product life
- Self-regulating pressure relief valves - prevent ingress of atmospheric oxygen
- Flame Arrestors – built into each bloc/cell for operational safety

3. Features & Benefits

- Excellent deep discharge recovery and cyclability
- Up to 4,100 cycles at 20% depth of discharge and 1,200 cycles to 60% Depth of Discharge (DoD)
- Vertical or horizontal installation (see PowerSafe SBS XC Installation, Operation and Maintenance Manual for further information)
- No topping-up required

4. General Operation Instructions

4.1 Capacity

Capacity is the number of ampere hours (Ah) a battery can supply for a specific current and an end of discharge voltage. Capacity varies with the discharge time, discharge rate and temperature.

The nominal capacity of PowerSafe SBS XC monoblocs and cells for renewable energy applications is given as follows:

Capacity (Ah)	Current (A)	Discharge Period (Hours)	End Voltage (Vpc)
C_{120}	I_{120}	120	1.85V

4.2 Discharge Rate:

This is the ratio of discharge current divided by battery capacity.

4.3 Depth of Discharge (DoD):

This is the capacity removed from the battery compared to total capacity. It is expressed as a percentage. The battery will be sized for solar applications with a DoD < 80% for the autonomy required.

4.4 Daily Cycle

The battery is normally used with a daily cycle - charge during the day hours and discharge during night hours. Typically, the daily discharge usage is between 2 and 20% DoD.

4.5 Effect of Temperature on Capacity

If the ambient temperature deviates from 25°C, a correction factor must be applied to the published rating in order to optimise the service life (see Figure 1 below).

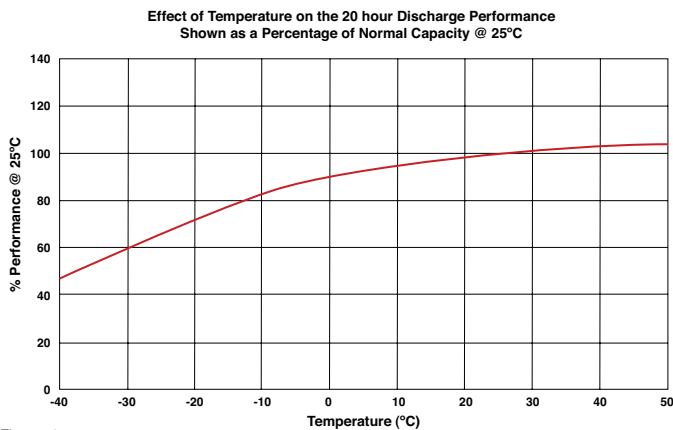


Figure 1

4.6 Operating Temperature Range

The recommended operating temperature range for optimum life and performance is between 20°C to 25°C. 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. Note, operation of batteries at higher temperatures will reduce life expectancy. All technical data relates to the rated temperature of +25°C.

4.7 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 a refresh charge is required.

The self-discharge rate of PowerSafe XC monoblocs and cells is a function of the temperature. See below for the rate of self-discharge at various temperatures:

Temperature	20°C	25°C	30°C	40°C
Monthly self-discharge rate	1.25%	1.76%	2.5%	5%

Batteries should be stored in a cool, dry area. Note that high temperature increases the rate of self-discharge and reduces storage life. The following table gives the maximum storage

time before a refresh charge is required and the recommended OCV audit intervals, at the given average storage ambient temperature:

Temperature (°C / °F)	Storage Time (Months)	OCV Audit Interval (Months)
+10 / +50	48	12
+15 / +59	34	12
+20 / +68	24	12
+25 / +77	17	6
+30 / +96	12	6
+35 / +95	8.5	3
+40 / +104	6	3

4.8 Refreshing Charge

Blocs and cells must be given a refreshing charge:

4.8.1 when the OCV approaches 2.10Vpc, or

4.8.2 when the maximum storage time is reached, whichever occurs first.

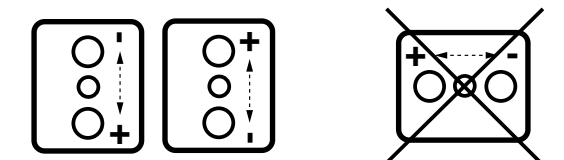
Charge the monoblocs or cells at a constant voltage equivalent to 2.40Vpc with minimum 0.1_{C10} Amps current for a period of 24 hours.

4.9 Installation and Ventilation

The electrical protective measures and the accommodation and ventilation of the battery installation must be carried out in accordance with IEC 62485-2, and applicable "local" national standards, rules and regulations.

The battery should be installed in a clean, dry area.

Whatever your application, PowerSafe SBS XC batteries can be mounted in any orientation except inverted. For the installation of cells in the horizontal position, the instructions below must be complied with.



- Do not use terminal posts to lift or handle cells.
- Ensure that the stand runners are located under the container rather than the lid and/or lid/container seal.
- Always ensure that the arrow on the lid of each unit is pointing in vertical orientation.

Avoid placing the battery in a hot place or in front of a window (no direct sunlight). Battery racks are recommended for proper installation.

The positive terminal is identified by a “+” symbol on each monobloc/cell. Install the batteries in accordance with the instructions and/or layout drawing, taking care to ensure correct terminal location and polarity.

Check that all contact surfaces are clean. Tighten terminal fasteners, taking care to use the correct torque loading. The fastener torque value is indicated on the product label. Fit the covers supplied for protection against short circuit.

Follow the polarity to avoid short circuiting of monoblocs/cells. A loose connector can cause erratic battery performance and possible damage to the battery and/or personal injury.

4.10 Commissioning Charge

The initial charge is extremely important as it will condition the battery service life. So, the battery must be fully recharged to ensure that it is in an optimum state of charge.

Case 1: Using a constant voltage charger. Cells here will need to be recharged at a constant voltage of between 2.35 and 2.40 Vpc (maximum) at 25°C for a minimum of 24 hours with a current limited to 0.01_{C10} Amps. Temperature compensation for charge voltage should be applied at the rates shown below:

Temperature (°C / °F)	Charge Voltage (Vpc)
+10 / +50	2.44
+20 / +68	2.40
+25 / +77	2.38
+30 / +96	2.36
+40 / +104	2.32

Case 2: With no external source available for recharging. Connect the battery to the solar panel regulator and leave at rest for 1 to 2 weeks. For this charge, set the regulator to the values outlined in the charging section.

4.11 End-of-charge reading

The table hereafter gives an indication of the state of charge of blocs and cells from a reading of open circuit voltage.

State of Charge (%)	Voltage (Vpc)
100	2.17
90	2.15
80	2.12
70	2.10

5. Cyclic Operation

5.1 Cyclic Performance

The graph below shows cycling capability of PowerSafe SBS XC products:

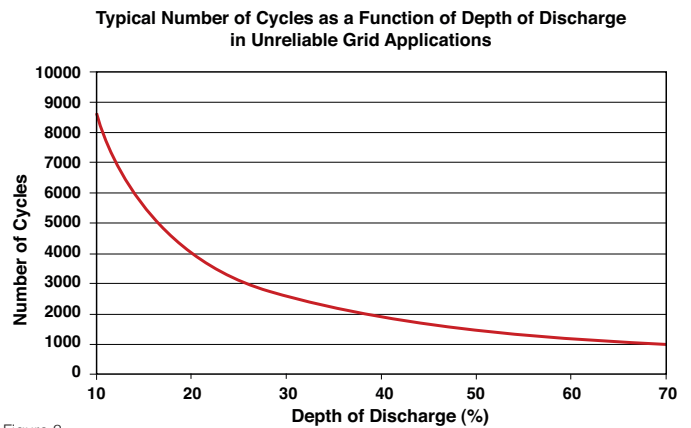


Figure 2

5.2 Discharging

Do not over-discharge the battery. This can be avoided by including a Low Voltage Disconnect (LVD) switch in the circuit or by disconnecting the battery from the load when the end discharge voltage is reached. As a rule, installations will be equipped with a regulator whose voltage threshold values will protect against deep discharge:

	Discharge Time (Hours)		
	10	120	240
Low Voltage Alarm	1.96Vpc	1.96Vpc	1.99Vpc
Disconnect Voltage (LVD)	1.93Vpc	1.93Vpc	1.96Vpc

5.3 Charging

The high charge acceptance of the TPPL technology used in PowerSafe® SBS® XC is suited for applications which require a fast time to repeat duty. In such applications the voltage regulator should be set at 2.35Vpc to 2.40Vpc at 25°C.

Once fully charged the voltage can revert 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 state of charge is obtained such as Current Absorption and Ah Counting.

Based on current absorption, the recharge can be stopped when current being absorbed by the battery reaches 0.01_{C10} Amps. At this point a timer can be set/activated to deliver an additional 1 hour of charge.

Ah counting can be used to control the recharge (i.e. 103% of discharged Ah is returned/115% in terms of Wh returned) using a device with accuracy $\pm 1\%$ of the expected current range. However, inaccuracies associated with equipment calibration and/or controller algorithm accuracy can lead to drift in determining the true state of charge (SoC), meaning 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 the voltage cannot be adjusted to values >2.40Vpc to compensate for temperatures below 20°C, the time to full state of charge will increase.

The voltage/temperature compensation is + 4mV/°C/Cell for a temperature lower than 20°C (77°F) (the reference temperature being 20°C) and - 4mV/°C/Cell for a temperature higher than 25°C.

6. Service Life

Under normal operating conditions, the battery lifetime largely depends on the temperature and depths of discharge. The service life in cycling applications is based on the number of years with a daily depth of discharge and can never exceed the design life of 12 years at 20°C.

See Number. of Cycles vs DoD graph, Figure 2, and an example of a PowerSafe® SBS® XC battery at 25°C:

Daily Depth of Discharge (%DoD)	Number of Cycles at 25°C	Estimated Life Expectancy (Years)
30	2,700	7.4

7. Maintenance

PowerSafe SBS XC monoblocs and cells are VRLA batteries and do not have to be topped up with water.

- Do not open the valve. Opening could cause lasting damage to the battery and is prohibited.
- The containers and lids should be kept dry and free from dust. Cleaning must be undertaken with a dampened cotton cloth without additives and without man-made fibres or addition of cleaning agents, never use abrasives or solvents.
- Do NOT use any type of oil, solvent, detergent, petroleum based solvent or ammonia solution to clean the battery containers or lids.
- Discharge any possible static electricity from clothes by touching an earth connected part.

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 input power source.

9. Disposal

PowerSafe SBS XC products are recyclable. End of life batteries must be packaged and transported according to prevailing transportation rules and regulations. End of life batteries must be disposed of in compliance with local and national laws by a licensed battery recycler.



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