PowerSafe® SBS

Application Guide

EnerSys® has optimised the very successful Thin Plate Pure Lead (TPPL) PowerSafe® SBS battery range that utilizes highest purity materials and state of the art manufacturing processes to deliver energy storage solutions that can meet the requirements of emerging applications while offering the end user enhanced performance in existing applications.

Historically, the useful service life of reserve power Valve Regulated Lead Acid (VRLA) battery systems was measured by their float life but, as applications evolve from pure standby to cyclic applications, some traditional VRLA technologies find that these new requirements push them beyond their scope of operation.

PowerSafe® SBS Technology monoblocs and cells retain the long float characteristics of standard PowerSafe® SBS batteries, with the added benefit of improved cyclic ability in both float voltage and fast charge applications.

EnerSys® Power/Full Solutions

Visit us at **www.enersys.com**

Applications

Table 1 below gives description of the range of reserve power applications covering stable grid, unreliable grid and off grid applications – the superior performance characteristics of PowerSafe® SBS batteries make it the ideal solution to be used in these applications.

While PowerSafe® SBS battery solutions are well proven in standby applications, recent developments have focused on improving robustness in harsh environments and challenging operating conditions. Today Powersafe® SBS battery has higher cyclic performance, improved endurance at high temperature and the ability to operate in partial state of charge conditions, providing that the operating conditions are well understood.

Application	Battery Demands	Suitability
Reliable Grid	Stable grid Controlled ambient temperature Compensated float voltage Very little cyclic use	Yes
Grid Assist	Regions where grid is supported with scheduled outages Reasonable temperature control Compensated float voltage Medium level cyclic use	Yes
Unreliable Grid (Low risk of PSoC)	Poor grid stability Frequent power outages / scheduled & unscheduled Poor temperature control High cyclic use Cycles can be shallow / deep Low risk for uncontrolled Partial State of Charge	Yes
Unreliable Grid (High Risk of PSoC)	Poor grid stability Frequent power outages / scheduled & unscheduled Poor temperature control High cyclic use Cycles can be shallow / deep High risk for uncontrolled Partial State of Charge	Yes
Off Grid Controlled Full State of Charge	Regular cyclic duty Battery is returned to full state of charge between cycles Battery can be exposed to fluctuating ambient temperature Balances Opex and battery life	Yes
Off Grid Controlled Partial State of Charge	Regular cyclic duty Battery is deliberately operated in Partial State of Charge condition Battery is periodically returned to Full State of Charge Battery can be exposed to fluctuating ambient temperatures Designed to maximize Opex savings	Yes

Table 1

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

Application	PowerSafe® SBS Battery Charge Parameter for Optimised Life and Performance
Reliable Grid	✔ Temperature compensated float voltage equivalent to 2.29Vpc @ 20°C ✔ Charge current - minimum 0.1C_{10}A, maximum unlimited
Grid Assist	✔ Boost voltage equivalent to 2.35Vpc to 2.40Vpc @ 20°C to fast charge ✔ Charge current – minimum 0.1C_{10}A, maximum unlimited ✔ Followed by float voltage with temperature compensation applied as required
Unreliable Grid	✔ Boost voltage equivalent to 2.35Vpc to 2.40Vpc @ 20°C to fast charge ✔ Charge current - minimum 0.1C_{10}A, maximum unlimited ✔ Followed by float voltage with temperature compensation applied as required
Hybrid Operation to Full State of Charge	✔ Boost voltage equivalent to 2.35Vpc to 2.40Vpc @ 20°C ✔ Charge current - minimum 0.1C_{10}A, maximum unlimited ✔ Return to full state of charge between discharge cycles ✔ Optimum charge factor 103% of discharged Ah
Hybrid Operation in Partial State of Charge (controlled PSoC) - Example	✔ Boost voltage equivalent to 2.35Vpc to 2.40Vpc @ 20°C to return to 95% state of charge ✔ Charge current - minimum 0.1C_{10}A ✔ Full recharge every 10 days ✔ EnerSys will consider variations in controlled PSoC operation as necessary - please contact your local representative to discuss details

Table 2

Operating Temperature Range

The recommended operating temperature range for optimum life and performance is 20°C. However, PowerSafe® SBS monoblocs and 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.

Storage

Monoblocs and cells lose capacity when standing on open-circuit because of parasitic chemical reactions. The self-discharge rate of PowerSafe® SBS monoblocs and cells is very low because of the high purity of the grid lead and electrolyte. Monoblocs and cells should be stored in a cool, dry area. High temperature increases the rate of self-discharge and reduces storage life.

Figure 1 shows the relationship between open-circuit voltage (OCV) and storage time at various temperatures.

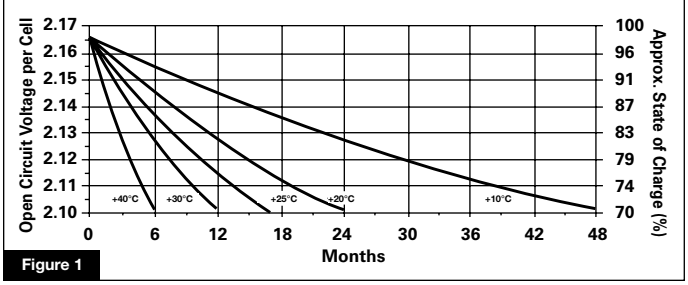

Figure 1

The maximum storage times before a freshening charge is required and recommended open circuit voltage audit intervals are:

Temperature (°C / °F)	Storage Time (Months)	OCV Audit Interval (Months)
+10 / +50	48	6
+15 / +59	34	6
+20 / +68	24	4
+25 / +77	17	4
+30 / +86	12	3
+35 / +95	8.5	2
+40 / +104	6	2

Monoblocs and 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.

Freshening Charge

Charge the monoblocs or cells at a constant voltage equivalent to 2.29 to 2.4Vpc with $0.1C_{10}$ Amps current for a period of 24 hours.

Commissioning Charge

Before conducting a capacity discharge or commencing cycling, the battery must be given a commissioning charge. In float applications the commissioning charge shall consist of 7 continuous days of float charge at the recommended float voltage (2.29Vpc at 20°C) with no load connected to the battery. In hybrid applications the commissioning charge shall consist of 24 hours charge at a voltage equivalent to 2.40Vpc with no load connected.

Float Operation

PowerSafe® SBS batteries are designed for continuous float operation on constant voltage chargers. Constant voltage charging is the safest, most efficient and recommended method of charging VRLA batteries.

The recommended float voltage setting is 2.29Vpc at +20°C/+68°F. Therefore the system voltage setting equals the number of cells in series x 2.29Vpc.

Battery life and charging characteristics are affected by temperature. Optimum battery life will be achieved when the battery is operating between +20°C/+68°F and +25°C/+77°F. Figure 2 illustrates the design life at 20°C from Accelerated Float Life testing at 55°C.

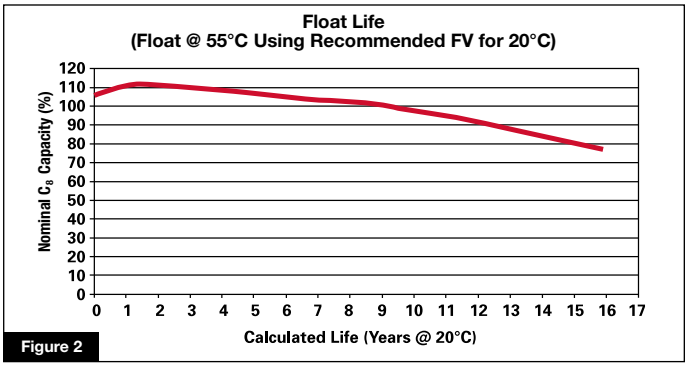

Figure 2

Battery life is reduced by 50% for every 10°C/18°F increase in temperature (see figure 3). Float voltage compensation reduces the charging current as battery temperature increases and partially negates the adverse effect of high temperature.

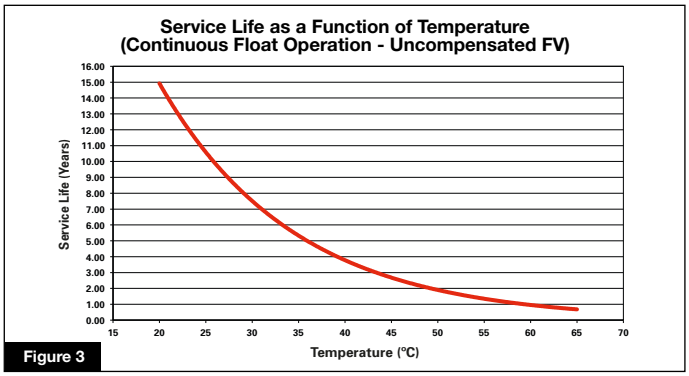

Figure 3

The recommended float voltage temperature compensation is:

- 2.29Vpc +4mV per cell per °C below 20°C
- 2.29Vpc -4mV per cell per °C above 20°C
  (refer to figure 4 for further details)

Temperature compensation is capped at +40°C/+104°F as 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.

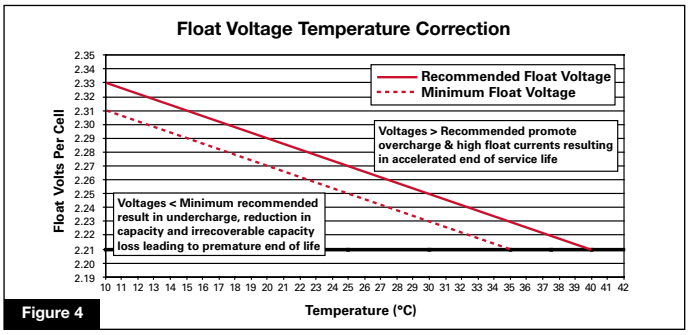

Figure 4

Float Charging Current Limit

Due to the very low internal resistance, PowerSafe® SBS monoblocs and cells will accept unlimited current during recharge but for cost and practical purposes in float applications where recharge time to repeat duty is not critical, the rectifier current can be limited to the load plus $0.1C_{10}$ Amps.

Fast Charging Operation

In addition to the long life characteristics inherent in traditional PowerSafe® SBS TPPL battery designs, PowerSafe® SBS TPPL monoblocs and cells have been developed to provide high performance in applications where the battery is subjected to repeated cyclic duty, in challenging operating conditions (high temperatures, unreliable grids, remote locations, etc).

Fast charge techniques are best utilized for frequent discharge cyclic applications. The high charge acceptance is suited for applications which require a faster recharge with reduced time to repeat duty. In such applications the rectifier voltage should be set at 2.35Vpc to 2.40Vpc at 20°C. Figure 5 illustrates the time to full state of charge from varying depths of discharge (C_{10}) as a function of charge voltage.

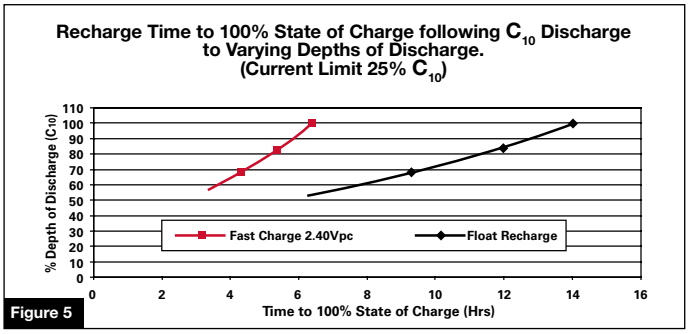

Figure 5

As with float charge, temperature compensation for voltage is applicable to fast charge techniques. The profile below (figure 6) gives the recommended compensation to charge voltage for temperature, based on fast charge of 2.40Vpc at 20°C.

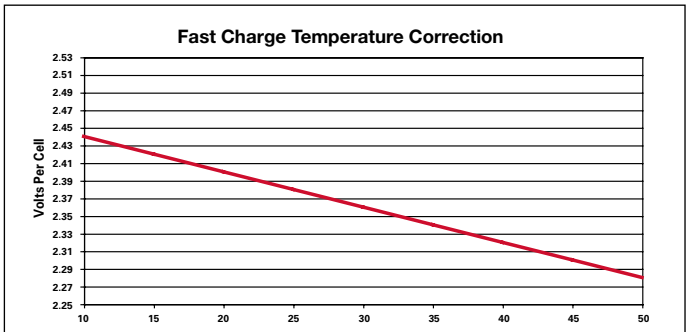

Figure 6

In systems where control of charge factor is not possible, it may be possible to estimate time to full state of charge by using the calculation:

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

Fast Charging Current Limit

In addition to the influence of charge voltage, the available charge current will impact the time to repeat duty. The low internal resistance of PowerSafe® SBS monoblocs and cells lends itself to absorption of unlimited inrush currents but can also be recharged with current limits equal to the standing load plus 0.1C_{10} Amps.

Figure 7 illustrates the typical time to full state of charge (2.40Vpc) as a function of available charge current from varying depths of discharge.

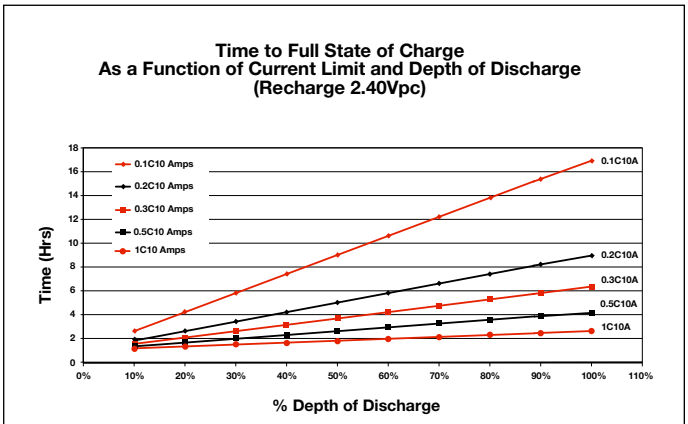

Figure 7

Cycling

Grid Assist / Unreliable Grid

PowerSafe® SBS batteries have been developed to retain the long float life characteristics associated with Thin Plate Pure Lead (TPPL) Technology and has the added capability to deliver high performance in harsh applications where cyclic duty predominates.

PowerSafe® SBS batteries delivers superior performance in grid assist and unreliable grid applications where power outages can be frequent and unscheduled leading to risk of uncontrolled partial state of charge cycling. Figure 8 indicates the cyclic capability in a typical unreliable grid application but is dependent on actual site conditions.

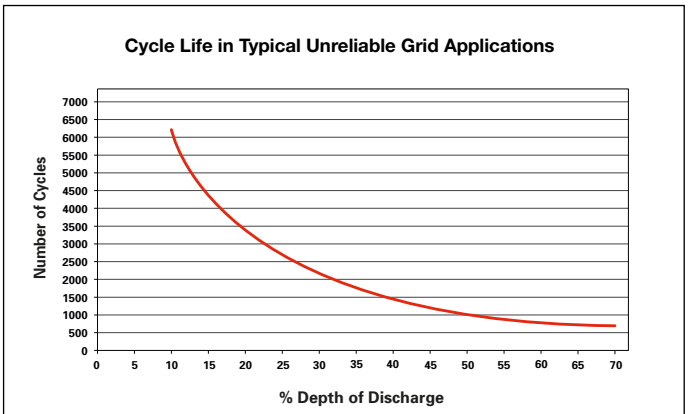

Figure 8

Hybrid Operation

The high charge acceptance of PowerSafe® SBS monoblocs and cells that enables the use of fast charge techniques provides the user with the advantage of reduced time to repeat duty and further extends the number of cycles available during service life to unparalleled levels (figure 9).

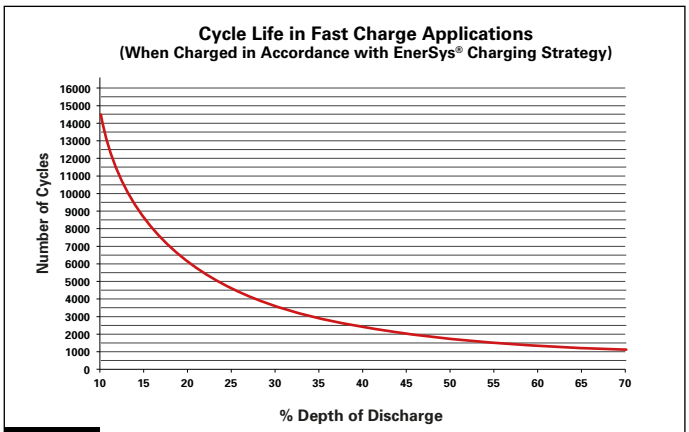

Figure 9

The optimal cyclic performance shown in figure 9 is based on the battery being returned to full state of charge between cycles. It is possible to operate PowerSafe® SBS monoblocs and cells in controlled partial state of charge condition to improve site operating expenditure savings, however it is very important to ensure that the battery is periodically returned to full state charge to ensure that the battery does not suffer from reduced performance due to the build up of irreversible sulphation. It is recommended to contact your EnerSys® representative to obtain additional information and guidance for such PSoC applications.

AMER-EN-AM-PS-SBS-1222

EnerSys®
Power/Full Solutions

EnerSys World Headquarters
2366 Bernville Road, Reading,
PA 19605, USA
Tel: +1-610-208-1991 /
+1-800-538-3627

EnerSys EMEA
EH Europe GmbH,
Baarerstrasse 18,
6300 Zug
Switzerland

EnerSys Asia
152 Beach Road,
Gateway East Building #11-03,
Singapore 189721
Tel: +65 6508 1780