

PowerSafe[®]
SBS



APPLICATION GUIDE

EnerSys[®]

Power/Full Solutions

RESERVE
POWER

Introduction

EnerSys® has optimised the very successful Thin Plate Pure Lead (TPPL) PowerSafe® SBS® battery range to create the revolutionary EON Technology®, a concept that utilises highest purity materials and state of the art manufacturing processes to deliver energy storage solutions that can meet the requirements of emerging applications whilst 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 EON Technology monoblocs and cells retain the long float characteristics of standard PowerSafe SBS monoblocs and cells, with the added benefit of improved cyclic ability in both float voltage and fast charge applications.

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 EON Technology makes it the ideal solution to be used in these applications.

PowerSafe SBS EON Technology solutions are well proven in stand by applications, recent developments have focused on improving robustness in harsh environments and challenging operating conditions, so that today EON Technology 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.

Float charge mode:

Stable reliable grid, stable ambient temperature, compensation to float voltage for any temperature fluctuation and no or very little cyclic use (<10 cycles per year).

Grid assist applications:

Quite a stable grid and ambient temperature, medium level of cyclic use (50 to 100 cycles per year) with low risk for partial state of charge cycling.

Partial state of charge:

Unstable grid, warm ambient temperatures with uncontrolled cyclic use meaning high risk for partial recharge.

Off grid applications:

Typically diesel generator and battery hybrid, it can also incorporate renewable energy sources such as wind turbine or PV array to alternatively supply energy to telecoms equipment, where mains grid power is not available. Warm ambient temperature with regular cyclic duty – typically 1 cycle per day.

Table 1

Off grid applications can be further split into two sub categories as shown in table 2.

Controlled full state of charge:

An operating mode with regular cyclic duty where the battery is returned to full state of charge between discharge cycles. The duty cycle is designed to optimized balanced battery life and operating expenditure savings. Can be subjected to high ambient temperatures.

Controlled partial state of charge:

An operating mode with regular cyclic duty where the battery is deliberately operated in partial state of charge to maximise operating expenditure savings. The battery is periodically returned to full state of charge when predefined trigger points are reached. Can be subjected to high ambient temperatures.

Table 2

Table 3 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® EON Technology® Charge Parameter for Optimised Life and Performance
Float charge (reliable AC power)	<ul style="list-style-type: none"> ✓ Temperature compensated float voltage equivalent to 2.29Vpc @ 20°C ✓ Charge current - minimum 0.1C₁₀A, maximum unlimited
Float charge unreliable AC power (uncontrolled PSOC)	<ul style="list-style-type: none"> ✓ Boost voltage equivalent to 2.40Vpc @ 20°C to fast charge ✓ Charge current - minimum 0.1C₁₀A, maximum unlimited ✓ Followed by float voltage with temperature compensation applied as required
Hybrid operation to full state of charge	<ul style="list-style-type: none"> ✓ Boost voltage equivalent to 2.40Vpc @ 20°C ✓ Charge current - minimum 0.1C₁₀A, 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	<ul style="list-style-type: none"> ✓ Boost voltage equivalent to 2.40Vpc @ 20°C to return to 95% state of charge. ✓ Charge current - minimum 0.1C₁₀A ✓ Full recharge every 10 days ✓ EnerSys will consider variations in controlled psoc operation as necessary - please contact your local representative to discuss details

Table 3

Operating Temperature Range

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

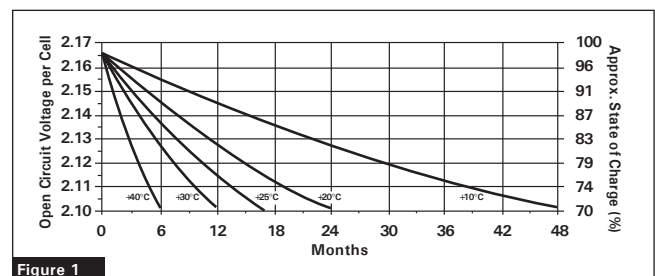


Figure 1

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 2.10 Volts per cell 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 0.1C₁₀ Amps current for a period of 24 hours.

Commissioning Charge

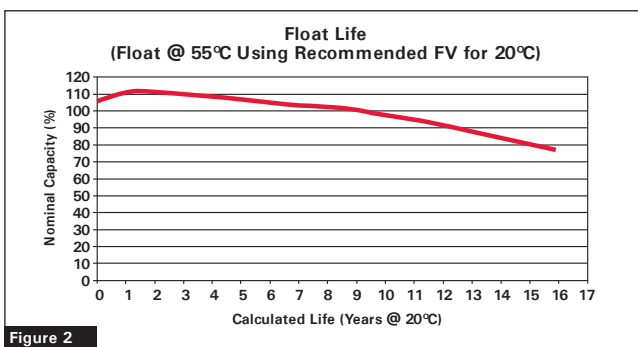
Before conducting a capacity discharge or commencing cycling, the battery must be given a commissioning charge. In float applications the commissioning charge shall consist of 7 continuous days of float charge at the recommended float voltage (2.29Vpc at 20°C) with no load connected to the battery. In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

Float Operation

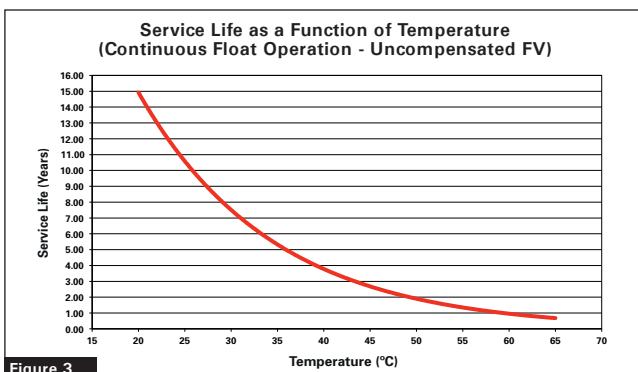
EON Technology[®] is designed for continuous float operation on constant voltage chargers. Constant voltage charging is the safest, most efficient and recommended method of charging VRLA batteries.

The recommended float voltage setting is 2.29Vpc at +20°C/+77°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 (see figure 2).



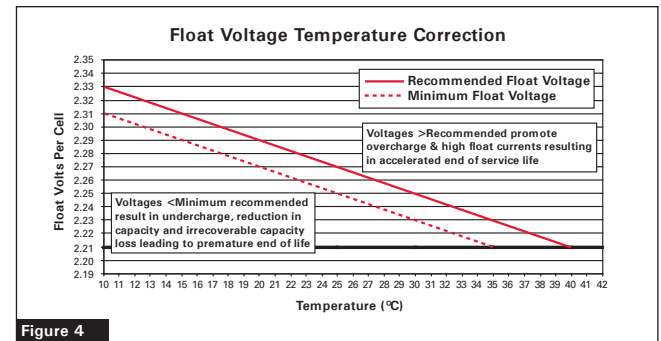
Battery life is reduced by 50% for every 10°C/18°F increase in temperature (see figure 3). Float voltage compensation reduces the charging current as battery temperature increases and partially negates the adverse effect of high temperature.



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.



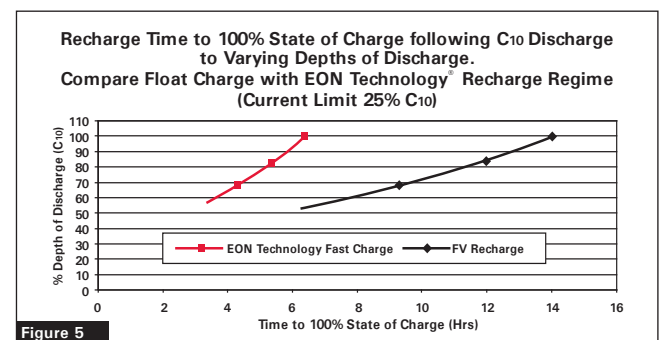
Float Charging Current Limit

Due to the very low internal resistance, PowerSafe[®] SBS[®] EON Technology 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 0.1C₁₀ Amps.

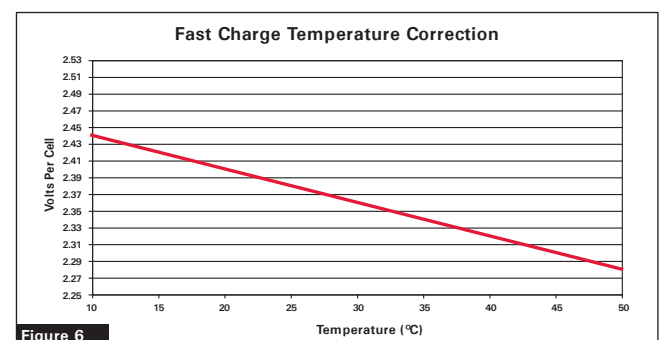
Fast Charging Operation

In addition to the long life characteristics inherent in traditional PowerSafe[®] SBS TPPL battery designs, EON Technology[®] 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 utilised for frequent discharge cyclic applications. The high charge acceptance of EON Technology 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 2.40Vpc at 20°C. Figure 5 illustrates the time to full state of charge from varying depths of discharge (C₁₀) as a function of charge voltage.



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.



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:

$$\text{Recharge time (hrs)} = 2 * ((0.8 \times \text{discharged Ah}) / \text{current limit}) + 1$$

Fast Charging Current Limit

In addition to the influence of charge voltage, the available charge current will impact on time to repeat duty. The low internal resistance of PowerSafe® SBS® EON Technology® monoblocs and cells lends itself to absorption of unlimited in rush currents but can also be recharged with current limits equal to the standing load plus 0.1C₁₀ 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.

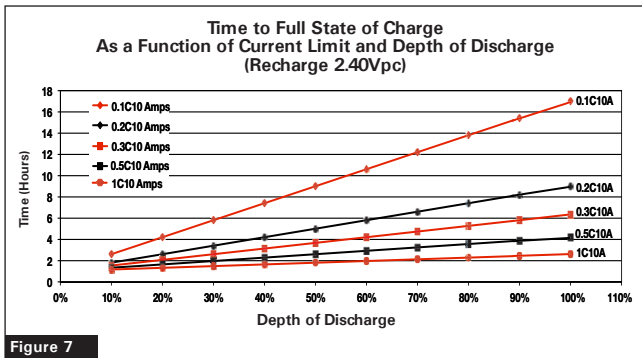


Figure 7

Cycling

Float Cycling

EON Technology has been developed to retain the long float life characteristics associated with standard PowerSafe SBS Technology and has the added capability to deliver high performance in harsh applications where cyclic duty predominates.

Extensive testing has shown that in traditional float cyclic applications PowerSafe SBS EON Technology surpasses the excellent performance of standard PowerSafe SBS battery designs, typically delivering a 33% increase in the number of cycles during evaluation to international benchmark standards (figure 8).

SBS EON Technology delivers superior performance in grid assist float applications where mains power supply can be semi stable or in applications where power outages can be frequent and unscheduled leading to risk of uncontrolled partial state of charge cycling.

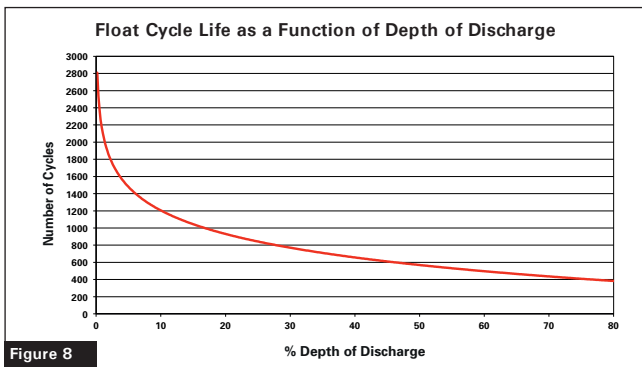


Figure 8

Fast Charge Cycling

The high charge acceptance of PowerSafe SBS EON Technology 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).

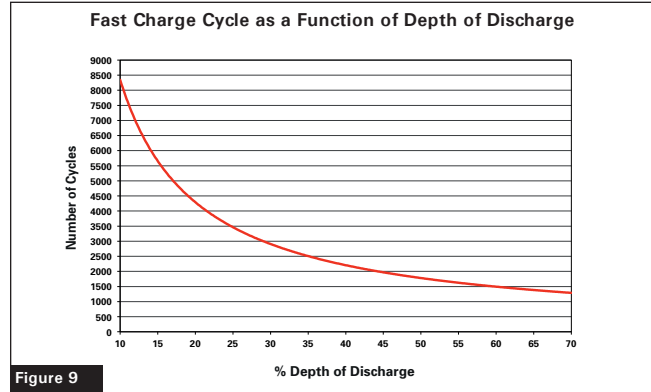


Figure 9

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 SBS EON Technology 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.



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