SBS™

THE POWER OF THIN PLATE TECHNOLOGY

OPERATION AND MAINTENANCE MANUAL

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General Guidelines And Information

HAWKER

IMPORTANT

Please read immediately on receipt of battery before unpacking and installing.

The installation and erection of batteries should be undertaken by suitably qualified persons only.

Failure to comply with these instructions will render any warranties null and void.

HEALTH AND SAFETY

SBS™ batteries are electrically live at all times. Care must be taken when handling the monoblocs, even when in a damaged or discharged condition.

ALWAYS....

- Remove all metal personal effects such as rings, metal watch bands, belt buckles.
- Switch off circuit before connecting or disconnecting battery.
- Use insulated tools.
- Keep sparks, flames and lighted cigarettes away from the battery.
- Remember - batteries are heavy; use appropriate handling techniques.
- Wear protective clothing (eg gloves, safety glasses etc).

NEVER....

- Lift a battery by its terminals.
- Charge in a sealed container.
- Incinerate.
- Short circuit.
- Charge with a voltage greater than specified in this manual.

STORAGE

- If the battery cannot be installed immediately, it should be stored in a cool, clean and dry environment.
- If the open circuit voltage drops to less than 2.09 Volts per cell, a recharge will be necessary. The ambient temperature will affect the self discharge and therefore the time between recharges - see appendix in self discharge curve of voltage temperature.

Months on shelf	State of-Charge (20°C)	State of-Charge (30°C)
0	100%	100%
1	99%	97%
2	97%	95%
3	96%	93%
4	95%	91%
5	94%	90%
6	93%	88%
7	92%	86%
8	91%	85%
9	90%	84%
10	90%	82%
11	89%	81%
12	88%	80%

The graph in Appendix (B) shows the above figures.

- It is advised not to keep batteries in a deeply discharged condition.

TRANSPORTATION

SBS™ batteries are classed as 'Non-Hazardous' for transportation by air, sea or road. They may, therefore, be transported without restriction, without the use of Hazardous Goods Notes, TREM Cards etc., provided the terminals are adequately protected from short circuit. For air transportation ICAO (and IATA) special provision A67 applies.

UNPACKING

On delivery, carefully examine the consignment for any obvious signs of transit damage and then ensure that the goods are complete and agree with the material list, advice note or invoice. Monobloc terminal nuts and washers are normally packed in a sachet inside the monobloc carton.

MONOBLOC CLEANLINESS

Please ensure that the monoblocs are clean at all times. Cleaning should be carried out using a damp soft cloth.

Do not use solvents, paraffin, abrasive or proprietary cleaning fluids or materials as this may cause permanent damage to the plastic containers and lids.

FLOAT CHARGING (PREFERRED METHOD)

For maximum service life SBS™ should be float charged using a well regulated constant voltage source with thermal compensation for the charge voltage.

Charging techniques

There are basically 2 different methods of charging the SBS™ valve regulated battery. These are constant voltage and constant current.

Constant Voltage Charging (Recommended Charging Method)

Constant voltage charging is the most efficient and safest method of charging a sealed lead acid cell. There are basically two methods of constant voltage charging, float and fast.

1. FLOAT CHARGING

This type of charging is to be used in standby applications.

Note: For battery to attain 100% capacity whilst being charged at 2.27 Vpc @ 20°C a minimum of 7 days recharge time is required.

Voltage Setting

When the SBS™ valve regulated cell is to be float charged in a standby application the constant voltage charger should be maintained at 2.27 Volts per cell whilst at an ambient temperature of 20°C for maximum float life.

Temperature excursions away from this will cause a reduction in life for high temperatures or a reduction in capacity due to undercharge at lower temperatures. The general rule is that for every 10°C rise in temperature there is a 50% reduction in the float life of the product.

A curve showing the recommended float voltages for a given temperature is shown in Appendix C. Using these values it is possible to maintain the battery condition whilst retaining its longevity of operation. To compensate for variations in ambient temperature, the following formula should be applied:

Float Vpc = 2.3773 - (Tx 0.00598) + (T^2 x 0.00004)

Note: At temperatures in excess of 40°C the compensated voltage approaches the open circuit voltage of the battery. The voltage should therefore be capped at this level so a greater reduction in life at temperatures in excess of 40°C, even with temperature compensation, is to be expected.

It is important to remember that the battery has a large thermal mass. Placement of the temperature indicating device is very important as instantaneous changes in the ambient temperature are not immediately reflected within the internal mass of the battery. It is therefore recommended that temperature probes/indicators should either be placed against the outer case of the battery with the outer face of the probe being insulated or commercially available ring tag temperature probes can be used fitted over the battery terminal during installation.

Current Setting

There is no upper limit setting to the current requirements during constant potential charging as the battery itself will regulate the current only accepting as much as is required to reach its fully charged condition.

It should however be noted that the higher the charge current available from the charging source, the quicker the battery will recharge.

In a fully charged float condition, at 20°C, the SBS™ product range will draw between 5 and 50 milli-amps from the charger.

2. FAST CHARGING

2.1 CONSTANT VOLTAGE, FAST CHARGING

In order to facilitate more rapid charging of the SBS™ product it is possible to use the 'fast' charge technique, ideally suited to more cyclic applications.

Voltage Setting

For applications requiring a faster recharge, a potential of 2.4 Volts per cell at 20°C can be applied across the battery terminals. This will facilitate a more rapid recharge although due to this higher potential it is recommended that this level is maintained only until the current being drawn by the battery has remained level for a period of 2 hours. Should this recharge potential be applied for extended periods the battery might become warm thus accelerating grid corrosion and reducing the service life of the product.

Fast Charge Vpc= 2.5023 - (Tx 0.00598) + (T^2 x 0.00004)

Current Setting

As with float charging, the greater the current available from the charging source the faster the recharge will be, with no limit being placed on that charging current. However at these elevated voltages, the final stabilised current being drawn from the charger as the battery reaches its full state of charge will be higher than the values attained at 2.27 Volts per cell.

2.2 CONSTANT CURRENT CHARGING

Constant current charging although efficient, requires a slightly more complex charging algorithm requiring a greater degree of control to prevent serious overcharge.

Constant current charging is accomplished by applying a non-varying current source with a high voltage.

The rate at which the current is applied to the battery governs the voltage requirement of the charger source. High current rates require a charging source with a higher voltage.

It is important with constant current charging to know how many ampere-hours (amps x hours) were taken out during discharge so that with a set constant current the duration of the recharge can be calculated to return between 103% and 105% of the removed capacity.

In order to calculate the maximum rate that can be used during a constant current recharge simply use 5% of the C_{10} capacity of the battery e.g. for an SBS 40, 5% of 40Ah equals 2 amps. This rate would then be used for the duration required to replace approx 103% of the battery's removed capacity during discharge.

INSTALLATION

TOOLS AND MATERIALS REQUIRED

- Insulated torque wrench. See monobloc details in this section for the correct settings.
- In adverse conditions, terminal grease, consisting of 20% lanolin in petroleum jelly, can be used to protect the terminal against external corrosive substances.
- Whilst not harmful to the battery, silicone grease should not be used as this can interfere with other electronic components.

MONOBLOC DETAILS

The following information is very important for the correct and efficient operation of SBS™ batteries:

- To allow an even air flow around the monoblocs, and thereby improve the dissipation of the small amount of generated heat, it is recommended, but not essential, that an air gap of approximately 5 mm is left between the monoblocs.
- Ensure that the correct torque setting for your particular type of SBS™ is selected and applied to the terminal nuts.

Terminal diameter	Torque setting
M4	1.0 Nm
M6	3.9 Nm
M8	5.0 Nm

Please Note: Over-tightening may result in damage to the terminal.

- When supplied with Hawker Energy standard connectors, they come with terminal shrouds already fitted. After the terminal nut is torqued down the shroud can be slid over the terminal. The shroud is flexible, allowing a voltmeter probe tip to be applied to the terminal.
- It is good practice to assemble large batteries in sections, leaving out connectors at, say, 48V intervals, so reducing the danger during the main part of the installation. When the rest of the installation has been checked carefully, the remaining connectors can be fitted.
- Rack and cabinets should normally be filled starting from the bottom, thus ensuring stability throughout the installation.
- Where parallel strings of monoblocs are being used, strings should normally be arranged on racks or cubicles so that there is thermal balance within each string. In other words; three strings on a three row rack should be arranged such that each string is spread across the three tiers.
- Total lengths of cable/connector runs should be the same in each string until the strings are combined at a transition box or circuit breaker.
- Monobloc numbers, when provided, can be affixed to any part of the monobloc plastic case EXCEPT over the vent disc(s) for future identification.

Site Acceptance Tests

HAWKER

OPERATION

A site acceptance test, consisting of a fully loaded discharge for the required autonomy time, should be performed approximately 7 days after installation and commissioning. Hawker Energy can give recommendations for each application.

The following tables show the effect of battery temperature on the electrical discharge performance at different discharge rates. Performance is given as a percentage of the performance at 20°C.

PUTTING INTO SERVICE

If the site acceptance test has been performed, the battery must then be fully recharged.

LOW VOLTAGE DISCONNECTS

On-load battery voltage should not normally be allowed to fall below 1.7 Volts per cell for discharge times greater than 30 minutes. A low voltage disconnect must always be used where possible to maintain the integrity of the battery system. This should completely isolate the battery (including removing any control circuit load) until power is fully restored to the charging equipment.

TEMPERATURE

Rate	0°C	5°C	10°C	15°C	20°C	25°C	30°C	35°C	40°C	REPV
5 m	67%	76%	85%	92%	100%	108%	116%	125%	133%	1.63vpc
10 m	73%	80%	86%	93%	100%	107%	113%	119%	125%	1.65vpc
15 m	74%	81%	87%	94%	100%	106%	111%	116%	121%	1.65vpc
20 m	76%	82%	88%	94%	100%	105%	110%	114%	118%	1.67vpc
25 m	77%	83%	89%	95%	100%	105%	109%	113%	117%	1.67vpc
30 m	78%	84%	90%	95%	100%	105%	109%	112%	116%	1.70vpc
45 m	80%	85%	91%	95%	100%	104%	107%	110%	113%	1.70vpc
60 m	81%	86%	91%	95%	100%	103%	107%	109%	111%	1.75vpc
2 hrs	83%	88%	93%	97%	100%	103%	105%	107%	108%	1.80vpc
3 hrs	85%	89%	93%	97%	100%	102%	105%	106%	107%	1.80vpc
4 hrs	86%	90%	94%	97%	100%	102%	104%	105%	106%	1.80vpc
10 hrs	88%	91%	95%	98%	100%	102%	103%	104%	105%	1.80vpc

Figures apply to all SBS™ products

The temperature expressed above relates to the monobloc, NOT ambient.

REPV = Recommended end voltage per cell.

Cycle Life

Hawker Energy products SBS™ range of products are designed to cycle at float voltage as well as higher voltages. Products can be cycled using charging voltages between 2.27 and 2.40 Vpc.

Charge acceptance and charge efficiency is exceptionally high, key factors for cyclability at float voltage recharge.

The cyclability of the SBS™ product ranges depends upon the following factors:

- Discharge rate / Depth of discharge / Discharge end point voltage.
- Recharge voltage.
- Recharge time.
- Recharge current available.
- Interval time available.

Because there are so many variables associated with the determination of the product cycle life, Hawker Energy request that customers contact our Technical Sales Department with specific details of the cyclic application in order to obtain a figure for product cyclic capability.

The recharge time and voltage will influence cell balance, particularly in the early stages of cycle life.

Cycling at float voltage (e.g. 2.27Vpc) generally requires longer recharge intervals because the charging rate is limited by the low charging overpotential. The charge factor (ratio of charge in / charge out) under float recharge conditions normally reaches >95% in 12 hours to 48 hours depending on the current available from the charging source. Additional time on float is crucial to keep the cells in a fully charged state and to also electrochemically "balance" the cells. A charge factor between 102% and 107% is required to maintain cyclability.

Maintenance And Inspection

The optimum maintenance and inspection procedure will vary considerably according to the application, number and critical nature of installations, along with other commercial considerations.

The following is a list of broad generic suggestions for the periodic maintenance and inspection of your batteries.

It is advised that, in addition to the instructions detailed below, the Battery Record Sheet as shown in Appendix E, is utilised.

MONTHLY INSPECTION			
WHAT TO INSPECT	METHOD	REQUIREMENT	ACTION
Total battery voltage on float charge.	Measure total battery voltage.	Recommended float volts per cell x number of cells series.	Adjust float voltage as specified in Section 2.
SIX-MONTHLY INSPECTION			
WHAT TO INSPECT	METHOD	REQUIREMENT	ACTION
1 Total battery voltage on float charge.	Measure total battery voltage.	Recommended float volts per cell x number of cells series.	Adjust float voltage as specified in Section 2.
2 Individual monobloc voltages on float charge.	Measure individual monobloc voltages.	Within 5.0% of the mean.	Contact Hawker Energy Products Ltd.
3 Appearance.	Check for damage or other impairment.		If a concern is found, check the cause and replace the monobloc as necessary.
4 Cleanliness.	Check for contamination by dust, etc.		If contaminated ISOLATE monobloc and clean with a damp soft cloth.
5 General condition.	Check for corrosion of the cubicle, battery stand, connecting cables and terminals.		Perform cleaning, corrosion prevention treatment, painting, etc.

ANNUAL INSPECTION

As with monthly and six monthly checks the type of annual inspection is based on the critical nature of installations, along with other commercial considerations i.e. feasibility of reduced autonomy, manpower availability etc. One method of checking the state of health of the battery is to perform a partial discharge using the actual system as the load.

Example
For a system with a back-up autonomy time of 4 hours.

Switch off the mains power supply and allow the battery to supply the required back-up power to the load.

After approximately 30 minutes* measure and note the terminal voltage of the individual monoblocs and the corresponding string from which the measurement was taken. An example of a battery record sheet is shown in Appendix E.

After all of the monoblocs have had their terminal voltages measured, the mains power should be returned to the system.

By reference to the noted values on the record sheet calculate the average monobloc terminal voltage for each individual string.

From this value, calculate a voltage equating to 5% less than the average. Monoblocs with a terminal voltage below the calculated value should be replaced at the earliest possible convenience to ensure the maximum system autonomy.

*The actual discharge duration is unimportant as the test is one of comparison and does not have a specific pass/fail criteria. It should be noted however that the longer the duration of the discharge is allowed to continue before measurements are taken, the earlier it might be possible to detect monoblocs prematurely failing.

It is only possible to check the actual capacity of the system battery by performing a full discharge test on the battery to a known end-point voltage. Unfortunately, although this gives excellent battery maintenance cover, it means that for a short period the battery will provide substantially reduced autonomy. Hence this method should only be implemented during times of complete system redundancy.

Hawker Energy can design a tailor-made maintenance procedure when supplied with the relevant information.

Reject Procedure And Disposal

REJECTION

Should a product, on receipt or otherwise, appear to be unserviceable, FIRST contact Hawker Energy Products detailing the circumstances.

Full details of date of shipment, commissioning records and all maintenance records should be relayed.

DISPOSAL

All monoblocs for disposal should be shipped to a recognised scrap recoverer, or regulated collection point.

Hawker Energy utilises a licenced reprocessor of lead and plastics. We will, at no charge, dispose of batteries if they are delivered to our factory in Newport, UK. Alternatively, please contact your local sales office who will be able to assist with your disposal needs.

In the UK this is a legal requirement and products should be disposed of in accordance with the rules of the relevant Local Authority. The Local Authority is required to maintain a list of their approved disposal and recycling operators.

DO NOT INCINERATE END OF LIFE BATTERIES

Appendices

APPENDICES

The following pages show the information listed below. If you have any other requirements, please do not hesitate to contact our Sales Offices or your local agent.

APPENDIX A

SBS™ RANGE - PRODUCT DETAILS

PRODUCT TYPE	NOMINAL VOLTAGE	CAPACITY (10HR TO 1.8VPC) @ 20°C	DIMENSIONS				WEIGHT	TERMINAL THREAD
			A	B	C	D		
SBS 8	12	7.4Ah	137.5	86	99	101	2.8	M4
SBS 15	12	14Ah	200	77	130.5	140	5.1	M6
SBS 30	12	25.8Ah	250	97	146	156	8.9	M6
SBS 40	12	36.6Ah	250	97	196	206	12.8	M6
SBS 60	12	50.8Ah	220	121	250	260	18.1	M6
SBS 110	6	115Ah	198	206	235	237	20.6	M8
SBS 114	4	115Ah	198	206	235	237	15.1	M8
SBS 130	6	132Ah	198	206	235	237	22.3	M8
SBS 134	4	132Ah	198	206	235	237	16	M8
SBS 300	2	310Ah	198	206	235	237	20.8	M8
SBS 390	2	360Ah	198	206	235	237	22.5	M8

Notes: Weight is in Kg. Dimensions are in mm, A = Length; B = Width; C = Container Height; D = Height over terminals

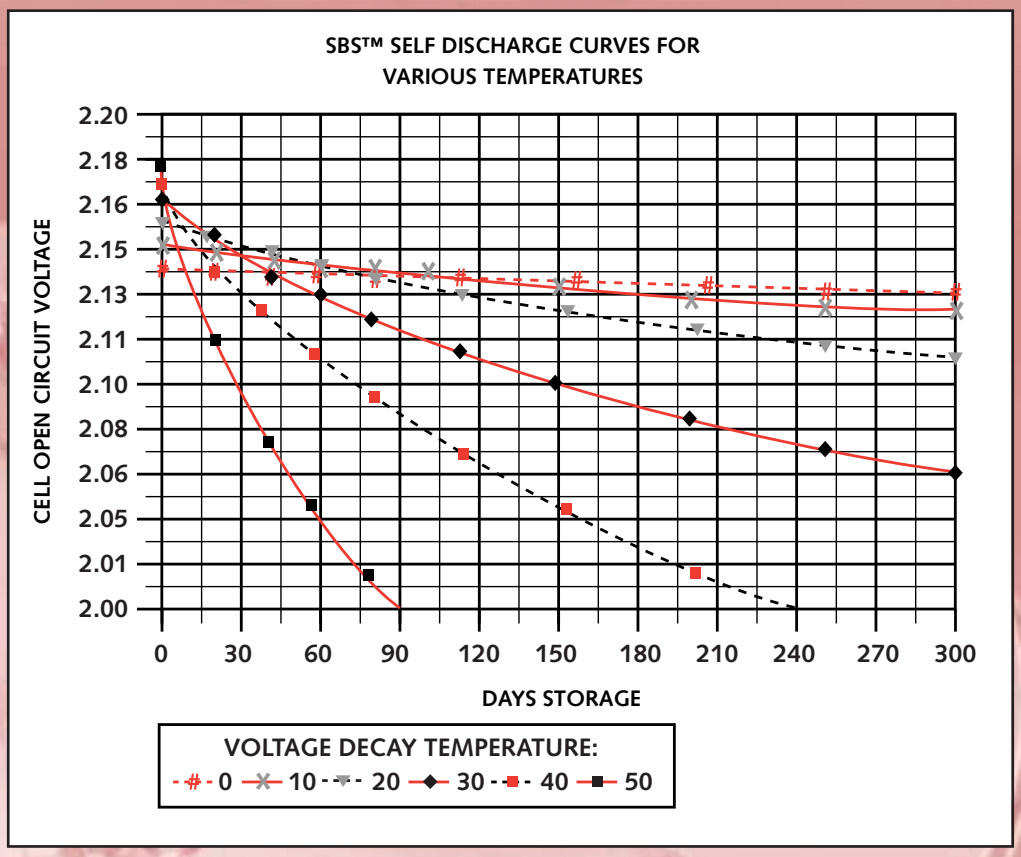
Above capacities are quoted at 20°C. Battery capacities increase with a higher temperature.

- Unless otherwise stated, all dimensions are in millimetres.
- Battery capacities are measured in Ah.

All products are fully compliant to BS6290 Part 4 and fully approved by British Telecom.

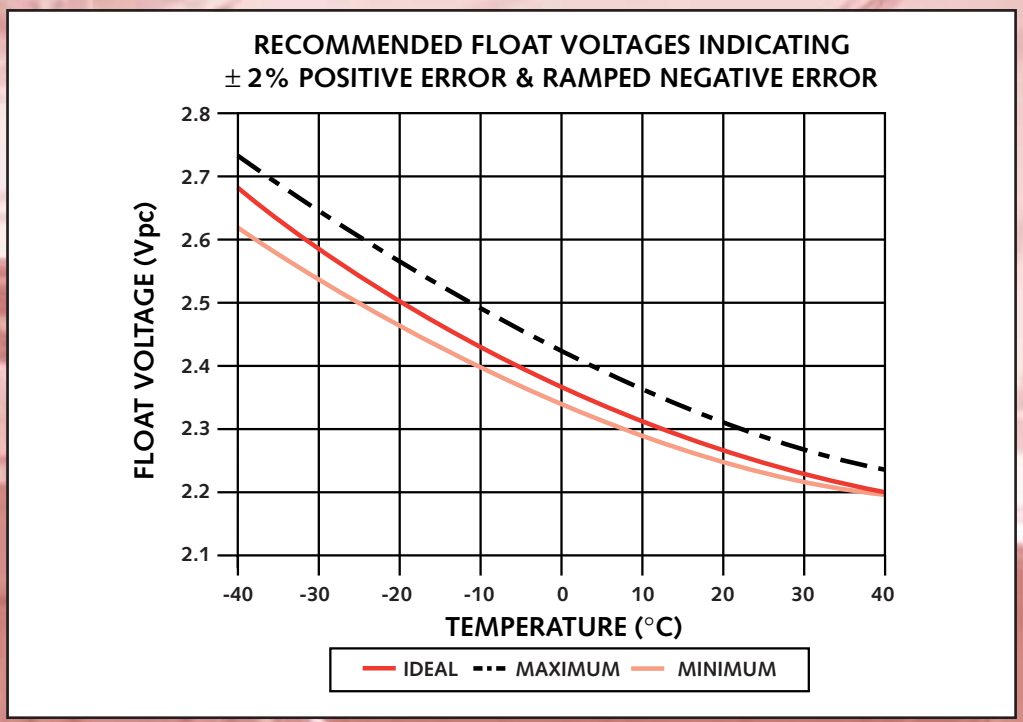
- For further information on any of our products, please contact our Sales Office at Newport.

APPENDIX B



Based on a single 12V monobloc with 6 cells

APPENDIX C



At temperatures greater than 40°C it is recommended that the same float voltage should be applied as that at 40°C with zero negative error permitted.

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BATTERY RECORD SHEET EXAMPLE

Site: Installation date: Inspection date:

Monobloc type: Float voltage:
No series: Temperature:
No parallel:

Battery Number: Bank Number:

Mb No	V/Mb	Mb No	V/Mb	Mb No	V/Mb	Mb No	V/Mb	Mb No	V/Mb	Mb No	V/Mb	Mb No	V/Mb	Mb No	V/Mb
1		29		57		85		113		141		169		197	
2		30		58		86		114		142		170		198	
3		31		59		87		115		143		171		199	
4		32		60		88		116		144		172		200	
5		33		61		89		117		145		173		201	
6		34		62		90		118		146		174		202	
7		35		63		91		119		147		175		203	
8		36		64		92		120		148		176		204	
9		37		65		93		121		149		177		205	
10		38		66		94		122		150		178		206	
11		39		67		95		123		151		179		207	
12		40		68		96		124		152		180		208	
13		41		69		97		125		153		181		209	
14		42		70		98		126		154		182		210	
15		43		71		99		127		155		183		211	
16		44		72		100		128		156		184		212	
17		45		73		101		129		157		185		213	
18		46		74		102		130		158		186		214	
19		47		75		103		131		159		187		215	
20		48		76		104		132		160		188		216	
21		49		77		105		133		161		189		217	
22		50		78		106		134		162		190		218	
23		51		79		107		135		163		191		219	
24		52		80		108		136		164		192		220	
25		53		81		109		137		165		193		221	
26		54		82		110		138		166		194		222	
27		55		83		111		139		167		195		223	
28		56		84		112		140		168		196		224	

Mechanical condition: Key:

Other observations: Mb = Monobloc

Signature: No = Number

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