STORAGE BATTERY SYSTEMS, INC.

Corporate Office
N56 W16665 Ridgewood Dr.
Menomonee Falls, WI 53051
www.sbsbattery.com
(800) 554-2243

INSTALLATION, OPERATING & MAINTENANCE INSTRUCTIONS

For Vented Lead-Selenium Standby Batteries (SR & STT-series)

Commissioning by: ..... Date: .....

Number of cells/blocks: ..... Type: .....

SAFETY PRECAUTIONS & WARNINGS

	Familiarize personnel with battery installation, charging and maintenance procedures. Display operating instructions visibly near the battery system. Restrict access to battery area, permitting trained personnel only, to reduce the possibility of injury.
	Wear rubber apron, gloves and safety goggles (or face shield) when handling, installing, or working on batteries. This will help prevent injury due to splashing or spillage of sulfuric acid. Observe all accident prevention rules.
	Prohibit smoking. Keep flames and sparks of all kinds away from the vicinity of storage batteries as liberated or entrapped hydrogen gas in the cells may be exploded, causing injury to personnel and/or damage to cells.
	Wash all acid splashes in eyes or on skin with plenty of clean water and seek immediate medical assistance. Acid splashes on clothing should be washed out with water. Acid on skin or clothing should also be immediately neutralized with a solution of baking soda and water.
	Explosion and fire risk. Avoid short circuits. Never place metal tools on top of cells, since sparks due to shorting across cell terminals may result in an explosion of hydrogen gas in or near the cells. Insulate tool handles to protect against shorting. Prior to making contact with the cell, discharge static electricity by touching a grounded surface.
	Electrolyte is highly corrosive. Promptly neutralize and remove any electrolyte spilled when handling or installing cells. Use a baking soda/water solution (1 lb. per gallon of water) to prevent possible injury to personnel.
	Block and single cell batteries are extremely heavy. Exercise care when handling batteries. When lifting use appropriate mechanical equipment to safely handle batteries and avoid injury to personnel.
	Dangerous voltage. Whenever possible, when making repairs to charging equipment and/or batteries, interrupt AC & DC circuits to reduce the possibility of injury to personnel and damage to system equipment. This is particularly import with high voltage systems (110 volts and above).
	Recycle and Dispose of Used Batteries Used batteries contain valuable recyclable materials. They must NOT be disposed of with domestic waste. Modes of return and recycling shall conform to the prevailing regulations in operation at the site where the battery system is located. Call SBS for recycling options.

Warranty

Any of the following actions will invalidate the warranty:

- Non-adherence to the Installation, Operating and Maintenance Instructions
- Repairs carried out with non-approved spare parts or by non-approved personnel
- Application of additives to the electrolyte
- Unauthorized interference with the battery.

1.0 DELIVERY AND STORAGE

Delivery
Unpack the batteries as soon as they are delivered.
Do not lift by the terminal posts! Batteries should be lifted by handles or supplied lifting straps. In addition at all times, exercise care when handling batteries to prevent scratching of plastic jars and covers. The cell containers and covers are delicate and scratches can lead to weakening of the cases.
Verify that all of the equipment has been delivered and in good condition. Check quantities against packing slip and accessories list.
If there is any damage or missing product, immediately notify the trucking company as well as your sales office.
If necessary, clean all parts before assembling.

Storage
Store the battery in a dry, clean and preferably cool and frost-free location. Do not expose the cells to direct sunlight as damage to the container and cover may occur.
When the batteries are supplied wet and fully charged, storage time is limited. In order to easily charge the batteries after prolonged storage, it is advised not to store batteries for more than:

- 3 months at 68°F
- 2 months at 86°F
- 1 month at 104°F

Failure to observe these conditions may result in greatly reduced capacity and service life as well as voiding the battery warranty.
The refreshing charge shall be carried out according to charging section (3.0).
Fully charged 2V cells have an open circuit voltage of 2.08V +/-.01V; 6V blocks average 6.24V +/- .04V; 12V blocks average 12.48V +/-.05V at 68°F.

If the batteries are supplied dry charged, the storage time shall not exceed 2 years. For filling, contact sales office for special instructions to fill and commission dry charged batteries.

Storage of a battery after use:
Never store a battery discharged but ensure it is completely charged before storage. Storage times shown earlier (before use) also apply after use.

2.0 INSTALLATION

The electrical protective measures, accommodation and ventilation of the battery installation must be in accordance with the applicable rules and regulations. This includes layout, safety equipment and warning signs required. Specifically, EN 50272-2 applies.

Ventilation
During the operation of lead-acid batteries, including all types of charging as well as during discharging, hydrogen and oxygen gases are produced. This results from electrolysis of the water portion of the electrolyte by the charging current. Natural or artificial ventilation should be provided in the battery room or area to prevent hydrogen from exceeding a 1% concentration. Concentrations above 1% can result in an explosive mixture, which could be ignited by sparks from adjacent electrical equipment as well as sparks or open flame introduced by personnel. All air moved by ventilation should be exhausted into the outside atmosphere and should not be allowed to re-circulate into other confined areas.
Ventilation requirements vary. Contact your local authority for requirements.

Location
The battery system should be installed in a clean, cool and dry location with a lockable door. Avoid placing the battery in a warm place or in direct sunlight. In addition heaters, radiators and steam pipes can cause serious electrolyte temperature variation among cells within a battery system. The layout and contents of a battery room must comply with all local standards as well as allow easy access to the batteries.

Handling
Vented lead-acid batteries are normally supplied in a fully charged state and must be unpacked carefully to avoid short circuit between terminals of opposite polarity. The cells are heavy and must be lifted with appropriate equipment.

Tools
Use tools with insulated handles. Do not place or drop metal objects onto the battery. Remove rings, wristwatch and metal articles of clothing which may come into contact with the battery terminals.

Removal
Before removing old batteries, ensure that all electric loads are switched off (separator, fuses, and switches). This must be carried out by a qualified professional. Batteries must be recycled per regulations.

Rack Installation
Assemble rack according to instructions supplied. If instructions are missing, contact rack supplier. Make sure the rack rails are insulated. Choose location to install rack and check that the rack is level and all bolts are tight after placed. Approved battery racks are recommended for proper installation. If required, ground the rack per applicable codes.
Note: If a SBS spill containment is also supplied the rack will fit into the spill pans. If the rack is being anchored to the floor drill through the spill containment system and caulk hole with a silicon sealant to avoid possible leaks. Contact SBS with additional questions.

Installation of Cells
Arrange batteries plumb and level with the correct polarity--see series vs. parallel connection for explanation. Carefully follow the polarity sequence to avoid short circuiting cell groups.

- **Series Connection - Battery cells are usually installed in series**
  Place the batteries on the rack making sure that the positive terminal of one battery is connected to the negative terminal of the next battery and continue in the same fashion. Make sure batteries are aligned properly.

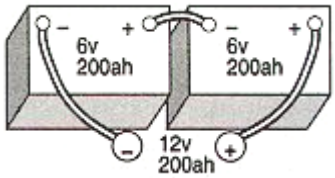


Figure 1: These are two 6V batteries in series to produce 12V. You can add more batteries for a higher voltage i.e. 24, 48, 130Vdc.

- **Parallel Connection**
  Batteries may be connected in parallel to give higher current capability. In the case of parallel connected strings, use batteries of the same capacity, design, and age only-with a maximum of four parallel strings. The resistance of the cables in each string must be the same, e.g. same cross section, same length. Connect battery strings in parallel at the end terminals.

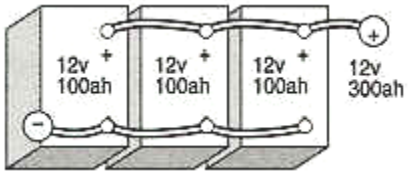


Figure 2: These are three 12V 100ah batteries in parallel. They produce 12V with 3X the capacity (300ah) of a single battery.

Start installing the batteries on the lower step or tier for stability and safety reasons
To minimize friction of batteries when transferring from platform lift to the rack rails or for positioning batteries, **talcum powder MAY BE USED** on the platform surface or plastic rails to ease movement. **DO NOT USE** any other type of lubricate such as **grease or oil** as they may contain mineral spirits which can cause crazing and cracking of the plastic jar material.
Make sure cells are aligned properly and the spacing is as required-(**Table 1**).

Battery Type	Required Spacing
SR series	**.40"**
STT series	**.50"**

Table 1

Check that all contact surfaces are clean and corrosion free. If required, clean with a brass brush.
Tighten the terminal screws with an insulated torque wrench in accordance with **Table 2**.
Fit inter-step, row or tier connectors observing the same specified torque values.
A loose connection can make adjusting the charger difficult, create erratic performance and lead to possible damage to the battery and/or even personal injury.

Battery Type	Terminal Bolt	**Maximum Torque +/-.05%**		
		Inch Pounds	Foot Pounds	Nm
SR series	**M8**	**132**	**11.06**	**15**
STT series	**M10**	**177**	**14.75**	**20**

Table 2

Fit the insulating covers supplied for protection against inadvertent contact.
If applicable, remove transport plugs and replace with flame retardant vent caps.
Number the cells for maintenance purposes (starting from the positive end terminal to the negative end terminal).

No-Ox Grease
Grease can damage the plastic material. It may contain mineral spirits which can cause crazing and cracking of the plastic jar material. Apply a thin coat (use sparingly) of No-Ox grease to terminals, on bolt threads and other exposed metal surfaces careful to avoid contact with the cover and container.
The SR-series do not require the use of grease and we do not supply it with the system. It will however, not hurt the battery if it is used carefully.
The STT-series battery system comes with **grease** and it **should be applied sparingly**.

Charger Connection
Before charger is connected, make sure cells are clean and double check all connections for correct torque (**Table 2**) and polarity.
Ensure all battery to battery, battery to terminal connections, as well as inter-level and load connections have appropriate internal resistances.
Measure the total voltage of the battery string at the end battery terminals. The voltage should be equal to the number of cells times the voltage of one of the cells.
Example: 60 cells times 2.00V= 120V.
Finally, with the charge switched off-the battery fuse removed-and the load disconnected, connect the battery to the DC power supply. Ensure that the polarity is correct – positive terminal of the battery to the positive terminal of the charger.
Switch on the charger, adjust float and equalize voltages as needed and charge according to charging instructions 3.0.

3.0 CHARGING

Initial Charge (Commissioning Charge)
Before initial charge, all batteries must be inspected for physical/mechanical damage.
Note: The first charge must be monitored to ensure that the limits are not exceeded and that no unacceptable temperatures occur.
The electrolyte level on delivery can vary. After a charger is applied to the batteries the electrolyte levels will rise. The final electrolyte level will be achieved after the initial charge.
Small quantities (up to 3 mm) can be topped off with distilled water after the initial charge.
When installing a new battery system, procedures a) or b) are recommended for initial charging.

a) The IU method of boost charging. At a raised voltage of 2.33 – 2.40Vpc, the charging time will be 4-24 hours depending on the charging current and initial charge conditions. The current must be limited to 30% the 8hr AH rating.
b) Float Charging. Charge at the recommended float voltage of 2.23Vpc. Full capacity will be obtained between 1 to 6 weeks depending on the initial state of charge upon installation.

The fully charged condition has been achieved when, for a period of two hours, the cell voltages do not continue to increase and the charging current does not continue to decrease. The nominal specific gravity of 1.240 shall be achieved at the end of charge (tolerance: +/- 0.01).
It is not recommended to leave the batteries on a boost or equalize charge unattended due to the possibility of overcharging.

Equalizing Charge
When should an equalize charge be applied?

- When S.G. readings corrected to 77°F are less than 0.010 units compared to nominal specific gravity.
- When individual cells show a voltage difference of +/-0.02V with the average cell voltage or are outside of the following range for block batteries: 13.38V (12V); 6.69V (6V) +/-1%.
- When electrolyte levels have been adjusted – water added. **Maximum 4 hour equalize charge!**
- After a deep discharge or after an inadequate recharging, an equalizing charge may be necessary.

Note: Our lead selenium batteries do not require a periodic equalize charge unlike lead-calcium batteries which do require this type of charge. Putting an equalize charge on our batteries when they are fully charged only causes problems due to over charging the batteries.
In addition, it is not a good practice to put the batteries on equalize charge for a set period of time and let them sit until the timer runs out. If the equalize timer is set for the maximum amount of time we specify e.g. 36 hours, but the cells are fully charged after the first 6 hours, it will lead to 30 hours of overcharging which leads to vent cap or other types of problems.

The battery system may be recharged at 2.33 – 2.40Vpc with a current limited to 30% of the batteries 8 hour AH rating.
The charging time must be limited to 36 hours.
The actual time needed to equalize depends on the voltage and current applied but should NEVER be more than 36 hours. To ensure the cells are not overcharged electrolyte S.G. should be checked on 3-4 pilot cells during equalize charge. Charging is complete when the SG readings or voltage do not change for two hours.
If the maximum temperature of 113°F is exceeded, charging must be terminated or continued at a reduced current or temporarily switched to float charging. The end of equalizing is reached when the S.G. of the electrolyte and the cell voltages have not risen for a period of two hours.
It **IS NOT** recommended that you equalize for a certain amount of time without periodically checking a pilot cells SG and voltage. This practice will lead to overcharging.
If there are still problems after an equalize charge is carried out contact your sales office.

Note: Because the permissible system voltage level may be exceeded when equalize charging at increased voltages, suitable measures should be taken to protect the load circuits, e.g. charging <<off line>>.

Boost Charge
A boost charge follows the same procedure as the equalize charge.
To reduce the recharge time the battery may be recharged at 2.33 – 2.40Vpc with a current limited to 30% of the batteries 8 hour AH rating.
The charging time must be limited to 36 hours.
Boost charging must be switched to float charging when the full charged status is reached. **Do not over charge!** The fully charged condition has been achieved when, for a period of two hours, the cell voltages do not continue to increase and the charging current does not continue to decrease.

Float Charge
The recommended float charge voltage is 2.23Vpc at 77˚F. However, the batteries can be floated as low as 2.15Vpc or as high as 2.25Vpc. Floating the batteries under the recommended 2.23Vpc will lead to an occasional equalize charge being required, as well as slightly reduced capacity. Floating the batteries above 2.23Vpc will lead to additional watering being required, as well as a shorter life.
For these reasons, we recommend 2.23Vpc @ 77°F, whenever possible. The system float voltage should equal: (# of cells in system) x 2.23Vpc = System Float Voltage. Float voltage should not vary by more than +/-1%. Should the float voltage of any cell vary by +0.1V or –0.05V from 2.23V, contact your sales office.

Float Charge Adjustment
The float charge voltage will need to be adjusted if the average operating temperature is above 86°F or below 50°F.
If the average battery temperature exceeds 86°F, the float charge voltage shall be reduced by (AT - 86) x .003Vpc when the temperature exceeds 86°F (but not less than 2.18Vpc).
The float voltage shall be increased by (50 - AT) x .003Vpc when the temperature is less than 50°F.
AT=the average operating temperature
Example: AT= 92°F: (92-86) x .003 = reduce Vpc by .018.
A 60 cell system with a standard float voltage of 133.8V (2.23Vpc) would be floated at 132.72V

Deviations of individual cell voltages of -.05 to +.10 Vpc may be observed. However, the total voltage of the battery system shall be within the limits stated above.

Recharge
After a discharge the battery can be recharged at the operating voltage (float voltage) or to reduce the charging time the recharging can be carried out per the boost/equalize charging instructions. The recharging times vary depending on the charging procedure and on the charging current available. Generally, 4 to 24 hours duration can be expected at charging currents between 5A and 35A per 100AH nominal capacity.
Recharge 1.2 times the discharged capacity.
During recharging up to 2.40 Vpc the effective value of AC ripple current can reach a temporary maximum 10 A per 100AH nominal capacity. This can lead to additional maintenance (watering) being required.

Charging Current
Limitation of the charging current is not required under floating condition. At higher charge, voltages up to 2.40Vpc, the charge current should be limited to 30% of the 8hr AH rating at 77°F. I.E. SR12100 = 100AH @ 8hr, maximum charge current should be .30 x 100 = 30amps.
After reaching the gassing voltage of 2.40Vpc, a current limit of 2.5-5amps per 100AH is recommended.

Ripple Current
In the standby operation mode, the effective value of the AC ripple current must not exceed 5A per 100AH @ 8Hr. Otherwise, reduced operational life as well as increased maintenance must be expected. Charging current should be filtered so that battery will have maximum life and minimum maintenance during its life.

4.0 TEMPERATURE

The permissible operating temperature range is 30°F to 131°F.
The recommended operating temperature range is 68°F to 77°F. This will maximize life and minimize maintenance. All technical data relates to a rated temperature of 77°F.
Higher temperatures reduce the operational life.
Lower temperatures reduce the available capacity.
Do not expose cells to direct sunlight.

Effect of temperature on capacity
If the battery operating temperature is different from 77°F, a correcting factor is to be applied to capacity value taking into account discharge time.

Temperature correcting factors:

Discharge Time	32°F	41°F	50°F	60°F	77°F	86°F	95°F	104°F
5 – 59 min	0.60	0.71	0.81	0.91	1.00	1.05	1.10	1.12
1 – 24 hrs	0.80	0.86	0.91	0.96	1.00	1.03	1.07	1.08

Table 3

Example: A battery with a capacity of 200Ah at 77°F (SR06200) for a 5 hour discharge will have a capacity of 182Ah when discharged at 50°F (200 x 0.91).

5.0 ELECTROLYTE

The electrolyte is a diluted sulphuric acid. The nominal S.G. of the electrolyte at 77°F is 1.240. The maximum deviation is +/-.01kg/l. Higher temperatures will reduce electrolyte density, while lower temperatures increase electrolyte density. The correction factor is .001 for each 3°F.
For each 3°F over 77°F, add .001 to the S.G. reading.
For each 3°F below 77°F, subtract .001 from the S.G. reading.
Example: Electrolyte density 1.23 at 95°F or 1.25 at 41°F corresponds to a density of 1.240S.G. at 77°F.

Approximate electrolyte values according to electrolyte level:

Type	Minimum	Medium	Maximum
SR	1.26	1.25	1.24
STT	1.26	1.25	1.24

Table 4

6.0 DISCHARGING

End of discharge voltage
The battery must not be discharged more than the capacity specified in the performance data tables. Deeper discharges may damage the battery and shorten its operational life.
As a general rule the end of discharge voltage shall be limited to the values listed below:

Discharge Time	End Voltage
5min < t < 59 min	1.60Vpc
1hr < t < 5hrs	1.70Vpc
5hr < t < 8hrs	1.75Vpc
8hr < t < 24hrs	1.80Vpc

Table 5

Individual cell voltages may fall below end voltage per cell by not more than 0.2Vpc. A low voltage disconnect is recommended to prevent deep discharge. Special attention should be given to small loads that are not automatically disconnected at the end of discharge.

Discharged Cells
Batteries must not be left in a discharged condition after they discharged. They must be immediately returned to recharge mode. Failure to observe these conditions may result in greatly reduced service life and unreliability. See section 3.0 for charging instructions.
Note: Each deep discharge is abusive and could affect the life expectancy of the battery.

7.0 TESTING

Capacity tests are to be carried out in accordance with IEEE485.
Check that the battery is fully charged. The battery system should be on float charge for a minimum of 24 hours before capacity test is to be performed.
Before testing new batteries, it must be ensured that a sufficient commissioning charge has been applied. If the cell S.G. is at 1.240 +/- 0.01 the battery is fully charged. Lower S.G. results in lower capacity.

8.0 SPECIAL APPLICATIONS

Whenever the batteries are to be used for special applications (non floating type applications) such as repeated cycling or under extreme ambient conditions, please contact your sales office. Different instructions may apply. In addition, the battery may have a shorter life.

9.0 MAINTENANCE & TESTING

Water Topping
Under ideal operating conditions, lead-selenium flooded batteries should require watering every 1 to 3 years. This depends on temperature, charging rates, and number and depth of discharges.
Note: DO NOT ADD WATER TO A BATTERY WHICH ISN'T FULLY CHARGED. This is especially important as the battery is being installed.
Top up the electrolyte level to the nominal level, but without exceeding the << Max >> mark. Topping over max line when combined with an equalize/boost charge can lead to plugged vent caps as noted below. Only de-mineralized or distilled water (purity grade: maximum conductivity 10 µS/cm) shall be used.
On float charge, the homogenization will eventually occur and an equalize charge isn't necessary.
If required after topping off the water level, an equalize charge up to 4 hours can be applied to reduce the time for homogenization of the electrolyte density.

Cleaning
Keep containers and lids dry and free from dust. Cleaning must be undertaken with a damp cotton cloth without man-made fibers or addition of cleaning agents. Do not use feather dusters or dry cloths. This could cause static discharge which can lead to an explosion hazard.

Ceramic Plugs
Wash ceramic plugs, only if soiled (about every two years), in clean water and dry them thoroughly before putting them back on the battery.

- **Note:** Standard SR vent caps can get plugged with electrolyte. It is due to overcharging, which leads to excessive gassing. This problem must be taken care of immediately to avoid larger problems.
  It can be determined that the caps are plugged if there is moisture inside of them or if the electrolyte levels and S.G.'s are out of the ordinary.
  The plugging occurs when the batteries are equalize charged either unnecessarily or for too long a time. It is caused by so much gassing that the caps can't handle filtering all of the hydrogen and got plugged with electrolyte. The clogging then creates a suction which takes electrolyte out of the cell into the vent well. From the vent well, the acid can be deposited into an adjacent cell creating low levels in one cell and high in the next. If a technician then adds water to the low level cell, the S.G. will be diluted and additional corrective actions must be taken. Unfortunately, electrolyte doesn't evaporate (the water will but the acid doesn't) so the caps will be plugged until removed and rinsed with water and then dried. As long as the caps are clogged, the potential of electrolyte transferring from cell to cell is there.

  An equalize charge should be used only in the following circumstances:
  1) During initial installation
  2) If the batteries were discharged and need to be recharged in a hurry
  3) If the batteries have sulfation
  4) If water is added to the cells (max. 4 hours)

  Note: Our lead selenium batteries do not require a periodic equalize charge unlike lead-calcium batteries which do require this type of charge. Putting an equalize charge on our batteries when they are fully charged only causes problems due to over charging the batteries.
  In addition, it is not a good practice to put the batteries on equalize charge for a set period of time and let them sit until the timer runs out. If the equalize timer is set for the maximum amount of time we specify e.g. 36 hours, but the cells are fully charged after the first 6 hours, it will lead to 30 hours of overcharging which leads to vent cap problems.

  If the caps are saturated they need to be thoroughly washed out (to get rid of the electrolyte and any lead particles). They must also be allowed to fully dry before they are put back on. An air hose works well for blowing out the moisture.

To fix the erratic specific gravity levels and readings, the only solution is to adjust the S.G. manually.
The acid must be transferred from the high cells and added to the low cells while taking the lower S.G. and using it to replace the acid recovered from the high cells. Additional water and a high S.G. acid may also be required for adjustment.
The vent caps will have to be washed out and completely dried to prevent this from happening again.

REQUIRED PERIODIC INSPECTION AND MAINTENANCE ACTIVITIES
Note: Keep a logbook in which the measured values can be noted as well as power cuts, discharge tests, equalize charges, topping up dates, storage times and general conditions.

To obtain the full capacity and service life from your SBS stationary battery system, the performance of complete and timely periodic maintenance is essential. Temperature extremes, improper electrolyte levels, charging voltage and specific gravity imbalance are a few of the items which can have a negative effect on the system.

Routine visual inspection, charger/rectifier checks, and pilot cell checks should be performed monthly. More detailed inspection of the battery is required on a quarterly and annual schedule.

BATTERY ROOM AND EQUIPMENT - GENERAL INSPECTION
Perform the following checks whenever in the battery room.

- The battery room is clean, dry, and clear of debris and within a 70°F to 80ºF temperature range
- The battery room ventilation system is operating
- Battery room and personal safety equipment is available and operational
- Battery cleaning and acid neutralization supplies are available on site
- Battery maintenance equipment and tools are available and operational

MONTHLY CHARGER/RECTIFIER OUTPUT CHECKS – record in a log book the following:

- Charger rectifier output voltmeter reading is the same value as that read with a calibrated voltmeter. Record the charger/rectifier output meter reading. Should be 2.23 volt DC x number of cells. If a deviation in voltage greater than +/- 1% occurs, the charger must be adjusted or checked for proper operation. (Measure voltage at battery terminals.)

MONTHLY BATTERY SYSTEM CHECKS -- record in a log book the following:

- Battery system float charging voltage-It should be equal to the number of cells multiplied by the recommended charging voltage per cell
- Record each individual pilot cell charging voltage. The pilot cell charging voltage should be: 2.23v +/- .05v for 2v cells 6.69v +/-1% for the 6v blocks 13.38v +/-1% for the 12v blocks
- Pilot cell electrolyte temperatures are in the normal range, usually 70°F to 80ºF, and with a variance no greater than 5ºF between individual cells. Record the readings
- Pilot cell specific gravities, corrected for temperature, are 1.240, within .005 of previous two normal readings, and within a range of .010 of the pilot cells average specific gravity. It is important to take specific gravity readings prior to adding water to the cells. Record the readings
- Electrolyte levels of all cells are between the high and low level marks on the cells
- All cells have clean vent caps installed
- Visually inspect each cell noting any changes or abnormalities. If anything odd is noticed, record and call sales office immediately to determine proper action. Changes you should look for may be, but are not limited to the following: discoloration, cracks, corrosion, growth inside or outside of container. Any noticeable sign may be a sign of trouble
- All cells and racks are clean, dry and free of any spilled electrolyte and corrosion
- Record room temperature
- Water levels-fill with distilled water to maximum line (not above), if necessary

NOTE: Individual cell charging voltage and specific gravity measurements are most accurate if 72 hours or more have elapsed since the system was discharged or equalized. Specific gravity readings taken within 6 weeks of water additions may not be accurate.

QUARTERLY BATTERY SYSTEM CHECKS -- record in a log book the following:
In addition to the monthly inspection the following checks should be completed quarterly.

- Record the charging voltage of each cell or multi-cell block in the battery system
- Record the Internal Resistance of each cell or multi-cell block
- Review the general condition or change in condition of the cells, racks, cables and connectors
- Record temperature of electrolyte in pilot cells on each rack

ANNUAL BATTERY SYSTEM CHECKS -- record in a log book the following:
In addition to the quarterly inspection checks, perform the following checks annually.

- Record the specific gravity of each cell in the battery corrected for temperature.
- Check torque of all connections-batteries and racks.
- Check to ensure ventilation is okay.

10. STANDARD WARRANTY

20 YEAR LIMITED WARRANTY & ADJUSTMENT AGREEMENT
COVERING SBS "SR & STT" LEAD-ACID STATIONARY BATTERIES

Storage Battery Systems, Inc. (SBS) warrants that every SBS stationary battery sold as a new battery to an original user will be free from defects in material and workmanship under normal and proper use, and maintained in accordance with SBS published and supplemental maintenance instructions.

SBS warrants that within **1 year** of the date of shipment to the original purchaser, it will repair, F.O.B. its factory, or replace without charge F.O.B. its factory, a new battery or any part of a new battery assembly which is proven to the satisfaction of SBS to have been defective at the time it was sold and which defect is found within **1 year** from the date of shipment to the original Purchaser provided that SBS is notified within 15 days of the said determination of the defect. Thereafter, and for a remaining period of **19 years**, SBS agrees that if the battery fails to deliver 80% of its published rated capacity in Ampere Hours at the 8 hour rate of discharge when tested under supervision, SBS may at its sole option, either repair the battery at its expense (excluding freight), or credit to the Purchaser (against the purchase of another SBS battery of equal or greater AH capacity) an amount equal in dollars to the net purchase price of the original battery, multiplied by the months of undelivered life, divided by the total number of months of expected life as out above.

No warranty expressed or implied applies to a battery which, after shipment from SBS has been altered, changed, repaired, treated in any manner by anyone other than SBS, or service personal authorized by SBS or which has performed a duty cycle at any time improper for its size, design or capacity or in excess of the duty cycle agreed upon by SBS and the Purchaser, or which has been subjected to misuse, ambient temperatures higher than 85°F*, extreme heat or cold, abuse or physical damage other than ordinary wear and tear. The warranty only applies to batteries with regard to which a SBS representative has had right-of access for purposes of inspection, at reasonable hours and intervals.

The Purchaser shall indemnify and save harmless SBS from any claims and liabilities arising out of the use, maintenance, transportation or installation of any equipment warranted hereunder.

This warranty is the only warranty either express, implied or statutory, under which the said battery is sold, the Company's liability in connection with this transaction is expressly limited to the repair, replacement, or credit of equivalent value expressed herein, and all other guarantees and warranties, statutory, legal or otherwise, except as may be compulsory applicable, and any claim for damages, are hereby expressly waived by the Purchaser.

This warranty applies only to the original user of the battery. No warranty of any nature whatsoever applies to any other user or purchaser of the battery.

*Batteries used in high temperature application, 85°F or above, are warranted using the following formula which prorates the prorated warranty period.

The following is an example of the calculation of the Prorated Warranty (PW) of a battery operated under elevated temperature conditions that had a Design Life (DL) of 20 years at 77°F.

Prorated Warranty = derating factor at Operating Temperature (DT) x Design Life (DL)

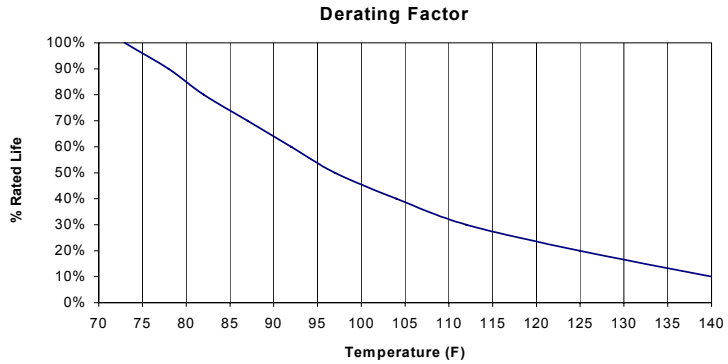
$$PW = \frac{\text{Design Life (Months)}}{\frac{\text{Time@ T1}}{DT1} + \frac{\text{Time@ T2}}{DT2} + \frac{\text{Time@ T3}}{DT3} + \frac{\text{Time@ T4}}{DT4}}$$

Operating Conditions:

Temperature (°F)	Months % of Life @ Temp.	DT
77° or below	7	100
80°	2	89
85°	2	75
95°	1	50

PW= 240 Months÷ [(7 Months/1.00) + (2 Months/0.89) + (2 Months/0.75) + (1 Month/0.50)]
PW= 240 Months÷ (7 Months + 2.25 Months + 2.67 Months + 2 Months)
PW= 240÷13.92= 17.241 years
Actual life expected (LA) = de-rating factor at operating temperature (DT) x design life (DL)

Prorated warranty=



Specifications subject to change without notification.