SEC FLOODED BATTERIES

TUBULAR PLATE
SEC 'T' RANGE - OPzS

STATIONARY BATTERIES

INSTALLATION and OPERATING

INSTRUCTIONS

Supplied Worldwide by :

SEC Industrial Battery Co.

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SECTION 1 - GENERAL INFORMATION

The SEC flooded Tubular series of batteries consists of the following types:

SEC TB-Bloc
SEC T-Range

*The SEC '**T'** series of batteries are **Tubular** low Antimony positive plate cells designed specifically for float service installations where cyclic discharges may occur. These cells are designed for performance reliability and long life 15+ years in stationary applications.*

SECTION 2 - SAFETY INFORMATION

2.1 General Information

Lead acid batteries require care in installation and maintenance. Unsafe installation or maintenance procedures can cause severe injury or death. Electrical shock or burns, acid burns and fire can result if proper safety precautions are not followed. These precautions apply to all battery installation and maintenance work.

For more information study the following sections.

(1) Always wear rubber apron, gloves and safety goggles or face shield when handling, installing or working with wet flooded batteries. This will help prevent injury due to splashing or spillage of sulphuric acid.

(2) 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 can explode, causing injury to personnel and damage to cells.

(3) Never place metal tools on top of cells since sparks due to shorting across cell terminals may result in an explosion of hydrogen gas. Insulate tool handles to protect against shorting.

*(4) When preparing electrolyte, **always pour acid into water - never pour water into acid.***

CAUTION: Never pour water into acid. Failure to follow this precaution may result in dangerous splashing which can cause serious injury to personnel.

(5) If electrolyte comes into contact with skin or clothing, immediately wash with water and neutralize with a solution of 0.5 kg baking soda in 4 litres of water. If electrolyte comes into contact with the eyes, wash or flush with plenty of clean water. Seek medical treatment immediately.

(6) Exercise care when handling cells. When lifting straps and strap spreaders are provided, use them with appropriate mechanical equipment to safely handle cells and avoid injury to personnel and damage to cells.

(7) Promptly neutralize and remove any electrolyte spilled when handling or installing cells.

(8) Ensure that all battery connections are properly made and tightened to prevent possible injury to personnel or failure of system.

(9) Familiarize personnel with battery installation, charging and maintenance procedures. Restrict access to battery area, permitting trained personnel only, to reduce the possibility of injury.

(10) Whenever possible when making repairs to charging equipment and/or batteries, disconnect AC/DC circuits to reduce the chance of injury to personnel and damage to system equipment.

CAUTION: If the above precautions are not fully understood, do not proceed with the installation or maintenance. Contact your SEC agent to obtain clarification of details not understood.

2.2 Sulphuric Acid

The SEC flooded batteries are lead acid batteries and contain sulphuric acid in diluted form. In the event of a container rupture, liquid acid will leak or run from the battery.

CAUTION: Sulphuric acid can cause burns and serious injury if it comes in contact with your skin or eyes. In the event of contact with sulphuric acid, flush thoroughly with water and neutralize any residual acid with baking soda (0.5 kg in 4 litres of water). Seek medical attention immediately. Do not handle batteries if the container has been ruptured except while wearing rubber gloves. Do not try to disassemble a cell.

2.3 Gassing

*All lead acid batteries emit some gases during charging and float operation. Flooded batteries release all the gases produced therefore **never charge or use batteries in an unventilated space.** This gas consists of mostly hydrogen gas and can explode if ignited in a confined area or space. Keep sparks, flame or any other ignition source (including smoking materials) away from batteries.*

CAUTION: Hydrogen gas can explode and cause serious injuries and fire. Do not allow any flame or ignition source near batteries. Always allow ventilation around operating batteries. Contact SEC if there are any questions regarding gassing or ventilation.

2.4 Electrical Shocks

Batteries store large amounts of electrical energy. Even a discharged battery can deliver a high short circuit current. Keep all metallic objects away from the battery terminals. Multi-cell systems can attain lethal voltages. Remove all jewelry before working on batteries. Cover all tools with vinyl electrical tape to minimize the possibility of shorting a battery during installation. Never lay tools or other metallic objects on batteries. Do not allow construction work over batteries to proceed unless the battery is protected by insulating rubber mats.

CAUTION: Shorting a battery can cause serious injury, fire or explosion. do not attempt to work on a battery unless you are familiar with battery installation procedures and have adequate safety information and equipment. Read this manual thoroughly before attempting to install the battery. if there are any questions about safety, contact SEC before installing the batteries.

REMEMBER: Safety is always the prime concern.

SECTION 3 - RECEIPT OF EQUIPMENT

3.1 Delivery Inspection

Immediately upon delivery, inspect the modules for damage caused in transit. Damaged packing material or staining from leaking electrolyte may indicate rough, or improper handling in transit. Describe in detail (and take photographs if necessary) any damage on the delivery receipt before signature. If any damage is found, contact the carrier immediately, request an inspection and file a damage claim.

3.2 Hidden Damage

Within 10 days of receipt, inspect all cells for hidden damage. Measure and record open circuit voltages (OCV's). Examine cells for container damage, misaligned elements, broken plates or any other visible damage.

If any damage is found, request an inspection by the carrier and file a hidden damage claim. Do not delay this step as it may result in a loss of right of reimbursement for hidden damages.

SECTION 4 - STORAGE

4.1 General

Do not store batteries outside, exposed to the elements. Store indoors in a cool, dry location. Do not store batteries in temperatures over 30ºC. The recommended storage temperature is 20ºC or less. Do not stack pallets, or allow any other material to be stored on top of the pallets or possible battery damage may occur. Do not store where the possibility of metallic objects falling on the battery may occur.
SEC flooded batteries are often shipped 'dry charged' from the factory. Do not remove the transport cell plugs until the cells are ready to be filled with acid. Dry charged batteries may be stored at 20C for up to 3 years.

SECTION 5 - GENERAL INSTALLATION PROCEDURES

CAUTION: Before attempting to install any SEC flooded batteries, study this section and the section on safety thoroughly. Failure to do so could result in personal injury and battery or equipment damage.

5.1 Battery Location.

5.1.1 Temperature

Battery location is very important in determining life and performance of the battery. The ideal environment would be a dry, indoor, temperature regulated area. The ideal operational temperature is 20ºC.

Operation at temperatures below this will result in a loss of battery performance and may result in a larger, more costly battery being needed. Operation at temperatures above 20ºC will result in loss of battery operational life. For every 8ºC rise in battery temperature above 20ºC, the life of the battery will be cut in half.

5.1.2 Temperature Variation

Maintaining temperature balance across the string is very important for maximum battery life. The difference between the maximum and minimum block temperature in a series string can be no more than 3ºC. Excessive temperature variation will result in the need for equalization and may result in loss of battery operational life.

Sources of battery temperature variation can be placement of the battery system near a heat source such as radiators, power equipment, windows or heating vents. Air conditioning vents can also cause temperature variations. It is recommended that the battery location be designed, engineered and monitored to minimize temperature variations. Seek assistance with battery room design from SEC if needed.

5.1.3 Ventilation

Proper ventilation of SEC flooded batteries is important for two reasons:

1) to minimize battery temperature variation and

2) to minimize build up of potentially explosive hydrogen gas.

5.1.3.1 Ventilation and Battery Temperature Variation

Proper ventilation is important to remove this heat and to prevent temperature differences from arising in the string. Sufficient air circulation should be present to prevent temperature layering effects. In an improperly designed room, there can easily be a 5ºC difference in temperature between the floor and the ceiling. If this difference exists in a series string, it will result in a need for equalization and in reduced battery life.

5.1.3.2 Ventilation and Gassing

As noted, lead acid batteries emit small amounts of gas during normal charging and floating. The gas composition, while on float, is approximately 80% by volume hydrogen with the remainder being oxygen.

CAUTION: Hydrogen gas can be explosive. Never install batteries in an air-tight space. Ventilation must be provided to remove this hydrogen gas.

5.1.4 Floor Loading

Before installing the racks/stands, it should be ascertained that the floor has the capability to support the weight of the battery and related equipment. The total system weight will be the sum of the modules plus 5% for the battery connectors and other components. ***Note: It is the responsibility of the installer to ensure adequate floor load carrying capabilities.***

5.2 Electrical Connections

Proper battery electrical connections are very important for the best battery performance and utility. Improper battery connections can cause a loss of standby time or even a battery fire. Follow the electrical connection instructions carefully and review Section 2.4 thoroughly before working on the battery.

CAUTION: Remove all jewelry and watches before installing the connectors on the batteries. Ensure that all tools are insulated with vinyl electrical tape to prevent shorting. Do not reach or lean across batteries. Remember, hazardous voltages may be

present. Be aware of what you are touching at all times.

2.1 Cabling Recommendations

Battery ratings are specified at the terminals of the battery. The cabling used to connect the battery terminals to the load has a voltage drop (when the battery is discharging) that is dependent on cable length and conductor size. The longer the cable run, the greater the voltage drop. The smaller the cable wire diameter, the greater the voltage drop. Therefore, to get the best performance from the battery short, heavy cables are recommended.

Do not size the cables based on current carrying capacity only. A general rule of thumb is to allow no more than a 30 mv of voltage drop per metre of cable run. As an example, if it is 10 metres from the battery to the load, the cable should be sized to allow no more than 2 x 10 x .030 = 0.6 volt drop.

In order to help select cable sizes for load connections, the following table should be consulted :

CABLE PROPERTIES AT 20ºC

U.S. CABLE SIZE	*AREA mm²*	*MAX AMPS 30mv DROP/M*
8 AWG	*8.4*	*15*
6	*13.3*	*23*
4	*21.2*	*37*
2	*33.6*	*59*
1	*42.4*	*74*
0	*53.5*	*93*
00	*67.4*	*117*
000	*85.0*	*148*
0000	*107.2*	*187*
250 MCM	*126.7*	*221*
350 MCM	*177.4*	*309*
400 MCM	*202.4*	*353*
500 MCM	*253.4*	*442*

Use 1.74 amps/mm² for other cable sizes.

5.3 Rack Assembly

To assemble the racks, proceed as follows :

(1) Carefully examine the layout drawing supplied with the battery system. If there are any questions on how the rack is assembled, contact your SEC representative for further information.

(2) Assemble the cross-pieces and girders with the long bolts. After tightening the long bolts, putty up the holes (wooden racks only).

(3) Place the assembled racks in the exact location where the battery is to be erected. Maintain a minimum of 50 mm between the stand and the wall.

(4) Place the insulating plates and insulators under the cross-pieces.

(5) Level the stands on the insulators. If a difference in level is found, put plastic or steel shims between the upper part and the lower part of the insulators.

(6) Align the racks, insulators and insulating plates.

5.4 Cell / Bloc Placement

Before placing the cells or Monobloc on the racks, ensure that they are not damaged. Also, ensure that the cells are clean and dry.
DO NOT LIFT CELLS BY THEIR TERMINALS.

(1) Carefully place the cells or Monobloc on the racks. Start by placing the cells or Monobloc in the middle of the lowest tier first. This will ensure stability of the rack. Care should be taken that the cells or blocs are alternated in polarity (positive to negative).

(2) Position the cells or Monobloc 10 to 15mm apart and align them.

(3) Carefully clean the cell posts and connectors. Use a brass bristle brush or a "Scotch-brite" pad. Take care not to remove the plating on the connector. Apply a thin layer of antioxidant grease (supplied) to the terminal posts, connectors, bolts, nuts and washers.

(4) Again, check that the cells have been connected in the proper sequence. The positive post(s) of one cell must be connected to the neighboring cell's negative post(s).

(5) Carefully place the connectors on the posts and gently insert the bolt. The connector must be in direct contact with the terminal post. Finger tighten the nuts on the bolts. Install all the connectors before final tightening and before torquing.

(6) Connect the straps between the rows and the battery terminals. Ensure that the cells or Monobloc are still aligned on the racks.

(7) Torque the bolts to 2mkg (175 in-lbs) for the M8 bolts and 0.8 mkg (70 in-lbs) for the M6 bolts.

(8) Using a brush lightly re coat the bolts and nuts with grease.

(9) Apply the self-adhesive numbers to the cells or Monobloc. Cell number "1" will always be the positive terminal of the battery string. Number all cells.

(10) Connect the battery to the charger. Connect the positive terminal of the battery to the positive terminal of the charger and the negative terminal of the battery to the negative terminal of the charger.

5.5 Prepare Acid

Prepare the sulphuric acid in accordance to B.S. 3031 or VDE 0510 to a specific gravity of 1.240 ±0.005 at 20ºC for tubular cells. If starting with concentrated acid, it should be diluted in deionized or distilled water.

Use containers of heavy plastic, earthenware, hard rubber or lead lined wood. Do not use other metal containers. Use only clean containers and mixing tools. Wear protective clothing and eye protection at all times.

While continuously stirring the water, cautiously pour the acid into the water a little at a time. The solution will get warm.

CAUTION: Never pour water into concentrated acid, always pour acid into water.

Dangerous splashing could result.

Allow the hot acid to cool to room temperature and check the specific gravity (See 5.5.1) of the mixed acid. Correct if necessary by adding acid or water. Stir well after each addition. As soon as the acid has cooled to room temperature and it is the correct specific gravity, it can be used for filling the cells.

5.5.1 Correcting Specific Gravity Readings

When checking the acid specific gravity, it must be referenced to 20ºC for Tubular plate cells. If the acid temperature deviates from this temperature, correct it to reference temperature by adding 0.002 for every 3ºC above or subtracting 0.002 for every 3ºC below the reference temperature. See the table below for the uncorrected specific gravity readings at various temperatures.

		Tropical Climate		DIN Standard
C	F	Nom. 1.215	Nom. 1.220	Nom. 1.240
- 15	5	1.236	1.241	1.261
- 10	14	1.233	1.238	1.258
- 5	23	1.230	1.235	1.255
0	32	1.227	1.232	1.252
5	41	1.224	1.229	1.249
10	50	1.221	1.226	1.246
15	59	1.218	1.223	1.243
20	**68**	**1.215**	**1.220**	**1.240**
25	77	1.212	1.217	1.237
30	86	1.209	1.214	1.234
35	95	1.206	1.211	1.231
40	104	1.203	1.208	1.228

The above values should be the measured specific gravity at the listed temperatures with the electrolyte level at the "MAX" line.

5.5.2 Filling the Cells

Before filling the cells, ensure that the mains supply will be available. Use plastic funnels. Do not allow any contamination to get into the acid. Remove the transport plug just before filling the cell. Fill the cell to the "MAX" level line and install the flame arresting vents on each cell.

5.6 Initial Charge

The first charge must commence between 1 and 2 hours after filling the last cell. Measure the voltage of the cells on open circuit before charging. The total string voltage should be the average of the cells multiplied by the number of cells. If the calculated string voltage does not match the measured string voltage, recheck the positive and negative connection of the battery.

The charge current should range from 2.5% to 4.0% of the nominal AH capacity of the battery. Ensure that the chosen charge current is maintained throughout the complete first charge. The first charge time is equal to the nominal AH capacity of the battery divided by the average charge current.

During the first charge, the electrolyte temperature should be monitored and not allowed to rise above 45ºC. If the electrolyte temperature is approaching 45ºC, the charge current should be reduced. In a high ambient temperature it may be impossible to charge the battery and not exceed 45ºC, therefore an absolute maximum temperature of 50ºC can be tolerated for a short period of time. If the temperature exceeds 50ºC the charge must be stopped and the battery allowed to cool. Ensure that adequate ventilation is present during the first charge.

During the first charge, the electrolyte specific gravity should also be monitored. The specific gravity will decrease immediately after filling the cells. At the start of the charge, the gravity will cease to fall and eventually start to rise. (Make sure the SG values are temperature corrected). When the specific gravity has stopped rising and remains constant for at least three hours, the battery is fully charged. The observed specific gravity values will be 0.010 to 0.020 above the filling acid gravity.

The cell voltages should also be monitored during the first charge. Initially, the cell voltages should all be over 2.0 volts and slowly rise to 2.6 to 2.7 volts at the end of the charge. The minimum volts per cell at a constant current of C/20 (where C is the nominal AH capacity) will be 2.6 volts / cell @ 20ºC.

The voltage measurement also has to be corrected for electrolyte temperature. As the temperature rises, the voltage decreases, therefore add 0.005 volts / cell / ºC (from a 20ºC baseline) to obtain the equivalent 20ºC voltage.

At the end of the initial charge, all plates in all the cells must be gassing freely. When the battery meets the above conditions of specific gravity, voltage and gassing, the initial charge is complete.

5.7 After the Initial Charge.

Allow the battery to cool to room temperature. Check the specific gravities of all the cells. If the electrolyte levels in all cells are similar and care was taken in filling the cells, the specific gravities should all be within ±0.005 or each other.

If the electrolyte levels differ, add filling acid to the low cells up to the value of the cell having the highest level. Boost charge the battery. See Section 6.4. Recheck the specific gravities.

The obtained specific gravities should be :

Tubular – DIN Standard 1.240 ±0.005 at 20ºC
Tubular – Hot Climate 1.220 ±0.005 at 20ºC

If the obtained specific gravities do not fall in the above range they must be adjusted. If the gravities are too high, electrolyte must be removed and replaced with distilled or deionized water to lower the SG. If the obtained gravities are too low, electrolyte must be removed and replaced with acid of a greater specific gravity. After the corrections, boost charge the battery again and recheck the specific gravities. Top off the cells to the maximum level using filling acid.

Neutralize any spilled acid and wipe the cells dry. Ensure that the flame arresting vents are in place. Place the cells on the proper float charge.

Section 6 - OPERATION

6.1 Float voltage

The float voltage is sometimes known as the continuous charge voltage. It is very important that it be calculated and

set properly for maximum battery life and performance. The purpose of the float voltage is to provide enough float voltage and current to the battery to compensate for self-discharge and maintain the battery in a fully charged condition of readiness.

Failure to properly follow float voltage recommendations can result in loss of warranty and premature battery failure.

6.1.1 Float Voltage Requirement

The allowable float voltage range for the SEC flooded Tubular batteries is 2.17 - 2.25 volts / cell @ 20ºC. The recommended float voltage setting is 2.23 volts / cell. If float voltages less than 2.20 volts per cell will be used, periodic equalize charge will be required.

6.2 Equalize Charge

Equalize charging is a temporary increase in the charge voltage that can: (1) reduce recharge times after a discharge or (2) reduce cell-to-cell float voltage variation when floating at voltages below 2.20 volts per cell. The standard equalize charge is a charge at 2.33 to 2.40 volts per cell for 15 to 24 hours or longer if the cells have been floating at low voltage or temperature for a long time.

An equalize charge is needed if any cell has a float voltage more or less than 0.030 volts from the average cell voltage.

6.3 Boost Charge

A boost charge is an additional charge which is applied to a normally charged battery in order to bring all the cells to their maximum full charge state. A boost charge may be used to mix the electrolyte after the addition of water or to destratify the battery. Boost charging does overcharge the battery so it should not be done unless needed. The boost charge is performed by constant current charging the battery with a current of C/20 to C/30 until uniform gassing occurs in all cells and voltages and specific gravities have stabilized.
See Section 5.5 for more information on voltages and specific gravities.

Section 7.0 - MAINTENANCE AND RECORD KEEPING

Proper maintenance and record keeping is critical to battery life and warranty continuance. The cell float voltages and specific gravity (SG) must be recorded at the time of installation and at least every 6 months thereafter. Proper maintenance will ensure that the batteries are being correctly used and will be available when needed. Proper record keeping will ensure that, if there is a problem with a battery, the customer can demonstrate the batteries were correctly used and so maintain the warranty.

7.1 General Maintenance

General maintenance of the battery means keeping the battery and surrounding area clean and dry. It also means a general inspection of the battery, cell terminals and battery room. Do not allow excessive dust to accumulate on the battery and always check that all flame arresting vents are in place and tight. Do not allow acid to be left on the cell cover. Acid on the cover may lead to erratic float voltages and shortened battery life.

Do not use any solvents or strong cleaners on or around the batteries. A dry brush may be used to remove any dust accumulations. If required, a solution of 1 kg of baking soda in 4 litres of water may be used as a multipurpose cleaner if more stubborn stains or dirt accumulations are present on the battery.

7.2 Specific Maintenance

Select 1 out of every 20 cells to be pilot cells. A pilot cell is a cell that is checked on a regular basis to gauge the condition of the battery string.

7.2.1 Monthly Maintenance

On pilot cells only :

(1) Check acid levels. The levels should be between the "MIN" and "MAX" level marks on the container.
(2) Measure the specific gravity.
See Section 5.6 for desired values.
(3) Measure cell float voltages.
(4) Measure the battery string voltage.

7.2.2. Six-Monthly Maintenance

(1) Measure and record specific gravity on all cells.
(2) Measure and record float voltages on all cells.
(3) Measure and record battery string voltage.
(4) Gently clean the cells, if needed.
(5) Add water to the cell "MAX" level. Record the amount of water added.

7.2.3 Yearly Maintenance

In addition to the maintenance performed every six months (Section 7.2.2.) :

(1) Perform an equalizing charge, if necessary.
(2) Clean the rack and the insulators
(3) Retorque intercell connectors.

CAUTION: only use insulated tools.

7.3 General Records

7.3.1 Installation Records

When the battery is first received, record such things as :
- *Date of receipt,*
- *Condition of the battery,*
- *Open circuit voltages (if measured)*
- *Date of installation*
- *Original P.O. number*
- *Installer (s)*
- *Ambient Temperature,*
- *Any unusual storage conditions.*

7.3.2 Maintenance Records

In addition to the six-monthly maintenance checks, record the following:
- *Float current*
- *Ambient temperature*
- *Battery temperature*
- *Battery conditions*
- *Any unusual charges or discharges in the last 6 months.*

Keep the above records in a safe place for review by maintenance personnel. Remember, these records are mandatory for any warranty claim on the battery.

Section 8 - STORAGE

When installed SEC flooded batteries will not be used (floated) for a period of time, the following procedure should be followed:

1. Equalize charge the battery (refer to Section 6.2).
2. Disconnect the battery from all loads. Do not allow any loads, no matter how small, to remain connected.
3. Equalize charge the battery every 3 months when the storage temperature is 20ºC or less. For every 8ºC rise in storage temperature, reduce the equalization interval by half.
4. Perform an equalization charge on the battery prior to returning to service.

During the storage time, particularly if it is extended, it is recommended to continue to monitor and record battery voltage levels. Measure and record the battery open circuit voltage just before equalization and then record the on-charge voltage and current just prior to completing the charge.

Section 9 - CAPACITY TESTING

9.1 General

Discharge testing of the battery is performed to determine the battery capacity. There are two reasons for performing this test:

(1) A ratings test discharge - the intention here is to determine the percent of battery capacity as compared to the rated capacity. This is typically an 8 or 10 hour discharge test. When a ratings test is being performed, the load current or power must be temperature corrected if the battery temperature is significantly different from 20ºC.

The capacity correction factor for SEC flooded batteries is 0.6% per degree C from the 20ºC reference temperature. The formula for calculating the corrected load is :

Temperature corrected load = load at 20ºC x CF, where CF is the capacity correction factor for temperature. The following table should be used :

Test Temperature ºC	ºF	Battery Capacity (%)	Correction Factor (CF)
-15	5	73	0.73
- 10	14	78	0.78
- 5	23	83	0.83
0	32	88	0.88
5	41	91	0.91
10	50	94	0.94
15	59	97	0.97
20	**68**	**100**	**1.00**
25	77	103	1.03
30	86	106	1.06
35	95	109	1.09
40	104	112	1.12

If the service test is being performed, no temperature correction is necessary.

(2) A service test discharge - this test is to determine the battery standby time under the actual load conditions of intended battery usage. The ratings test discharge is usually performed using a suitably designed and sized load bank to provide a constant current load to the battery. The test is performed for the specified period of time to an end-point voltage per cell (usually 1.75 or 1.80VPC) with the ampere hour capacity of the battery calculated by multiplying the load current by the number of hours of run time. The actual AH capacity can be compared to the rated AH capacity to determine percentage capacity. This type of test is usually used as an acceptance test of the battery.

The service test is usually performed by placing the actual load on the battery and determining the actual time the battery will support the load. This test is done, in the case of a UPS, by switching into test mode where the battery becomes the primary source and the normal AC line becomes the back-up. If the load is not critical, the AC input can simply be shut off to simulate a loss of power event and total system operation can be verified as well. A load bank can be used if the normal battery load is well defined.

9.2 Test Procedure

The battery test procedure for either test is :

(1) Ensure the battery is fully charged before capacity testing and that all connections are clean and tight. An equalization charge is highly recommended before performing a capacity test and is mandatory if the battery has not been on continuous float charge for at least one week or if there is any questions about the battery's state of charge. After the equalization charge, return the battery to float charge and allow at least 1 hour to stabilize.

(2) Prepare the load bank or test load system. Ensure all temporary cable connections are: secure, connected to the proper polarity, and have sufficient current carrying capacity.

(3) Determine the battery temperature by measuring and recording the temperature of every 6 cells. Use this to determine average battery temperature. Measure battery temperature by placing a thermometer in the cell vent. Do not allow the thermometer to drop into the cell.

(4) If a ratings test is being performed, the load current or power must be temperature corrected if the battery temperature is significantly different from 20ºC. (Refer to Section 9.1 - item 1).

(5) Just prior to starting the discharge test, measure and record the individual cell voltages, the string voltage and float current (if available).

(6) Remove or disconnect the charger from the battery string.

(7) Connect the load to the battery and start a timer. Monitor the string voltage and record the lowest voltage reached and the time reached.

(8) Record the load current, string and individual cell voltages on a regular basis. A minimum of three sets of readings should be taken. The time interval between sets of readings will vary based on the expected test time. For example, take readings every hour for the first 4 hours of an 8 hour rating test. For the following 3 hours take readings every ½ hour. For the last hour, take readings every 15 minutes. For a 15 minute UPS discharge, readings every 5 minutes would be desirable.

(9) Continue the discharge until the string voltage drops below the end-point voltage per cell times the number of

cells in the string. For example: 1.75 VPC x 60 cells = 105.0 Volts is the stop discharge voltage.

(10) Stop the timer and remove the load from the battery.

(11) Recharge the battery using the existing charger or an external charger. An equalize voltage may be used to reduce the charge time.

(12) Record the discharge time and calculate percentage capacity if a ratings test was performed.

(13) Keep a copy of all the test data with the battery records.

9.3 Discharge Test Notes:

(1) When batteries are new, the battery may deliver only 90% of rated capacity. Full capacity will be obtained after 3-6 months in float service.

(2) String voltage should be measured at the battery terminals, not at the load connections.

(3) Accurate meters are essential for correct test results. Ensure all meters, shunts, etc., have been properly calibrated within the last six months before use.

(4) If a long duration test is being performed, the terminal to terminal voltage drop across the intercell connections should be measured and recorded. This will serve as a reference for any needed terminal maintenance work and will assist in verifying the battery integrity.

(5) A float voltage check after the test and recharge is desirable, but not required information.

CELLS COVERED BY THIS MANUAL

SEC Type	***DIN Type***
SEC T5-05	*2 OPzS 100*
SEC T5-07	*3 OPzS 150*
SEC T5-09	*4 OPzS 200*
SEC T5-11	*5 OPzS 250*
SEC T5-13	*6 OPzS 300*
SEC T7-11	*5 OPzS 350*
SEC T7-13	*6 OPzS 420*
SEC T7-15	*7 OPzS 490*
SEC T10-13	*6 OPzS 600*
SEC T10-17	*8 OPzS 800*
SEC T10-21	*10 OPzS 1000*
SEC T10-25	*12 OPzS 1200*
SEC T12-25	*12 OPzS 1500*
SEC T12-29	*14 OPzS 1750*
SEC T12-31	*15 OPzS 1875*
SEC T12-33	*16 OPzS 2000*
SEC T12-37	*18 OPzS 2250*
SEC T12-41	*20 OPzS 2500*
SEC T12-49	*24 OPzS 3000*

SEC BATTERY MAINTENANCE REGISTER

Date	Maintenance Description

SEC
Industrial Battery Co.

SEC
Industrial Battery Co.

11 TECHNICAL SUPPORT

SEC is always ready to assist you in your installation and operation of SEC ***Tubular Plate Flooded OPzS Range*** *batteries. If you have any questions on any portion of this manual, please do not hesitate to call or fax any of our offices listed below and request assistance.*

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Iver, Bucks, SLO 9AQ,
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Fax.: 44-1895-431880
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Email:brian.harper@secbattery.com

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Tel.: +33 675 590 692
SEC Website: www.secbattery.com
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SEC Industrial Battery Co. BSC
P.O. Box 32225,
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Tel.: 97317-721322
Fax.: 97317-740743
SEC Website: www.secbattery.com
Email: sujo.pulikottil@secbattery.com

SEC Industrial Battery Co. Ltd.,
Unit 6, 6F Hewlett Centre,
No.54 Hoi Yuen Road, Kwun Tong
Kowloon, Hong Kong.
Tel.: 852-230 44382
Fax.: 852-230 44013
SEC Website: www.secbattery.com
Email: duncan.low@secbattery.com

SEC BATTERY REPORT

Installed by: _____ Representative: _____

Operating Company: _____ Date: _____ Time: _____

Address/Location: _____

Battery Information

Type of Battery: _____ No. of Cells/String: _____ String Float Voltage: _____

Installation Date: _____ No. of Strings/Battery: _____ Float Voltage/ Cell: _____

Battery Charge Current: _____ Battery Code: _____ Float Current: _____

Charging Equipment: _____ Ambient Temperature: _____ Cell Temperature: _____

Battery Charger Information

Make _____ Type _____ Current rating _____

Model _____ Year of manufacture _____ Charging voltage _____

INDIVIDUAL CELL READINGS

Cell/ Unit No.	Open Circuit Voltage	Float Charge Voltage	Cell/ Unit No.	Open Circuit Voltage	Float Charge Voltage	Cell/ Unit No.	Open Circuit Voltage	Float Charge Voltage	Cell/ Unit No.	Open Circuit Voltage	Float Charge Voltage	Cell/ Unit No.	Open Circuit Voltage	Float Charge Voltage
1			26			51			76			101		
2			27			52			77			102		
3			28			53			78			103		
4			29			54			79			104		
5			30			55			80			105		
6			31			56			81			106		
7			32			57			82			107		
8			33			58			83			108		
9			34			59			84			109		
10			35			60			85			110		
11			36			61			86			111		
12			37			62			87			112		
13			38			63			88			113		
14			39			64			89			114		
15			40			65			90			115		
16			41			66			91			116		
17			42			67			92			117		
18			43			68			93			118		
19			44			69			94			119		
20			45			70			95			120		
21			46			71			96			121		
22			47			72			97			122		
23			48			73			98			123		
24			49			74			99			124		
25			50			75			100			125		

Remarks and Recommendations: _____

_____

_____

_____

_____

_____

SEC
Industrial Battery Co.

Signed: _____

SEC
Industrial Battery Co.