CELLYTE 2TLAM AGM
Modular & Tubular

STATIONARY BATTERIES
Fitted with Catalyst

INSTALLATION and OPERATING INSTRUCTIONS

Supplied Worldwide by :

SEC Industrial Battery Co

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SECTION 1 - GENERAL INFORMATION

1.1 CELLYTE 2TLAM Modular/Tubular Battery Characteristics

The CELLYTE 2TLAM Modular/Tubular battery fitted with Catalyst is a sealed, valve-regulated lead-acid recombinant, low maintenance battery designed for stationary or cycling applications. This type of battery has no special ventilation or handling requirements. Because the electrolyte in the battery is immobilized, the batteries are considered dry and can be handled and shipped accordingly.

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.

The following precautions apply to all battery installation and maintenance work. For more information see the following sections.

- *Disconnect all power before attempting to install, remove or perform maintenance work on batteries. When on-charge float voltages must be measured, be particularly careful because shorting a battery at this time can cause not only personal injury, but severe equipment failure as well.*

- *Do not tamper with any parts of the battery, including cover, vents, terminal covers etc.*

- *Keep batteries clean and dry. Use ½ kg of baking soda in 4 litres of water to neutralize any possible acid. Do not use cleaners or solvents on any part of the battery. Do not allow excessive dust to accumulate on the battery or cabling.*

- *Keep battery connectors clean, greased and tight. A loose connection can reduce battery standby time and cause battery fires.*

WARNING Do not turn batteries up side down or tilt to the front more than 30° as this will 'wet' the vent with electrolyte which will be vented when the cell is charged.

2.2 Sulphuric Acid

The CELLYTE 2TLAM Modular/Tubular battery is a lead acid battery and contains sulphuric acid in diluted form. Because the electrolyte is immobilized, in the event of a container rupture, no liquid acid will leak or run from the battery. However, if the internal components of the battery are touched or handled, contact with the acid will result.

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 (1 kg in 4 liter's 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. Conventional flooded batteries release all the gases produced to the environment whereas sealed, valve-regulated batteries re-combine most of the gases internally, releasing very little to the environment. Compared to a flooded battery of equal capacity, a CELLYTE 2TLAM Modular/Tubular battery releases a gas volume of 1% or less than the flooded battery. Because of this characteristic, no special ventilation is required under normal usage conditions.

Because some gas is released from lead acid batteries, ***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 some 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 pallets could indicate rough, 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, measure and record open circuit voltages (OCV's). 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.

4.2 Short Term Storage

CELLYTE 2TLAM Modular/Tubular batteries are shipped fully charged from the factory. If the batteries are to be stored 6 months or less at 20-25ºC or less before being put into service, nothing need be done at this time. If the batteries are to be stored longer than 6 months, at temperatures greater than 25ºC, or installation is delayed beyond expected time, a storage charge may be required. A storage charge is an equalizing charge applied to a battery that is stored in open circuit (not float charging) condition. See Section 6.5 for details.

If the storage temperature is 20ºC or less, CELLYTE 2TLAM Modular/Tubular batteries must be charged at least every 6 months while in storage. For every 8ºC increase above 20ºC, the storage time between charges is cut in half. Therefore, at 28ºC the maximum storage time is 3-4 months. At 24ºC the maximum storage time would be 4-5 months.

Storage of batteries beyond the recommended temperatures or storage times, without charging, can result in loss of capacity, cell shorting and loss of float life. It can also void the battery's warranty. Keep careful records of battery time of arrival, storage time and when last charged.

SECTION 5 - GENERAL INSTALLATION PROCEDURES

CAUTION: Before attempting to install CELLYTE 2TLAM Modular/Tubular 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, indoors, 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 expectancy of the battery will be cut in half. For example, the CELLYTE 2TLAM Modular/Tubular battery is designed for a 15 year float service life at 20ºC. If the battery were to be continuously operated at 28ºC, the life expectancy would be halved.

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 cell temperature in a series string shall not be 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.

5.1.3 Ventilation

Proper ventilation of CELLYTE 2TLAM Modular / Tubular 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

Recombinant batteries such as CELLYTE 2TLAM Modular/Tubular give off a small amount of heat during charging and float operations. 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. Allow about 1 litre per hour per cell of air exchange to prevent hydrogen accumulation.

NOTE: In virtually all cases, the amount of air circulation required for battery cooling and temperature variation maintenance will far exceed the amount of air circulation required to prevent gas build-up. However, ensure some air exchange is present in the ventilation.

5.1.4 Floor Loading

Before installing the modules, 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. It is the responsibility of the installer to ensure adequate floor load carrying capabilities.

5.1.5 Seismic Considerations.

CELLYTE 2TLAM Modular/Tubular batteries are capable of withstanding seismic events of UBC Zone 4 magnitude in horizontal stacks of up to 8 modules high and when properly installed. When seismic capability is desired, suitable floor anchoring should be provided. Proper floor anchoring is the responsibility of the installer. Ensure that the anchors used are of sufficient strength to withstand the maximum seismic load foreseeable.

5.2 Unpacking

CELLYTE 2TLAM Modular/Tubular batteries are shipped on pallets with cells / modules in the horizontal position. All the accessories needed for installation and use are packed in boxes and shipped on top of the modules or on a separate pallet. Unpack all items carefully and note the quantities received.

5.3 ***Installation***

5.3.1 General

Note: The lifting slings / straps provided are designed to lift one module at a time never attempt to lift more than one module at a time or you will damage the module.

CELLYTE 2TLAM Modular/Tubular modules types 2TLA500S and 2TLA800S are designed to be stacked in the horizontal position. Modules are configured to provide the termination at the top of the battery while providing the shortest possible connections. When a system requires fewer cells than are needed to completely fill all modules, the extra spaces will be filled with a dummy cell(s). Place the modules with the dummy cells at the top of the stack.

CELLYTE 2TLAM Modular/Tubular when mounted in the vertical position may be placed end-to-end or side-by-side or a combination of the two. Note that standard horizontal configuration will be supplied unless specified differently at time of order. Also note that when modules are vertically mounted, they do not meet seismic zone 4 qualifications.

NOTE: Handle/lift modules by the lifting slings hooked diagonally in front and rear mounting channels only. Do not lift the battery / module by the cells because damage to the cells will result.

5.3.2 Location Layout

. Ensure that sufficient space is available for handling and placement of the modules. Do not locate the battery system near a source of heat or in direct sunlight. Locate and mark the position of the battery system leave a space of at least 900 mm between the front of the battery and any adjacent equipment.

5.3.3 Horizontal Module Installation

Hook the two lifting straps diagonally across the top module on the pallet. Then, by removing 3 front bolts, unbolt the module from the module below and lift one module at a time from the pallet using a crane or fork truck. When all the modules have been lifted of the pallet unbolt the base support from the wooden pallet. Place the base support in position and drill the anchors bolt holes down into the floor then remove the base plate and increase the size of the bolt holes in the floor to suit the size of the anchor bolts. Bolt down the base plate on a level floor and check with a spirit level. On an uneven or sloping floor it may be necessary to use shims. Bolt down the base support and check the level again in both directions.

Using the wiring diagram supplied, identify the bottom module and lift with diagonal hooked straps / slings. Lift the module with the crane or fork truck and gently lower into place on top of the bolted down base plate. Locate the three pins at the back of the module and push back into place. Then bolt loosely from the front to the base plate using the 3 x M10 bolts supplied. Repeat the lifting procedure with the next module and lower in place on top of the bottom module. Engaging the three location pins push back into place then bolt the second module to the module below using the 3 x M10 bolts provided. Repeat this procedure until all the modules are in place. Ensure that the module stack is plumb and level as the modules are being assembled. Then torque the bolts to 100 ft-lbs (11.4 N-m) when the modules are fully assembled and aligned.

***Read Section 5.4** then using the wiring diagram fit the bus bars between the cells and the top terminal plates. When connected check the battery voltage to ensure that the cells are connected in the correct polarity. Then torque all the terminal bolts to 100 ft-lbs. (11.4 N-m). Fit the cell numbers starting at the positive post with No. 1. Check the cell voltages and record with the cell ID. Fit the clear insulating cell covers. The clear terminal plate covers must be filled when the terminal cables are being connected.*

If the battery system consists of multiple stacks, the stacks are positioned 12 mm apart next to each other side by side. The base plates are bolted together between module stacks. The uppermost modules of the adjacent stacks must be bolted back and front together using the tie plates provided. The tie plates with captive nuts are designed to fit in the module channels and be bolted through the module mounting channel holes. The tie plate must be places in the channel before the adjacent modules is fitted then slid into the adjacent module and bolted.

5.3.4 Vertical Module Installation

When modules are installed in the vertical position, the modules are bolted to the base plate through the bottom / back channel of the module. Attach the hooks in the slings to the channels. Repeat this procedure with the remaining modules. The modules must be bolted together with 3 No. M10 bolts per module. When assembling modules end to end bolt the modules together using the tie plates supplied. It is always highly recommended to attach the battery system to the floor using suitable floor anchors.
***Note**: that modules installed in a vertical position do not meet seismic zone 4 qualifications.*

WARNING Do not turn batteries upside down or tilt to the front more than 30° as this will 'wet' the vent with electrolyte which will be vented when the cell is charged.

5.4 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. Make sure that all terminals and interconnects are cleaned and are covered with the No-Oxide grease provided.*

CAUTION: Remove all rings 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 do not hurry take your time.

5.4.1 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 drops.

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 20-30 mv of voltage drop per meter of cable run. As an example, if it is 10 meter's 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.

5.4.2 Terminal Preparation

Gently clean the contact surface of the terminals with a brass bristle brush or a Scotch Brite pad. Immediately after this cleaning, apply a thin layer of No-Ox-Id "A" or NCP-2 antioxidant grease to the contact areas. A petroleum jelly such as "Vaseline" may also be used.

5.4.3 Connector Installation

The CELLYTE 2TLAM Modular/Tubular batteries are supplied with intercell busbars or cables sized for the specified discharge time. The busbars are plated with a tin-lead alloy and should require little or no cleaning prior to installation.

If the tin plated busbars need to be cleaned, carefully use a Scotch-Brite pad or a soft brass bristle brush to clean to bright metal. Take care to ensure the plating is not removed. Lightly grease the contact surfaces of the busbars before installation. Following the supplied wiring diagram, install the intermodule/interstack connections carefully using the supplied M8 and M10 bolts and washers supplied and tighten the hardware finger tight.

CAUTION: Use extreme care not to short the battery connections. CELLYTE 2TLAM Modular/Tubular batteries are capable of very high short circuit currents containing a very high energy level.

Before the final tightening of the intercell connections, visually check that the connections are properly made and in the proper sequence. ***See Section 5.5.4*** *for the proper procedure for checking string voltage. When proper connection has been verified, torque all intercell connections to 100 in-lbs (11.4 N-m) including the factory made connections.*

Install the terminal plates by attaching the plastic strip to the front, of the top module channel using the supplied hardware. Attach the terminal plates to the cell terminals and to the plastic support. Torque hardware to 100 in-lbs (11.4 N-m).

When installing the battery load cabling, attach the load cabling to the wall or the cable tray so that the weight of the cable is not on the battery terminal plate. If using a stiff cable, pre-bend the cable so no "spring" force is placed on the terminal plate. Failure to support the cable weight could result in premature cell failure and loss of battery integrity. Fit the terminal plate insulating cover over the cable before bolting to the terminal plate.

5.4.4 Voltage Checks

Visually check that all connections are properly made (positive to negative) and are tight. Measure string voltage, check that this is about 2.14 x No. of cells.

CAUTION: High voltage may be present.

The total string voltage should be approximately 2.13 - 2.15 volts multiplied by the number of cells in the string (for 24 cell battery 51.12 to 51.6 volts). If the measured string voltage is not close to the calculated value, recheck the battery connections to ensure proper polarity sequence and measure the individual cell voltages. Calculate the average cell voltage and use this value to recalculate the string voltage. If the recalculated and measured string voltages do not match reasonably well, contact your SEC representative for further instructions.

5.4.5 Battery to Charger Connection

Ensure that the charger is disconnected from the power line. If a battery disconnect is installed, open it.
Note: *The positive terminal of the battery bank should be connected to the positive terminal of the charger and the negative terminal of the battery bank should be connected to the negative terminal of the charger.*

5.4.6 Paralleling of Batteries

When greater capacity is desired than available from a single cell or string, paralleling of batteries becomes necessary. Batteries must be properly paralleled in

order to get the best system performance and longest battery life.

The battery strings must be treated as equally as possible. This means equal length cabling to a common collection point for the load cables, uniform temperature between the strings and equal strings of batteries. Do not parallel flooded batteries with valve-regulated batteries if the charge voltages differ between the batteries. Ask SEC for advice on paralleling flooded and VR batteries.

To check the proper paralleling of the strings, connect the strings in the final form and place a load on the battery. Measure the load cable voltage drops. The voltage drops should match within 10%.

SECTION 6 - OPERATION

6.1 Initial Charge

The initial charge on the battery is essentially an equalization charge of the battery. ***Always*** *perform this charge of the battery when it is first installed. Failure to do so could result in uneven float voltages and low initial capacity.*

The equalization or initial charge voltage in this case, for the CELLYTE 2TLAM Modular/Tubular battery is 2.35 volts per cell at 20-25°C. Calculate the initial charge voltage for your installation, based on the number of cells in the string. Turn on the charger and raise the charger output voltage (using the equalization control) to the calculated value (for 24 cell battery this is 56.4 volts). Leave the string charging at this level for 12 hours to a maximum of 24 hours. ***(Check after 3 hours that the string voltage has not changed.)*** *At the end of this time, reduce the charger output voltage to the float voltage (2.25 vpc at 20-25°C.).*
See Section 6.2. *Just prior to reducing the string voltage to the float voltage, measure and record the individual cell voltages and cell ID's.*

If the charger output voltage cannot be raised to the calculated initial charge voltage or the load cannot tolerate a charge voltage this high, raise the charger output voltage to the maximum permissible level. Measure the charger output voltage and calculate the voltage per cell. Use the following as a guideline:

Max. Voltage Obtained (25ºC)	*Charge Time (Hrs) Min/Max.*
2.32 - 2.33 vpc	*36 / 48*
2.29 - 2.31 vpc	*48 / 60*

At voltages below 2.29 vpc, adequate equalization will not be obtained. Contact your SEC representative for additional details on procedures to equalize a battery under these conditions.

If the ambient temperature is not in the range of 20-25ºC, the initial charge voltage will have to be temperature compensated. Temperature compensation is the process whereby the charge voltage is changed as the function of the battery temperature. The temperature correction factor (TCF) for CELLYTE 2TLAM Modular/Tubular batteries is -0.003 volts / cell per ºC from a 20ºC baseline temperature. This means that as the battery temperature rises (falls) above (beneath) 20ºC, the charge voltage must be reduced (raised) the TCF amount for every degree of change. The formula to calculate the temperature corrected voltage is:

TCV= chg. voltage (20ºC) - [T -20ºC] x (-0.003 v/c)

As an example, if the initial charge was going to be performed at 28ºC the temperature corrected charge voltage would be:

TCV = 2.35 - (28-20) x (-0.003 v/c) = 2.31 volts/cell

6.2 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.

6.2.1 Float Voltage Requirement

The allowable float voltage range for CELLYTE 2TLAM Modular/Tubular batteries is 2.27 - 2.23 volts/cell at 20-25ºC. The recommended float voltage setting is 2.23 to 2.25 volts/cell at 25°C or 2.25 to 2.27 volts/cell at 20°C. The average recommended setting being 2.25 vpc.

6.2.2 Float Voltage Temperature Compensation

The float voltage temperature compensation factor is -0.003 volts / cell / ºC from a 25ºC baseline (the same as the equalization TCF). For temperatures around 25ºC, use the following table:

Temperature	*Float Charge*
°C	*volts / cell*
-5	*2.350*
0	*2.330*
5	*2.310*
10	*2.290*
15	*2.270*
20	*2.250*
25	*2.250*
30	*2.230*
35	*2.210*

For temperatures outside of this range see ***Section 6.1*** *for the equation used for calculation of the temperature corrected float voltage.*

6.3 Maximum Charge Current

The maximum charge current is limited to prevent the possibility of charging the batteries at a higher rate than they can efficiently accept. Greater than recommended maximum charge currents can result in excessive battery heating and gassing and a shortened battery life. The maximum normal charge current is the C/5 rate in amps. If a very rapid recharge is desired, please contact SEC for more instructions.

6.4 Recharge

Recharge batteries immediately or as soon as possible after a discharge. Do not wait more than 24 hours to initiate the recharge after the batteries have been discharged. Failure to follow this

recommendation could result in a permanent loss of capacity due to plate sulphation. The approximate recharge time can be calculated as follows:

AH discharged
---------- X F = number of hours to charge
Available charge current

where F = 3 if the batteries are charged at the float voltage and F = 2 if an equalization voltage is needed.

6.5 Equalization Charge

The equalization charge voltage of the CELLYTE 2TLAM Modular/Tubular battery is 2.35 volts per cell at 20-25°C. While equalization is not required by the CELLYTE 2TLAM Modular/Tubular battery under normal operating conditions, it is possible to operate the battery in such a way that equalization would be needed. These conditions would include:

-Temperature variation in the string greater than 3ºC
-Low float voltage
-Low operational temperature without temperature compensation
-Frequent deep discharges
-Rapid recharge required
-Long delay in recharging the battery after a discharge
-Unevenly paralleled string balance

Equalization should be performed on an 'as needed' basis. The standard equalization would be 12-24 hours maximum at a constant voltage of 2.35 VPC at 20-25°C. For equalization at voltages and temperatures other than the above, see ***Section 6.1*** *for methods to compensate.*

Section 7 - STORAGE

When installed CELLYTE 2TLAM Modular/Tubular 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 6.5).***
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 6 months when the storage temperature is 20-25ºC 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 and cell ID's just before equalization and then record the on-charge voltage and current just prior to completing the charge. Refer to ***Section 4.0*** *for more information.*

Section 8.0 - MAINTENANCE AND RECORD KEEPING

Maintenance and record keeping is critical to battery life and warranty continuance. 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.

8.1 General Maintenance

General maintenance of the battery means keeping the battery and surrounding area clean and dry. Since CELLYTE 2TLAM Modular/Tubular batteries are of low maintenance design, there is no addition of water or specific gravity checks needed for the life of the battery. The only required maintenance action is an annual retorque of the battery connections to 100 in-lbs. (11.4 N-m). Review ***Section 2.4*** *on Electrical Shock before performing this action.*
CAUTION: Always use insulated tools.

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.

8.2 General Records

8.2.1 Installation Records

When the battery is received, record such things as:

- *Date of receipt,*
- *Condition of the modules,*
- *Open circuit voltages (if measured)*
- *Date of installation*
- *Original P.O. number*
- *Installer (s)*
- *Equalization time and voltage*
- *Any unusual storage conditions.*

8.2.2 Maintenance Records

At least twice per year, record the following :
- *Cell float voltage*
- *String voltage*
- *Float current*
- *Ambient temperature*
- *Battery temperature*
- *Battery conditions*
- *Any unusual charges or discharges - 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 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 a 3, 5, 8 or 10 hour discharge test.

(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 to 1.80 VPC) 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 a test mode where the battery becomes the primary power 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 torqued tight. An equalization charge is highly recommended before performing a capacity test and is ***mandatory if the battery is new or has not been on continuous float for at least one week or if there is any questions about the battery's state of charge.***

(2) Prepare the load bank or test load system. Ensure all temporary cable connections are secure and 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. Average the readings to determine average battery temperature. Measure the cell temperature in the middle of the module (preferably) or the end wall of the module.

(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 20-25ºC. The formula for calculating corrected load is :

Temperature corrected load = load at 20-25ºC x CF, where CF is the capacity correction factor for temperature. The following table should be used :

Test Temperature ºC)	*Capacity Correction Factor (CF)*
-5	*0.73*
0	*0.78*
5	*0.84*
10	*0.89*
15	*0.97*
20	*1.00*
25	*1.00*
30	*1.03*
35	*1.05*

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

(5) Just prior to starting the discharge test, measure and record the individual cell voltages, the string voltage and float current. This can be accurately measured using a calibrated shunt.

(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 1 minute UPS discharge, readings every 5 minutes is 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 24 cells = 42.00 Volts is the stop discharge voltage. Do not be concerned if the voltage of some cells falls below 1.75 on a new battery these cells will be restored to full capacity when the battery is recharged.

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

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

DISCHARGE TEST NOTES:

(1) When batteries are new, the battery may deliver only 95% of rated capacity. Full capacity will be obtained after 3-6 months in float service or after cycling about 10 times.

(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., are properly calibrated 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.

11 TECHNICAL SUPPORT

*SEC is always ready to assist you in your installation and operation of SEC **CELLYTE 2TLAM** 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.*

SEC Industrial Battery Co. Ltd.
Thorney Weir House
Iver, Bucks, SLO 9AQ,
United Kingdom.
Tel.: 44-1895-431543
Fax.: 44-1895-431880
SEC Website: www.secbattery.com
Email:brian.harper@secbattery.com

SEC European Sales Office
42 rue de la Rochette
77000 Melum
France.
Tel.: +33 6 75 59 06 92
SEC Website: www.secbattery.com
Email: Christian.dhainaut@secbattery.com

SEC Industrial Battery Co. BSC
P.O. Box 32225,
Kingdom of Bahrain
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.

SEC BATTERY MAINTENANCE REGISTER

Date	Maintenance Description

SEC Industrial Battery Co.

SEC Industrial Battery Co.