Eastman®
ENERGY. UNLIMITED.

A GREEN INNOVATION FROM EASTMAN GROUP

Tall Tubular Conventional / Short Tubular Maintenance Free Battery (Flooded Battery Range) Installation, Maintenance and Operating Manual

TALL TUBULAR CONVENTIONAL / SHORT TUBULAR MAINTENANCE FREE BATTERY FOR INVERTER, HOME UPS & SOLAR APPLICATIONS

- Higher Cycle Life
- Fast Recovery In Deep Cycle
- Higher Pressure Die Cast Spine Grids
- Proven Cycling & Deep Cycling Capacities

www.eaplworld.com

Table of Contents

Sr. No	Particulars	Page No.
1	General Warning	01
2	Safety	02
3	Battery connection	03
4	Torque Value	03
5	Terminal protection	03
6	Battery inspection	03
7	Battery watering	04
8	Battery cleaning	04
9	Battery charging and Equalizing	05
10	Battery storing	05
11	Charging setting	06
12	Charging Instructions & Charging Profile	06
13	Measure of SG and OCV	07
14	Battery Installation, Service and Maintenance	08-11
15	Battery Inspection Check List and Cell Reading	12-13

General Warning

- **Important information regarding possible personal injury.**
- **Important information regarding possible equipment damage.**
- **Additional information concerning important proceduresand features of the battery.**
- **It is important to operate the device with careto avoid undesirable consequences.**

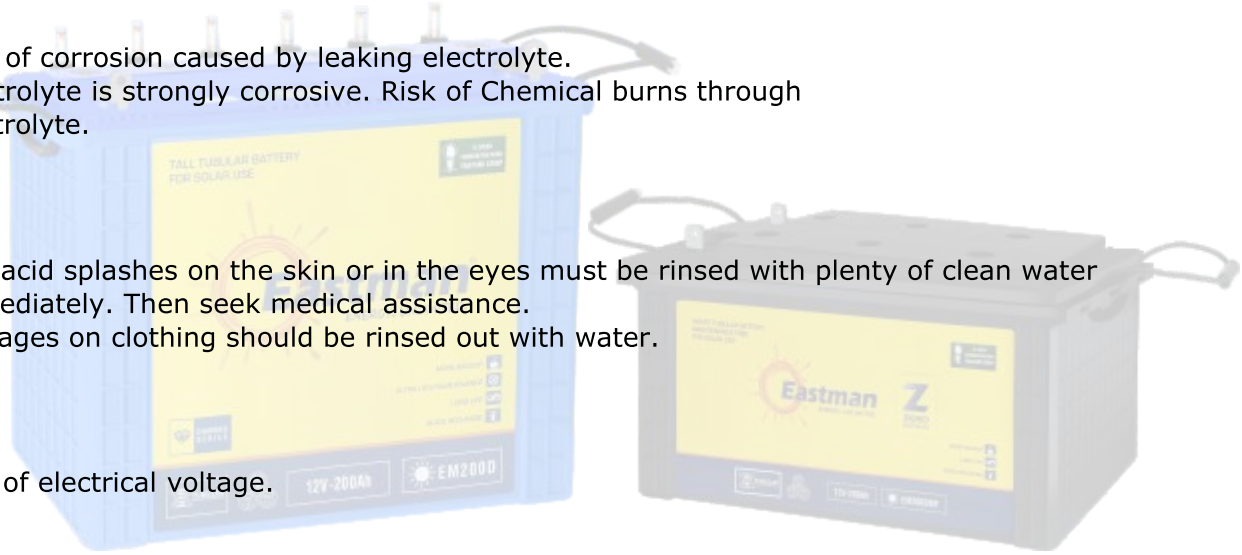
Incorrect use of the products described here can lead to personal and material damage. EASTMAN is not responsible or liable for direct or indirect personal and material damages which occur as a result of handling the products described here.

Risk of explosion or blast, splashing of hot or molten substances. Risk of explosion and fire, avoid short circuits.
Avoid electrostatic charges and discharges/sparks.
Failure to observe this hazard notice can lead to severe or fatal injury.

Risk of corrosion caused by leaking electrolyte.
Electrolyte is strongly corrosive. Risk of Chemical burns through electrolyte.

Any acid splashes on the skin or in the eyes must be rinsed with plenty of clean water immediately. Then seek medical assistance.
Spillages on clothing should be rinsed out with water.

Risk of electrical voltage.



SAFETY

- Always wear protective clothing, gloves and goggles.
- Do not smoke near batteries.
- Keep sparks, flames and metal objects away from batteries.
- Use insulated tools when making battery connections.
- Electrolyte is a solution of acid and water, so avoid skin contact. If acid contacts skin or eyes, flush with water immediately and contact a medical professional.
- Ensure the cable connections to the terminals are properly tightened.
- Do not lay objects on top of battery.
- Always charge and handle batteries in a well-ventilated area.
- Never add acid to a battery.

Do not throw battery in the garbage. Do not dispose in fire.

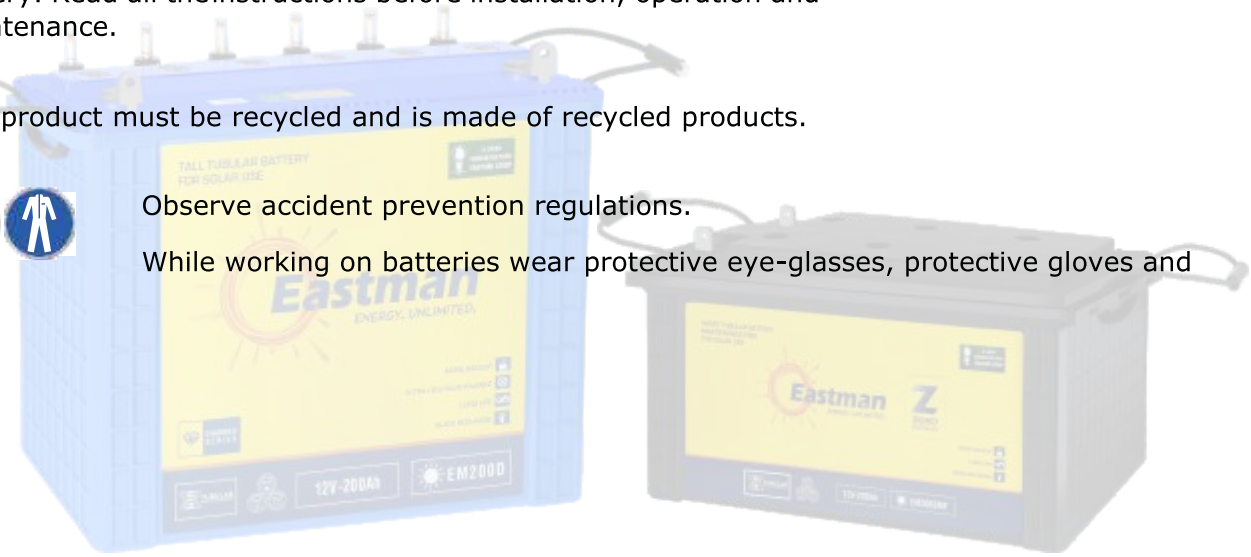
Use personal protective equipment when working with batteries.

Additional information concerning important procedures and features of the battery. Read all theinstructions before installation, operation and maintenance.

This product must be recycled and is made of recycled products.

Observe accident prevention regulations.

While working on batteries wear protective eye-glasses, protective gloves and clothes.



BATTERY ORIENTATION

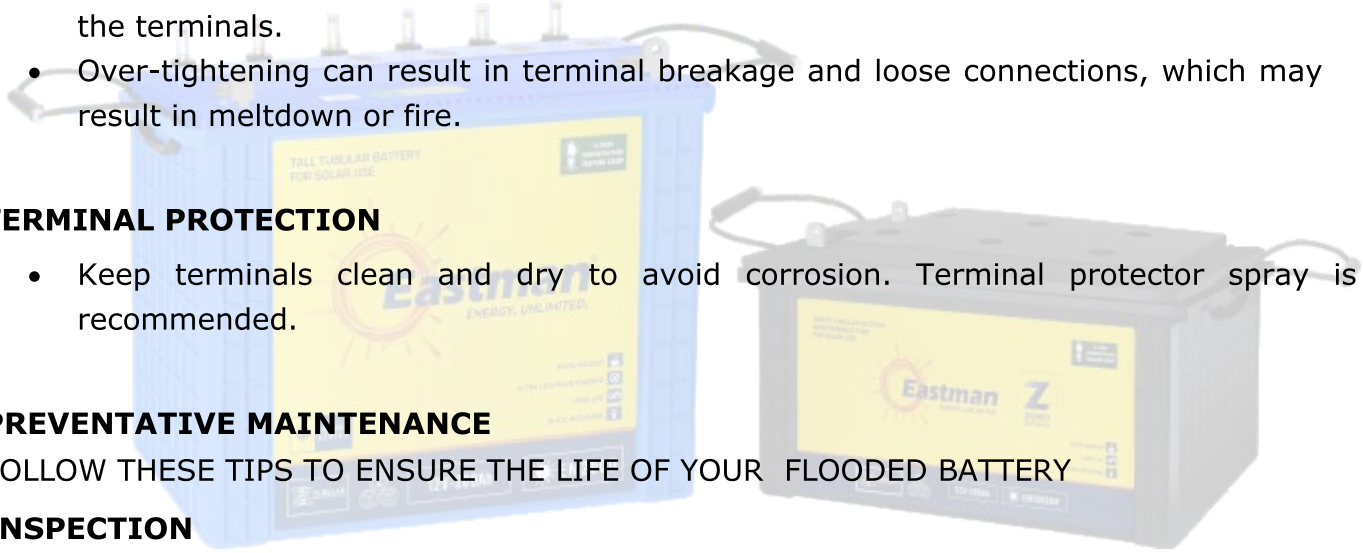
- Flooded batteries must be placed and installed upright at all times.
  (Fluid will spill if the battery is placed on its side or at an angle).

BATTERY CONNECTION

- If using washers to connect the wire connections, ensure the connection is in direct contact with the lead surface of the terminal.
- Ensure the washer is placed on top of the wire connection (between the connection and the nut).
- Do not place the washer between the terminal and the connection as this creates high resistance and can cause terminal meltdown.

TORQUE VALUES

- Tighten all cable connections to the specified values*, ensuring proper contact with the terminals.
- Over-tightening can result in terminal breakage and loose connections, which may result in meltdown or fire.



TERMINAL PROTECTION

- Keep terminals clean and dry to avoid corrosion. Terminal protector spray is recommended.

PREVENTATIVE MAINTENANCE

FOLLOW THESE TIPS TO ENSURE THE LIFE OF YOUR FLOODED BATTERY

INSPECTION

- Inspect battery at regular intervals.
- The tops of the batteries and terminal connections should be clean, dry, and free of dirt or corrosion.
- Fluid on top of a flooded battery may indicate over-watering or overcharging.

WATERING

- Fully charge the batteries prior to adding water. Only add water to discharged or partially charged batteries before charging if the plates are exposed.
- In this case, add just enough water to cover the plates and then charge the batteries. Once fully charged continue with the watering procedure.
- If electrolyte level is above the plates it is not necessary to add water.
- If electrolyte is needed, add distilled or deionized water to a level 1/8” (3mm) below the vent well (plastic shield inside the vent hole).
- After adding water, secure vent caps back on batteries.

    - Proper Water Level: 1/8” below vent well

    - Water Quality: Only use deionized water or water free from high impurity levels
    - (<100 parts/million)
    - Weekly: Check water level after a charging cycle

    - Bi-Monthly: Manually check cell’s water level and watering system functionality

WARNING: Always wear protective clothing, gloves and goggles.

CLEANING

- Inspect battery for cleanliness at regular intervals and keep terminals and connectors free of corrosion.

- Prior to cleaning check that all vent caps are secured properly on the battery.

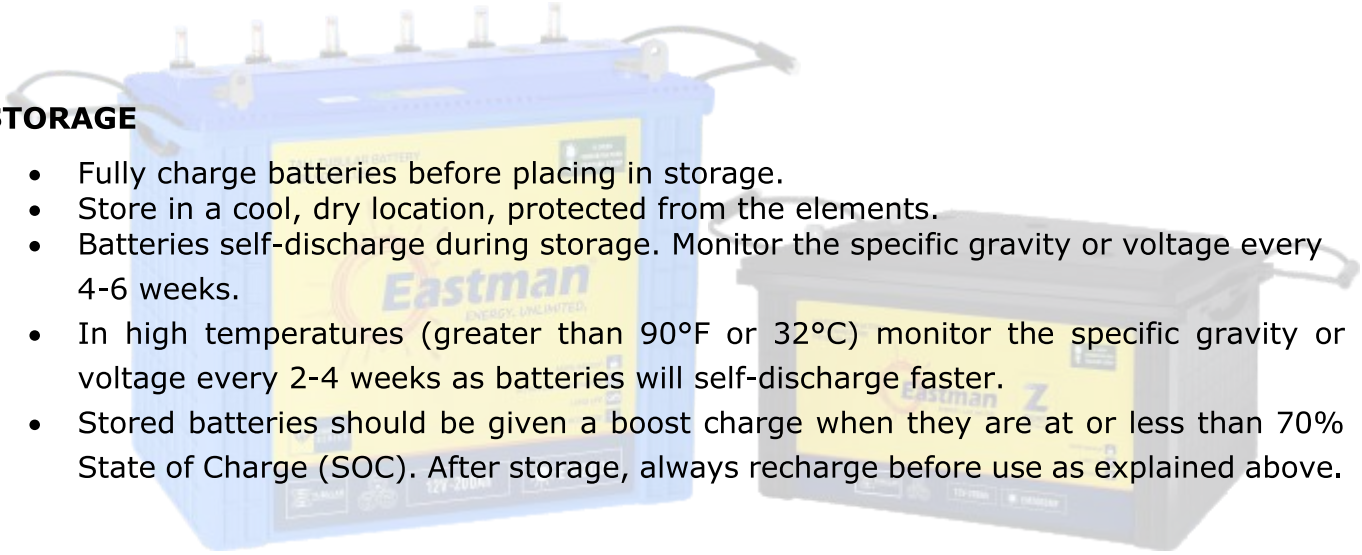
- Clean the top of the battery, terminals and connections with a cloth or brush and a sodium bicarbonate solution (1 cup of baking soda to 1 gallon of water (150g/1L)).
- Do not allow the cleaning solution to get inside the battery.
- Rinse with water and dry with a clean cloth.
- Keep the area around batteries clean and dry.

CHARGING

- Proper charging will maximize battery performance.
- Both under and over-charging can reduce the life of the battery.
- Do not discharge your battery more than 80% to prevent over-discharging and damaging the battery's internal components.
- Avoid charging at temperatures above 122°F (50°C).

EQUALIZING (flooded batteries only)

- Eastman recommends equalizing flooded batteries (NEVER AGM or Gel batteries) every 30 days or when batteries have low specific gravity, below
- 1.235 or wide ranging specific gravity, > 0.030 points between cells, after fully charging. Please consult Eastman's Battery's complete User's Guide and your battery charger's user manual for detailed instructions on equalization.
    - Ensure charger is properly programmed and sized for the battery
    - Every 180 days of frequent cycling recommended for equalization. Parameters as per recommended in chart of different charger voltage settings table.
    - Batteries must rest after charge; resting period ≥ charging period



STORAGE

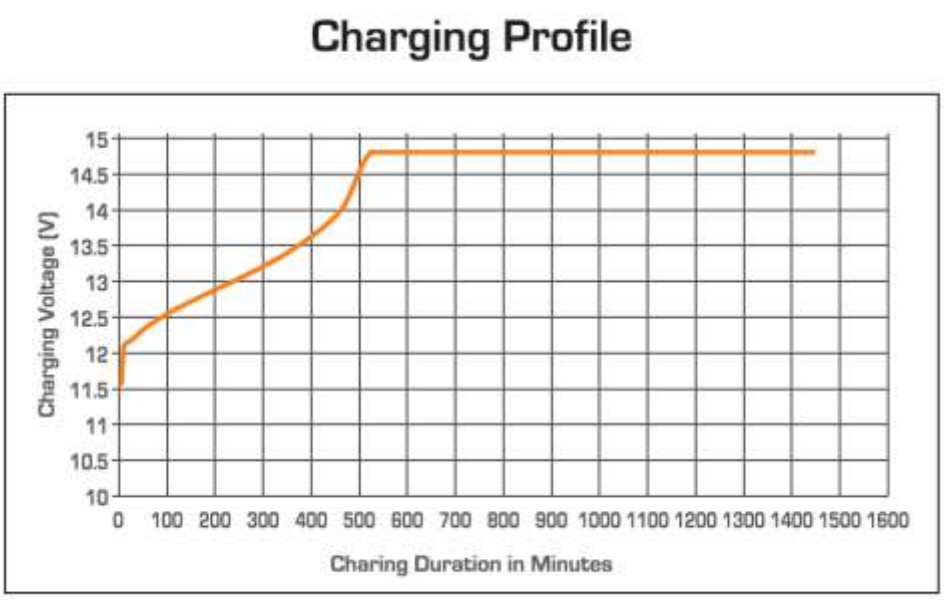
- Fully charge batteries before placing in storage.
- Store in a cool, dry location, protected from the elements.
- Batteries self-discharge during storage. Monitor the specific gravity or voltage every 4-6 weeks.
- In high temperatures (greater than 90°F or 32°C) monitor the specific gravity or voltage every 2-4 weeks as batteries will self-discharge faster.
- Stored batteries should be given a boost charge when they are at or less than 70% State of Charge (SOC). After storage, always recharge before use as explained above.

CHARGING INSTRUCTIONS

Charging Instructions

Charger Voltage Settings (at 77° F/ 25°C)			
System Voltage	12V	24V	48V
Maximum Charge Current	0.2C10		
Maximum Absorption Phase Time (hours)	4		
Absorption Voltage	14.4	28.8	57.6
Float Voltage	13.6	27.2	54.4
Equalization Voltage	16	32	64
Do not install or charge batteries in a sealer or non- ventilated compartment. Constant under or overcharging will damage the battery and shorten its life as with any battery.			
Periodic Charge	Provide a periodic freshening charge to maintain a SOC greater than the threshold of 70%		

RECOMMENDED FLOODED DEEP CYCLE BATTERY CHARGING PROFILE



FLOODED BATTERY STATE OF CHARGE AS A MEASURE OF SG AND OCV

Eastman recommends returning 120% of Ah removed to ensure 100% SoC (State of Charge).

The below chart details OCV & to SoC:

State of Charge Measure of Open-circuit Voltage @ 27°C

State of Charge	Specific Gravity	Voltage
100%	1.245-1.275	12.55V-12.70V
75%	≤ 1.225	≤ 12.4V
50%	≤ 1.190	≤ 12.1V
25%	≤ 1.155	≤ 12.0V
0%	1.120	11.8V

SPECIFIC GRAVITY AND SELF DISCHARGE

Specific Gravity & Self Discharge w.r.t. Temperature

CHARGING TEMPERATURE COMPENSATION	Add	Subtract
	0.005 volt per cell for every 1°C below 25°C 0.0028 volt per cell for every 1°F below 77°F	0.005 volt per cell for every 1°C above 25°C or 0.0028 volt per cell for every 1°F above 77°F
OPERATIONAL DATA	Operating Temperature	Self Discharge
	-4°F to 131°F (-20°C to +55°C) At temperatures below 32°F (0°C) maintain a state of charge greater than 60%.	As per discharge Graph

BATTERY INSTALLATION

Receiving a Battery

After receiving a battery, examine the crate and pallet for signs of damage. If the battery may have been damaged during transit. Be careful when handling a crate. Do not try to open the vent plugs as this battery is sealed maintenance.

All damaged components should be inspected by your Eastman representative.

Call your Eastman representative immediately. **Do not attempt to discharge or charge the battery.**

Lifting Batteries

Always use the proper lifting equipment to reduce the risk of tray damage, shorting and possible injury.

Chain hoists used to handle batteries should be equipped with a non-metallic container or bucket to prevent the chains from dangling and possibly causing a short by coming in contact with exposed intercell connectors on the battery top. If no protection is available, cover the battery with a non-conducting insulating material such as plywood or heavy plastic.

Installing Batteries

There should be some type of barrier/racking between the floor and the batteries. Battery rack(s) should be installed per rack manufactures instructions. Battery rack should be securely anchored to the floor. Floor anchoring and its design are the responsibility of the owner and should meet all Local, State and/or Federal codes.

Caution should be observed when installing battery on racking system. Consult battery layout to ensure batteries are installed in the correct polarity order. Batteries are shipped assembled and charged.

Battery terminals should be cleaned of all oils, greases or corrosion prior to installing cables. The surface of the battery terminals may be cleaned using a stiff-bristle non-metallic brush/pad until a clean bright surface is accomplished.

Ensure all inter-battery connections and battery cables are properly connected and polarity is correct. All inter-battery cables should be of the same length and wire gauge. Cables should be at minimum length to reduce voltage drop. Use a voltmeter to confirm correct polarity. Lug bolt hole should be 5/16" in diameter. Hardware supplied with battery should be used. All battery connections should be torque to 150 in/lb.

All parallel connections should be of the same length and wire gauge and be terminated at a common bus. This will ensure all parallel battery strings are being discharged and changed at the same voltage and current.

Charging Safety

There are several important safety precautions that should be taken when charging a battery:

- Keep away batteries from fire, sparks, flames and other reacting components.
  - Keep all open flames, sparks and matches away from the charging area. DO NOT SMOKE around the charging area.
- Only properly trained personnel understanding all safety measures, charging parameters and required maintenance prior to charging should charge batteries.
  - The charger should be OFF before connecting it to the battery.
- All mechanical connections on the battery and charger should be tight. Torque all connections to specification. Loose connections can overheat and cause arcing that could cause a gassing cell to explode, or cables to become hot to the touch.
  - The charger should be OFF before disconnecting the battery.
  - Never ever open the vent plugs of the battery

Connecting/Disconnecting Charger

Always turn the charger OFF before connecting or disconnecting a battery. Live leads can cause arcing and sparking, which could cause an explosion if battery gases are present. In addition, the contact surfaces of the plugs or connectors will become pitted over time.

BATTERY SYSTEM OPERATION

There are several factors that affect the operation of the battery concerning its ability to deliver capacity and life expectancy. Many chemical reactions are affected by temperature, and this is true of the reaction that occurs in a storage battery. The chemical reac- tion of a lead-acid battery is slowed down by a lowering of the electrolyte temperature that results in less capacity. A battery that will deliver 100% of rated capacity at 77° F (25°C) will only deliver 65% of rated capacity at 32°F (0°C).

Discharge Voltage Curve

To estimate battery voltage during a constant current discharge at various DoD (Depth of Discharge) consult chart Discharge Voltage Curve in Appendix B.

NOTE: ***Battery voltage can vary depending on temperature, age and condition of battery.***

Charger Voltage Settings (at 77° F/ 25°C)			
System Voltage	12V	24V	48V
Maximum Charge Current	0.2C10		
Maximum Absorption Phase Time (hours)	4		
Absorption Voltage	14.2	28.4	56.8
Float Voltage	13.8	27.6	55.2
Equalization Voltage	14.8	29.6	59.2
Do not install or charge batteries in a sealer or non- ventilated compartment. Constant under or overcharging will damage the battery and shorten its life as with any battery.			
Periodic Charge	Provide a periodic freshening charge to maintain a SOC greater than the threshold of 70%		

Charging

The majority of battery capacity/life issues can be traced to improper charging.

Improper charging settings may lead to an overcharging or undercharging condition.

Inverter/Charge Controller Settings

Proper inverter/charge controller settings are necessary to ensure peak battery performance and life. All bulk, absorption, float and equalize settings should be verified they are within the battery manufacturers settings. These settings include but are not limited to; voltage, current and time. **Default setting should not be presumed to be correct.**

Stand-Alone/Off-Grid Systems

Absorption stage time should be set to optimize the available sun hours during the winter or cloudy months. If improperly set, there is a risk of undercharging the battery system.

For battery system located in an uncontrolled temperature environment, temperature compensation should be used.

Charge Current

To properly determine the amount of charge current required, the following variables are to be considered:

- DoD (Depth of Discharge)
- Temperature
- Size and efficiency of the charger
- Age and condition of battery(ies)

Maximum charge current (Bulk current) should be limited to 15% of the C20 Ahr rate for the battery being used in the system.

Example: C20 rate – 200 Ahr
Max. recharge rate: 200 Ahr x 0.15 = 30 A

Calculating Recharge Time

The following can be used as a guideline for determining recharge times:

85% to 90% SoC (State of Charge)Time (hrs) = (Ahr x 1.2)/Ic

Note: ***Ic should be < 20% of C20***

Ahr = Amp Hours removed during discharge.

Ic = Maximum current available tobattery from charger.

C20 = C20 rate in Ahr

Placing Battery into Service

Battery voltage of each individual cell as well as ambient temperature should be taken and recorded prior to battery being placed on charge.

Proper charging is essential for maximum battery life.

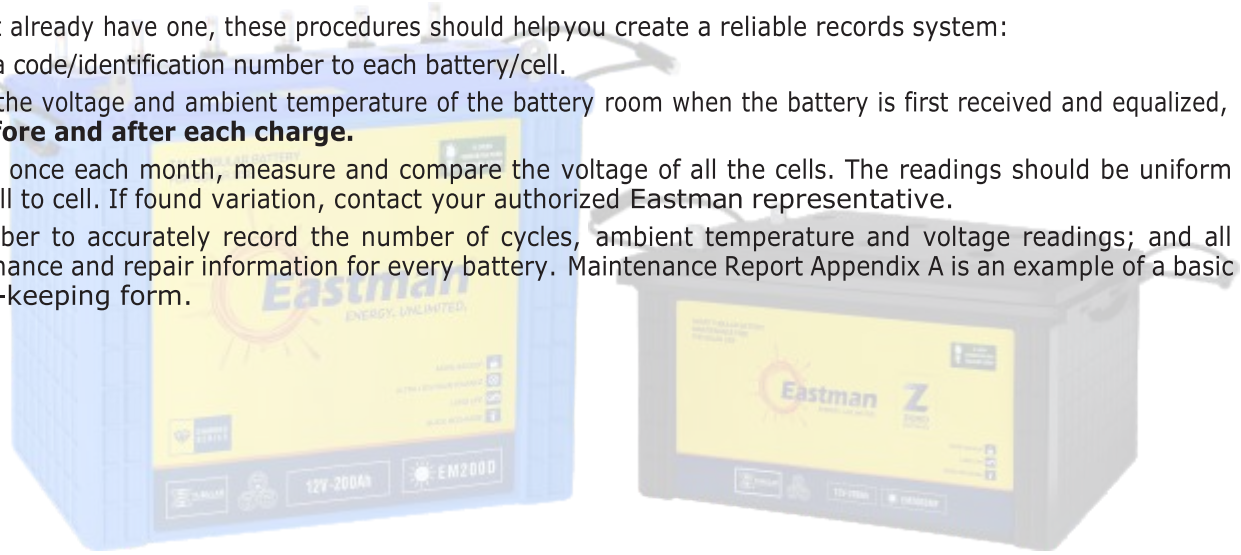
A temperature compensated voltage regulated charger is recommended to be used in renewable energy applications. When a discharged battery is initially placed on charge, it draws a current equal or close to the charger's maximum output. As the battery's voltage rises, the charger output should adjust to the changing voltage to assure a safe, efficient charging rate during all stages of the charge.

A freshening charge at the absorption charge rate should be given to a new battery before putting it into service. The battery should be cool; around 80°F (25°C), when it is installed.

Proper maintenance is essential to obtain long life and maximum efficiency from any renewable energy battery. Carefully following a scheduled maintenance routine will help increase battery performance and prolong service life. Maintain an accurate records system of battery cycles and maintenance/repair work for each battery. A records systemis particularly important for operations that use a large number of batteries.

If you don't already have one, these procedures should helpyou create a reliable records system:

1. Assign a code/identification number to each battery/cell.
2. Record the voltage and ambient temperature of the battery room when the battery is first received and equalized, and **before and after each charge.**
3. At least once each month, measure and compare the voltage of all the cells. The readings should be uniform from cell to cell. If found variation, contact your authorized Eastman representative.
4. Remember to accurately record the number of cycles, ambient temperature and voltage readings; and all maintenance and repair information for every battery. Maintenance Report Appendix A is an example of a basic record-keeping form.



BATTERY MAINTENANCE

Batteries should be inspected periodically to avoid damage resulting from previously undetected problems or improper maintenance and operational procedures.

Look for:

- Corrosion on the tray, terminals or intercell connectors.
- damages on the battery.
- Damaged cable leads, terminals or connections.
- Damaged, clogged, or missing vent caps.

Repair or replace any damaged parts and thoroughly clean the battery. In case of serious damage or for major repairs, contact nearest authorized East Penn representative.

Before taking any voltmeter readings, the battery should be fully charged. Take voltage readings for each cell and record the readings on your battery inspection form. Use the battery's positive terminal cell as cell #1 and follow the intercell connectors to the last cell (the battery's negative terminal cell). Look for any unusual readings that might indicate a problem cell.

Performing a Discharge Test

To determine if a battery can deliver its rated capacity, a discharge test, or capacity test, can be performed to determine the "health" of a battery.

When the battery was put on discharge and when the final cut off voltage was reached, you can determine whether the battery is delivering its rated capacity:

1. Give the battery an equalizing charge.
2. Start the test and record the starting time.
3. Record individual cell voltages and overall battery voltages during the first hour at 10 minutes, 30 minutes and then 60 minutes. After the first hour, take hourly readings until the first cell voltage reaches 1.80 volts per cell. From this point on, record the voltage of the cells every 5 minutes.
4. Carefully monitor the voltage of the low cells and as the voltage of each cell drops below the predetermined final voltage, record the time.
5. When the majority of the cells reach termination value, stop the test. Do not let any cells go into reversal.

For example, if the test was run at the 360 minute rate was terminated after 336 minutes; the capacity percentage would be 93%

6. If the test indicates that less than 50% of the battery's rated capacity is being delivered, the battery should be either repaired or replaced, depending upon its age and overall condition.

CHECKLIST			
PURCHASE & INSTALLATION			
QUANTITY:		MODEL:	
CUSTOMER:		PURCHASE DATE:	
PHONE:		INSTALLATION DATE:	
DISTRIBUTOR:		PHONE/EMAIL:	
INSTALLER:		PHONE/EMAIL:	
DATE CODE(S):			
SYSTEM & CHARGING PARAMETERS			
SYSTEM VOLTAGE:		¨12V ¨ 24V ¨ 48V ¨	
CHARGE SOURCE:			
CHARGE OUTPUT:			AMPS
BULK VOLTAGE:			VOLTS
ABSORPTION VOLTAGE:			VOLTS
ABSORTION TIME:			HH:MM
FLOAT VOLTAGE:			VOLTS
EQUALIZATION VOLTAGE:			VOLTS
EQUALIZATION TIME:			HH:MM
INITIAL BATTERY INSPECTION			
INSPECTION CHECKLIST:	CHECK ¨	INSPECTION CHECKLIST: (cont'd)	CHECK ¨
No Shipping Damage		Cables (where applicable)	
Batteries Clean & Dry		Specific Gravity	
Electrolyte Levels		Voltage	
Vent Caps		Terminal Polarity	

SPECIFIC GRAVITY					
CHARGE	100%	75%	50%	25%	0%
SPECIFIC GRAVITY	1.255-1.275	≤1.255	≤1.190	≤1.155	≤1.120

BATTERY CELL READINGS DATE:					
Cell #	Specific Gravity	Voltage	Cell #	Specific Gravity	Voltage
1			25		
2			26		
3			27		
4			28		
5			29		
6			30		
7			31		
8			32		
9			33		
10			34		
11			35		
12			36		
13			37		
14			38		
15			39		
16			40		
17			41		
18			42		
19			43		
20			44		
21			45		
22			46		
23			47		
24			48		
INSPECTION					
CHECKLIST:		CHECK ¨	CHECKLIST: (cont'd)		CHECK ¨
Batteries Clean & Dry		¨	Terminals Connections		¨
Vent Caps Tight		¨	Hydrocaps		¨
Electrolyte Levels Check & Top		¨	Specific Gravity		¨
Terminals Clean					
		¨	Voltage		¨