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VRLA Technology – Amara Raja Batteries Limited

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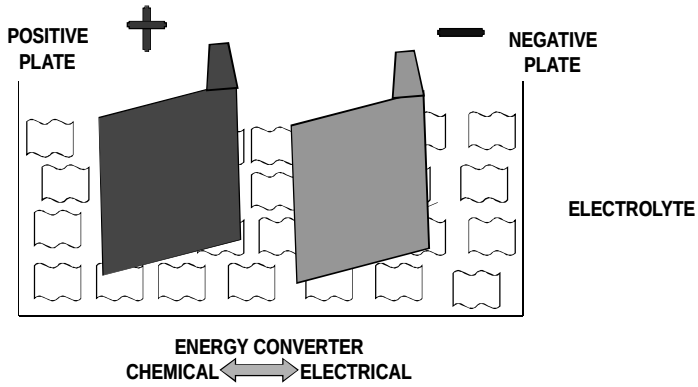
Cell Basics - Electrochemical

❑ **Cell is a device which converts Chemical energy into Electrical energy**



Some of Popular Electrochemical couples

- ✓ Lead Acid
- ✓ Nickel Cadmium
- ✓ Nickel Iron
- ✓ Lithium Ion

When two unlike metals are immersed in a di-electric medium, a potential difference (Voltage) is developed between the metals. The voltage developed depends upon the type of metals and the medium used.

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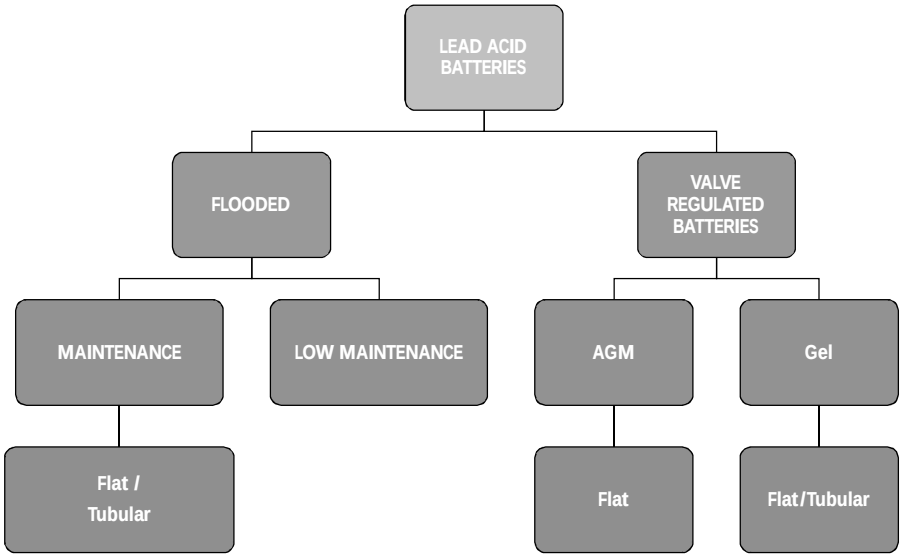
Where is AGM-VRLA in Lead Acid family?



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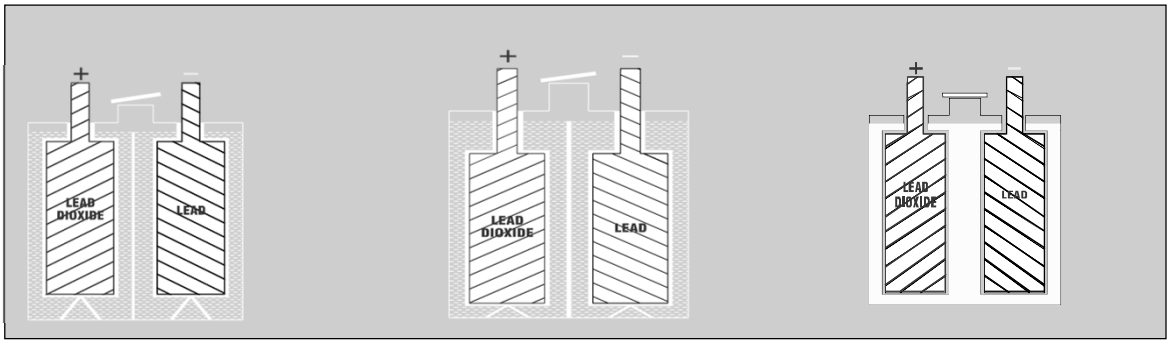
Evolution of VRLA Design



Conventional
- * Vented
- * Less Top Acid
- * Free Acid

Low "Maintenance"
- * Vented
- * More Top Acid
- * Free Acid

Valve Regulated
- * Closed
- * Acid Starved
- * Immobilized Acid.

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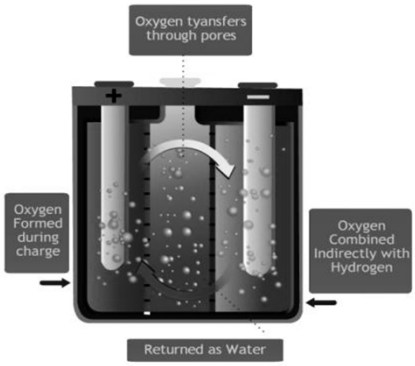
Cell Chemical Reactions



In VRLA Batteries, the oxygen gas generated at the +ve plate is transported in the gaseous phase through the absorbent micro porous glass mat (AGM) separator to the surface of the –ve plate.

The oxygen gas gets reduced by reacting with the charged active material, spongy lead of the –ve plate. There by the evolution of hydrogen gas is effectively suppressed. Consequently, the VRLA batteries do not lose any water under normal operation and therefore, no topping up is required.

This phenomenon is called the **Oxygen Recombination Principle**.

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Major Advantages with VRLA Batteries

- No periodic topping up
- No separate battery room required
- Spill and leak proof
- No acid fumes
- No electrolyte stratification
- Good at deep discharge
- Explosion proof
- Rugged construction
- Ready to use
- Low self discharge
- Savings : 50% place, 40% volume & 30% weight

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Customers preference for VRLA

- ✓ 1st Choice Technology
  - ✓ Over 80% of India market adapted VRLA for standby by application in last two decades
  - ✓ Reliability & Durability
  - ✓ Environment friendly
  - ✓ At the global level the preference is for Flat plate AGM
  - ✓ Deployed in diverse environments -critical to non-critical, cyclic and float applications
  - ✓ Competitive cost of ownership
  - ✓ Easy to dispose & completely Recyclable

Safety Elements In VRLA Technology –Our 2V Products

- No Acid Leakage as acid in starved condition.
- No/Nominal acid fumes
- Fitted with explosion with safety valve
- All our products are UL certified
- Tested and certified for National & International standards for safety & reliability w.r.t IEC 60896 & IS 15549
- All Modules are provided with front covers to prevent the external short circuits
- Providing Insulation rubber sheet to bottom supports for racks-For prevent the earth leakage

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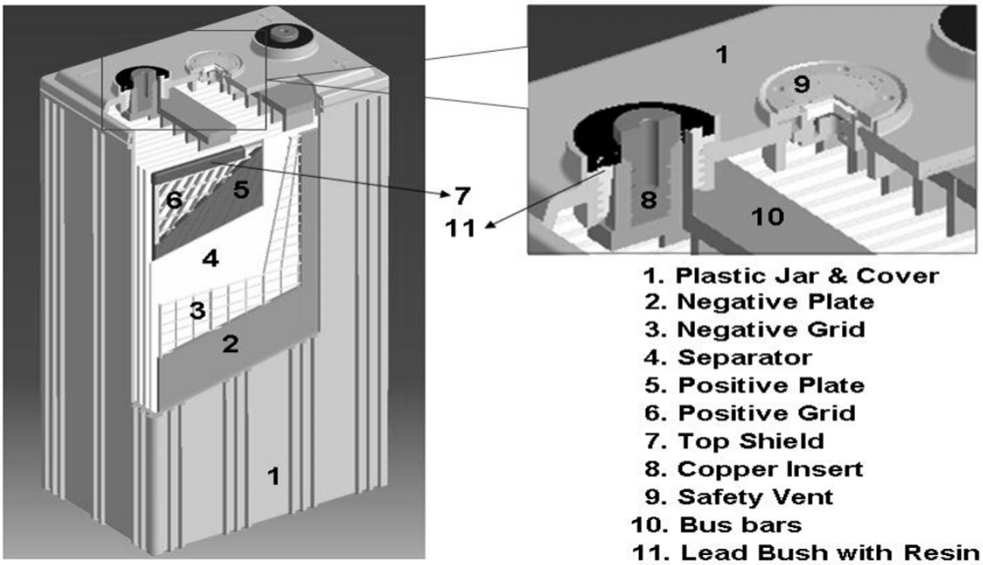
Cut section View of VRLA Cells



1. Plastic Jar & Cover
2. Negative Plate
3. Negative Grid
4. Separator
5. Positive Plate
6. Positive Grid
7. Top Shield
8. Copper Insert
9. Safety Vent
10. Bus bars
11. Lead Bush with Resin

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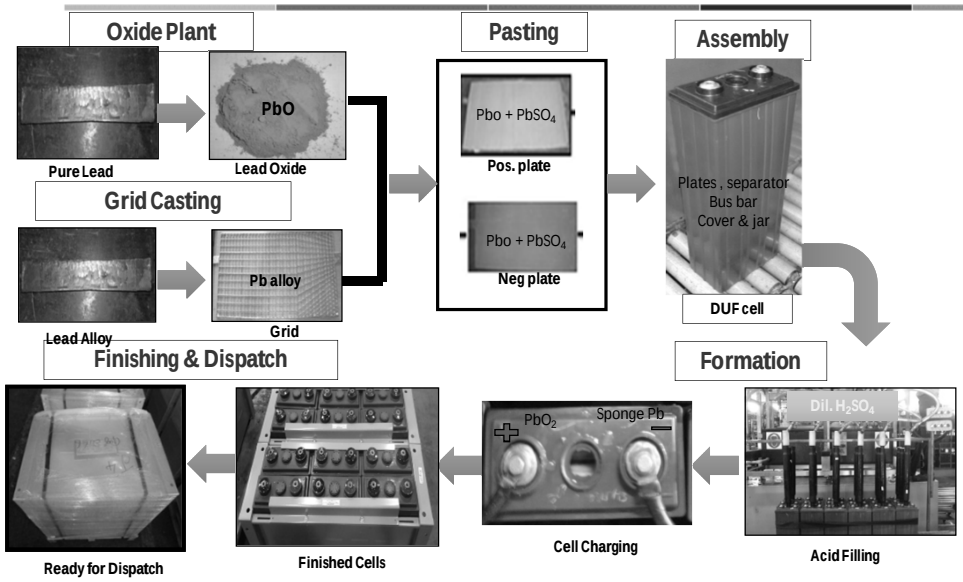
2V Cells Manufacturing Flow



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Installation & Operating procedure

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Installation

- Unloading procedure
- Receiving Inspection
- Installation considerations
- System assembly
- Post preparation
- Connections
- Do’s and Don'ts
- System monitoring

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Installation

Precautions. . .

- Use insulated tools only.
- Lifting equipment must withstand to hold the module weight
- Always start connections as per connection drawing.
- Avoid installation damages.
- Avoid short circuits.

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Installation

Tools required. . .

- Digital multimeter with ± 0.5% accuracy
- AC/DC Clamp meter
- Torque wrench with extension rod.
- Spanners set (10-11 to 20-22)
- Screw driver
- Sockets (10 mm & 16 mm)
- Box spanner

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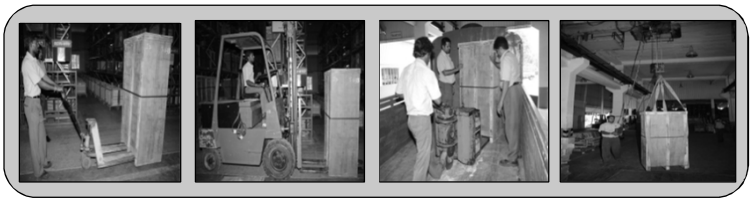
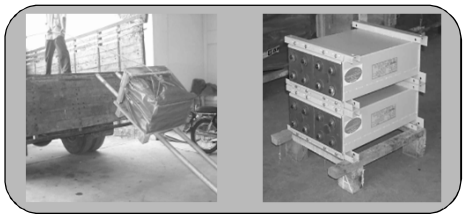
Installation

Material Unloading . .

Safely unload the material by using pallet truck, Fork lift and cranes





Note: If proper infrastructure is not there, make it to use some special arrangements for unloading the material.

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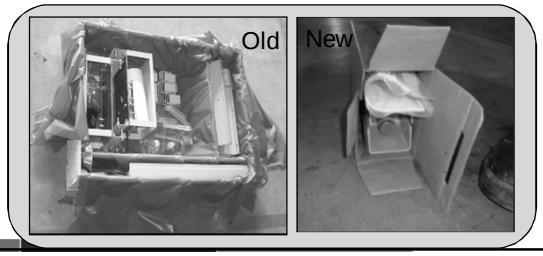
Installation

Receiving inspection . . .

Unpack the battery module, accessories box and check the following,



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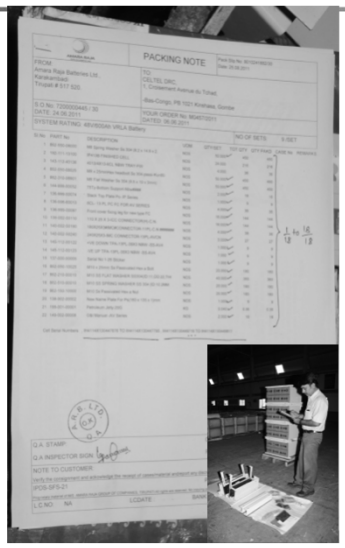
Installation

Receiving inspection . . .

- Transit damages
- Quantity of the accessories as per the packing note



Note: Damage/short supply needs to be reported in writing within a week for insurance claim

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Installation considerations

Space considerations . . .

- Install the battery bank in a clean, cool and dry location.
- Floor should be reasonably level.
- A location having an ambient temperature of 24° C to 30° C will result in optimum battery life and performance.

Note: A minimum of one mtr. front side and 0.5 mtr. all the remaining three sides should be provided for initial installation as well as for service.

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Installation considerations

Floor loading . . .

- System weight and dimensions are provided in the drawing
- If floor loading exceeds the permissible limits, assemble the batteries on a steel sheet of min. 5-mm thickness.

Note: Provision of the same is the responsibility of the user.

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Installation considerations

Ventilation . . .

- No separate ventilation or battery room is required for VRLA batteries
- Normal room ventilation is sufficient.

Note: Do not install batteries in airtight enclosures.

Installation considerations

Floor anchoring . . .

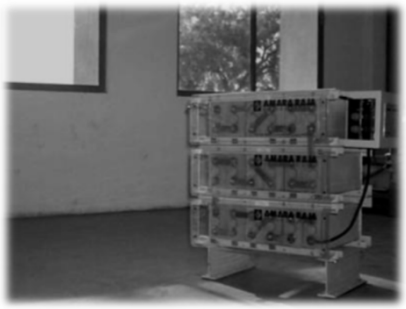
- Generally the system does not need to be anchored
- Where seismic conditions are anticipated, floor anchoring, should be provided

Note: Such anchoring is the responsibility of the customer/end user.

Installation considerations

Temperature variations . . .

- Sources of heat or cooling directed to a portion of the battery bank can cause temperature variations within the system
- Results in cell voltage differences and lead to premature failure of battery system



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Installation

System assembly contd. . .

- Fix the horizontal supports to the module
- Marking to be done on floor
- Place the module on the marked line and Adjust the module on the marked line
- Similarly place all bottom row modules and fix the tie plates.
- Place the other modules one over the other as per connection diagram.
- Fix the modules with hardware to finger tight.
- Ensure the terminal orientation as per the connection diagram.
- Tighten all the hardware to 32.5 Nm.

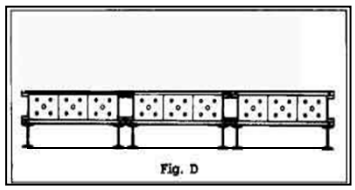
Fig. D

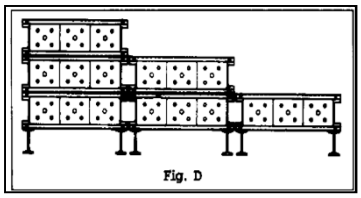
Fig. D

Note: For multiple stacks follow staircase method

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Connections

Post preparation . . .

- Ensure the cell polarities as per connection diagram
- Clean the terminal posts with brass brush or emery paper
- Start the connections from + Ve take off terminal
- Give Inter cell, Inter module, Inter stack, end cell and terminal plate connections
- Torque all the terminal bolts to 11Nm's for M6 & 16 Nm for M8 bolts

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Connections

Connections check . . .

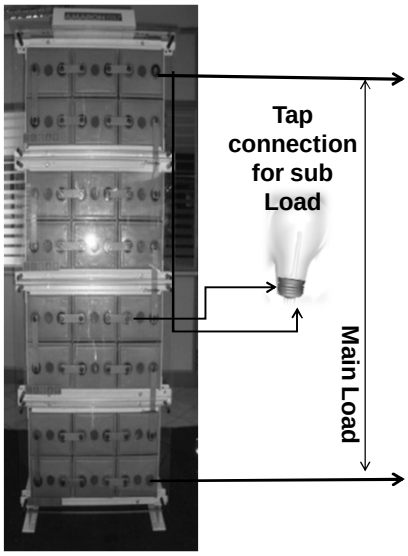
- Check all connections visually.
- Do not use tap connections.
- Cell number to be pasted from +Ve. take off terminal.

Name Plate details . . .

- Nameplate will be fixed to top tray
- Fill the date of installation column

Protective front cover. . .

- Fix the protective transparent front covers to avoid accidental shocks.
- The front covers legs are press fit type and can be fixed directly to the C channel of the module



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Charging requirements of VRLA

Constant potential with current limited type charger with the following features are most suitable for VRLA Batteries

LVRLA Set Points	VRLA	
	Temp above 26◦C	**Temp up to 26◦C**
Float voltage	2.23VPC(Above 26◦C)	2.25VPC (15 - 26◦C)
Boost Voltage	2.28VPC (Above 26◦C)	2.30VPC (15 - 26◦C)
Charging current limit	Min 10% and Max 20% of the rated capacity	Min 10% and Max 20% of the rated capacity
Higher voltage cut-off	2.33 VPC.	2.33 VPC.
Under voltage cut-off	1.75VPC	1.75VPC
Voltage regulation	± 1%	± 1%
Voltage ripples	Less than 2% of RMS value	Less than 2% of RMS value
Auto float to boost change over facility at		
Float to Boost	At 5% of rated Ah capacity in Amps	At 5% of rated Ah capacity in Amps
Boost to Float	At 3% of rated Ah capacity in Amps	At 3% of rated Ah capacity in Amps

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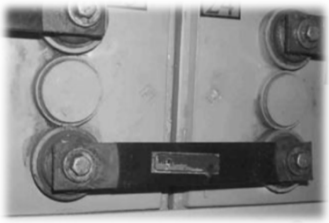
Do 's

- Keep the batteries away from heat source, sparks, fire etc.,

- Clean the batteries as and when dust accumulates.



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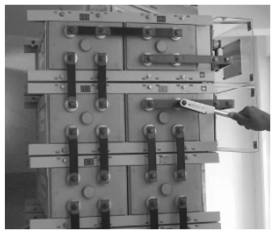
Do 's

- Charge the batteries once in every six months @ 2.30 VPC for 24 hrs. If stored for longer periods

Do ‘s

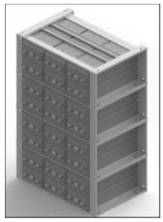
- Wherever cables are used ensure using proper cable size and crimping of the lug to the cable.

- Torque all terminal bolts to 11 Nm (100 Lb.-inch) for M6 & 16 Nm for M8 bolts.
- Re- torque the terminal bolts once in every six months.



Do ‘s

- After discharge, recharge the batteries when power restores.



- Always use calibrated instruments for measurements.

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Do 's

- Tools and tackles should be properly insulated to avoid short circuits

- Follow the inspection /monitoring procedures.
- Maintain battery records

- Provide freshening charge for spare cells as per O&I Manual.

Note: Once in 6 months for 24 Hrs boost charge

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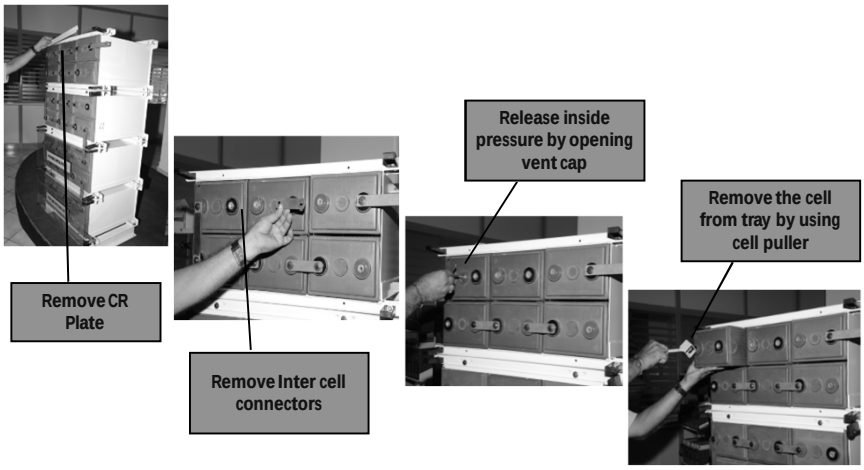
Do 's

- Follow the manufacturer instructions while replacing the cells from the bank.



Note: Proper care should be taken while replacing the defective cell

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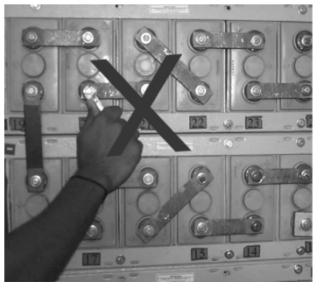
Don'ts

- Do not attempt to tamper the safety valves

- Do not over tighten the terminal bolts



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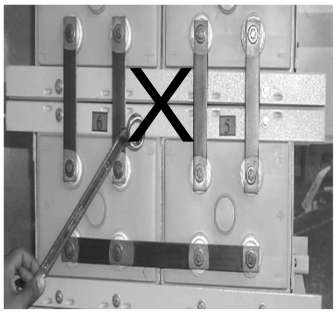
Don'ts

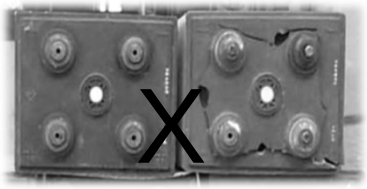
- Do not allow any metal objects to fall across the battery terminals



- Avoid loose connections in the bank

Don'ts

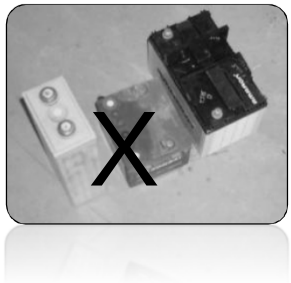
- Do not install physically damaged cells



- Do not allow any direct sunlight to fall on batteries

Don'ts

- Do not mix the batteries of different capacities or makes
- Do not mix ordinary conventional/low maintenance batteries with Maintenance Free VRLA batteries



Don'ts

- Don't keep the batteries in airtight containers during installations.

- Never attempt to reverse charge the batteries.

System monitoring

Sl. No	Checks	Action
01	Physical damages, Heat seal leakage, Cracking of cover & container	Replace the cell
02	Check the over voltage cut off and under voltage trip. (Over voltage cutoff: 2.33VPC, Under Voltage trip: 1.75 VPC)	If varies, reset the same in the charger
03	Ripple: < 2% RMS & O/p voltage regulation: ± 1%	If varies, reset the same in the charger

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System monitoring

Description of the check				
Check the float charging voltage and current (Voltage: 2.23 volts per cell, Current: Min 10% to max. 20% of cell rated capacity)	√			
Note down the average ambient battery room temps. (Battery will give optimum performance when operated at 27°C. The temperature compensation factor is – 3 mV/cell º C rise from the ambient temp. of 27º C and vice versa)	√			
Maintain battery record		√		
Before starting this test ensure that the batteries are in fully charged condition. Note down individual cell voltage readings after discharging the battery bank for 30 min (with current of min 10% & max. 20% of the rated capacity) by switching OFF the rectifier to identify weak cells if any in the battery string		√		
Boosts charge the batteries for 24 Hrs. (Voltage: 2.30 VPC, Current: 20% (max.) of cell rated capacity			√	
Check for terminal post corrosion, if any remove the connector, clean with brass brush or emery paper & Re-torque the terminal Bolts to 11Nm.			√	
Test discharge of the battery bank @ C10 rate				√

Monthly | Quarterly | Half-yearly | Yearly

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Quarterly monitoring

- Discharge the battery bank with equipment load (normally 10% but not exceeding 20% of the rated capacity) for 30 minutes and note down the individual cell readings
- Calculate the average cell voltage of the battery bank as follows

$$\text{Average cell voltage} = \frac{\text{Total bank voltage}}{\text{No. of cells}}$$

- ✓ If the average cell voltage is >2.0 volts, Individual cell readings should be with in a range of $\pm$ 0.03 V
- ✓ If the average cell voltage is <2.0 volts, Individual cell readings should be with in a range of $\pm$ 0.1 V

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Quarterly monitoring

- If any cell voltage reading falls out of the above range those cells should be monitored very closely since there is a possibility that these cells can become faulty in future

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Yearly monitoring

- Charge the batteries at a constant voltage of 2.30 volts per cell with current limited to 20% of the rated capacity for 48 hr. or to 72 hrs if the current is limited to 10%.
- Then discharge the batteries at C10 rate. ie 10% current of the battery rated Ah capacity
- Note down the hourly readings in test data sheet.

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Yearly monitoring

- After completing the test, if the capacity obtained is more than 90% of the rated capacity then the same may be connected back to load after recharge as mentioned in point (i) above.
- If the capacity obtained is less than 90% repeat the above process two more times. If the capacity obtained is still less than 90% contact the nearest service center

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