RITAR®

Energy Storage Batteries

User Manual for VRLA Battery

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Contents

01

Shipment, delivery and storage

1. Choose adequate means for shipment,delivery and handling, for batteries are heavy. Don't roll or throw a battery pack.
2. Avoid being upside-down.
3. Be careful and not damage the terminals and valve plugs.
4. Avoid short-circuit of a battery,since it's fully charged.
5. Store batteries in a dry, clean, and well-ventilated environment. Batteries can be stored at 0~30℃ for 6 months with recharge. Recharge the batteries once if storage period exceeds 6 months.
6. Self-discharge will increase during shipment and storage due to higher temperature and poor ventilation.Keep good ventilation and away from heat, flame or spark.
7. Disconnect batteries from a load and charging system when store the batteries.
8. Recharge the batteries as per table two during storage.

02

Installation and service

1. Inspection upon unpacking

Handling:

Avoid pulling or pushing on terminals,to prenvent damage of terminals and sealing of terminals.Avoid being upside-down, impact,or throw of batteries. Avoid metal rope or wire for handling to prevent short-circuit of batteries.

Inspection:

Package and appearance of batteries should be no sign of damage.

Counting out:

Make sure batteries' number,connectors and hardware are correct.Refer to installation drawing and manual for guide.

2.Cautions before installing

Battery inner resistance should be tested after full charged, temperature should be 25℃±5℃.

Batteries matching:

The OCVs of batteries in a group should be close.

Max.voltage difference in one group(V)		
2V BATTERY	6V BATTERY	12V BATTERY
0.02	0.06	0.12

- If total system voltage is more than 450V,Insulation pad should be set under the batteries.
- Begin installing only after no abnormality be found.
- Install the batteries at lower position,as far as possible,in the battery room.
- The position should be away from heat sources,such as a transformer.
- The position should be away from spark sources,such as a fuse, to prevent the possible ignition of hydrogen.

Clean or polish the terminals before connection of batteries.
Be careful to prevent the short circuit of battery positive and negative terminals by metal items.
Make sure the connection of batteries is correct before connecting the batteries to equipment.Connect the positive end of batteries to positive output terminal of the charger(the equipment),connect the negative end of the batteries to negative output terminal of the charger, otherwise damage of charger(equipment)or injure of body may occur.
Use a torque wrench for adequate tightness of the connection.
Recommended torque value in the following table.

Item	Terminal size	Value
1	M5	6-7N*m
1	M6	8-10N*m
2	M8	10-12N*m

The safe current value of RITAR standard cable connectors for long duration is as follow
Cable 70mm2,220A/cable.
Cable 50mm2,170A/cable.
Cable 35mm2,130A/cable.
State clearly if working current is higher than above value and RITAR will specify correct connectors for the application.

3. Connecting of batteries
Use insulated tools for the connecting.
Connect batteries first,then connect batteries to charger and load.
Connect batteries in a string first, then connect strings in parallel.
Clearance between batteries should be no less than 10~20mm for better heat dissipation.
After connecting the cables with battery terminals, antirust such as vase line may be applied onto the junction points.
Measure the total voltage of battery group before connect to power.

4. How to use the batteries

4.1 Recharging

Recharge the batteries before put into service to makeup the self-discharge during shipment and storage.
If no service for a long period of time,recharge the batteries on schedule.
Refer to the following table for recharge schedule

Temp. range	Recharge interval	Recharge parameters
Lower than 20℃	Every 9 months	a) Constant voltage 2.27-2.30V/cell，initial current 0.3C(A), for 2~3 days.
20℃～30℃	Every 6 months	b) Constant voltage 2.43~2.47V/cell，initial current 0.3C(A) for 10~16 hours.
30℃～40℃	Every 3 months	c) Constant current 0.1C(A) for 8~10hours.(Optional one)

Note:C means nominal capacity of the battery.

For example:The nominal capacity of RA12-100 is 100AH,

0.1C（A）=0.1X100=10A.

Charge voltage:12V battery 2.25X6=13.50V,6V battery 2.25X3=6.75V

4.2 Capacity test and end of discharge

4.2.1 Determination of discharge cut-off voltage

The cut-off voltage of discharge and low voltage limit are specified in the following table.

Disch. rate(A)	**Cut-off**(V/cell)	**Disch. rate**(A)	**Cut-off**(V/cell)
Less than $0.1I_{10}$	1.80	$5\sim7I_{10}$	1.65
$1\sim2I_{10}$	1.75	$7\sim30I_{10}$	1.50
$2\sim5I_{10}$	1.70	Higher than $30I_{10}$	1.30

Note:

1) Not allowed to discharge a battery to a voltage below the low voltage limit.
2) Recharge the battery in 24 hours after discharge,not store a battery in discharged conditions.Not attempt to discharge an empty battery,the SOC is at least 60% before discharge.

4.2.2 Capacity confirmation test

During service regular capacity confirmation test, such as yearly, is recommended. One of the following methods may be used.

Off-line test

a) Batteries are disconnected from power supply and stand by for one trough four hours, then connected to a dummy load and perform 10 hr capacity test at 25±5℃.

b) Measure and record voltage, ambient temp. and time of starting.

c) During discharge, measure and record voltage, ambient temp. every one hour. The deviation of discharge current should be less than 1% of the setting value.

d) Near the end of discharge, measuring of voltage should be frequently performed in order to catch the cut-off voltage of discharge.

e) Discharge capacity is calculated by discharge current multiply discharge time. If the temp. is other than 25℃,capacity at 25℃, Ce is converted as per the formula:

Ce=Cr/{1+K(t-25℃)}----------(A)

Where:t—average ambient temp.during discharge.

K—coefficient (for 10hr capacity, K=0.006/℃ ;

3hr capacity K=0.008/℃;1hr capacity K=0.01/℃)

f) Recharge the batteries after discharge with a charging amount of 110% through 120% the discharged capacity.

On-line test

a) Disconnect the system from power line,discharge the batteries with load and set the cut-off voltage at low voltage limit,find out the battery with lowest voltage during discharge, i.e. the one with lowest capacity.

b) Recharge the batteries fully with charging system and stand for one hour or longer.

c) Discharge the batteries at 10hr,measure and record the voltage, temp,of the selected battery once an hour,measure and record the room temp.

d) Calculate the discharged capacity and converted to that of 25℃.

e) Recharge the batteries after capacity test.

f) Make discharge curve from recording data.

Remark:

(1) For UPS batteries, off-line test is not recommended.

(2) When perform on-line test, switch the UPS to discharge-test mode if available. If no discharge-test mode, then disconnect AC power and discharge the batteries with load.

Note:

1) Above mentioned capacity tests are for routine maintenance use.Make sure the test is well arranged and safety of system is guarantied.

2) Before discharge test,preventative tests using multi-meter,IR or conductance tester is recommended.

3) In order to get correct result,calibrate the load,current precision before test.

Determination of backward battery.

The backward battery in the discharge of the terminal voltage is low, so the lagging battery should be measured in the discharge state. If the terminal voltage is tested in three continuous discharge cycles, which is lower than the average voltage of more than 5%, it can be judged as a lagging battery in the group.

Treatment of backward batteries.

1. When the battery is backward, the battery should be equalization charged.
2. If equalization charge can not solve the problem, you need to remove the battery from the battery pack, using battery activation instrument.
3. If single activation is still unable to solve the problem, please replace the battery.

4.3 Battery charging

4.3.1 Floating charge:

Charging parameters

Voltage:2.27~2.30V/cell(25℃)(set point of 2.27V/cell is recommended).

Max.initial current:0.30C

Temp. compensation coefficient:-3mV/℃. Per cell(from 25℃)

Voltage deviation allowed:±0.02V/cell.

Note:

1) The initial deviations of battery voltages in a group will reduce to a low level after a period of service, for example, after a half year.

2) Effects of lower or higher voltages:

Higher voltage(overcharge):Shorten battery life.

Lower voltage(under-charge):Low battery capacity and shorten battery life.

4.3.2 Equalization charging:

Parameters

Voltage:2.35~2.40V/cell(25℃)(set point of 2.35V/cell recommended)

Max.initial current:0.30C

Temp.compensation coefficient:-3mV/℃.cell(from 25℃)

Voltage deviation allowed:±0.02V/cell.

Condition of terminating equalization charge

Charging current drop to 0.01C

4.3.3 Cyclic charging:

Parameters

Voltage:2.43~2.47V/cell (25℃) (Set point of 2.45V/cell is recommended).

Max. initial current:0.30C

Temp.compensation coefficient:-4mV/℃.per cell(from 25℃)Voltage deviation allowed:±0.02V/cell

Recharge amount 1.1~1.2 times of the discharged capacity,upper level of recharge amount is selected when ambient temp.below 5℃.If discharge capacity is not sure,recharge the batteries according to the following table:

Ambient temp(℃)	Charging voltage (V/cell)	Charging time(h)
5	2.34	7
	2.51	4
20	2.30	7
	2.45	4

Ambient temp(℃)	Charging voltage (V/cell)	Charging time(h)
35	2.26	7
	2.39	4

Note:

1) Charging time in table four means charging period after voltage reaches the specified value,initial max. current is less than 0.3C.
2) Follow the above charging specifications,otherwise batteries will be overcharged or undercharged,service life of batteries will shorten.
3) Charge the batteries as per cyclic charging parameters after capacity test discharge.

4.4 Cautions

Measure the output voltage of equipment once every 2 hours for new installations for the initial 72 hours, to make sure the stable output of charging voltage.The output voltage should also be confirmed during yearly maintenance check preventing the deviations due to aging.

If a current value at final charging stage is over 0.05C, damage on battery service life may occur.

For cycle charging,timer is recommended to switchover to trickle charging mode, preventing over-charging.

For temperature other than 25℃,charge voltage setting need to be compensated as formula:

$UT = U_{25℃} - K \times (T-25)$(T—actual temperature,

K—compensation coefficient)

Judging on completion of charging

When one of the following conditions occurs, charging is considered

be completed.

1) Charging amount reaches 1.1~1.2 times of discharged value.
2) Charging current is less than 0.005C at final stage of charging.
3) Charging current keeps stable for 3 hours.

4.5 Hydrogen emission volume during charging

Ambient temp(℃)	Hydrogen volume(ml/cell/Ah(C10)/month)		
	RA	RL	FT
2.27~2.30	3.8	1.5	3.2
2.43~2.47	25	12	24

For example:Hydrogen emission volume of RA12-100 under floating charging at 13.62V is 3.8×6×100=2280ml/month

03

Maintenance

1. Cleaning

Keep batteries and battery room clean and dry.

Avoid inducing of static electricity during cleaning of batteries.

Use damp cloth for cleaning, don't use gasoline, alcohol and other organic solvents.

2. Check and maintenance

Perform following routine checks and keep records.

2.1 Monthly inspection items

Items	Details	Benchmarks	Maintenance
1.Total battery group voltage	Use multi-meter to check total voltage across positive and negative terminals	1.The value of measured and displayed on equipment should be close. 2.Voltage error after compensation should be less than ±50mV	Adjust the charging voltage to recommended range if there is a deviation; Repair the equipment if voltage can't be adjusted

Items	Details	Benchmarks	Maintenance
2.Battery appearance	Bulge, leakage or damage	Appearance should be ok	Replace the battery if there is bulge,leakage or damage
	Dust, dirty	Clean	Cleaning
	Connectors, terminals	No rust	Clean and antirust dealing
3.Battery surface temperature	Use infrared thermometer to measure surface temperature	Less than	Further check and analysis if the temperature is high
4.Connections	Use torque wrench to check connection hardware	Refer to torque values	Re-tight if there is a loose connection
	Connector appearance	No rust	Clean or replace if rusted connectors is found
5.Valve plug check(2V batteries)	Loose plug check	Plug should be tight,no loose	Re-tight the loose plug
	Soap water to check air-tightness	Intermittent bubbles	Further check if no bubble or frequent bubbles
6.Switch-over	Disconnect AC power,switch-over to UPS,or DC power	Switch-over is smooth	Further check if there is a problem

2.2 Quarterly inspection items

Items	Details	Benchmarks	Maintenance
1.Float voltage for each battery	Measure the voltageof each battery under floating, using a meter with four and half digits	Voltage differences less than 2V: 90mV 6 V: 240mV 12 V:480mV	If there is a deviation, discharge the batteries and perform a equalizing charging, observe for one through two months under floating. Contact us if no improvement
2.Correct the low voltage batteries	1. Charging the whole battery group, using equalizing voltage and discharge for one through three times. 2. Use a charger to repair the individual battery	Voltage differences less than 2V: 90mV 6 V: 240mV 12 V:480mV	Replace the battery if can't be corrected
3.Activated discharge	Perform a discharge-charge cycle, using lower level of equalizing charge voltage for the charge.	Discharge around 30% of the nominal capacity.	Perform the discharge-charge cycle if no power-off for six months.

2.3 Annual inspection items

Items	Details	Benchmarks	Maintenance
1.Check-up discharge	Disconnect the AC power and discharge the battery to a DOD of 30%～40%	The final voltage should be greater than 1.90V/cell.	Perform a equalizing charge if voltage less than 1.90V/cell. Observe for one through two months. Contact us if no improvement
2.Capacity test	Discharge battery at I_{10} current to 1.80V/cell	Remained capacity higher than 80%	Replace the battery of low capacity

Requirements and cautions

1).Insure personal and utilities safe during check operation.

2).Follow the instructions of operation and keep records.

3).Refer to recommended parameters of batteries.

4).Wear preventative clothes, use insulated tools.

5).Use calibrated tools and meters

04

After-sales service

1. General Inspection

Inspection of General Aspect,Terminal, Weight,OCV, Internal Resistance.

2. Repair and Testing(After Item1# General Inspection is ok)

2.1 Constant Voltage Recharge:

Limited recharge voltage at 2.5V/cell,0.1C current recharge 12 hours.

After 2hours on standing,Inspection of Battery OCV, Weight, Internal Resistance and C10 or C20 Capacity Discharge.

2.2 Constant Current Recharge:

0.05C recharge 2hours + 0.1C current recharge 6hours + 0.05C recharge 4hours.

After 2hours on standing, Inspection of Battery OCV, Weight, Internal Resistance and C10 or C20 Capacity Discharge.

2.3 Active and Repair:

0.1C current discharge battery to 0V, constant current recharge 0.05C current recharge 6hours + 0.15C current recharge 4hours + 0.1C current recharge 6hours + 0.05C current recharge 6hours.

After 2hours on standing, Inspection of Battery OCV, Weight, Internal Resistance and C10 or C20 Capacity Discharge.

05

Cautions

1. Keep batteries away from children's reach.
2. Use a battery for it's specified application, don't misuse a battery, avoiding fire, explosion or corrosion.
3. Don't disassemble, rework, impact, toss a battery, avoiding fire, explosion or corrosion.
4. Don't put a battery in water, fire, or heat a battery.
5. Don't short-circuit a battery across the terminals.Wear preventative clothes and use insulated tools when battery group voltage exceeds 450V.
6. Don't lean on or over a battery during test or maintenance, keep a certain range from the battery.
7. Battery contains acid, wash immediately if acid spoil on cloth, skin, or eye. See a doctor if necessary.
8. To use batteries in 25±5℃ for a long service life.

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