

Technical Manual

GEL SERIES VALVE REGULATED LEAD-ACID BATTERY



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Prolegomenon

In order to use Ritar GEL series battery correctly and safely, please read this technical manual and other data together with battery carefully for a comprehensive understanding.

- ★ Pay attention to safety during installation to avoid accident.
- ★ It is required for users to read this manual carefully and keep it well.
- ★ If you have any questions about the Technical Manual or any technical problems, please contact us or our local agent.

Dangerous!				
				
High Voltage..... Don't touch any terminals or connectors without insulation to avoid electric shock.	Eyes Protection: Gas from explosion may harm eyes or even cause blindness.	Prohibition: Sparks, fire and smoking.	Vitriol: May cause blindness or severe burns.	Wash eyes with clean water immediately and go to see a doctor.
Do not loosen the safety vales.		Keep the battery in a well ventilated environment when in operation.		
Please read carefully the installing and using instructions in this manual.		Battery maintenance and repair should be conducted by experienced technicians.		

1 Application Range

This manual is applied to the following Nano Silicon GEL series battery (hereafter referred to as battery).

GEL Battery Parameters (GEL Standby Series)

Model	Voltage (V)	Capacity (20hrs@25°C) (AH)	Dimension (mm)			Weight (kg)	Termina
			Length	Width	Height		
RT12260G	12	26	166	175	125	8.2	F3/F13
RT12260SG	12	26	166	175	125	8.2	T24
RT12280G	12	28	166	175	125	9.2	F3/F13
RA12-33G	12	33	195	130	159	10.2	F7/F11
RA12-40G	12	40	198	166	171	13.5	F4/F11
RA12-45G	12	45	198	166	171	14.0	F4/F11
RA12-55G	12	55	229	138	210	18.0	F11/F15
RA12-60G	12	60	260	169	210	20.5	F11/F15
RA12-65G	12	65	350	167	180	21.0	F5/F11
RA12-70G	12	70	350	167	180	23.0	F5/F11
RA12-70SG	12	70	260	169	210	21.5	F11/F15
RA12-75G	12	75	260	169	210	23.5	F11/F15
RA12-80G	12	80	350	167	180	24.0	F5/F11
RA12-85G	12	85	306.5	169	210	26.0	F11/F15
RA12-90G	12	90	306.5	169	210	28.5	F11/F15
RA12-100G	12	100	328	172	222	30.0	F5/F12
RA12-120G	12	120	409	177	225	36.0	F5/F12
RA12-134G	12	134	340	173	280	41.5	F12
RA12-145G	12	145	340	173	280	44.0	F12
RA12-150G	12	150	483	170	240	45.0	F5/F12
RA12-160G	12	160	530	209	214	53.0	F12
RA12-180G	12	180	530	209	214	54.0	F12

(GEL Standby Series)

Model	Voltage (V)	Capacity(20hrs@25℃) (AH)	Dimension (mm)			Weight (kg)	Termina
			Length	Width	Height		
RA12-200G	12	200	522	240	219	60.0	F12/F16
RA12-225G	12	225	522	240	219	65.0	F12/F16
RA12-230G	12	230	521	269	203	69.0	F12
RA12-260G	12	260	520	268	220	74.0	F14
RA12-55FG	12	55	227	106	222	18.0	F11
RA12-90FG	12	90	563	114	188	24.0	F6
RA12-105FG	12	105	508	111	236	32.5	F8
RA12-110FG	12	110	394	109	285	33.0	F9
RA12-125FG	12	125	551	109	239	36.0	F9
RA12-135FG	12	135	551	109	239	41.0	F9
RA12-150FG	12	150	555	110	288	45.0	F9
RA12-160FG	12	160	555	110	288	49.5	F9
RA12-170FG	12	170	555	110	288	51.0	F9
RA12-180FG	12	180	560	125	316	53.5	F9
RA8-150G	8	150	260	182	295	33.0	F16
RA6-100G	6	100	194	170	205	16.5	F14
RA6-150G	6	150	260	180	247	23.5	F12
RA6-180G	6	180	306	168	222	28.0	F12
RA6-200G	6	200	322	177.5	226	30.0	F14/F16
RA6-200SG	6	200	260	180	247	32.0	F12
RA6-225G	6	225	322	177.5	226	32.0	F14/F16
RA6-225SG	6	225	243	187.5	275	32.0	F14
RL250G	2	50	166	50	166	4.5	F11
RL2100G	2	100	171	72	206	6.5	F10
RL2150G	2	150	172	102	205	8.0	F10
RL2200G	2	200	171	111	366	15.0	F10
RL2250G	2	250	171	150	365	18.0	F10
RL2300G	2	300	171	150	365	20.0	F10
RL2350G	2	350	211	176	329	24.0	F10
RL2400G	2	400	211	176	329	27.0	F10
RL2450G	2	450	242	172	329	29.0	F10
RL2500G	2	500	242	172	329	32.0	F10
RL2600G	2	600	302	175	328	41.0	F10
RL2650G	2	650	302	175	328	42.0	F10
RL2800G	2	800	411	175	327	53.0	F10
RL21000G	2	1000	479	175	327	65.0	F10
RL21200G	2	1200	479	175	327	76.0	F10
RL21500G	2	1500	401	352	338	100.0	F10
RL22000G	2	2000	490	349	338	132.0	F10
RL22500G	2	2500	712	351	338	178.0	F10
RL23000G	2	3000	712	351	338	201.0	F10

(GEL Deep Cycle Series)

Model	Voltage (V)	Capacity(20hrs@25℃) (AH)	Dimension (mm)			Weight (kg)	Termina
			Length	Width	Height		
RT12240DG	12	24	166	175	125	8.2	F3/F13
RT12260DG	12	26	166	175	125	9.2	F3/F13
RT12260SDG	12	26	166	175	125	9.2	T24
RA12-33DG	12	33	195	130	159	10.2	F7/F11
RA12-40DG	12	40	198	166	171	13.5	F4/F11
RA12-55DG	12	55	229	138	210	18	F11/F15
RA12-65DG	12	65	350	167	180	22.2	F5/F11
RA12-70SDG	12	70	260	169	210	23.0	F11/F15
RA12-75DG	12	75	260	169	210	23.5	F11/F15
RA12-80DG	12	80	350	167	180	24.0	F5/F11
RA12-80HDG	12	80	350	167	180	25.0	F5/F11
RA12-80SDG	12	80	260	169	210	24.8	F11/F15
RA12-85DG	12	85	307	169	210	26.8	F11/F15
RA12-90DG	12	90	307	169	210	28.5	F12/F15
RA12-100DG	12	100	328	172	222	30.0	F5/F12
RA12-120DG	12	120	407	177	225	36.0	F5/F12
RA12-134DG	12	134	340	173	280	41.5	F12
RA12-145DG	12	145	340	173	280	44.0	F12
RA12-150DG	12	150	483	170	240	45.0	F5/F12
RA12-160DG	12	160	530	209	214	48.0	F12
RA12-180DG	12	180	530	209	214	49.0	F12
RA12-200DG	12	200	522	240	219	60.0	F12/F16
RA12-230DG	12	230	521	269	203	69.0	F12
RA12-260DG	12	260	520	268	220	74.0	F12
RA12-55FDG	12	55	227	106	222	18.0	F11
RA12-90FDG	12	90	563	114	188	24.0	F6
RA12-105FDG	12	105	508	111	236	32.5	F8
RA12-110FDG	12	110	394	109	285	33.0	F9
RA12-125FDG	12	125	551	109	239	36.0	F9
RA12-135FDG	12	135	551	109	239	41.0	F9
RA12-150FDG	12	150	555	110	288	45.0	F9
RA12-160FDG	12	160	555	110	288	49.5	F9
RA12-170FDG	12	170	555	110	288	51.0	F9
RA12-180FDG	12	180	560	125	316	53.5	F9
RA8-150DG	8	150	260	182	295	33.0	F16
RA6-100DG	6	100	194	170	205	16.5	F14
RA6-150DG	6	150	260	180	247	23.5	F12
RA6-180DG	6	180	306	168	222	28.0	F12
RA6-200DG	6	200	322	177.5	226	31.0	F14/F16
RA6-200SDG	6	200	260	180	247	30.0	F12
RA6-225DG	6	225	322	177.5	226	32.0	F14/F16

(GEL Deep Cycle Series)

Model	Voltage (V)	Capacity (20hrs@25°C) (AH)	Dimension (mm)			Weight (kg)	Terminals
			Length	Width	Height		
RA6-225SDG	6	225	243	187.5	275	32.0	F14
RA6-225SHDG	6	225	243	187.5	275	33.0	F14
RL2200DG	2	200	171	111	366	15.0	F10
RL2250DG	2	250	171	150	365	18.0	F10
RL2300DG	2	300	171	150	365	20.0	F10
RL2350DG	2	350	211	176	329	24.0	F10
RL2400DG	2	400	211	176	329	27.0	F10
RL2450DG	2	450	242	172	329	29.0	F10
RL2500DG	2	500	242	172	329	32.0	F10
RL2600DG	2	600	302	175	328	41.0	F10
RL2650DG	2	650	302	175	328	42.0	F10
RL2800DG	2	800	411	175	327	53.0	F10
RL21000DG	2	1000	479	175	327	65.0	F10
RL21200DG	2	1200	479	175	327	76.0	F10
RL21500DG	2	1500	401	352	338	100.0	F10
RL22000DG	2	2000	490	349	338	132.0	F10
RL22500DG	2	2500	712	351	338	178.0	F10
RL23000DG	2	3000	712	351	338	201.0	F10

2 Check

1. After receiving the batteries, please check the packing and make sure the batteries are intact. Avoid bumping during carrying, and be careful when open the cartons.
2. Please open the cartons near the installation place and check appearance and quantity of the battery accessories after opening.
3. It's difficult to detect leakage if there are slight damages on the battery shell. Please check carefully and make sure there is no damage or leakage on the battery shell.
4. If the battery falls to the ground or its shell is bumped abnormally, please report the details to our company for confirmation and aftermath arrangement.

3 Storage before Installation

1. Storage Environment
If the battery is not installed immediately after being received, please store it in a clean, ventilated and dark place at around 5~30°C.
2. Storage Time
Due to self-discharge, the battery capacity will lose gradually in storage. Do not store the battery for more than 12 months or it will affect the battery performance eternally. After being stored for 6 months, the battery should be charged in voltage of $2.40 \pm 0.1V$ for 24 hours and hereafter should be recharged at least once every 6 months. A relatively high temperature will accelerate the battery self-discharge; from 20°C when the temperature increases every 10°C, recharging interval should be reduced half. For example, when the battery is stored at 35°C, its initial charging or recharging interval should be 3 months.
If the battery is not charged properly, its performance and life will be affected and cause the normal guarantee invalid.

4 Installation Cautions

1. Before touching the battery, please wear a rubber apron, rubber gloves, safety goggles or other eyes protection equipments; do not wear metal objects, such as jewelry etc.
2. The battery is very heavy. Be careful and do not pump the battery when moving it.
3. Smoking or lighting fires are strictly forbidden. Keep the battery away from electric arc.
4. Avoid short circuit. The battery has been charged and please prevent battery from short circuit to avoid equipment damage or personal injury.
5. Put the battery in a cool and well ventilated place. Do not install the battery in a place that is possible to be immersed by water.
6. Fix the bolts and nuts on the connection terminals to the specified torque; otherwise it may cause sparks or damages to the terminals.
7. Please clean the battery shell and cover with a wet cloth; to prevent static and spark, do not use a duster or a dry cloth to clean the battery. It's prohibited to use organic solvent such as rubber solution or naphtha, which will cause the battery shell cracking.
8. In normal operation, there will be no dissociative electrolyte attached on the shell after battery gets fully sealed. However, if the battery shell is damaged, dissociative vitriol is possible to leak. In case electrolyte splashes onto eyes, skin or clothes, flush it with a large quantity of water. If it splashes into eyes, after rinsing with water, please go to see a doctor promptly.
9. Make sure the positive (+/red) and negative (-/black) terminals are connected properly, otherwise it will cause fire or damages to the battery or charger.
10. Please use the following protection equipments when you carry, install and maintain the battery.
 - 1) Safety goggles or protective face-shield;
 - 2) Acid-resistant gloves;
 - 3) Acid-resistant apron, safety shoes;
 - 4) Proper carrying instruments;
 - 5) Insulation instruments.
11. Battery posts, terminals and fittings contain lead or lead compound; and other chemical compositions in the battery are harmful to personal health.

Wash your hands after touching the battery!

5 Battery Features

1. Long Service Life
Heavy duty lead-calcium grids ensure mild corrosion and enable a long designed service life of 10 years standby use under optimal float charge conditions and below optimal operating temperature of 25°C.
2. Patent Designed Construction
RITAR batteries are equipped with PE compound separator construction, which ensures that gel electrolyte is distributed evenly through-out the inner battery and ensures the best evenness of all parts of the battery.

3.Triplex Sealed Construction

Valve regulated sealed construction and triplex strengthened sealing on terminals and posts prevent electrolyte leakage, and guarantee the air tight and liquid tight state of batteries in normal operation and prevent external air from entering battery inner.

4.Low Self Discharge

Because of the use of lead-calcium grids alloy, RITAR batteries have low self discharge and reliable performance. In room temperature, self discharge ratio per month of RITAR battery is about 3% of the battery capacity.

5.High Security

RITAR batteries are equipped with explosion-proof safety valves to prevent production of redundant gas. And the construction is designed to prevent setting fire to the internal battery in case sparkles approach.

6.High Efficiency of Recovery

Unique formulas are used in lead paste of positive post and ensure the battery can be recharged easily to a normal level.

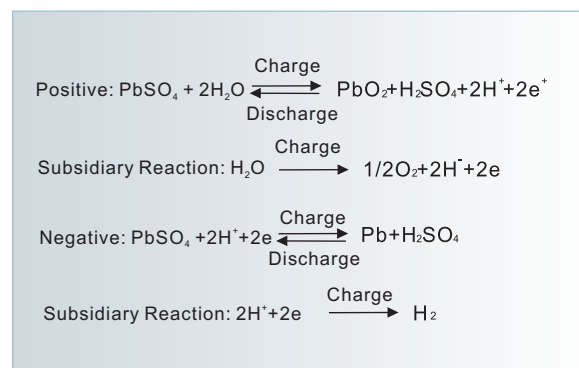
7.No Electrolyte Stratification

Special additives are use in electrolyte to give it a gelatinous consistency without flowing, leaking or stratification, and make all parts of plates react evenly.

6 Operating Principle

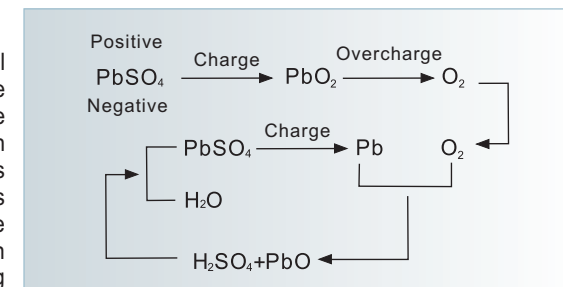
1.Electrochemistry

A lead-acid battery is an electrical storage device that converts electrical energy into potential chemical energy; when needed the stored chemical energy can be converted back into electrical energy again to be supplied to external systems. In the discharge state, part of PbO_2 at the positive turns into $PbSO_4$, and part of Pb at the negative also turns into $PbSO_4$. In this electro-chemical reaction, both positive and negative electrodes generate $PbSO_4$. In the charging state, the lead sulfate ($PbSO_4$) at the positive and negative turns into PbO_2 and Pb , respectively. When in discharging, the concentration and density of electrolyte H_2SO_4 decreases gradually; while in charging, it increases. Battery charging and discharging are realized by electrochemical reactions.



2.Oxygen Combination

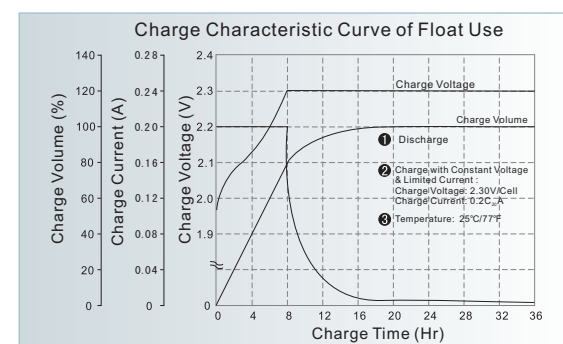
The positive plate generates oxygen gas in the final stage of charging. Under the condition of excessive additives at the negative, oxygen spreads to the negative plates through PE compound separator and reacts with spongy lead and forms lead oxide and then turns into lead sulfate and water. Keep the negative plates in depolarization or undercharge state so that the battery cannot reach the overpotential of oxygen gassing. Thus the battery avoids oxygen gassing and water loss and is made a maintenance free sealed storage battery.



7 Battery Charge, Discharge & Life

1. Charge Characteristics

Charge condition is one of the important factors in battery use. The battery performance and service life are directly related to its charging methods and charging parameters in using. The battery is recommended to be charged at the temperature range of 5-30°C . At any temperature lower than 5°C or higher than 35°C it will cause undercharge or overheating and then decrease the battery life.



2. Charge Curve of Float Use

3. Relationship between Float Charge Voltage and Environment Temperature

At general temperature (5°C~30°C), float charge voltage is 2.25V~2.30V. The batteries for float charge service adopt the constant voltage but limited current method. The initial current is 0.1C₂₀A and the maximum current is 0.2C₂₀A.

1) At 25°C, the float charge voltage of 2V battery is 2.27V per cell.

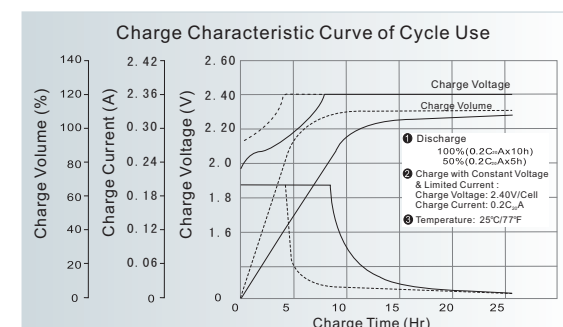
2) When the ambient temperature changes, the float charge voltage should be adjusted. The temperature compensation coefficient is -3mV/, i.e., U_{float}=「2.25 - 0.003(t-20)」 * n.

4. Charge Curve of Cycle Use

The batteries for cycle service adopt the constant voltage but limited current method. At 20°C ~25°C , the charge voltage of GEL series battery is 2.40V per cell; the initial charge current is not larger than 0.2C₂₀A and the battery fully charges in approximately 24 hours.

In the final stage of charging, if the charge current value remains unchanged for 3 hours, it indicates that the battery is fully charged.

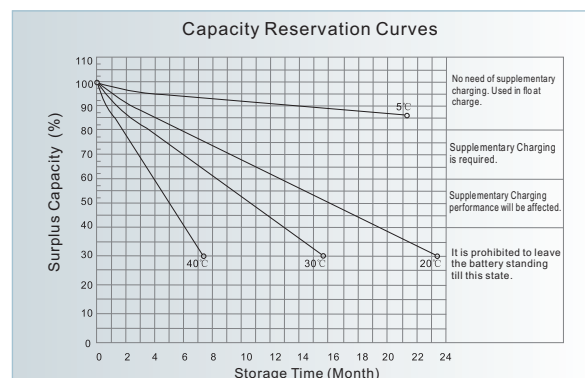
Charge curves are as right.



5. Supplementary Charging

Due to self discharge, battery stocked longtime, the capacity reduce slowly, the relationship between capacity reservation, temperature and stock time as right curves.

Supplementary Charging adopts the constant voltage but limited current method. Initial charging current is $0.05 C_{20} - 0.1 C_{20}$, charging voltage is 2.35 - 2.4V/Cell, generally charge for 36 hours. After longtime storage, before use, battery should be makeup charged.



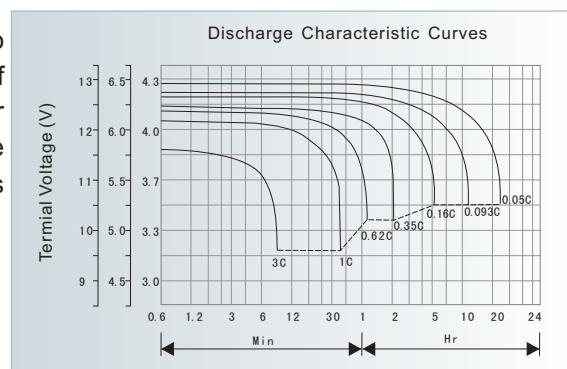
Storage Time vs Charge Voltage and Charge Time

Storage Time (Month)	Charge Voltage (V/Cell)	Maximum Charge Current (A)	Charge Time (Hr)
3~6	2.35	$0.2 C_{20}$	36
6~12	2.40	$0.2 C_{20}$	48
12~20	2.40	$0.2 C_{20}$	60

6. Discharge Characteristic

Discharge rate is different, the cutoff voltage also different. Higher discharge current, lower cutoff voltage; reversely, lower discharge current, higher cutoff voltage. Normally the battery cutoff voltage set at 1.80 - 1.6V. The discharged capacity is lower with higher discharge current.

Discharge characteristic curves are as right:



Discharge Capacity vs Temperature

Battery discharge capacity is related with temperature. Lower temperature, lower capacity discharged; higher temperature, higher capacity discharged. But the too high temperature will seriously damage the battery lifetime. The best working temperature for battery is 20- 25°C. The discharged capacity at different temperature C_t vs Discharged capacity at 25°C C_{25} have below relationship:

$$C_{25} = \frac{C_t}{1 + K(t - 25)}$$

C_{25} Discharged capacity at 25°C (AH)

C_t Discharged capacity at t°C (AH)

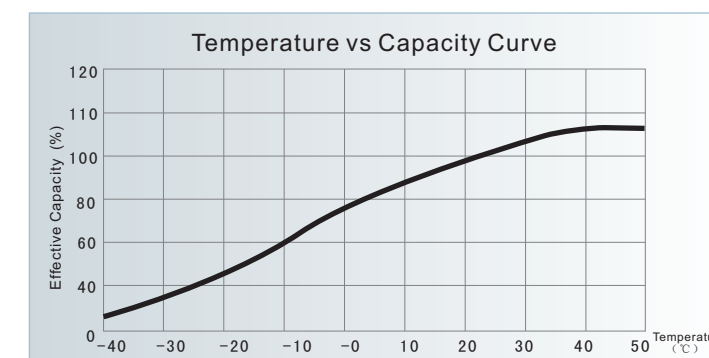
t Environment temperature during discharge (°C)

K Temperature compensation coefficient

20Hr rate discharge : $K=0.006/°C$; 5Hr rate discharge : $K=0.007/°C$

3Hr rate discharge : $K=0.008/°C$; 1Hr rate discharge : $K=0.010/°C$

Temperature vs Capacity Curves as below:



7. Float Life Characteristic

At recommended float charging situation at 25°C, GEL battery design life is over 10 years. Battery's usage lifetime is related with ambient temperature, depth of discharge, discharge rate and float charging voltage. In real usage, deep discharge, frequent discharge, and incorrect float charging voltage will affect the battery lifetime directly.

Float Life characteristic curves are as below:

Float Lifetime vs Temperature

According to Arrhenius equation, battery design life fluctuated with temperature, temperature increased every 10degree, the float lifetime cut half.

$$\ln \frac{K_1}{K_2} = \frac{E_a}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$$

K_1 : Equal constant at T_1 temperature

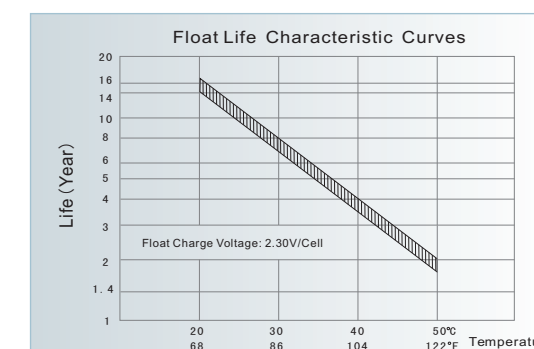
K_2 : 1 (Equal constant at T_2 temperature)

E_a : activation energy

R: air constant, 8.3143J·mole·K⁻¹

T_1 : environment temperature at during discharge, K

T_2 : standard temperature 293K



Float Charge Voltage (V)	Battery Actual Float Life at Different Temperature (Year)				
	20°C	25°C	30°C	40°C	50°C
2.30	15.0	10.6	7.5	3.7	1.9

8 Record

The operating record of fixed batteries is very important for battery maintenance and protection. This information is useful for user to confirm battery life and adjust the longevity.

Battery is allowed to operate at a temperature lower than 25°C, however, the charging time will be relatively long. After installing batteries and a week of float charge, it's required to record the following information:

- 1) Battery terminal voltage
- 2) Charger voltage
- 3) Float charging voltage of each battery
- 4) Internal resistance of each battery. Within the same battery, put the meter that tests internal resistance at the two terminals that is in farthest diagonal position.
- 5) Environment temperature
- 6) Check if all the connecting points have been fixed to the proper torque (11.3N.M). Use a milliohm meter to test internal resistance of each connecting strip. Conduct the test according to the probe position on the instruction manual. If the data range is 20% bigger than that during installation, fix screws again to the torque of 11.3N.M. If the data remains high, please wipe terminals and the interface between terminals and connecting strips.

9 Maintenance

Put mask or protective glass when approach battery, make sure not put battery next to fire/smoking place.

It can prolong battery life and easy to judge when battery need replacement by proper maintenance. If the maintenance way differs from this manual, users can only make the maintenance method according to battery usage and using reliability. All maintenance needs the professionals to execute.

1. Checking

Try to make all checking under float charging conditions. Measurements should be made according to specification from suppliers and keep the records for future collation.

1. 1 Monthly checking

Record for monthly checking:

1. 1. 1 All batteries float charging voltage
1. 1. 2 Current and voltage from charger
1. 1. 3 Temperature, ventilation and monitor equipments situation.
1. 1. 4 Eye check record for battery string:
 - 1) Battery appearance: terminal, connector, any corrosive phenomena with battery rack.
 - 2) The clearance region between batteries and rack
 - 3) Any phenomena of crack or leakage for battery
 - 4) Any phenomena of deformation for battery and rack

1. 2 Quarterly checking

Apart from checking items of above 1.1 as quarterly checking, plz also checking following issues and keep record. (Need to collate with previous records.)

- 1) Resistance per block
- 2) Temperature of negative terminal for each battery
- 3) Check connect resistance at random (at least check 10% or not less than 6 connectors), if resistance is higher than initial resistance, then need to check all connectors' resistance and dig out reason. (Plz check different connectors each time)

1. 3 Yearly checking and initial checking

Apart from checking items of above 1.1 and 1.2 as yearly checking, plz also checking following issues and keep record (Need to collate with previous records.)

- 1) Check all connector resistance;
- 2) Try to check AC current and voltage from rectifier.

1. 4 Special checking

Batteries need inspection to check if they were get damaged in special situation (like over-discharge, abuse charging machine or charging machine can not work properly ect). The inspection includes all yearly checking clause and make records.

2. Ripple Voltage of rectifier

We recommend ripple Voltage of rectifier should not be bigger than 0.5% of charging voltage, and librating ripple time should be shorter than 8 millisecond.

3. Battery cleaning

Use water or carbonic acid water to clear battery and cover.

4. Capacity test

If batteries can work properly, no need to check capacity. Only to check capacity when doubt battery capacity. Battery cut voltage after discharge should not be lower than suppliers specification.

Before capacity testing, make sure battery get fully charged for more than 48 hours under float charge, if not, make a equalization charge for 24 hours then let batteries rest for 8-24 hours.

10 Common Faults & Solutions

No.	Common Fault	Solution
1	Leakage	Pls contact the supplier for replacements.
2	Crack	Pls contact the supplier for replacements.
3	Low floating V.	After 24-48hrs equalization charger, still low,
4	Battery less capacity	After 24-48hrs equalization charger, still low,
5	High temp.round pole	Inspect connect point, charger, ventilation and charging current.
6	Abnormal Appearance	Pls contact the supplier for replacements.
7	Grounding Fault	Check leakage or ground faulty.
8	Abnormal connect & inner resistance	Check good connect or charging method.



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