

OPzV SERIES SEALED VALVE-REGULATED TUBULAR GEL BATTERY

USER MANUAL

Energy Storage Systems · Rail Transit Systems ·
Power Systems · Telecommunications



PROVIDE YOU WITH COMPREHENSIVE BATTERY SOLUTIONS

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BECOME AN OUTSTANDING LEADER IN THE POWER SUPPLY WORLD



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1 Foreword

Thank you for your understanding and support of Ritar Power. This "User Manual" is specially compiled to enable customers to use the OPzV Series Tubular Gel Batteries (hereinafter referred to as the battery) correctly and safely.

Please read this manual and other materials attached to the product carefully before use to fully understand its content.

- ⚠ Pay special attention to safety during construction to avoid accidents.
- ⚠ Users are required to read this manual carefully and keep it properly.
- ⚠ If you have any questions about this "User Manual" or need to discuss related technical issues, please contact our company or agents.

Safety and Warning Signs



Please follow the instructions and keep them near the battery for reference. Only professionals should operate the battery, paying attention to the precautions in the manual



Keep away from any open flames or ignition sources



Wear protective clothing and glasses when handling the battery



Use appropriate tools for transportation and handle with care



If acid splashes onto skin or eyes, rinse with clean water and seek medical attention promptly



Non-standard malicious operation risks fire and explosion



Waste batteries should be recycled by formal recycling agencies or the manufacturer



The electrolyte is Under normal working conditions, contact with electrolyte is impossible, but if the battery is damaged and electrolyte leaks, do not touch it



Do not discard waste batteries arbitrarily



Batteries are shipped charged; avoid short circuits



Keep upright during transportation and storage; do not invert or lay on side

2 Working Principle Product Standards Model Number Explanation

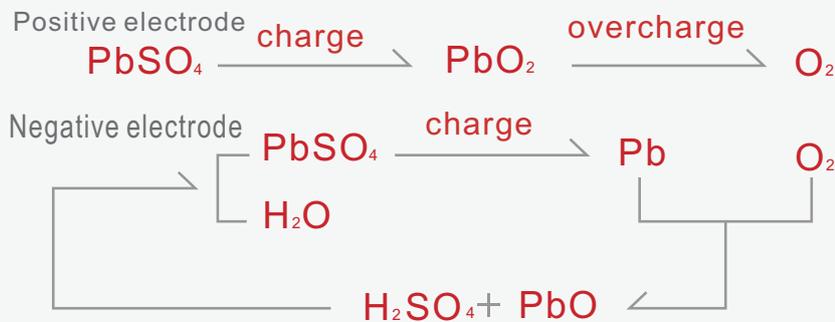
1. Electrochemical Theory

The battery is a device that stores electrical energy in the form of chemical energy and converts chemical energy back into electrical energy when needed, supplying it to external electrical systems. According to the "double sulfate" theory, during battery discharge, part of the PbO_2 on the positive electrode is converted to H_2SO_4 , and part of the Pb on the negative electrode is also converted to $PbSO_4$. During battery charging, the H_2SO_4 on the positive and negative electrodes is converted back to PbO_2 and Pb , respectively.



2. Oxygen Recombination Reaction

When the positive electrode is charged to about 70%, oxygen begins to evolve. Provided the negative active material is in excess, oxygen diffuses to the negative plate and reacts with spongy lead to form PbO . PbO continues to react with H_2SO_4 , in the electrolyte to form $PbSO_4$ and H_2O . This keeps the negative plate in a depolarized or undercharged state, preventing it from reaching the hydrogen evolution potential. The battery does not release gas, thus it does not lose water, eliminating the need for additional water throughout its life cycle.



Product Standards, Model Number Explanation

The OPzV series tubular gel batteries comply with standards such as IEC60896-21/22, GB/T19638.1-2014, YD/T1360-2005, etc.

The meaning of OPzV2-200

OPzV 2 - 200



3 Product Specification

Battery Model	Rated voltage	C10 Capacity (Ah@1.80V/cell)	Battery Dimensions(mm)				Terminal Option
			Length	Width	Height	Total Height	
OPzV12-60	12	60	260	169	211	216	F11(M6)
OPzV12-80	12	80	328	172	215	220	F12(M8)
OPzV12-100	12	100	407	177	225	225	F12(M8)
OPzV12-120	12	120	483	170	241	241	F12(M8)
OPzV12-140	12	140	532	207	214	219	F12(M8)
OPzV12-160	12	160	532	207	214	219	F12(M8)
OPzV12-180	12	180	522	240	219	224	F10(M8)
OPzV12-200	12	200	521	268	220	225	F14(M8)
OPzV2-200	2	200	103	206	355	390	F10(M8)
OPzV2-250	2	250	124	206	355	390	F10(M8)
OPzV2-300	2	300	145	206	355	390	F10(M8)
OPzV2-350	2	350	124	206	470	505	F10(M8)
OPzV2-420	2	420	145	206	470	505	F10(M8)
OPzV2-490	2	490	166	206	470	505	F10(M8)
OPzV2-770	2	770	254	210	470	505	F10(M8)
OPzV2-600	2	600	145	206	645	680	F10(M8)
OPzV2-800	2	800	191	210	645	680	F10(M8)
OPzV2-1000	2	1000	233	210	645	680	F10(M8)
OPzV2-1200	2	1200	276	210	645	680	F10(M8)
OPzV2-1500	2	1500	275	210	795	830	F10(M8)
OPzV2-2000	2	2000	399	214	770	805	F10(M8)
OPzV2-2500	2	2500	487	212	770	805	F10(M8)
OPzV2-3000	2	3000	576	212	770	805	F10(M8)

Remark: the battery shell and cover have flame retardant performance, and the default flame retardant grade is UL94-HB (UL94-V0 optional)

4 Battery Transportation and Storage

Due to the heavy weight of the battery, attention must be paid to the selection of transportation vehicles. Rolling and throwing are strictly prohibited.

- 1 Avoid Inverting the Battery
- 2 Do not touch the terminals and safety valves when moving the battery
- 3 Batteries are shipped fully charged; short circuits should be prevented during transportation
- 4 If the battery is not installed immediately after receipt, it should be stored in an environment of 0°C to 30°C as much as possible. The storage location should be clean, ventilated, dry, without direct sunlight, and avoid contact with organic solvents
- 5 Due to the self-discharge characteristics of the battery, it will gradually lose capacity during idle storage. Do not store it for a long time, otherwise it will cause irreversible damage. Recharge the battery every 3 months at 25 °C, with a maximum interval of 6 months
- 6 High temperature or poor ventilation during battery storage and transportation will increase self-discharge
- 7 When the battery is stored or transported already installed in equipment, the battery should be completely disconnected from the equipment
- 8 When the battery has been stored for 6 months, it is recommended to perform an equalizing charge at 2.30V/cell~2.35V/cell, current limited, for 24 hours. Thereafter, re-equalize charge should be performed at each storage interval (not exceeding 6 months). At higher storage temperatures, battery self-discharge accelerates; for every 10°C increase from 20°C, the recharge interval should be halved. For example, when the battery is stored at an ambient temperature of 35°C, the initial/recharge time interval should be 3 months. Failure to perform supplementary charging according to the specified storage interval will affect battery performance and life, and may cause the battery to fail within the normal warranty period

5 Battery Usage Conditions

- 1 Series Use: Recommended system DC voltage is within 600V. If it exceeds 600V, please file a record with our company so that our technical personnel can provide correct guidance; if the system DC voltage exceeds 380V, it is recommended to add insulation measures such as leak-proof trays or insulating plates
- 2 Parallel Use: Recommended for up to 4 groups. If it exceeds 4 groups, please file a record with our company so that our technical personnel can provide correct guidance
- 3 Multi-layer installation: Control the temperature difference between layers within 3°C
- 4 Batteries are defaulted to be placed upright. If placed on their side, the plate surface must be perpendicular to the horizontal plane. If side placement is required, please contact our technical personnel
- 5 Heat dissipation conditions: Maintain a distance of more than 10mm between batteries
- 6 Ventilation conditions: Ensure the volume concentration of released hydrogen is less than 0.8%
- 7 Float use conditions (25°C): Float voltage 2.23V/cell to 2.25V/cell, temperature compensation coefficient: -3mV/°C/cell
- 8 Equalizing charge conditions (25°C): Equalizing voltage 2.30V/cell to 2.35V/cell, temperature compensation coefficient: -4mV/°C/cell; current limited, time limit within 24 hours. For stationary applications, it is recommended to perform equalizing charge every 3 months. For energy storage applications, please consult our technical personnel
- 9 Battery charging temperature limit range: 0°C to +50°C, discharge temperature limit range: -40°C to +60°C, storage temperature limit range: -40°C to +60°C; optimal operating temperature range: 20°C to 25°C; for every 10°C increase above 25°C, battery life is reduced by half
- 10 Regarding battery usage: Products of different specifications, ages, manufacturers, capacities, and performances cannot be mixed. If mixing is required, please contact our company and file a record so that our technical personnel can focus on inspection
- 11 For the above requirements that need filing, if the customer fails to do so, any loss caused by improper use by the customer shall be borne by the customer

6 Battery Installation And Use

Unpacking Inspection

- 1 After the battery arrives, first carefully check if the packaging is abnormal. During handling, do not apply force to the terminal area to prevent terminal damage and seal cracking
- 2 Unpack as close to the installation site as possible. After unpacking, please check the appearance, type, quantity, etc., of the battery and accessories
- 3 Avoid using any conductor to short-circuit the battery when unpacking
- 4 When the battery case has minor damage, it is difficult to detect leakage. Therefore, please carefully check the battery case for damage, leakage, etc
- 5 If the battery is dropped or the case is abnormally impacted, please contact our company or agents

Installation and wiring

- 1 When handling batteries, wear a rubber apron, rubber gloves, safety goggles, or other eye protection; do not wear metal items such as watches, key chains, etc
- 2 Wrap metal installation tools (such as wrenches) with insulating tape for insulation
- 3 No open flames, keep away from heat sources
- 4 Tighten the connection bolts and terminals to the specified torque, otherwise sparks may occur or terminals may be damaged
- 5 First connect the batteries to each other, then connect the battery bank to the charger or load. Pay attention to ensure the positive (+/red) and negative (-/black) polarity of the terminals are connected correctly
- 6 When multiple battery banks are connected in parallel, follow the wiring method of series first then parallel
- 7 To ensure good heat dissipation conditions, maintain a distance of more than 10mm between batteries
- 8 Before and after connection, apply an appropriate amount of anti-rust agent (such as Vaseline) to the surface of the battery posts
- 9 After the battery installation is completed, measure the total voltage of the battery bank to ensure it is correct before applying load and powering up
- 10 Clean the battery case and cover with a damp cloth. To prevent the risk of static electricity and sparks, do not use a duster or dry cloth to wipe the battery. Do not use organic solvents such as rubber water or thinner, to avoid cracking of the case and cover
- 11 Battery posts, terminals, and accessories may contain lead or lead compounds, and other chemical components in the battery are not conducive to health. Be sure to wash your hands after handling the battery

Supplementary Charge

During transportation and storage, the battery will lose some capacity due to self-discharge. Please perform a supplementary charge before use; if the battery is temporarily idle during use, please perform periodic supplementary charging. Refer to the "Battery Transportation, Storage" section for the supplementary charge method or consult our technical personnel

Criteria for Determining Battery Discharge Termination

Selection of discharge termination voltage: Generally, set according to the relationship between discharge current and discharge termination voltage in the table below

Discharge Current (A)	Termination Voltage (V/cell)
Below 0.1C	1.80
0.1C-0.5C	1.75
0.5C-1C	1.70
Above 1C	1.60

⚠ Note

- a Do not allow the battery termination voltage to drop below the above specified values, otherwise the battery risks over-discharge
- b Do not let the battery remain under-charged for a long time, as it will be damaged. After discharge, please recharge within 24h; do not force start discharge without recharging after discharge, at least until the battery capacity recovers to above 60%, otherwise do not continue discharging
- c The rated capacity is based on the 20-hour rate. Its discharge current is 0.05C, and the termination voltage is 1.75V/cell

Capacity Discharge Test

✓ After fully charging the battery bank, disconnect it from the system and let it stand for more than 1 hour. Perform a discharge test using an external (smart) dummy load under ambient temperature of 25±5°C

✓ Measure the battery terminal voltage, ambient temperature, and time before starting discharge

✓ During discharge, measure and record the battery terminal voltage, discharge current, and room temperature. The measurement interval is 1 hour. The discharge current fluctuation shall not exceed 1% of the specified value

✓ At the end of the discharge, measure and record the battery terminal voltage and room temperature at any time, with a measurement interval of 1 hour, to accurately determine the time when the discharge termination voltage is reached

✓ Discharge current multiplied by the discharge time is the capacity of the battery bank. If the temperature is not 25 °C, the actual measured capacity should be converted to the capacity at 25°C according to the following formula:

$$C_e = C_r / \{ 1 + K(t - 25^\circ\text{C}) \} \text{ (A)}$$

Where: t--Ambient temperature at discharge
K - Temperature coefficient

It is suitable for ambient temperature of 15 °C~30 °C

(10h rate discharge K=0.006/°C ; 3h rate discharge K=0.008/°C ; 1h rate discharge K=0.01/°C)

✓ After the discharge is completed, charge the battery bank. The amount of charge input should be 1.1 to 1.2 times the amount of discharge

⚠ Note

- a The above battery capacity test method is a common method in daily maintenance work. Ensuring system operation during capacity testing is very important. Therefore, when performing a capacity test, check in advance if there is any planned power outage from the mains, and ensure the backup generator set is in good condition
- b Before conducting the battery capacity discharge test, perform a preventive check on the battery performance using a multimeter, internal resistance meter, or conductance meter
- c To ensure the accuracy of the capacity test, use professional online battery capacity test equipment or a dummy load for testing

Judgment Criteria

The terminal voltage of the lagging battery is low during discharging, so the lagging battery should be measured in the discharge state. If the terminal voltage is measured to be more than 5% lower than the average voltage for three consecutive discharge cycles, it can be judged as a weak battery in the group. When weak batteries appear, operations such as equalizing charge for the entire bank, single-cell activation, or battery replacement should be performed

Float Charge Parameters

Charging voltage	2.23V/cell~2.25V/cell(at 25 °C)(Recommended setting:2.25V/cell)
Max charging current	See specification sheet for details)
Temperature compensation	-3mV/ °C/cell(with 25 °C as the reference temperature)
Variation range of charging voltage	±0.02V/cell

⚠ Note

- a** The voltage values of each monoblock in the same battery bank may show some deviation in the initial stage of use and will tend to be consistent after half a year
- b** Effect of float charging voltage on battery:
- ! Too high for a long time (overcharge): Grid corrosion intensifies, life shortened
 - ! Too low for a long time (undercharge): The battery is in a undercharged state for a long time, the active material gradually hardens, leading to decreased battery capacity, poor voltage consistency, and shortened life.

Equalizing Charge Parameters

Charging voltage	2.30V/cell~2.35V/cell(at 25 °C) (Recommended setting:2.35V/cell)
Max charging current	See specification sheet for details
Temperature compensation	-4mV/ °C/cell(with 25 °C as the reference temperature)
Variation range of charging voltage	±0.02V/cell

Exit Equalizing Conditions (Exit equalizing if one of the two conditions is met)

Condition 1: The reference current for exiting equalizing charge is generally set to 0.01C, multiplied by the number of parallel battery banks

Condition 2: The equalizing time reaches the set charging time

⚠ Note

Consider using equalizing charge under the following circumstances

- Discharge capacity is less than 80% of rated capacity
- Idle time exceeds 3 months
- Float voltage of any monoblock is below 2.18V/cell
- After continuous floating for 3~6 months or if weak batteries appear within the bank
- Supplementary charge is required before use after battery installation and commissioning

Cycle Charge Parameters

Charging voltage	2.35V/cell~2.40V/cell(at 25 °C)(Recommended setting:2.40V/cell)
Max charging current	See specification sheet for details
Temperature compensation	-4mV/ °C/cell(with 25 °C as the reference temperature)
Variation range of charging voltage	±0.02V/cell

The battery is considered fully charged when one of these three conditions is met:

Charge input is 1.1~1.2 times the discharge output;

Charging current in the late stage is less than 0.005C;

Charging current remains unchanged for 3 consecutive hours in the late stage;

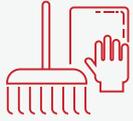
⚠ Note

- a** For battery capacity testing, it is recommended to charge according to the cycle charging method
- b** For battery cycle testing or use, it is recommended to charge according to the cycle charging method

Charging Voltage (V/cell)	Hydrogen Evolution Volume (ml/cell/Ah/month)
	OPzV Series
2.23~2.25	1.5
2.30~2.35	12

Example: The hydrogen evolution amount for OPzV2-200 at float voltage 2.25V is: $1.5 \times 1 \times 200 = 300$ mL/month

7 Battery Maintenance



Cleaning

- Always keep the battery surface and working environment clean and dry
- Avoid generating static electricity when cleaning the battery
- Clean the battery with a damp cloth. Do not use organic solvents such as gasoline or alcohol



Inspection and maintenance

- To understand the operating status of the battery and equipment, and to prevent accidental damage to the battery during inspection, regularly check and record the battery maintenance items and cycles according to the following methods

Monthly Check Items			
Item	Content	Criterion	Maintenance
Battery Bank Float Voltage	Measure the terminal voltage at the positive and negative output ends of the battery bank with a voltmeter	<ol style="list-style-type: none"> 1. Measured value is consistent with the panel display float voltage and meets the float voltage standard for the current temperature 2. The error of the float charging voltage value after temperature compensation $\leq \pm 50\text{mV}$ 	For those that still cannot reach the allowable error range after adjustment through the monitoring module, repair or return the monitoring module to the factory
Battery Appearance	Check the battery case and cover for bulging, acid leakage, and damage	Normal appearance	If the appearance is abnormal, confirm the cause first. If it affects normal use, replace it
	Check for dust and stains. Check for rust and other abnormalities at connecting wires, terminals, etc.	Clean appearance, no rust	Clean dust and stains with a wet cloth. If rust appears, perform derusting, replace connecting wires, apply anti-rust agent, etc
Battery Temperature	Measure the surface temperature of the terminals and battery case using a remote infrared thermometer	Below 35°C	If the temperature is higher than the standard value, investigate the cause and take corresponding measures.
Connection Points	Check the tightening bolts and nuts for looseness using a wrench	Firm connection (Refer to product specification book for torque value)	If looseness is found, tighten the loose bolts and nuts promptly
	Cleanliness of battery bank connecting bars and terminals	No corrosion	For slight corrosion, remove the connecting bar and clean by soaking in water. For severe corrosion, replace the connecting bar, clean all connection points with a steel brush, reconnect and tighten
Safety Valve Check (2V battery)	Gently shake the safety valve by hand to check if it is installed firmly	Safety valve is installed firmly without looseness	If the safety valve is loose, tighten and install it securely
	Check if the safety valve exhaust is normal. Apply foam liquid around the safety valve and observe	Periodic bubbles are generated	If the safety valve is normally closed or normally open, it is abnormal and needs replacement. (Must also check the battery's water loss situation)
Switching	Cut off AC power, switch to UPS power cabinet or DC panel	AC power supply smoothly switches to UPS, power cabinet, or DC panel	Correct any possible deviations

Quarterly Inspection Items

In addition to the monthly inspection and maintenance items, the following content is added:

Item	Content	Criterion	Maintenance
Float Voltage of Each Battery	Measure the terminal voltage of each monoblock under float charge at the prevailing temperature using a 4-digit multimeter.	The voltage difference between individual cells within the battery bank should meet the following standards: 2V series \leq 90mV 6V series \leq 240mV 12V series \leq 480mV	If deviating from the criterion, discharge the battery bank, perform an equalizing charge first, then switch to float charge and observe for 1-2 months. If it still deviates from the criterion, please contact our technical personnel
Repair of Under Performing Individual Battery Cells	Whole-Bank Equalizing Charge: Charge using the upper limit equalizing voltage for more than 10 hours. In severe cases, perform three charge-discharge cycle. Online Single-Cell Repair: Connect an activator or charger correctly (positive to positive, negative to negative) to the terminals of the weak online monoblock to charge it.	The float charge voltage difference between individual battery cells within the battery bank should meet the following standards: 2V series \leq 90mV 6V series \leq 240mV 12V series \leq 480mV	If the monoblock still cannot be repaired, it should be replaced
Activated Charge - Discharge	Perform a complete charge-discharge cycle on the battery. Use the lower limit equalizing voltage for charging	Release approximately 30% of the nominal capacity	Perform this operation on float-charged batteries that have not been discharged for more than six months while online

Annual Inspection Items

In addition to the quarterly inspection and maintenance items, the following content is added

Items	Content	Criterion	Maintenance
Verification Discharge Test	Disconnect AC power and perform a load discharge, releasing 30% to 40% of the battery's rated capacity	At the end of the discharge, the battery voltage should be greater than 1.90V/cell	If below the criterion, discharge the battery bank, perform an equalizing charge first, then switch to float charge and observe for 1-2 months. If it still deviates from the criterion, please contact our technical personnel
Internal Resistance	Use a dedicated internal resistance tester to measure the internal resistance of each battery	Internal resistance should not exceed 100% of the rated internal resistance	If the battery's internal resistance exceeds 100% of the rated internal resistance, please contact our technical personnel
Capacity Test	Discharge using an online capacity tester or a dummy load	Capacity remaining above 80%	Record and store various parameters during the discharge test. Address any weak/underperforming batteries found

Basic Requirements for Maintenance and Testing

- ✓ When performing battery testing, adhere to the principle of "Identify hidden dangers, ensure safety"
- ✓ Strictly execute the daily battery maintenance tasks and performance analysis according to the work plan
- ✓ Strictly follow maintenance procedures and battery-related requirements for battery parameter settings and related operations
- ✓ Implement safety protection measures: wear insulating gloves and insulate metal tools
- ✓ Use tools and instruments that meet testing requirements

8 Battery Replacement And Recycling

Replacement Criteria

80%

- In stationary applications, if a verification discharge shows the battery capacity has dropped below 80% of the rated capacity, replacement should be considered
- In energy storage applications, if the battery capacity can no longer meet the usage requirements, replacement should be considered



Replacement Timing

- Batteries are consumables with a limited lifecycle. Considering factors such as usage conditions and ambient temperature, replace with new batteries before reaching the battery's designed service life. This fully ensures the safety, reliability, and normal operation of the power system. Used batteries replaced should be promptly recycled according to relevant national laws and regulations



Waste Battery Recycling

- The recycling/disposal of waste batteries must comply with relevant national laws and regulations
 - ⚠ Direct disposal is prohibited. Substances inside the battery pose environmental pollution risks, and the main battery materials are recyclable
 - ⚠ Do not disassemble waste batteries privately, due to risks of environmental pollution and personal injury
 - ⚠ Waste batteries must be stored categorized, with anti-corrosion and isolation measures in place
 - ⚠ Waste batteries should be recycled by formal recycling organizations or the manufacturer

9 Precautions

- Store and use batteries in a place out of reach of children
- Do not use batteries for purposes other than those specified. Use outside specified purposes may cause battery leakage, fire, or explosion
- Do not disassemble, modify, damage, subject to strong impact, or throw batteries, as this may cause leakage, fire, or explosion
- Do not immerse batteries in water or fire, or heat them
- Do not short-circuit the battery terminals
- If the total voltage of the battery bank exceeds 380V, safety measures such as insulating gloves must be used before starting work. Failure to take safety measures during work risks electric shock
- During maintenance and measurement, do not face the top of the battery directly; maintain an angle or distance
- The battery's plates and separators contain adsorbed sulfuric acid. If the battery is mechanically damaged, prevent sulfuric acid from contacting skin or clothing, and especially avoid splashing into eyes. If any of these situations occur, rinse immediately with plenty of clean water. Seek hospital treatment for serious cases
- Using the battery within the 20°C ~ 25°C range is more beneficial for its lifespan
- After the warranty period ends, the float charge voltage for batteries in backup applications should be adjusted to 2.20V/cell ~ 2.23V/cell

(Note) All the above information is subject to change without notice. We reserve the right to interpret the information contained in this manual