Extreme Environment Applications

Ultra-safe, wide temperature range, long-life energy systems

Winston Battery

Types and Challenges of Global Extreme Environments

Globally, industrial equipment and energy systems must operate reliably under various harsh conditions. From polar research stations to equatorial deserts, from sea level to high-altitude regions, each environment presents unique challenges for battery systems. Understanding these environmental characteristics is the first step in developing adaptable energy solutions.

High-Cold Environments

Temperatures in polar and high-latitude regions can drop below -40°C, severely testing battery performance at low temperatures.

High-Temperature Environments

Surface temperatures in deserts and equatorial regions can reach above 60°C, accelerating battery aging and increasing safety risks.

High-Humidity Environments

Humidity in tropical rainforests and coastal areas often exceeds 90% year-round, leading to corrosion and insulation failure.

High-Salt Fog Environments

Island and offshore areas experience severe salt fog corrosion, making metal components highly susceptible to damage.

High-Altitude Environments

High-altitude regions have low atmospheric pressure, large temperature differences, and strong UV radiation, demanding extremely high reliability from equipment.

Strong Vibration Environments

Continuous vibration in mobile equipment, construction machinery, and other scenarios can lead to structural failure and short-circuit risks.

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Rigorous Requirements for Batteries in Extreme Environments

Battery systems deployed in extreme environments must not only provide stable power output but also meet performance standards far exceeding conventional applications. These requirements are directly related to the system's safety, economic viability, and long-term reliability. Failure in any single indicator can lead to the failure of the entire project, or even cause safety incidents.

Zero Safety Accident Tolerance

In extreme environments, rescue is difficult and consequences are severe once thermal runaway or fire occurs. Battery systems must not experience safety incidents under any conditions; this is the most basic and strictest requirement.

Voltage Stability

Equipment operation requires stable voltage output. Voltage drops or fluctuations can lead to protective shutdowns or damage to equipment. Batteries must maintain a smooth discharge curve in rapidly changing temperature environments.

Anti-Attenuation Capability

Frequent battery replacement in extreme environments is costly and difficult. Batteries must have an extremely low capacity decay rate to ensure long-term stable operation without premature replacement.

Maintenance-Free Design

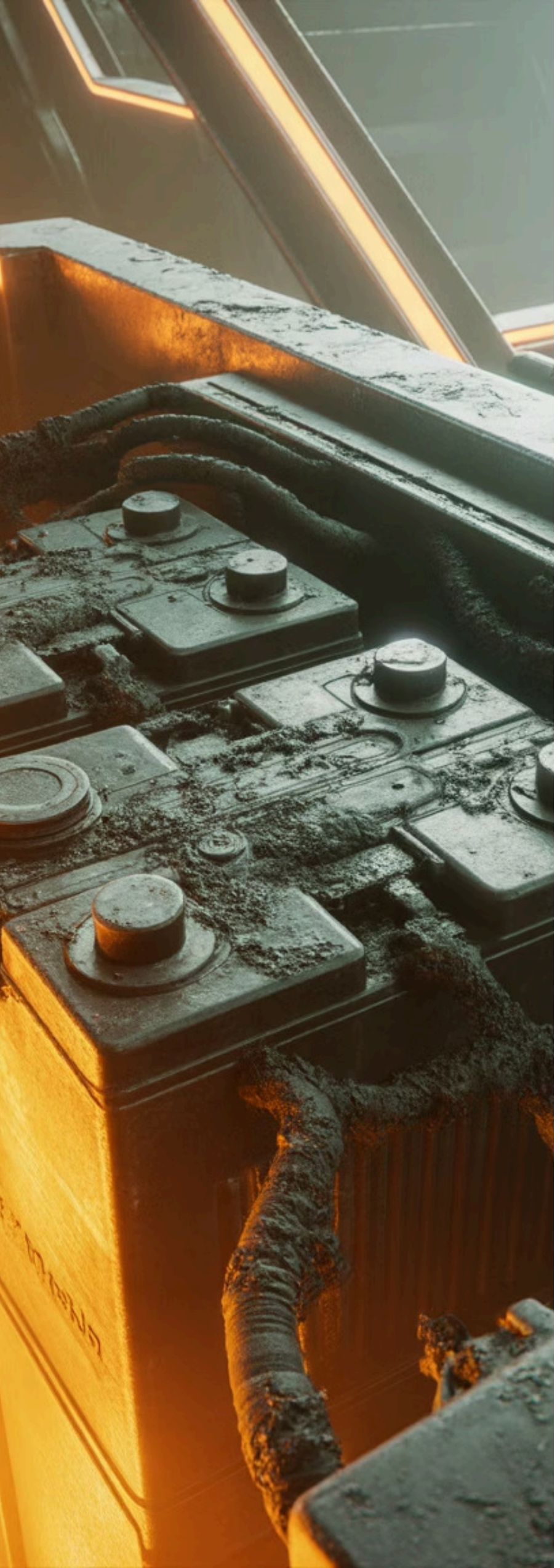
In uninhabited areas, border regions, offshore platforms, etc., manual maintenance costs are extremely high or simply impossible. Battery systems must be able to operate autonomously and reliably under long-term unattended conditions.

Triple Protection Performance

Anti-salt spray, anti-humidity, and anti-corrosion are core requirements for extreme environments. Shell materials, sealing design, and internal structures must all be able to withstand severe chemical corrosive environments.

True Wide Temperature Range Performance

Nominal wide temperature range does not equal practical wide temperature range. Batteries must provide effective capacity and power output throughout their claimed temperature range, not just "be able to work."



Technical Bottlenecks of Traditional Battery Systems

While traditional lithium-ion batteries perform well in conventional environments, they expose numerous inherent defects under extreme conditions. These issues cannot be resolved by simple engineering optimization but stem from the fundamental limitations of battery chemistry and structural design.

→ Corrosion Risk of Metal Casings

Aluminum or steel casings are prone to corrosion and perforation in salt spray and high-humidity environments, leading to electrolyte leakage and short-circuit risks, threatening the safety of the entire system.

→ High-Temperature Expansion and Thermal Runaway

Organic electrolytes gasify and expand at high temperatures, increasing internal pressure, which can lead to casing deformation or even explosion, and a sharp increase in thermal runaway risk.

→ Severe Low-Temperature Performance Degradation

Increased electrolyte viscosity and reduced lithium-ion migration rate lead to a significant decrease in available capacity at low temperatures, or even complete failure to operate normally.

→ Thermal Runaway Chain Reaction

Thermal runaway of a single cell can quickly spread to the entire battery pack. In extreme environments, heat dissipation difficulties further amplify this risk.

→ Unstable Discharge Voltage

Temperature changes cause internal resistance fluctuations, leading to voltage dips in the discharge curve, making it impossible to provide stable and reliable power supply for equipment.

→ High Maintenance Costs

Frequent balancing charges, temperature management, and capacity testing are difficult and costly to implement in extreme environments.

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Core Advantages of LYP Technology in Extreme Environments

Winston Battery's LYP lithium iron phosphate batteries utilize a unique aqueous electrolyte system and innovative structural design, fundamentally addressing the technical bottlenecks of traditional batteries in extreme environments. These advantages are not just marketing claims, but a true performance demonstrated through thousands of globally verified projects.

Aqueous System for Intrinsic Safety

Using an aqueous electrolyte instead of flammable organic solvents fundamentally eliminates the risk of thermal runaway. Even in extreme high temperatures or external short circuits, there will be no combustion or explosion, ensuring intrinsic safety.

Corrosion-Free Plastic Casing

Utilizes a high-strength engineering plastic casing instead of a metal shell, completely immune to salt spray corrosion and chemical erosion. It can be used long-term in harsh environments such as islands, rainforests, and chemical industries without casing damage.

Ultra-Long Cycle Life

Standard cycle life exceeds 6000 cycles, and can be used for more than 10 years in practical applications. Long life means lower total cost of ownership and less maintenance, making it particularly suitable for hard-to-replace application scenarios.

True Wide Temperature Range Operation

Provides effective capacity output and stable power performance across an ultra-wide temperature range of -45°C to +85°C. This is not a theoretical value, but a usable temperature range verified in practical applications.

Ultra-Stable Discharge Voltage

The unique electrochemical system ensures a stable voltage platform throughout the discharge process, without voltage drops. Even in environments with drastic temperature changes, it can provide stable and reliable power output for equipment.

Large Capacity Reduces Parallel Connections

Single cell capacity is available in various specifications from 40Ah to 1000Ah. The large capacity design reduces the number of parallel connections, lowering system complexity and failure points, and improving overall reliability and safety.

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Wide Temperature Range Performance Test Data

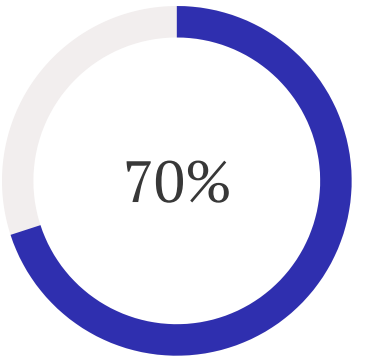
In extreme temperature environments, the actual discharge performance of a battery directly determines whether equipment can function properly. LYP batteries have undergone rigorous wide temperature range testing, proving their excellent discharge characteristics at both low and high temperatures.

LYP Wide Temperature Range Discharge Characteristics

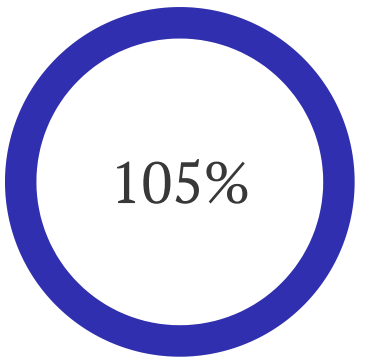
Test data clearly shows that LYP batteries can still release over 70% of their nominal capacity at -30°C, with the discharge voltage platform maintained above 3.0V, showing no sudden drops. At +60°C, the discharge capacity even slightly improves, and the voltage curve remains stable.

In contrast, traditional lithium-ion batteries experience capacity degradation to below 50% at -20°C, with severe voltage fluctuations. At high temperatures, they face thermal runaway risks, requiring complex temperature control systems for protection.

Key Conclusion: LYP voltage does not drop suddenly, discharge is stable, truly achieving full temperature range usability.



-30°C Low Temperature Capacity Retention Rate



+60°C High Temperature Capacity Output

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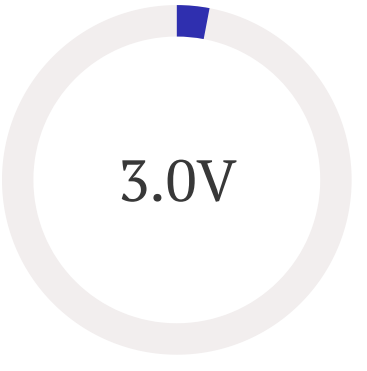

Voltage Platform Across Full Temperature Range

Test Conditions: Using Winston 200Ah LYP batteries, 0.1-0.5C constant current discharge tests were conducted in a professional environmental chamber. The temperature range was -45°C to +85°C, with testing points every 5°C, recording complete discharge curves and capacity data.

Application Cases: High Altitude and Extreme Cold Regions

In high altitude and extreme cold environments, traditional battery systems often face challenges such as difficult low-temperature startup, significant capacity degradation, and frequent failures. LYP batteries, with their excellent low-temperature performance and high reliability, have been successfully applied in various harsh environment projects.

High Altitude Communication Base Stations

In plateau regions at an altitude of 4500 meters, with ambient temperatures ranging from -35°C to +30°C, LYP batteries provide stable backup power for communication base stations. Operating flawlessly for 3 years, with a capacity retention rate of over 95%, they have completely solved the problem of traditional batteries failing in low temperatures.

Extreme Cold Microgrid Systems

An off-grid photovoltaic microgrid project in a region at 55 degrees North latitude, with winter minimum temperatures reaching -42°C. Utilizing Winston 700Ah LYP batteries as the core energy storage, it has achieved stable year-round power supply, capable of normal charging and discharging even under extreme cold conditions.

Low-Temperature Industrial Equipment

Electric equipment and emergency power systems in extreme cold regions like mining areas and border outposts operate continuously in sub-zero environments. LYP batteries can start without preheating, offer stable discharge power, significantly reducing operation and maintenance costs and failure rates.

These applications fully demonstrate the outstanding performance of LYP batteries in extreme low-temperature environments, providing reliable energy solutions for high-altitude and extreme cold regions.

Case Study: High Temperature, High Humidity, and High Salt Fog Environments

In high temperature, high humidity, and high salt fog environments, such as coastal areas, rainforests, and deserts, traditional battery systems are highly susceptible to corrosion. Metal-cased batteries often show severe rust within months. LYP plastic-cased batteries, however, demonstrate unparalleled durability in these conditions.

Coastal Government Project

A power supply bureau on an island adopted Winston LYP batteries to build an energy storage power station. The environment had high salt fog concentration and humidity exceeding 85% year-round. After 5 years of operation, the battery casings were intact and the performance stable, while synchronously deployed metal-cased batteries had been replaced multiple times.

Rainforest Communication Equipment

In mobile communication base stations in Southeast Asian rainforests, where temperatures and humidity are high all year, traditional batteries lasted less than 2 years. After adopting LYP batteries, they have operated maintenance-free for over 4 years, with capacity retention rates still above 90%, significantly reducing maintenance frequency.

Desert PV Microgrid

An off-grid photovoltaic system in a Middle Eastern desert experienced ground temperatures exceeding 60°C during the day and a diurnal temperature range of 40°C. LYP batteries operated stably under extreme temperature differences and high temperatures, without issues like swelling or leakage, proving their high-temperature reliability.

Corrosion Resistance

Plastic casing completely immune to salt fog corrosion, extending service life by 3-5 times compared to metal casings.

High Temperature Stability

Safe operation even at 85°C, with no risk of thermal runaway.

Sealing Performance

Internal dryness maintained in high humidity, electrical performance unaffected.

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Application Cases: Unmanned Areas and Long-Cycle Equipment

In remote areas such as borders, forests, and pipelines, battery systems must be able to operate reliably unattended for extended periods. Frequent maintenance is not only costly but often impractical. The maintenance-free characteristics and ultra-long lifespan of LYP batteries make them an ideal choice for these scenarios.

01

Border Monitoring Equipment

Border outposts and monitoring stations are located in remote mountainous areas with inconvenient transportation. LYP batteries provide continuous power for monitoring systems, requiring no maintenance for 5 years, completely solving the problem of frequent battery replacement and ensuring the continuity of border security monitoring.

02

Forest Fire Monitoring

Forest fire monitoring systems are deployed in deep forests, with maintenance cycles often exceeding one year. Winston batteries have an extremely low self-discharge rate, allowing them to remain operational after long-term storage, providing a reliable energy guarantee for forest fire prevention.

03

Oil Pipeline Monitoring

Thousands of kilometers of oil pipelines require independent power supply for their monitoring equipment. LYP batteries, combined with solar panels, achieve truly maintenance-free operation, significantly reducing pipeline operation and maintenance costs and increasing safety monitoring coverage.

04

Emergency Backup Power

Emergency power supplies for communication hubs, data centers, and medical facilities must be guaranteed to start at critical moments. LYP batteries maintain stable performance during long-term storage, are always ready for use, and provide ultimate assurance for critical infrastructure.

> **"In unmanned areas, reliability is everything. Winston LYP batteries truly allow us to achieve the ideal state of 'deploy and forget,' which is unimaginable with traditional battery systems."**
>
> — Project Manager, Remote Area Operations, State Grid

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Why Choose Winston Battery LYP

Choosing a battery system for extreme environment applications is a critical decision that impacts the success of a project. Winston Battery LYP, with its unique technological advantages and globally verified reliability, has become the preferred solution for energy systems in extreme environments.

1 Globally Verified Reliability

Proven in thousands of extreme environment projects in over 70 countries and regions worldwide, from the Arctic Circle to the Equator, from sea level to plateaus, accumulating extensive application experience and reliable performance data.

2 Inherently Safe, No Thermal Runaway

The aqueous binder system inherently eliminates the risk of thermal runaway, preventing combustion or explosion even under the harshest conditions, providing fundamental safety assurance for personnel and equipment.

3 Wide Temperature Range, True Performance

The ultra-wide operating temperature range of -45°C to +85°C is not just a paper specification, but true performance verified through rigorous testing and real-world applications, ensuring stable operation under any climatic conditions.

4 Plastic Casing Structure, Lifetime Corrosion-Free

High-strength engineering plastic casing is completely immune to salt spray, humidity, and chemical corrosion, making it particularly suitable for harsh environments such as islands, rainforests, and deserts, with a service life far exceeding metal-cased batteries.

5 Ultra-Long Lifespan, Reduced Total Cost

With a service life of over 10 years and more than 6000 cycles, it significantly reduces replacement costs and maintenance frequency. In extreme environments, a long lifespan means lower total cost of ownership and higher return on investment.

Leading Technology, Excellent Performance

Winston Battery is one of the earliest developers of LiFePO4 batteries and the pioneer of aqueous lithium yttrium, with over 20 years of technological research and development, possessing complete independent intellectual property rights and advanced production processes. Our LYP batteries not only meet the stringent requirements of extreme environments but also set industry benchmarks in safety, reliability, and economic efficiency.

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Become a Partner Get a Quote

Ushering in a New Era of Extreme Environment Energy

Winston Battery LYP — Your trusted energy partner in extreme environments

70+	85°C	8000+	10年
Countries and regions of application	Maximum operating temperature	Cycle life times	Actual service life

Technical Consultation

Our professional team provides customized solutions for you

Sample Testing

Free samples provided for real-world environmental testing

Project Support

Full technical support from design to implementation

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