



eForce, eFlex Max, eBoost & eVault Max – High-Altitude Operation Limits

System

eForce, eFlex Max, eBoost & eVault Max LFP Battery Systems

Subject

Altitude limitations, thermal performance, and operating guidelines

1. Background & Specifications

Fortress Power eForce, eFlex Max, eBoost, and eVault Max batteries use lithium iron phosphate (LFP) chemistry with prismatic cell architecture. These systems are designed for residential and light commercial energy storage at standard altitudes. At higher elevations, atmospheric pressure and air density decrease exponentially, which affects battery thermal performance during charge and discharge cycles.

Operating Temperature & Altitude Rating

- Charging: 0 °C to 45 °C; Discharging: -20 °C to 55 °C
- Maximum recommended altitude: 3,000 m (9,843 feet)

Key point

Do not operate eForce, eFlex Max, eBoost, or eVault Max above 3,000 m (9,843 ft). Below this altitude, passive air cooling keeps both systems within safe thermal limits; above it, install only after consulting Fortress Power technical support.

2. Technical Rationale: Why Altitude Matters

1. At sea level, atmospheric pressure is 101.3 kPa. As altitude increases, pressure and density decrease, reducing air's ability to dissipate heat.
2. As altitude rises to 3,000 m, air density drops to ~74% of sea-level density (pressure ~70 kPa). Above 3,000 m, usable capacity may drop 5-15%, cycle life shortens, and thermal protection may limit performance.
3. Reduced air cooling creates a thermal feedback loop: higher altitude → less cooling → hotter battery → higher internal resistance → more heat.

Operating Altitude Ranges

Altitude range	Fortress Power batteries
Up to 2,500 m (8,202 ft)	Supported
2,500-3,000 m (9,843 ft)	Supported – monitor temperature

Altitude range	Fortress Power batteries
Above 3,000 m (9,843 ft)	Not recommended

Rule of thumb: The 3,000 m limit is where passive air cooling is sufficient for reliable residential energy storage.

3. Best Practices for High-Altitude Installations

Keep battery enclosures in cool locations (basements, shaded garages, climate-controlled rooms). Avoid direct sunlight and heat sources. Ensure passive air circulation. Monitor internal battery temperature via the BMS if available. For installations above 3,000 m, contact Fortress Power technical support before proceeding.

5. Test Specifications

The eForce, eFlex Max, eBoost, or eVault Max systems are built on Grade A prismatic LFP cells. Those cells are qualified for the test program summarized below. The tests most relevant to high-altitude operation are the low-pressure altitude-simulation test and the temperature-dependent performance and cycle-life tests.

Qualification Test Summary

Test	Condition	Result / criterion
Low pressure (altitude simulation)	11.6 kPa, $\geq$ 6 h, ambient temperature (per UN 38.3 Test)	No fire, no explosion, no leakage

Altitude Test – Data and Interpretation

The low-pressure test holds the cell at 11.6 kPa for at least six hours – the pressure at roughly 15,000 m – and confirms the cell vents safely with no capacity loss or loss of integrity under extreme low pressure. This is a safety and transport qualification (UN 38.3 Test T.1), not a continuous-operation rating.

Key finding

Altitude testing confirms cell safety down to 11.6 kPa (~15,000 m), and published data show no capacity loss down to 25 kPa (~10,400 m). The 3,000 m operating limit is set by the pack's air cooling, not by the cell's tolerance to low pressure.

Email: sales@fortresspower.com
Website: www.fortresspower.com
Phone: (877) 497-6937