

Whitepaper FDM

**BATTERY QUALIFICATION: ENVIRONMENTAL TEST PROTOCOLS FOR SAFETY  
AND PERFORMANCE**

## Executive Summary

Battery systems are increasingly used in critical applications—from electric vehicles to medical devices and aerospace components. Ensuring their safety, reliability, and performance under varying environmental conditions is essential. This whitepaper outlines the main environmental testing procedures for battery qualification, focusing on thermal behavior, humidity resistance, and safety compliance.

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## Key Environmental Parameters

Battery packs must endure extreme conditions throughout their lifecycle, including transport, storage, and use. Environmental testing simulates these stresses to prevent failures such as thermal runaway, leakage, or capacity loss.

Typical parameters include:

- **Temperature range:** -40°C to +85°C
- **Humidity range:** 10% to 95% RH
- **Thermal cycling:** ±5°C/min (fast ramping for stress testing)
- **Altitude simulation:** for transport and aerospace batteries
- **Dust and water ingress (IP ratings):** combined with temperature stress

High-precision climate chambers like those from FDM ensure consistent and repeatable results, a critical requirement for certification.

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## Standard Test Protocols

Battery testing must comply with strict standards depending on the application:

- **UN 38.3** – Transportation safety
- **IEC 62133** – Rechargeable battery safety
- **UL 1642 / UL 2054** – Lithium battery and pack standards
- **ISO 12405** – Performance testing for automotive batteries
- **SAE J2464 / J2929** – Abuse testing protocols

Environmental testing supports these standards by verifying thermal stability, operational reliability, and aging under controlled conditions.

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## Case Study: EV Battery Pack Pre-Launch Testing

A European battery developer performed environmental validation for an EV battery pack using FDM's climatic chambers. The testing included 10 cycles of thermal shock (-20°C to +60°C), 1000 hours of humidity exposure, and altitude testing at 15,000 ft. This helped detect a connector flaw early, preventing future recalls and ensuring ISO and UN certification before market release.

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## Conclusion

Environmental qualification is essential to safe and high-performing battery systems. With advanced control of temperature and humidity, FDM climate chambers offer reliable, customizable test environments. Our expertise and “100 Tests Gold Check” guarantee support battery innovators from R&D to certification.

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