Automated pole piece coating technical data - Tier-1 LFP Hardware Deep-Dive and Performance Ledger

AUTOMATED POLE PIECE COATING TECHNICAL DATA - TIER-1 LFP HARDWARE DEEP-DIVE AND PERFORMANCE LEDGER

EXECUTIVE SUMMARY

This document provides a comprehensive technical overview of the automated pole piece coating process and its critical impact on the performance, longevity, and safety of our Tier-1 LFP (Lithium Iron Phosphate) battery cells. As a foundational step in electrode manufacturing, the precision and consistency of the coating process directly determine the electrochemical characteristics of the finished cell. This whitepaper delves into the specific process parameters, quality control metrics, and resulting performance ledger for cells used within our commercial energy storage systems. The data presented underscores our commitment to engineering excellence, process control, and the delivery of market-leading energy storage solutions. This document serves as both a technical reference and a commercial datasheet for potential clients, investors, and engineering partners.

SYSTEM ARCHITECTURE AND CELL MANUFACTURING CONTEXT

The performance of any energy storage system is fundamentally anchored to the quality of its core electrochemical cells. Our vertically integrated manufacturing process ensures that every cell, and subsequently every module and rack, adheres to the most stringent quality benchmarks. The automated pole piece coating process is the heart of this operation. It involves the precise application of a homogenous slurry – a mixture of active material, conductive additives, binders, and solvents – onto a metallic current collector foil (aluminum for the cathode, copper for the anode). This step is crucial for establishing the electrode's microstructure, which governs ionic and electronic conductivity, interfacial impedance, and long-term cycle stability.

KEY FEATURES AND PROCESS ADVANTAGES

- ULTRA-PRECISE COATING THICKNESS CONTROL: Our advanced slot-die coating systems utilize closed-loop feedback control to maintain a coating thickness uniformity of ±1.5%. This level of precision is critical for minimizing internal resistance and ensuring a homogeneous current distribution across the electrode, thereby mitigating the risk of localized hotspots and lithium plating.
- HIGH-SPEED AUTOMATED PRODUCTION LINE: The coating process is integrated into a fully automated, high-throughput production line capable of speeds up to 80 meters per minute. This high-speed process is maintained without sacrificing quality, ensuring economies of scale and the ability to meet large-scale project demands while maintaining production consistency.
- ADVANCED DRYING PROFILES AND SOLVENT RECOVERY: Following the coating application, the wet electrodes pass through a multi-zone convection oven with precisely controlled temperature gradients. This ensures the uniform evaporation of solvents, preventing binder migration and crack formation. The integrated solvent recovery system captures and recycles over 98% of the NMP (N-Methyl-2-pyrrolidone) solvent, aligning with our environmental, social, and governance (ESG) objectives.
- REAL-TIME INLINE INSPECTION: A comprehensive suite of inline inspection systems, including X-ray, optical cameras, and laser calipers, continuously monitor the electrode web for defects such as pinholes, agglomerates, and edge bead formation. Any deviation from the strict quality specifications

triggers an automated alarm, and defective sections are marked and subsequently removed, guaranteeing that only flawless electrodes proceed to the next stage of cell assembly.

- LASER EDGE CLEANING AND CALENDERING: Post-drying, the electrodes undergo a two-step finishing process. First, a high-precision laser ablation system removes any residual coating from the edge of the foil, creating a clean, weld-ready tab area. Second, the electrodes are calendered (compressed) with a high-force calender stack to achieve the precise target density. This densification process enhances particle-to-particle contact, further reducing internal resistance and increasing volumetric energy density.

COMPLIANCE AND STANDARDS

All manufacturing processes, including the automated pole piece coating, are designed and executed in full compliance with global quality and safety standards. The manufacturing facility is certified to IATF 16949, the global standard for quality management in the automotive industry, which demands rigorous process control and continuous improvement methodologies. The resulting cells and subsequent battery modules are extensively tested and certified to meet or exceed the requirements of:

- UN 38.3: Transport of Dangerous Goods (Lithium Batteries)

- UL 1642: Lithium Batteries
- UL 9540A: Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems
- IEC 62619: Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries

The inherent stability of the LFP chemistry, combined with the precision of our electrode manufacturing, ensures that our cells possess exceptional thermal and chemical stability, significantly reducing the risk of thermal runaway events.

TECHNICAL SPECIFICATIONS: THE PERFORMANCE LEDGER

The following table details the key metrics derived from the quality of the automated pole piece coating process, demonstrating its direct contribution to cell and system-level performance. This data is collected from rigorous testing of production cells and validated through third-party testing.

Parameter	**Specification / Value**
Cell Chemistry	Lithium Iron Phosphate (LFP)
Nominal Cell Voltage	3.2 V
Cell Capacity (Nominal)	280 Ah
Cell Energy (Nominal)	896 Wh

Electrode Coating Thickness Uniformity	±1.5% (3-sigma)
Electrode Coating Defect Rate	< 50 ppm (parts per million)
Cell Cycle Life (0.5C/0.5C, 25°C)	> 6,000 cycles to 80% SOH
Cell Roundtrip Efficiency (DOD 100%)	> 95%
Cell DC Internal Resistance (DCIR)	< 0.25 mΩ (at 50% SOC)
Operating Temperature Range (Discharge)	-20°C to +55°C

These metrics are not just static numbers; they represent a ledger of performance, guaranteeing a long operational life, high round-trip efficiency, and reliable power delivery. For example, the excellent capacity retention after 6,000 cycles is a direct result of the uniform coating preventing localized degradation mechanisms. Similarly, the low direct current internal resistance (DCIR) is attributed to the optimized electrode microstructure achieved through precise coating and calendering.

INDUSTRIAL DEPLOYMENT AND FINANCIAL MODEL IMPLICATIONS

The superior technical data from our electrode coating process translates directly into tangible benefits for our commercial and industrial (C&I) clients.

The enhanced cycle life reduces the need for early battery replacement, significantly lowering the total cost of ownership (TCO) and improving the levelized cost of storage (LCOS). The exceptional round-trip efficiency ensures that a higher percentage of energy stored is returned, maximizing the return on investment (ROI) for applications such as peak shaving, load shifting, and backup power. Moreover, the robust safety profile, underpinned by the stability of the LFP chemistry and precise manufacturing, simplifies site permitting and community acceptance, accelerating project deployment timelines.

For strategic asset owners, the predictable and dependable performance of our LFP cells, validated by this performance ledger, ensures long-term financial performance and operational reliability. This technical datasheet serves as an official reference for procurement, engineering, and asset management teams. Our commitment to continuous process improvement guarantees that the data within this ledger will remain a benchmark for quality and performance in the energy storage industry.