

INTERNSHIP ON EV BATTERY MANUFACTURING

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Engineering degree in

ELECTRIC AND ELECTRONICS ENGINEERING

BY

MALA A (41140050)



**DEPARTMENT OF ELECTRICAL AND ELECTRONICS
ENGINEERING SCHOOL OF ENGINEERING**

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC

JEPPIAAR N AGAR, RAJIV GANDHI

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119



SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119
www.sathyabama.ac.in

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
BONAFIDE CERTIFICATE

This is to certify that this Report is the bonafide work of **A MALA (41140050)** who carried out the internship entitled **EV BATTERY MANUFACTURING** under my supervision from 16-05-2023 to 26-05-2023

EXTERNAL GUIDE

Head of the Department

Submitted for Viva voce Examination held on _____

INTERNAL EXAMINER

(SIGNATURE)

EXTERNAL EXAMINER

(SIGNATURE)

DECLARATION

I am **MALA A** here by declare that the Report entitled **EV BATTERY MANUFACTURING** done by me at **PINNACLE LITHIUM POWER, COIMBATORE** is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in ELECTRICAL AND ELECTRONICS ENGINEERING.

DATE:16-05-23 to 26-05-23

PLACE: COIMBATORE



MALA A

SIGNATURE OF THE CANDIDATE

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this Report and for completing it successfully. I am grateful to them.

I convey my thanks to **DR. N. M. NANDHITHA, Prof. & Dean, School of Electrical and Electronics Engineering** and **DR.S.RADHIKA ,Head of the Department, Dept. of ELECTRICAL AND ELECTRONICS ENGINEERING** for providing me necessary support and details at the right time during the progressive reviews.

I wish to express my thanks to all Teaching and Non-teaching staff members of the Department of **Electrical and Electronics Engineering** who were helpful in many ways for the completion of the Report.

MALA A

Name of the candidate

TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
A	BONAFIDE	2
B	DECLARATION	3
C	ACKNOWLEDGEMENT	4
E	TABLE OF CONTENTS	5
F	ABSTRACT	7
1	INTRODUCTION ABOUT THE COMPANY	7
2	NATURE OF WORK DONE	8
3	METHODS AND PROCESSES	10
	3.1 BATTERY USED	
	3.2 BATTERY TESTING OPERATIONS	
	3.2.1 CELL CHARACTERIZATION	
	3.2.2 PERFORMANCE TESTING	
	3.2.3 SAFETY TESTING	
	3.2.4 ENVIRONMENTAL TESTING	
	3.2.5 HUMIDITY TESTING	
	3.2.6 QUALITY CONTROL AND CONSISTENCY	
	3.2.7 SAFETY CERTIFICATION	
	3.2.8 DOCUMENTATION AND TRACEABILITY	
	3.2.9 AGING AND LIFE PREDICTION	
	3.3 BATTERY SIZE CLASSIFICATION	
	3.3.1 PHYSICAL DIMENSIONS	
	3.3.2 CAPACITY	
	3.3.3 VOLTAGE	
	3.3.4 APPLICATIONS	
	3.3.5 INDUSTRY STANDARDS	
4	KNOWLEDGE AND EXPERIENCE	14
	4.1 BATTERY SELECTION CRITERIA	
	4.2 TESTING AND QUALITY ASSURANCE	
	4.3 BATTERY SIZE CLASSIFICATION	
	4.4 SPOT WELDING	
	4.5 BMS	
	4.6 HOUSING DESIGN	

	4.7	QUALITY CONTROL AND TESTING	
	4.8	DOCUMENTATION AND COMPLIANCE	
	4.9	PACKAGING AND SHIPPING	
5		SUMMARY AND CONCLUSION	17
6		CERTIFICATE OF COMPLETION	18

ABSTRACT

The battery production process represents a complex and meticulously managed sequence of operations, commencing with the discerning selection of battery cells based on factors like chemistry, capacity, and performance attributes. These chosen cells are then subjected to exhaustive testing to affirm their quality and safety. Subsequent size classification ensures compatibility with specific applications, while the assembly process involves intricate spot welding to create durable battery packs. Integration of Battery Management Systems (BMS) ensures monitoring and safety, and protective housings are tailored to varying environmental requirements. Rigorous quality control, comprehensive documentation, and adherence to industry standards permeate each stage. Finally, the battery packs are packaged and dispatched globally, emphasizing the significance of secure transit packaging. The knowledge derived from this process underscores the precision and complexity needed to provide reliable, high-quality battery solutions, further emphasizing the commitment to safety, innovation, and sustainability in the pursuit of powering a more sustainable future.

CHAPTER 1

INTRODUCTION ABOUT THE COMPANY

Pinnacle Lithium Power is a Lithium battery manufacturing company which produces batteries under the brand name PULZE. PULZE batteries are used in various applications such as Electric Vehicles, Solar, Robotics and Marine. A start-up organisation which was founded in the year 2021 started with a team of six. With our friendly work environment our team works efficiently to deliver to the needs of the customer on time and through our solid workplace principles we help each individual, customers and our cluster to respect and value relationships. Our team working at Pinnacle Lithium Power are determined about having a single-minded vision and mission.

CHAPTER 2

NATURE OF WORK DONE

The nature of work within a company involved in battery production is a comprehensive and meticulous process that spans various stages, starting with the selection of battery cells. Initially, engineers and procurement specialists assess battery cell options, considering factors such as chemistry, capacity, voltage, and performance characteristics. Once suitable battery cells are identified, rigorous testing operations are conducted to evaluate their quality, performance, and safety. These tests include capacity assessments, voltage and current checks, and cycle life testing, ensuring that only reliable cells are chosen for further processing.

Following the testing phase, the selected battery cells undergo size classification, a critical step where they are categorized based on physical dimensions, such as diameter, length, and form factor. This classification ensures compatibility with the intended applications and devices, whether they are destined for electric vehicles, consumer electronics, or renewable energy storage systems.

Once the battery cells are appropriately classified, the manufacturing process advances to spot welding, where individual cells are skillfully and securely joined together to form battery packs. This spot welding process is essential for creating a robust electrical connection between cells and establishing the structural integrity of the pack, guaranteeing reliable performance under various conditions.

Simultaneously, a Battery Management System (BMS) is meticulously integrated into each battery pack. The BMS plays a crucial role in monitoring and managing the individual cells within the pack. It ensures balanced charging and discharging, protects against overcharging and over-discharging, and provides essential safety features. Proper BMS installation is paramount for the safety, longevity, and overall performance of the battery packs.

Following the integration of the BMS, the battery packs are encased within protective housings or casings. These housings are meticulously designed to shield the battery packs from external elements, impacts, and potential damage. Depending on the intended application, the housing may also incorporate features for thermal management, shock resistance, and weatherproofing, ensuring the battery packs can perform reliably in diverse environments.

At every stage of production, stringent quality control checks and testing procedures are carried out to guarantee the safety and functionality of the battery packs. These tests encompass spot weld integrity assessments, BMS functionality checks, voltage and capacity verification, thermal stress testing, and comprehensive safety evaluations. Any deviations or defects are promptly addressed, underscoring the commitment to delivering high-quality products.

Once the battery packs successfully pass all quality control checks and are deemed safe and functional, they undergo careful packaging, ensuring they arrive at their intended destinations in impeccable condition. Proper packaging safeguards the battery packs during transit, ready for installation in a myriad of applications, from electric vehicles to renewable energy systems and consumer electronics.

Throughout these intricate processes, meticulous documentation is maintained to track each battery pack's specifications, quality control results, and compliance with industry standards and regulations. This documentation is indispensable for traceability, warranty claims, and providing exceptional customer support.

Finally, the completed battery packs are readied for shipping, where they embark on their journey to customers, manufacturers, or distributors. These battery packs are not merely products but the culmination of a carefully orchestrated process that guarantees the highest standards of safety, reliability, and performance. This comprehensive approach underscores the commitment of the company to providing energy solutions that power a sustainable future while adhering to stringent quality and safety standards.

CHAPTER 3

METHODS AND PROECESSSES

3.1 BATTERY USED

NMC (Lithium Nickel Manganese Cobalt Oxide) batteries utilize a cathode composed of nickel, manganese, and cobalt, offering advantages such as high energy density, balanced performance, and improved safety, making them ideal for applications like electric vehicles (EVs), portable electronics, and energy storage systems. In contrast, Lithium Iron Phosphate (LiFePO₄) batteries feature a lithium iron phosphate cathode, known for its exceptional safety, long cycle life, and wide operating temperature range, making them suitable for solar energy storage, electric bicycles (E-bikes), telecommunications, and demanding environments like marine and RVs. These two lithium-ion battery types cater to distinct needs, with NMC excelling in high-energy-density applications and LiFePO₄ prioritizing safety and durability.

3.2 BATTERY TESTING OPERATIONS

3.2.1 Cell Characterization:

Capacity Testing: Cells undergo capacity tests to determine their energy storage capacity. This involves charging the cell to its maximum capacity and then discharging it while measuring the energy output.

Voltage and Current Testing: Voltage and current characteristics are closely monitored to ensure that cells operate within specified voltage and current ranges.

3.2.2 Performance Testing:

Cycle Life Testing: Cells are subjected to numerous charge and discharge cycles to

evaluate their durability and how well they maintain capacity over time.

Rate Capability Testing: Cells are tested at various charge and discharge rates to assess their performance under different conditions, including rapid acceleration and regenerative braking in EVs.

3.2.3 Safety Testing:

Thermal Testing: Cells are subjected to extreme temperature conditions to assess their thermal stability and the risk of overheating. This is crucial for EVs, where safety is paramount.

Overcharge and Over-discharge Testing: Cells are intentionally overcharged and over-discharged to evaluate their safety features, such as protection circuits that prevent hazardous conditions.

Puncture and Crush Testing: Cells are subjected to physical abuse tests to assess their ability to withstand damage without catastrophic failure.

3.2.4 Environmental Testing:

Temperature Cycling: Cells are exposed to a range of temperatures to mimic real-world conditions and evaluate their performance and longevity.

Humidity Testing: Cells are tested in high humidity environments to assess their resistance to moisture and corrosion.

3.2.5 Quality Control and Consistency:

Cell Matching: Cells are grouped based on their performance characteristics to ensure that individual cells in the EV battery pack have similar capacities and behaviours. This minimizes imbalances that can affect pack performance.

3.2.6 Safety Certification:

Regulatory Compliance: Cells must meet international safety standards and certifications, such as UN 38.3, IEC 62619, and UL 1642, to be considered safe for use in EV battery packs:

3.2.7 Documentation and Traceability:

Record Keeping: Detailed records of each cell's test results, manufacturing date, and other relevant information are maintained to ensure traceability and accountability.

3.2.8 Aging and Life Prediction:

Accelerated Aging Tests: Cells are subjected to accelerated aging conditions to predict their long-term behaviour and lifespan, which is crucial for estimating the service life of EV battery packs.

3.3 BATTERY SIZE CLASSIFICATION

The classification of battery sizes for different battery packs involves a standardized process to categorize batteries based on their physical dimensions, capacity, and voltage. This classification helps manufacturers, consumers, and researchers identify and select the appropriate battery for various applications. Here's an overview of the battery size classification process:

3.3.1 Physical Dimensions:

Form Factor: Batteries come in various form factors, such as cylindrical, prismatic,

and pouch. Each form factor has distinct physical characteristics that influence its compatibility with different devices and applications.

Diameter (for Cylindrical Batteries): Cylindrical batteries are often classified based on their diameter, with common sizes like 18650 (18mm diameter and 65mm length) and 21700 (21mm diameter and 70mm length) being widely used.

Length (for Cylindrical Batteries): The length of a cylindrical battery is also a key factor in classification. Longer cylindrical cells often have higher capacity.

Dimensions (for Prismatic and Pouch Batteries): Prismatic and pouch batteries are classified based on their length, width, and thickness, which are critical for fitting into specific devices and battery packs.

3.3.2 Capacity:

Capacity Rating (mAh or Ah): Battery capacity is measured in milliampere-hours (mAh) for small batteries and ampere-hours (Ah) for larger ones. This rating indicates the amount of energy the battery can store and is a fundamental parameter for battery classification.

Capacity Range: Batteries are categorized into various capacity ranges, such as small, medium, and large capacity, to provide a general idea of their energy storage capabilities.

3.3.3 Voltage:

Nominal Voltage (V): Batteries have a nominal voltage that represents their average voltage during discharge. Common nominal voltages include 3.6V, 3.7V, and 3.2V for lithium-ion batteries, and 1.5V for alkaline batteries.

3.3.4 Applications:

Intended Use: Batteries are often classified based on their intended applications.

For example, button cells are typically used in small electronics like watches and calculators, while larger batteries are used in smartphones, laptops, electric vehicles, and renewable energy storage systems.

3.3.5 Industry Standards:

International Electrotechnical Commission (IEC) Standards: The IEC has established standards for battery sizes, such as the IEC 61951 series for nickel-metal hydride (NiMH) batteries and the IEC 62133 standard for lithium-ion batteries. These standards define specific sizes and characteristics for batteries to ensure compatibility and safety.

CHAPTER 4

KNOWLEDGE AND EXPERIENCE

4.1 Battery Selection Criteria:

Companies involved in battery production carefully assess and select battery cells based on critical factors such as chemistry, capacity, voltage, and performance characteristics. This knowledge emphasizes the importance of choosing the right cells for specific applications.

4.2 Testing and Quality Assurance:

Rigorous testing procedures are integral to ensure the quality, performance, and safety of battery cells. This underscores the significance of thorough testing to identify and address any cell defects or issues before they progress further in the manufacturing process.

4.3 Battery Size Classification:

The process of classifying battery cells based on their physical dimensions is crucial to ensure compatibility with various devices and applications. This knowledge highlights the importance of standardized size classifications to streamline product development and sourcing.

4.4 Spot Welding:

Spot welding is a fundamental technique in battery pack assembly that creates secure electrical connections between cells while ensuring structural integrity. Understanding this process underscores its role in creating reliable battery packs.

4.5 Battery Management Systems (BMS):

Integrating a BMS into battery packs is essential for monitoring and managing cell performance, balancing charging and discharging, and ensuring safety. Knowledge about BMS installation emphasizes its critical role in battery management.

4.6 Housing Design:

Protective housing designs are crucial to shield battery packs from external elements and potential damage. This knowledge underscores the importance of tailored housing solutions for different applications, considering factors like thermal management and shock resistance.

4.7 Quality Control and Testing:

Stringent quality control checks and testing procedures are essential at every stage to guarantee safety and functionality. This knowledge highlights the commitment to

delivering high-quality products and preventing potential issues.

4.8 Documentation and Compliance:

Maintaining detailed documentation throughout the process is essential for traceability, warranty claims, and regulatory compliance. This emphasizes the significance of record-keeping in the battery manufacturing industry.

4.9 Packaging and Shipping:

Proper packaging Safeguards battery packs during transit and ensures they arrive in optimal condition. This knowledge underscores the importance of secure packaging to protect products during delivery.

CHAPTER 5

SUMMARY AND CONCLUSION

In summary, the battery production process is a meticulously orchestrated series of stages that begins with the selection of suitable battery cells based on chemistry, capacity, and performance characteristics. These cells undergo rigorous testing to ensure their quality and safety before being classified by size, enabling compatibility with specific applications. The assembly process involves spot welding cells together to form packs, integrating Battery Management Systems (BMS) for monitoring and safety, and encasing packs within protective housings designed for various environmental conditions. Quality control checks and testing procedures are paramount throughout, and thorough documentation and compliance with industry standards are maintained. The final step involves packaging and shipping battery packs to customers worldwide, emphasizing the importance of secure packaging for product integrity during transit.

In conclusion, the knowledge gained from the battery production process underscores the intricacies and precision required to deliver safe, high-quality battery solutions for a diverse range of applications. It highlights the critical role of testing, quality control, regulatory compliance, and customization to meet specific energy storage needs. Battery production is not just about manufacturing; it's a customer-centric endeavor focused on providing reliable, sustainable, and efficient energy storage solutions for a rapidly evolving technological landscape. This knowledge underscores the industry's commitment to safety, performance, and innovation as it continues to power a sustainable future.

CERTIFICATE OF COMPLETION



To whomever it may concern

We here by certify that **Ms. Mala.A**, Register No: 41140050 studying in II year of Bachelor of Engineering - EEE Department in Sathyabama Institute of Science and Technology have undergone internship in our concern from 16.05.2023 to 20.05.2023. During this period, she well studied about factory activities, General Information's about BMS and Testing Process of our company.

Place: Coimbatore

Date: 20.05.2023

Best Regards,

For Pinnacle Lithium Power



Authorized Signature