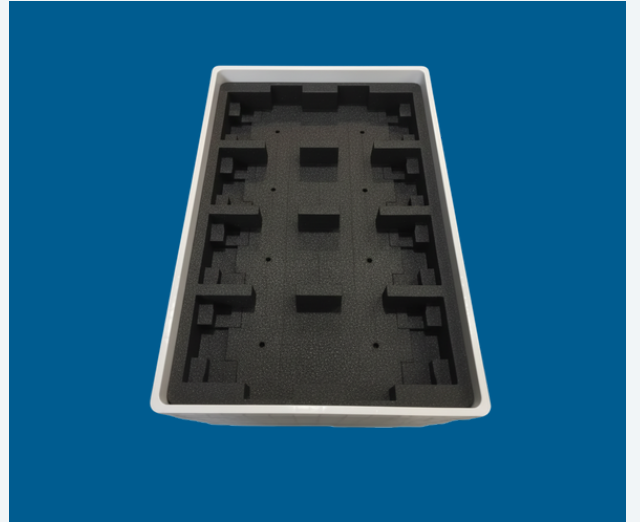


CASE STUDY

Engineering Safety: Custom Dunnage for High-Value Lithium-Ion Battery Packs



► Introduction

As India accelerates in electric mobility, the demand for high performance lithium-ion batteries is rising. A leading Indian battery manufacturer, supplying key components to a major Japanese EV brand, needed a durable, protective and precise packaging solution. Their existing systems lacked impact resistance, ergonomic design and dust-free handling.

K. K. Nag Private Limited was approached to deliver a customised solution using Expanded Polypropylene (EPP) - renowned for its lightweight, durability and shock-absorbing properties.

► Key Challenges

- **Shock Protection:** Existing packaging lacked adequate cushioning, putting sensitive batteries at risk during handling and transit.
- **Heavy Handling:** Bulky packaging increased manual effort, causing handling difficulties and operator fatigue.
- **Poor Fitment:** The earlier dunnage was a generic, non-custom solution with loose fitment, which failed to secure batteries tightly - leading to movement, dust ingress and potential product damage

► Solutions

In 2024, K. K. Nag Private Limited initiated the development of a fully assembled EPP dunnage system tailored for lithium-ion battery applications. The solution combined technical innovation with customer-centric design, following these key steps:

- 1. Material Selection and Density Optimisation:** Initial trials began with EPP at 27 GPL density. Based on customer feedback, this was optimised to 23 GPL to strike the perfect balance between cushioning and durability for multi-use applications.
- 2. Shrinkage Control via Tool and Process Modifications:** Moulds were redesigned to accommodate shrinkage variations. Cooling fixtures were introduced post-heating to lock in dimensional accuracy, ensuring that the fill gap tolerance was maintained consistently.
- 3. Custom Assembly Design:** We developed and supplied additional parts such as Velcro belts, foam sheets and polypropylene components. Changes in Velcro size, thickness and stitching were suggested and approved, making the final assembly easier and more efficient for the customer.
- 4. Comprehensive Execution Plan:** From tool design and sample submission to pilot production, every phase was aligned with quality, precision and repeatability.

► Results

Our customised EPP dunnage solution enhanced supply chain efficiency and product protection. Key outcomes included:

- **Improved Battery Protection:** The EPP dunnage offered excellent shock absorption, reducing the risk of battery damage during transport and handling.
- **Enhanced Operational Efficiency:** The reduced packaging weight made manual handling easier and safer, improving efficiency and ergonomics on the production floor.
- **Dust-Free Precision Fitment:** Through close-tolerance fitment between dunnage and bins effectively prevented dust accumulation, maintaining hygiene and product quality