

Thermal and Structural Design of Li-Ion Batteries



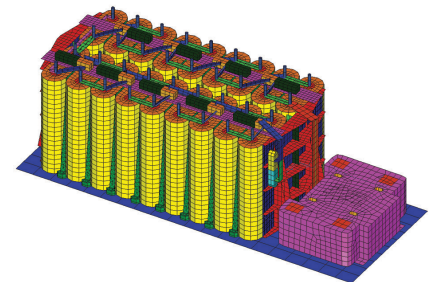
Case Study

OVERVIEW

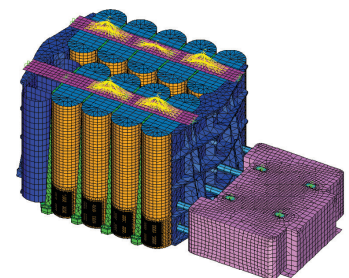
EaglePicher Technologies is a leading producer of batteries and energetic devices for the defense, space, and commercial industries. In particular, EaglePicher is a leading developer and supplier of lithium-ion (Li-Ion) batteries to satellite manufacturers. The batteries are subjected to high dynamic accelerations during liftoff and extreme temperature environments once deployed. ATA has supported EaglePicher since 2007 by providing a comprehensive suite of thermal and mechanical analyses to support design of several different Li-Ion battery systems.

TASKS PERFORMED & KEY OUTCOMES

- Developed thermal and structural finite element models (FEMs) of the batteries.
- Defined thermal coupling and resistances between components.
- Performed transient thermal analysis for multiple load cases to simulate the maximum depth-of-discharge eclipse cycle and predict temperature profiles throughout the 70-minute discharge period for end of life without cell failure and with one cell failure.
- Developed summaries of predicted thermal profiles for all load cases and maximum and minimum temperature time histories for each cell.
- Correlated thermal FEM using thermal couple test data at 24 locations on the structure.
- Performed quasi-static analyses and determined component stresses and fastener margins of safety.
- Conducted modal analyses and determined both random response and shock response.
- Calculated component and fastener margins of safety and predicted RMS accelerations at critical locations.



Thermal analysis model of an 18-cell Li-Ion battery



Structural analysis model of a 9-cell Li-Ion battery