

## Data Base and Guidelines Document Developed for Lithium-Ion Battery

Lithium-Ion (Li-Ion) batteries are fast becoming the battery chemistry of choice for aerospace applications requiring (rechargeable) power supplies. These batteries offer high-energy density and high-specific energy combined with excellent rate capability and cycle potential. The increased energy content and operational characteristics of this system require defined safety and handling procedures to ensure the safe implementation. Standardized approaches to defining, determining, and addressing safety, handling, and qualification for Li-Ion batteries have been developed and published as an NESC-sponsored Li-Ion Battery Guidelines Document. A data base was established cataloging cells and batteries that have been considered for aerospace applications.

### Applicability

These resources are applicable to missions and applications considering the use of Li-Ion batteries in the energy storage subsystem.

### Background

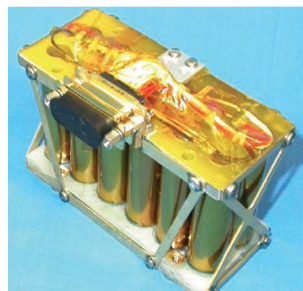
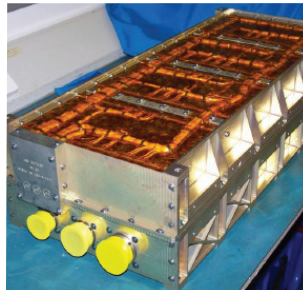
Li-Ion batteries are an attractive alternative to traditional alkaline-based battery systems. They offer reduced weight and volume and additional rate capability over the nickel-cadmium (Ni-Cd), nickel-hydrogen (Ni-H<sub>2</sub>) and silver-zinc (Ag-Zn) battery systems they will replace.

To be considered for aerospace mission applications, Li-Ion batteries must meet stringent safety and performance requirements. These considerations have been defined in documents from various sources that address safety, use, issues, qualification, and testing of aerospace Li-Ion batteries. To facilitate and ensure the safe implementation of this technology, important guidelines and recommendations were compiled, and then revised and enhanced in the NESC-sponsored Li-Ion Battery Guidelines Document.

To date, cells and batteries from several manufacturers have been qualified for use in specific aerospace mission applications. A survey was also conducted (both within and outside the United States) on existing Li-Ion battery manufacturers' capabilities to meet future NASA mission needs.

### Li-Ion Battery Database

A Microsoft® Excel®-based database of Li-Ion batteries and cells appropriate for aerospace applications was established. The database describes the performance of cells and batteries along with the reported testing that they have undergone (either at the manufacturer or by other government agencies). The database includes batteries and cells appropriate for multiple NASA mission needs including: Low Earth Orbit (LEO), Geostationary Orbit (GEO), and the Constellation Program.



Li-Ion batteries flown on NASA Missions: Mars Exploration, Rover, and the Lunar Reconnaissance Orbiter.

Additionally, the database contains commercial-off-the-shelf cells and batteries.

### Li-Ion Guidelines Document

The Li-Ion Guidelines Document addresses the issues and concerns associated with the use of Li-Ion chemistries resulting from their inherent high-specific energy combined with flammable electrolytes.

The guidelines document provides background on the technology; basic operational information discussing the electrochemical reactions that take place within the cells; a summary of factors that affect battery performance; battery design considerations; cell and battery hazards and controls; battery requirements; cell and battery handling and procedures; typical Li-Ion cell and battery test procedures; and definitions. A listing of references that provide more detail on program-specific requirements is also included.

It is recommended that all users considering this technology for space applications, especially for applications involving humans, consult this document for guidance prior to implementation due to the extreme importance of appropriate design, test, and hazard control of Li-Ion batteries.

### References

NASA Aerospace Flight Battery Program Year 1 Report – Part 1, Volumes 1 and 2, Generic Safety, Handling and Qualification Guidelines for Lithium-Ion (Li-Ion) Batteries, Li-Ion Batteries, Maintaining Technical Communications Related to Aerospace Batteries (NASA Aerospace Battery Workshop), NESC Document Number RP-08-75.

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