



NESC Lithium Battery Guidelines

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Lithium-Ion Battery Guidelines

- **The Team:**
 - NASA GRC
 - NASA JSC
 - NASA KSC
 - NASA MSFC
 - NASA GSFC
 - NASA JPL
 - NASA LaRC
 - Aerospace Corp.
 - NRL
 - AFRL
 - NSWC Crane



Lithium-Ion Battery Guidelines

- **Objective:**
 - Develop standardized approaches to defining, determining, & addressing safety, handling and qualification standards for Li-Ion batteries
 - The guidelines and recommendations will aid in the implementation of Li-Ion battery technology for aerospace applications
- **Approach**
 - Generate a general guidelines document defining specific parameters that must be addressed for the safe implementation of Li-Ion battery technology
 - For project managers, payload managers, technologists



Lithium-Ion Battery Guidelines

- **Outline**

- **Introduction**

- Purpose
 - Basic Chemical Information
 - Hazard and Safety Overview
 - Applications

- **Definitions**

- **Factors Affecting Battery Performance**

- Capacity
 - Voltage Level
 - Current Drain
 - Type of Discharge (continuous or intermittent)
 - Modes of Discharge (constant power, constant current, constant load)
 - Temperature
 - Service Life
 - Voltage Regulation
 - Charging Voltage
 - Battery Age and Storage
 - Battery Design



Lithium-Ion Battery Guidelines

- **Outline**
 - **Battery Requirements**
 - Crewed Spacecraft
 - Unmanned Spacecraft
 - **General Hazards and Controls**
 - Structural
 - Battery Gases
 - Pressure
 - Electrolyte Leakage
 - Short Circuits
 - Circulating Currents
 - High Temperature
 - Charging
 - Overdischarge
 - Emergency Procedures
 - Storage
 - Disposal
 - Transportation
 - Orbital Debris



Lithium-Ion Battery Guidelines

- **Outline**
 - **Cell/Battery Test Plans**
 - Purpose
 - Outline
 - Qualification
 - Flight Acceptance
 - Life
 - Cell Screening
 - Ground
 - Cell and Battery





Lithium-Ion Battery Guidelines

- **Source Documents:**

- Payload Safety Review and Data Submittal Requirements For Payloads Using the Space Shuttle and International Space Station
- Safety Policy and Requirements For Payloads Using the Space Transportation System
- Battery Design and Safety Evaluation Form (JSC)
- Electrical Power Systems for Unmanned Spacecraft (AIAA)
- JPL Standard For Anomaly Resolution
- Battery Processing (JSC)
- NASA Software Engineering Requirements
- TEST REQUIREMENTS FOR LAUNCH, UPPER-STAGE, AND SPACE VEHICLES, Vol I : Baselines (MIL-STD)
- PRODUCT VERIFICATION REQUIREMENTS FOR LAUNCH, UPPER STAGE, AND SPACE VEHICLES (MIL-STD)
- SPACE ENVIRONMENT FOR USAF SPACE VEHICLES (MIL-STD)



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- **Source Documents:**

- Preliminary Lithium-Ion Battery Qualification Standards for Transformational Communication satellite System (TSAT) (Aerospace)
- International Space Station Program Qualification and Acceptance Environmental Test Requirements
- Joint 45 SW/SE and 30 SW/SE Interim Policy Regarding EWR 127-1 Requirements for System Safety for Flight and Aerospace Ground Equipment Lithium-Ion Batteries (USAF)
- FTS Lithium Ion Battery – Design and Test Chapters 3, 4, and 5
- GLM-QE-8715.1 Battery Safety and Design Manual for Payloads
- IEEE Standard for Rechargeable Batteries for Portable Computing
- IEEE Standard for Rechargeable Batteries for Cellular Telephones
- Specification for Lot Testing and Flight Screening of Canon BP 927 and BP 930 Lithium Ion Batteries (JSC)
- Crewed Space Vehicle Battery Safety Requirements (JSC)



Lithium-Ion Battery Guidelines

- **Source Documents:**

- Primary Battery Design and Safety Guidelines Handbook (NASA)
- Space Shuttle Program, Payload Bay Payload, User's Guide
- HTV Li-ion Battery PFT/AT Summary (JAXA)
- H-II Transfer Vehicle CDR Data Package, HTV Verification Requirements Document (JAXA)
- 100Ah Lithium Ion Rechargeable Battery Cell Model Name: LFS100-006 , Instruction Manual (Yuasa)
- Space Product Assurance (ESA)
- Space engineering Electrical and electronic (ESA)
- Acceptance, Qualification and Reliability Tests on Li-Ion Batteries“generic tests for Li-ion batteries supporting planetary surface missions.” (JPL)
- GSFC Qualification/ Acceptance Procedure
- Lithium Ion Battery Acceptance/Safety Test Report Procurement Specification MISSE5/PCSat2 Project