

National Aeronautics and Space Administration

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High Specific Energy Primary Batteries for NASA Missions

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Technology



- Recent significant investments by Europa Lander project advanced the technology
- High capacity anode (Li) and cathode (CF_x)
- Standard D-cell format similar to heritage designs
- Low mass aluminum packaging
- Cell chemistry is highly exothermic, for cell self-heating in cold environments



EaglePicher



Rayovac

Applications

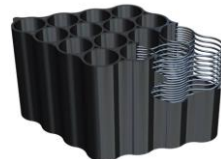
- Gas and ice giants atmospheric probes
- Mars, Small Body and Ocean Worlds landers, probes, impactors and penetrators
- Lunar probes and lunar night survival

Benefits

- High specific energy (650-770 Wh/kg)**
 - For long run time / low mass power
- Minimal voltage delay**
 - Potential to eliminate depassivation circuitry
- Heat generation (~1:1 ratio of heat/power)**
 - Reduce or eliminate external heating
- Low self-discharge (~1% annually)**
- High radiation tolerance with minimal loss in capacity up to 10 Mrad total ionizing dose levels**



12.5 kWh battery module
~500 Wh/kg design

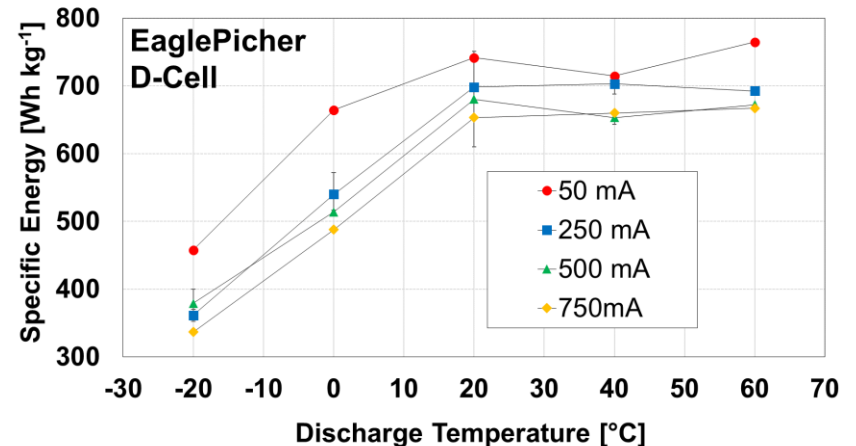


JPL additively manufactured battery module with heat pipes

Comparison of SOA vs. Advanced Cells

Cell Chemistry	Vendor	Part Number	Format	Specific Energy, Wh/kg (20°C, 50 mA)
Li/SO ₂	Saft	LO 26 SXC	D cell	420
Li/SOCl ₂	Saft	LSH 20	D cell	421
Li/MnO ₂	Ultralife	CR15270	D cell	250
Li/FeS ₂	Energizer	L91	AA cell	350
Li/CF _x -MnO ₂	EaglePicher	LCF-133 (COTS and modified)	D cell	514
Li/CF _x	Rayovac	Europa Lander Developmental	D cell	730
Li/CF _x	EaglePicher		D cell	741

Wide Temperature Operation



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