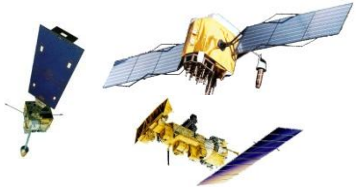

Li Ion Batteries

20 May 2011

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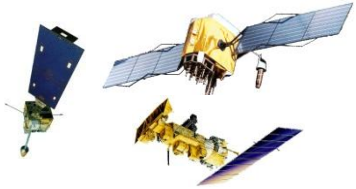
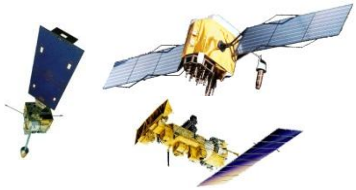
Topics



- JC-24 LIRB changes
- Power Sources Technical Working Group
- Li Ion Battery Safety and Technical Group
- RTCA activities
- RTCM SC-128
- JC-25 LIRB proposed changes
- Issues list

JC-24 LIRB Changes



- USA paper for JC-24 proposed a number of changes to the Interim type approval standard (LIRB)
- Letter of compatibility in lieu of type approval: limits LIRB to specialized applications rather than all types of distress beacons
- Detailed list of problems.
- Warning on temperature exposure
- Corrected a number of LIRB errors
- Action to further investigate

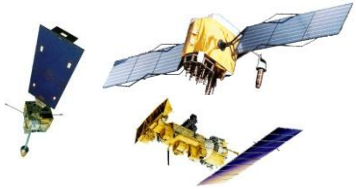
Power Sources Technical Working Group

- US Dept of Defense convened a working group (PSTWG) to facilities better power sources (battery and fuel cells) utilization across military services
- Problem is that each service specified own batteries and fuel cells leading to a large number of different batteries types which caused logistics and supply problems in war theaters
- Goal is to reduce the number of different batteries in the inventory and to have different applications use a smaller set of batteries
- Subgroup chartered to write a common Li Ion spec for all services
  - First meeting Oct 2010 and met again earlier this week
- Monthly PSTWG telecons

Li Ion Battery Technical and Safety Group

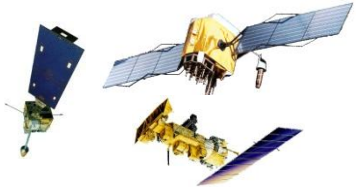
- Long standing group acts as a clearinghouse of military service battery safety and technical information
- Navy, NASA, Army, Air Force, Marine Corps, National renewable Energy Lab, Sandia Labs are players
- Meets twice a year
- Next meeting in Napa Valley Sept 2011

RTCA



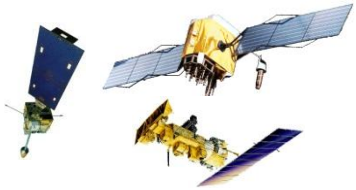
- RTCA convened SC-225 to write a spec for small and medium Li Ion batteries onboard aircraft
- Started March 2011
- Quarterly meetings and monthly telecons
- Goal is to either revise DO-311 or generate a new document by Sept 2012
- Next meeting May 24-25 at RTCA

RTCM SC-128



- RTCM SC-128 has approved a spec for commercial SEND devices (SPOT, Iridium)
- Language in spec pertains to Li Ion batteries

JC-25 Proposed Changes to the LIRB

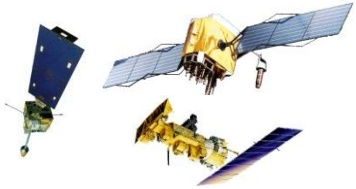


- Two changes are proposed
- Definition of Li Ion batteries to limit application of the LIRB to Li Ion batteries
- Change constant current protocol to determine lifetime for a pulsed nature – this was due to a Navy paper presented at a Technical and Safety group meeting concerning primary batteries
- Results: accelerated aging done by higher temperatures

Discharge Current	Age	% change in lifetime over rated capacity	% reduction in lifetime from constant current measurement
Pulsed	0		9.3
Pulsed	5 yr	-11	18.3
constant	0	+10	baseline
constant	5 yr		-4.6

- Question is what happens to Li Ion rechargeable batteries.

Problems with Li Ion Batteries



Issue #	Problem
CSC-43 -1	Determination of irreversible capacity losses resulted from repeated charge/discharge cycles
CSC-43-2	Testing of battery charger as part of the beacon design
CSC-43-3	Information to users that the battery needs to be charged.
CSC-43-4	Diligence of users maintaining rechargeable batteries as they would need more attention than what was required for non-rechargeable batteries
CSC-43-5	Reliability of beacons equipped with rechargeable batteries
CSC-43-6	Mounting as beacons would require frequent removal for recharging of batteries and inspection
CSC-43-7	Potential increase in beacon activations of less than 24 hours
USA-1	Inapplicability of Arrhenius equation to batteries (to determine accelerated testing at higher temperatures)
USA-2	Higher capacity fades at higher temperatures/temperature loss mechanisms
USA-3	lack of state of charge indication to user
USA-4	Measuring voltage on a flat voltage-time discharge curve
USA-5	unjustified 1.65 safety factor applied to Li ion batteries