Flight Standards Concerns for Energy Sources and Fire Risks

Federal Aviation Administration

Presented to: International Fire & Cabin Safety Research Conference

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Date: October 31, 2007

Subjects of Today's Discussion

- **Characterize failures of lithium (Li) (metal) and lithium-ion (Li-Ion) batteries as used in portable electronic devices (PED), e.g. laptop computers, cell phones, DVD players, etc. caused by improper charging, mishandling, or misuse.**
  - Example of one such failure in portable air purifying device…
- **Review exposure to passengers and crew in all aircraft, particularly generally aviation aircraft operated without flight attendants and proper fire fighting training.**
- **Review initiatives being considered by FAA to restrict charging of PEDs and to publish advisory circular (AC).**
- **Address external initiatives underway with aviation trade associations and the airports communities to increase public awareness of risks of carriage and use.**
- **Share thoughts on how the aviation community can reciprocally and anonymously share incident data with the FAA and how to capture in consolidated database.**

Failures of Li and Li-Ion Batteries (1/2)

- **There are many different types of failures of Li-Ion cells used in notebooks, camera, cell phones, etc. batteries.**
  - There are many ways for particles/impurities to get into a cell during the manufacturing processes
  - Flaws in Li-Ion cells can cause deposits or dendrites of Li metal or copper to form in the battery. These can grow with each cycle of charging until an internal short circuit is caused
  - The cathode materials of batteries are hard and rough and can wear down the manufacturing tools and can cause metal particles to contaminate the cell
- **There are no industry "clean" standard for the Li and Li-Ion battery manufacturing process other than a manufacturer's own quality control. Manufacturers of faulty cells had ISO 9000-series QC certifications.**

Failures of Li and Li-Ion Batteries (2/2)

- **For detecting problem cells, the UN and UL tests pale in effectiveness compared to internal quality control tests…**
  - The reason is that internal QC tests are run on every batch
  - It is easy for manufacturers to adjust to standardized tests like the UN and UL tests (and do the bare minimum to pass those tests)
  - The subtle design changes that are allowed in the UN tests are exactly the kind of changes that cause problems in cell manufacturing. A different tool, a different supplier, a different assembly technique are where the problems are introduced
- **The electronics of a device can cause good batteries to catch fire…**
  - ***Lithium fires burn hotter than the melting point of aluminum!***
- **The least damaged cell in a battery fire is often the one that had the original failure…**
  - Because the thermal runaway starts with the remaining cells with stored energy that elevate in temperature causing unstable state

Potential Hazardous Exposure (1/3)

- **Increased risks with use of Li and Li-Ion battery applications and growing technologies in PEDs.**
- **Previous energy sources such as nickel-metal hydride, nickel cadmium, alkaline, even lithium disulfide, are less hazardous in carriage and in use.**
- **Battery "expulsion" from air purifier device at LGB terminal at right –**

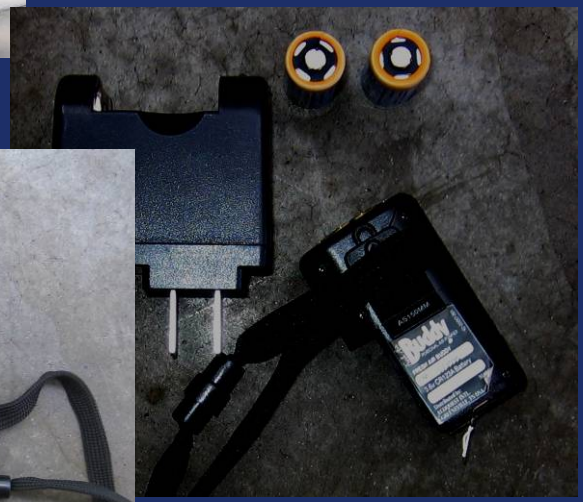
  Roll the footage Duke!

There have been two reported incidents of battery failures in flight…

Fortunately no one was seriously injured…

Potential Hazardous Exposure (2/3)

- **The possibility exists that a non-rechargeable Li (metal) battery was charged before using this device…**
  - Most people are not aware of the volatility of these types of batteries.
- **Serious injury or death by misuse of Li and Li-Ion batteries is a distinct possibility!**
- ***Agents need to be discovered, developed, and deployed quickly to successfully extinguish lithium (metal) fires…***



Potential Hazardous Exposure (3/3)

Many airline marketing departments are promoting passenger convenience item (PED) or In-flight Entertainment system use to stimulate competition…

Exposure to Passengers and Crew (1/2)

- **Operators need to be consciously aware of *non-replaced* batteries following mandatory recalls.**
  - Topping the current list are 46 million Nokia cell phone batteries of which CPSC and manufacturers estimate that only 3% of those batteries will be replaced and fewer than those surrendered, returned, or destroyed
  - Preceded by 10 million notebook computer batteries over past 2 years, which CPSC reports that fewer than 10% of those notebook batteries were surrendered or returned following recall notification
- ***Defective recalled batteries are being kept as spares!***
- **Operators should establish policies to prevent carriage of any batteries, protected or not, within stowed luggage and baggage compartments - - *keep them in the cabin…***
- **Charging Li-Ion batteries in any environment is potentially hazardous! *Never charge a lithium (metal) battery!***

Exposure to Passengers and Crew (2/2)

- **Portable Oxygen Concentrators are converting to Li-Ion power and are likely to be restricted from charging.**
  - Oxygen reservoir is small, and expends quickly, but is vulnerable
- **Flight Standards Service (AFS) has serious concerns over types of chargers being used, including in-seat power supply systems (ISPSS).**
  - AIR published only cursory policy on incorporating ISPSS
  - Many 110 Volt/60 Hz inverters produce square wave outputs which negatively impact efficiency of charging “bricks”
  - Tighter, more compatible, performance standards must be established for new and retrofit installations
- **AFS will work with Aircraft Certification Service (AIR), airlines, and modifiers to ensure that designs are easily “retrofittable”.**
  - FAA will revise the Non-Required, Non-Essential Systems AC…

External FAA Initiatives

- **Work with industry trade associations to develop and publicize awareness campaign to inform the public of risks in carriage, stowage, and charging of batteries.**
- **Promulgate Advanced Notice of Proposed Rulemaking (ANPRM) to address questions and seek public response to restrict carriage, use, and recharging of batteries.**
- **Charter an Aviation Rulemaking Committee (ARC) to evaluate and provide recommendations to FAA on effects of stowage and carriage of energy sources onboard all-cargo and "combi" airplanes.**
- **Facilitate means for industry trade associations to provide means to report such incidents which would allow FAA to track and collect data on number and type of reported battery incidents.**
  - A web portal could be established for anonymous reporting

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FAA InFO 07016, dated 8/3/2007) –
http://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/info

PHMSA Safe Travel URL – **http://safetravel.dot.gov**

Questions?