

Battery Fires in Air Transportation

Presented to: **International Cabin Safety
Conference**

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**Federal Aviation
Administration**



Background

- Battery problems have been cited in:
 - **NTSB Recommendations**
 - **GAO/OIG Reports**
- 80+ aviation-related fires/dangerous heat
 - **28 lithium related incidents**
 - **See separate list**
- Two FAA Tech Center Reports
- UK Civil Aviation Authority Report
- Numerous CPSC recalls for overheating

Division of DOT Regulatory Responsibility for Hazardous Materials (Dangerous Goods)

- **Pipeline and Hazardous Materials Safety Administration**
 - Issues the Hazardous Materials Regulations
 - With air-mode support from the FAA
- **Federal Aviation Administration**
 - Enforces the Hazardous Materials Regulations
 - With support from PHMSA

Previous US DOT Advisory Notices

- **Lithium Battery Notices**
 - September 7th 2000, Public Federal Register Notice
 - September 7th 2000, Bulletin to Air Carriers
- **General Battery and Devices Notices**
 - July 7th 1999, Public Federal Register Notice
 - July, 7th 1999, Bulletin to Air Carriers
 - May 23rd 2002, Bulletin to Air Carriers

Three Published Studies on Lithium Battery Fires in Aviation

- FAA - June, 2004, *Flammability Assessment of Bulk-Packed, Non-rechargeable Lithium primary Batteries in Transport Category Aircraft.*
- FAA – September, 2006 *Flammability Assessment of Bulk-Packed Rechargeable Lithium Ion Batteries*
- Civil Aviation Authority, United Kingdom July, 2003 *Dealing With In-Flight Lithium Battery Fires In Portable Electronic Devices.*

Some Report Conclusions

see <http://www.fire.tc.faa.gov/>

- Lithium metal (primary) battery “cargo” fire can not be suppressed by Halon (FAA)
- Lithium-ion rechargeable battery “cargo” fire can be suppressed by Halon (FAA)
- Passenger-related rechargeable li-ion battery-powered device fire can be suppressed using the fire fighting equipment available to the crew (UK CAA)

Some Report Observations

- Lithium-metal primary battery fires appear to act more like a “flammable metal” fire
- Lithium-ion rechargeable battery fires appear to act more like a “flammable liquid” fire
- Heat from a suppressed fire can still cause other batteries to burn and explode
- Battery explosions create a pressure pulse and spew molten electrolyte.

Incidents

- **The following slides describe recent battery incidents that have occurred:**
 - In the aircraft cabin
 - In the airport prior to boarding
 - In checked baggage
 - In cargo on passenger or cargo aircraft

Personal Air Filters – Two explosions

- On two different occasions the “Fresh Air Buddy” device has exploded while being worn around a passenger’s neck.
- One incident occurred in the aircraft cabin at altitude causing an emergency landing.
- The other incident occurred in the airport (see video in next slide).
- Charging a non-rechargeable lithium battery is suspected in both incidents.

Airport security video of personal air filter exploding while on passenger's neck



Laptop fire in LAX gate area

- Passenger was charging laptop with airport electrical outlet while waiting for flight.
- Laptop started to smoke, was unplugged, and then caught fire.
- Laptop continued to smoke after suppression with fire extinguisher
- See video in next slide

Amateur video of laptop fire at LAX



News crew audio/video equipment causes fire in cabin and emergency landing

- A JetBlue passenger aircraft made an emergency landing shortly after takeoff from NYC.
- Batteries in a bag of audio-video equipment caused a fire in an overhead compartment.
- A 9-volt lithium battery is the most likely source.



Laptop and spare with Lithium-ion battery in carry-on baggage



Started burning in the overhead bin in the passenger cabin minutes before pushback from gate for trans-Atlantic flight. Fire extinguished on the ramp.

9-volt lithium battery explodes in cabin



Lithium battery exploded in aircraft cabin as cameraman switched batteries on presidential candidate's campaign plane. Small fire in aircraft seat extinguished by Secret Service.

CR123A batteries in multiple incidents

- Flashlight bought in China starts fire in seatback during passenger flight from China to Canada
- Flashlight bought in China “pops” and smokes in UPS cockpit flight bag – batteries confirmed as counterfeit
- Single battery explodes in passenger cabin when dropped during flight from Buenos Aires to Miami.



Burnt counterfeit battery

Portable drill in checked baggage



Battery-powered drill accidentally activated in checked baggage. Drill/battery overheated and caused suitcase to catch fire on the ramp right before loading on passenger flight in Chicago.

Prototype Lithium Battery shipped as cargo by a US DOT Approval Holder



Fire discovered as ULD was being loaded for trans-Atlantic cargo flight in Memphis.

Two 12-volt nonspillable batteries packed together in cargo



These “excepted” batteries were packaged together in same box. Package caught fire in air cargo sort facility.

12-volt nonspillable battery in powered hand truck



Hand truck activated during taxi for takeoff on passenger flight. Packaging prevented motor movement. Overheated battery and motor and melting cables set off smoke alarm and aircraft returned to gate.

Lithium Ion Batteries for Remote Control Model Cars



Shipment being returned to manufacturer in Korea caught fire in air cargo warehouse.



Observations from incidents

- Fire extinguishers do not immediately “extinguish” fires involving lithium metal or lithium ion batteries
- Suppressing/extinguishing a small lithium battery fire may expend all the in-cabin fire extinguishers
- Fires suppressed in cabin still lead to panic, emergency landings, and breathing complaints related to smoke *and* extinguishing agents
- Some CR123A lithium batteries (used in cameras and flashlights) burn or explode when dropped (counterfeiting a problem with this size)

Battery Fire Trends

- Most incidents involve undeclared/unlabeled “excepted” or “special provision” batteries
- Short-circuit is the most common cause of fires (either through design, packaging, or handling)
- Lithium and lithium-ion usually involved in unexplained fires (no obvious short circuit, etc)
- Nearly all reported fires are discovered on the ground
- Airlines do not always report incidents involving “excepted” batteries
- None of the incidents involve consumer-type batteries in their retail packaging (blister packs)

Most lithium battery shipments are excepted from the dangerous goods regulations

- No recognized hazmat label leads to air carrier handling problems.
- Air carriers are not aware of the risk they are accepting.
- The batteries are not listed on the pilot's hazmat notification form – complicating any potential in-flight emergency procedure.
- Fire departments have no way of knowing what they may be responding to.

Voluntary Industry Efforts

- Voluntary labeling is being used by some “excepted” lithium battery shippers
- Some air carriers are mandating pre-approval for acceptance of excepted lithium batteries
- IATA Dangerous Goods Regulations (8.2.6) requires that the air waybill for excepted batteries be annotated “Not restricted by Special Provision AXX” along with the description of the articles.

Recently Published DOT Rules on Lithium Batteries

- **HM-224C and HM-224E Combined Final Rule**
 - In part, aligns domestic standards with certain UN testing and marking standards.
 - Aligns with ICAO rules on excepted lithium batteries
 - Bans primary lithium batteries as air cargo on passenger flights to, from, and within the US.

Additional DOT Rulemaking Efforts Underway

- **HM-224D** – Propose rulemaking to strengthen standards concerning electrical hazards (fire hazards) of all battery shipments
- Notice of Propose Rulemaking expected in December 2007.

Airline Pilots Seek an End to Lithium Battery Exceptions

- ALPA & IFALPA seek the full regulation of all lithium and lithium-ion battery shipments as dangerous goods
- Without it, there's no way for the air crews to know they are carrying these lithium batteries
- Want greater packaging standards for the batteries, including individual inner packagings
- Disagree with system that forbids lithium metal batteries from passenger aircraft, but allows them on cargo aircraft undeclared

Oversight

- **January, 2003 – General Accounting Office**
 - GAO-03-22, page 21
- **November, 2004 – DOT Office of Inspector General**
 - DOT OIG SC-2005-015, page v
- **Various, 1999 – 2006 National Transportation Safety Board**
 - A-99-80, A-99-81, A-99-82, A-99-83

Recent Outreach

- **PHMSA – Enterprise Government Approach**
 - Action Plan
 - SafeTravel.dot.gov
- **July, 2007 – Hong Kong Civil Aviation Department**
 - Dangerous Goods Advisory Circular
- **July, 2007 – FAA**
 - Dangerous Goods Advisory Bulletin