



EUROPEAN AVIATION SAFETY AGENCY
AGENCE EUROPÉENNE DE LA SÉCURITÉ AÉRIENNE
EUROPÄISCHE AGENTUR FÜR FLUGSICHERHEIT

The Lithium batteries air transportation: a global safety issue ?

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Your safety is our mission.

- ▶ Lithium batteries air transportation as global safety issue
- ▶ Actual and future regulation changes – considerations
- ▶ Update on recent case of cargo fires with “lithium batteries as primary suspect”
 - ▶ UPS 006, B747, N571UP, in Dubai on 3 September 2010
 - ▶ (?) Asiana B747-400, HL7604, flight from Seoul to Shanghai on 28 July 2011
- ▶ Safety initiatives
 - ▶ EASA, FAA and UPS



LB air transportation issue

- LB are widely used today in electronics, from lap top, digital cameras, electric motors, etc.
- Unpredictable, intense and persistent fire starters.
 - chemical (e.g., flammable electrolytes) and electrical hazards.
 - If not safely packaged and handled, lithium batteries can present a significant risk in transportation.
 - Misused, mishandled, improperly packaged, improperly stored, overcharged, or defective can overheat (thermal runaway) and ignite and, once ignited, fires can be especially difficult to extinguish.



LB air transportation issue

- ▶ Lithium battery fires (regardless of the source or cause) burn hotter, propagate faster, and are more difficult to suppress than other cargo fires.
- ▶ In the presence of typical cargo fires, LB will exacerbate the hazard.
- ▶ Severity of a fire:
 - ▶ total number and type of batteries on board an aircraft;
 - ▶ batteries' proximity to one another.
- ▶ Many packages of closely packed batteries, such as a palletized unit, pose a substantial hazard.

FAA – propagation tests

- Tests designed to measure the propagation between cells when a single cell fails (thermal runaway)
- Lithium-ion and metal used
- Tests with multiple boxes of cells in original shipping packaging
- Unsuppressed compartments, main deck freighter (on-going)
- Suppressed compartments, class C cargo compartment (future)





LB air transportation issue

- 34 battery-related incidents have been reported to the FAA since February 2007
- In 2009 one carrier shipped 49 million of LB from seven suppliers.
- Lithium batteries are regulated for transport across all modes of transport (road, rail, sea and air) as Dangerous Goods.
- **LB are an emerging aviation hazard and international air freight is rapidly growing.**



Regulations on Dangerous Goods

- Major actors...
 - ICAO/IATA
 - FAA/DOT
 - SAFO, NRPM,...
 - EASA/EU aviation authorities



Regulations on Dangerous Goods

- ▶ Carriage of dangerous goods by air:
 - ▶ ICAO Standards and Recommended Practices (SARPS) of Annex 18 and the associated Technical Instructions for the Safe Transport of Dangerous Goods by Air produced by ICAO (Doc. 9284).
 - » Requirements for proper preparation and transport.
 - ▶ Annex 18: States must take the measures necessary to achieve compliance with the Technical Instructions;

- ▶ It is imperative that any other requirements peculiar to a particular region of the world, such as EU-OPS, are closely aligned with the Technical Instructions so as to ensure States meet their international obligations under ICAO.



EU-OPS on Dangerous goods

- ▶ EU-OPS Subpart R (Transport of Dangerous Goods by Air), set up the requirements for the operators.
 - ▶ An operator must comply with ICAO Technical Instructions and shall not transport dangerous goods unless approved to do so by the Authority.
 - ▶ Adequate training has to be given, all relevant documents (e.g. for ground handling, aeroplane handling, training) must contain information and instructions on dangerous goods, and that there are procedures in place to ensure the safe handling of dangerous goods at all stages of air transport.
- ▶ **Dangerous goods have to be transported in accordance with the latest ICAO T.I.**



Regulations on Dangerous Goods

- ICAO and IATA provide guidance material for operators to develop dangerous goods training programs.
- Guidance material is updated annually (ICAO Doc. 9284 every two years) and provides operators with an excellent source of information on dangerous goods.



Regulations on Dangerous Goods

- Many aviation authorities, including EASA, require that operators provide dangerous goods training for cabin crew during initial and recurrent training.
- 2009-2010 edition of the ICAO TI introduced significant enhancements to the conditions under which lithium batteries can be transported by air.



Future changes

- ▶ Latest developments regarding changes in the requirements for transportation by air.....

- **PHMSA NPRM on transportation of lithium batteries - 11 January 2010**
 - It was prompted by the accident on 7 February 2006 on the UPS DC-8 aircraft;
 - Applies to lithium batteries/cells transported in cargo aeroplanes or in the cargo holds of passenger aeroplanes; not to individual batteries carried on board by passengers.
 - All lithium batteries be treated as hazardous cargo.
 - It will have the effect of moving a discrete number of shipments of lithium cells and batteries that are currently handled as general cargo into the hazardous material transport system.
- NPRM is proposing to exceed the international regulation requirements for the air transportation of lithium batteries.



NPRM HM-224F - update

- 169 public comments received from a variety of entities
- Expire period: 13 March 2010
- Current status: US White House Office of Management Budget (OMB) undergoing a cost/benefit analysis
- An unusual situation...stalling situation....?

- ▶ In the NPRM, there are quoted a number of lithium battery incidents resulting in cargo fires, which have occurred around the world, but.....,
 - ▶there is not a single documented case of an incident being caused by lithium batteries prepared in accordance with the latest ICAO standard.



FAA initiative at ICAO DGP level

- ▶ FAA's representative at ICAO DGP meeting last October presented a working paper (WP/72) on the LB issue
- ▶ Revise Packing Instructions 965 and 968 of the ICAO TI doc. 9284, mainly to introduce a limit on the number of packages of LB within an overpack, palletized and transported in a single unit load device, or placed in a single aircraft cargo compartment.
 - ▶ (1) shippers would be required to receive formal training in the requirements for shipping lithium batteries;
 - ▶ (2) operator acceptance checks for compliance prior to loading and stowage aboard an aircraft would be required;
 - ▶ (3) pilots would be notified of the presence, location and quantity of lithium batteries aboard the aircraft.



FAA initiative at ICAO DGP level

- Proposal was not approved (10-6 vote)
- Another meeting in January in Montreal to again discuss the US proposal.
- In case no agreement can be achieved within ICAO in January 2012, the U.S. is likely to issue its own rule in mid-February 2012.

- To introduce yet more requirements will do nothing to address those shippers who are not complying with the current rules and may actually result in an increase in undeclared (hidden), non-compliant shipments due to the increased costs of compliance.
- If additional/different US requirements are introduced, this will cause significant disharmony with the (ICAO) requirements applied across the world.
 - Two sets of requirements for an international journey: not envisaged.



Update on recent cargo fire events

- ▶ EASA is participating as advisor to GCAA, in the B-747 UPS accident
 - ▶ Better understanding of the level of threat posed by the lithium battery and jointly determine if any certification (Cargo compartment) and regulatory actions are necessary.
- ▶ Close relationship between Korean investigators on the Asiana B747 event on 28 July 2011 and the UAE/NTSB team



B747, N571UP flight UPS 006, Dubai Update investigation

- Investigation is underway and the cause of the accident has not been determined.
- Preliminary and Interim report released (April and November 2011)
- Several safety advisory notices were appended to the Preliminary Report
 - to alert to the risks associated with the undeclared hazardous cargo:
 - ground handlers, ground handling agents
 - flight crews and airline operators



Investigation update

➤ SRs issued by NTSB

- ▶ September 2011: NTSB to the training for and use of oxygen masks; communicating with oxygen masks donned; and oxygen mask stowage and the smoke, fire, or fumes checklists.
- ▶ Flight crewmembers indicated to ATC that they experienced smoke in the cockpit and were unable to see their radios.
- ▶ CVR data revealed that both pilots experienced difficulties establishing internal cockpit communications and communicating with each other via the 747-400 communications system after donning their oxygen mask/goggle sets.



NTSB Safety recommendations – September 2011

- ▶ Require operators to **install full-face oxygen masks** on aircraft used for 14 Code of Federal Regulations Part 121, 135, and 91 subpart K operations and provide training on their use. (A-11-87)
- ▶ Require operators of 14 Code of Federal Regulations Part 121, 135, and 91 subpart K flights to include, **during initial and recurrent training, tactile, hands-on training on the use of operable oxygen mask/goggle sets**, including the use of the regulator's emergency selector and the venting of the smoke goggles. (A-11-88)
- ▶ Require operators of 14 Code of Federal Regulations Part 121, 135, and 91 subpart K flights to include, during initial and recurrent training, **aircraft-specific training on establishing and maintaining internal cockpit communications when the oxygen masks are donned**. (A-11-89)
- ▶ Require operators of 14 Code of Federal Regulations Part 121, 135, and 91 subpart K flights to educate flight crews about the importance of stowing their oxygen masks set to 100%. (A-11-90)
- ▶ Require that operators' **smoke, fire, or fumes checklists include, as the first step, that flight crewmembers don their oxygen masks and verify that the regulator is set to 100%**. (A-11-91)

Flight crew oxygen mask



Donned oxygen mask/goggle set



Donned full-face oxygen mask



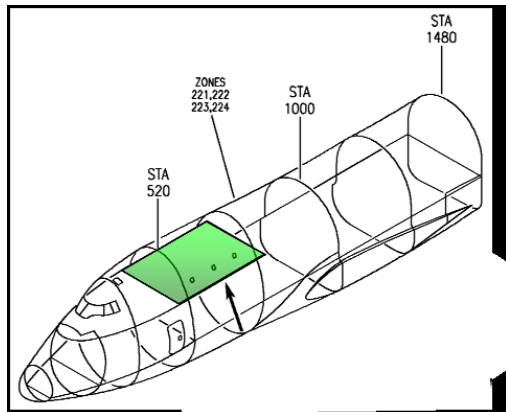


UPS 006 – B747, Dubai

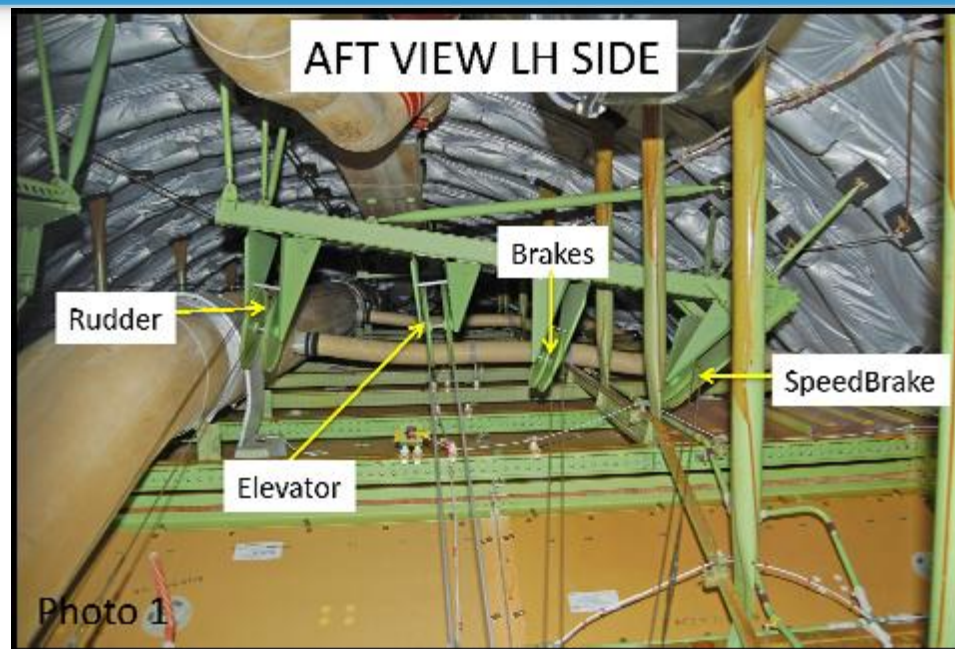
- Investigation has centered on a probable uncontained fire on the cargo main deck as the primary significant factor.
- Probable location of the fire been determined (forward cargo area). Several possible ignition sources, primarily the location in the cargo of lithium and lithium derivative batteries that were on board.
- Consequential fire effects:
 - compromised flight controls, flight crew supplemental oxygen system, the environmental control system, fire suppression and cockpit visibility



UPS 006 – B747, Dubai



MAIN DECK CEILING PANEL DIAGRAM STATION 400 TO 718.40



Flight control cables, pulleys and support trusses at the location of the main deck transition ceiling panel, located above the probable fire zone.



UPS 006 – B747, Dubai

- Further detailed investigation is on going to determine the requisite safety recommendations to address the findings.
- Wider systemic risks associated with cargo fires and the carriage of hazardous air cargo will be addressed in the accident final report's safety recommendations.



UPS 006 – B747, Dubai

- The aircraft cargo load included large quantities of LB.
 - Real or counterfeit ?
 - Properly packed ?
- For sure some of the LB were not declared as dangerous goods and hence were not packed in accordance with the applicable regulation.
- Of the 10 shipments that contained LB, nine were lithium ion batteries and one was of the lithium metal variety.

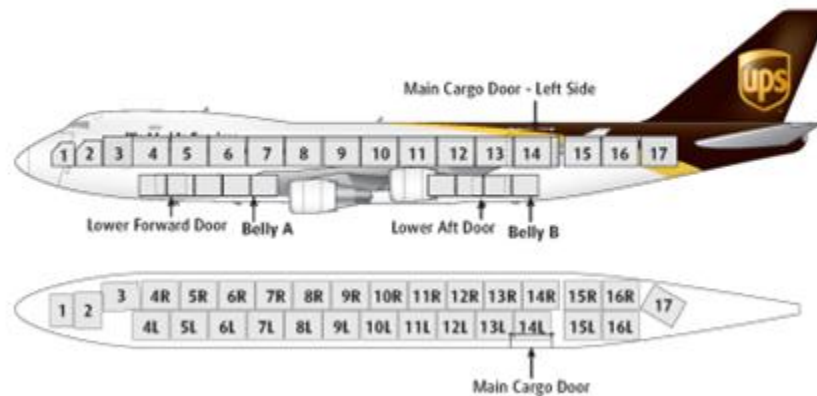


UPS 006 – B747, Dubai


- ▶ 3 of 9 shipments contained lithium ion battery packs with Watt-hour (Wh) ratings >> than 100Wh, which classifies them as Class 9 materials.
 - ▶ Accordingly, these shipments should have been shipped as regulated materials per ICAO TI, and thus should have appeared on the cargo manifest.
- ▶ Two of these three shipments were located inside containers situated in positions 6L and 6R, which are located beneath the area of interest due to systems indications on the flight recorders.
- ▶ Some of the battery packs shipped were not tested in accordance with UN Standards; tests which are required.

LBs runaway as possible source of fire

B747-400 FREIGHTER



ULD Position	Shipment Information		
	No. Packages	Item Description	No. Pieces
1	1 of 10	LED flashlight & hoister (**incl. primary lithium battery)	138 1
1	3 of 5	LED flashlight & displays (**incl. primary lithium battery)	190
1	6 of 6	Lithium-ion batteries ("BRR-L, BRR-F5, BDF-4, DFLY, BRR-LA")	648
2	1 of 1	Dry Batteries - silver oxide SR626SW	500 0
6LS	5 of 5	Eyewear video recorder	210
6LS	6 of 6	Power Supply	222
6LS	13 of 13	Lithium Batteries - lithium polymer "lead out two wires and connector, the wire length: 160mm"	50
6LS	3 of 3	Battery Pack - NiMH	110
6RS	58 of 58	Lithium Batteries - lithium ion for electric vehicle	12 5



Asiana 991, B747-400F, HL7604 on 28/07/2011. Cargo fire

➤ RESERVED



Safety initiatives:FAA

➤ FAA

➤ SAFO 10017 dated 8 October 2010

- It follows the 3 September 2010 accident of the UPS B-747-400 in Dubai.
- Alert the operators to take prudent steps to reduce the risk when transporting lithium batteries.



EASA actions update

- ▶ Safety Information Bulletin – SIB 2010-30 _ 20 October 2010
 - ▶ Practically endorsed the FAA SAFO 100117
 - ▶ Misinterpretations of some operators....
 - ▶ It was initially published in order to enable owners and operators of aircraft, registered in European Union Member States or associated countries, to note the content of the FAA SAFO.

- ▶ Revised SIB published on 31 March 2011:
 - ▶ It refers the latest ICAO Electronic Bulletin 2001/7 issued on 15 February 2011: “GUIDANCE FOR SHIPMENT OF LITHIUM BATTERIES BY AIR”.
 - ▶ ICAO Bulletin is highlighting the need for States to ensure adherence to the ICAO TI and for them to actively engage to promote awareness of the requirements relating to the shipment of lithium batteries by air.
 - ▶ EASA wishes to further highlight the safety issues associated with the transport of lithium batteries by air and asks those involved in such operations to carefully note the points made in the ICAO Bulletin.

➤ Transport of lithium batteries on aircraft

- The fire hazards of small quantities lithium primary, lithium secondary (ion) and lithium polymer batteries have been documented.
- Test project started before the UPS 747 accident. Some of the testing that has been completed or will be performed include:
 - ❑ Testing the effectiveness of various fire suppression agents on the different battery types.
 - ❑ Testing the effectiveness of a variety of shipping containers to contain battery fires.
 - ❑ Developing and testing new types of containers to contain the fire and overpressure generated by batteries in thermal runaway.
 - ❑ Testing the effectiveness of intumescent paint applied in a variety of ways on containing battery fire spread.

- **Fire Suppression on Freighter Aircraft.**
 - Project initiated before the UPS 747 accident
 - It will test a variety of fire suppression systems to attempt to identify some cost effective methods to suppress main deck freighter fires.
 - Study completed to document the costs and benefits of a total flood Halon 1301 system in main deck cargo compartments.
 - Cost of that type of system would be on the order of 20 times more costly than the benefit it would provide.
 - Testing on other possible methods of improving the fire suppression capability on freighters will include:
 - ULD based fire suppression systems independent of the aircraft.
 - Protection of individual ULDs through an umbilical type of connection to an aircraft based suppression agent storage reservoir.
 - Testing of ULD's constructed of fire resistant materials.



FAA projects



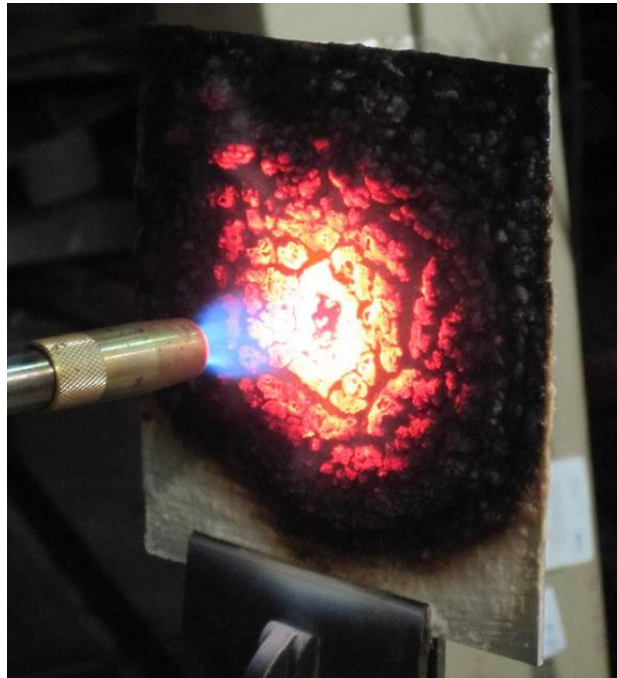
FAA projects - FCC

- ▶ The FAA has requested that ISO develop a standard for Fire Containment Covers (FCC's).



FAA safety projects – Intumescent paint

- ▶ Utilizing Intumescent paint in the packaging of LB
 - ▶ Intumescent coatings expands on heating, which acts as a thermal barrier that protects the underlying material.
- ▶ Cover the exterior of a lithium battery container in intumescent paint and place it in a cargo container fire.





UPS safety initiatives

- ▶ Identify customers who ship large volumes of batteries.
- ▶ Increase awareness around customers regarding safely shipping batteries (customers letters, website enhancements, develop guidance material on shipping batteries safely by air).
- ▶ Conduct compliance audits of high risk shippers, high volume shippers.
- ▶ Commit dedicated resources for lithium batteries inquiries.



Safety initiatives:UPS

- Update the policy on non-compliant lithium batteries shipments (shippers are banned on first offence);
- Ops part: feasibility studies of carrying large shipments of lithium batteries in class C compartments.
- Employees awareness campaign (Service alerts letters, leaflets on training, etc.):
- Identification of potentially unsafe packages.



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QUESTIONS ?

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