Mitigating the Risk Transporting Batteries on Aircraft



Captain Bob Brown UPS/IPA Safety Task Force

Presentation Objectives

- Is there a risk?
- What can your airline do now?
- What can we do in the future?



The Risk to Airlines Transporting Batteries

- From 1990 to 2022, there have been 19 major accidents involving in-flight fires. (Flight Safety Foundation)
- These accidents resulted in 425 fatalities

(Flight Safety Foundation)

 Testing at FAA Technical Center proved battery smoke is different from theatrical smoke and enters the cockpit (FAA TECH Center Report, Feb. 26, 2013)



Normal Flight Profile Assumed Risk



Source: Flight Safety Foundation

Aviation Risk Transporting Batteries



Source: Transport Canada

Did any airlines declare an emergency this year due to smoke, fire, or fumes?

Jan 6	Finnair	Apr 6	Qatar	Jun 28	American
Jan 10	Swiss International	Apr 10	Lufthansa	Jul 5	HK Express
Jan 10	Aviastar	Apr 15	Spirit	Jul 5	SpiceJet
Jan 31	EasyJet	Apr 19	Indigo	Jul 10	Delta
Jan 31	Rex Airlines	Apr 19	Spirit	Jul 10	American
Feb 7	Southwest	Apr 24	Delta	Jul 17	American
Feb 16	Republic	May 4	Endeavor	Jul 25	United
Feb 18	American	May 10	KLM	Jul 28	Southwest
Feb 18	Nordic Regional	May 11	Thai	Aug 5	TUI
Feb 25	Pakistan	May 13	Southwest	Aug 23	Lufthansa
Feb 25	Nouvelair	May 16	Central Mount	Aug 29	Hawaiian
Mar 2	Nouvelair	May 20	Philippine	Aug 30	Alaska
Mar 7	Air Plane	May 24	Piedmont	Sep 2	American
Mar 11	Transavia	May 28	Lufthansa	Sep 7	United
Mar 20	Delta	Jun 14	Wizz		
Mar 24	United	Jun 28	FedEx		

46 - From public press releases January – September 2022

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<mark>Southwest</mark>
TUI
Lufthansa
<mark>Hawaiian</mark>
<mark>Alaska</mark>
<mark>American</mark>
<mark>United</mark>

Jun 28

Jul 5

Jul 5

Jul 10

Jul 10 Jul 17

Jul 25

Jul 28

Aug 5

Aug 23

Aug 29

Aug 30

Sep 2

Sep 7

46 - From public press releases January – September 2022

How often does a smoke, fire, or fumes event causing a diversion occur in aviation?

- A Monthly
- B Weekly
- C- Daily

How often does a smoke, fire, or fumes event causing a diversion occur in aviation? <u>C- Daily</u>

- Data from several sources indicate the probability of passengers experiencing an in-flight smoke event is greater than one in 10,000.

(Smoke, Fire, and Fumes in Transport Airplanes, Rev 5 Royal Aeronautical Society)

- In the late 1990s, the rate of diversion in the US, on average, was more than one airplane each day diverted due to smoke. (Shaw, 1999)

Is the trend of lithium-ion battery thermal events in aviation getting better or worse?



Thermal Runway Incident Program



Figure 1 – Trend, All Reports, 2017–2021

TRIP Report Trend



Thermal Runaway Incident Program (TRIP) Annual Report – 2021



"The absence of an accident does not mean the presence of safety."



Magic 8-Ball Airline Safety Analyzer and Decision Maker

What can your airline do now?



The Layered Solution Set



UPS/IPA Safety Task Force Improvements



The Combination of Two Technologies Greatly Improves Safety





Full-Face Oxygen Masks

- Flight crews must be protected not only from smoke, but also from toxic fumes
- All UPS aircraft have been retrofitted with full-face oxygen masks
- Thought: Should these masks be a requirement for cargo aircraft after FAA battery smoke tests?



Full-Face Oxygen Masks

- Supernumerary seat occupants must also be protected.
- All UPS aircraft have been retrofitted with quick-donning oxygen masks in all positions.
- Thought: Should cargo aircraft with "Dixie cup" jump seat masks be retrofitted



Emergency Vision Assurance System



Emergency Vision Assurance System

- Emergency Vision Assurance System (EVAS) is installed on all UPS aircraft.
- Historically, smoke has entered the cockpit numerous times due to fire onboard an aircraft and remained a continuous threat. (UPS 6, Asiana 991, Express Jet 5912)





Checklist Design

Checklist Design CAP 676 Audit Tool

Checklist Audit Tool (CHAT)

The purpose of CHAT is to determine whether your checklist complies with best human factors practice as defined in the appropriate paragraph in Chapter 7 of CAP 676 (paragraph references are given in the first column of the table).

Ch. 7	Title	Attribute	Y	N	N/A	Comments
Physica	Characteristics					
1.1	Document size	Is the size of the document appropriate to the stowage space available?				The checklist must be able to be stowed in an accessible location and easily retrieved in an emergency.
		Can the document be used without interfering with the controls or obscuring the displays?				This check needs to be carried out on the flight deck. The document should be reduced in size if there is any interference or obscuration.
1.2	Binding	Can the document be opened through 360°?				Access to required page(s) needs to be accomplished without requiring the crew to hold the pages open. Thus ideally the checklist will be able to fold back on itself. Recommend change if this cannot be achieved.
		Can amendment pages be easily inserted?				Ring binders are recommended.
		Is binding robust?				Can it fall apart? If the binding is loose, pages could be lost. Recommend change binding.
1.3	Cover	Is the cover robust to protect pages within?				
		Is the colour significantly different to minimise incorrect checklist selection?				The Emergency and Abnormal operation should be easy to distinguish. Recommend change colour of cover.

Checklist Design

Checklist Design





Checklist Design

Checklist Design

B767-300F

- Automatic cargo fire depressurization rate differs from other aircraft
- Depressurization rates to 25,000 feet
 - 747-400F 1.3 minutes
 - 757-200 7.5 minutes
 - 767-300F 22 minutes

 Boeing provided operators a checklist procedure requiring manual intervention



Fire Containment Cover (FCC)

FCC Fire test with 5000 lithium-ion batteries conducted March 18, 2014

Test duration of 4 hours was obtained with a peak temperature of 1500F

FCC test with 4800 lithium metal batteries performed March 25, 2014

Test limited to 15 minutes with peak temperature of 3000F





Fire Containment Cover (FCC)

- FCC requires no additional time and are used on palletized freight
- 700 currently in use
- UPS ordered 2100 additional this year
- UPS covers from origin to final destination





Fire Resistant Container (FRC)

Fire Resistant Container (FRC)

The initial design goal was:

Contain a Class-A fire in a ULD for 4 hours

4 hour+ containment achieved with Class-A fires



Fire Resistant Container (FRC)

UPS is pleased with the benefits of MACROlite FRCs including:

- Enhanced fire safety
- Weight savings
- Reduced repair frequency and cost

48,000 New MACROlite ULDs have been purchased





The Future





ULD Fire Detection/Suppression





Enhancing Safety for the Aviation Community



TIME TO MANAGE IN-FLIGHT EMERGENCY

ULD with Detection & Suppression



Goal: 6+ Hour Fire Containment!

3rd Party Review & Risk Assessment



Cargo and Passenger Airlines Benefit

- Batteries from participating manufacturers can be risked for safety
- Airlines will have objective data for SMS risk assessments
- Pilots will have confidence in an objective and impartial Third party review and certification process



Cockpit Fire Containment Systems

- Numerous devices in the market place
- UL 5800 Standard has now been developed to guarantee performance
- Transporting a PED into a containment system and managing toxic smoke emissions is critical



Cell Block



PlaneGard

Lithium Battery Air Safety Advisory Committee



Committee Representation



Final Thoughts...

- A greater level of aviation safety is possible
- New technologies, materials and designs show great promise
- If we do our jobs well, aviation safety will be greatly enhanced

Questions?

