



Transportation of Lithium Batteries by Air

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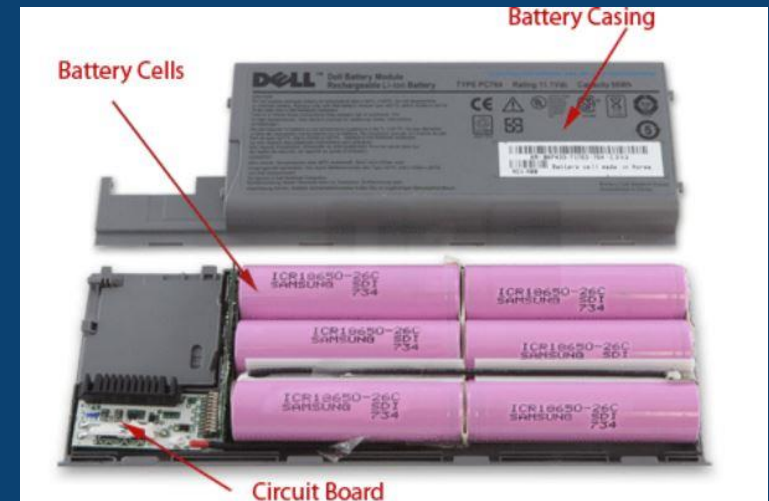
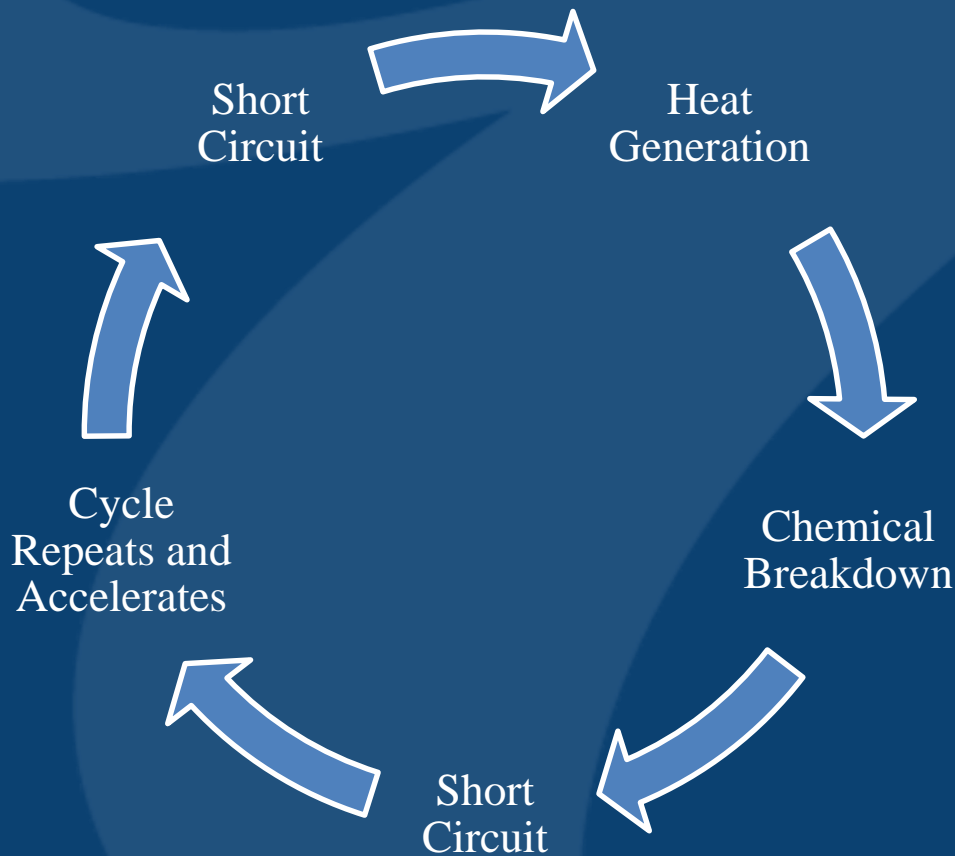
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Lithium Batteries

- ▶ Billions Shipped By Air As Cargo Each Year
- ▶ Can Initiate And Propagate Dangerous Events
 - Fire
 - Smoke Evolution
 - Explosive Gas Production
 - Heat Generation
 - Projectiles
- ▶ Fire Suppression Systems/Procedures Inadequate



Thermal Runaway And Propagation



Batteries On Aircraft

- ▶ Operator Equipment
- ▶ Passenger Carry On
- ▶ Passenger Checked Baggage
- ▶ Cargo Shipments



Hoverboards And Phones

- ▶ Undeclared/Non Compliant Shipments
- ▶ Adequacy of Regulations
 - UN Tests
 - Batteries in Equipment
- ▶ Regulatory Complexity

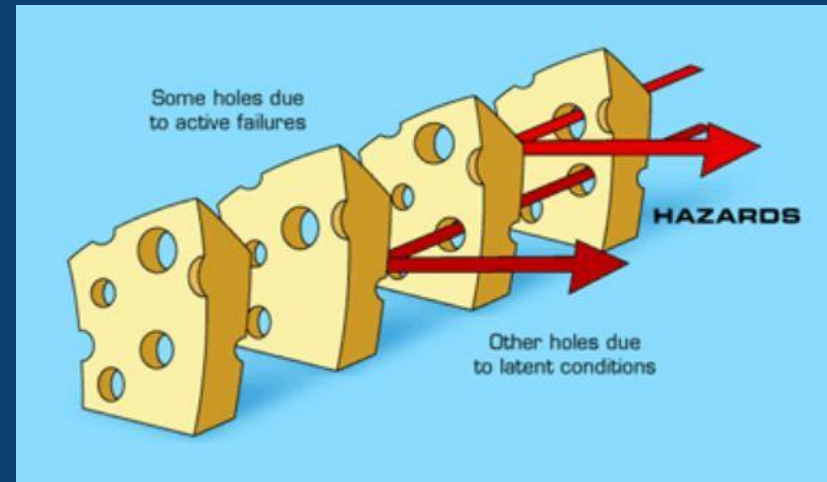


Cargo Hold Fire Suppression

- ▶ Halon (**Passenger And Freighter**)- Class C
 - Belly
- ▶ Depressurization (**Freighter**)- Class E
 - Main Deck And Some Bellies
- ▶ **None Are Effective On Lithium Batteries**
- ▶ **Detection Issues**

Layered Approach

- ▶ Battery Design
- ▶ Package
- ▶ Container
- ▶ Compartment
- ▶ Aircraft



2015 Regulations

- ▶ No ULD/Compartment/Aircraft Limits
- ▶ Reduced Regulations for Most Shipments
- ▶ No Limit On Overpacking
- ▶ Li Metal Battery Shipments Banned on PX Flights



2016 ICAO Cargo Changes

- ▶ Temporary Ban of Li Ion Battery Shipments on Passenger Flights
- ▶ 30% State Of Charge Limit on Cargo Aircraft
- ▶ Overpack Restrictions
- ▶ Safety Risk Assessment



ICAO Process

- ▶ SAE Standard Produces A Package With A Known Hazard
- ▶ How will ICAO Incorporate Result?
 - Applicability
 - One Part Of Mitigation System?
 - One Means Of Compliance?

SAE Approach

- ▶ Develop A Standard To Prevent Propagation Between Packages Following Thermal Runaway
- ▶ Standard Consists Of A Test
- ▶ Successful Test Contains Any Resulting:
 - Hazardous Flames
 - Hazardous Fragments
 - Hazardous Heat
 - Flammable Gas

SAE Issues

- ▶ Technical:
 - How To Initiate Thermal Runaway
 - Defining And Measuring Hazards
 - What Constitutes A New Battery Or Package?
 - Demonstrated Containment Time
- ▶ External Fire Threat
- ▶ Low Hazard Batteries



One Airline's Strategy

- ▶ Only Accept Fully Regulated Batteries
- ▶ Segregate Them From Flammable DG
- ▶ Load Them In Lowest Risk Compartments



- ▶ Use Container Fire Protection
- ▶ Supplement Aircraft Systems

Conclusions

- ▶ Important Progress Is Being Made
- ▶ Goal-Safe Transportation Of All Cargo
- ▶ Effective Solution Is
 - Multilayered
 - Multidisciplinary



Questions?

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