

SAE INTERNATIONAL

STATUS OF SAE G-27 LITHIUM BATTERY PACKAGING PERFORMANCE COMMITTEE

Presented to Dangerous Goods Panel
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Montreal, Canada

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Current Status for Carriage of Lithium Batteries

- **Lithium batteries as cargo only allowed on freighter aircraft.**
- **Lithium ion batteries as cargo only allowed on freighter aircraft at a 30% State of Charge (SOC)**
- **Does not apply to batteries packed in or with equipment**
- **Stricter restrictions on Section II batteries – only one package per consignment and no overpacks.**

SAE G-27 Lithium Battery Carriage Packaging Standard Committee

- **Monthly WebEx meetings**
- **Draft Packaging Standard in work – expect finalization of draft in 2017.**
- **Balloting (formal process for approval) expected in 2018**

SAE G-27 Committee formed in March, 2016 to create a performance-based package standard (AS6413) for the safe transport of lithium batteries as cargo by air.

Co-chaired by Doug Ferguson (Boeing) and Claude Chanson (Recharge)

~ 160 individuals on G-27 Committee

- Includes international organizations, airframe manufacturers, regulators, cell manufacturers, battery manufacturers, battery users, operators, package manufacturers, test facilities

Monthly Webex teleconference calls

Writing Team subcommittee of ~20 people to create draft for the standard

- Several multi-day or week-long face to face meetings, currently on 4th draft

External Fire Consideration subcommittee of ~20 people to collect and present data to larger committee


- Telecons, 2 face to face meetings to identify issues, gather material and determine potential methods for addressing concern

Standards Development Process

Writing Team developed draft for standard (~20 people)

- Draft standard circulated to entire G-27 committee (over 160 people) for review and comments (iterative process to incorporate comments)
- Balloting process involves all stakeholders with opportunity to comment on proposed standard:
- Ballot disapprovals must be resolved between the commentor and document sponsor.
- Comments from non-voting members must be reviewed and considered.
- Voting members (~50) have been identified

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	AEROSPACE STANDARD	AS6413	REV. X
		Issued XXXX-XX Revised XXXX-XX Reaffirmed XXXX-XX Stabilized XXXX-XX Cancelled XXXX-XX Superseding XXXX	
Performance based package standard for lithium batteries as cargo on aircraft			

RATIONALE

The fire protection capabilities and certification of original equipment manufacturers' (OEMs) airframes and systems were developed considering the carriage of general cargo and not the unique hazards associated with the carriage of dangerous goods, including lithium batteries. The Council of the International Civil Aviation Organization (ICAO) established a prohibition on the transport of lithium batteries as cargo on passenger aircraft as a temporary measure until controls were put into place which establish an acceptable level of safety. A performance-based packaging standard was identified as one of the controls.

Draft Packaging Standards

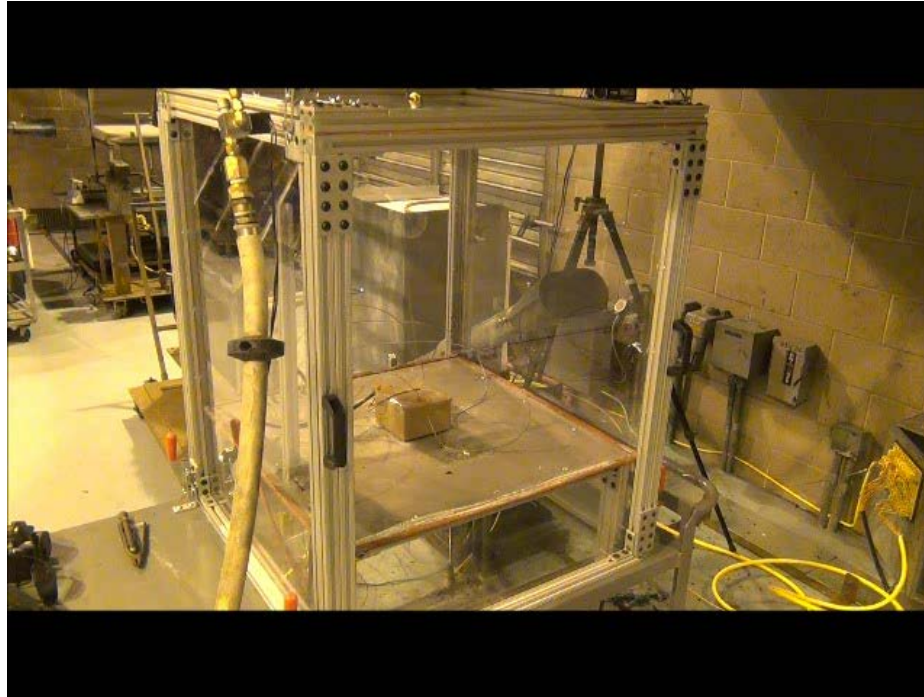
Intention is to address the safety of the cell/battery and packaging material (box, etc) together. Allow for less protection from the package if the cell is inherently safer.

- No hazardous amount of flame is allowed outside the package;
- No hazardous fragments can exit the package and the package must maintain structural integrity;
- After confirming thermal runaway in the initiation cell, the external surface temperature of the package cannot exceed the amount that would ignite adjacent packing material or cause batteries or cells in adjacent packages to go into thermal runaway. Initially this was chosen as not exceeding a temperature excursion above [200°C] for more than 3 minutes. Current proposal is to not allow the outer package thermocouple placed adjacent to the initiation cell from increasing by more than 150 C for more than 3 minutes after the heater for the initiation cell is turned off;

Draft Packaging Standards

- **The quantity of flammable vapour must be less than the amount of gas that when mixed with air and ignited could cause a pressure pulse in a [2.83 m³] volume that could dislodge the overpressure panels of the compartment or damage the cargo liner [3.45 kPa].**
 - The gases are captured within the test chamber and subject to a constant ignition source. If the gases become flammable and ignite, the test is a failure.
- **It could be assumed that smoke released outside the package may not be a consideration if the event is contained within the package.**
- **Test methods defined to reduce repetitive testing and also to allow packages that do not fit in the specified test chamber.**

Engineering Development testing for flammable vapor test method



Draft Packaging Standards – External Fire Considerations

Mixed views on addressing scenarios involving the packaged lithium batteries being exposed to the hazards from a cargo compartment fire originating outside the package.

“External Fire Consideration” subcommittee meetings discussed:

- Probability approach versus SMS approach as a rationale
- Threats from cargo compartment scenario
- Potential mitigations
- Potential criteria for demonstrating acceptable performance
- Potential approaches to address external fire considerations

Draft Packaging Standards – External Fire Considerations

“External fire” meeting in September:

- Recognition that the “internal protection” packaging is reducing the hazard, but not eliminating it completely in case of external fire. Possible protections and tests described. Discussion did not resolve the question about integrating these protections in SAE AS 6413.

Draft Packaging Standards – External Fire Considerations

		Mitigation method and location	
		At higher level (covers, containers, etc..)	At packaging level
Threat	Individual cell thermal runaway (internal to packaging)	1: not discussed	2: core of the AS 6413 scope, protection and test described
	Cargo compartment fire (external to packaging)	3: possible protections and test discussed	4: possible protections and test discussed

Draft Packaging Standards – External Fire Considerations

There was agreement from the members to create an output document to present to the G27 that includes:

- a brief introduction regarding the need for considering an external fire
- the high level characteristics of the threats posed by an external fire to a package of lithium batteries
- some generic requirements for showing an acceptable level of protection against an external fire
- some specific proposals for methods of testing a package for demonstration of protective features
- Pros and Cons of including performance requirements within the AS6413 document or creating a separate AS document.

Draft Packaging Standards – External Fire Considerations

- **2 Potential implementation methods discussed:**

Additional section of AS6413:

- Part A has internal thermal runaway performance criteria
- Part B has external fire performance criteria

Threat	Hazard Protection
Internal Cell Failure	AS6413 Class 1
Internal Cell Failure and External Fire	AS6413 Class 2

Additional Aerospace Standard [ASTBD]:

- Contains external fire performance criteria

Threat	Hazard Protection
Internal Cell Failure	AS6413
External Fire	ASTBD

Pro: Clarity when implementing all performance requirements at package level

Con: Implies all mitigation for external fire implemented at package level

Pro: More clearly allows implementation of the external fire performance criteria with different mechanisms according to the various transport conditions

Con: Delay of implementation because of an additive standard requirement. Complexity of solutions implementation.

Wrap-up

- **The output document will be discussed during the upcoming G27 face to face meeting in Renton in November.**
- **Expecting a standard to go through the SAE balloting process early in 2018**
- **ICAO Air Navigation Commission have stated that there will need to be other mitigation in addition to packaging standard before allowing lithium ion batteries on passenger aircraft.**

QUESTIONS?

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