SAE INTERNATIONAL

STATUS OF SAE G-27 LITHIUM BATTERY PACKAGING PERFORMANCE COMMITTEE

Presented at Tenth Triennial Aircraft Cabin and Fire Safety Conference
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Doug Ferguson, Co-Chair G-27 Committee
Claude Chanson, Co-Chair G-27 Committee
Maureen Lemankiewicz, SAE Specialist G27 Committee

Standards Development Process

SAE G-27 Committee formed in March, 2016 at ICAO ANC request 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)

SAE G27 Committee Activity Update

~ 200 individuals on G-27 Committee

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

~ 40 Voting members,

~ 75 individuals consistently, actively engaged

- Monthly Webex teleconference calls
- Average of 3 in-person multi-day meetings per year (multi-day meetings virtual in 2020 and 2021, and Hybrid face to face working groups combined with virtual committee meetings in 2022)
- Next in-person meeting will be in San Diego in November, 2022

SAE G27 Committee Activity Update

Documents in process:

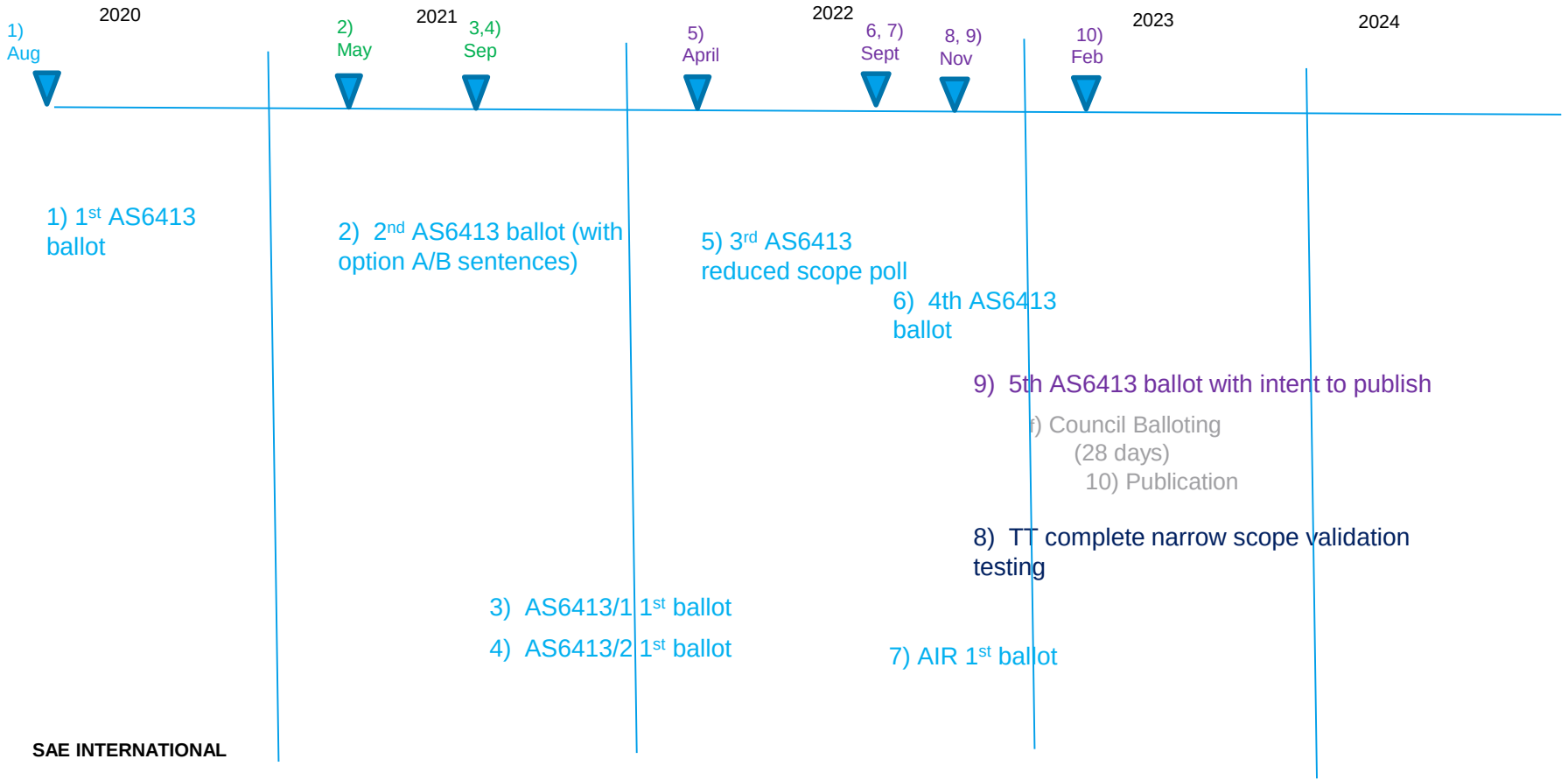
AS6413: Performance based package standard for lithium ion cylindrical cells as cargo on aircraft

AS6413/1: Performance based package standard for lithium batteries as cargo on aircraft – Package Testing with External Thermal Challenge

AS6413/2: Performance based package standard for lithium batteries as cargo on aircraft – Package Testing with Direct External Flame

AIR6840: Performance based package standard for Lithium batteries as cargo on aircraft – Background Information and Rationales

SAE G27 Document Progress Timeline (as of October 2022)



AS6413

- This standard provides a test method to demonstrate and document the control of the potential hazards from Lithium metal batteries (UN 3090) and Lithium ion batteries (UN 3480) when transported as cargo on aircraft.
- It addresses the need to control the hazards which might arise from a failure of an individual cell by containing the hazards within the package.
- Controlling the consequences of a failure within the package is intended to prevent uncontrolled fire and pressure pulses that may compromise current fire suppression systems within the cargo compartment.
- The intent of this test is to severely abuse a single cell such that it is most likely to enter thermal runaway with the presumption that a single cell may enter thermal runaway during transport.

AS6413

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.

1. **Initiate a thermal runaway in a cell within the package by heating at ~ 10 °C per minute.**
2. **Remove heater power when cell has entered thermal runaway.**
3. **If no confirmation of cell thermal runaway after cell reaches 200 °C, maintain at that temperature for one hour and then remove heater power.**
4. **Monitor pass/fail criteria for 5 hours after removing power.**

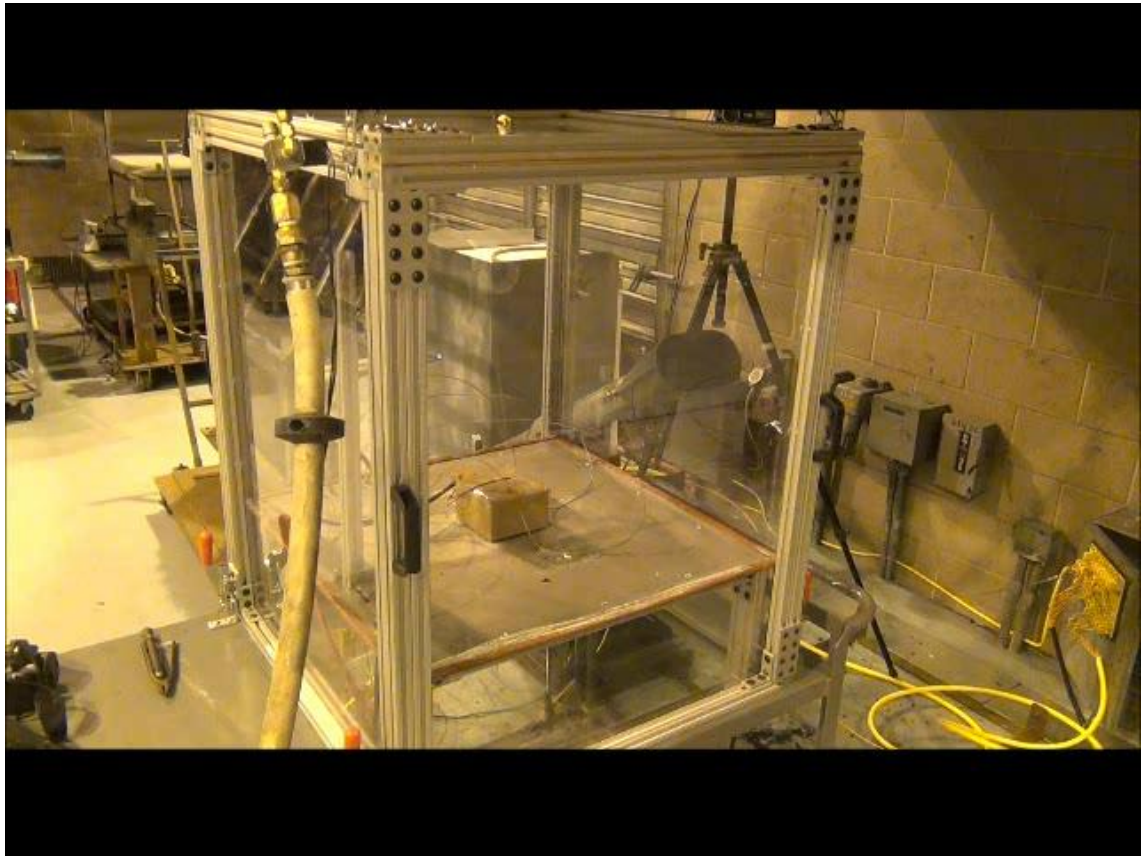
AS6413 Pass/Fail Criteria

- **Verification of “non-hazardous flame” and “non hazardous particle” achieved visually or with witness panels**
  - Visually: no flame or fragments
  - Witness panel: cheese cloth placed less than 25 mm away from package does not ignite
- **Surface temperature of package shall not be sufficient to ignite adjacent materials.**
  - Temperature of thermocouple placed on package surface adjacent to the initiation cell shall not increase by more than 150 C for more than 3 minutes during the remaining 5 hours after the heater for the initiation cell is turned off.
  - Average increase in temperature of each thermocouple on each face of package shall not be greater than 100 C during the remaining 5 hours after the heater for the initiation cell is turned off.
- **Non-hazardous quantity of flammable vapor released outside package**
  - No ignition of vapor collected within test chamber

SAE G27 Committee Activity Update

AS6413 Basic (baseline) test method

[video courtesy of FAA Technical Center]



SAE G27 Committee Activity Update

Baseline test method has been validated with cylindrical lithium ion cells.

Many additional “variations” or alternatives still require validation, including cells in batteries.

- Pouch and prismatic types (one lab’s data provided in July)
- Reduced cell quantity in package (one lab’s data provided in July)
- Lithium metal
- Benign @SOC
- Oversize package
- Generic package (Universal Packaging)

AS6413/1

Elevated Temperature Test (Oven Test)

- 3 hours at 205 C

Material Test:

- **Package made from materials to be in final product**
- **Simulated 18650 cell with thermocouple in center**
- **Thermocouple does not exceed [100 C]**

Or

Package with Cells test:

- **No thermal runaway**
- **Any venting does not result in hazardous quantity of flammable gas (not defined)**

AS6413/2

Direct Flame Test

FAA Oil burner horizontal test 5 minutes

Material Test:

- **Test articles made from materials and interfaces to be in final product**
- **Simulated 18650 cell with thermocouple in center**
- **No burn-through**
- **Thermocouple does not exceed [100C]**

Or

Package with Cells test:

- **No burn-through**
- **No thermal runaway**
- **Any venting does not result in hazardous quantity of flammable gas (not defined)**

AS 6413 Draft Content

NEXT STEPS

- Finish validation testing of “baseline” test method to include all lithium ion cells and reduced cell configuration to have a “narrow scope” standard to be balloted before end of 2022.
  - Facilitate discussions outside the G27 committee between operators, shippers, test labs, and authorities
    - What requirements are expected to be contained within standard?
    - How is standard expected to be incorporated into regulations?
  - Use the released standard to conduct a true “round-robin” review of the ability of the test standard to provide consistent results from multiple labs unfamiliar with the standard

- Publish AIR with appropriate intended use, rationales for various parameters

- Validate external fire test methods and publish those slash sheets

- Continue to validate test methods for lithium metal, Benign @SOC, Oversize, and Generic for expanded scope standard in the near future.

QUESTIONS?

Maureen Lemankiewicz
Aerospace/Systems Management Committee Manager
SAE International

o +1.724.772.7147

Maureen.Lemankiewicz@sae.org

Doug Ferguson
Boeing Associate Technical Fellow
SAE G-27 Co-Chair

0 +1 562.366.6194
douglas.e.ferguson@boeing.com

Claude Chanson
General Manager - RECHARGE
SAE G-27 Co-Chair

0 +32 (2)777-0567
cchanson@rechargebatteries.org