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Lithium-ion Batteries Packed in Equipment

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Federal Aviation Administration

Background

- For transportation purposes, lithium batteries are currently categorized by their [1]:
  - Type (Ion or Metal)
  - Manner in which they are shipped:
    - Stand-alone
    - Packed with equipment
    - Contained in equipment
    - Etc.
- Stand-alone lithium-ion batteries (UN 3480) limited to 30% state of charge when shipped as cargo on aircraft
- Lithium batteries **packed with** or **contained in equipment** (UN 3481) **previously** did not have any SoC requirements

[1] – https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2023-07/Lithium%20Battery%20Guide.pdf

Regulatory Changes

- ICAO Dangerous Goods Panel Meeting
  - Lithium-ion batteries **packed with** equipment **required** to be 30% SoC or less, effective Jan 1st, 2026
  - Lithium-ion batteries **contained in** equipment **recommended** to be 30% or less, effective Jan 1st, 2025

30% SoC Requirement?

Stand-alone Cells

Packed with Equipment

Packed in Equipment

Project Motivation

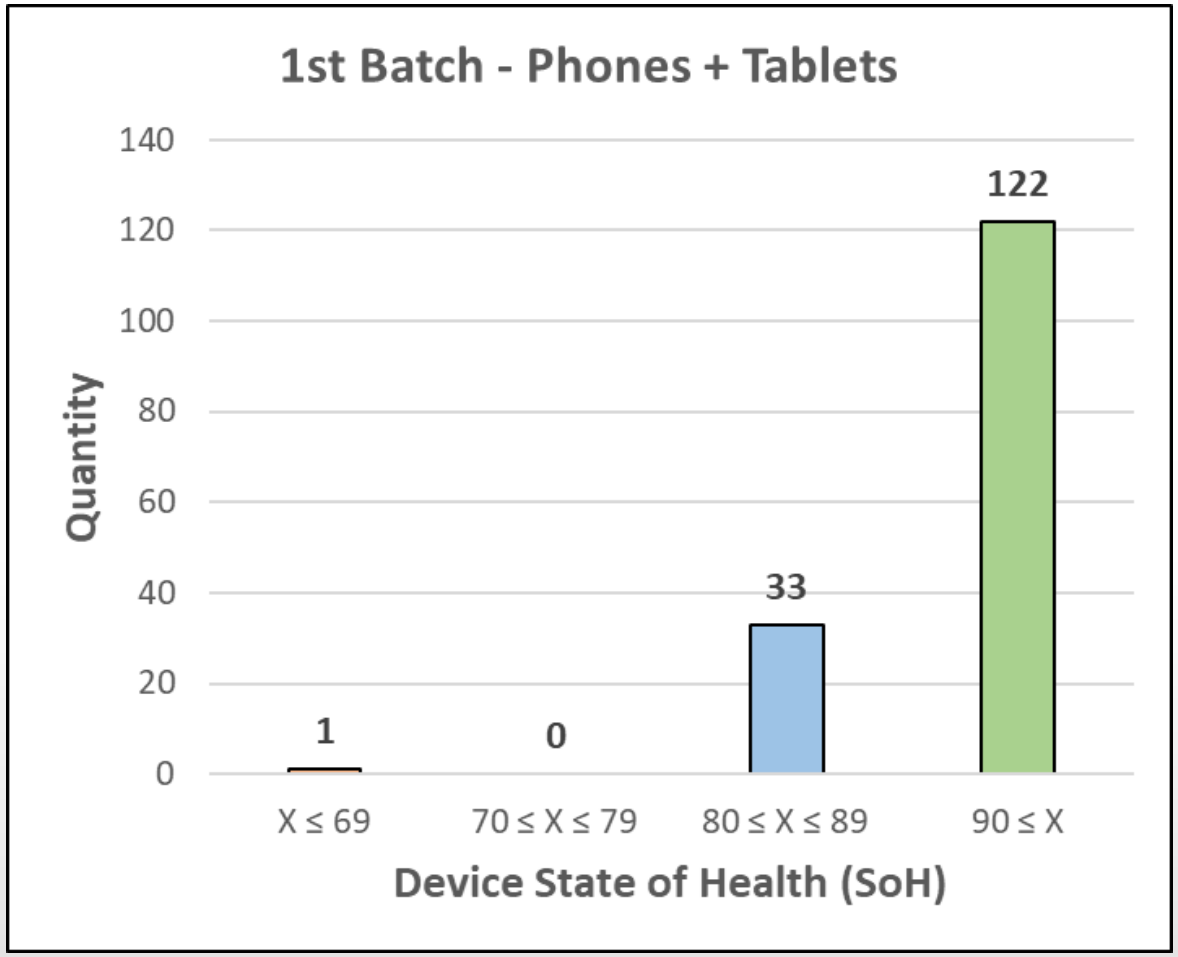
- Some precedent of fires involving lithium batteries packed in equipment
  - Hong Kong Airport (2021)
- Risk not deemed high enough to warrant further regulations, due to following reasons:
  - Protection equipment provided
  - Lesser package energy densities
- Little research on this topic due to the high associated costs

Pallets of phones catch fire prior to being loaded on an aircraft (April, 2021)

FAA Testing

- The FAA plans to conduct testing on lithium-ion batteries contained in equipment
  - Testing will be conducted on **used** devices, previously utilized as part of the FAA's National Wireless Program (NWP)
  - First shipment consists of phones and tablets, future testing may include laptops
  - The state of health (SoH) of each device was recorded when possible

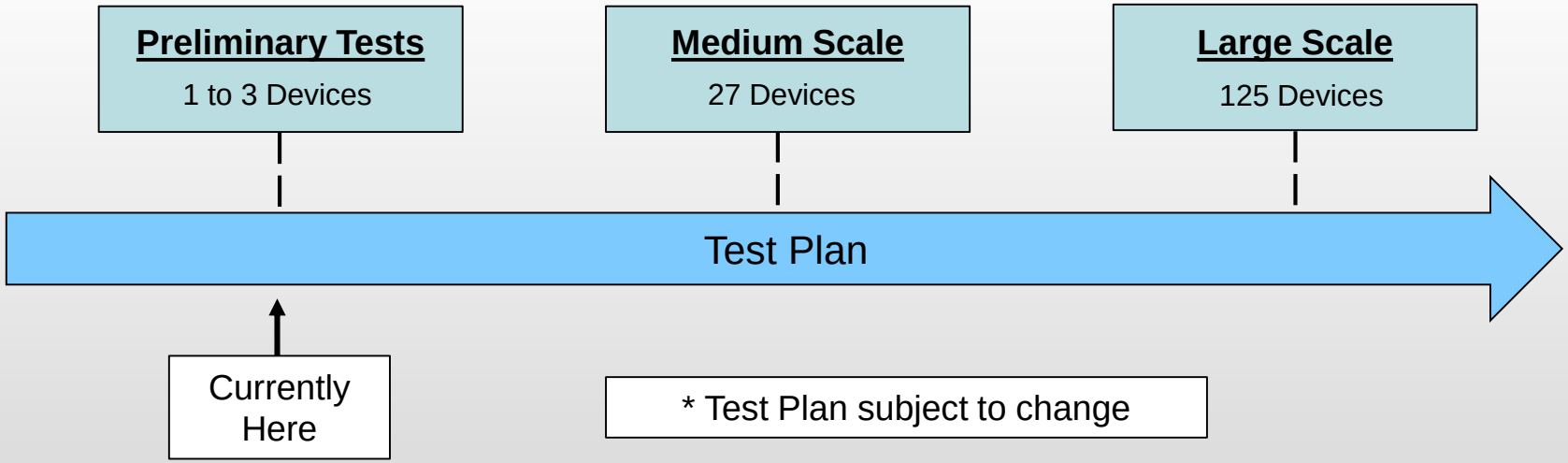
156 total devices, majority phones



Device energy capacities ranged from 10 to 41 Wh

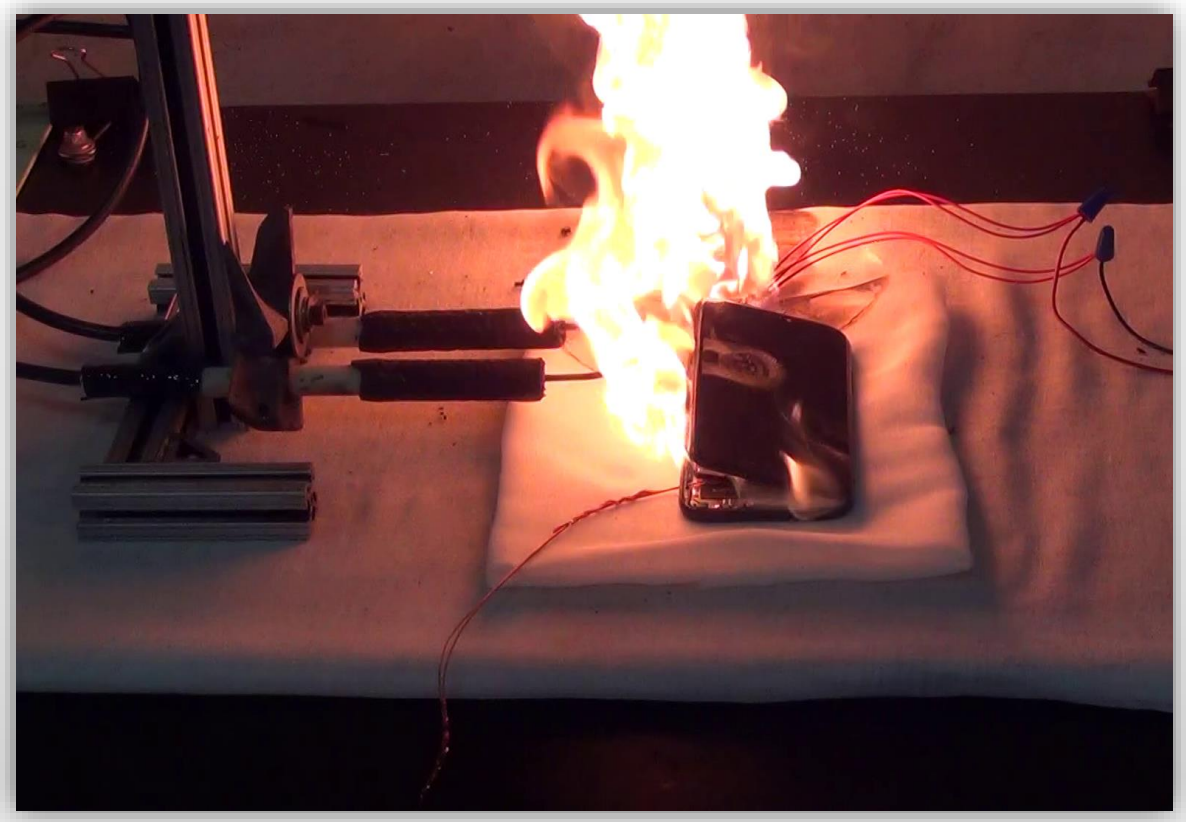
Test Plan

- Goal is to replicate realistic packaging layouts
  - Devices will be stored in original manufacturer packaging if possible
  - Further discussions are needed to determine how PEDs are packaged beyond individual boxes
- Tests will progress from small to large scale tests



Preliminary Tests

- Ignition of battery off-gasses is inconsistent and sporadic
- Spark ignitors are commonly used in testing to provide consistency
- Problem: Tests with batteries in equipment cannot utilize ignitors
- Initial tests are being conducted to determine how the following factors impacts PED ignition:
  - Heating Rate
  - Battery SoH

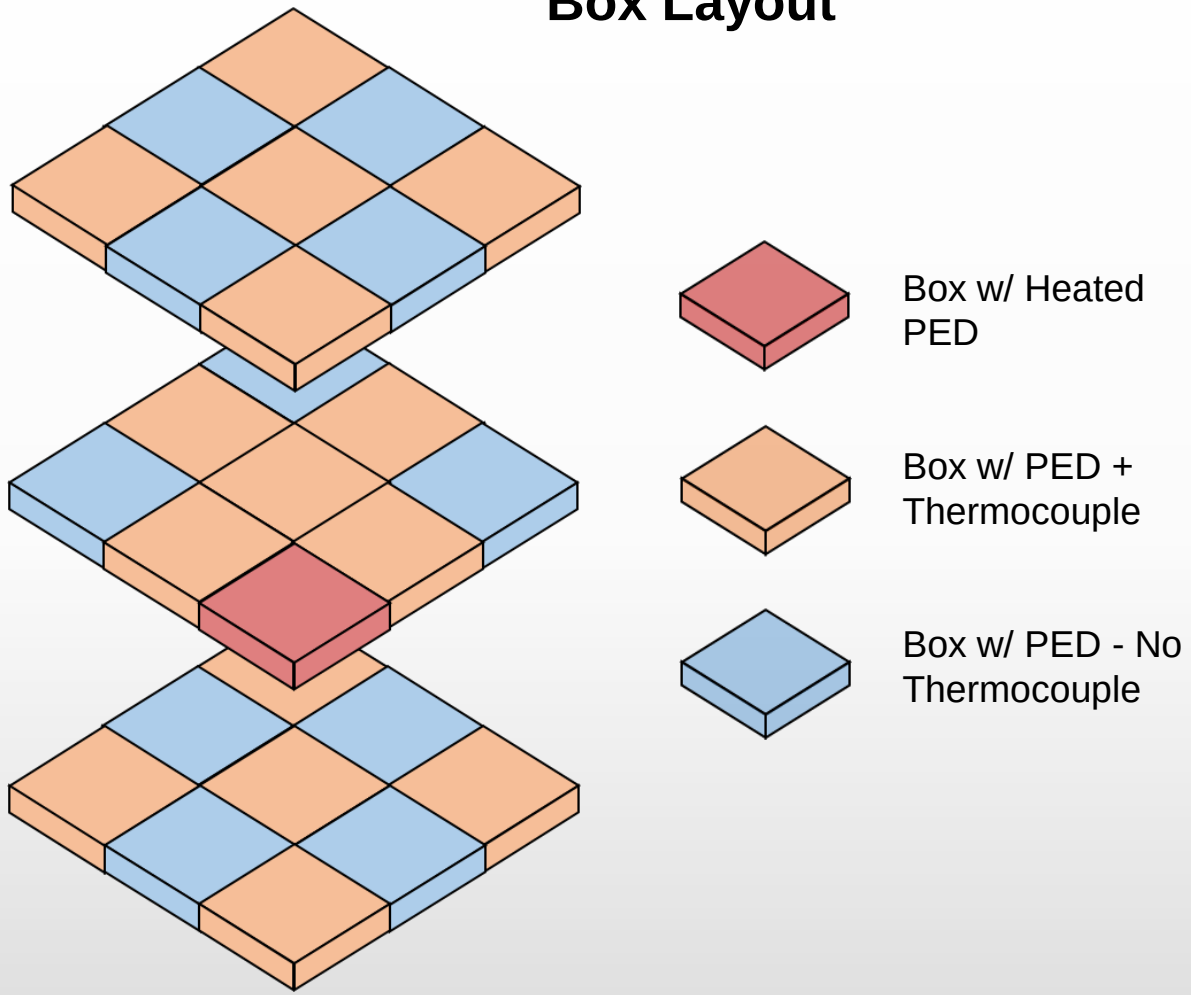


Phone off-gasses igniting when placed next to a spark ignitor

Medium Scale Tests

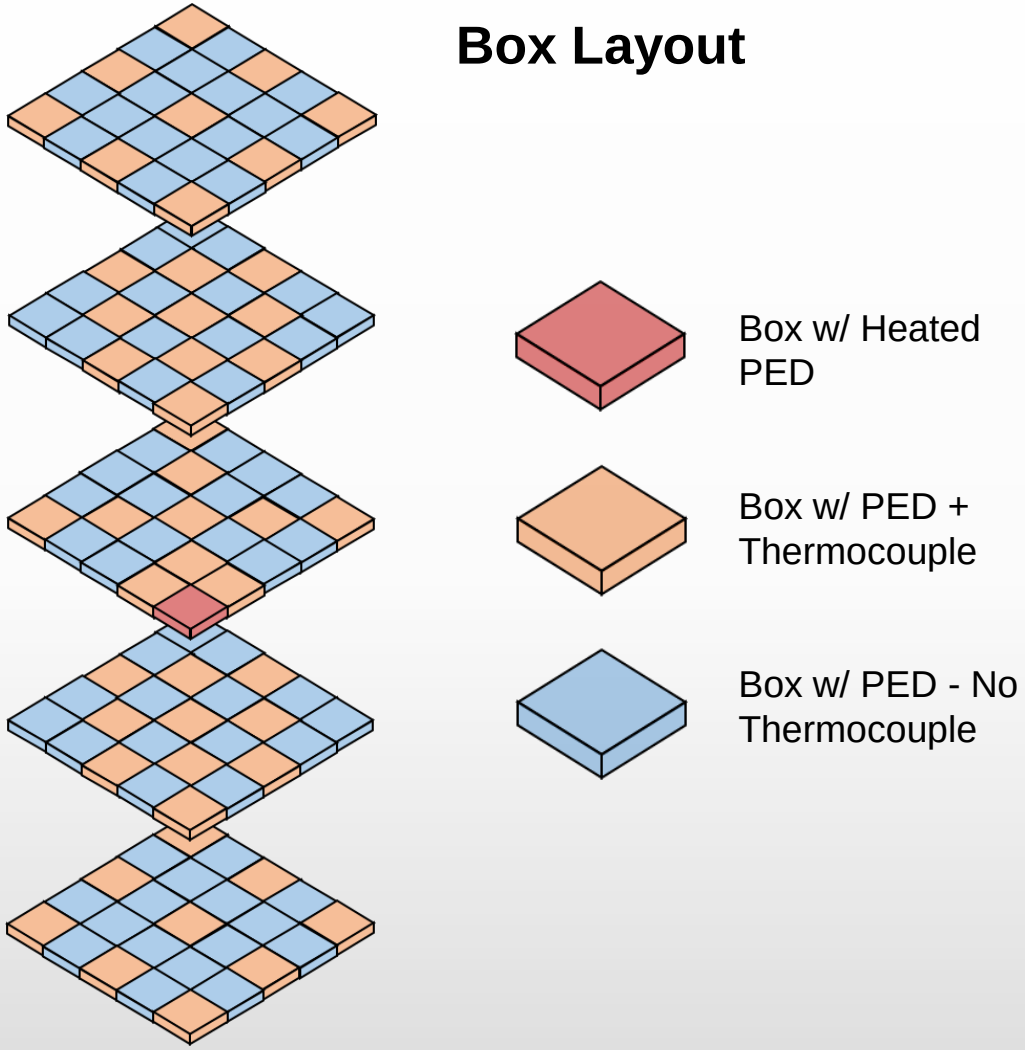
- Boxes will be placed in a 3 by 3 by 3 orientation (27 total devices)
- Initiating PED will be placed in the box on the outermost corner to provide maximum airflow
- Thermocouples will be placed within PEDs at 16 different locations

Box Layout



Large Scale Tests

- PED boxes will be placed in a 5 by 5 by 5 layout (125 total devices)
- Thermocouples will be placed within PEDs in 49 different locations



Summary

- The FAA will be conducting testing on lithium batteries packed in equipment
- Preliminary tests are ongoing, but medium and large scale tests will be conducted in the future
- Further discussions are needed to determine how large quantities of PEDs are packaged
  - Feedback from the audience?

Questions?

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