Akro Fireguard

Shipment of Lithium Batteries
Technology Concept, Development and Testing

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Akro Fireguard

Akro Fireguard is a solutions-oriented engineering company specializing in fire and thermal management for the Aerospace Industry.

Products and services cover OEM, Aftermarket and Defense.

This expertise has led to the development of a wide range of products and services including repair products for aircraft maintenance, interior products, high temperature insulation systems, firewall and fire hard composites and hazardous material packaging solutions

Background

‘AkroTherm’ syntactic foam

Spin-off development for HM224B Oxygen cylinder transportation:

Key material properties:

- **fire resistance.**
- **heat absorption.**
- **thermal insulation**.
- **thermal stability.**

Technical challenge of HM224B:

- **Fire resistance 5 min**
- **Heat differential 400^{o}F / <200^{o}F for 180minutes**

R&D: Further develop the technology to understand if a loose fill concept could be a viable way to protect shipments of Lithium Batteries.

Introduction

Developmental Concept: Loose Fill Packing Media “Packing Peanuts”

1. Protect shipment from external fire: **direct flame impingement**
- does the concept protect from an external fire?

2. Protect shipment from heat: **Halon suppressed cargo fire**
-does the concept prevent the batteries from reaching a critical temperature?

3. Protect adjacent packing : **battery runaway**
- does the concept prevent adjacent packaging being affect by a runaway condition?

Concept

Loose fill "Packing Nut" that following exposure to significant heat / fire forms a homogeneous rigid barrier protective barrier.

Key properties

- Heat absorption
- Heat resistance
- High temperature stability

size: approx. $1in^3$ ($25mm^3$)
weight = approx. 2g

Shipment Configuration

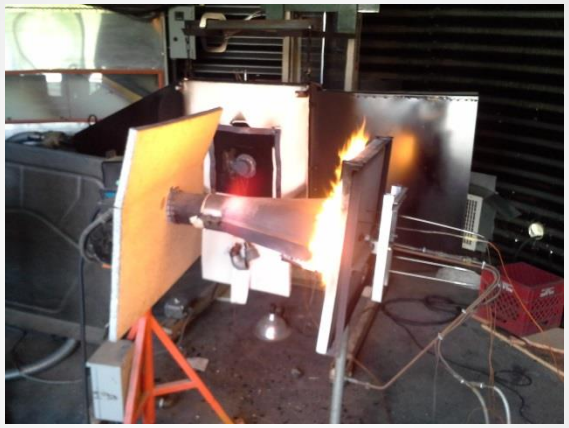
Test articles used: 16 x Lithium metal non rechargeable AA cells

single wall inner box (2.5in^3 / 65mm^3)

UN Rated HazMat double wall cardboard outer box (7x7x8 in / 18x18x204cm)

1. Direct flame impingement

Calibration



Test Configuration

'Park' oil burner in horizontal configuration .

Burner throttled to:

- Heat Flux: 7.5BTU(ft^2sec) / 8.6W/cm^2
- Flame Temp: 1600^{o}F / 871^{o}C

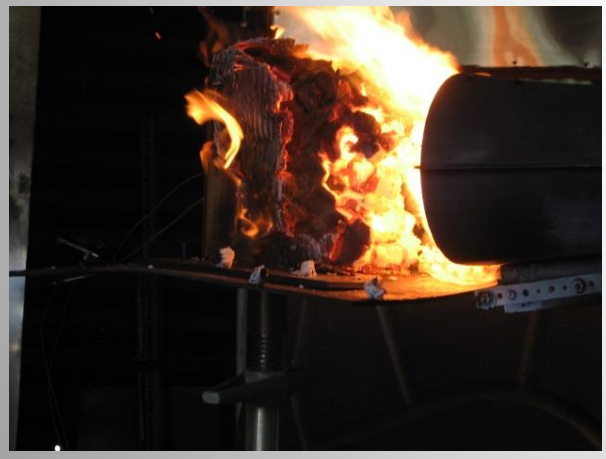
(generally as per requirements of FAR25.855)

1. Direct flame impingement

Start of test.

Approx. 30sec.

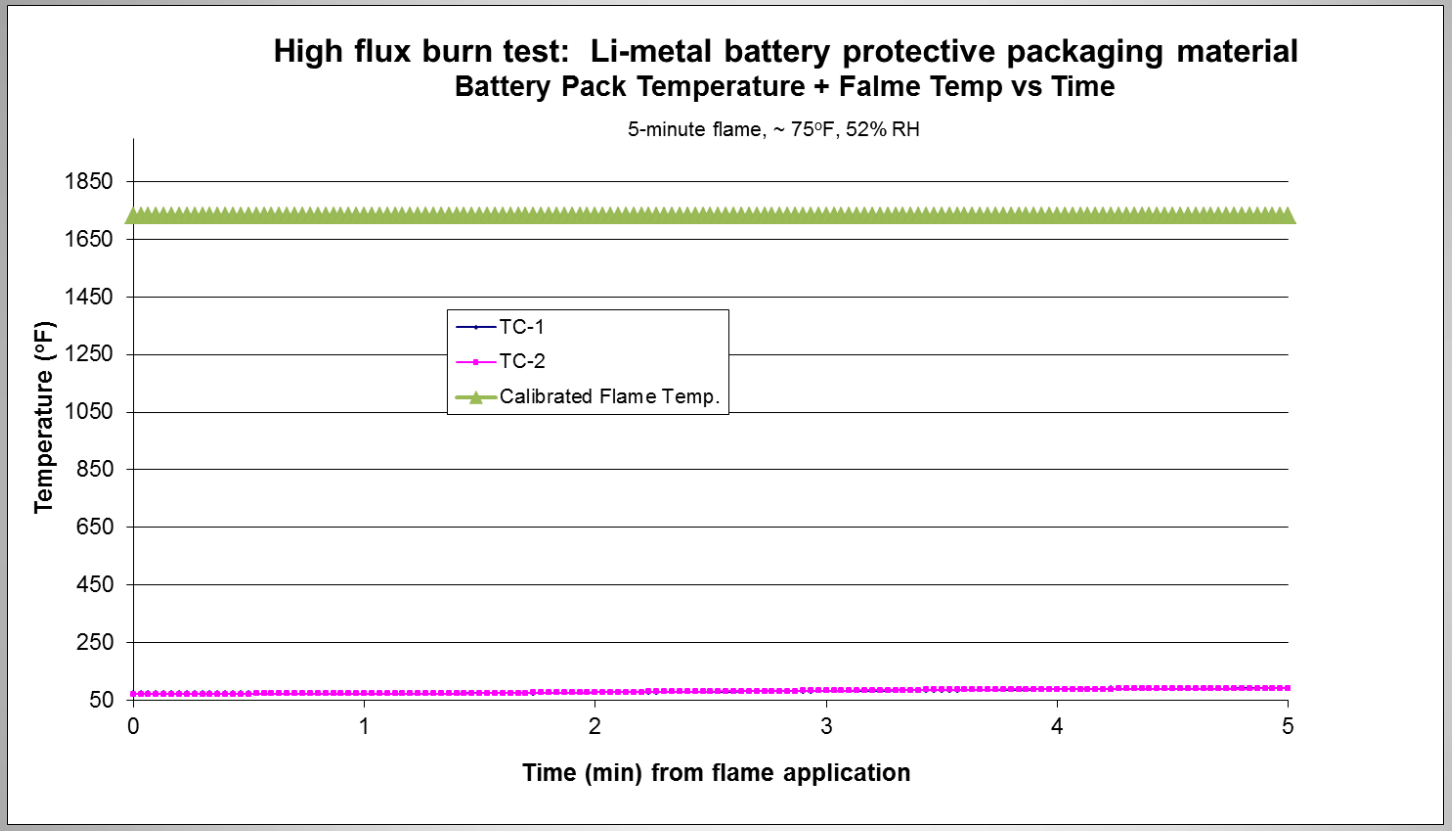
Approx. 2 min.



Approx. 5 min.

Post Test
Packing fuses to form a protective barrier.

1. Direct flame impingement



Maximum ‘battery’ temperature after 5 min = 92ºF / 33ºC

2. Suppressed cargo fire – Thermal Resistance Test

400°F / 204°C Environment for 3 hours.
AL blocks with the same thermal mass of 16 AA Cell pack.

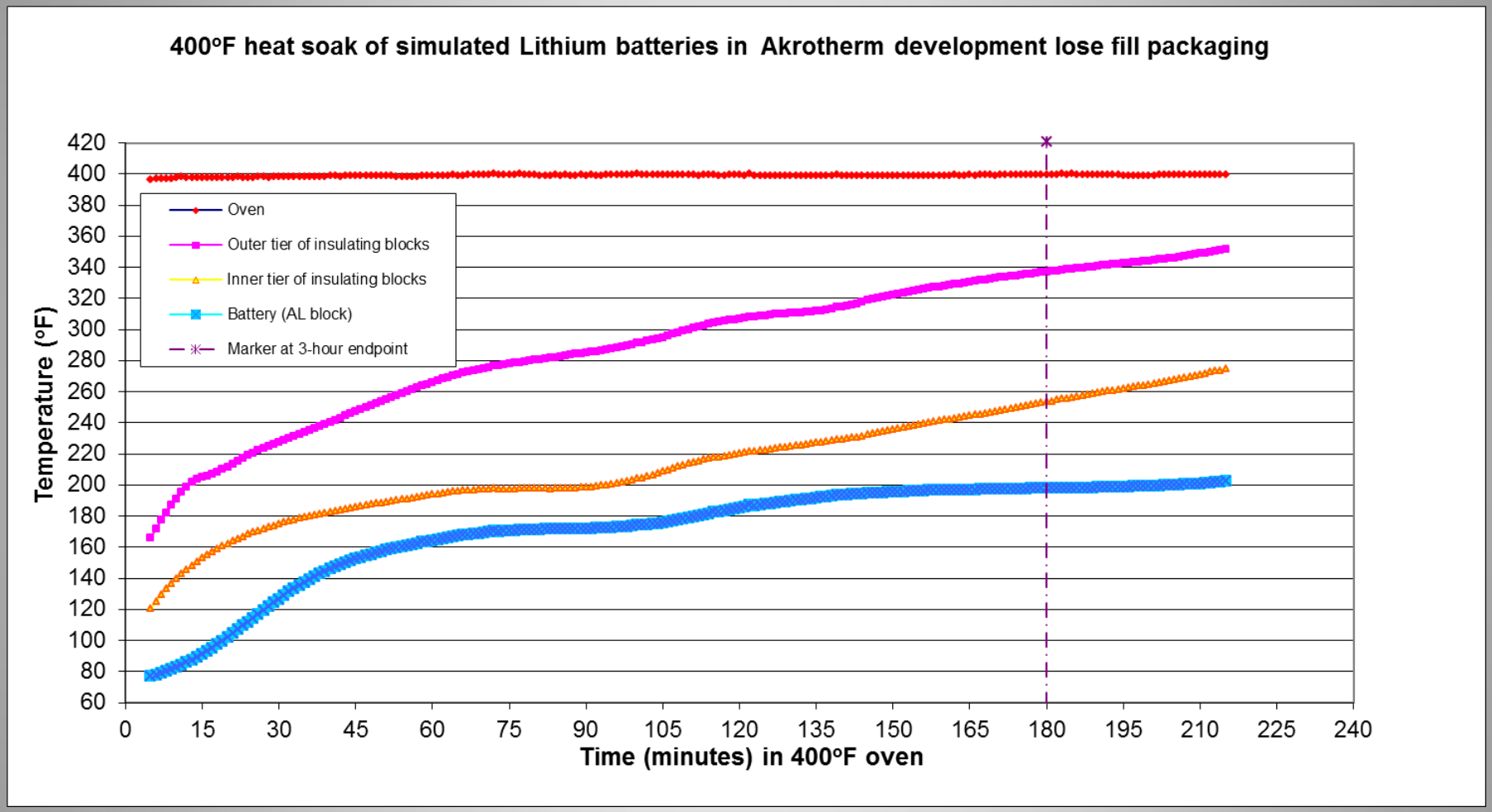
Pre-test – Simulated 16 Cell pack

Post Test

Post Test dissection

Battery

2. Suppressed cargo fire – Thermal Resistance Test



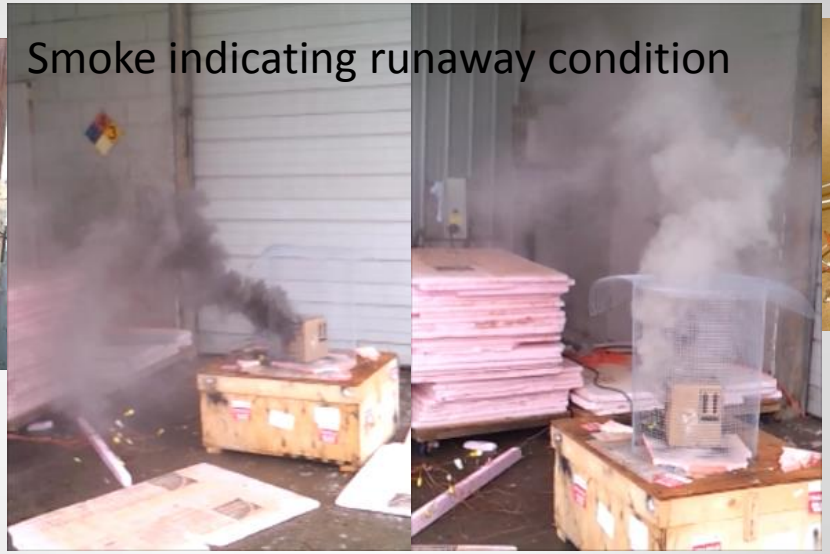
Maximum temperature of Cells = 202°F / 94°C

3. Battery runaway

Cell package: 15 batteries + 75Watt cartridge heater
Temperature of Cell package raised to induce runaway condition.

Battery Pack

Pre-Test

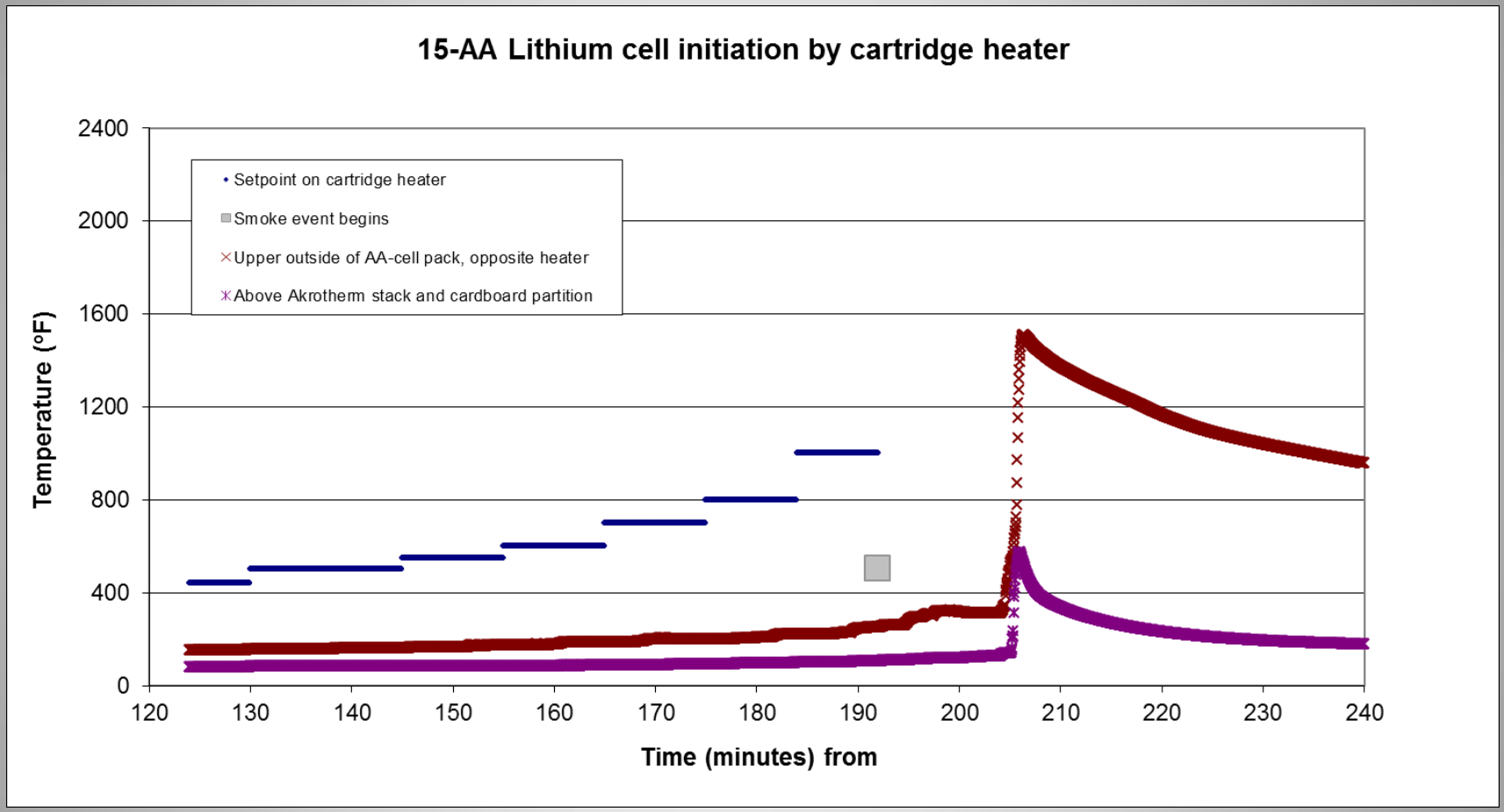


Post Test

Post Test Dissection

Battery Pack

3. Battery runaway



Temperature of cartridge heater increased over a 190 minutes, runaway occurred at approximately 205 minutes.

Maximum temperature above packaging = 500°F / 260°C with no exterior flame

Interim Conclusion

Concept appears to provide a viable media that would provide thermal and fire protection for Battery Shipments.

- Is it Industry / Regulatory Relevant?

Further Study

- Different and more numerous Li Batteries (rechargeable and non-rechargeable).
- Volume of loose fill vs. battery mass study.
- Fire Test packaging in different orientations.
- Performance study of loose fill geometric shapes
- Other?

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