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Heating Methods for Lithium Polymer in Aircraft

PANACIS

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EMC MEC Electric Mobility Canada Mobilité électrique Canada

What is Panacis

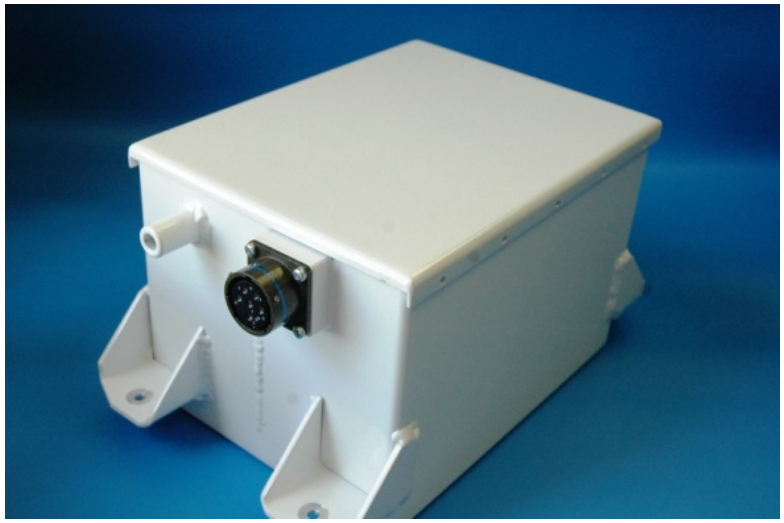
- Product co-development and manufacturing
- Profit 100 Company
- ISO-13485, GMP and FDA registered
- Shipping products internationally
- Multiple established partnerships
- Full range of engineering expertise from power systems to complex devices
- Medical, defense, consumer and Industrial markets

Aircraft Need Lithium

- Weight reductions have measurable impact on fuel savings “per pound” with ROI often measured in months
- Weight reductions increase available payload
- Additional emergency flight time, estimate 10x increase for fighter jets after generator failure
- Greater complexity and amount of on-board electronics increases energy demand
- Built-in diagnostics increase safety and allow pre-flight inspection every time

Aircraft & HEV Have Similar Needs

- Extreme temperature operation, -40C to +80C
- Vibration requirements
- Weight
- Diagnostics
- Balancing
- Safety protection



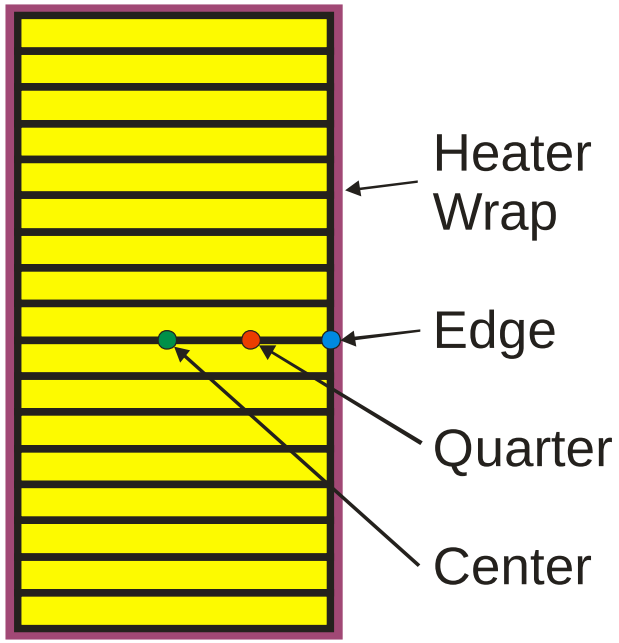
Aircraft & HEV Differences

- Backwards compatibility – No aircraft mods!
- Lightning strike operation (1/100th second loss of power unacceptable)
- Rapid pressure changes
- Salt fog

- Focus on keeping aircraft alive, even through 1000+Amp continuous loads

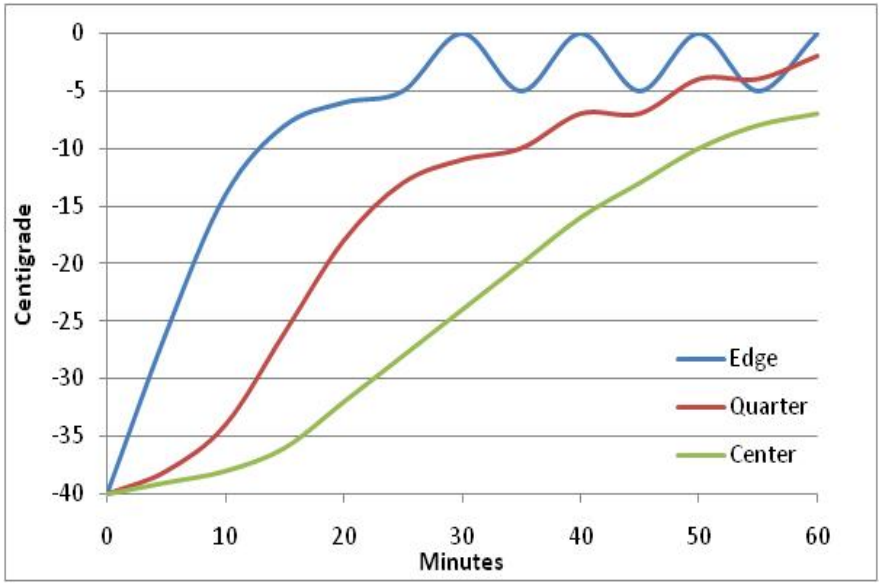
Focus on Heater Operation

- Sample Lithium Polymer stack shown with heater wrapped around circumference
- Temperature sensors on edge of pack, about ¼ distance into pack, and at geometric center of pack



Standard Heater Wrap

- AC or DC powered heater
- Outside of battery heats quickly
- Interior heats very slowly
- Battery may appear to deliver sufficient power after 10 minutes, but this stresses the cells unevenly geometrically
- Warmer cells can cause cell-reversal of colder cells

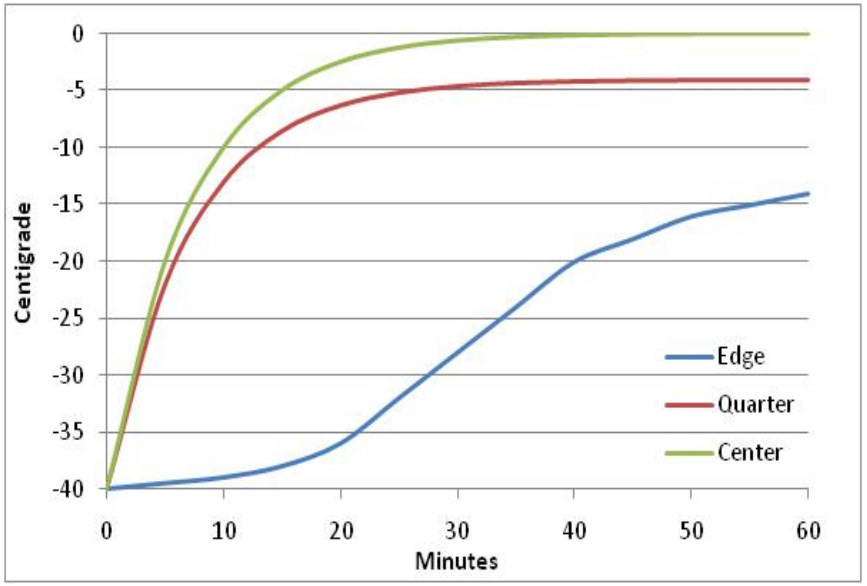


Self-Heating System

- Power extracted from battery, stored inductively then returned to pack
- Energy storage/return can be 90-95% efficient
- Heat is generated due to cell impedance $P=I^2R$
- Impedance rises when battery is cold, the heat generated will actually increase with a colder battery
- The coldest cells will heat faster than the warmer cells

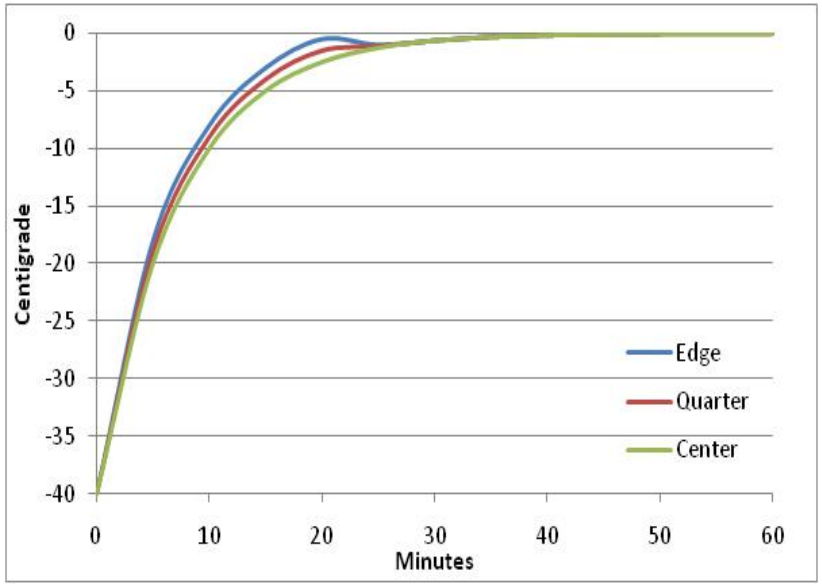
Self-Heating System

- Inside of battery heats quickly
- Exterior heats very slowly
- Exterior cells may never get very warm, their heat is lost to ambient too quickly



Hybrid Heating System

- Combine external heat with internally generated heat
- Both interior and exterior heat rapidly
- Matching of curves by choice of power levels and due to self-leveling nature of the self-heating system



Conclusion

- Heating approaches for Lithium cells can reach beyond standard resistive heating methods
- Properties of impedance rise at cold temperatures can be exploited to heat pack and automatically level out areas of maximum heat generation

Thanks!

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