Preliminary Testing to SAE G-27 Packaging Standard

ICAO Dangerous Goods Panel
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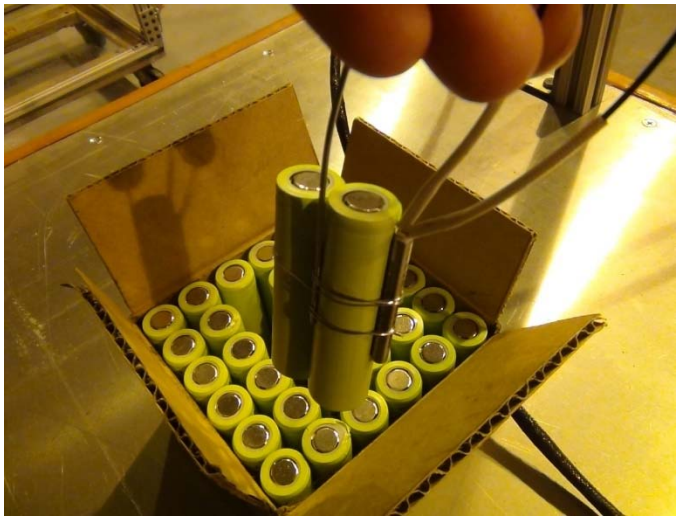
2016 U.S. Cargo Shipments by Air; Lithium Battery Air Shipments

	2016 Air Weight (kg)		
	U.S. Imports	U.S. Exports	Combined
Lithium Metal Batteries	1,293,895	706,137	2,000,032
Lithium Ion Batteries	6,758,066	1,762,909	8,520,975
	8,051,961	2,469,046	10,521,007
	0.19%	0.08%	0.14%
All Commodities	4,248,689,020	3,085,047,573	7,333,736,593

SAE G-27 Lithium Battery Packaging Standard

- Test procedure requires abuse of single cell; presumption that cell may enter thermal runaway during transport
- Package must contain all hazards (*e.g.*, hazardous flames, fragments, vapors)
- 0.3 m^3 test chamber with spark ignitor
- Maximum external package temperature

SAE G-27 General Test Setup

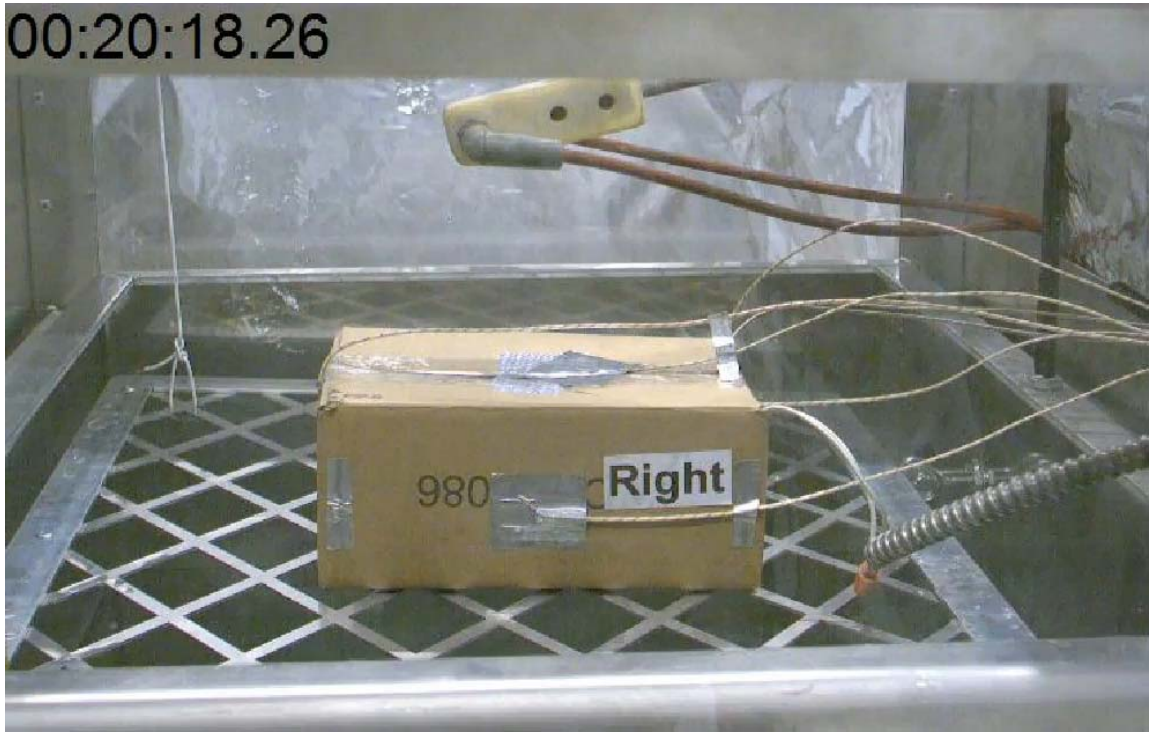


Use a heat source (*e.g*. tape, cartridge) to create a temperature rise at 5 to 20 °C per minute as measured at an external point on cell

Lithium ion Battery Tested as Packaged for Transport

COURTESY OF FULCRUM TESTING | 1602 EAST MAIN #400 | WAXAHACHIE, TX 75165

Results of Recent Testing on Lithium ion Batteries at 30% SOC



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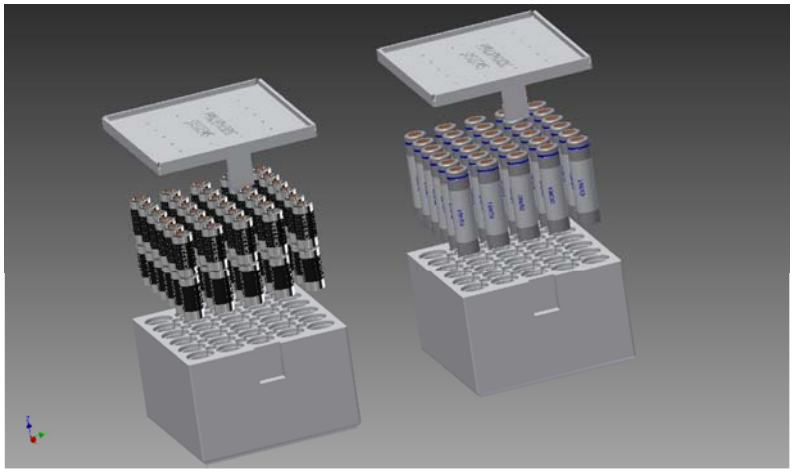
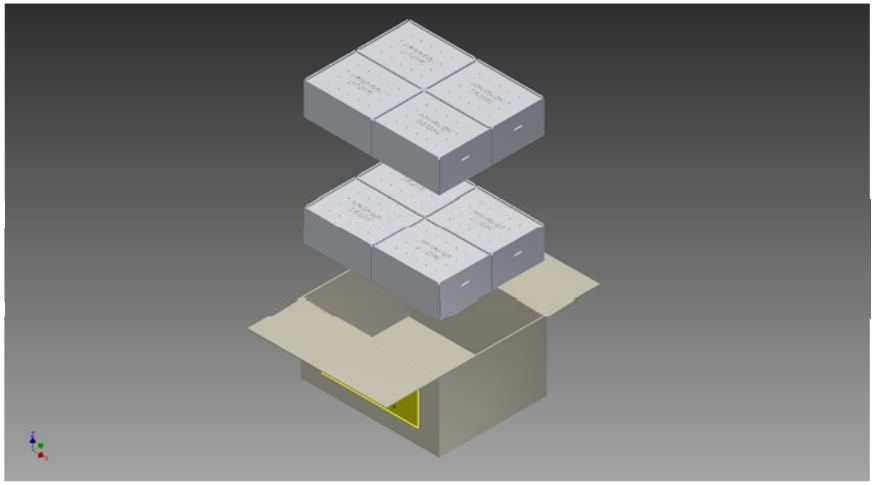
Pyro-Phobic Packaging

"Lithium Prevent"

- Proprietary intumescent, fire resistant, polymer composite technology
- Injection molded to form fire resistant components
- Contains spread of runaway lithium batteries in wide range of applications





Level of Protection: Fire Resistance

- Fire resistant technology designed to hold mixed loads of lithium-ion and non-lithium batteries
- Perfect solution when looking for a step above a regular corrugated box
- Single use only
- Intended for battery recycling and disposal shipping by ground
- Ground or air transport for phone or tablet with battery in the device
- May also be used for temporary storage in aircraft cargo compartment
- Perfect for battery recyclers and phone/tablet ground transport

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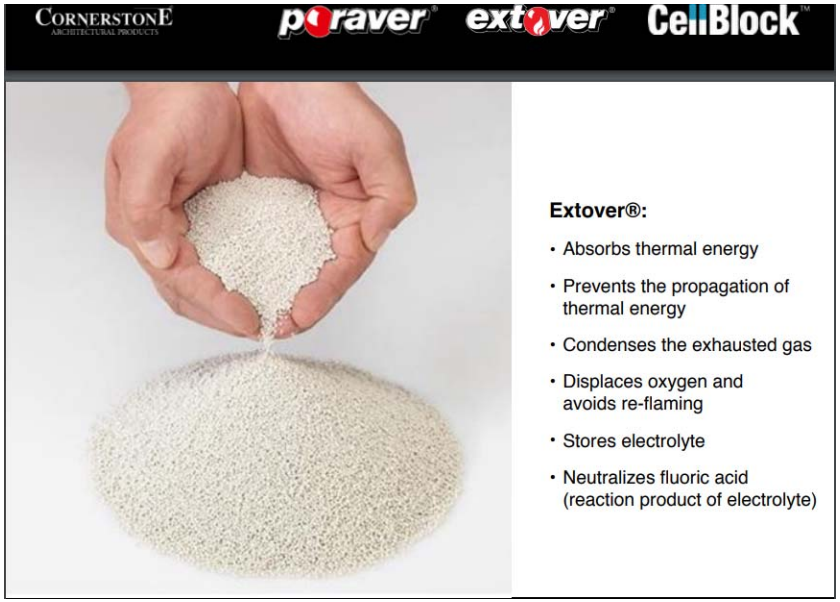
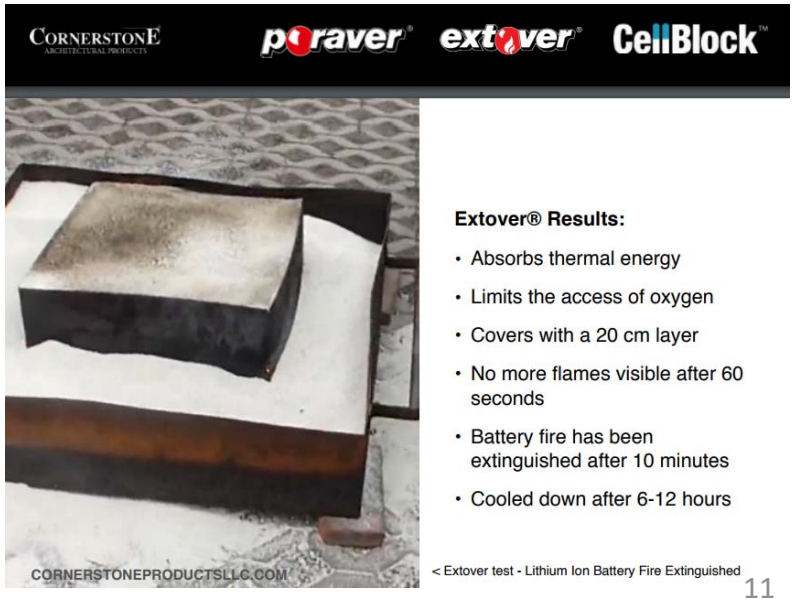
Additional Packaging Developments

"Thermal Management System“ (TMS) by Fireproof Solutions, Inc. Comprised of “cooling inserts" (treated corrugated) to contain thermal runaway

Z-Block™ Fire Containment Bag by Newtex.

Additional Packaging Developments





< Extover test - Lithium Ion Battery Fire Extinguished

Additional Packaging Developments

- Overpack solution developed using adjacent technology from Fire Containment Covers (FCC)
- Passive System providing a Fire Barrier - Oxygen suppression secondary function
- Recent developments in industry have resulted in lithium battery tests, including FAA Tech Center
- Releases smoke to ensure detection systems are activated
- Overpack designed with or without restraint straps, customisable sizes
- Developed for using on palletized loads or within containers

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