Preliminary Testing to SAE G-27
Packaging Standard
ICAO Dangerous Goods Panel
October 16 - 27, 2017

George A. Kerchner
PRBA – The Rechargeable Battery Association
1776 K Street, NW
Washington, DC 20006
202.719.4109
gkerchner@wileyrein.com
# 2016 U.S. Cargo Shipments by Air; Lithium Battery Air Shipments

<table>
<thead>
<tr>
<th></th>
<th>2016 Air Weight (kg)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>U.S. Imports</td>
<td>U.S. Exports</td>
<td>Combined</td>
<td></td>
</tr>
<tr>
<td>Lithium Metal Batteries</td>
<td>1,293,895</td>
<td>706,137</td>
<td>2,000,032</td>
<td></td>
</tr>
<tr>
<td>Lithium Ion Batteries</td>
<td>6,758,066</td>
<td>1,762,909</td>
<td>8,520,975</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8,051,961</td>
<td>2,469,046</td>
<td>10,521,007</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.19%</td>
<td>0.08%</td>
<td>0.14%</td>
<td></td>
</tr>
<tr>
<td>All Commodities</td>
<td>4,248,689,020</td>
<td>3,085,047,573</td>
<td>7,333,736,593</td>
<td></td>
</tr>
</tbody>
</table>
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 m³ 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

00:20:18.26

COURTESY OF FULCRUM TESTING | 1602 EAST MAIN #400 | WAXAHACHIE, TX 75165
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
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®:**
- Absorbs thermal energy
- Prevents the propagation of thermal energy
- Condenses the exhausted gas
- Displaces oxygen and avoids re-flaming
- Stores electrolyte
- Neutralizes fluoric acid (reaction product of electrolyte)

**Extover® Results:**
- Absorbs thermal energy
- Limits the access of oxygen
- Covers with a 20 cm layer
- No more flames visible after 60 seconds
- Battery fire has been extinguished after 10 minutes
- Cooled down after 6-12 hours
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