



FIRE CONTAINMENT SOLUTIONS – R&D AND TESTING

Pravin Gunasekera
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➤ The Specialist in Aviation Restraint and Safety Technology products including

- _ Tarian® Armour System
- _ 9G aircraft barrier nets, with smoke/thermal protection
- _ Fire containment products

➤ Tier 1 supplier to Airbus, Boeing, etc.

➤ World leader in cargo restraint equipment

➤ Leading supplier to Defence forces worldwide



➤ Declared Li-ion Bulk Shipments

- _ Flammable gas release
- _ Even at 30% SOC, a 2600mAh 18650 battery cell releases 1.5 liters of flammable gas

➤ Undeclared Li-ion content

- _ Rechargeable device sales rising
- _ Cross Border E-Commerce rising
- _ Increase in individual shipments
- _ DG shipments are complex and expensive
- _ Risk of fires that cannot be stopped by existing Halon systems



Declared Li-Ion Bulk Shipments



Undeclared Li-Ion Content

WHAT IS FCC/ FRC ETC.? WHAT IS THE OPTIMUM SOLUTION?



- ⊗ **FCC** – Fire Containment Cover (for palletized loads)
FRC – Fire Resistant Container (for ULD containers)
FCB – Fire Containment Bag
CFCC – Container Fire Containment Cover (used over ULD containers)
- ⊗ Developed as a solution to UDG, Lithium battery shipments, mobile electronics (10+ years at ASB)
- ⊗ TSO-C203 certified (FAA/EASA) and meets SAE AS6453 & ISO 14186 requirements
- ⊗ Fire Resistant Fabric Cover
 - Passive system
 - Fire Barrier - Oxygen suppression secondary function
 - Patented designs
- ⊗ FRC – ISO 19281 released, AS8992 WIP
- ⊗ Tested with Class 'A' fire & Lithium-ion battery fire
- ⊗ Palletized main deck cargo – Class E & B (optional for Class C and other compartments)
- ⊗ Extensive trials & testing fed back into design
- ⊗ Already in revenue service and trials (UPS, LH, Blue Dart, Cathay Pacific, DHL, etc.)



AmSafe Bridport (*INTERNAL*) TEST

- Test spec defined by Operator and ASB
- FCC dimensions 125" x 96" x 96" height
- Qty of 1,500 Lithium-ion batteries
- 18650 type cells – 2600mAh, 3.7V, SOC 70%-90%
- Battery boxes placed in 3 positions
- Result: **PASS**
 - _ All batteries vented
 - _ No external flames beyond limits
 - _ Peak temperatures measured 4" away below 204°C (400°F)



FRONT

SIDE

FAA (*EXTERNAL*) TEST

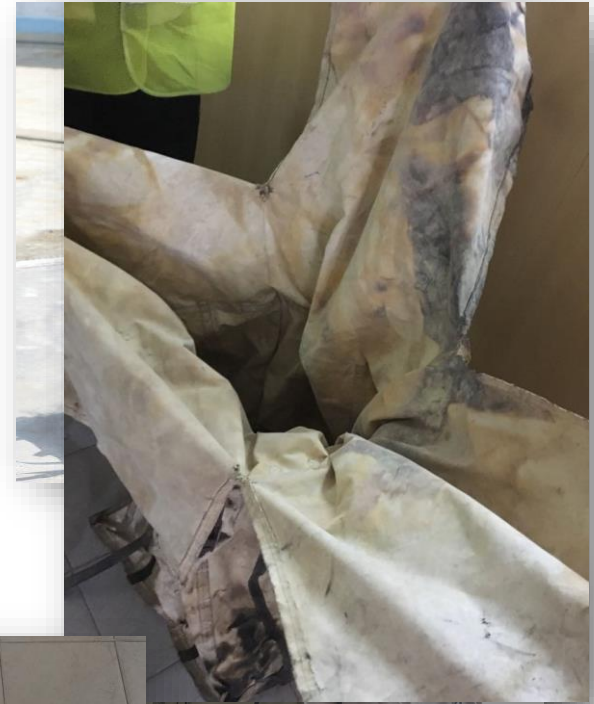
- Test method defined by FAA (no standardised test)
- FCC dimensions 125" x 96" x 96" height
- Qty of 1,000 Lithium-ion batteries
- 18650 types cells – 3000mAh, 3.7V, SOC 30%-40%
- Battery boxes placed in 1 position, pallet corner
- Result: **FAIL**
 - _ Batteries escaped confines of FCC / pallet
 - _ All batteries vented



- ⓧ FCC solution for OEM aircraft conversion project. Test method defined by OEM and FAA, and test witnessed by FAA-DER.
- ⓧ FCC dimensions 108" x 88" x 96" height, 463L pallet compatible
- ⓧ Class A material, Class B flammable fluid (3.75-liter ethanol), Class D (300 lithium-ion batteries)
- ⓧ Two tests conducted; Damaged and Repaired condition.
- ⓧ Result: **PASS** (both tests)
 - _ No flame penetration / burn-through
 - _ Peak temperatures measured 4" away below 204°C (400°F)
 - _ External flames within allowable limits

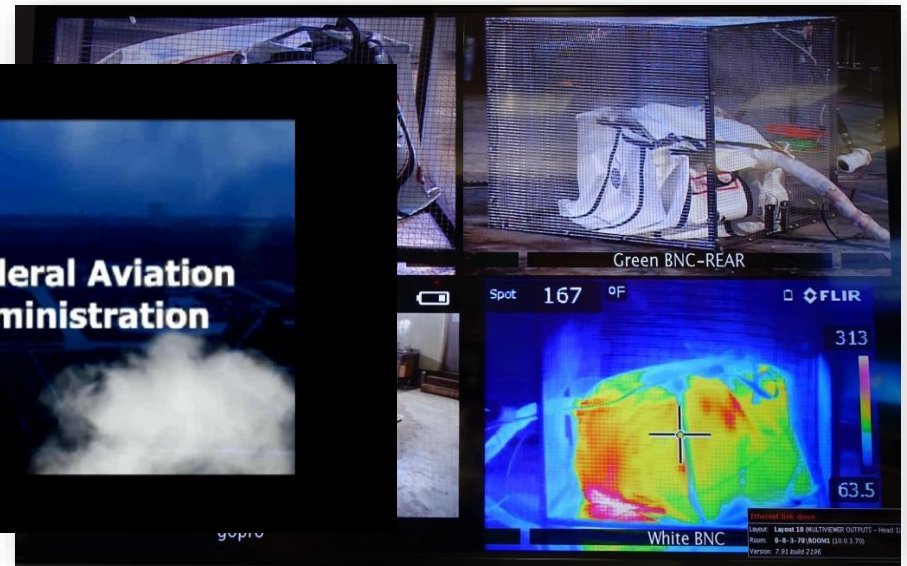


- A derivative of the FCC, developed for smaller cargo loads
- Uses same technology as FCC, and will contain Class 'A' and Lithium-ion fires for up to 6 hours
- Allows smoke to be released, ensuring detection systems continue to activate
- Can be used as an 'OVERPACK' at any stage of supply chain
- Enabled airlines to lift battery shipment embargo
- Protected aircraft in real life fire



- Testing conducted by the FAA
- FCB dimensions 24" x 24" x 20"
- Qty of 1,000 Lithium-ion batteries
- 18650 type cells – 3000mAh, 3.7V, SOC 30%-40%
- Load consisted only of batteries
- Result: **PASS**

- _ All batteries vented
- _ No external flames
- _ No batteries escaped



CONTAINER FIRE CONTAINMENT COVER (CFCC)



- A derivative of the FCC, developed as a solution for use over standard ULD Containers.
- Customizable to all ULD contours.
- Already in revenue service and trials

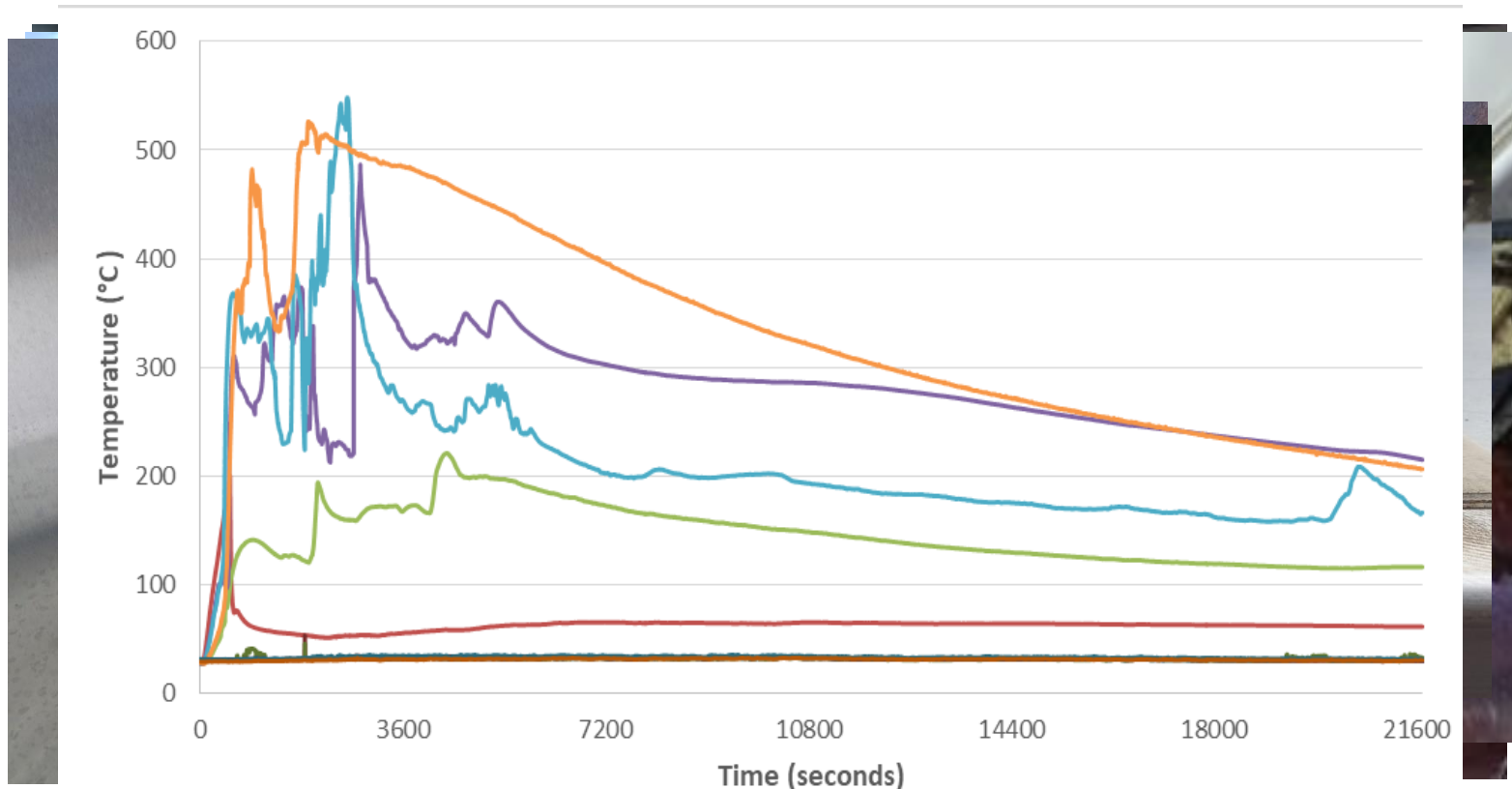


- Test spec defined by Operator and ASB
- AKE metal container with metal door, in new condition
- Mixed Class Load
 - _ Class A material (36 boxes with shredded paper)
 - _ Class B flammable fluid (2.0-liter ethanol)
 - _ Class D (2,000 lithium-ion batteries)
- 18650 type cells – 2600mAh, 3.7V, SOC 50%



Result: **PASS**

- 6 hour fire containment
- >75% of batteries vented
- No flame penetration / burn through
- No external flames
- Peak temps 4" away below 204°C (400°F)
- 4 min 30 sec – initial smoke visible
- Peak internal temp – 548°C (1018°F)
- Side & Door peak temp (4" away) – <34°C (93°F)
- Peak Surface temp – 70°C (158°F)
- Container fire damaged beyond limits



- ⌚ Test spec defined by Operator and ASB
- ⌚ AMJ metal container with fabric door, in used condition
- ⌚ Mixed Class Load
 - _ Class A material (144 boxes with shredded paper)
 - _ Class B flammable fluid (4.0-liter ethanol)
 - _ Class D (5,400 lithium-ion batteries)
- ⌚ 18650 type cells – 2600mAh, 3.7V, SOC 50%
- ⌚ FCB with 400 cells, included into test load
- ⌚ Test Plan Revision
 - _ Phase I (4 hours)
 - _ Phase II ('worst case' configuration)
 - Open pull flaps
 - Unsealed cover



➤ Result: **PASS (Phase I)**

- _ 4 hour fire containment
- _ No flame penetration / burn through
- _ No external flames
- _ Peak temps 4" away below 204°C (400°F)
- _ 1 min 20 sec – initial smoke visible
- _ Peak internal temp – 581°C (1078°F)
- _ Peak external temp – 88°C (190°F)
- _ Container fire damaged beyond limits

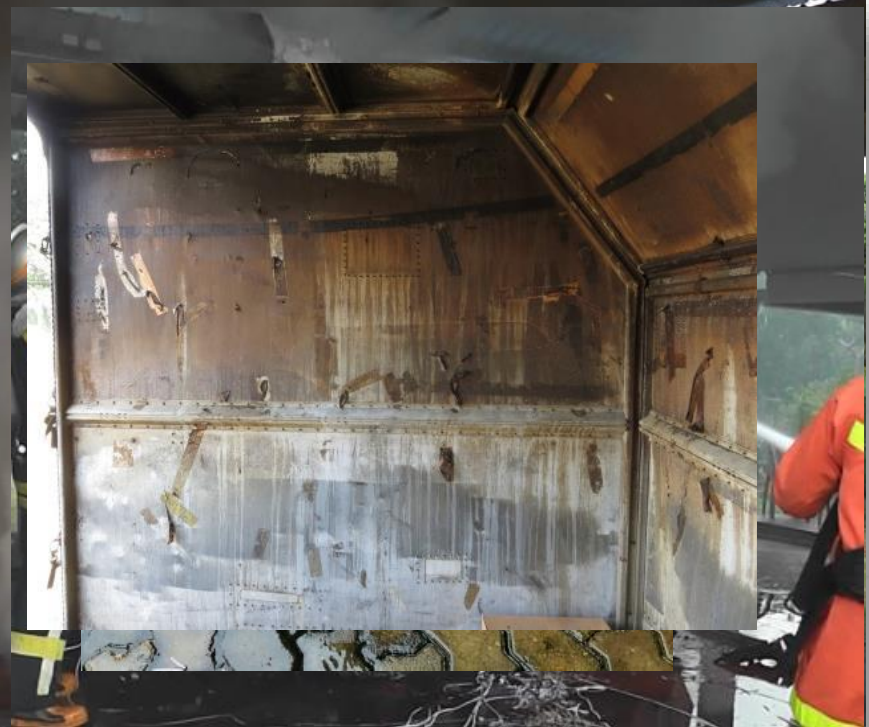


Result: **Phase II**

- _ +35min test terminated
- _ >75% of batteries vented
- _ Fabric failure / burn-through
- _ External flames
- _ Battery ejections
- _ Peak internal temp – 1000°C+ (1832°F)
- _ Peak external temp – 88°C (190°F)
- _ Peak temps 4" away above 204°C (400°F)
- _ FCB compromised & all 400 cells vented



Phase I



Thank you for your time

Pravin Gunasekera CEng MIMechE, PMP, BSc Aero

Lead Engineer

Cargo Business Unit

AMSAFE BRIDPORT

Mobile: +94 (0) 770 527354

Direct: +94 (0) 114 516888 / Ext: 5149

Email: pravin.g@amsafebp.com