



## RESEARCH AND TESTING OF AIR CARGO FIRE CONTAINMENT SOLUTIONS

### - SKID FIRE CONTAINMENT BAG -

The Tenth Triennial International Fire &  
Cabin Safety Research Conference  
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- Introduction
- Mantle brand
- Mantle product range and previous testing
- Motivation and Solution
- Aim and Objectives
- Test details and Procedure
- Results and Observations
- Conclusion

- AmSafe Bridport is the specialist in highly engineered textile Aviation Restraint and Safety Systems including:
  - Pallet nets and Tie down straps
  - 9g aircraft barrier nets and underfloor nets
  - Smoke/thermal protection systems
  - Fire containment products (Mantle®)
- Tier 1 supplier to major OEMs, airlines and freight forwarders
- World leader in cargo restraint equipment
- Leading supplier to Defence forces worldwide





- AmSafe Bridport Fire Containment Covers (FCCs) have been used in the industry for the past 15 years.
- AmSafe Bridport Fire Containment products were rebranded as Mantle™ in 2018 at the World Cargo Symposium in Dallas.
- The brand covers all products within the Fire Containment product portfolio and continues to surpass expectations in both performance and handling targets.
- The AmSafe Bridport's Mantle Fire Containment Cover was the world's first to be awarded both FAA and EASA Technical Standard Order TSO-C203 approvals, answering the demands of both the industry and its regulators.
- Link to the Mantle web page

<https://amsafebridport.com/cargo/fire-containment-solutions/>





Fire Containment Bag (FCB)



Fire Containment Cover (FCC)



Container Fire Containment Cover (CFCC)



Fire Containment Pouch (FCP)



## FCC

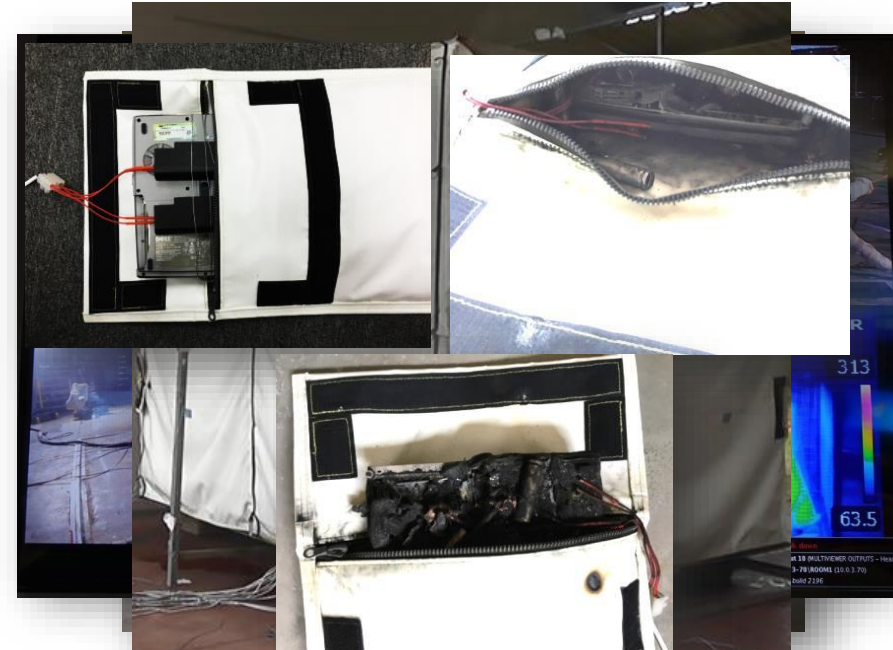
ETSO-C203 certified (FAA/EASA) and meets SAE AS6453 & ISO 14186 requirements

- Tested with Class 'A' fire
- Tested with 1500 LIB fire

➤ FCB - Testing conducted by FAA with 1000 LIBs

➤ CFCC - Tested AKE CFCC with 2000 LIB fire  
- Tested AMJ CFCC with 5400 LIB fire

➤ FCP - Fire tests conducted with laptop batteries





- Exponential growth in the transportation of LIB shipments.
- Need for quick transportation while maintaining safety.

## ➤ SKID FCB



Height adjusted Skid FCB



Full size Skid FCB



Transporting cargo with Skid Cover installed

- Attached to a Skid Pallet during operations to protect the cargo in case of a fire.
- Comprises of 2 parts, Top and Bottom and is height adjustable
- Allows the cargo to be moved using a forklift while the cover is still attached.

## ➤ Aim

- Analyse the fire containment capability of a Skid FCB in a lithium-ion battery (LIB) fire scenario.

## ➤ Objectives

- Perform full scale fire testing on a skid FCB with LIBs.
- Test the Skid FCB for 6 hours.
- Validate the test results using SAE AS6453 and ISO 14186 aerospace fire containment standards.



## Item Under Test

- Skid FCB components



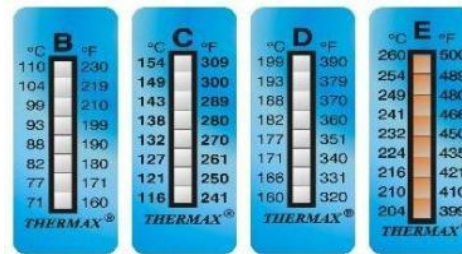
- Tested Skid FCB size: 48" X 41" X 64"

## ➤ Test Equipment

- Cylindrical cartridge heaters
- Worm screw clamps
- Data acquisition system
- Hygrometer
- Irreversible temperature indicators
- K-type thermocouples
- Internal: rated to 1000 °C
- External: rated to 260 °C
- Video recorders



Data measurement processor



Irreversible temperature indicators

## ➤ Adjacent Cargo Load

- 24" x 24" x 20" size FCB
- 400 LIBs with Class A material
- To understand any LIB behavior when placed next to a Skid FCB



LIB bundle, worm-screw clamps and ignitor



Adjacent cargo load

## 🔍 Fire Load Composition

### ❑ Lithium-ion batteries (LIB)

- 3.6 v 18650-size, average capacity: 2200 mAh
- State of Charge: 50-70%
- Number of LIBs: 4800 batteries distributed over 12 bundles (400 ea).



LIB bundle

### ❑ Class A (general combustible materials)

- 18" x 18" x 18" size corrugated cardboard boxes
- 75% volume filled with shredded paper
- Wooden skid pallet



LIBs within 'Class A'  
cardboard box

## 🔍 Test Location

- Mirigama BOI export processing zone, Sri Lanka

## ➤ Pass/Fail Criteria

Defined considering the SAE AS6453 standard applicable for Fire Containment Covers (FCCs)

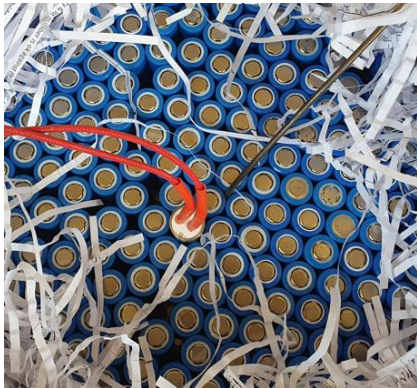
- No flame penetration at any given time over the total duration of the test.
- Peak temperatures located 4" away from the external surface of the Skid FCB shall not exceed 204 °C (400 °F).
- Duration of any flames external to the Skid FCB must be less than 15 s.

## ➤ Test Duration

- 6 hours as derived from the minimum protection time for unlimited aircraft type use.



## 🔍 Skid FCB Fire Test Setup



Heater and thermocouple positioning



Cargo load with LIBs and class A material



FCB base setup with wooden Skid



Setting up LIB boxes



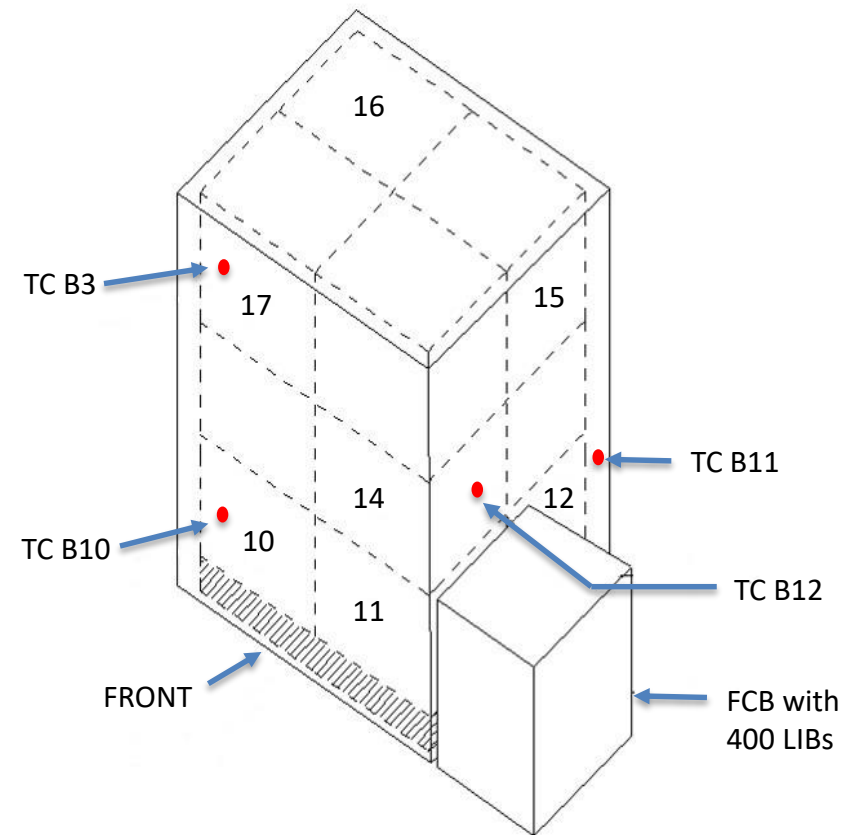
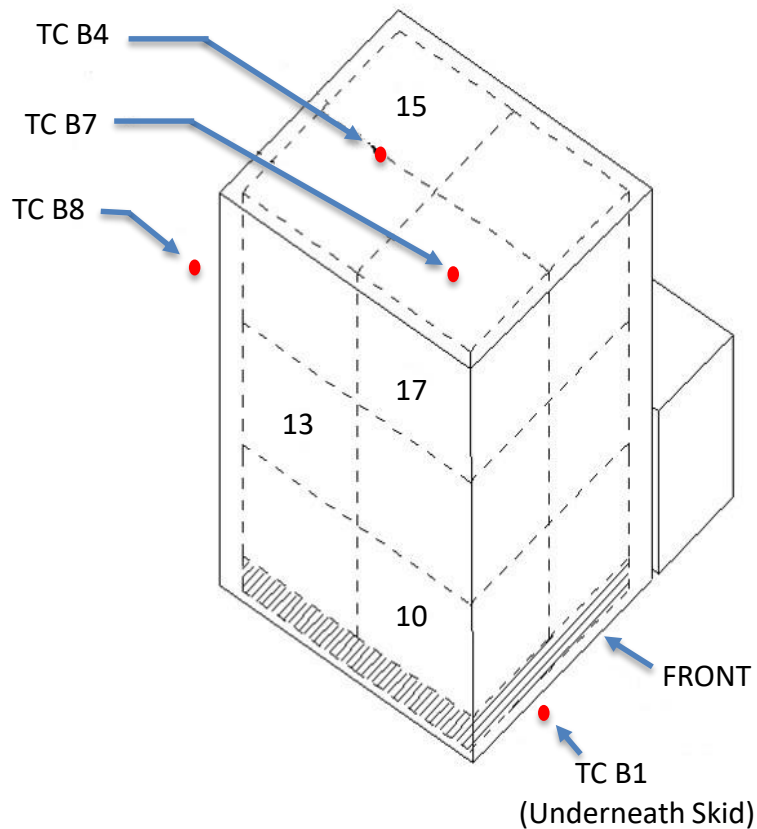
Completed fire load setup



Skid FCB load setup



## Thermocouple Positions

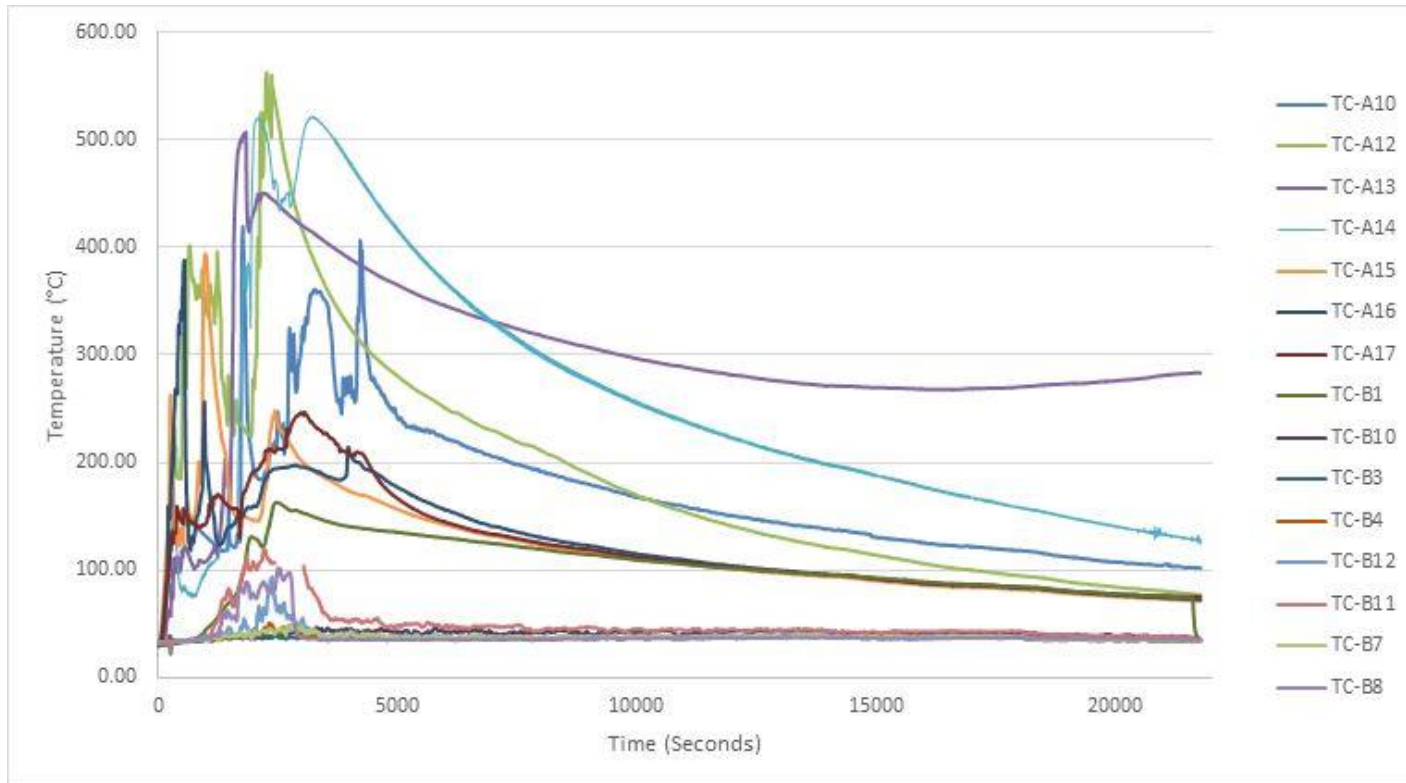


- 8 internal thermocouples – 10, 11, 12, 13, 14, 15, 16, 17
- 8 external thermocouples – B1, B3, B4, B7, B8, B10, B11, B12 (4" away from Skid FCB outer surface)

- 6 hour fire containment
- No flame penetration / burn through
- No external flames
- Initial smoke visible – 3 min
- First audible sounds of battery venting – 3 min
- First signs of browning of cover fabric – 6 min



➤ Temperature profile recorded by thermocouples



- Peak internal temperature – 1633 °C (2971 °F)
- Peak temperature 4" away from FCB surface – 119 °C (246 °F)

Requirement  
< 204 °C

## ➤ Post-test Observations

- 100% batteries had experienced thermal runaway.
- No flame observed after the cover was removed.
- Interior and exterior of the skid FCB showed fabric discolouration and blackening on all panels.



Fire load; post-test



Skid FCB inner side discolouration



Skid FCB right side post-test



Skid FCB left side post-test



Skid FCB Bottom outer side post-test



- No impact seen to the battery box on the adjacent FCB.



Adjacent FCB fire load post-test

### ➤ Conclusion

- The fire test was concluded as 'PASSED' based on the results and observations with the Skid FCB successfully containing 4800 Lithium ion battery fire of which all experienced thermal runaway, in addition to a Class A fire.



# Thank you for your time

## Contact details for inquiries

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