# The Use of ULD Contained Suppression for Hazardous Air Cargo

## INTERNATIONAL AIRCRAFT SYSTEMS FIRE PROTECTION WORKING GROUP MEETING

May 24, 2012

# Firetrace International

## Overview

Firetrace International is based in Scottsdale, Arizona with offices in the United Kingdom, Dubai, Singapore and Australia

Firetrace specializes in applying fire engineering research to unique and unusual small volume hazards (<2000 cu ft)

Firetrace has been the global leader in providing "micro" environment fire protection solutions for commercial, industrial, and military applications for over 25 years

# Air Cargo Fire Incidents

- The incident rate for air cargo fires is increasing
- The increase is due in part to increasing air freight volumes
- However, other contributing factors appear to be the composition of the freight involved with lithium batteries being suspected of playing a significant role
- The FAA sponsored *Freighter Airplane Cargo Fire Risk Model (*RGW Cherry & Associates Limited) predicts more than 4 additional major crashes among US based cargo companies over the next decade attributed to the transport of lithium batteries.

# Options Are Available

- There may be some debate regarding the cause and contribution of lithium batteries, packaging and labeling in the two recent fatal crashes.
- However, it is clear that current fire alarm and suppression options are not providing adequate protection to allow the crew the extended time required to execute a safe landing
- There are readily available, simple options which can demonstrate control of a fire for extensive periods of time

# One Approach - ULD Contained Suppression

ULD contained suppression systems target the fires inside the ULD and provide several advantages over cargo bay protection:

- Detection is nearer to the source of ignition, speeding detection and therefore suppressing the fire at its more incipient stage
- Attacking the fire at its source and in a contained volume prevents the fire from engaging additional fuel loads, using less suppressing agent which equates to:
  - Less agent used and therefore less expense
  - Reduced environmental impact from the agent
  - Reduced secondary effects from the agent
  - Reduced human exposure to the agent or potential agent decomposition products

# ULD Contained Suppression

Other Advantages Include:

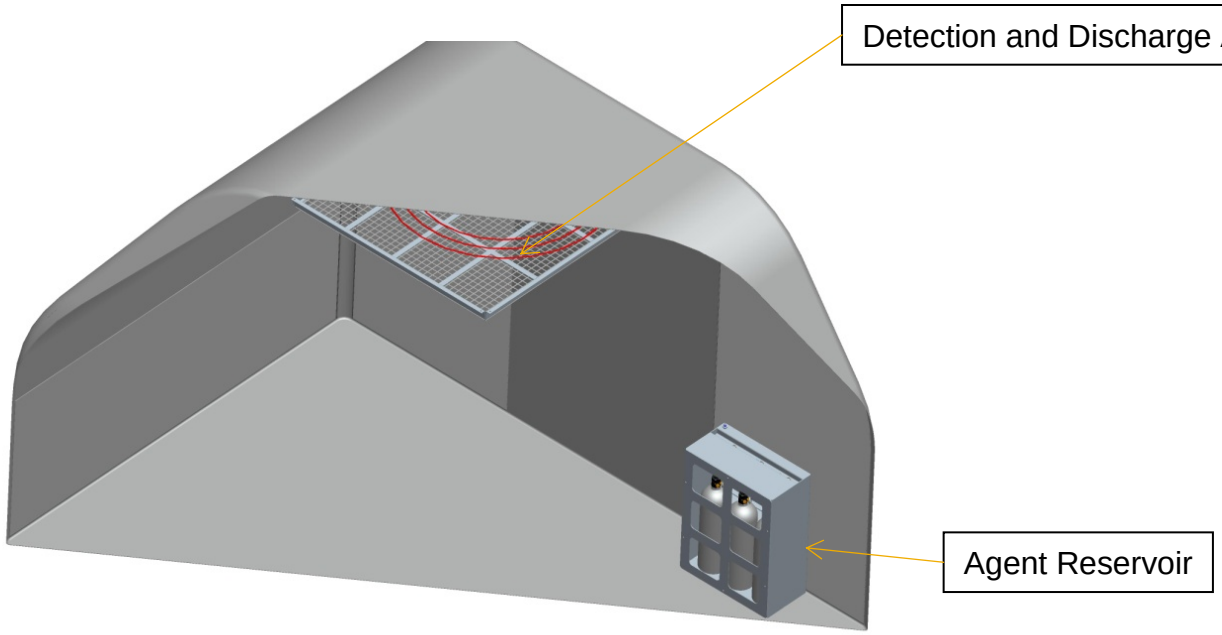
- The system is independent of the airframe
  - A non-operative ULD mounted system can easily be replaced by a ULD with a functional system without grounding the aircraft
- It can be modified to accommodate various sizes of ULDs and configurations which makes it usable on almost all aircraft types
- Modifications could make this viable for palletized freight

# Firetrace ULD System Design

The Firetrace prototype system:

- Does not impede cargo loading/unloading
- Is tamper resistant, armored, impervious to dust, grease, fuels, vibration
- Provides wireless reporting of fire events and immediate crew notification
- Self reports system status on demand or automatically minimizing routine maintenance
- Will not discharge unless a fire is present, eliminating false discharge risks

# Prototype System Design



# Firetrace ULD System Design

Suppression Agent

- The choice of suppression agent is vital to successful extinguishment
- For air cargo, the agent must have several capabilities:
  - Effective for Class A paper and Class B flammable liquids
  - Safe for people
  - Safe for the environment
  - Compatible with aircraft materials
  - Non-corrosive and without harmful secondary effects
  - Effective on deep-seated fires
- After testing clean agents, dry chemical, foam and CO2, Firetrace selected water mist as the best solution

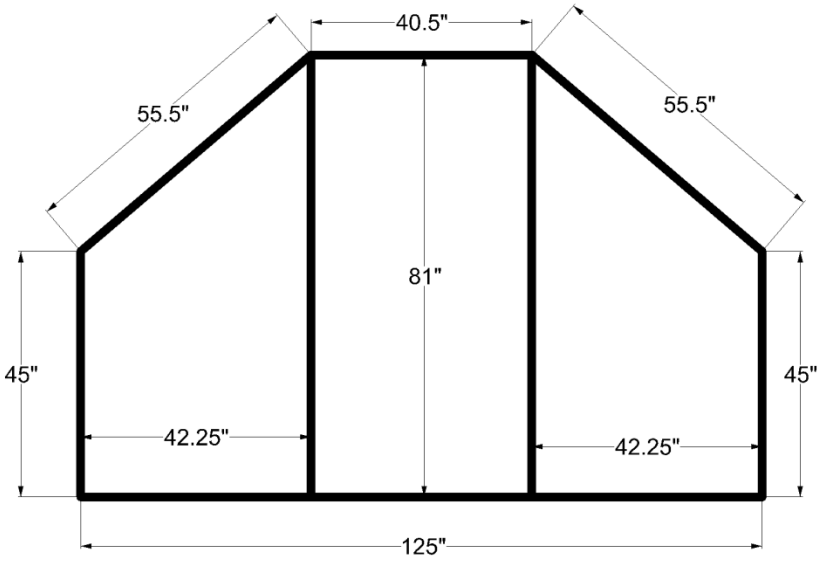
How Does the System Perform Against Standardized Tests?

# ULD Test Mockup

Previous testing was conducted in standard aluminum-acrylic ULDs

A2N ULD made of steel to measure the severity of an uncontrolled fire

Instrumentation: fuel temps, air temps, ULD temps and $O_2$



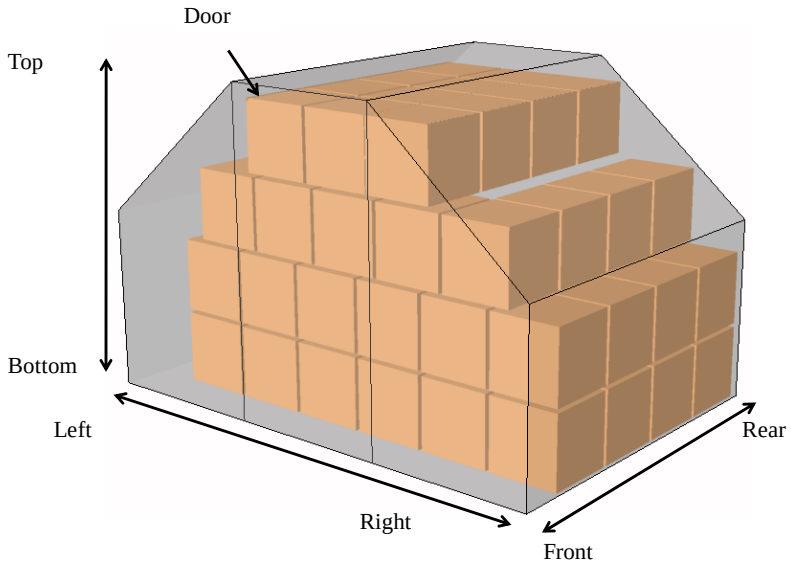
# FAA Minimum Performance Standard for Aircraft Cargo Compartment Halon Replacement Fire Suppression Systems

[Test modified to remove artificial openings. Modified door flap]

## Fuel Type and Configuration

- Cardboard boxes w/shredded paper (FAA)
- ½ full ULD (helps with $O_2$ issues)

- Various ignition locations
- A2N ULD (420 cu ft)




Shredded paper

## Test parameters added by Firetrace

Styrofoam packing peanuts with a battery pack

Lithium batteries added by Firetrace

**Shredded paper may not be a commonly represented fire type, but certainly represents one of the most difficult scenarios to be expected**

# Results

- Detection from 50s to 110s (60s typical)
- Maintains ULD integrity and suppresses the fire for 4 hours or more
- Reduces smoke emissions (yet to be quantified)
- Maintain temperatures to an average of less than 100C other than during ignition spikes
- Complete system weight of less than 50 lbs for A2N ULD (420 cu ft)

## Flammable liquids

- Fuel – n heptane
- Pan size – 2 ½ sq. ft.
- Extinguishment within 30 seconds of discharge

# Summary

- With simple technology, we have demonstrated that even lithium battery fueled fires can be suppressed for extensive periods of time
- Using wireless signaling provides immediate notification of a fire, automates routine maintenance and provides system readiness reporting on demand
- Even an imperfect solution can provide a valuable contribution
- Solutions available today can provide early warning and mitigate an event in progress can make the difference between survival and disaster

QUESTIONS?