

Aircraft Fire Safety R&D: Past, Present & Future

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Federal Aviation
Administration



An Awesome Challenge: *Aircraft Fire Safety (and R&D)*

- **Fire Protection in a Densely Populated and Isolated Cylinder Amid:**
 - Flammable Jet Fuel
 - Plastic Interior Materials and Wiring
 - Passenger Carry-Ons
 - Passenger Stowed Luggage
 - Cargo of all Sorts
 - Declared and Undeclared Hazardous Materials

1980's

R&D Drivers

- Fire Fatalities in Survivable Accidents
- Material Flammability
- Material Smoke (Obscuration) Emissions
- Material Toxic Gas Emissions
- L-1011, Riyadh, 8/80
- DC9, Cincinnati, 6/83
- 737, Manchester, 8/85

R&D

- Seat Cushion Fire Blocking Layers
- Heat Release Rate (OSU) Test Method for Large Surface Area Cabin Materials
- Electrical Wiring Arc Tracking
- Cargo Liner Burnthrough Resistance
- Aircraft Material Fire Test Handbook
- Seat Gasoline Fire Extinguishment (Halon 1211 Hand-Held Extinguisher)
- Floor Proximity Lighting
- Passenger Smoke Hoods (Reexamined)
- Cabin Water Spray
- In-Flight Smoke Venting

Note: Full-Scale Fire Test Facility became Operational in 1980



Saudia L-1011

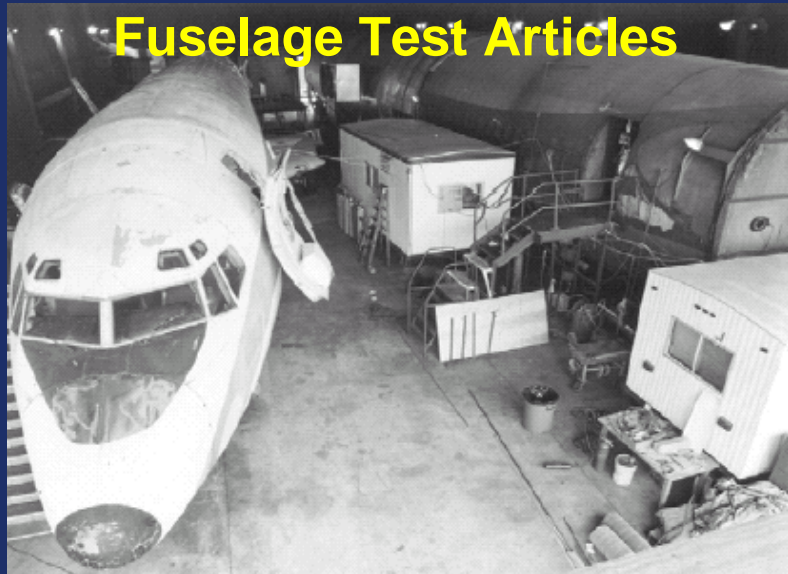
Riyadh, Saudi Arabia; August 19, 1980



Manchester Accident



Full-Scale Fire Test Facility



Seat Fire Blocking Layer Benefits

Fire Test Standard

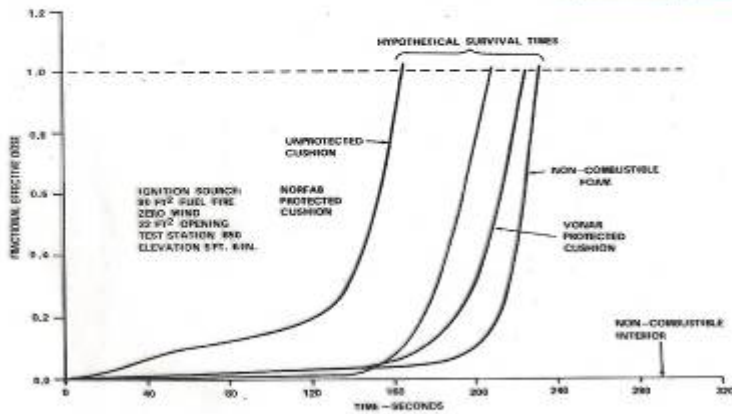
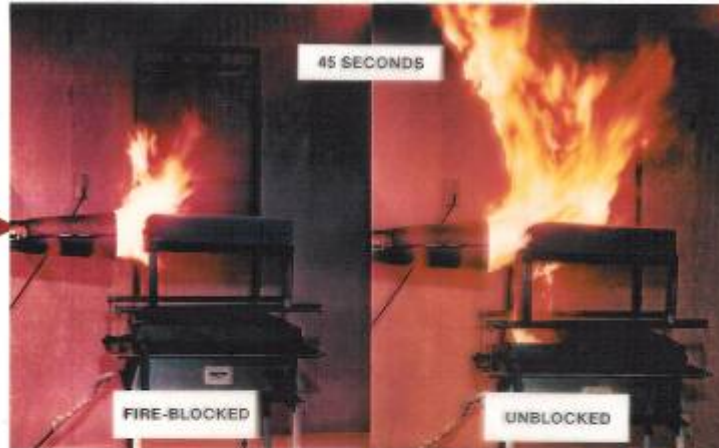


FIGURE 2. EFFECT OF SEAT CUSHION PROTECTION ON FRACTIONAL EFFECTIVE DOSE

Full-Scale Test Benefit



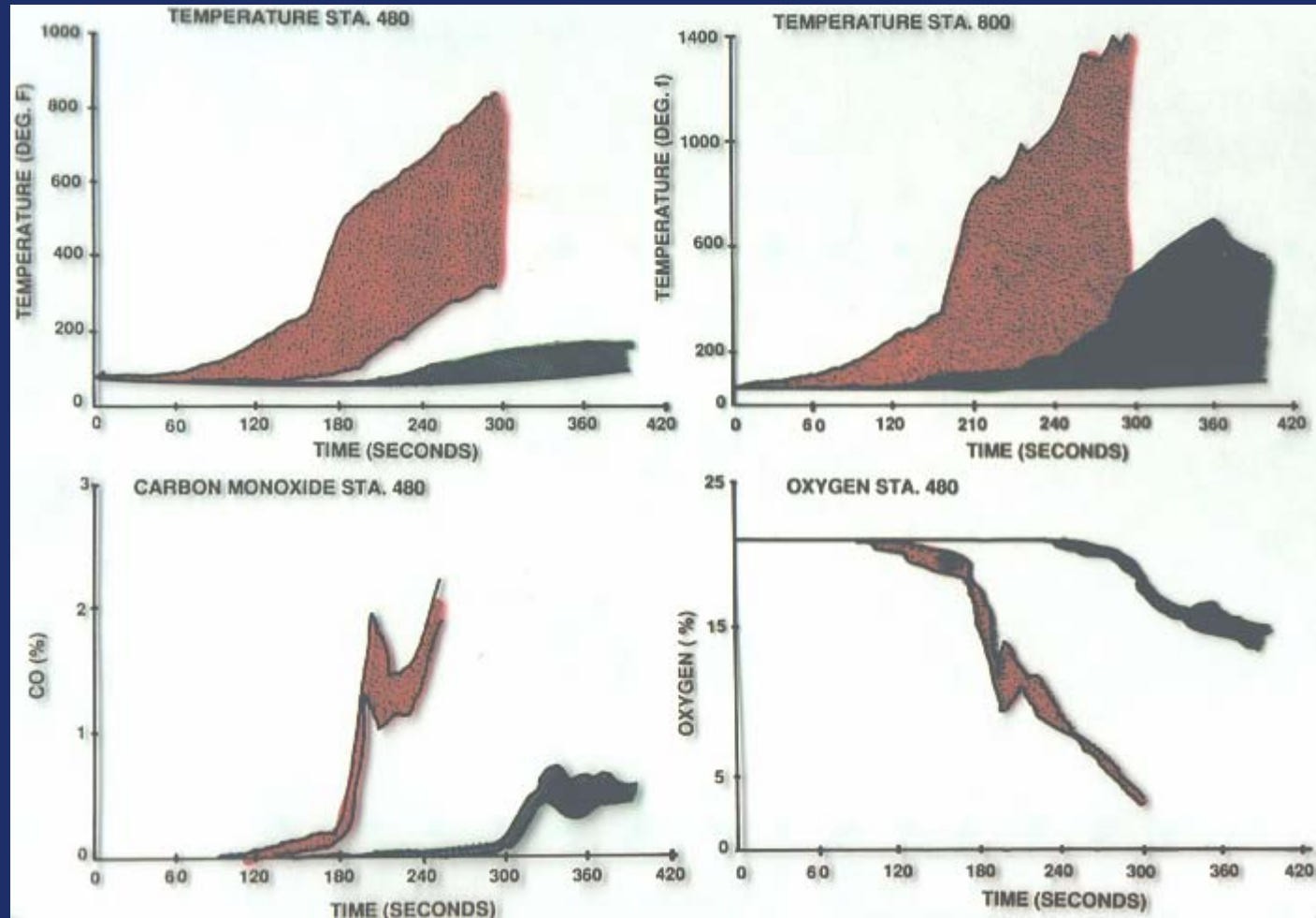
Accident Benefit

Heat Release Rate Test for Cabin Materials



Cabin Water Spray Results (707)

External Fuel Fire/Fuselage Opening/Wind



Red = Standard & Green = Waterspray

1990's

R&D Drivers

- Aviation Safety Research Act of 1988
- Ban on Global Production of Halon (1/94)
- DC9, Everglades, 5/96
- 747, New York, 7/96
- MD11, Nova Scotia, 9/98

R&D

- **Halon Replacement**
- Exploding Aerosol Cans
- **Fuel Tank Flammability**
- **Ground Based Inerting Cost Analysis**
- **Thermal Acoustic Insulation**
 - Radiant Panel Test (In-Flight Fire Ignition Resistance)
 - Oil Burner Test (Postcrash Fire Burnthrough Resistance)
- Flight Data Recorders Fire Resistance
- Aircraft Command in Emergency Situations (ACES)
- **Fire Research Program (Ultra-Fire Resistant Materials)**

Trans World Airlines

Boeing B747-131; July 17, 1996

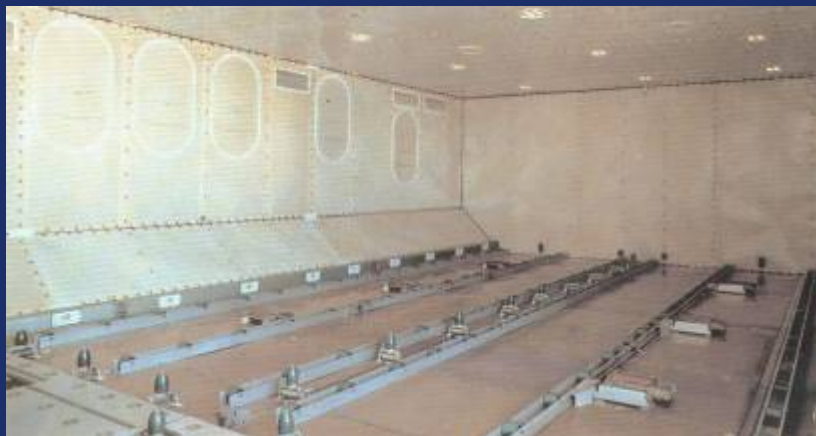


Swiss Air MD-11

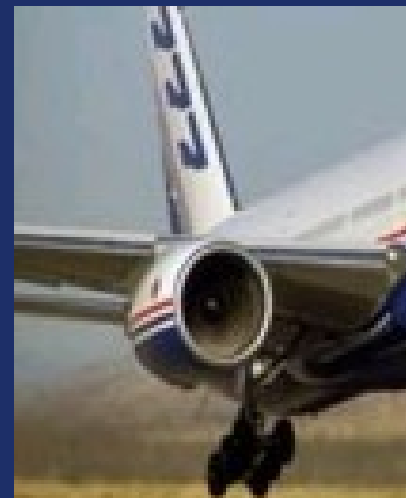
Peggy's Cove, Nova Scotia; September 2, 1998



Current Usage of Halon 1301/1211



Cargo Compartments



Engine Nacelles

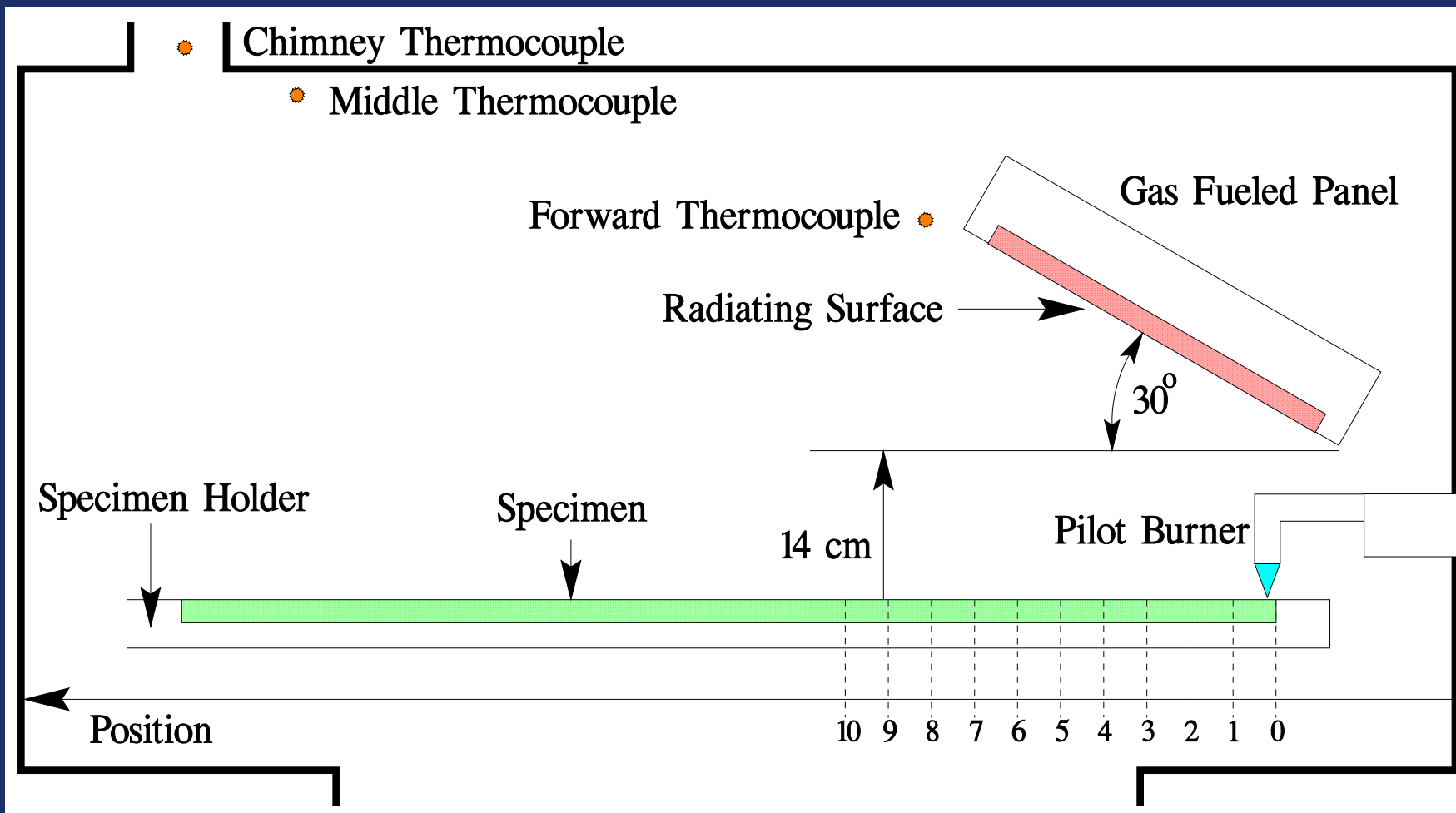


Hand Held Extinguishers

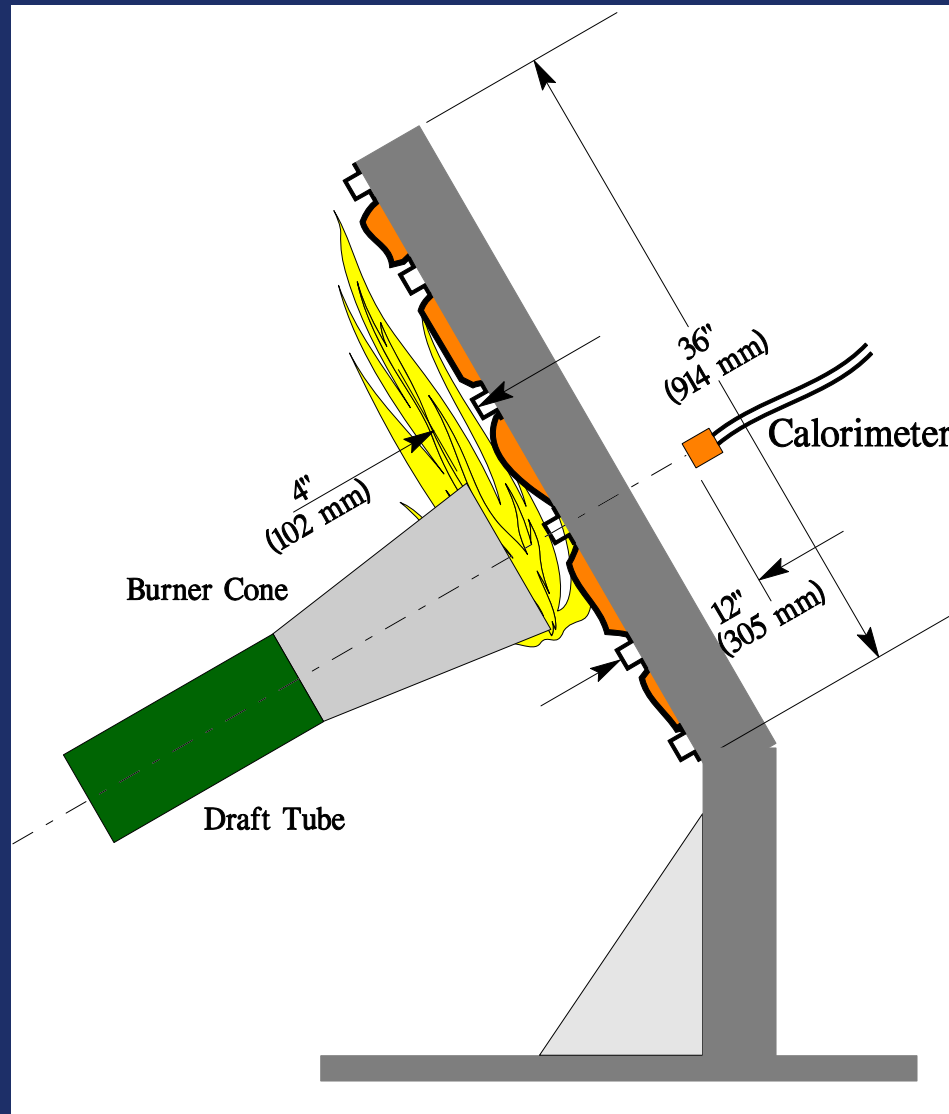


Lavatory Trash Receptacles

Schematic of Radiant Panel Test Apparatus



Burnthrough Test Apparatus



2000's

R&D Drivers

- NTSB & TSB Accident-Related Recommendations
- Composite Transport Aircraft (B787)
- Halon Replacement Activities
- 737, Bangkok, 3/01
- DC8, Philadelphia, 2/06
- 747, Dubai, 9/10

R&D

- Insulation Advisory Circulars
- Next Generation Burner
- Improved Fire Tests for Ducting and Wiring
- On-Board Inerting System (OBIGGS)
- Limiting Oxygen Concentration
- Composite Fuselage and Wings
- Magnesium Seat Structure
- Lithium Battery Fire Hazards
- Freighter Fire Suppression
- Halon Replacement
- Fire Research Program



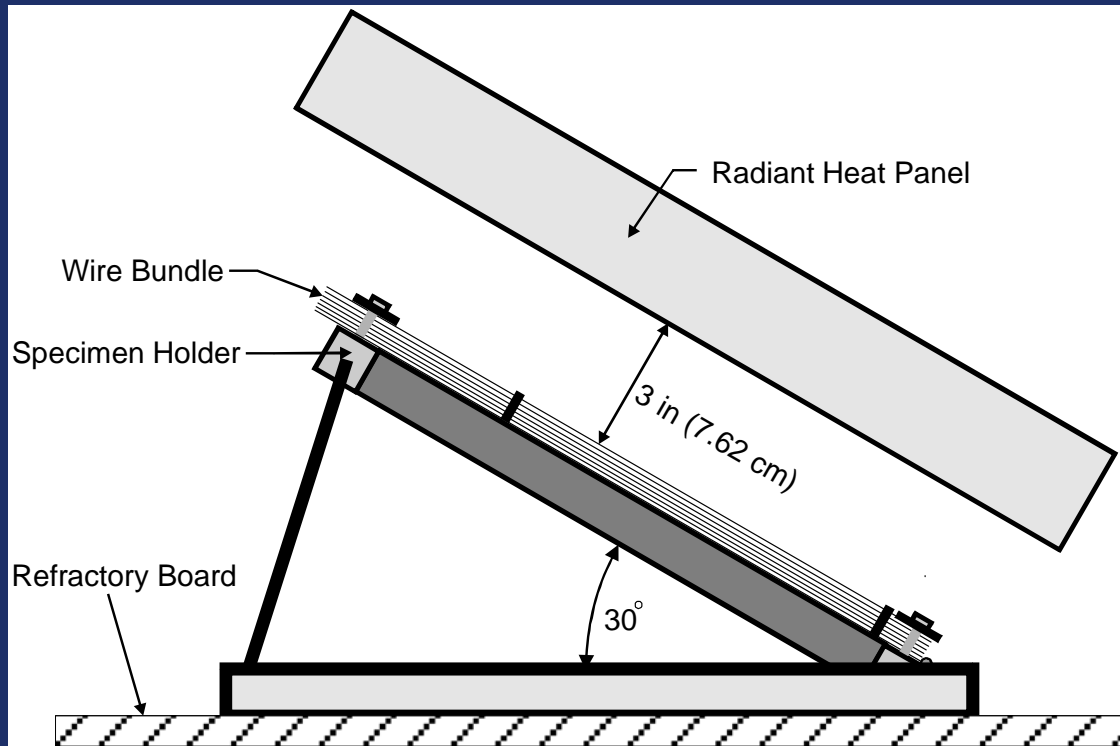
UPS DC-8
Feb. 7, 2006
Philadelphia, PA



NTSB Recommendation to the FAA

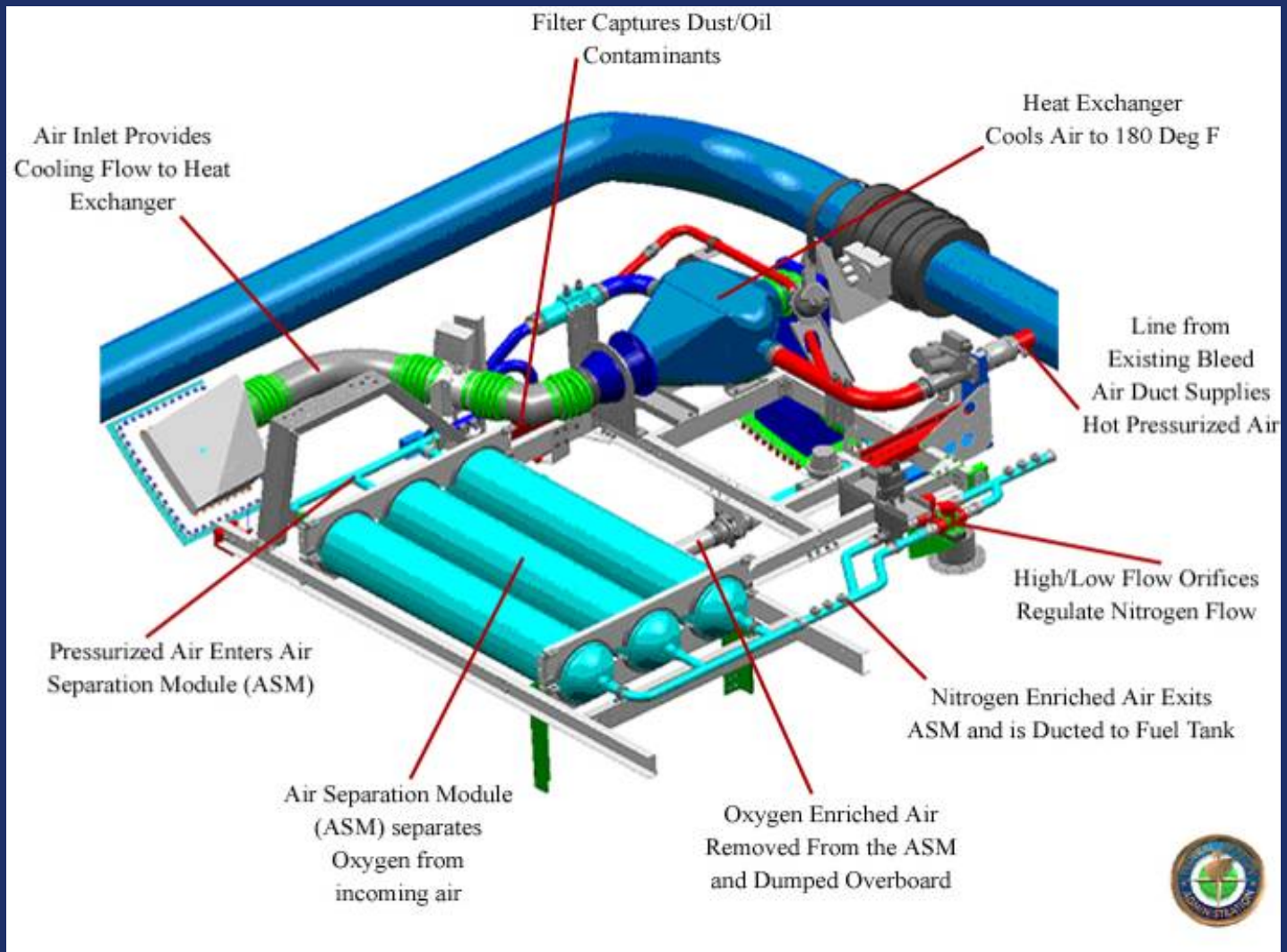
“Require that fire suppression systems be installed in the cargo compartments of all cargo airplanes operating under 14 *Code of Federal Regulations* Part 121. (A-07-99)”

Test Apparatus



- On this horizontal surface, place the specimen holder so that the wire bundle specimen is $3 \pm 1/16$ (7.62 ± 0.16 cm) inches away from the radiant heat panel and clears the pilot burner.

Schematic of On-Board Inert Gas Generation System (OBIGGS)



Full-Scale Test Results, Structural Composite System *Post-Test*



Lithium-Ion Batteries

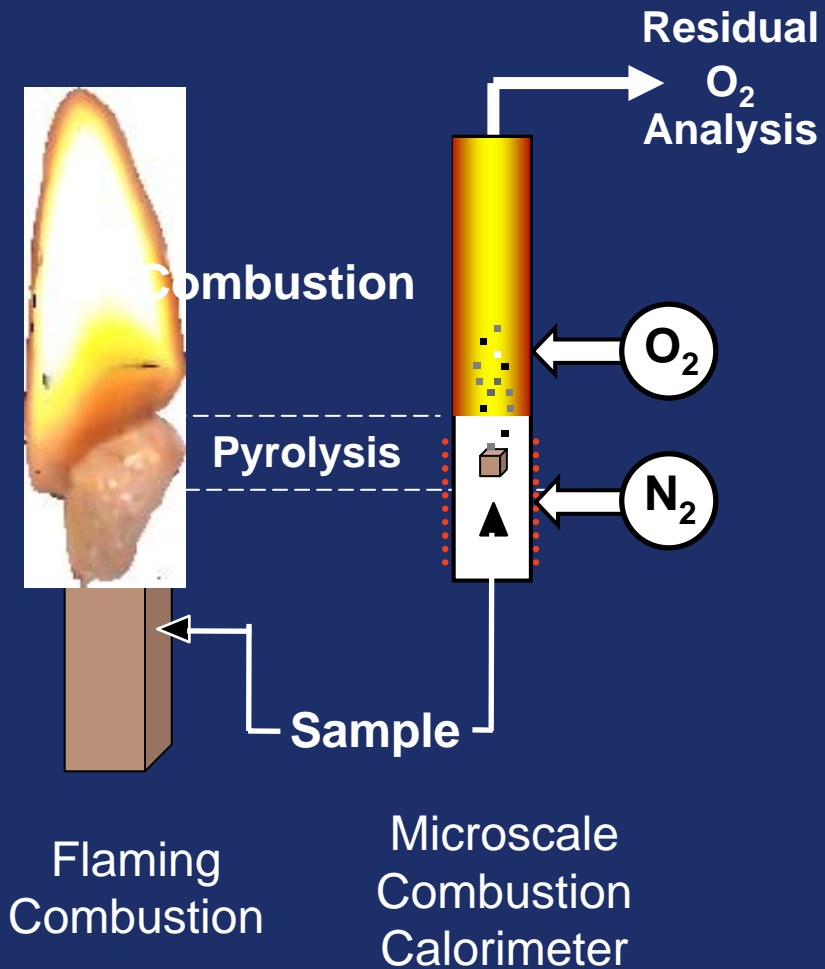


**Bulk Load Configuration
before Testing**



**Bulk Load Configuration
after Testing**

Microscale Combustion Calorimetry Reproduces Elements of Flaming Combustion in Non-flaming Laboratory Test



2010's?

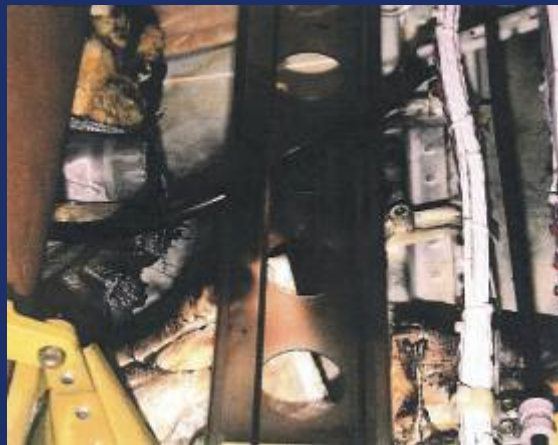
- **Freighter Fire Suppression**
- **Lithium Battery Safety**
- **Hidden Fire Detection and Extinguishment**
- **Halon Replacement**
- **Material Flammability FAR's Improvement**
- **Powerplant Flammability Standardization**
- **Fire Research (Long Range)**
- **Oxygen Systems**

COMPLACENCY

- **Complacency is a Concern**
- **Major Reduction in Accident Rate Tends to Promote Status Quo**
- **Accident Statistics can be Misleading**
- **Aircraft Fire Safety Merits Continuous Improvement Because of Ever Present Potential**



Cabin Fire Caused by Lightning Strikes



Boeing 757

*Copenhagen, Denmark
11/15/2000*

**Two
Weeks
Later**



American MD-80

*Dulles Airport
11/29/2000*

SUCCESS

Pursue Improvements that are
PRACTICAL and COST/BENEFICIAL

Cooperation ...
Cooperation ...
Cooperation.