

# Flight Deck Smoke Penetration Testing



Federal Aviation  
Administration



Presented to: Systems Working Group Meeting  
Bremen Germany

By: Robert Morrison, FAA Technical Center Fire Safety  
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# Overview

- Basically a quick overview and an update of the December 2013 Systems Meeting presentation
  - Test article reconstruction still underway
- Objective is to determine if current flight deck smoke penetration certification testing is adequate.
- We are finishing interim smoke penetration testing on Fire Safety's 727 freighter main cargo deck.
- Results from the interim 727 smoke test data will be used to configure the main deck and both forward and aft cargo compartments of Fire Safety's 747SP aircraft for smoke testing.
- Test conditions will include smoke penetration tests using each individual pack selections. (i.e. only pack1, only pack2, and only pack 3)

# Background

- Our target was to mimic a Class E 4800 lithium primary battery fire test that took as little as 16 minutes to completely obscure the flight deck. (Harry Webster's May 1, 2013 Lithium Battery Test)
- Configured 727 cabin for smoke certification test per (AC25-9A)
  - 18" hand to eye visibility requirement
- Two test procedures chosen, one with an FAA developed Helium-injected smoke box (adds buoyancy) and the other without.
- Previous testing revealed corrosion problems with our aging and broken Rosco 1500 Pro theatrical smoke generators
  - Replaced with Rosco 1700 units (1500 pro equivalent)

## Aircraft Test Configuration

- Emergency mode with no airflow to main cabin
- Max air flow into ECS plenum feeding the flight deck.
- Outflow valves set to maintain .1 PSI differential

# Interim Fire Safety 727 Test Results

## Stand alone Rosco 1700

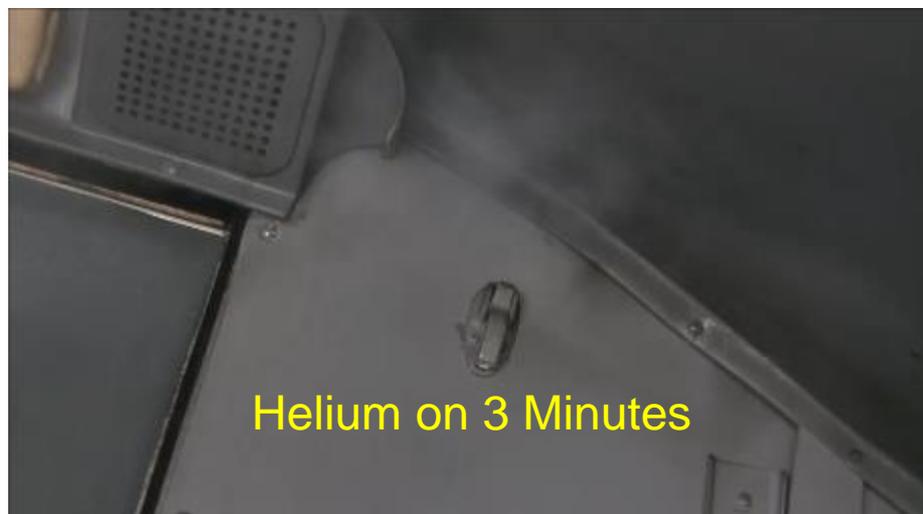
- No visible smoke in flight deck

## Helium-injected Rosco 1700 theatrical smoke generator

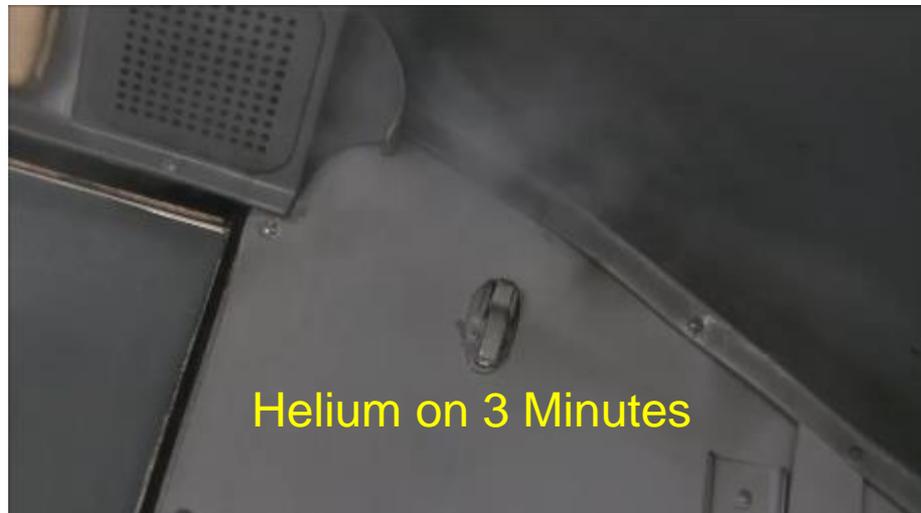
- 50/50 Helium/Air mix, giving equivalent buoyancy properties of air heated to 490°F
  - Faint wisps of smoke coming in at rear bulkhead ceiling area above the flight deck door, smoke cleared with no measurable reduction in visibility
- 70/30 Helium/Air mix, giving equivalent buoyancy properties of air heated to 940°F
  - Visible smoke in flight deck after 3 minutes from helium injection.
  - Light to medium obscuration at end of 20 minute test.



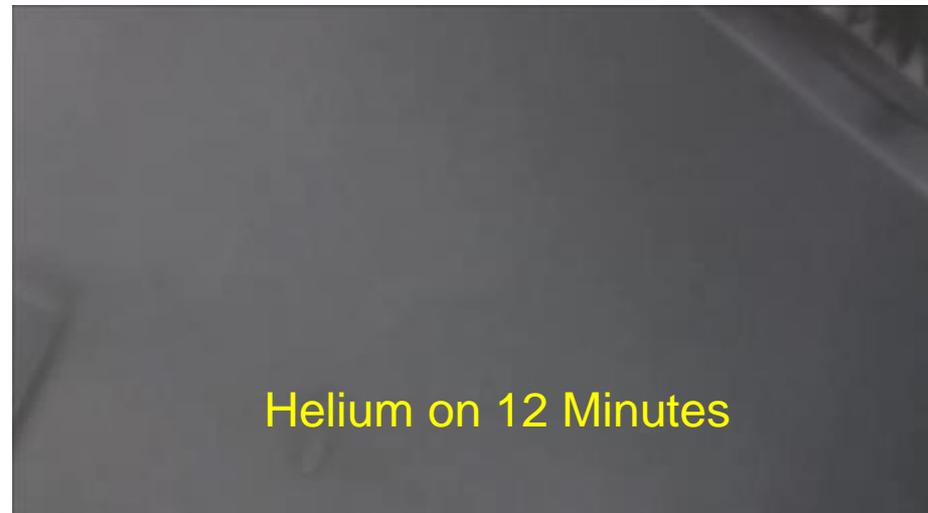
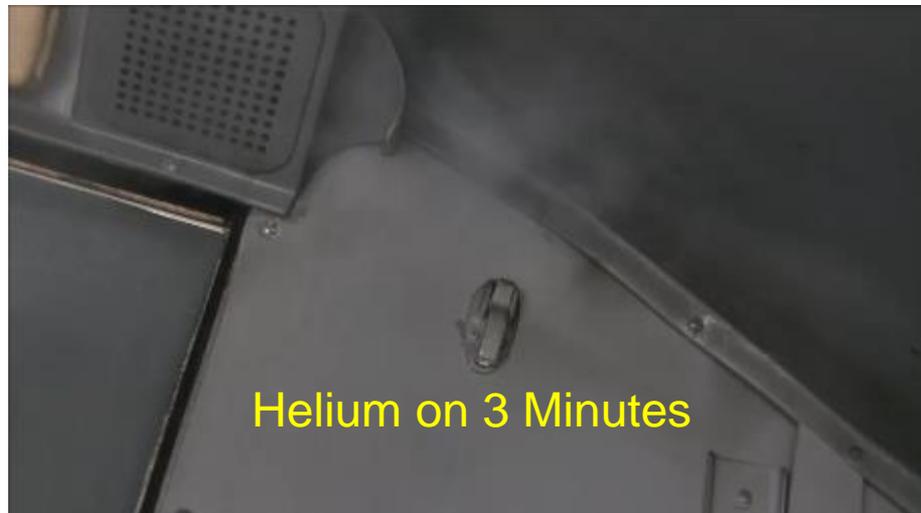
# Interim Fire Safety 727 Test Results



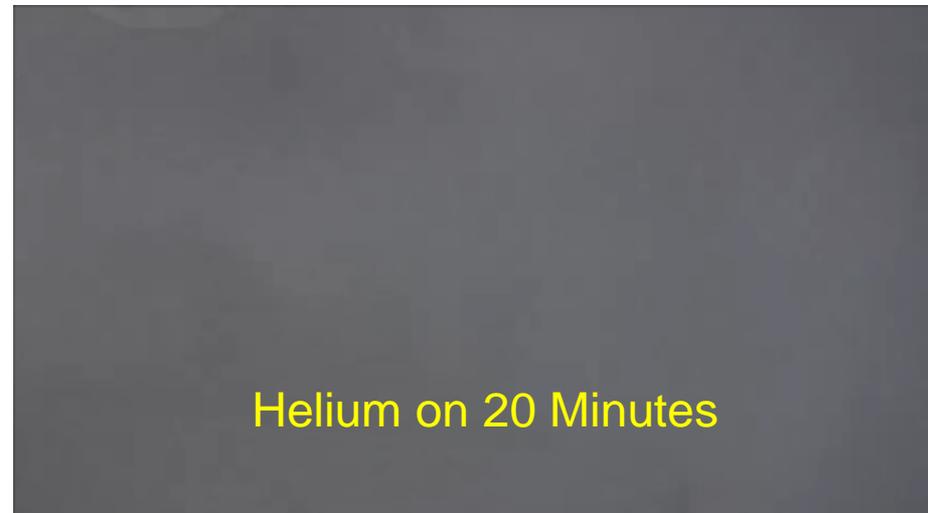
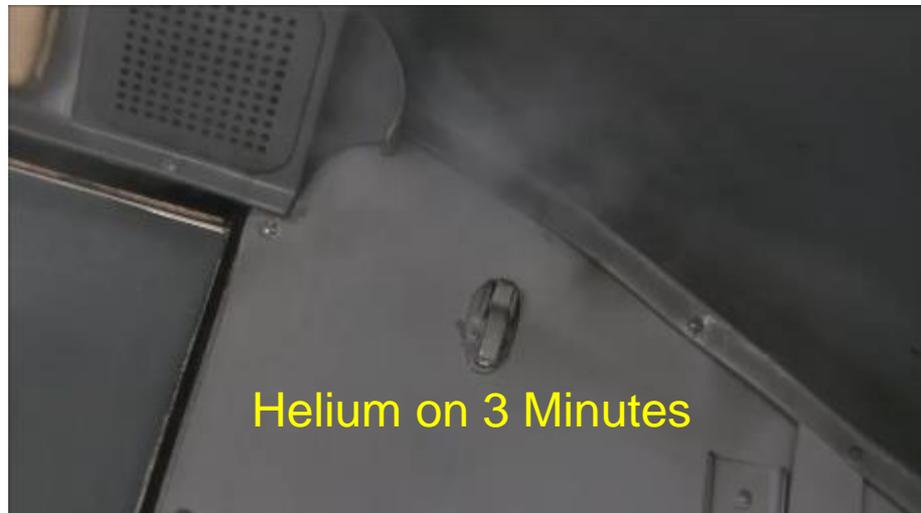
# Interim Fire Safety 727 Test Results



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# Interim Smoke Penetration Testing

- A retest is required due to the failed recording of the reduction of light transmissibility parameter on the 70/30 Helium/Air mix test.
- Before the retest could be accomplished, the final lithium primary battery test (test 10 of 10) was run and resulted in an explosion in the Class C cargo/ECS compartment which blew out a 20 x 10 section of the floor and ruptured all under floor ECS ducting.



# Current Status

- The overhead air conditioning duct network in the main cargo area has been replaced
- The flight deck bulkhead has been reconstructed
- The forward cargo compartment is being repaired and the lower air conditioning duct system is being installed



# Planned Work

- Restore Fire Safety's 727 ECS and forward cargo areas for testing
- Retest the 70/30 Helium/Air mix smoke penetration scenario using a Helium-injected Rosco 1700 theatrical smoke generator
  - Measure the reduction in light transmission in the main cabin and the flight deck
- Compare pre & post explosion video files.
- Discuss results with Transport Airplane Directorate before reconfiguring the 747SP for testing.

Contact Info & Questions: [robert.morrison@faa.gov](mailto:robert.morrison@faa.gov) (609) 485-4507

