

# Flight Deck Smoke Penetration Testing



Federal Aviation  
Administration



Presented to: Systems Working Group Meeting  
Atlantic City, New Jersey

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# Overview

- Objective is to determine if current flight deck smoke penetration certification testing is adequate for freighter aircraft.
- Show data from interim smoke penetration testing accomplished on Fire Safety's 727 freighter flight deck.
- Discuss reconfiguring Fire Safety's 747SP aircraft for Flight Deck smoke penetration testing producing smoke from the upper deck, main deck forward cabin, and both forward and aft cargo compartments.
- Test conditions will include smoke penetration tests using singular packs only (pack1, pack2, and pack 3 separately)

# 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)

## B727-200F Aircraft Test Configuration

- Configured 727 cabin for smoke certification test per (AC25-9A)
- Two smoke penetration test methods chosen
  - Rosco 1700 theatrical smoke generator
  - FAA developed Helium-injected Rosco 1700 theatrical smoke generator
- 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
  
- August 14, 2013 testing revealed smoke penetrating into the Flight Deck in as little as 3 minutes; obscuration in 6 minutes
- No light transmission/smoke meter data collected



# Background

## Method 1 - Stand alone Rosco 1700

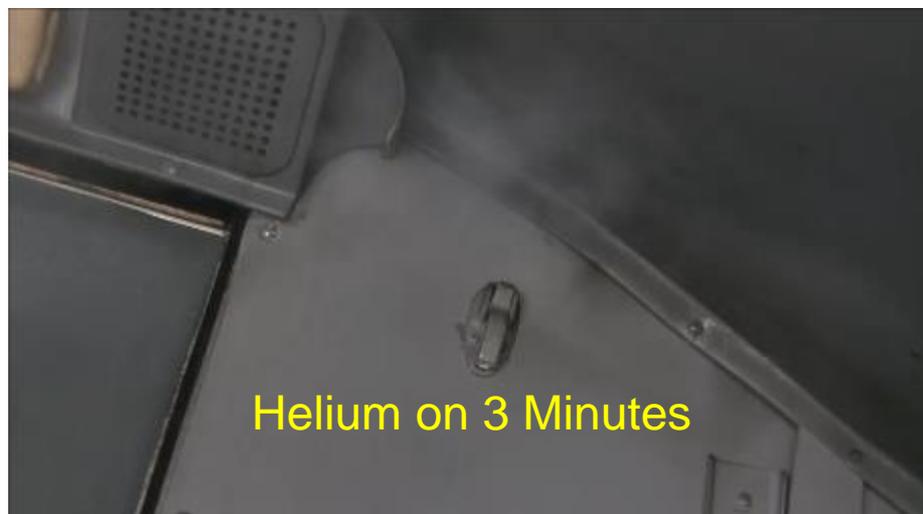
- No visible smoke in flight deck

## Method 2 - Helium-injected Rosco 1700 theatrical smoke generator

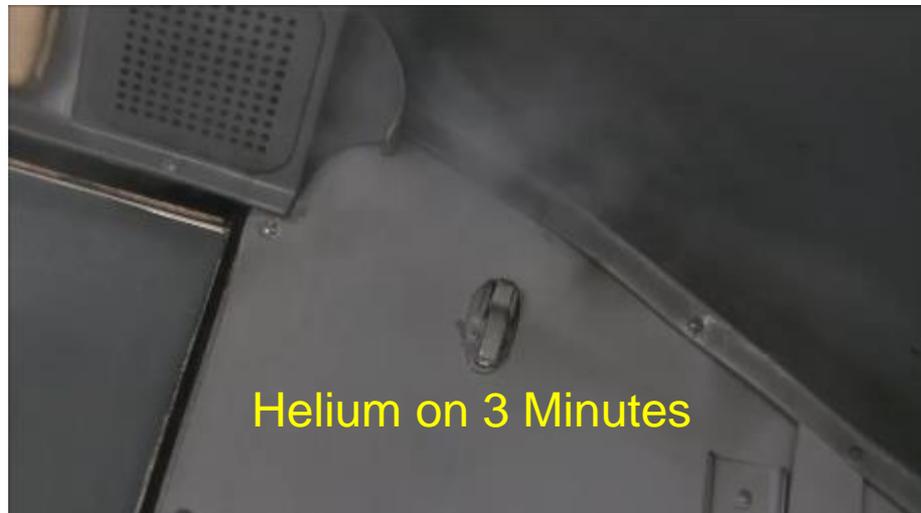
- 50/50 Helium/Air mix, giving equivalent buoyancy properties of air heated to 490°F
  - Faint wisps of smoke coming in at rear bulkhead ceiling area above the flight deck door, smoke cleared with no measurable reduction in visibility
- 70/30 Helium/Air mix, giving equivalent buoyancy properties of air 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.



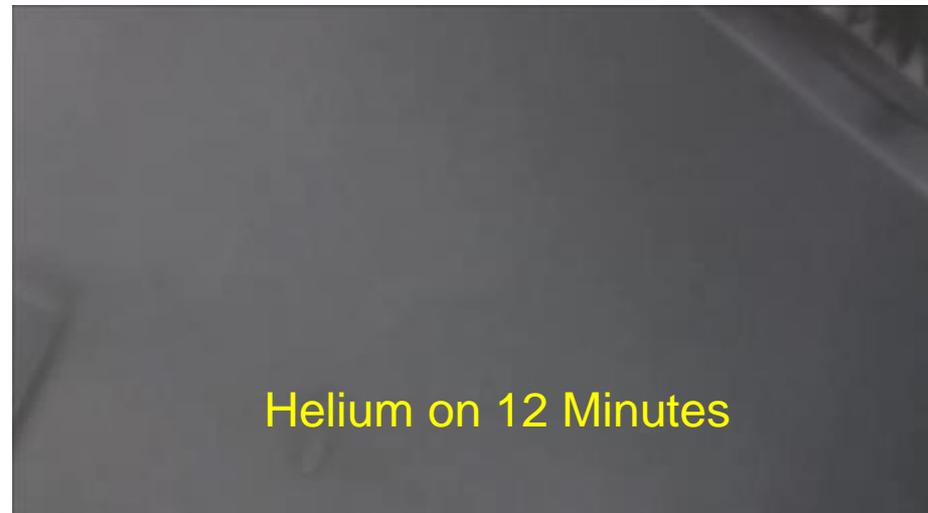
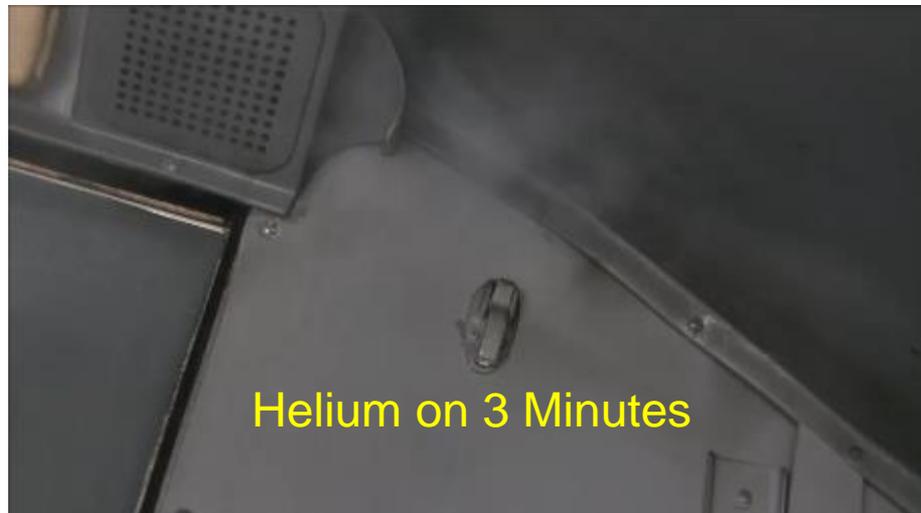
# Interim Fire Safety 727 Test Results



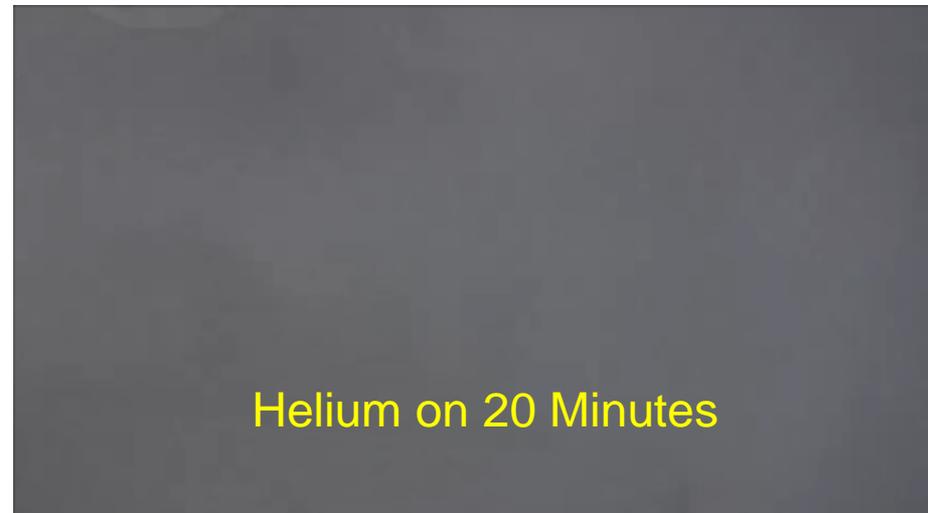
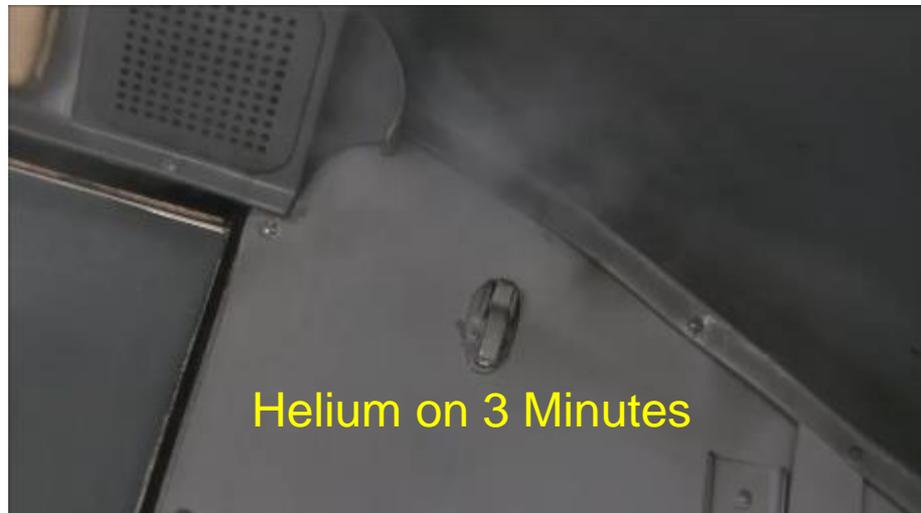
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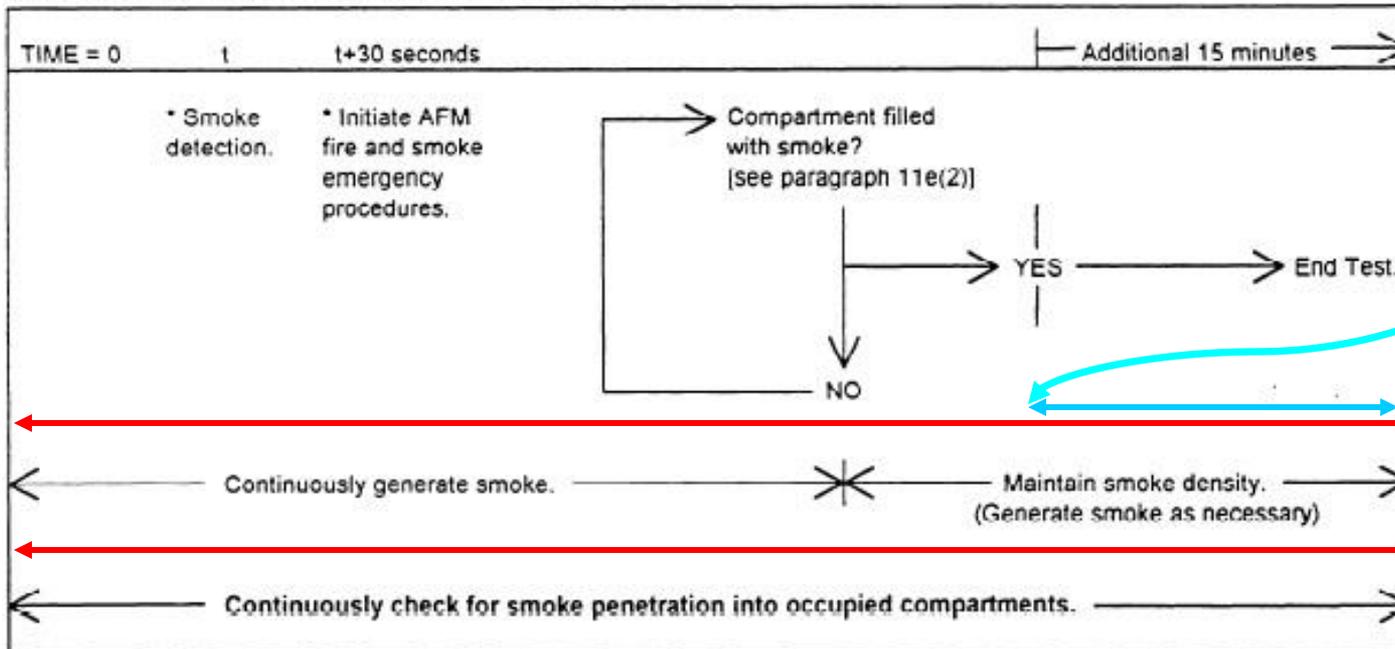
# Interim Fire Safety 727 Test Results



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- Method 1  (2) stand alone Rosco 1700 theatrical smoke generators  
 Method 2  Same as Test type 1 but adds Helium into Rosco #1's Smoke stream

## Smoke Penetration Test Procedure



\* If compartment is equipped with a smoke detection system.

NOTE: This test procedure is not intended to show compliance with the requirements of § 25.857, § 25.858, and § 25.1301 as they relate to smoke detection.

Observe that a light haze or stratified haze does not form

# Interim Fire Safety 727 Test Results

Sept 16, 2014, - Helium Set at 80 psi



17 Minutes - 100 %



21.5 Minutes - 95 %



26 Minutes - 90 %



Flight Deck Smoke Penetration  
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# Interim Fire Safety 727 Test Results

Oct 1, 2014, - Helium Set at 240 psi



8 Minutes - 100 %



12 Minutes - 90 %

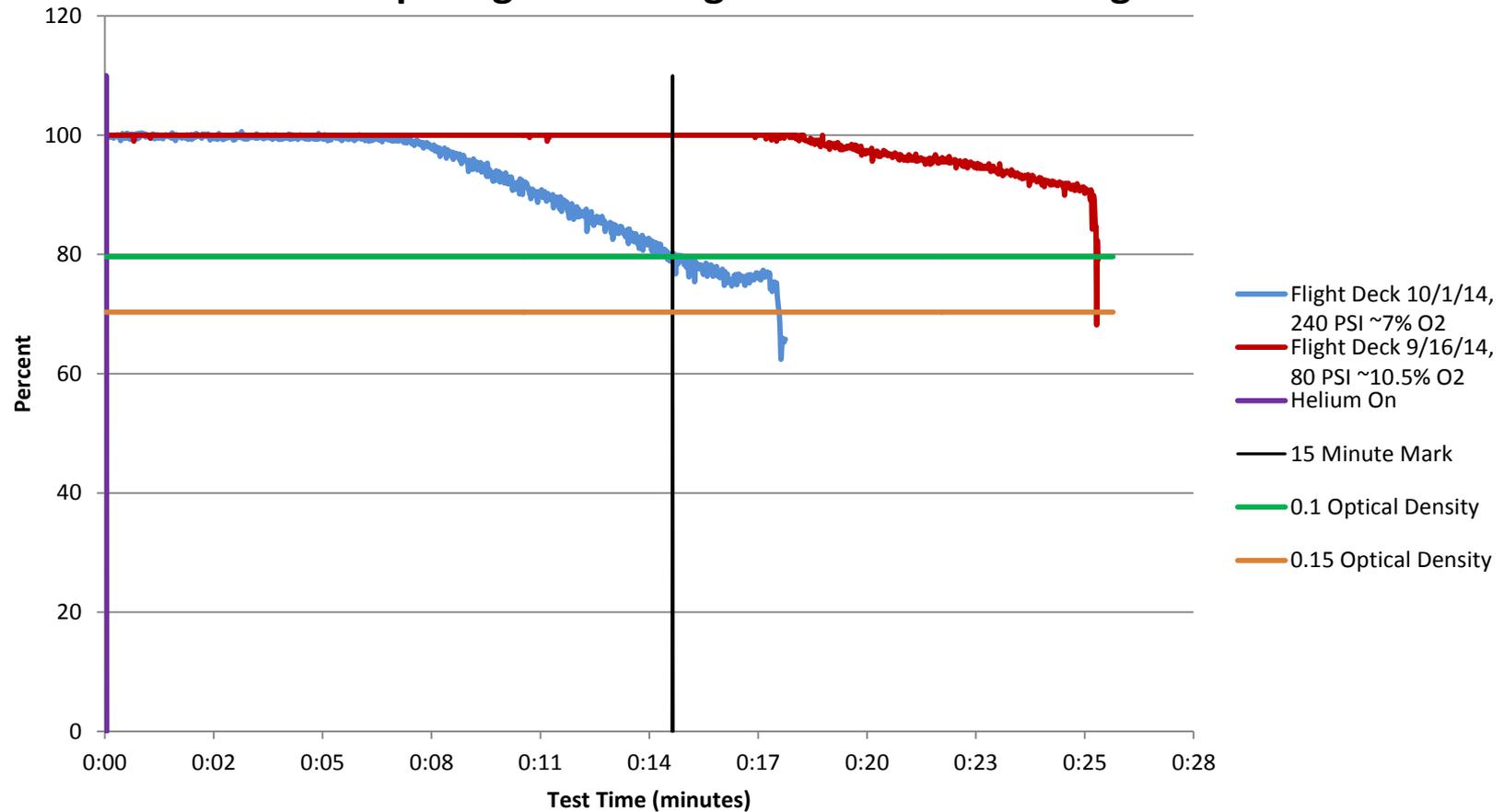


15 Minutes - 80 %



# Interim Fire Safety 727 Test Results

## B727-200F Smoke Penetration Test Comparing Percent Light Transmission in Flight Deck



# Planned Work in 747SP

- Move all test equipment from Fire Safety's 727 to 747SP aircraft
- Increase the Helium tank supply and develop manifold system
- Configure 747SP for Emergency Mode ECS operation
- Install Instrumentation in Flight Deck
  - Measure the reduction in light transmission in the Flight Deck & Main Cabin
  - Measure and adjust Flight Deck pressure differential to .1 psi



# Planned Work in 747SP

- Prepare for single A/C pack comparison test
  - Each pack test series will include running the Helium-injected Rosco 1700 theatrical smoke generator in the Upper Cabin, Main Deck Forward Cabin, and Forward and Aft Cargo Compartments
  - Additional tests will be conducted under the above conditions but with varied areas of cargo liner removed for the below floor tests.



Upper Cabin



Forward Cabin



Aft Cargo

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