Feasibility of Using Nitrogen Enriched Air for Fire Protection in Inaccessible Areas in Aircraft

Federal Aviation Administration

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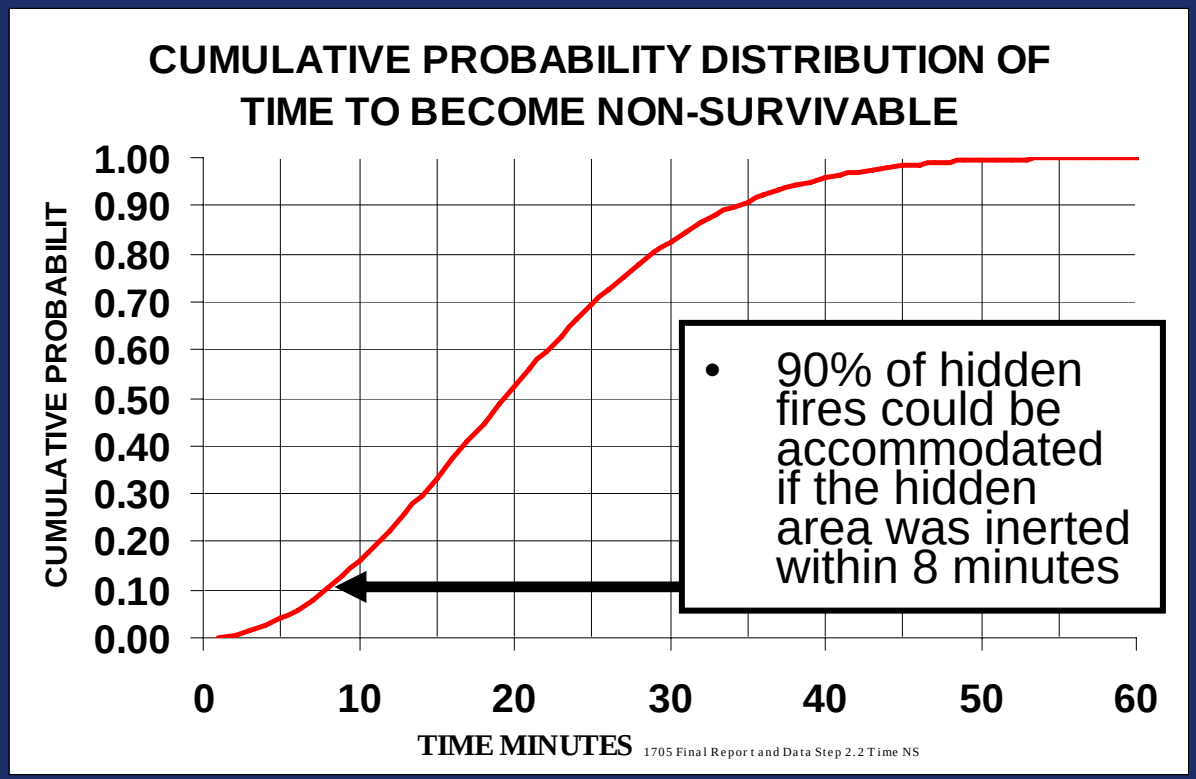
Background

- The FAA recently has released an NPRM requiring the reduction of flammability within heated fuel tanks (affecting over 3,200 in service aircraft)
- The most likely method of conformance is the utilization of an On Board Inert Gas Generating System (OBIGGS)

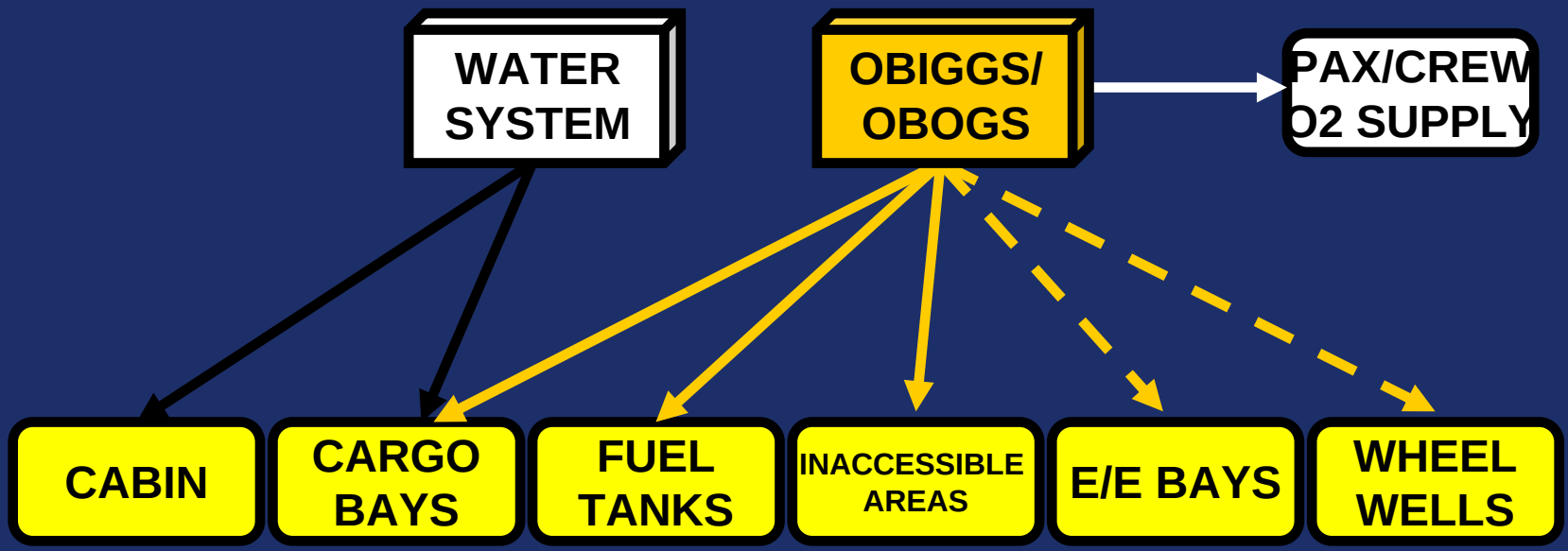
Background

- CAA Paper 2002/01 (FAA Reference DOT/FAA/AR-02/50) determined that 90% of non-survivable hidden area fires could be prevented if extinguished within 8 minutes



Background

- With inerting systems now/soon to be on board, an integrated fire protection system to provide protection for these hidden areas may be feasible
- Such a system would provide enhanced fire protection while utilizing a system already installed, thus saving on cost, weight and space on board the aircraft



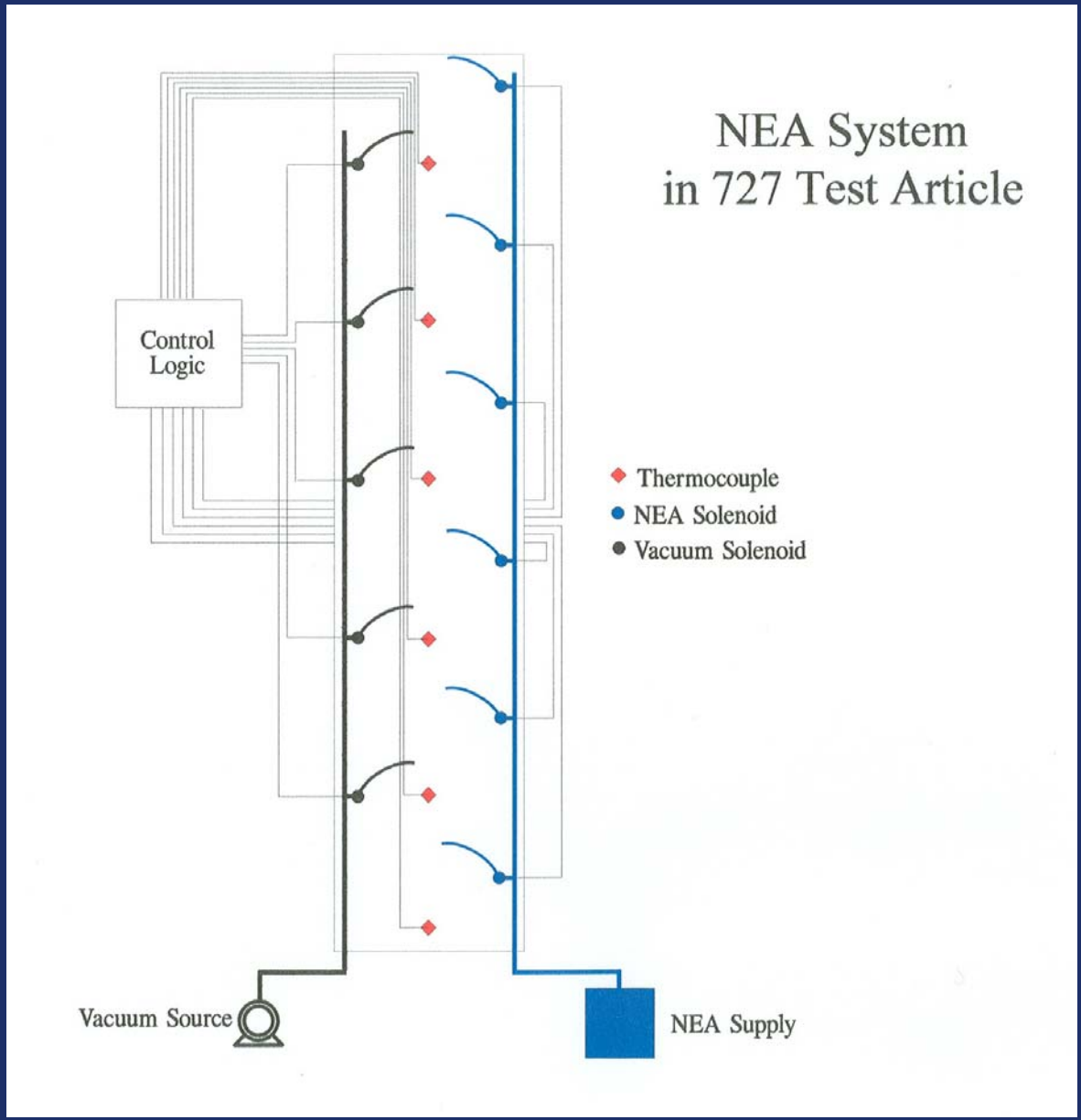
OBJECTIVES

- Design and install an NEA distribution system for fire protection of the overhead area of the FAAs 747SP, 727 and 737 test articles
- Examine the effectiveness of OBIGGS to extinguish fires existing in overhead areas
- Examine the effect of various conditions on the ability of the OBIGGS to successfully protect the overhead area:
    - Bleed air pressure
    - OBIGGS feed pressure
    - OBIGGS back pressure
    - Permeate pressure (altitude)
    - Ventilation
    - Etc.
- Future work may include expanding the OBIGGS system to other hidden areas aboard the aircraft (E/E bays, wheel wells, etc.)

Limiting Oxygen Index Data

Material	Limiting Oxygen Index
Polyurethane Foam	16.5
Polyethylene	17.4
Epoxy resin	19.8
Phenolic resin	21
Nylon	25
Neoprene	40
Polycarbonate (Lexan)	27
Cardboard	24.7

Theoretical minimum oxygen concentrations to sustain combustion of solid fuels are in the range of 12.5% to 13.5%.

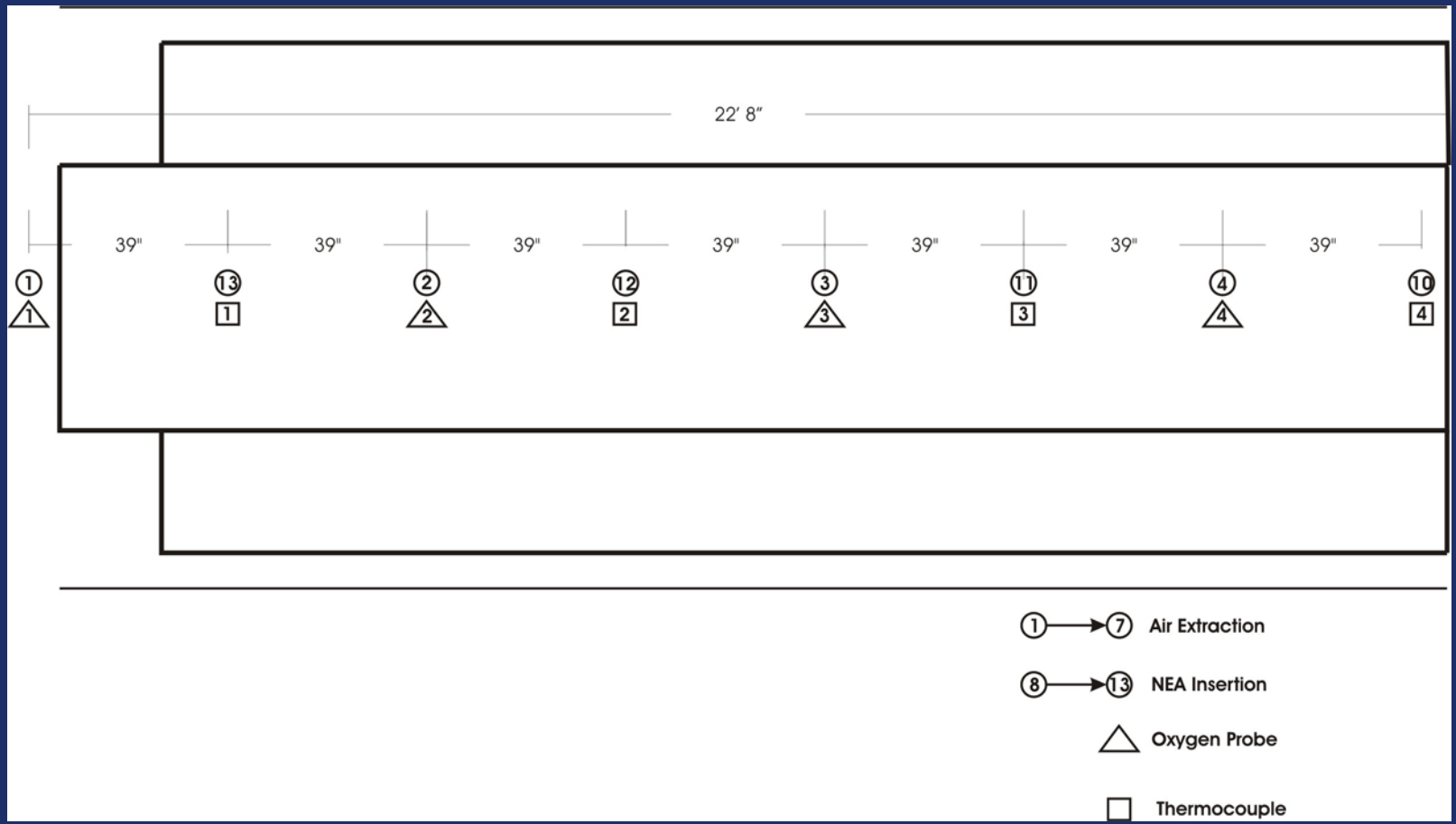

NEA System
in 727 Test Article
Control
Logic
Thermocouple
NEA Solenoid
Vacuum Solenoid
Vacuum Source
NEA Supply

NEA Source

NEA (blue) and vacuum (red) lines attached to 727 fuselage

727 Interior cabin ceiling mockup

727 Instrumentation in area of cabin ceiling mockup

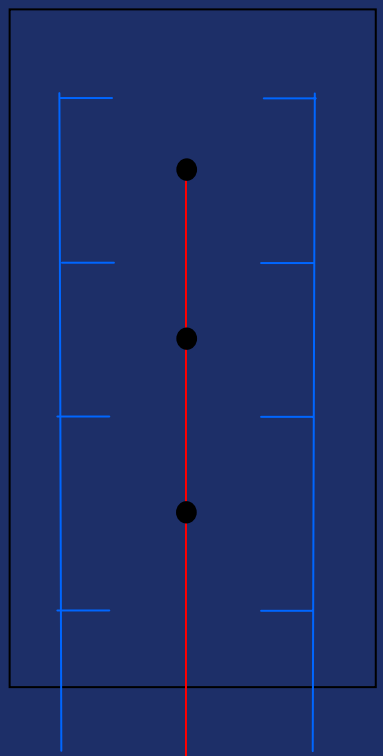


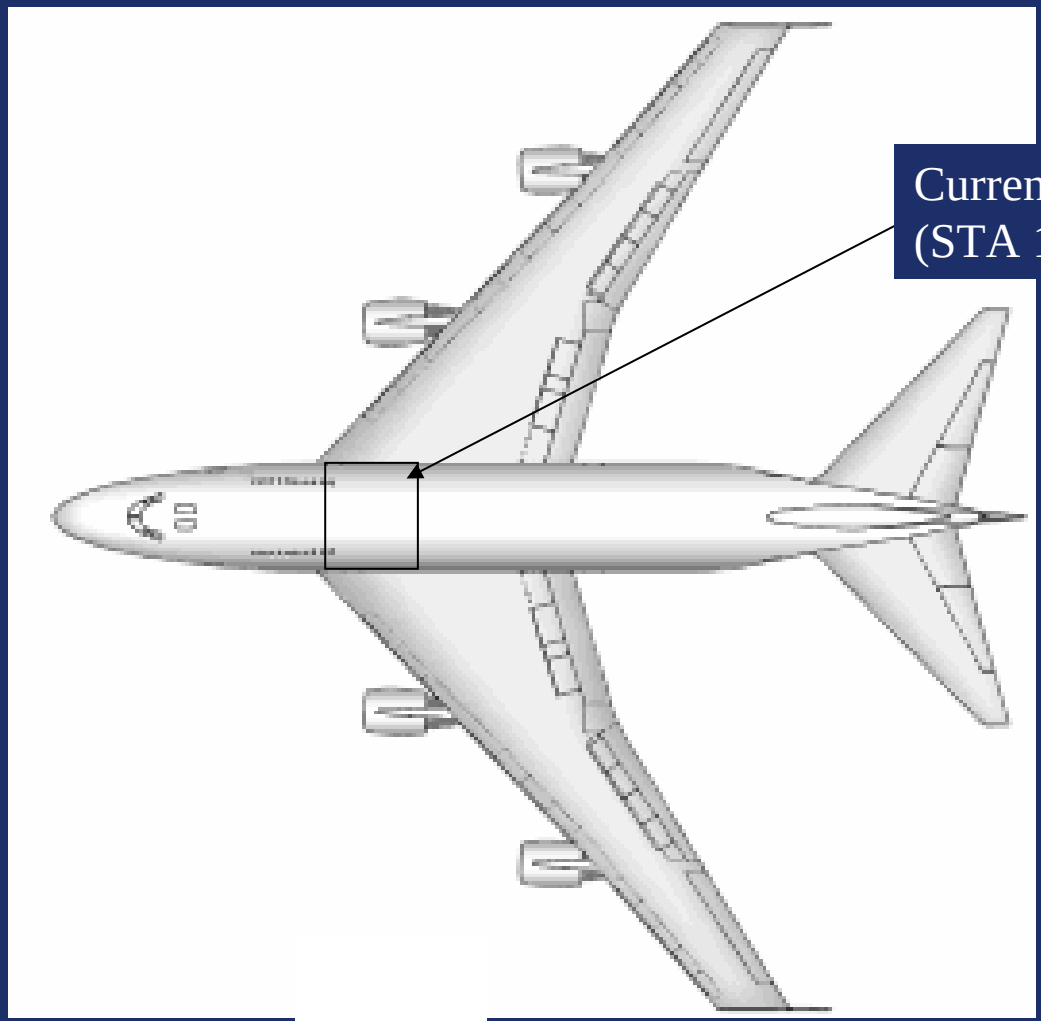
737 & 747SP TEST ARTICLES

- 747SP equipped with OBIGGS installed in the empty pack bay utilizing up to 6 ASMs
- 737 aircraft in process of being equipped with a single ASM OBIGGS

- Instrumentation allowing for monitoring of oxygen at 12 locations in overhead area of each aircraft
- NEA flow and purity also measured as well as various system pressures

TEST CONFIGURATION – 747SP

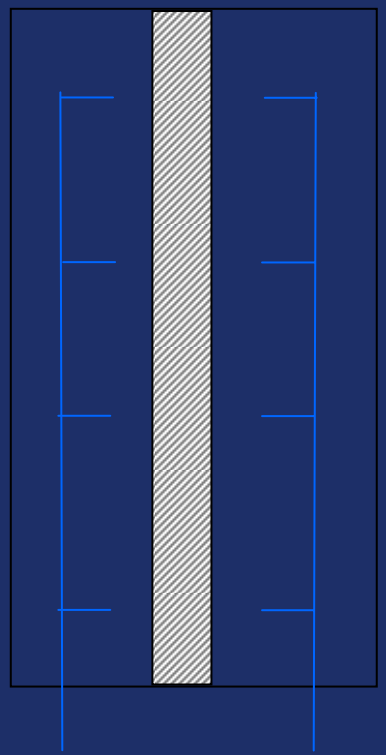


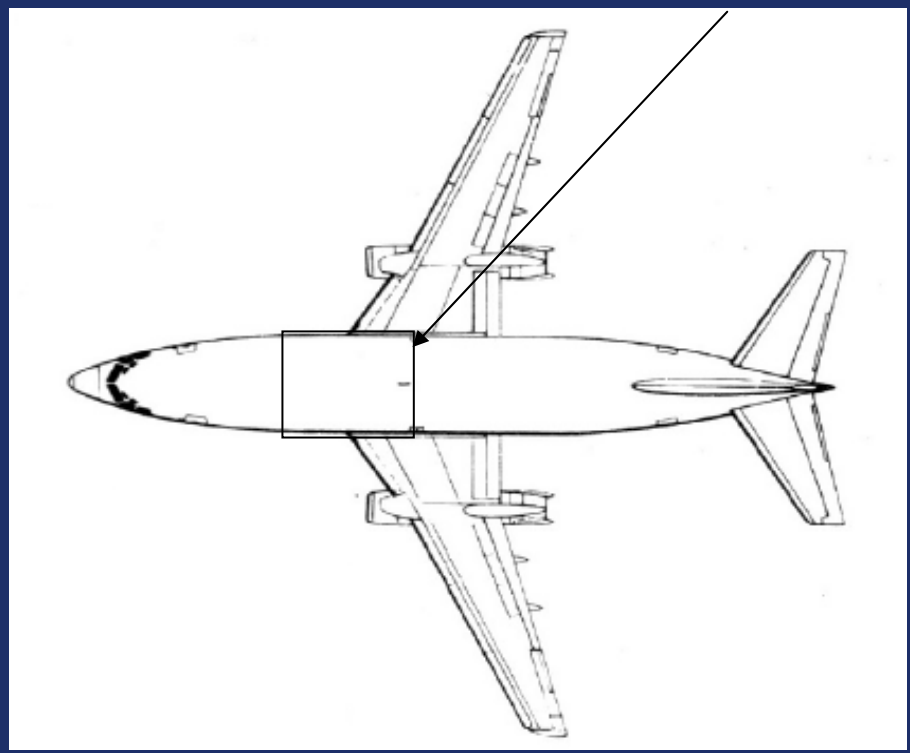


TEST SECTION – 747SP

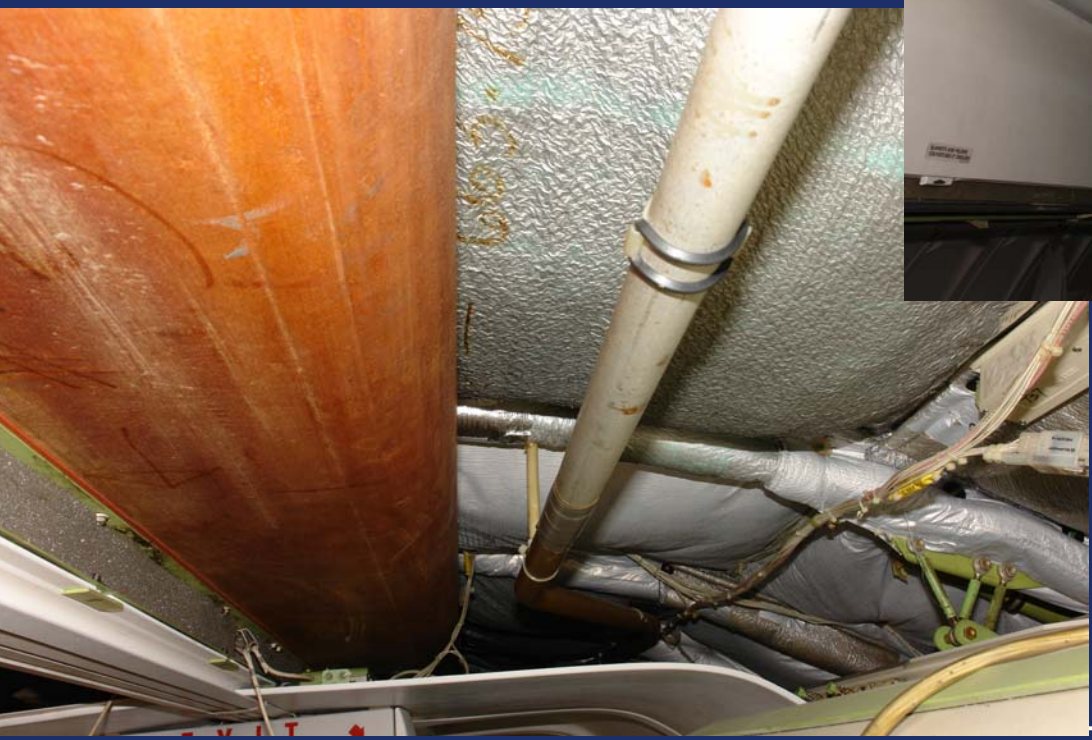
- Located at approximately STA 1241
- Approximately 20 ft. wide, 5 ft. tall at center
- Cross-sectional area of approximately 42 ft^2

TEST CONFIGURATION – 737





TEST SECTION – 737



- Approximately 9 ft. wide, 10 in. tall at center
- Cross-sectional area of approximately 3 ft^2

Planned Activities

- Determine flow rate and oxygen concentration of NEA needed to inert the attic space in a narrow body fuselage.
- Preliminary testing on 747SP with a single NEA deposit location has confirmed the need for a vacuum source (or other method) to control the spread of NEA
- OBIGGS and test instrumentation build up on 737 is underway