



# Dispersion Characteristics of $\text{CF}_3\text{I}$ in APU Applications

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# CF<sub>3</sub>I vs Halon 1301

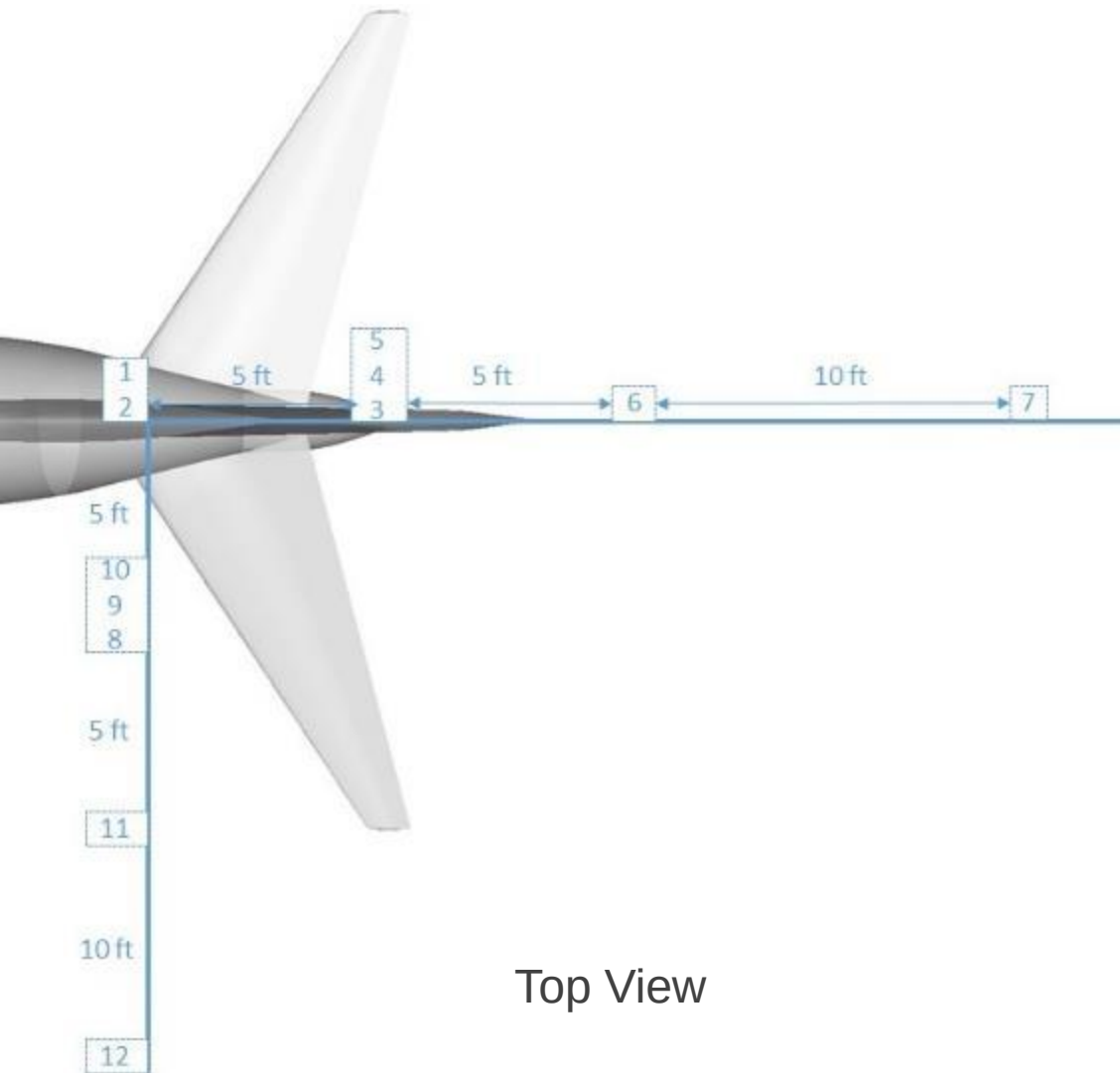
| Agent             | Formula            | Boiling Point | Molecular Weight | MPSE Concentration Requirement | Storage Density         | SNAP Status |
|-------------------|--------------------|---------------|------------------|--------------------------------|-------------------------|-------------|
| Halon 1301        | CF <sub>3</sub> Br | -71F          | 148.91           | 6% by volume                   | 96 lbm/ft <sup>3</sup>  | N/A         |
| CF <sub>3</sub> I | CF <sub>3</sub> I  | -9F           | 195.91           | 7.1% by volume                 | 132 lbm/ft <sup>3</sup> | Approved*   |

\*SNAP approved for use in non-occupied areas

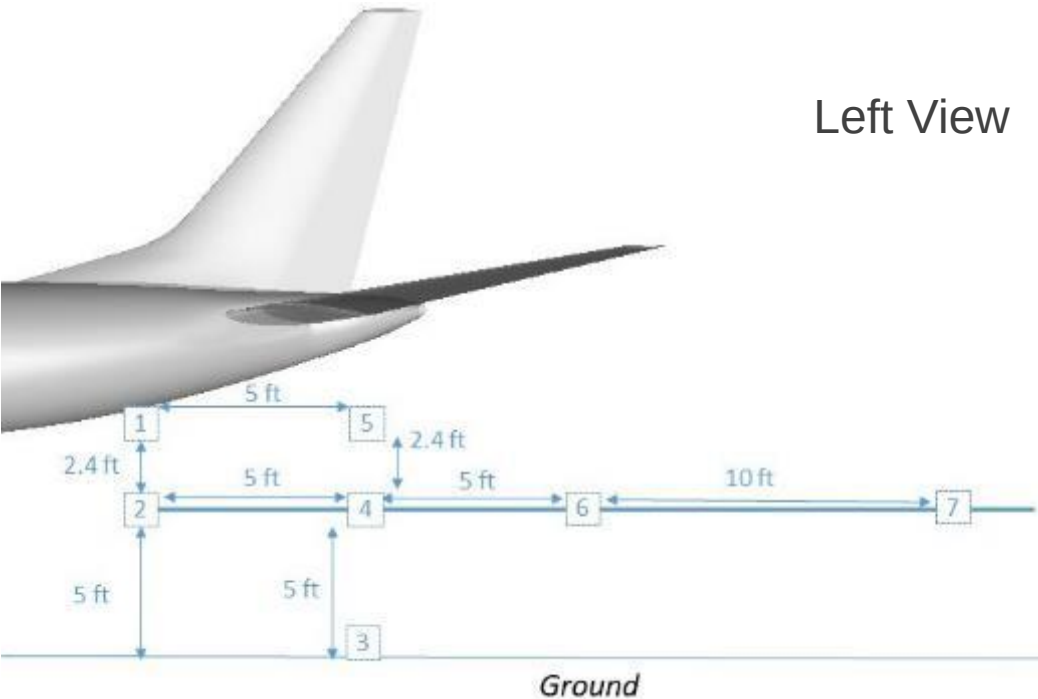
Boeing is evaluating the use of trifluoroiodomethane (CF<sub>3</sub>I) as a fire extinguishing agent to replace Halon 1301 in APU and engine applications.

CF<sub>3</sub>I, like Halon 1301 is a total flooding agent, and moves similarly through the APU compartment, although there are some differences in behavior.

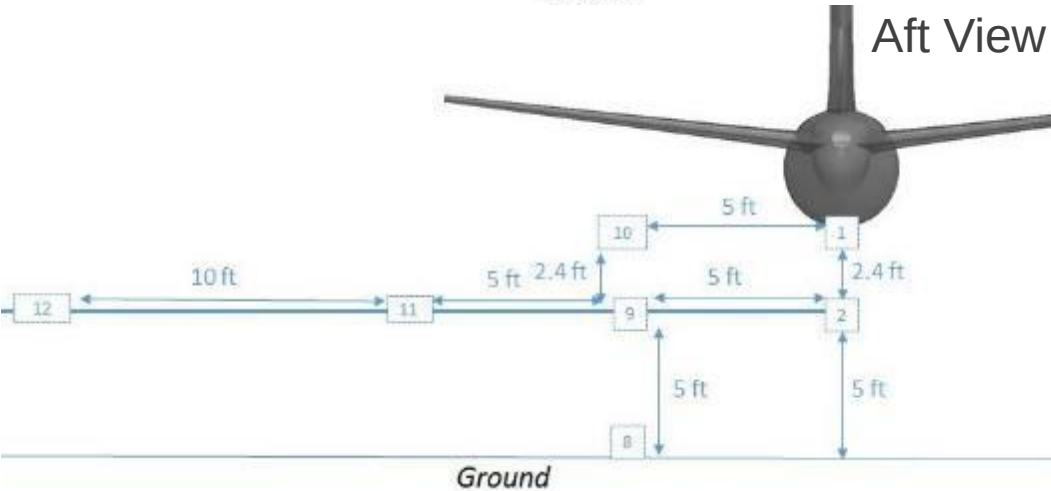
# Dispersion Testing Setup



Top View

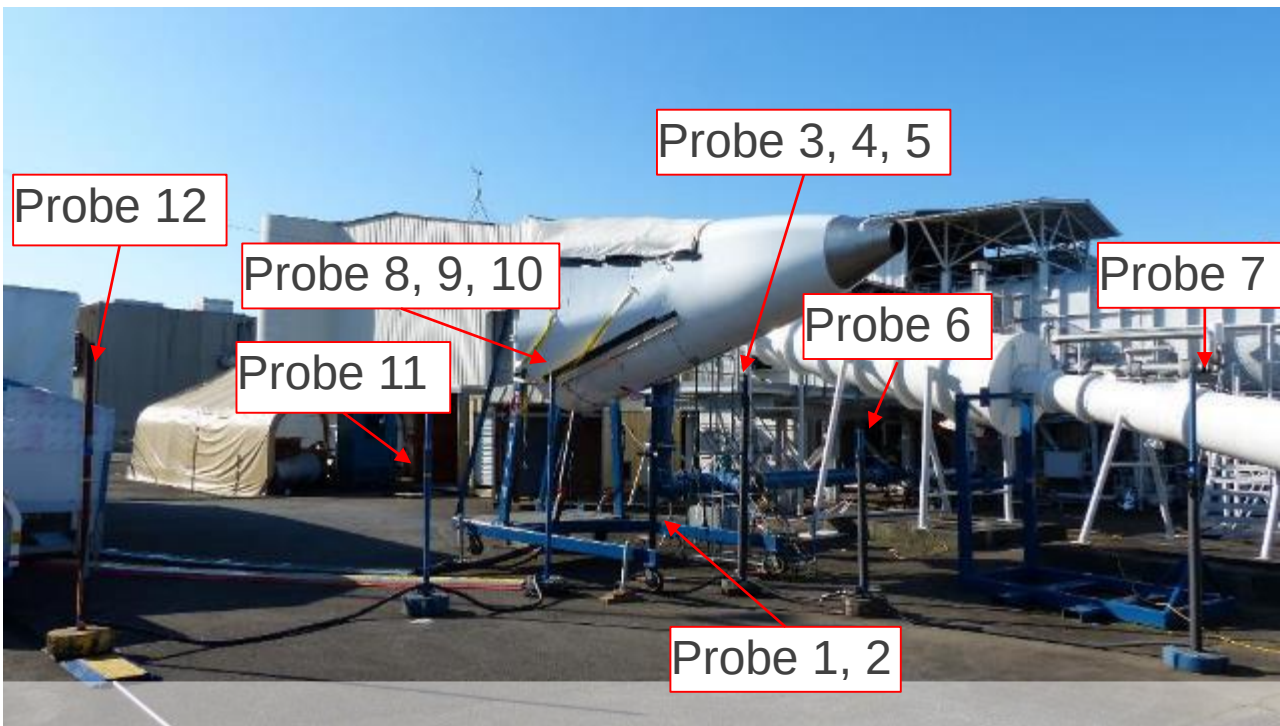
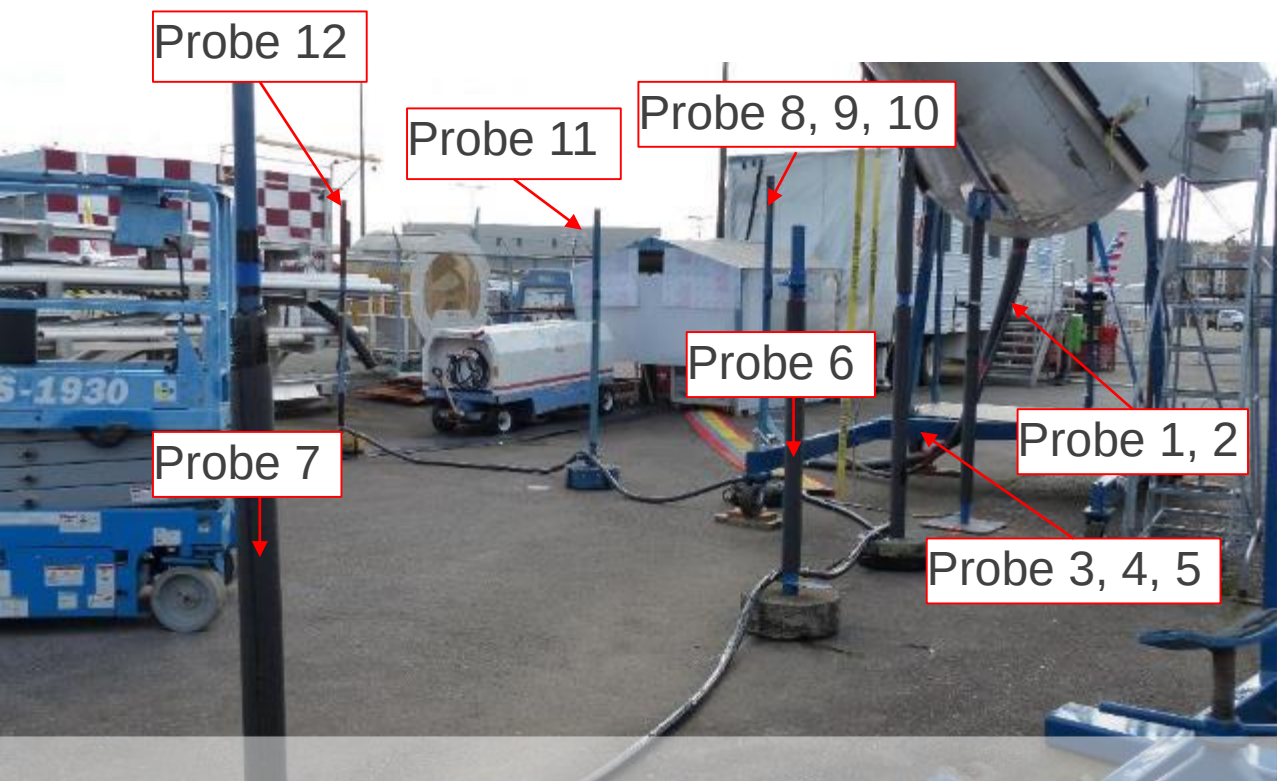


Left View



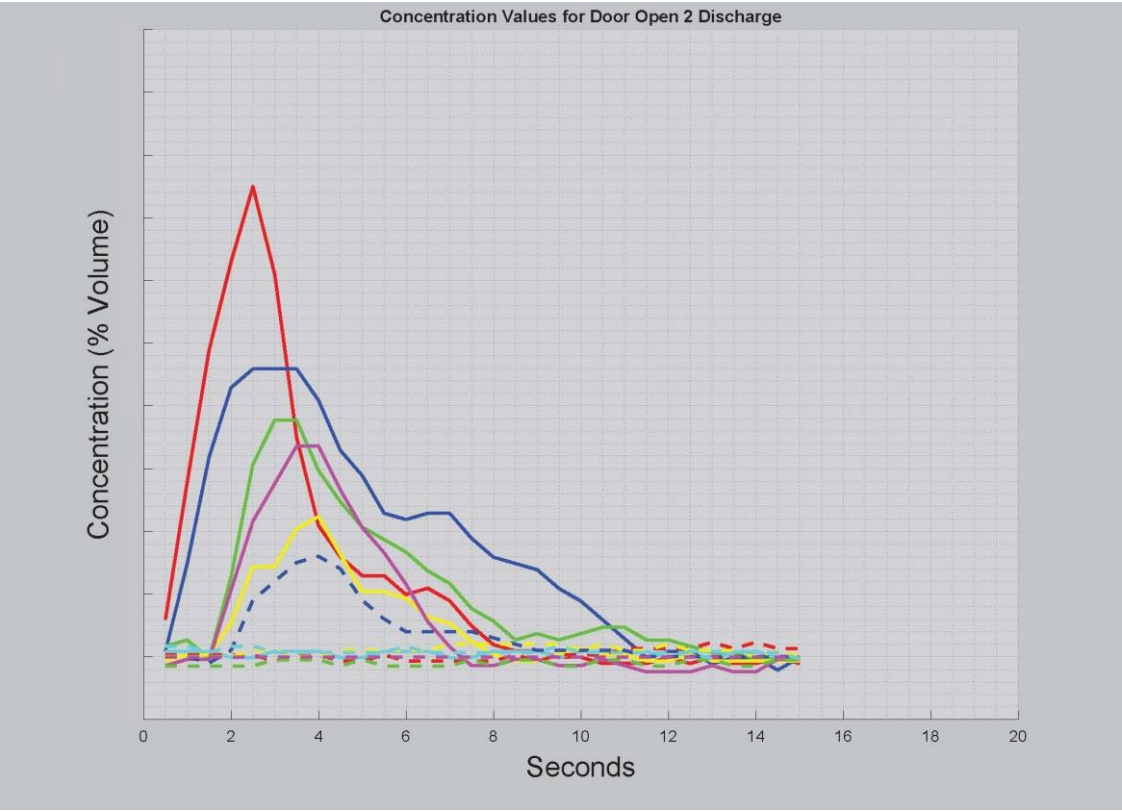
Aft View

# Dispersion Test Setup



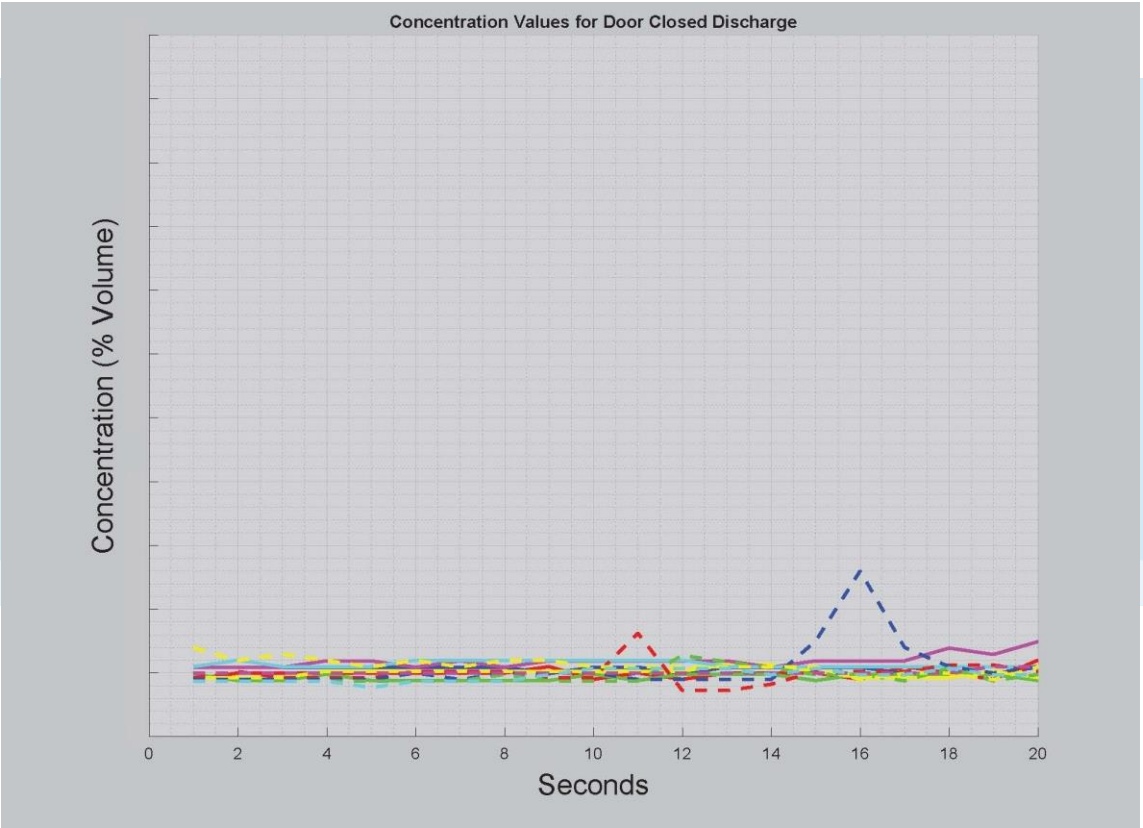
Probe Locations for the dispersion test

# Test Results



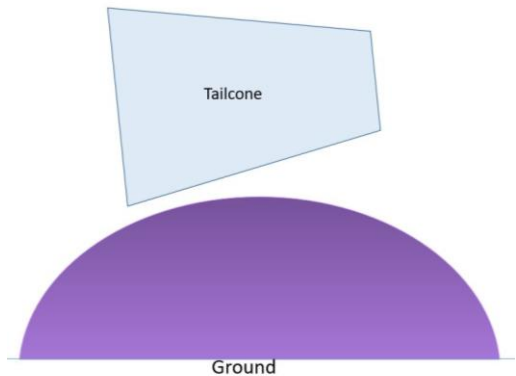
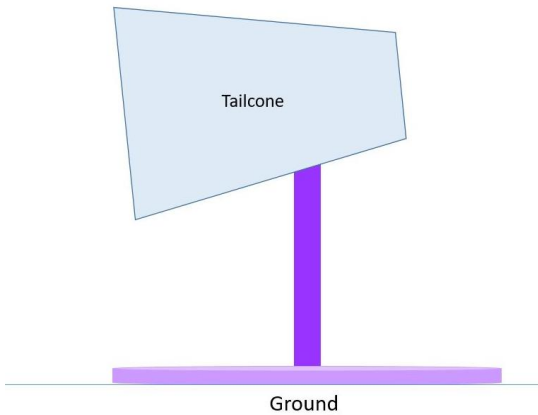
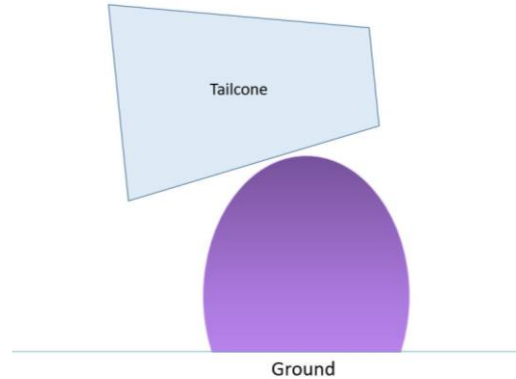
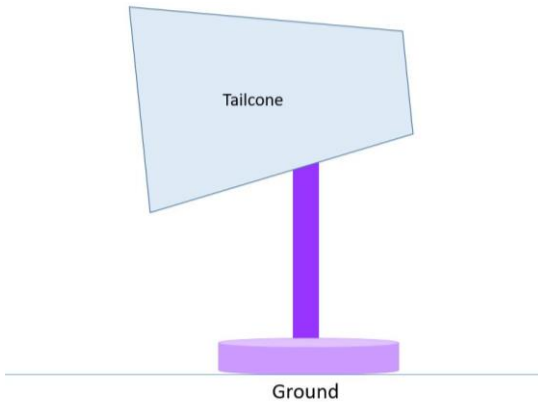
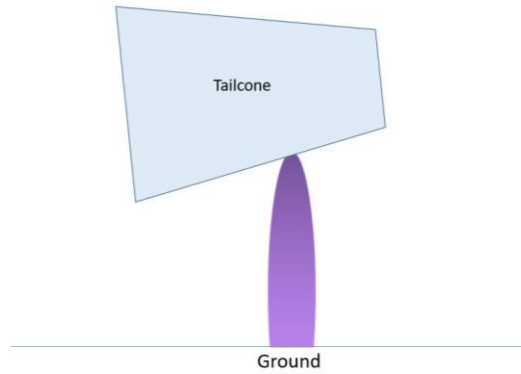
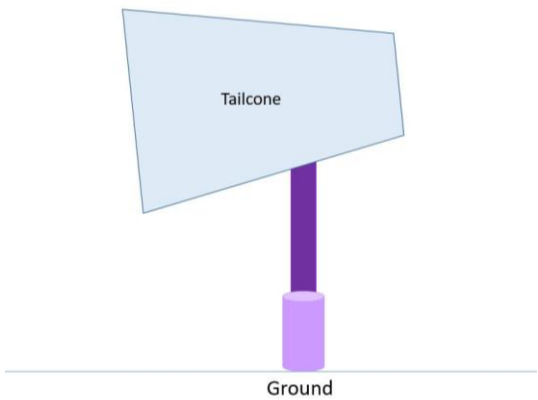
## Open Door APU Compartment

Concentrations spiked, then rapidly decreased and returned to pre-discharge levels within 30 seconds



## Closed Door APU Compartment

Very little concentration rise observed outside compartment



## Shape/Size of Discharge Plume

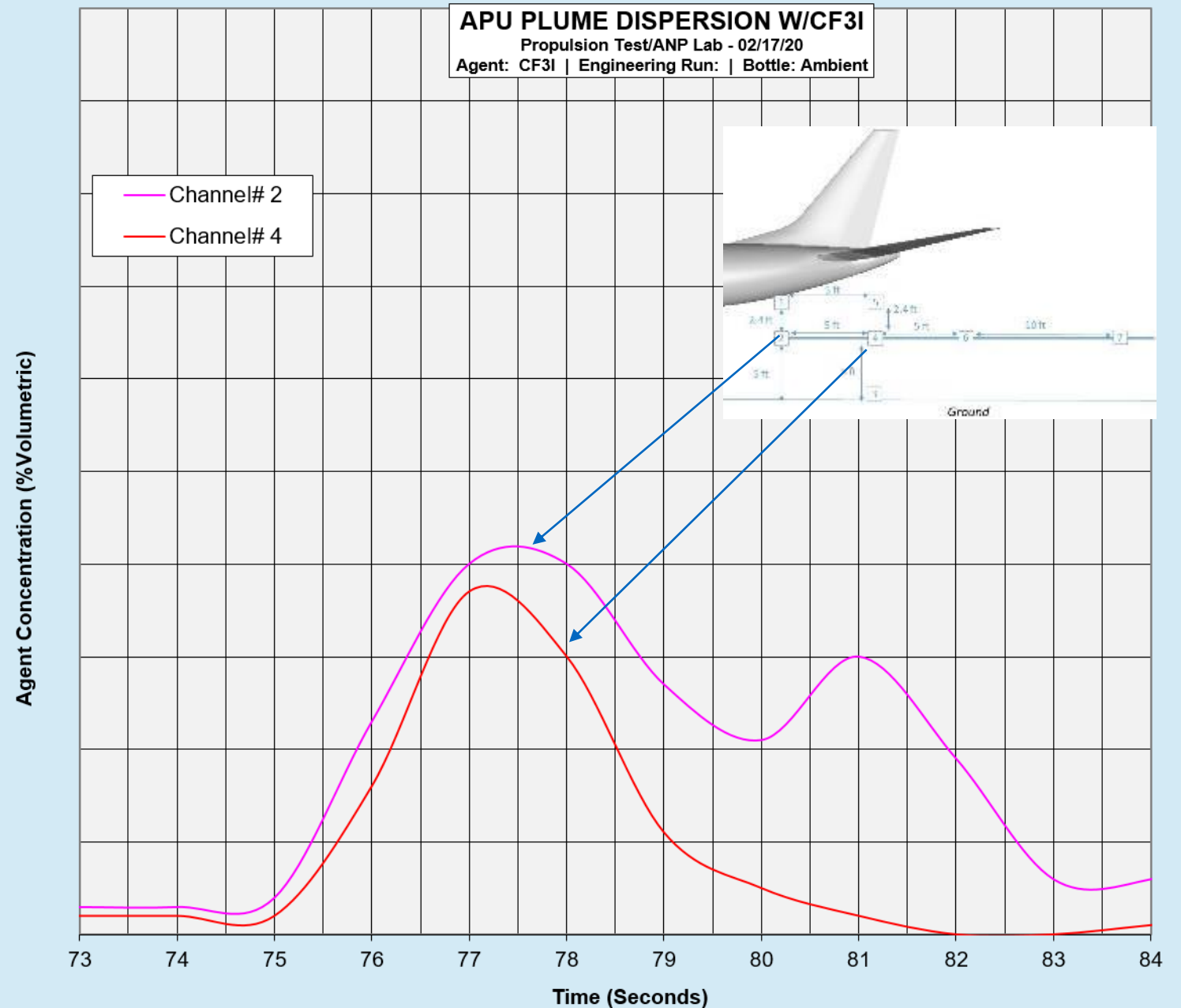
The shape of the discharge plume can be looked at as either a disc or a hemisphere of a circle. Initial predictions based on vapor density and observation of the condensation clouds suggested the flat disc as shown on the left. Results from the test show that the actual shape is more complicated, and is somewhere between the two shapes.

When looking at a height of 5 ft (60 inches), which is at the average breathing height, the radius of the circle segment is around 30-40 ft when the concentrations return to below 0.2% by volume.

## Average speed of dispersion plume

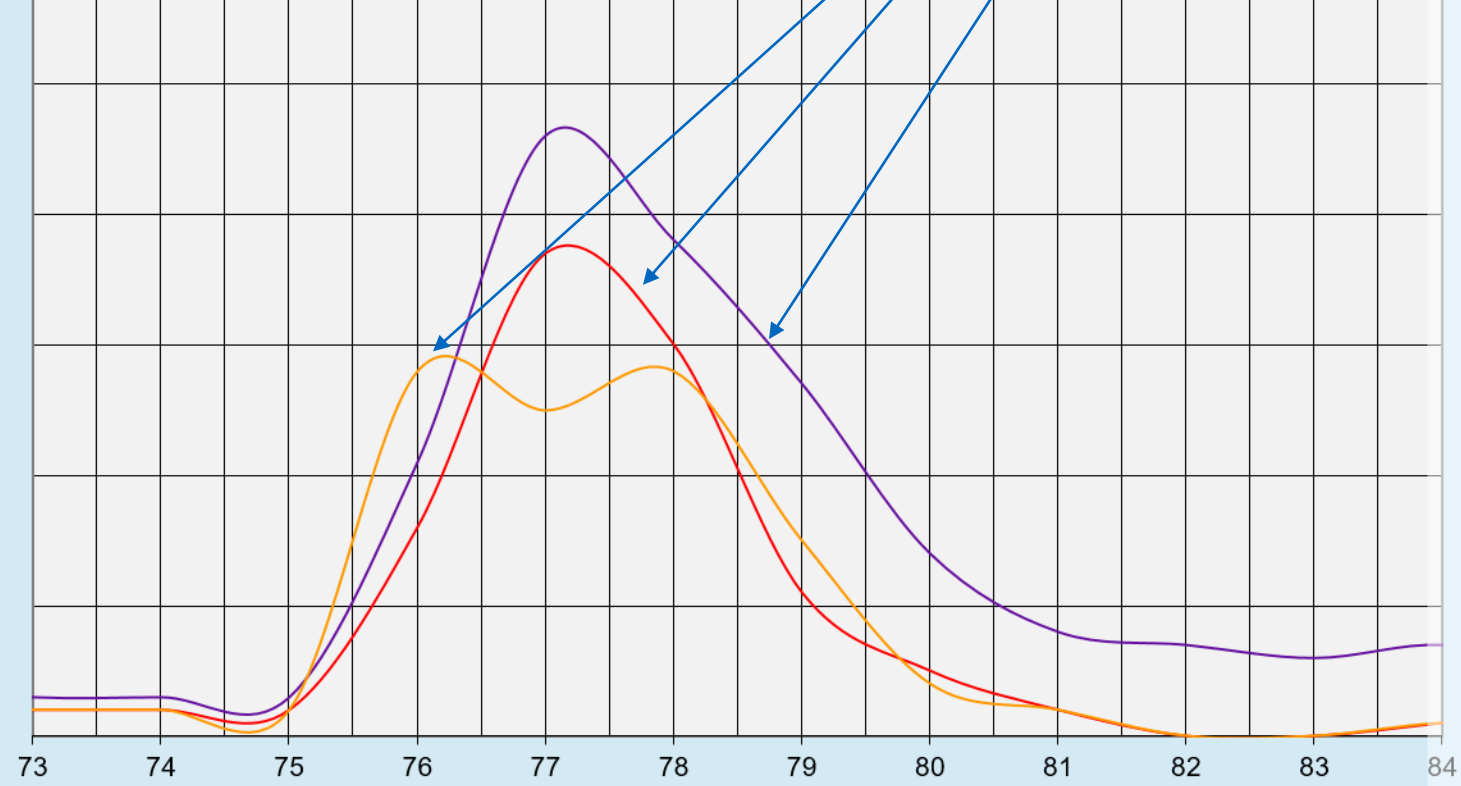
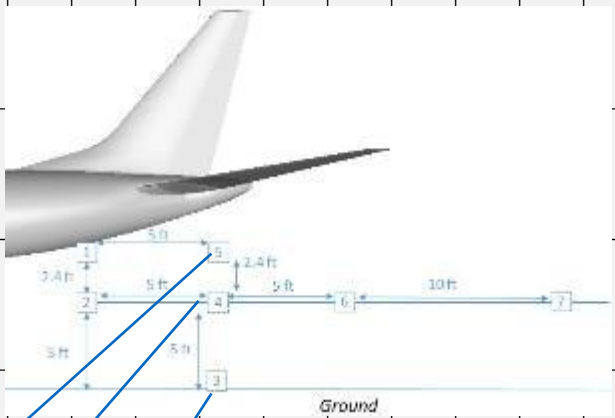
Probe 2 and 4 are both located at a height of 5 ft. Probe 2 is directly under the tailcone and Probe 4 is 5 ft directly behind Probe 2.

Agent travels around 20 ft/sec at 5 ft high



Agent Concentration (% Volumetric)

- Channel# 3
- Channel# 4
- Channel# 5



Time (Seconds)

## Dispersion Plume Observations

Probes 3, 4 and 5 were located 5 ft behind the APU doors at ground level, at 5 ft and at 7.4 ft respectively.

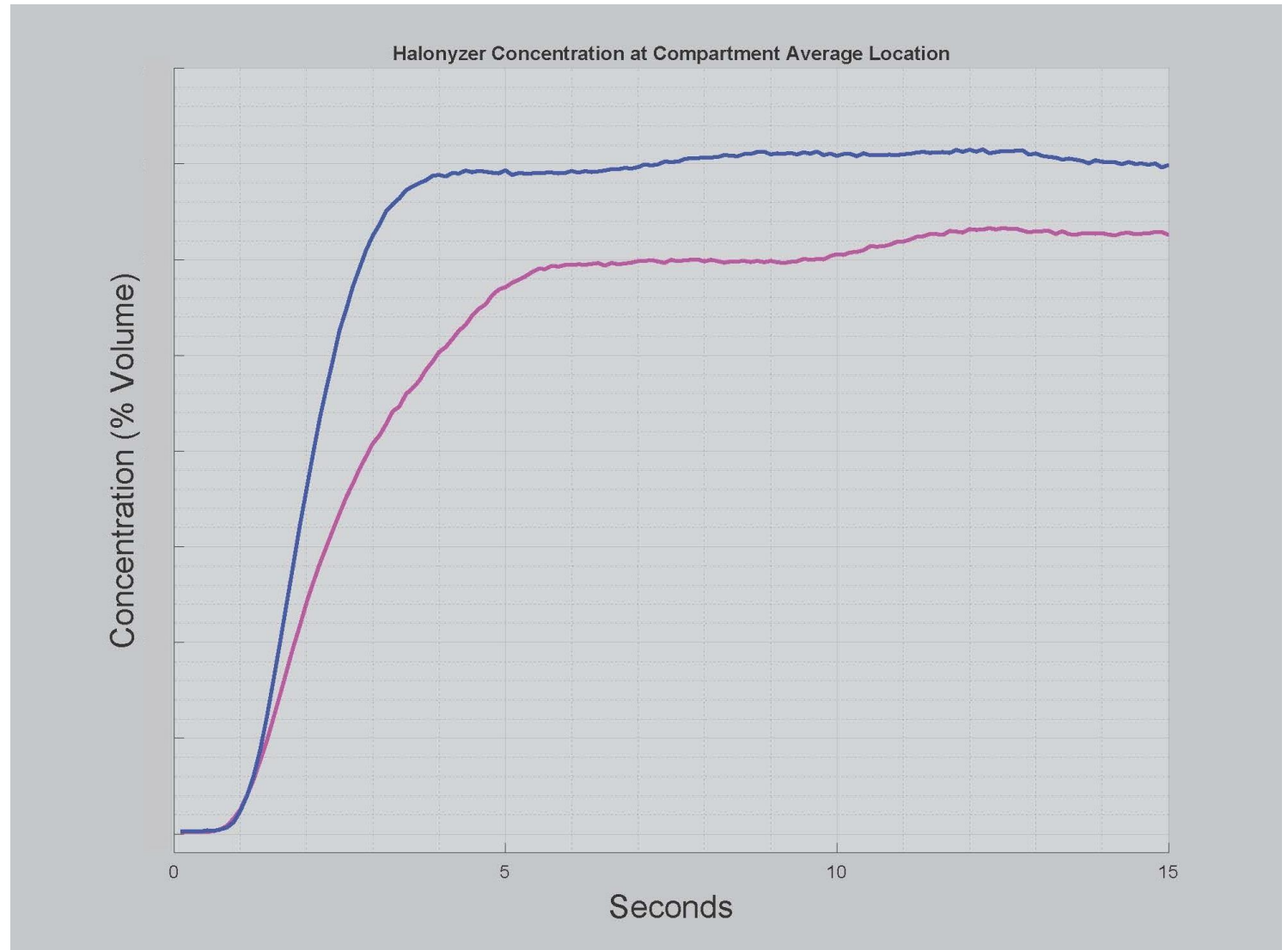
Higher concentrations were at ground level as the agent sank quickly and dispersed.

## Cold Behavior

Testing showed that  $\text{CF}_3\text{I}$  is slightly slower to vaporize than Halon 1301, but reached a plateau within 2-3 seconds of HFC-125.

Agent vaporized and expanded rapidly even when it was cold-soaked, though it was slightly slower than Halon or HFC-125 to get to that state.

Concentration numbers are slightly higher for HFC-125, but  $\text{CF}_3\text{I}$  was still well above the minimum required concentration.



# Open Door Test



# Closed Door Test

Date 02/17/2020



# Cold Testing Behavior



