

# Class C Cargo Compartment ULD Suppression Agent Penetration



FAA William J Hughes Technical Center  
Fire Safety Branch

Presented to: International Aircraft Systems Fire Protection  
Working Group. Atlantic City, NJ

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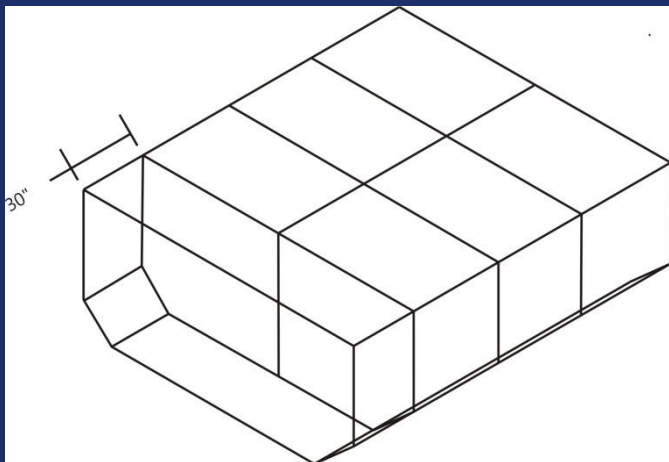
Federal Aviation  
Administration

# Background

- Recent test results have shown the potential for vapors vented from lithium ion batteries in thermal runaway to produce flammable gas mixtures inside ULDs.
- Testing was initiated to measure the concentration of suppression agent both inside ULDs and in the surrounding cargo compartment.
- FE-25 used as a surrogate gas for Halon 1301.

	Halon 1301	FE-25
Boiling Point (°F)	-72	-55
Vapor Pressure (psi)	208	200
Molecular Weight (g/mol)	149	120

# DC-10 Test Article Aft Cargo Compartment



**Compartment Volume: 1303 ft<sup>3</sup>**

Four continuous gas analyzers calibrated for FE-25 were used to simultaneously record gas concentrations. The probes were located inside and outside of the ULDs.

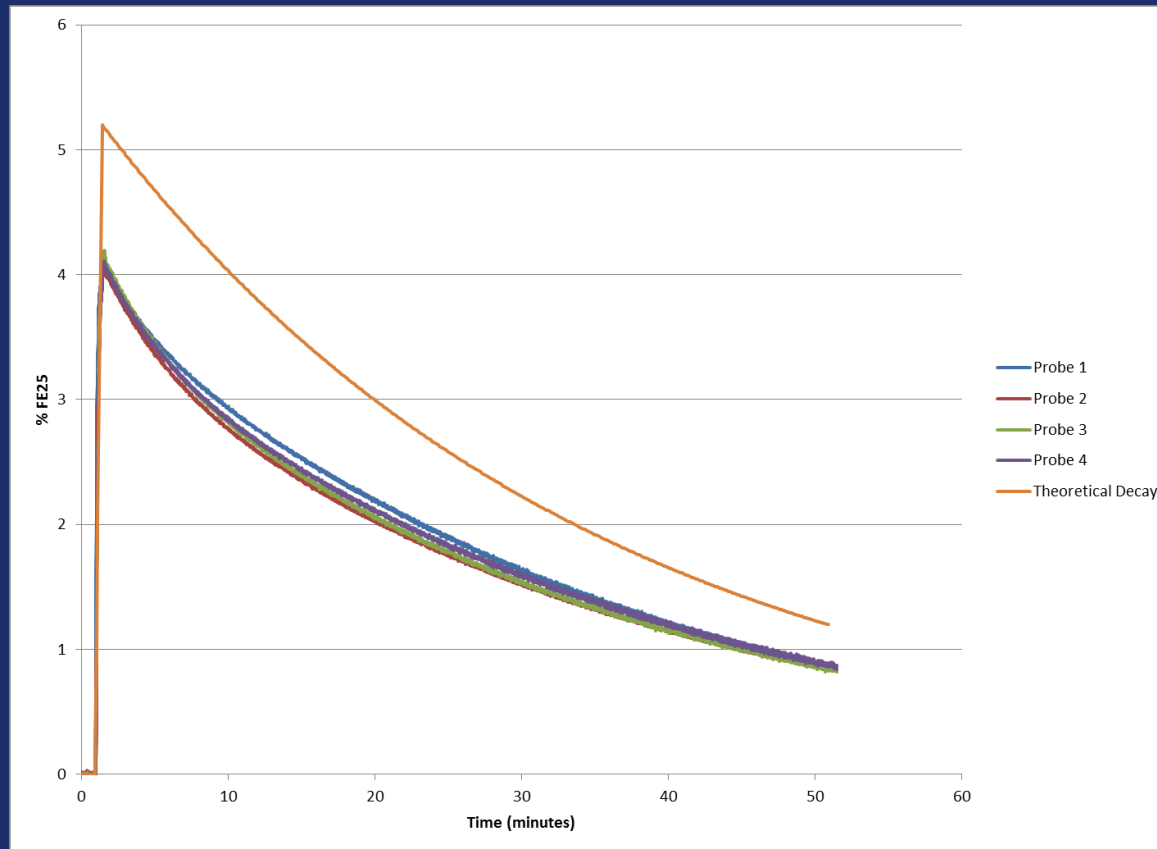


21 lbs FE25 discharged into empty compartment with mixing fans.

Gas probes spaced equidistant between floor and ceiling.

Cabin ventilation fan on.

Leakage calculated from agent decay rate: 39 ft<sup>3</sup>/minute.

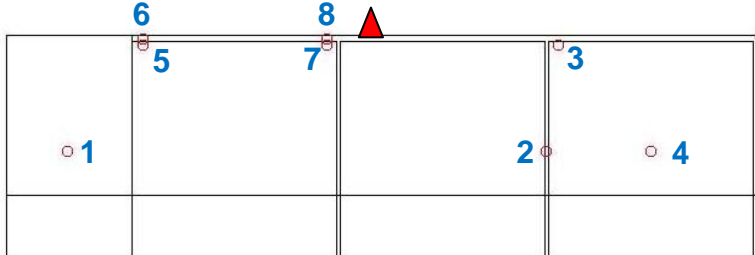
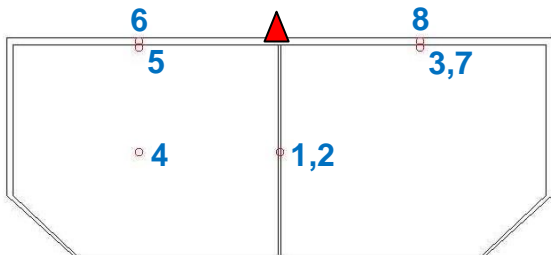
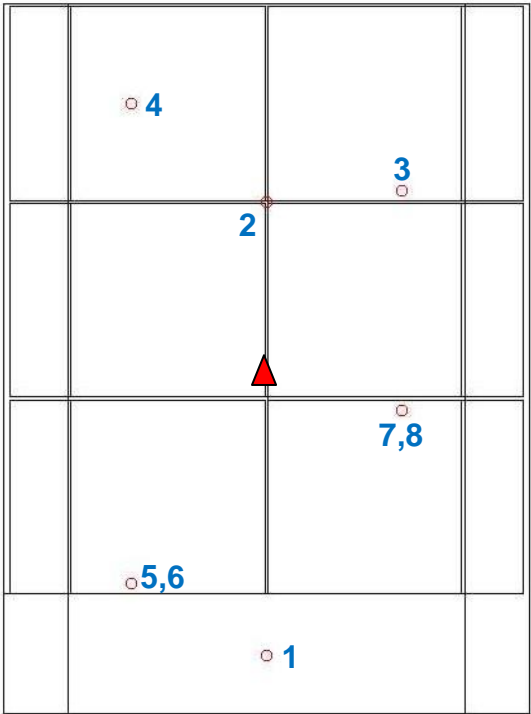


**AKE Unit Load Devices (ULDs) with flexible fabric door covering. Filled to approximately 85% with cardboard boxes filled with bubble wrap plastic and taped closed.**



# Gas Probe Locations

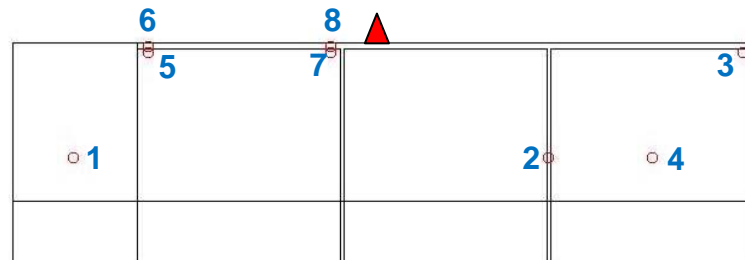
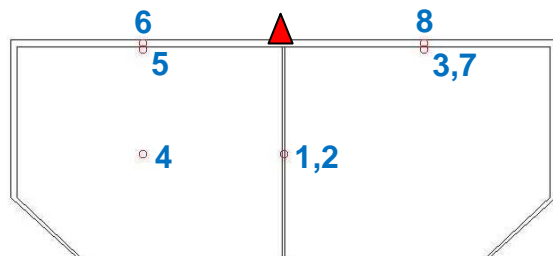
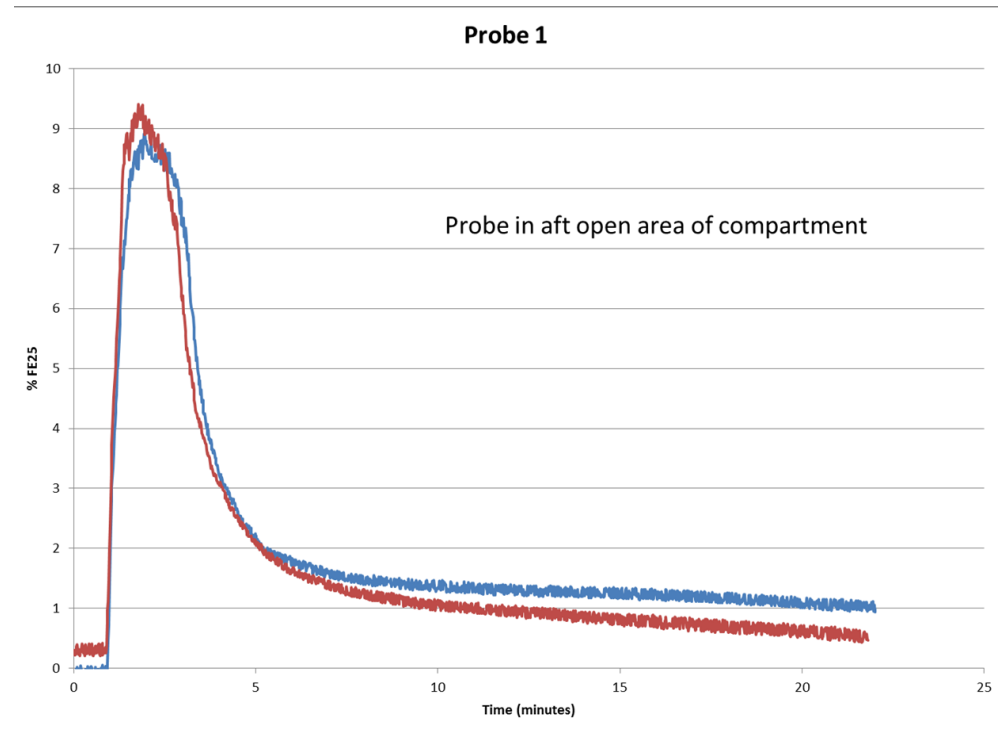
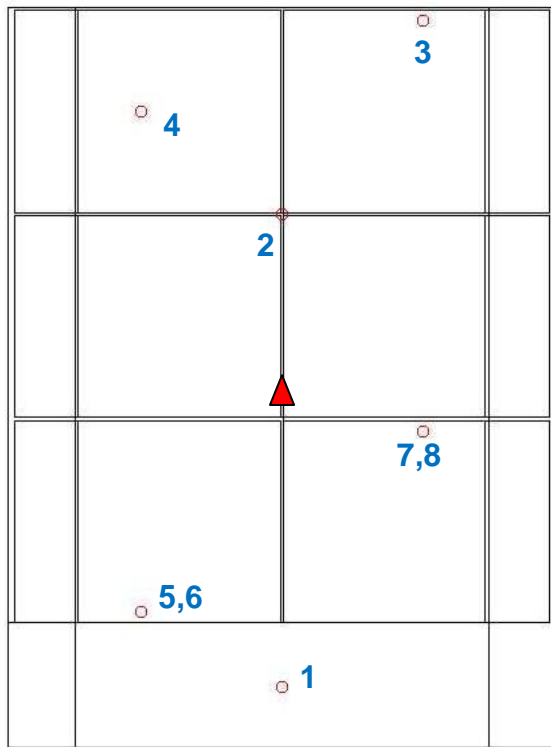
▲ Agent Discharge Nozzle Location



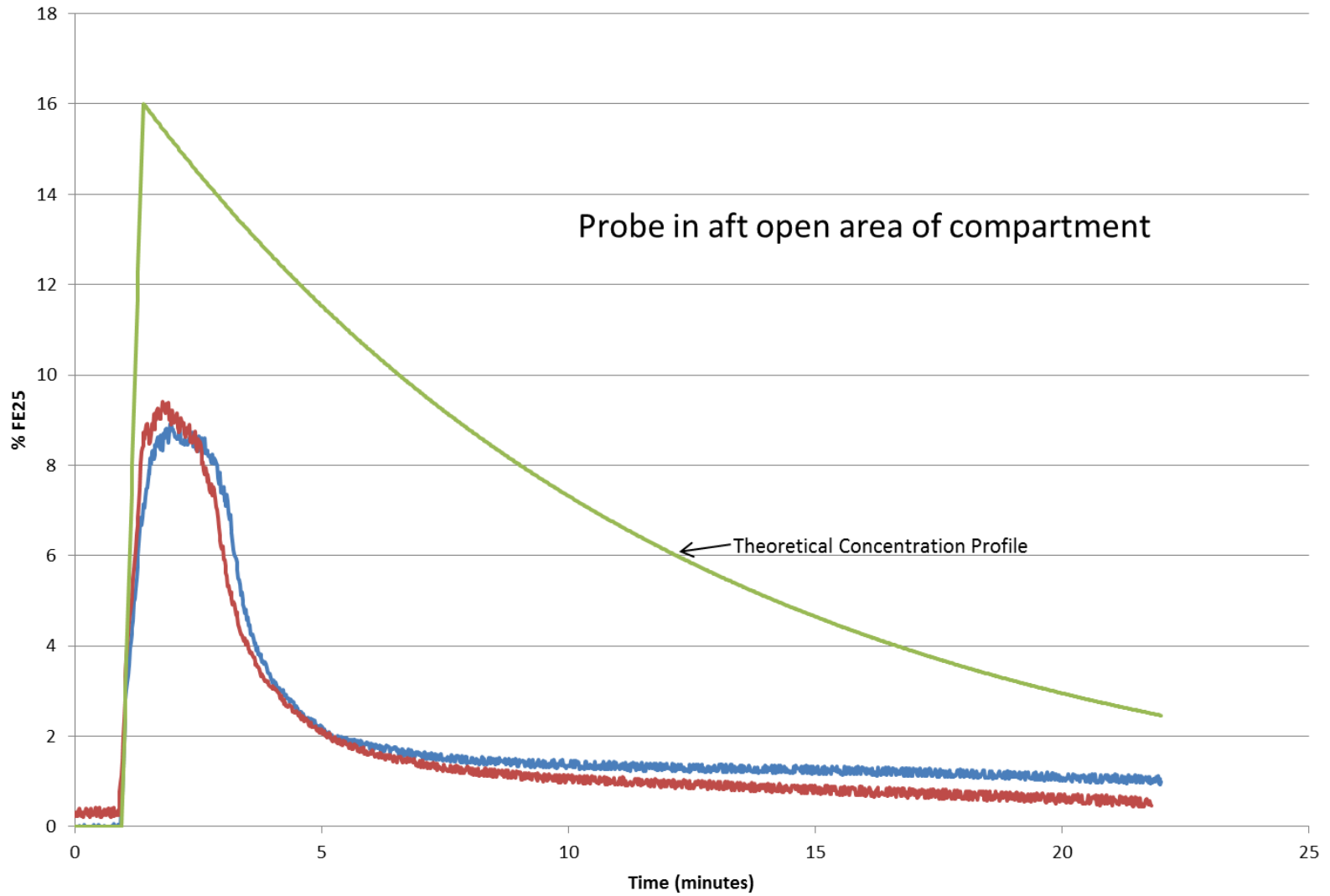
# Interior Gas Probes

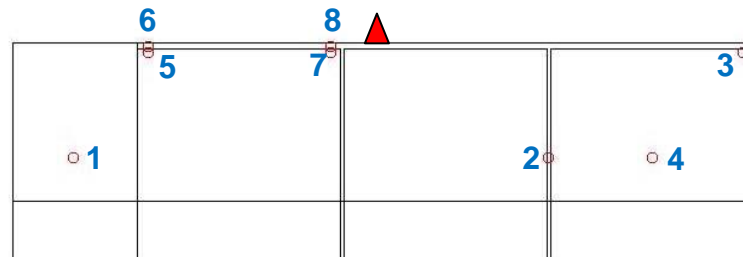
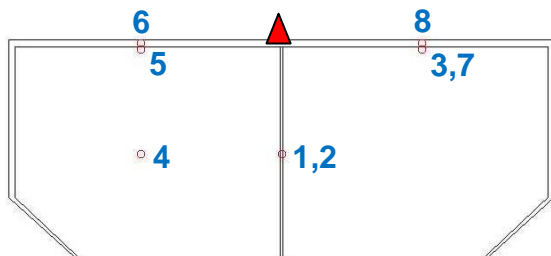
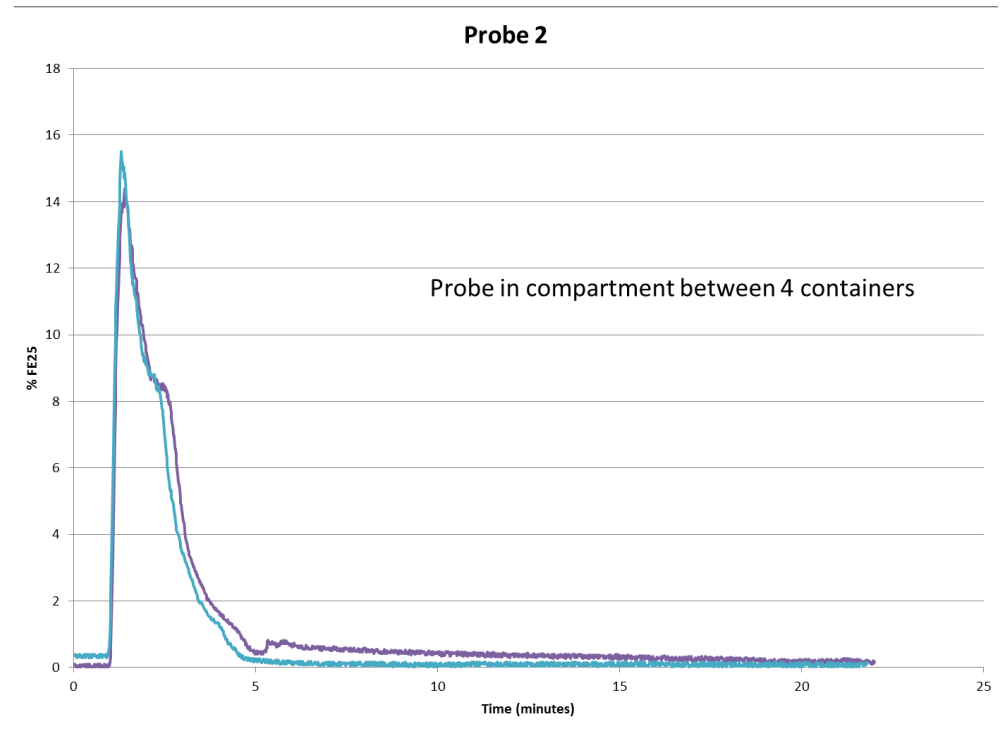
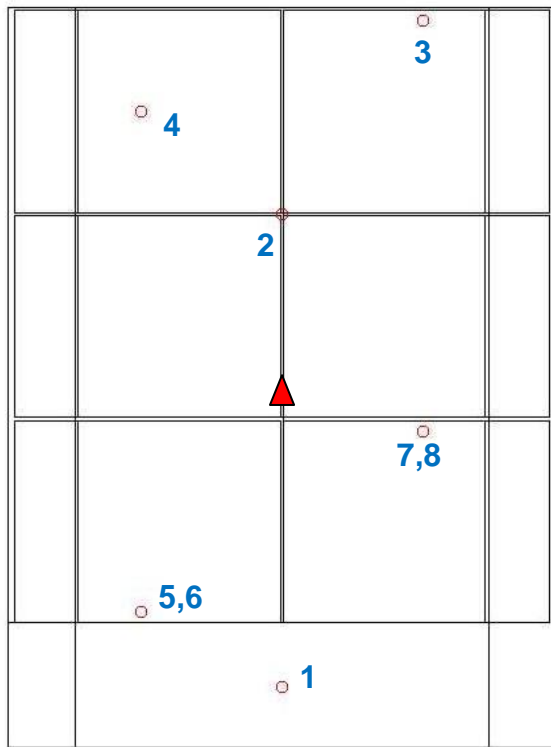




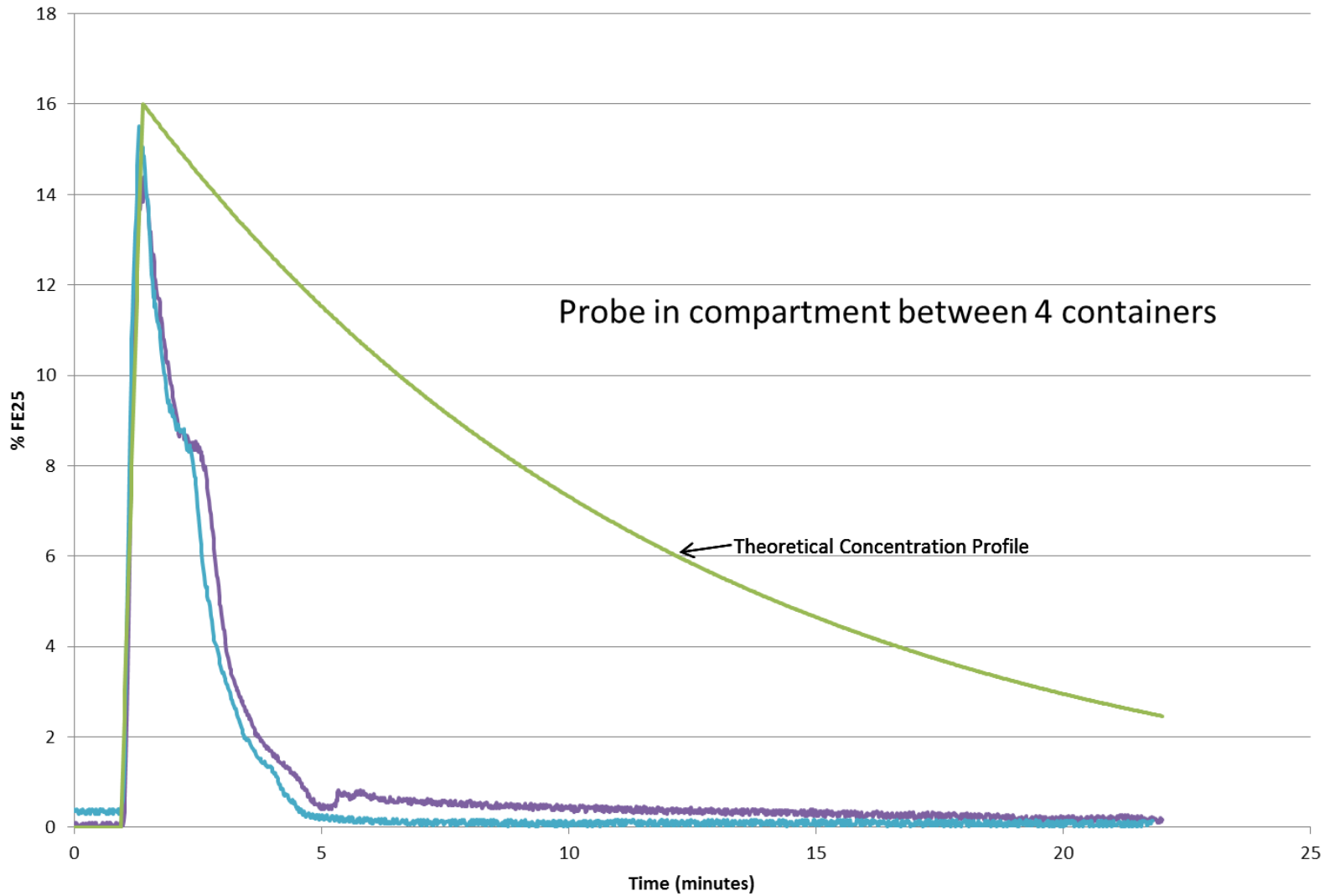


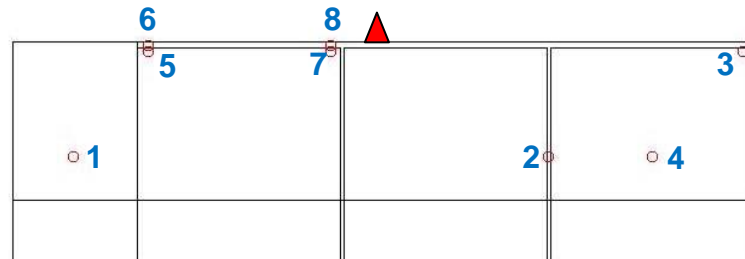
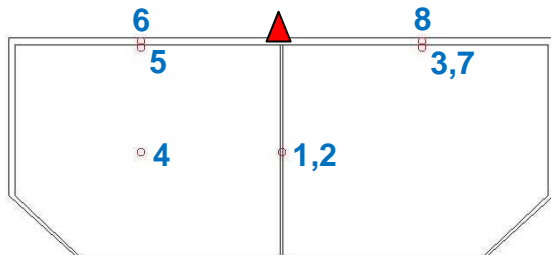
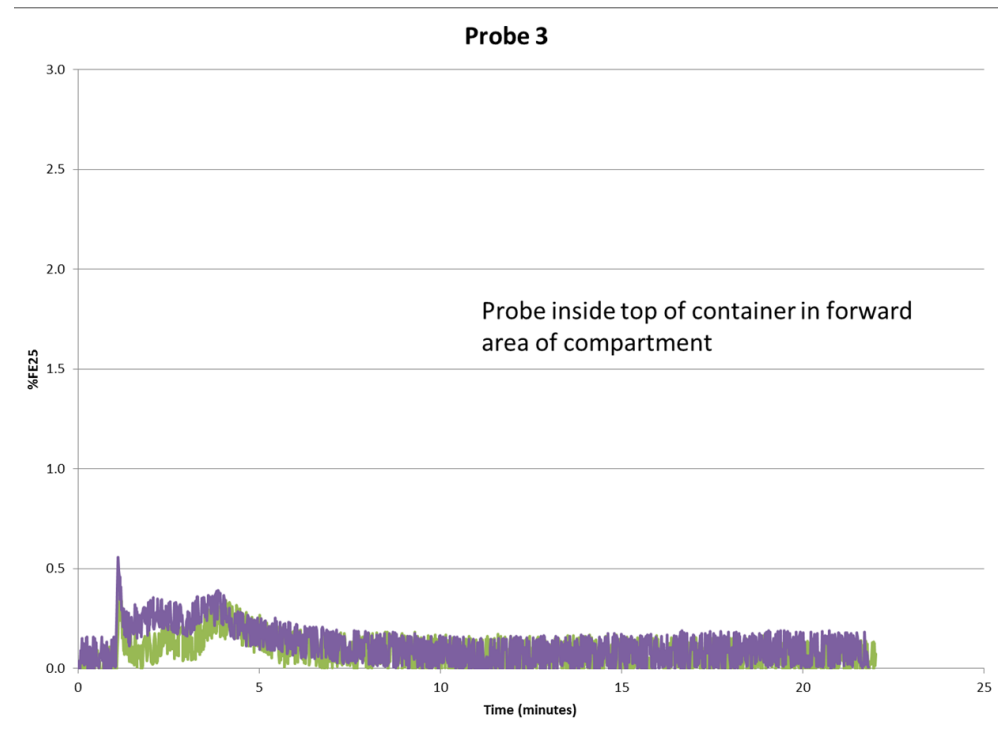
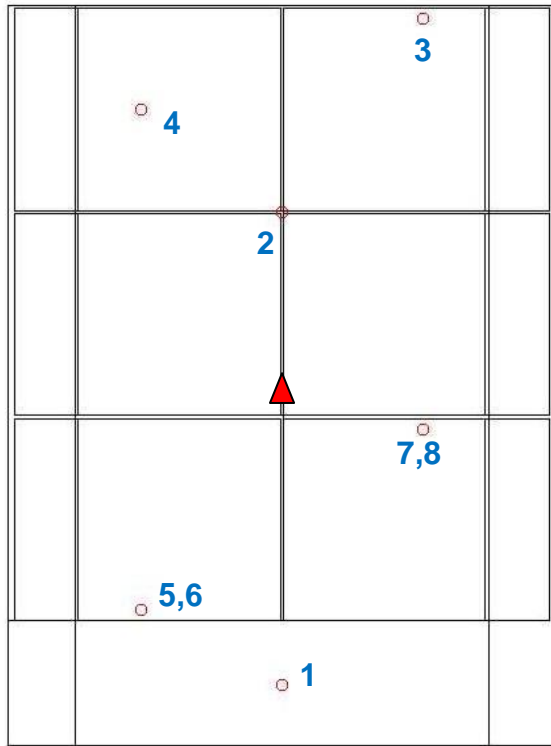
# Probe 1

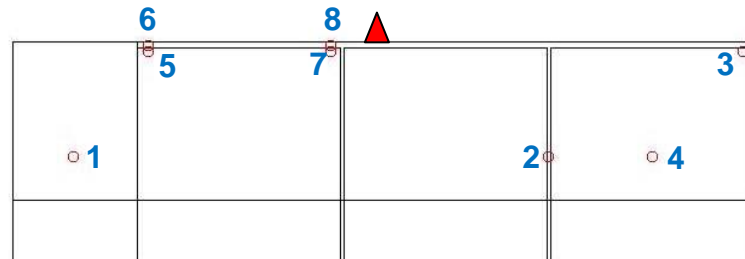
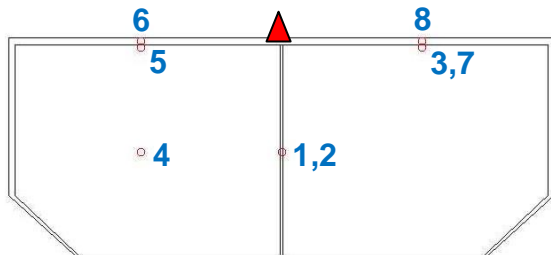
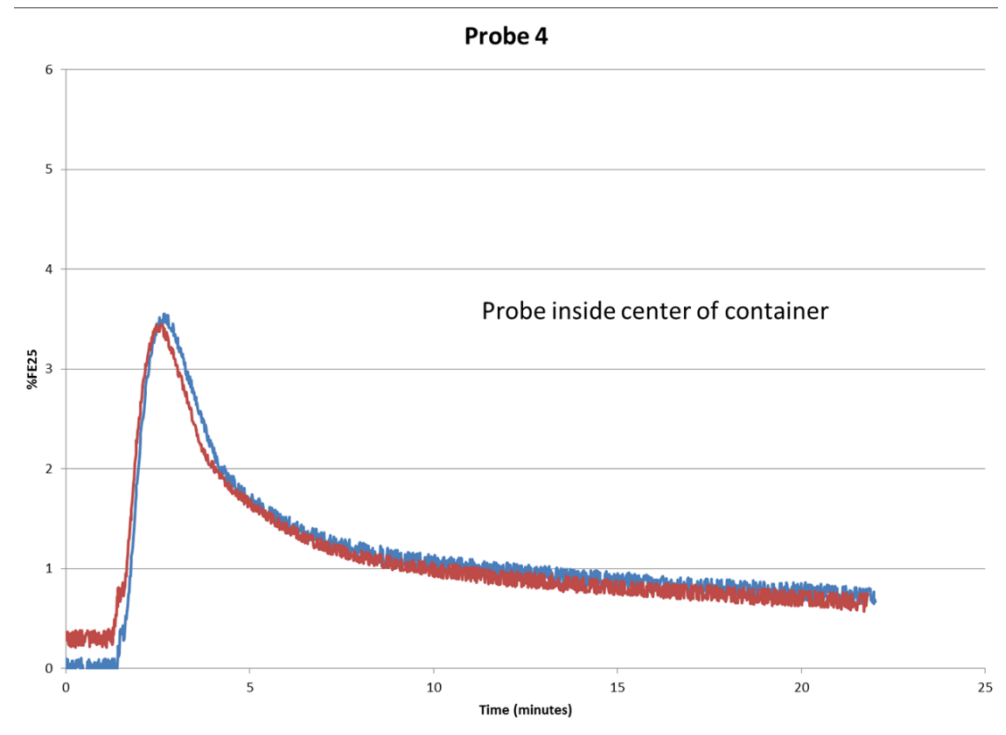
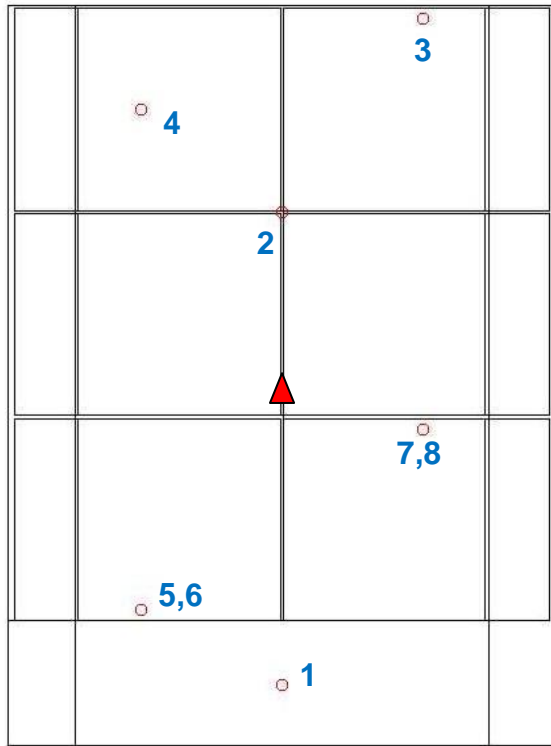


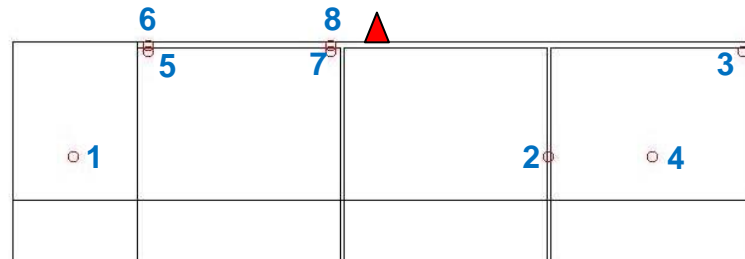
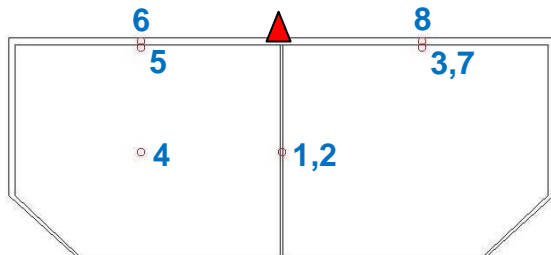
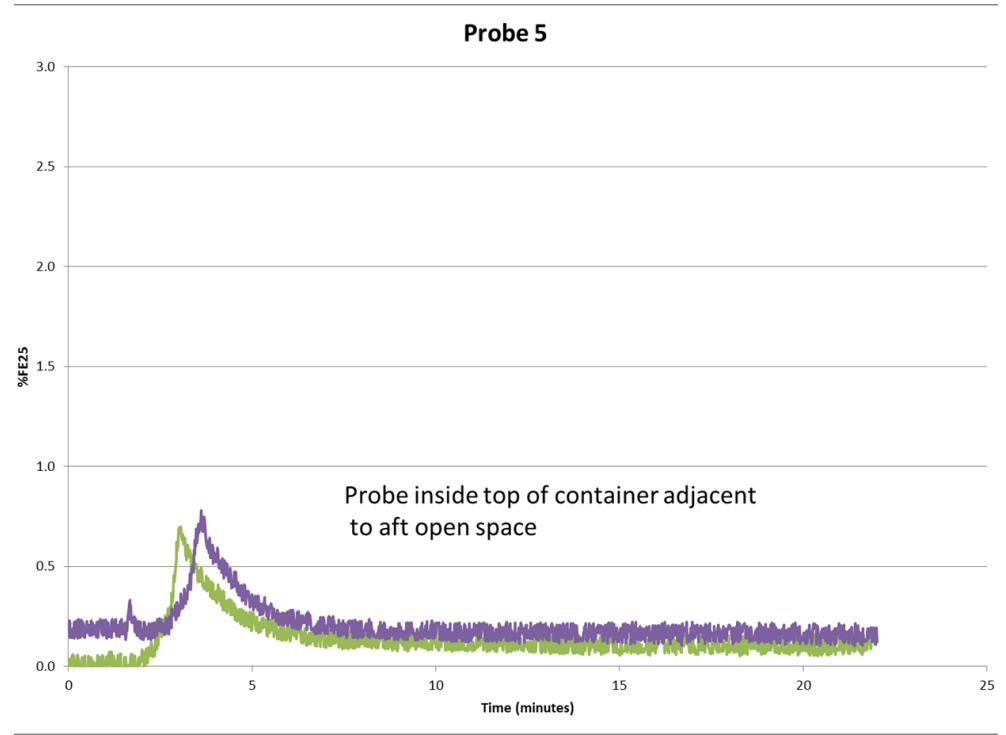
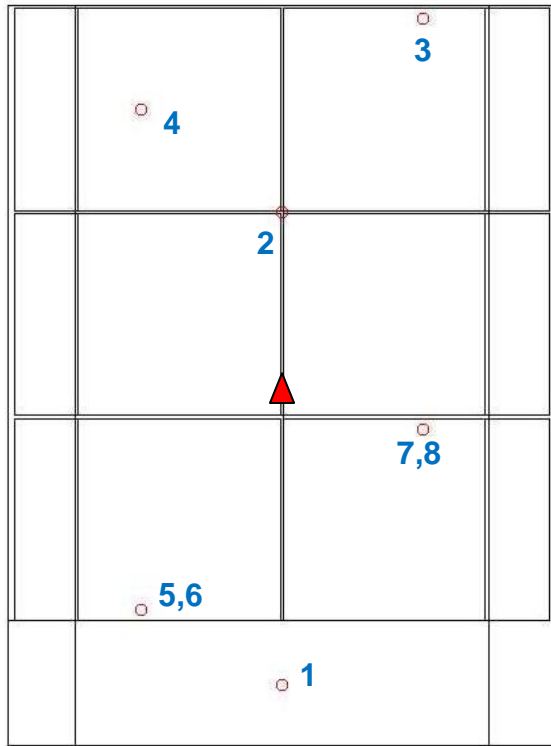


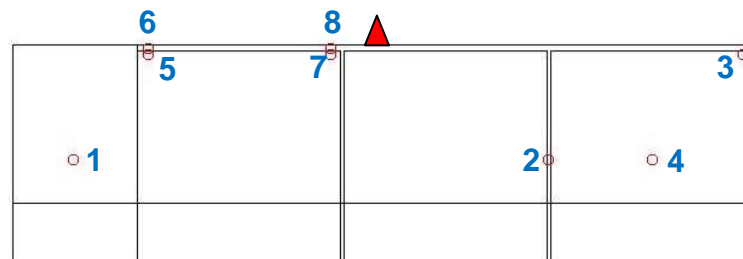
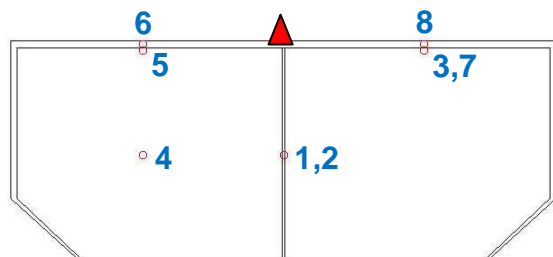
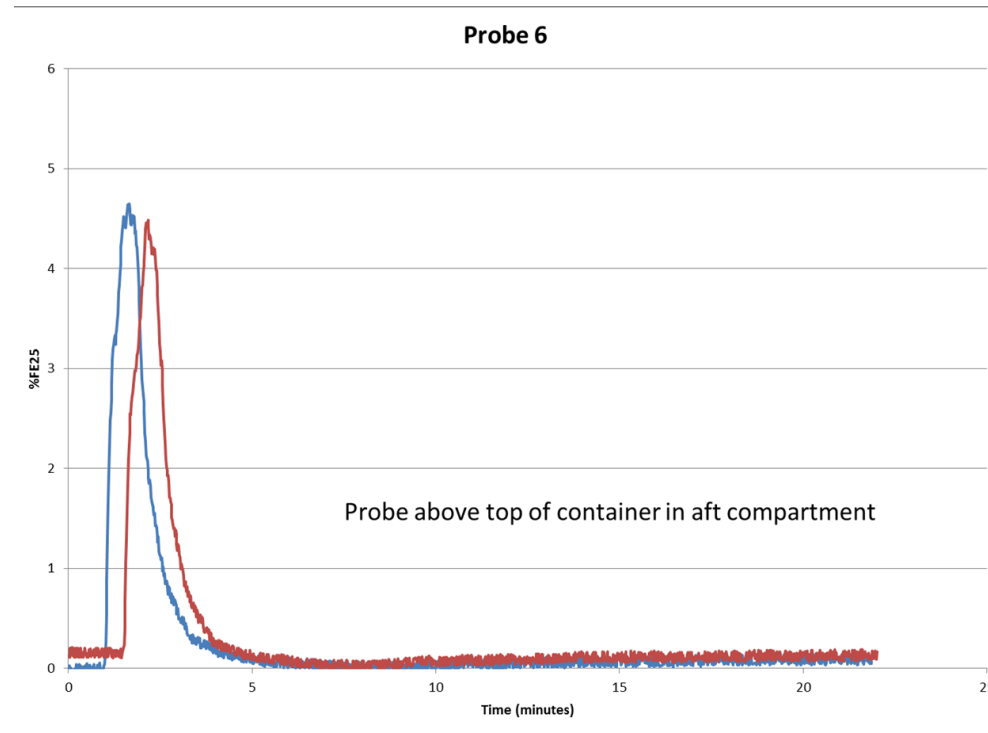
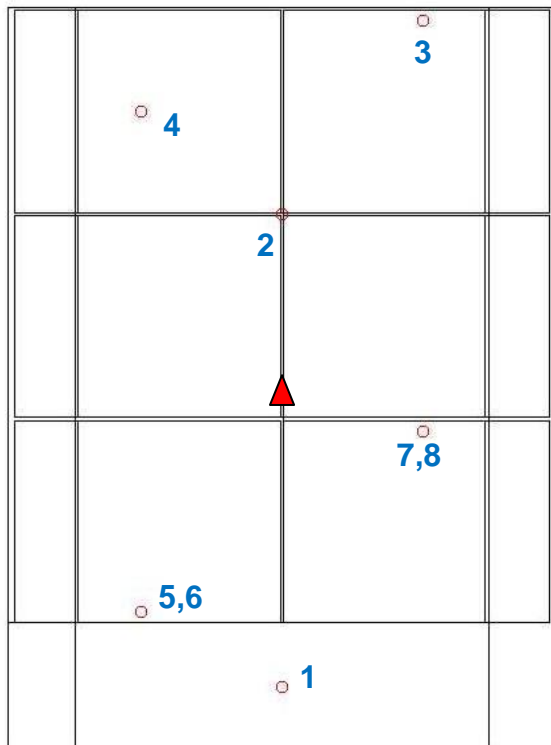
# Probe 2



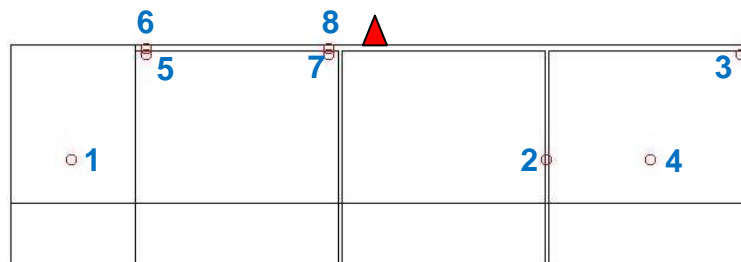
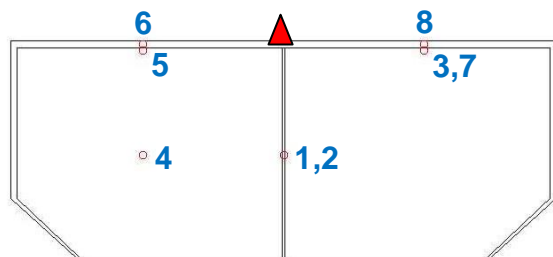
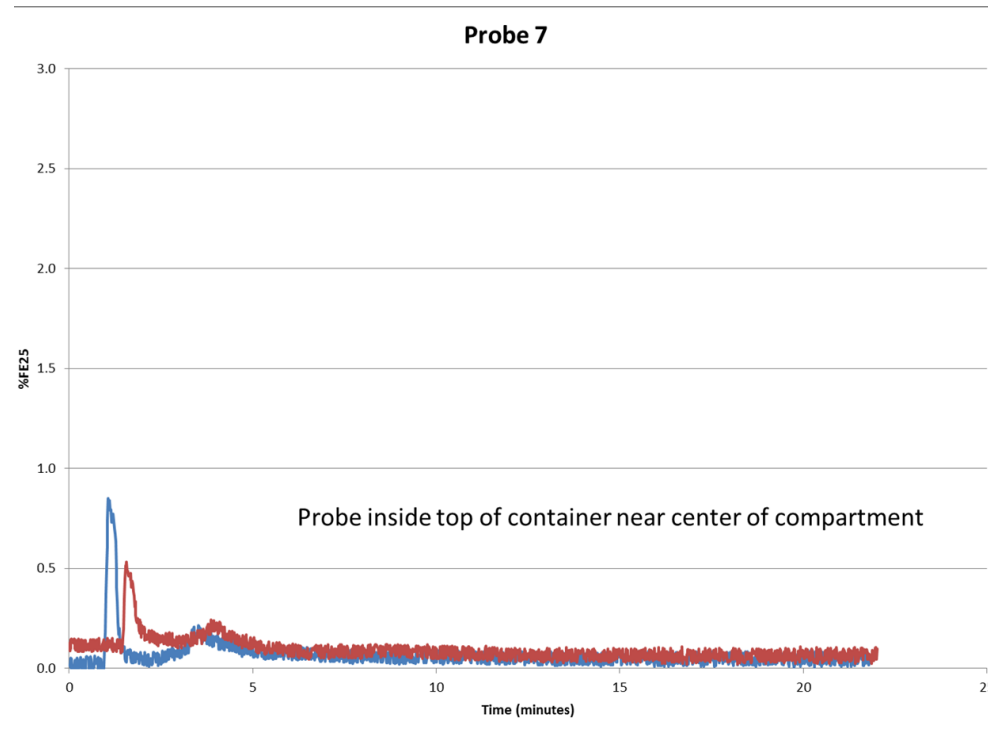
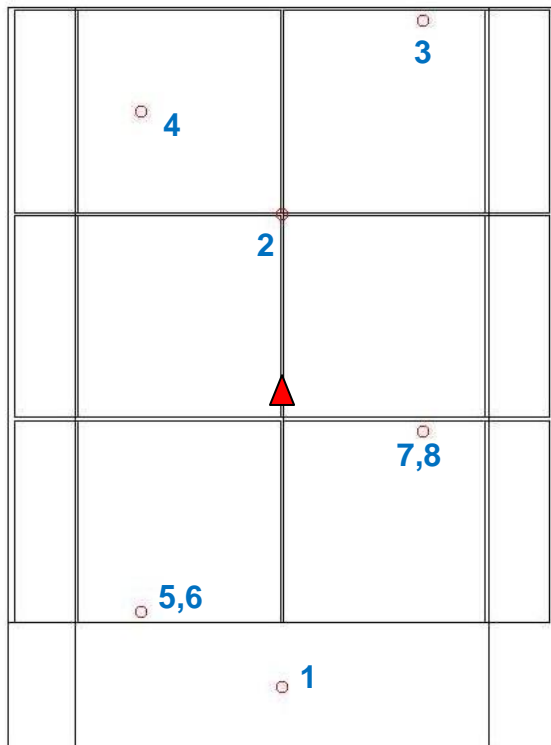


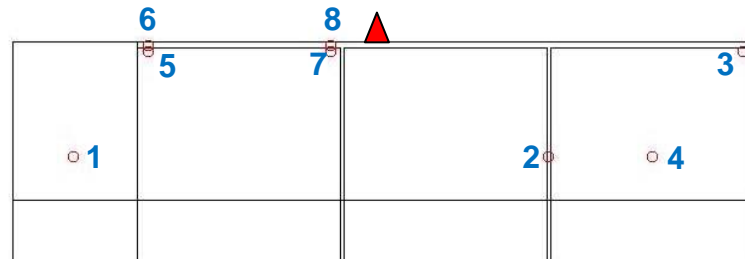
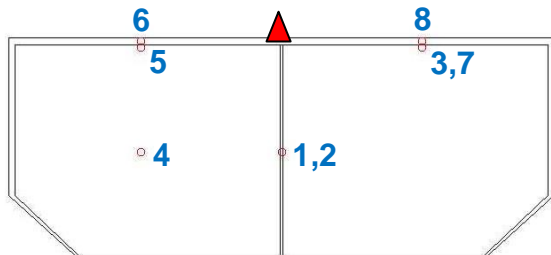
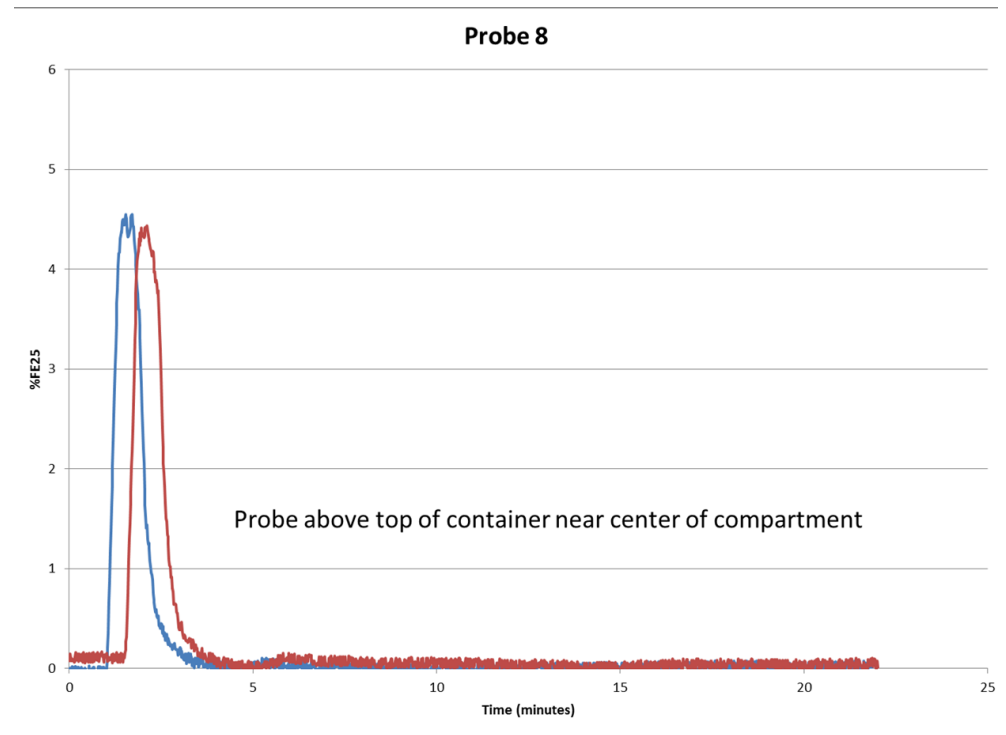
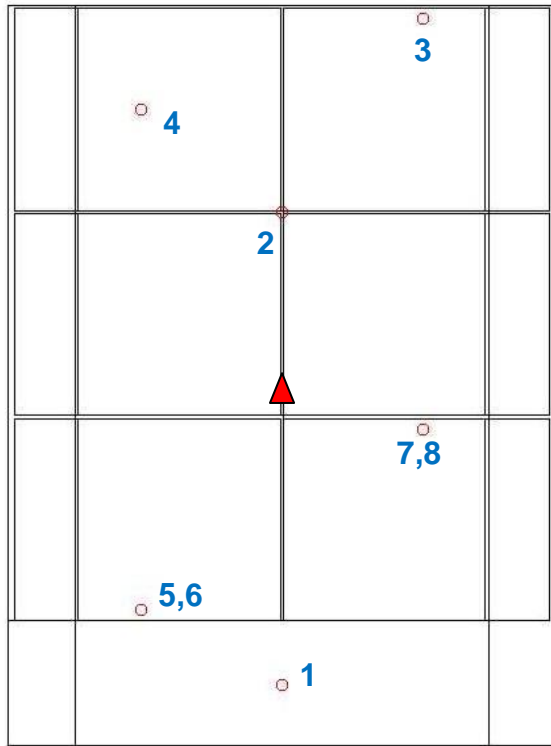












# Summary

- **Very little suppression agent penetrates inside ULDs and would not be adequate to suppress flammable gas mixture from lithium ion batteries in thermal runaway.**
- **Agent concentrations outside of ULDs dissipates much faster than theoretical calculations would indicate for the conditions tested.**

