Minimum Performance Standard

For Aircraft Cargo Compartment Built-In Fire Suppression Systems




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INTRODUCTION

Federal Aviation Regulations and Joint Airworthiness Requirements, such as 25.851 - 25.857, require fire protection systems for Class C aircraft cargo compartments

In the past, the aircraft industry has selected Halon 1301 total flood fire suppression systems as the most effective systems for complying with the FARs. But, it is an ozone depleting agent.

Because of the ban on production of Halon 1301 (Montreal Protocol, 1994), new fire suppression systems will need to be certified when the use of halon is no longer viable.

INTRODUCTION

In 1994, the FAA sponsored International Halon Replacement Working Group created a task group to develop the MPS for aircraft cargo compartment.

The FAATC Fire Safety Section developed the standard, in conjunction with the IHRWG task group members, and ran the necessary tests to back the developed document.

The MPS document defines the fire test protocols required to test Halon 1301 replacements/alternatives.

AGENT SELECTION GUIDANCE

ENVIRONMENTAL.

The replacement agent must be approved by the U.S. EPA under the Clean Air Act, Significant New Alternatives Policy (SNAP) Program, or other international governmental approving program.

The primary environmental characteristics to be considered in assessing a new agent are Ozone Depletion Potential (ODP), Global Warming Potential (GWP), and Atmospheric Lifetime.

TOXICOLOGY.

As a general rule, the agent must not pose an unacceptable health hazard to workers or passengers during installation, flight, and maintenance of the suppression system.

TEST REQUIREMENTS

TEST CELL

The fire tests are to be conducted inside a simulated below floor cargo compartment of a wide-body aircraft

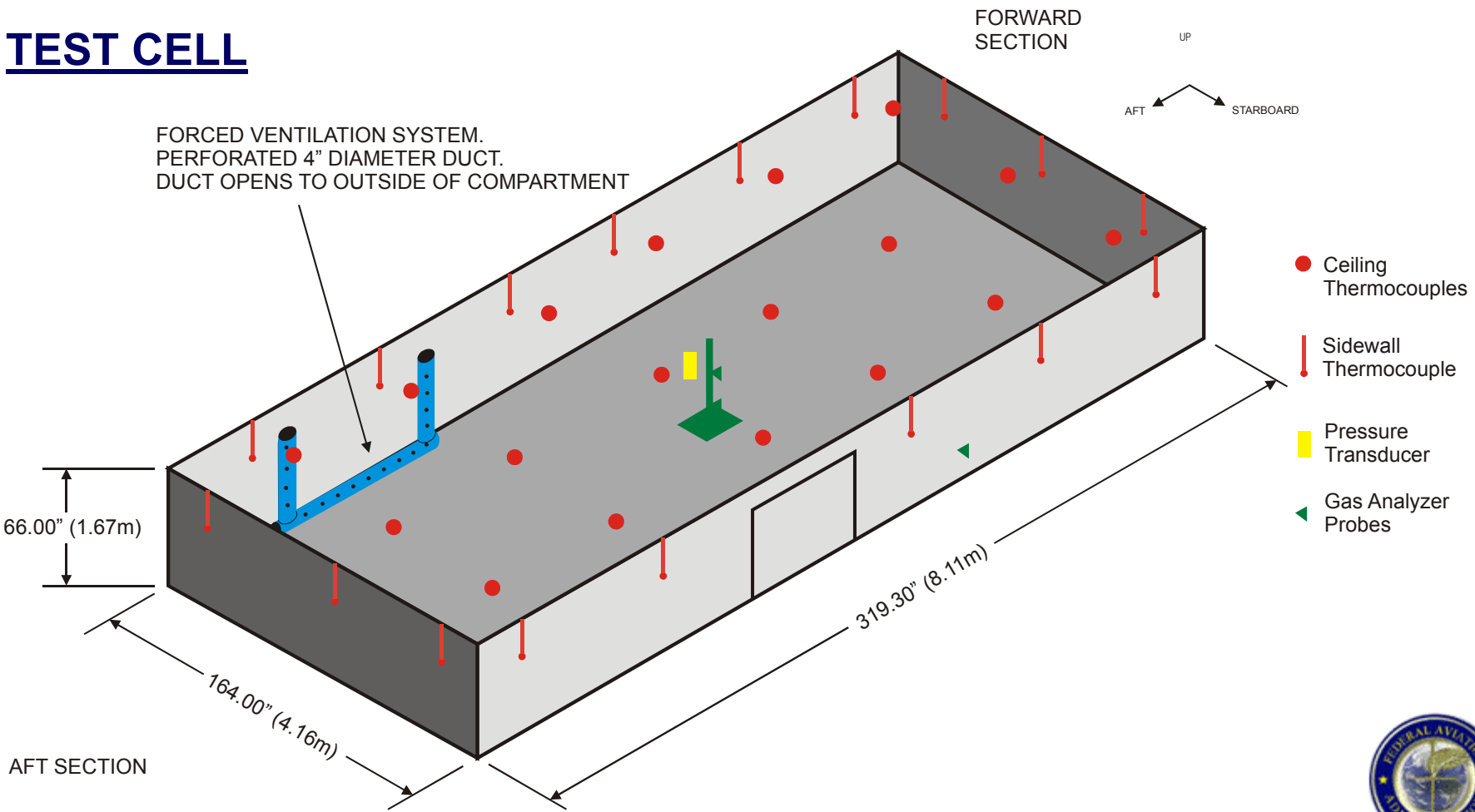
Cargo Compartment = 2000 ft^3

Leak Rate = 50 CFM (“U” Shape Ducts)

Instrumented with thermocouples, gas analyzers, and pressure transducers

TEST REQUIREMENTS

TEST CELL



TEST REQUIREMENTS

INSTRUMENTATION

- Thermocouples –
  - Type K chromel/alumel, 22 gauge.
  - To be mounted 1.00” below the cargo ceiling with a maximum horizontal distance of 60.00”
  - To be mounted 12.00” below the ceiling on the sidewalls with a maximum horizontal distance of 60.00”

TEST REQUIREMENTS

INSTRUMENTATION (CONT.)

- Fire Suppression Agent Analyzer –
  - Must be a continuous reading analyzer (at least 0.2 Hz)
  - Accuracy: +/-5% of reading
  - To measure the agent volumetric concentration, density, particle size, or any other type of measurable parameter.
  - Multiple vertical sampling probes (No averaging)

TEST REQUIREMENTS

INSTRUMENTATION (CONT.)

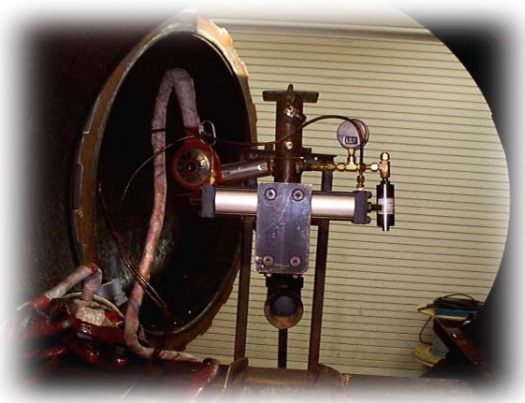
- **Pressure Transducer –**
  - **Frequency Response: at least 3000 Hz**
  - **Pressure Range: maximum 0-50 psig**

FIRE SCENARIOS

Bulk Load Fires

Containerized Fires

Flammable Liquid Fires



Aerosol Can Explosion Simulation

BULK LOAD

Fire Load = 178 card board boxes (30% of Vol.) containing 2.5 lbs of shredded office paper (strips, not confetti) at standard room temp.

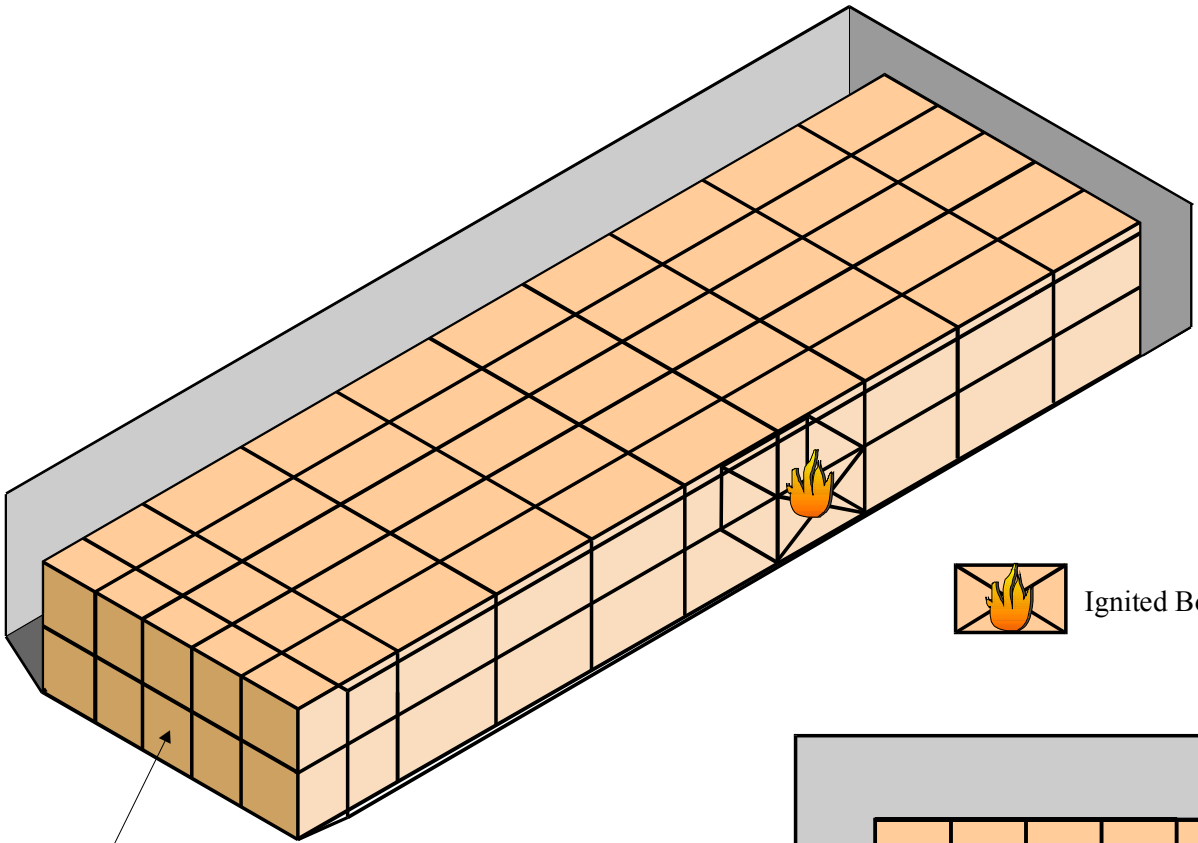
Boxes nominal dimensions: 18'x18"x18"

Fire Ignition = 7 ft of nichrome wire wrapped around four folded paper towels (Energized with 120 Vac) inside box (with 1" holes).

Fire Suppression System Activation = 1 minute after one of the ceiling T/C reaches 200 ^{o}F

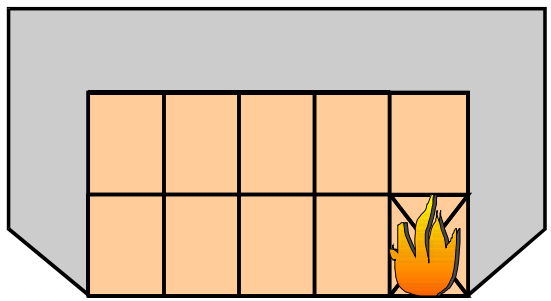
Test Duration = Four tests @ 30 minutes each; fifth test shall for at least 180 minutes. Hybrid systems shall run for 180 min.

BULK LOAD



178 Cardboard Boxes

Ignited Box



CONTAINERIZED

Fire Load = 33 card board boxes inside an LD3. 3 LD3 in Compartment

Two ventilation slots in main LD3 container size 12” x 3” +/-1/4 (access panel, and lower right panel)

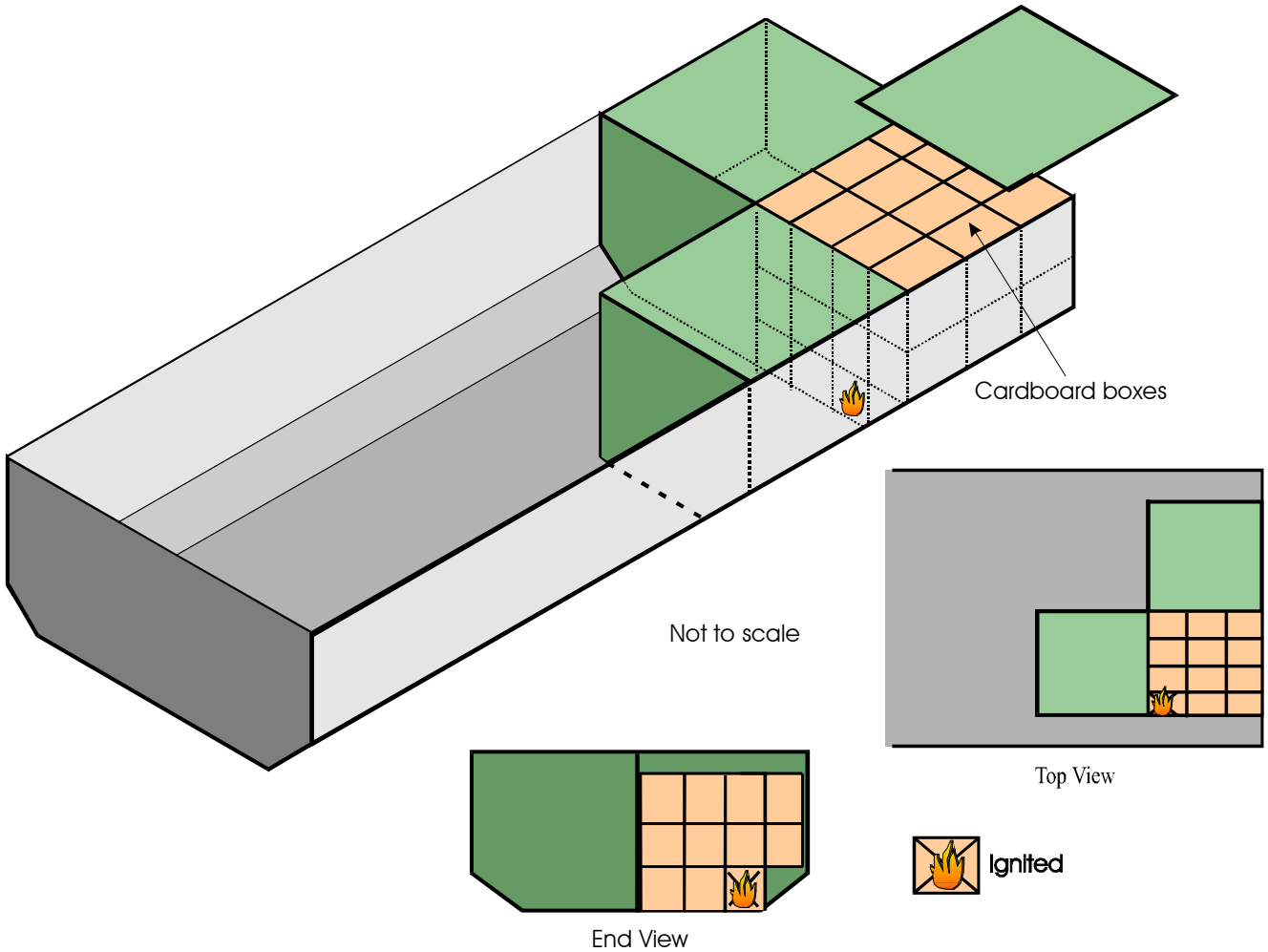
The LD3 access panel is made out of 0.08” polycarbonate sheet

Fire Ignition = 7 ft of nichrome wire wrapped around four folded paper towels (Energized with 120 Vac)

FSS Activation = 1 min. after one of the ceiling T/C reaches 200 ^{o}F

Test Duration = Four tests @ 30 minutes each; fifth test shall for at least 180 minutes. Hybrid systems shall run for 180 min.

CONTAINERIZED



SURFACE BURN

Fire Load = 0.5 U.S. Gallon of Jet A fuel (with 13 oz of gasoline) inside A 2 ft x 2 ft x 0.33 ft pan

Add 13 oz of gasoline to make ignition easier; add 2.5 gallons of water to reduce pan warping.

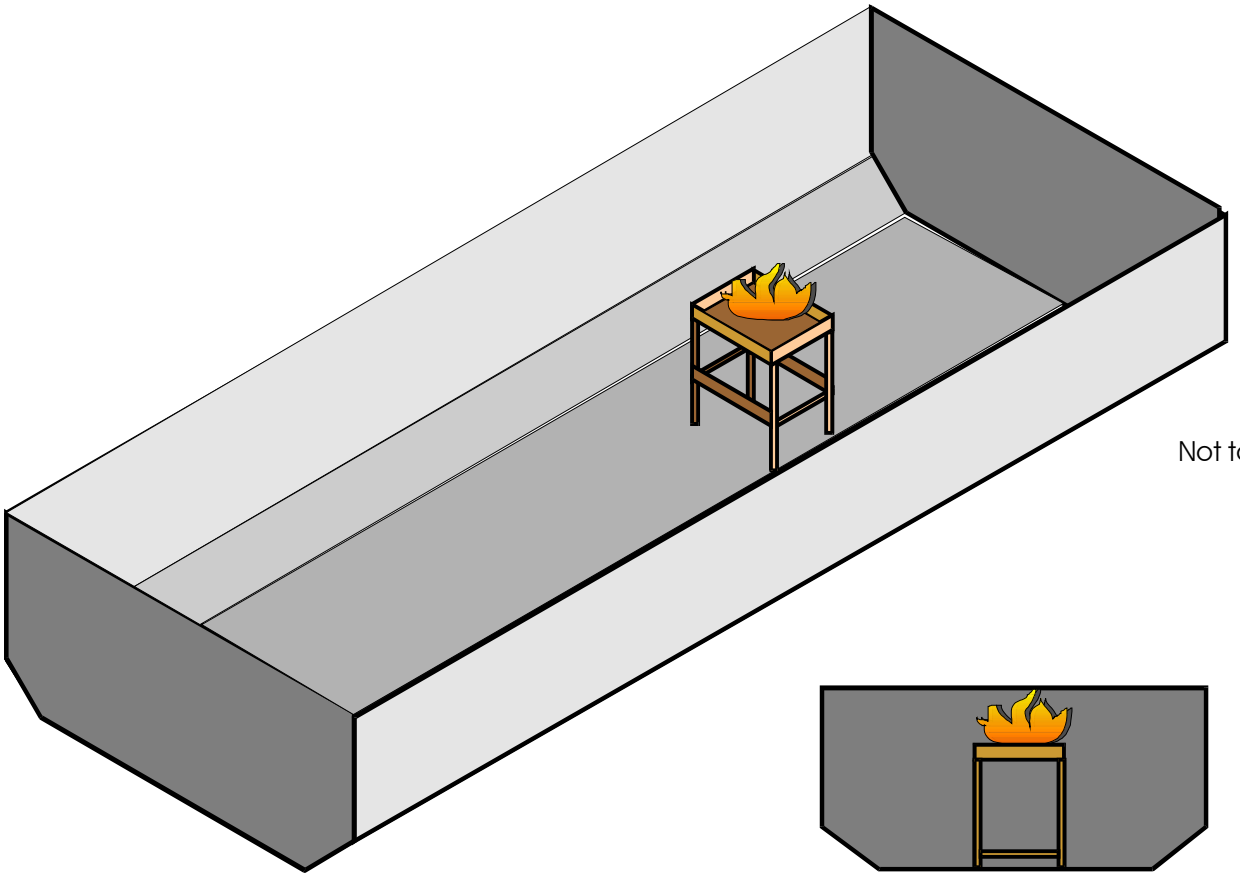
Place pan in most difficult location (1 ft)

Fire Ignition = Arc created by two electrodes

FSS Activation = 1 min. after one of the ceiling T/C reaches 200 °F

Test Duration = 5 minutes after agent discharge

SURFACE BURN

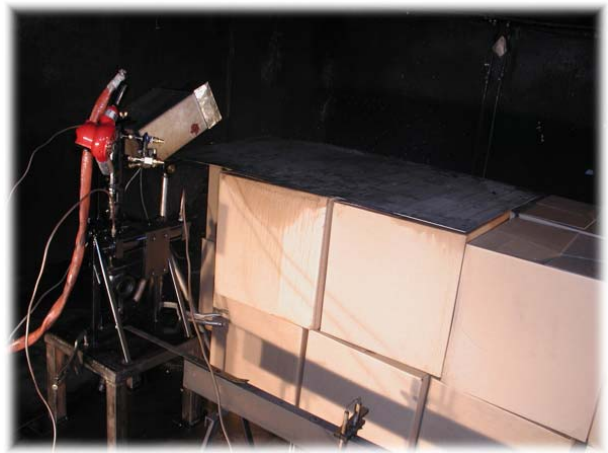


Not to scale

End View

AEROSOL EXPLOSION

Fire Load:
Simulator - 0.2 lb. Propane, 0.6 lb. of denatured alcohol, 0.2 lb of water
Cargo Bay - 59 cardboard boxes



Ignition Sources = Nichrome wire/paper towel and electrodes (away from sim)

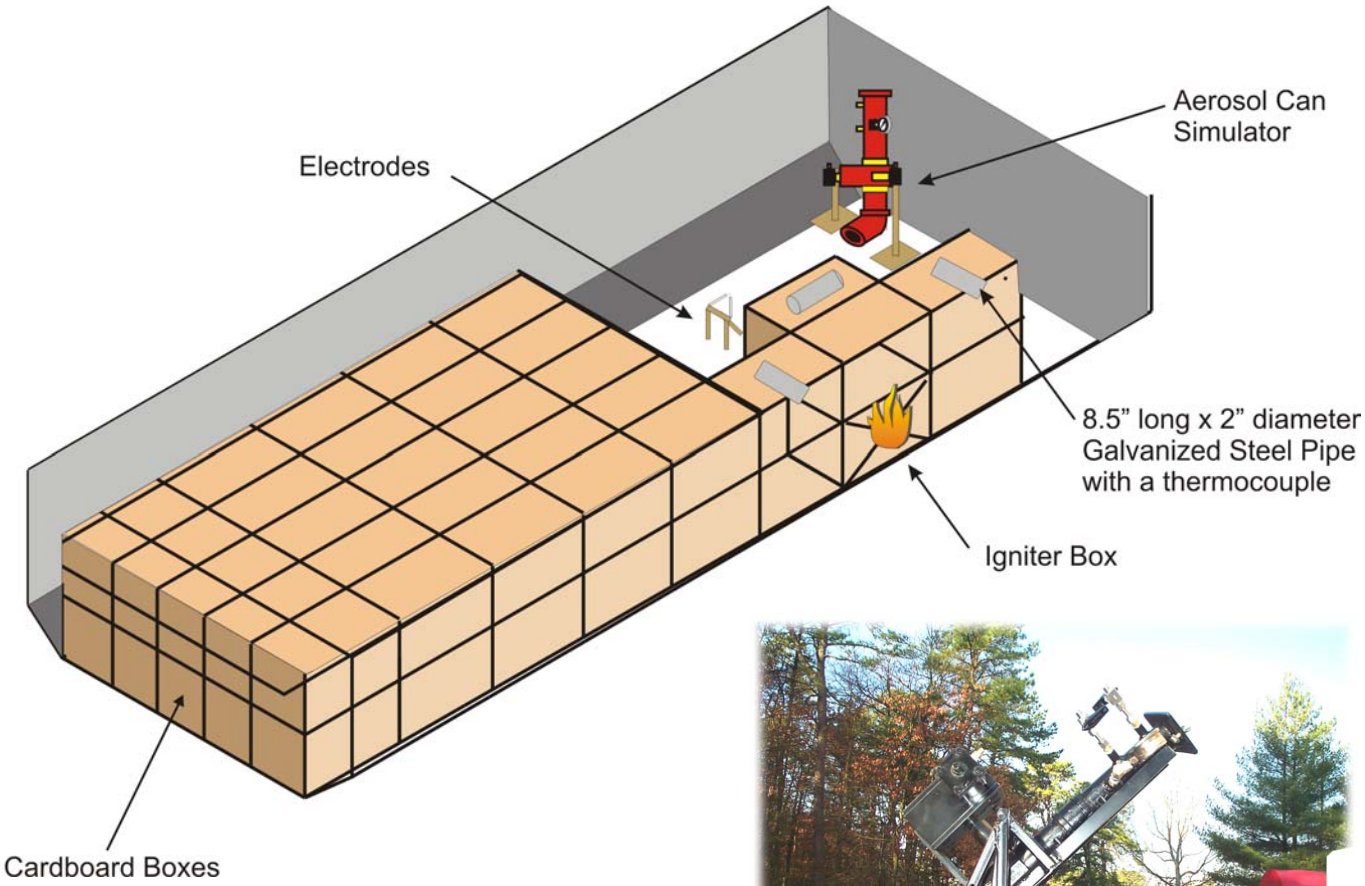
FSS Activation = 1 min. after one of the ceiling T/C reaches 200 ^{o}F

Heat up simulator to increase pressure in content chamber to 240 psig

Aerosol Can Simulator Activation = 5 minutes after one of the TCs, attached to the pipes, reaches 400 degF.

Test Duration = shall be conducted for at least 180 minutes or until the simulator is activated

AEROSOL EXPLOSION



Aerosol Can Simulator

AEROSOL EXPLOSION

SHORT VERSION

Fire Load = 0.2 lb. Propane, 0.6 lb. of Denatured Alcohol, 0.2 lb of water

Ignition = Arc created by two electrodes (230 W) that are 2 ft from the floor and 3 ft away from the simulator

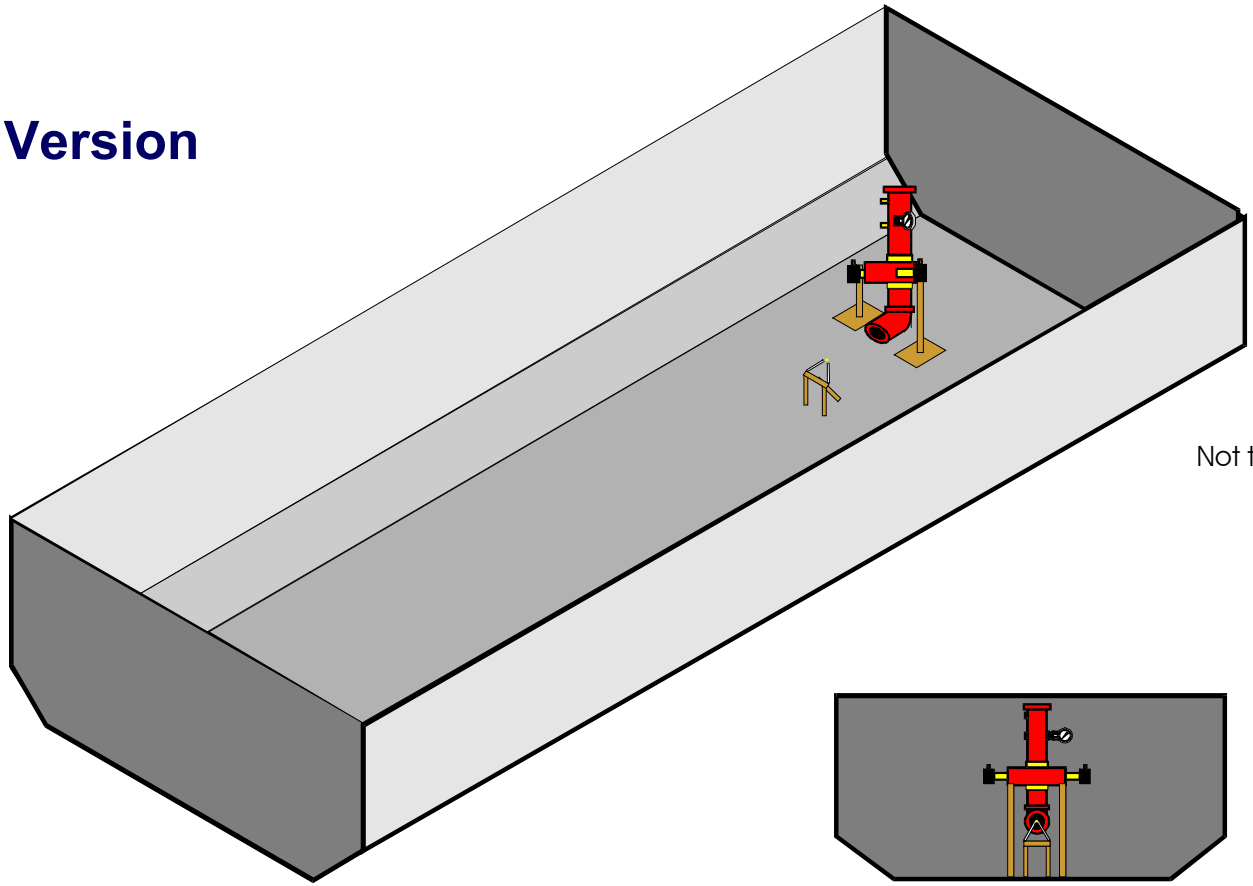
Test Initiation = Discharge agent and allow 2 minutes for dispersion

Simulator Activation = When the agent, at 2 feet from the floor, is at the minimum protection concentration (must be measured)

Test Duration = shall be conducted for at least 180 minutes or until the simulator is activated

AEROSOL EXPLOSION

Short Version



Not to scale

End View

TEST REQUIREMENTS

SUPPRESSION SYSTEM DESIGN

- The FSS to be installed in an aircraft shall be based on the results of the MPS tests.

- The minimum agent concentrations that meet the MPS shall be measured objectively, not extrapolated.

- Extrapolation of data to account for the required duration and analysis for cargo load configurations are acceptable provided there is sufficient test data to support it.

- Airplane design initial knockdown and sustained agent concentrations for the duration of a diversion, accounting for leakage rates in an empty compartment, must be demonstrated to be equal to or greater than that established in the MPS

TEST REQUIREMENTS

SUPPRESSION SYSTEM DESIGN (CONT.)

- The method of measuring the concentration of agent in the required flight shall not use the arithmetic average of the gas analyzer probes.

- The following table provides a synopsis of the required arirplane design minimum fire protection when associated with the four MPS test scenarios:

MPS Test	Airplane Design Minimum Knockdown Concentration is MPS Test Demonstrated Maximum Concentration for Knockdown of:	Airplane Design Minimum Sustained Concentration is MPS Test Demonstrated Maximum Concentration to:
Bulk-Load Test	Flames	Maintained Continued Fire Suppression
Containerized Test	Flames	Maintained Continued Fire Suppression
Surface Burn Test	Flames	Prevent Re-Ignition of Class-B Fire
Aerosol Can Explosion	Flames (Long Version)	Prevent Hydrocarbon Explosion

TEST REQUIREMENTS

MINIMUM AGENT CONCENTRATION AND SYSTEM CONFIGURATION

- The minimum agent concentration (knockdown and sustained) or system configuration shall be dictated by the fire protection system performance during the MPS tests.

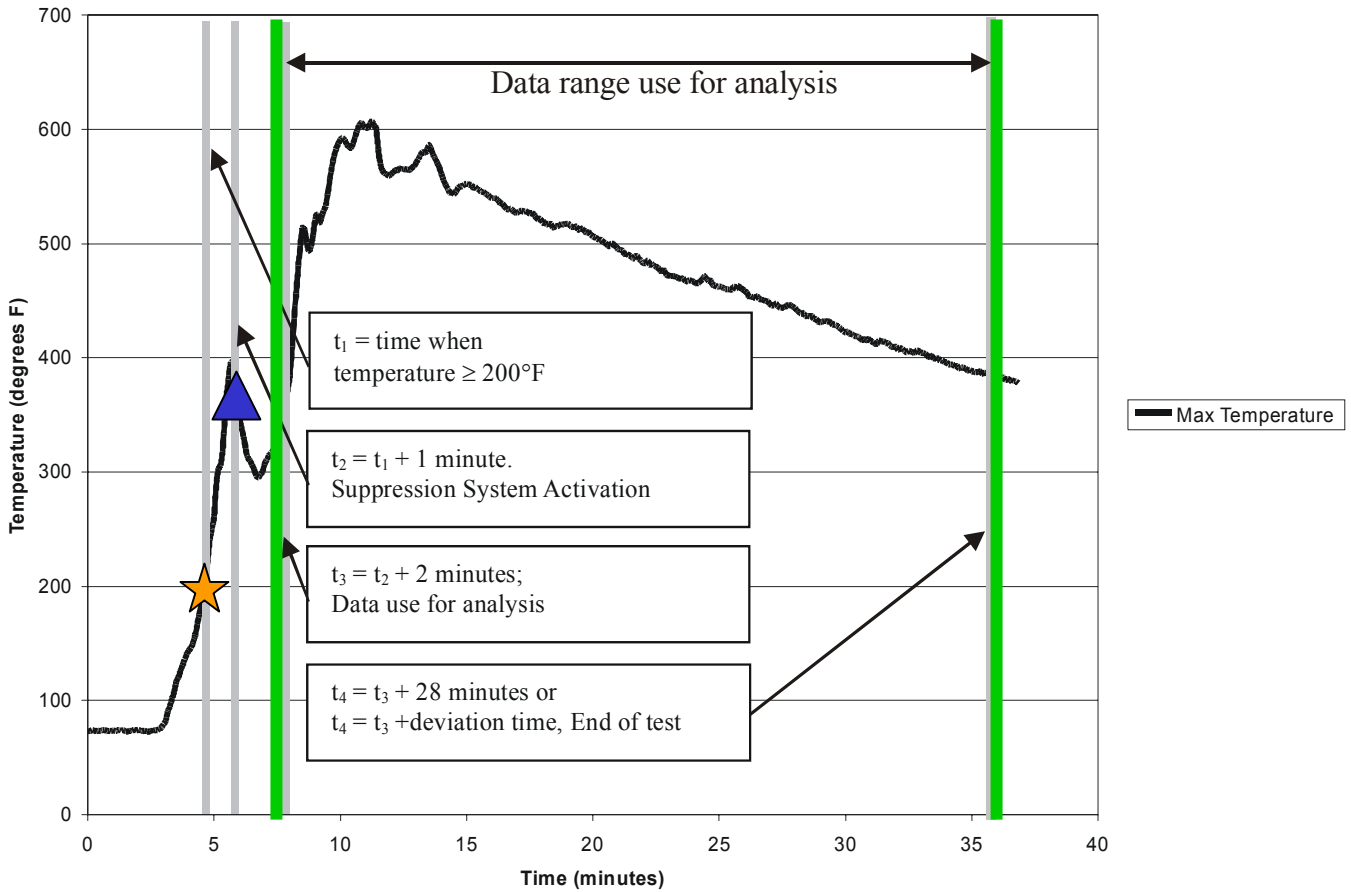
- These minimum values will be based (measured objectively) on an empty 2000 ft3 cargo compartment.

- The minimum selected value or configuration shall be the one that was capable of suppressing/inerting all of the four MPS fire threats.

- Minimum agent concentrations/system configuration must be verified in a non-fire test in a discharge identical to the agent discharge in an actual fire test.

ACCEPTANCE CRITERIA

For Bulk Load, Containerized, Surface Burn Tests Only



ACCEPTANCE CRITERIA

FIRE SCENARIO	MAXIMUM TEMPERATURE °F (°C)	MAXIMUM TIME-TEMPERATURE AREA °F -MIN (°C-MIN)	PRESSURE PSIG (KPa)	COMMENTS
Bulk Load	720 (382)	9940 (5504)	N/A	Use the data that is between 2 minutes and 30 minutes after suppression system activation. See figure 11.
Containerized Load	650 (343)	14040 (7782)	N/A	Use the data that is between 2 minutes and 30 minutes after suppression system activation. See figure 11.
Surface Burn	570 (299)	1230 (665)	N/A	Use the data that is between 2 minutes and 5 minutes after suppression system activation.
Aerosol Explosion	N/A	N/A	0	There shall be no evidence of an explosion.