THE FIRE PROTECTION RESEARCH FOUNDATION

Obstructions and ESFR Sprinklers

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Outline

- Introduction
- ESFR Sprinkler Design Concept
- Previous Actual Delivered Density Testing
- Proposed Actual Delivered Density Testing
- Proposed Full-scale Testing
- Questions

Introduction

- Project Goal: Develop a tool which can be used to provide a reliable analysis of the impact of obstructions on ESFR sprinkler performance.
  - Existing data
  - New fire testing/analysis
- Phase I of the project included:
  - Literature review
  - GAP analysis
  - Test plan development
- Phase II of the project includes:
  - Actual Delivered Density testing
  - Full-scale fire testing
- The results of the project will be provided to the NFPA 13 Technical Committee to develop requirements for inclusion in the standard.

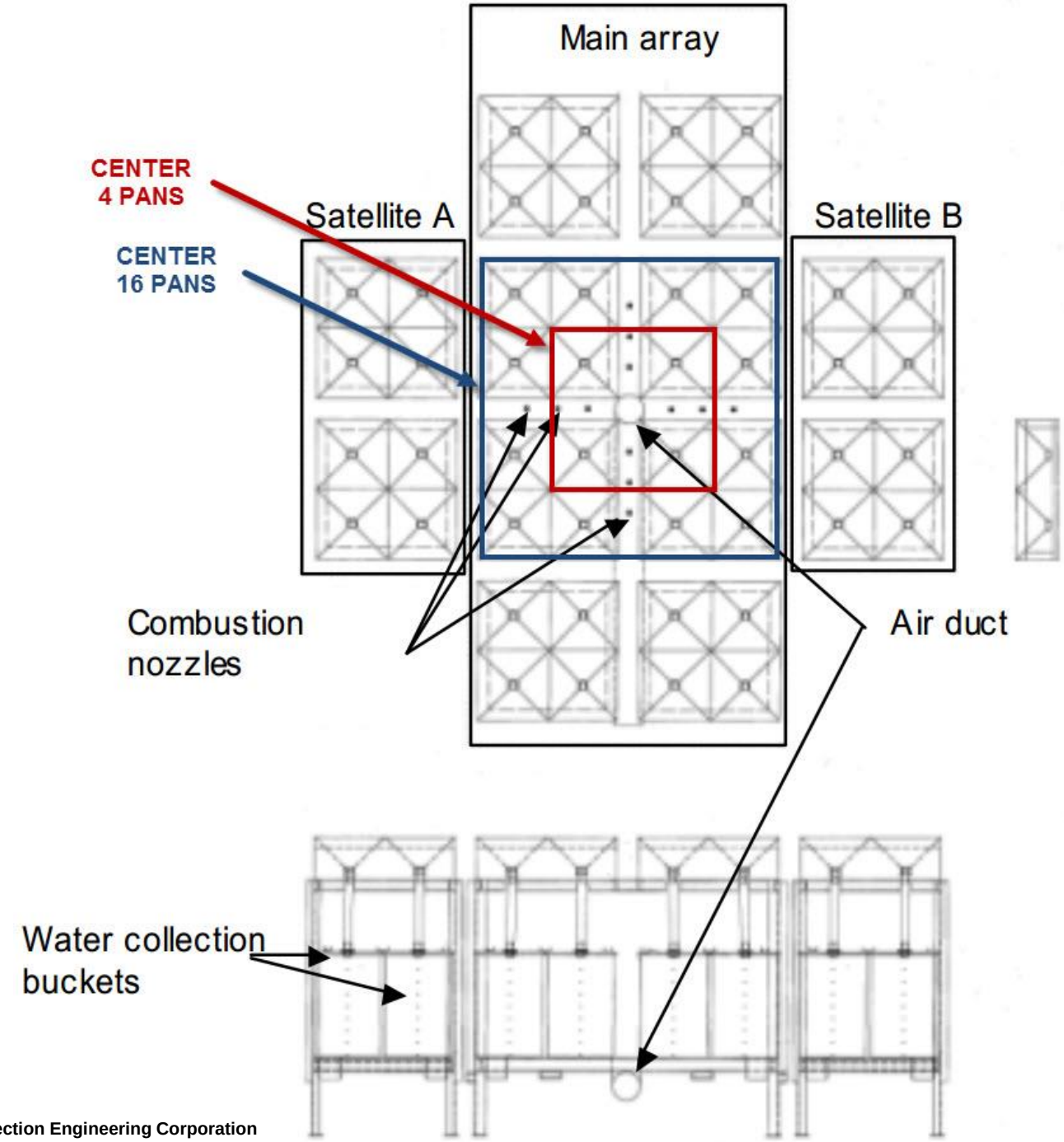
ESFR Sprinkler Design Concept

ADD > RDD = Fire Suppression

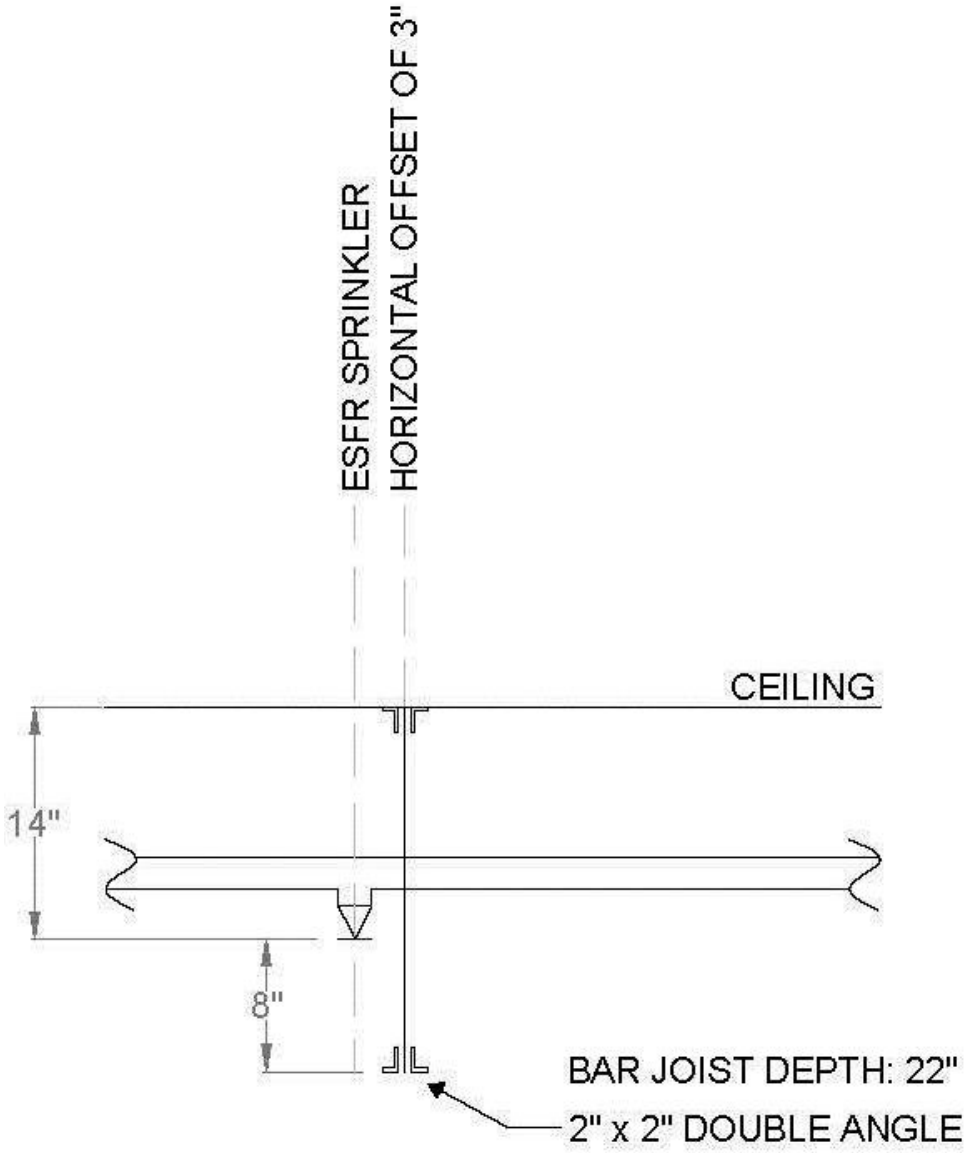
Where:

ADD - Actual Delivered Density (gpm/sq. ft.)
RDD - Required Delivered Density (gpm/sq. ft.)

ESFR Sprinkler Head Obstruction Demo



Bar Joist Obstruction ADD Testing – Mammoser & McCormick, UL



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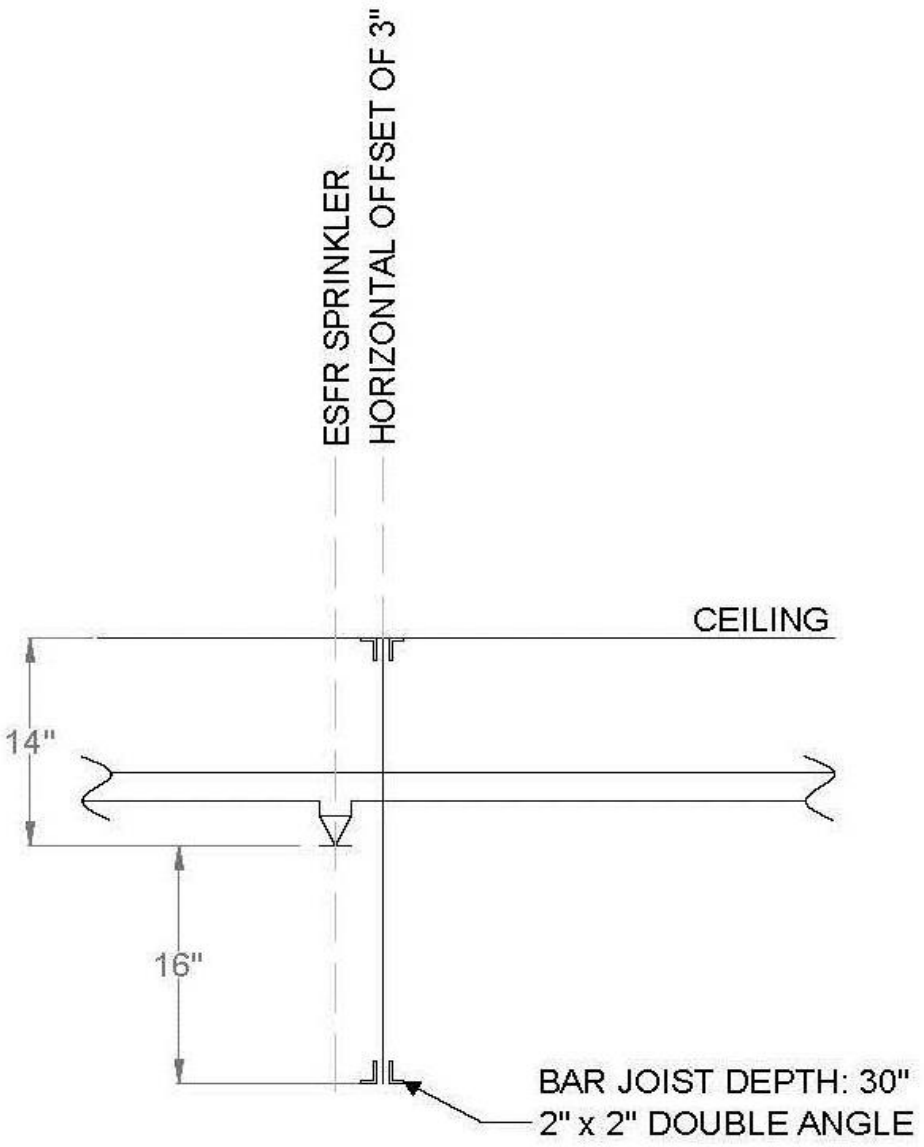

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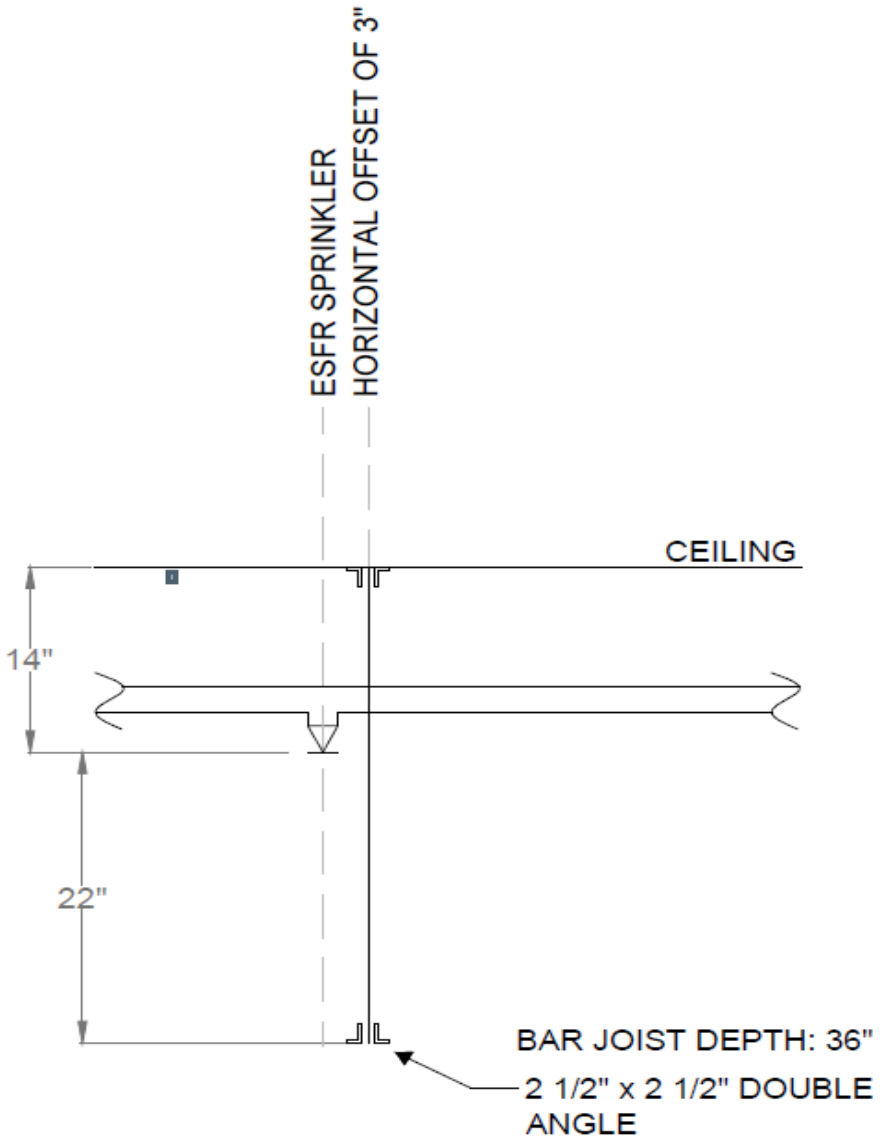
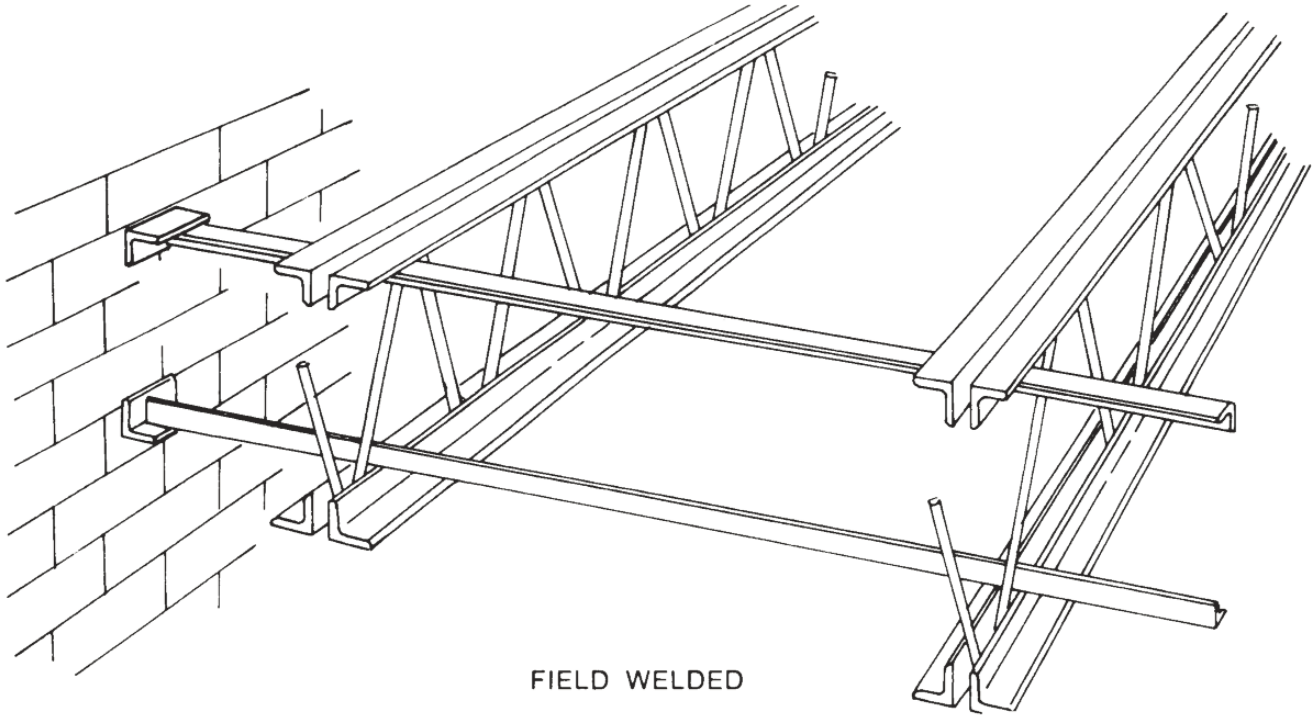


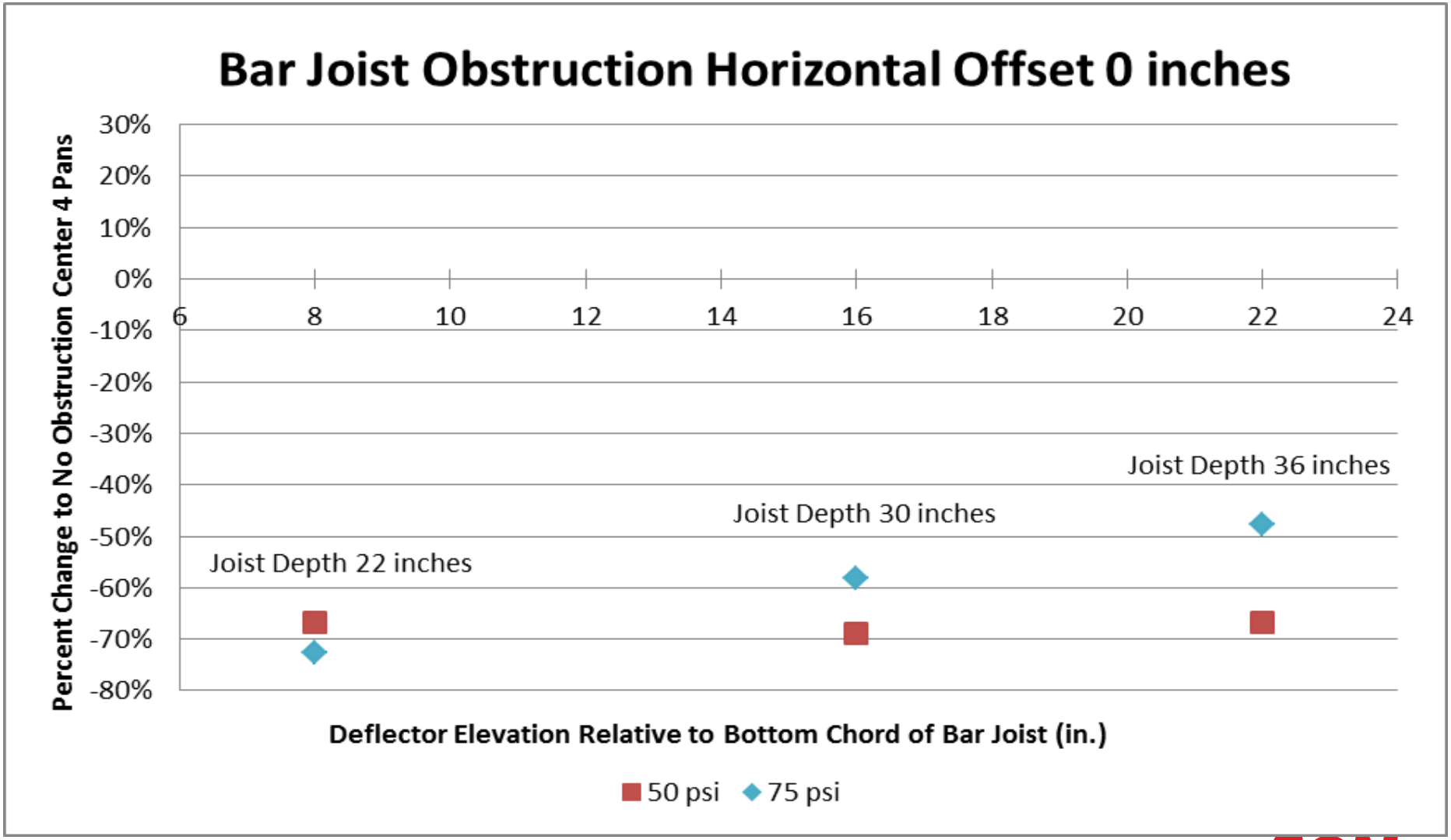
Bar Joist and Bridging Member Diagram



ADD Testing Parameters – Mammoser & McCormick, UL

Bar Joist Depth (In)	Bar Joist Offset (In)	Ceiling to Apparatus Top (Ft)	Fire Size (MW)	Fire Location	Sprinkler Type	Discharge Pressure (PSI)
22,30,36	0,3,6	10	1.5	Centered under one sprinkler	ESFR K-14	50, 75

Actual Delivered Density (ADD) Testing – Mammoser & McCormick, UL



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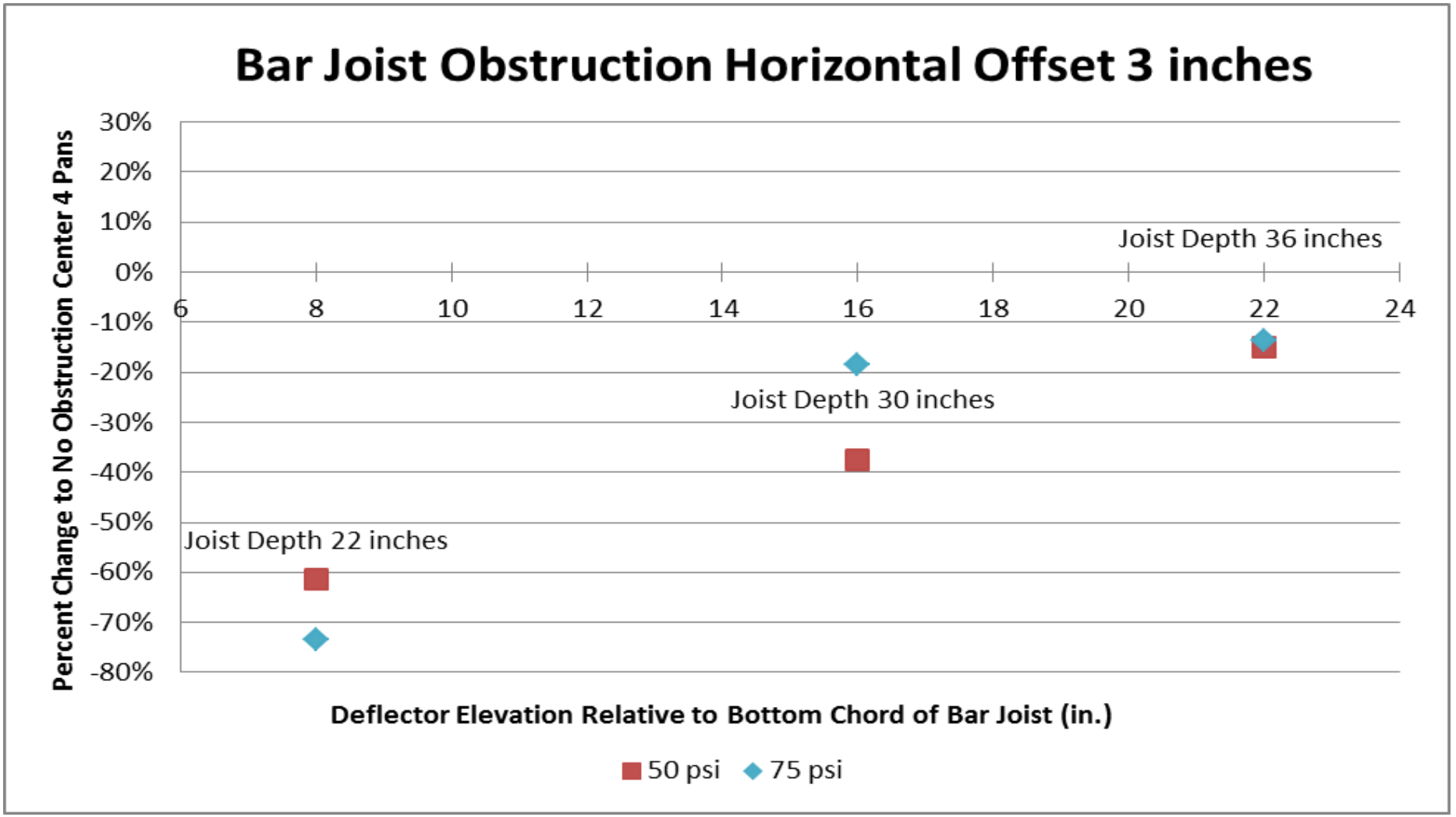


Actual Delivered Density (ADD) Testing

Goal: Determine the ESFR K17 sprinkler to be used in the full scale testing.

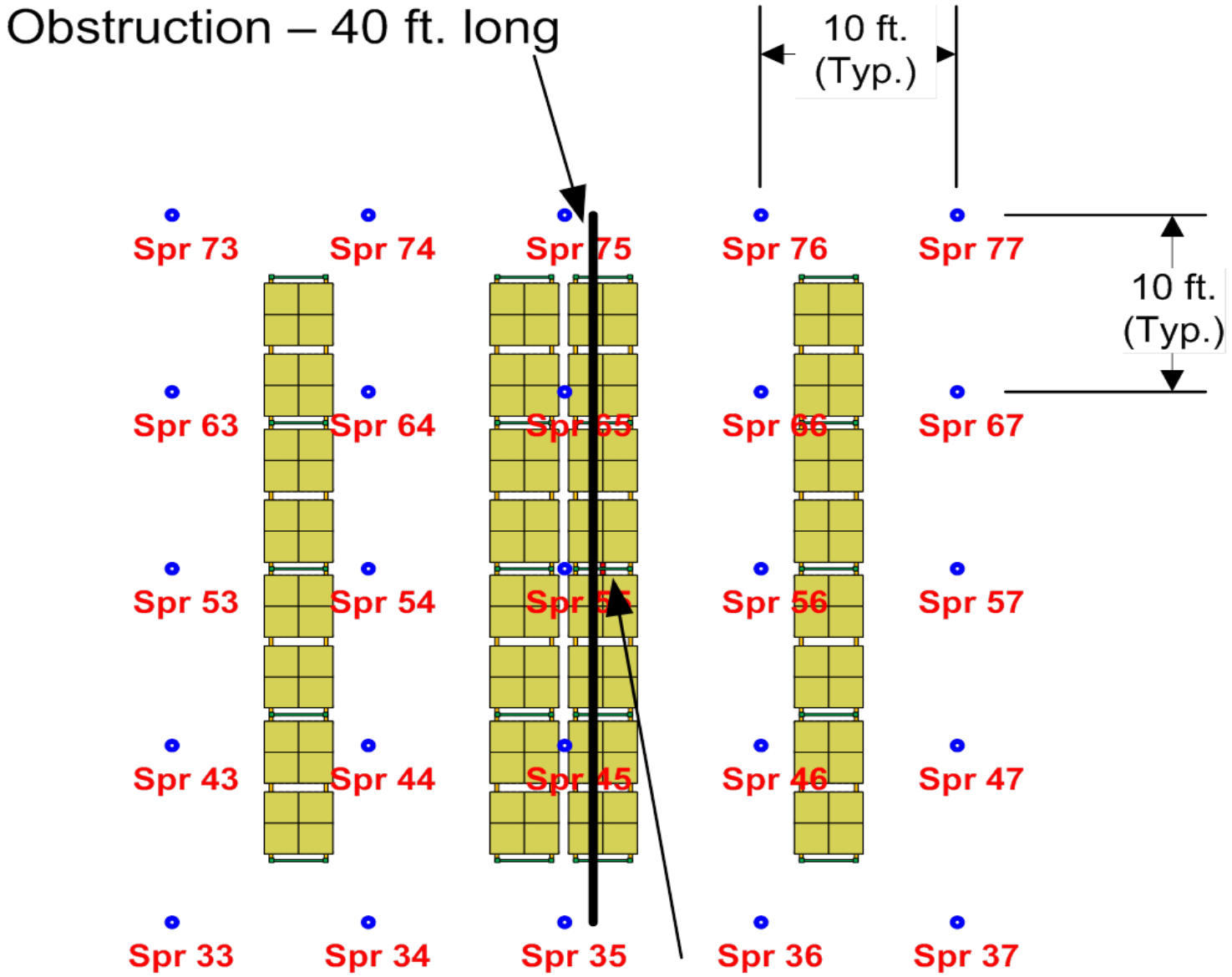
- ADD testing of three different manufacturers' ESFR sprinklers:
  - Tyco
  - Reliable
  - Viking
- Apparatus – UL Third Generation ADD Apparatus
- Fire Size – 2.5 MW fire to simulate the heat release rate of the 30 Ft. Group A plastic commodity in full scale test.
- The first series of tests will be used to establish the sprinkler with the strongest center core ADD. This sprinkler will then be further tested in more scenarios. A total of 22 tests will be completed.

ADD Testing Parameters

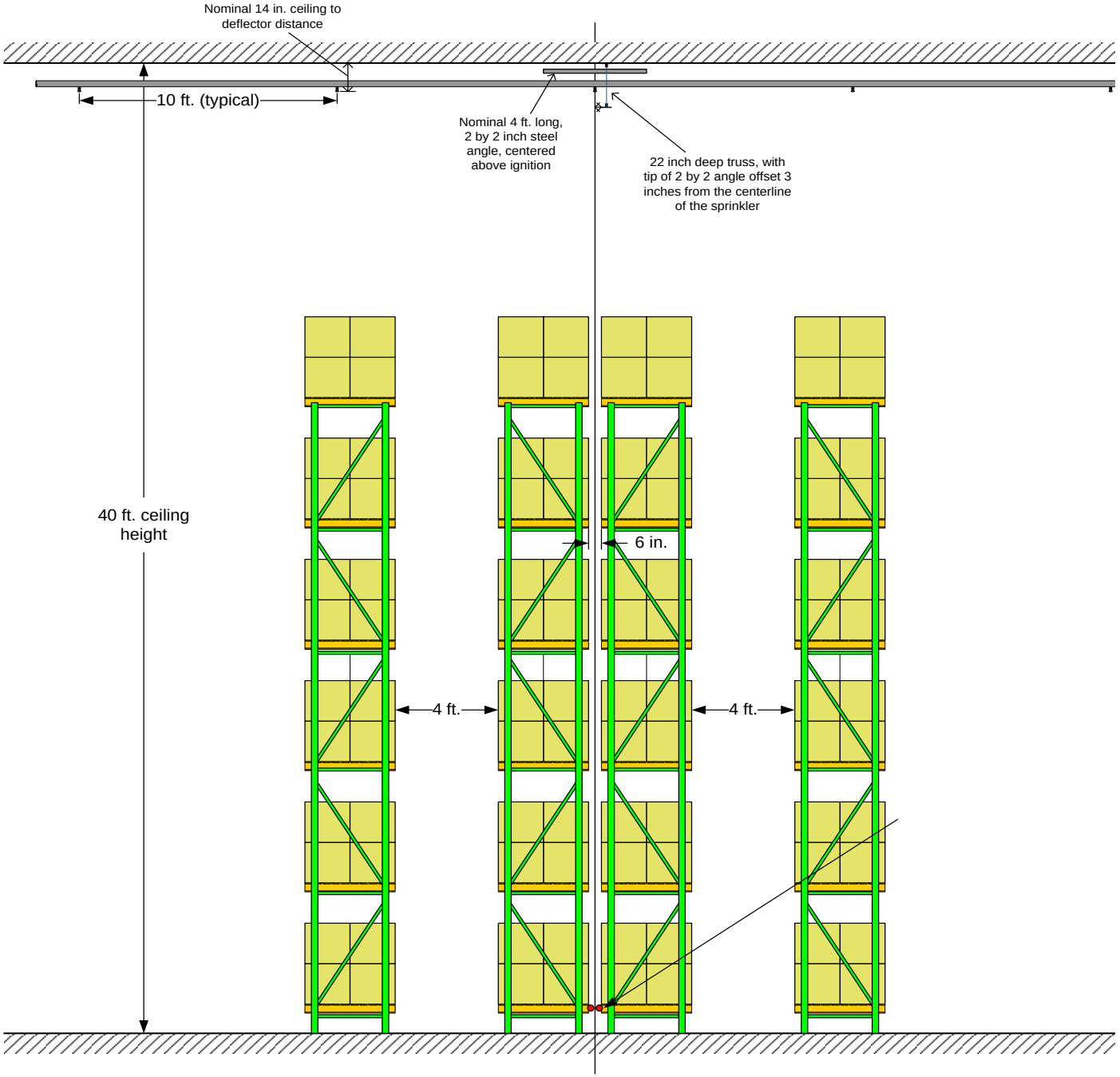
Bar Joist Depth (In)	Bar Joist Offset (In)	Ceiling to Apparatus Top (Ft)	Fire Size (MW)	Fire Location	Sprinkler Type	Discharge Pressure (PSI)
22,30,36	0,3,6	10	2.5	Centered under one sprinkler	ESFR K-17	52

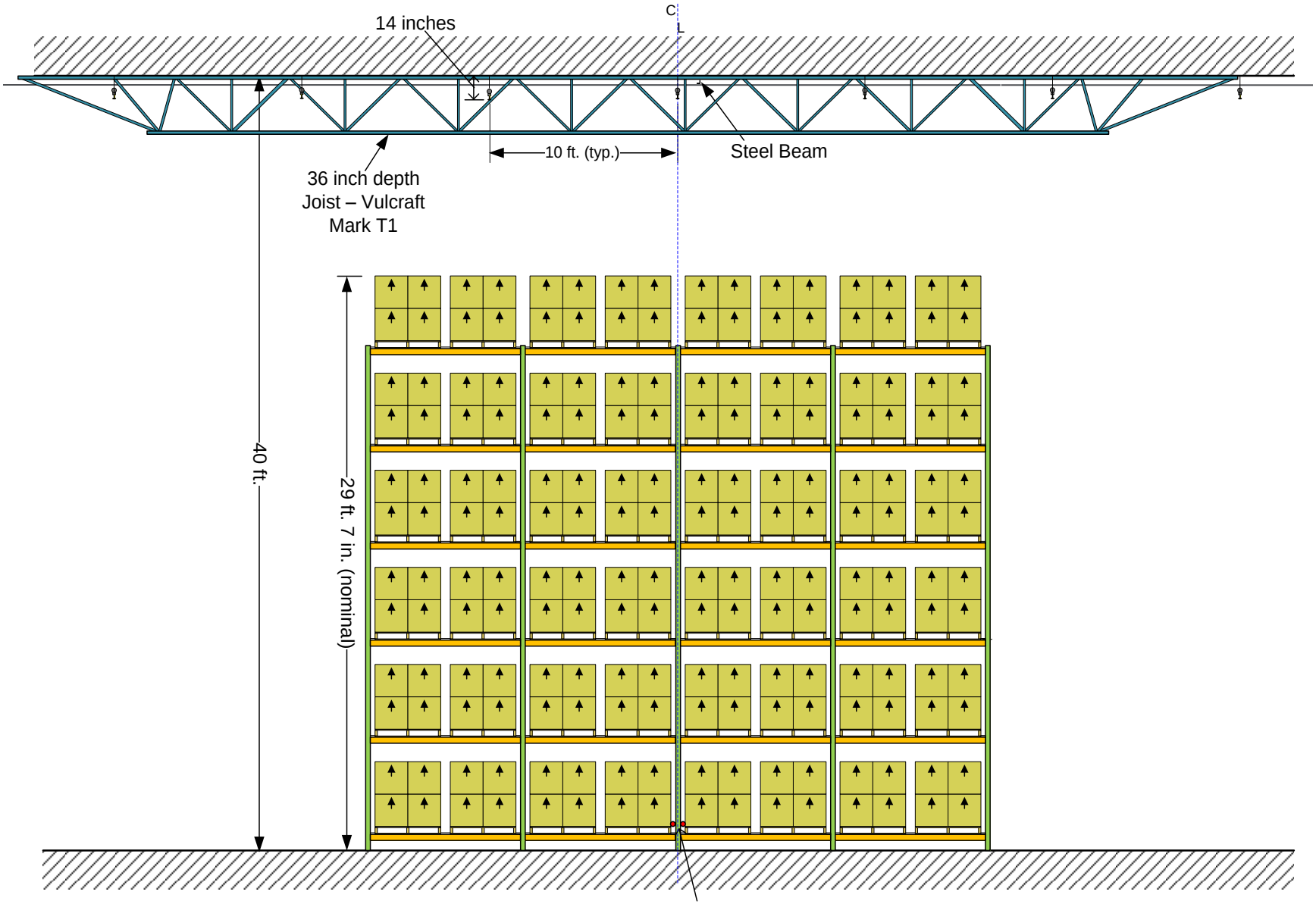
ESFR Full Scale Testing Overview

- Test Array
  - Standard Group A commodity
  - 30 ft. storage, 40 ft. ceiling
  - Double row racks, 6 in. longitudinal and transverse flue space
  - ESFR K17 sprinklers, 52 psi
  - 4 ft. aisles
  - 4 bay target arrays
  - Sprinkler spacing 10 ft. x 10 ft.
  - The ignition point will be under one sprinkler at the intersection of the transverse and longitudinal flues in the pinwheel configuration.

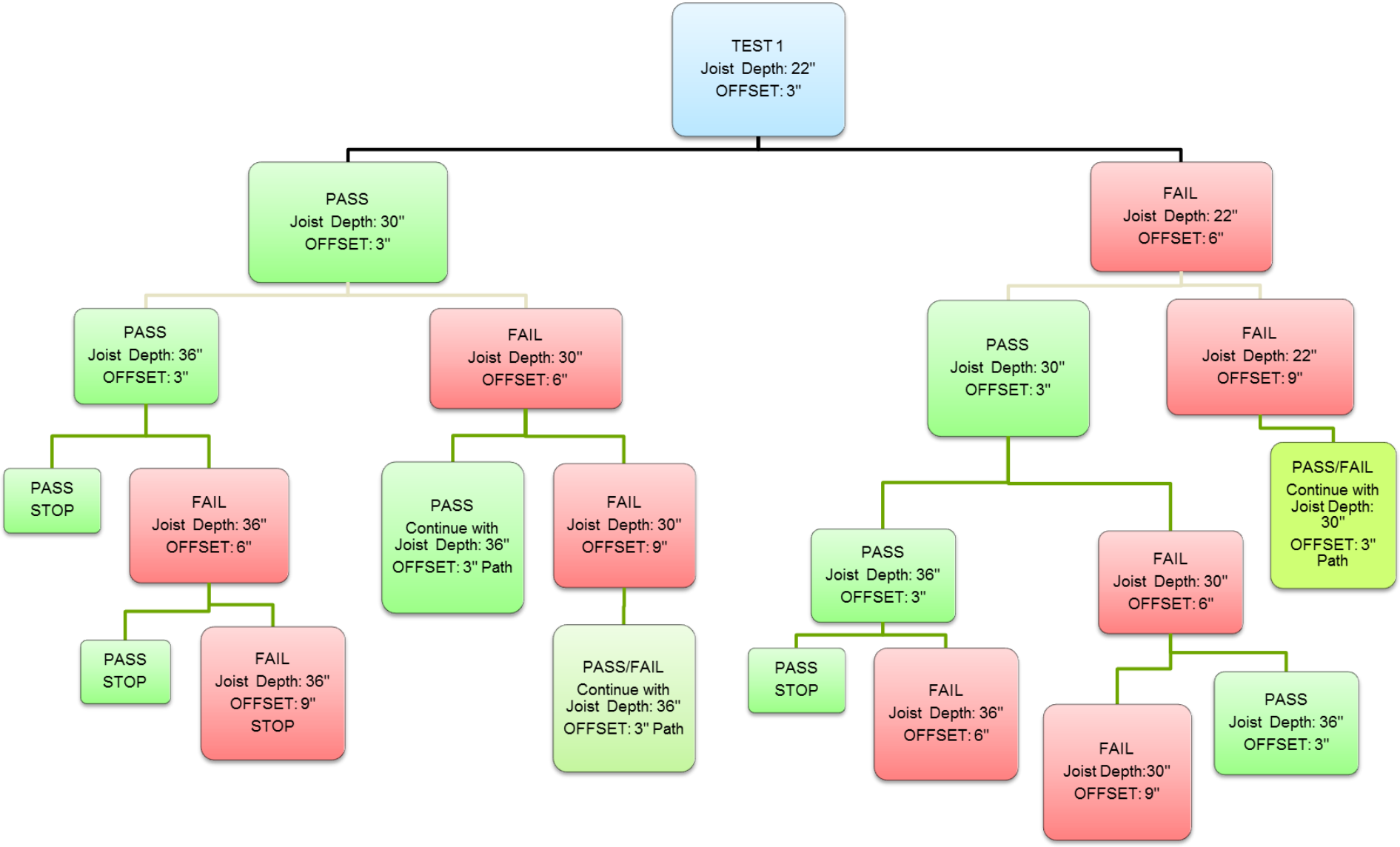


Plan View of Test Arrangement – 4 Bay Targets with Single Line Obstruction


Nominal 14 in. ceiling to deflector distance
10 ft. (typical)
Nominal 4 ft. long, 2 by 2 inch steel angle, centered above ignition
22 inch deep truss, with tip of 2 by 2 angle offset 3 inches from the centerline of the sprinkler
40 ft. ceiling height
6 in.
4 ft.
4 ft.

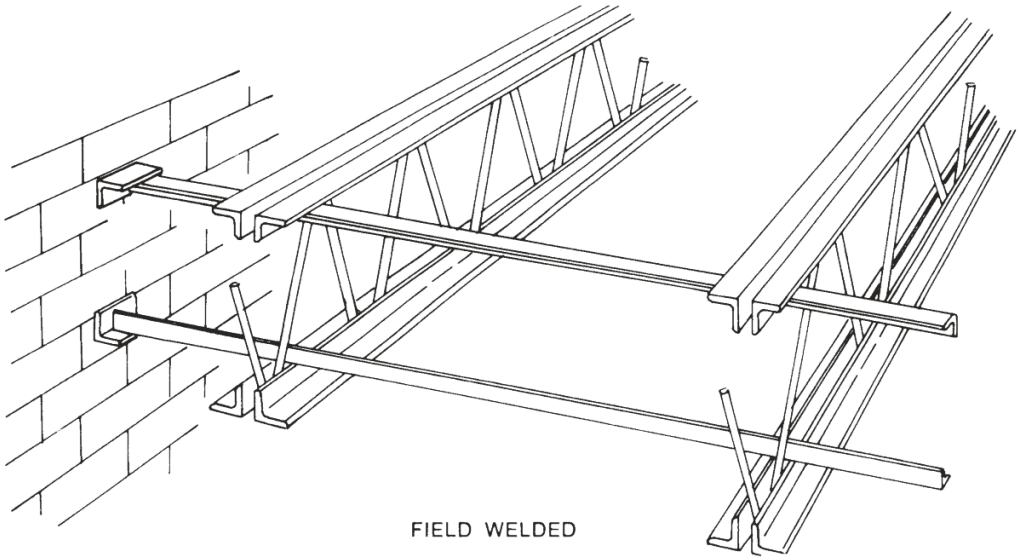

14 inches
C
L
10 ft. (typ.)
Steel Beam
36 inch depth
Joist – Vulcraft
Mark T1
40 ft.
29 ft. 7 in. (nominal)

Full Scale Testing – Bar Joist Obstructions



Full Scale Testing – Bridging Member Obstructions

- The most rigorous successful bar joist depth and offset will be used in the initial bridging member test arrangement.
- The bridging member will be located on the bar joist with variable offsets that increase if the test results in a failure.
- The bridging members will have an initial offset from the sprinkler of 0 inches that can be increased to 3, 6, and 9 inches.



Pass/Fail Criteria for Full Scale ESFR Tests

- The following pass/fail criteria were established:
  - A maximum of eight sprinklers activate
  - The fire is generally contained to the ignition array
  - Ceiling gas temperatures are such that exposed structural steel would not be endangered (peak one minute average temperatures less than 1,000˚ F)

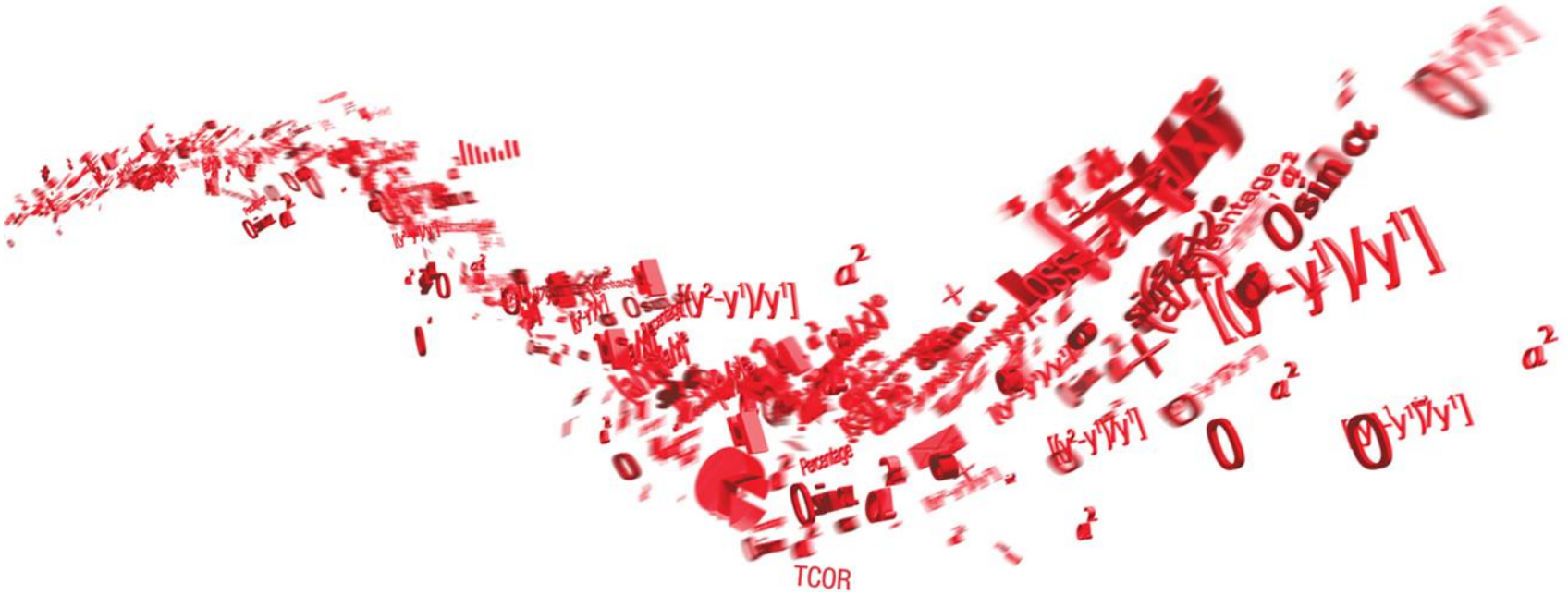
Conclusion

A test plan has been developed which will allow measurement of the sensitivity of ESFR K17 sprinklers to near field obstructions.

This data should allow the NFPA 13 committee to develop scientifically based requirements for inclusion in the standard.

Data is still needed for various other obstruction situations such as miscellaneous piping, light fixtures, or duct work.

Questions and Answers



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