Equivalent Protection Schemes for Fire Sprinkler Systems
Full-Scale Fire Testing for Performance-Based Fire Protection
Why?

- The prescriptive solutions do not fit my needs
- Operations cannot Comply
- What is the actual hazard or risk?
- What is the return on investment?
Why?

Old / Current

Proposed / New
The Challenge?
The Challenge?

What is the actual hazard or risk?
Goals

Develop a performance based fire protection solution to provide:

- Improve Compliance
- Superior fire suppression in the event of an incident
- Operational flexibility for maximum Product height in the fixture
- Remove sprinklers from inside the Array (between levels) to allow for more compact fixture
- Limit impact of fire sprinkler modifications to the lower level of the in rack sprinklers
- Limit or eliminate need to modify overhead fire sprinkler system piping.
ELEVATION VIEW
IN-RACK FIRE SPRINKLER

DEFLECTORS TO BE APPROXIMATELY 1" BELOW HORIZONTAL BARRIER

1/2" VERTICAL PLYWOOD BARRIER TO BOTTOM OF HORIZONTAL BARRIER
1/2" VERTICAL PLYWOOD BARRIER TO TOP OF RACK UPRIGHT

165° EC-25 SPRINKLERS
LOWER LEVEL PLAN VIEW
IN-RACK FIRE SPRINKLER PLAN

½" PLYWOOD Lintel at
±8'-0" Aff, 8" Deep Across
Front Face and Between
Aerosol Racks

½" Vertical Plywood Barrier to Bottom of Horizontal Barrier

½" Vertical Plywood Barrier on Sides and 1
Large Scale Testing
# Test Parameters

<table>
<thead>
<tr>
<th>Test Date</th>
<th>January 25, 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test Parameters</strong></td>
<td></td>
</tr>
<tr>
<td>Storage Type</td>
<td>Double Row Rack with Retail Display</td>
</tr>
<tr>
<td>Commodity Type</td>
<td>Level 3 Aerosols</td>
</tr>
<tr>
<td>Pallet Type</td>
<td>42x42 Partial 4-way entry Oak pallet</td>
</tr>
<tr>
<td>Retail Enclosure Within Rack</td>
<td>1/2 inch Plywood dividing 2-8 ft sections and 4 sides with all seams filled or taped with only opening on aisle side; rack uprights filled with insulation at transition to storage level above enclosure</td>
</tr>
<tr>
<td>Nominal Storage Height, ft.</td>
<td>16</td>
</tr>
<tr>
<td>Ceiling Height, ft.</td>
<td>27</td>
</tr>
<tr>
<td>Deflector to Plywood Barrier, in</td>
<td>1</td>
</tr>
<tr>
<td>Aisle Width, ft.</td>
<td>8</td>
</tr>
<tr>
<td>Ignition Location</td>
<td>Between 2 Sprinklers on floor behind 1st layer of display cut cartons</td>
</tr>
<tr>
<td>Sprinkler Type</td>
<td>K = 25.2 Extended Coverage Upright</td>
</tr>
<tr>
<td>Deflector to Commodity, in</td>
<td>12 (nominal)</td>
</tr>
<tr>
<td>Sprinkler Spacing, ft.</td>
<td>4 ft. (symmetrical in each 8 ft. retail rack bay</td>
</tr>
<tr>
<td>Temperature Rating, F</td>
<td>165</td>
</tr>
<tr>
<td>Sprinkler Response Type</td>
<td>QR (link)</td>
</tr>
<tr>
<td>Nominal Sprinkler Discharge</td>
<td>25.2</td>
</tr>
<tr>
<td>Nominal Discharge Pressure, psig</td>
<td>Declining - 32 (1st sprinkler); 20 (2nd sprinkler)</td>
</tr>
</tbody>
</table>
Sprinkler Hydraulic Calculations for Protection of the Aerosol Fixture will be based on In Rack Sprinkler protection only, based on a declining density calculation. Overhead sprinkler systems are not included in the calculations for the protection of the Aerosol products in the Aerosol Fixture. Four calculations will be provided including:

- One EC25 Sprinkler flowing 32 psi, plus 500 gpm hose allowance.
- Two EC25 Sprinklers each flowing 20 psi, plus 500 gpm hose allowance.
- Three EC25 Sprinklers each flowing 11 psi, plus 500 gpm hose allowance.
- Four EC25 Sprinklers each flowing 7 psi, plus 500 gpm hose allowance.
Aerosol (January 2018) Fire Test Video
# Test Results

<table>
<thead>
<tr>
<th>Test Results</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of Test, minutes</td>
<td>32</td>
</tr>
<tr>
<td>Number of Activated Ceiling</td>
<td>0</td>
</tr>
<tr>
<td>Peak Gas Temperature at Ceiling</td>
<td>135</td>
</tr>
<tr>
<td>Maximum 1 minute Average Gas</td>
<td>97</td>
</tr>
<tr>
<td>Peak Steel Temperature at Ceiling</td>
<td>72</td>
</tr>
<tr>
<td>Maximum 1 minute Average Steel</td>
<td>70</td>
</tr>
<tr>
<td>Fire Travel to Extremities of Test</td>
<td>No</td>
</tr>
<tr>
<td>Ignition of Target Commodity</td>
<td>No</td>
</tr>
</tbody>
</table>

**In Rack Sprinkler System**

| First Sprinkler Operation Time, min:sec          | 01:22 |
| Last Sprinkler Operation Time,                   | 04:50 |
| Number of Operated Sprinklers                    | 2 (out of 18 active in rack) |
Test Results
Test Results

Telgian Fire & Life Safety/Home Depot
Test 2 - 01/25/2017
K25.2 EC Sprinkler Temperatures
Inside Retail Fixture Enclosure
Telgian Fire & Life Safety/Home Depot
Test 2 - 01/25/2017
K5.6 QR Sprinkler Temperatures
Longitudinal Flue - Lower Line

Temperature (°C)

Time (Min)
Test Results

Telgian Fire & Life Safety/Home Depot
Test 2 - 01/25/2017
K16.8 SR 286F Ceiling Sprinkler Temperatures (13-18)
Test Results
Test Results

Additional features to note for this test arrangement are as follows:

- A total of 18 active in rack sprinklers were installed in the rack array for the test, including (4) K25.2 EC upright 165°F sprinklers within the retail enclosure and (9) K5.6 quick response upright 155°F sprinklers on both cross mains in the longitudinal flue (5 on the upper and 4 on the lower cross mains) as well as (5) K5.6 quick response upright 155°F sprinklers in the shelf above the retail display to protect cartoned aerosol stock.
- The rack sprinkler system was controlled to provide a declining pressure of 32, 20, 11 and 7 psig to the (4) K25.2 EC sprinklers.
- The ceiling was positioned at a nominal height of 27 ft.
- There were a total of 48 shelves within the retail display, each holding the maximum amount of 80 cans. (3840 cans).
- There were 6144 cans in total, including the retail shelf, floor stock and stock on the shelf above the display.
- Main array rack upright members were 42 in. wide, and beams were 8 ft., 3 in.

During the test, a total of 2 sprinklers operated. The first K25.2 EC sprinkler operated at 01:22 after ignition, and the 2nd and final K25.2 EC sprinkler in the same segregated retail enclosure operated at 04:50 after ignition. The adjacent (2) K25.2 EC sprinklers did not operate. None of the K5.6 sprinklers located above the retail enclosure operated. No ceiling sprinklers operated during the test, which continued for 32:00 before finally being manually extinguished. The horizontal fire travel within the retail sales display rack was limited to just one of the two 8 ft. display racks in the area where the ignition package was located. There was no ignition of the target commodity nor any indication of fire damage.
Performance Based Solution

Two EC25 Upright, 165 deg. F sprinklers per aerosol fixture bay. Located @ ¼ points in the bay and 1” below “lid”.

½” Plywood Barrier to approx. 12” ht. at the perimeter of the Aerosol Fixture bays. Sides and Back of Rack

½” Plywood Barrier to underside of “lid”, approx. 8.5”” ht. between the Aerosol Fixture bays.

½” Plywood lintel on face of rack to extend 8” below bottom of “lid”
Performance Based Solution

NOTE: No barrier between bays above “lid”.

NOTE: Plywood seams sealed with aluminum tape.

½” plywood lintel extending 8” below “lid”.

½” plywood barrier to approx. 12” ht at perimeter of Aerosol Fixture Bays. Sides and back of Rack.

Existing Face and Flue Sprinklers inside barrier ABOVE “lid” to remain.

NOTE: “lid” under 2”x6” “stickers”.
Questions

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