AFSA45
COLD STORAGE FIRE PROTECTION
Melisa Rodriguez, PE, SET
SAN ANTONIO, TX
AFSA
American Fire Sprinkler Association

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For the last 22 years, Melisa has worked in Fire Protection with experience in sprinkler design, manufacturing and consulting engineering. Her role at Johnson Controls puts her at the forefront of the storage market across North America as she drives business and new technology development.
NFPA Technical Committees
Standpipes (SPI-AAA)
Garages and Parking Structures (GAR-AAA)
Residential Sprinkler Systems (AUT-RSS)
Sprinkler System Discharge Criteria (AUT-SSD)
Industry
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MN Board of AELSLAGID – Past Chair
Minnesota SFPE - Past President
MN Governor's Council for Fire Prevention and Control – Vice Chair
SFPE Virtual Learning Committee – Chair
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The authority on fire, electrical, and building safety
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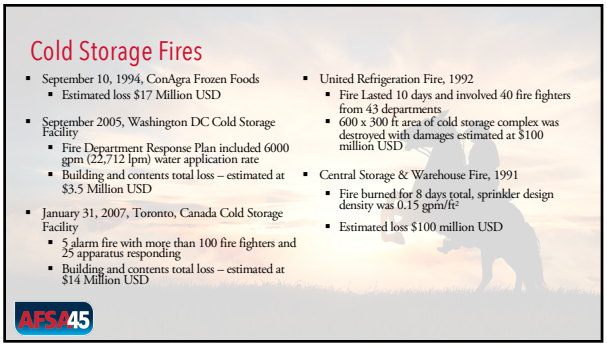
Cold Storage Fires
September 10, 1994, ConAgra Frozen Foods
Estimated loss $17 Million USD
September 2005, Washington DC Cold Storage Facility
Fire Department Response Plan included 6000 gpm (22,712 lpm) water application rate
Building and contents total loss – estimated at $3.5 Million USD
January 31, 2007, Toronto, Canada Cold Storage Facility
5 alarm fire with more than 100 fire fighters and 25 apparatus responding
Building and contents total loss – estimated at $14 Million USD
United Refrigeration Fire, 1992
Fire Lasted 10 days and involved 40 fire fighters from 43 departments
600 x 300 ft area of cold storage complex was destroyed with damages estimated at $100 million USD
Central Storage & Warehouse Fire, 1991
Fire burned for 8 days total, sprinkler design density was 0.15 gpm/ft²
Estimated loss $100 million USD

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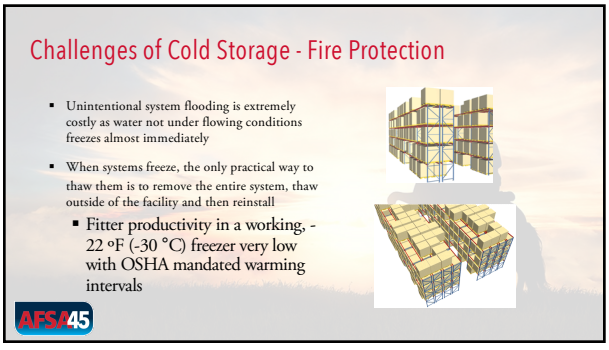
Challenges of Cold Storage - Fire Protection
Unintentional system flooding is extremely costly as water not under flowing conditions freezes almost immediately
When systems freeze, the only practical way to thaw them is to remove the entire system, thaw outside of the facility and then reinstall
Fitter productivity in a working, -22 ºF (-30 °C) freezer very low with OSHA mandated warming intervals

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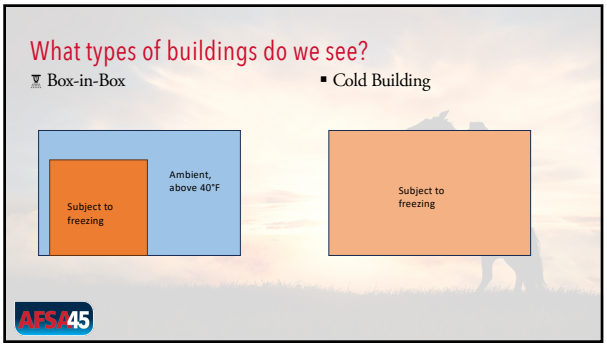
What types of buildings do we see?
Box-in-Box
Cold Building
Subject to freezing
Ambient, above 40°F
Subject to freezing

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What types of buildings do we see?

- Box-in-Box

- Cold Building

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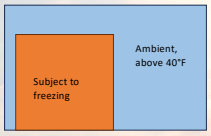
Solution for box-in-box

- Box-in-Box
  - Dry ESFR-17 & ESFR-25



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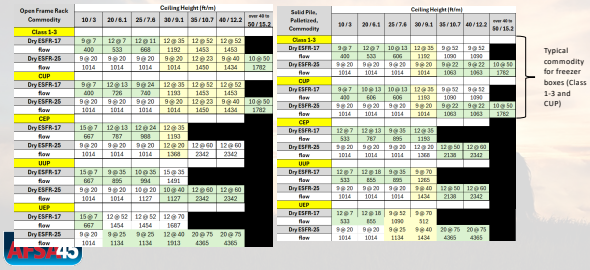
Heights and Commodities - FM



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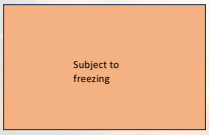
Solution for Cold Building

- Cold Building



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Heights and Commodities - Prescriptive

- Ceiling only protection – Dry Systems
  - Limited heights of about 25-30'
  - Less with plastics
  - Dry System penalties and requirements (water delivery)
- Ceiling plus in-racks– Dry Systems
  - Potential for impact during operations
  - Low Point drains

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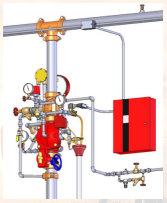
Challenges of Cold Storage - Fire Protection

- Typically Double Interlock Preaction Systems are used to minimize the chance of system flooding
  - Linear Heat Detection run in the racks near in-rack sprinklers
- Falling boxes or fork lift damage will occasionally damage both the in-rack sprinkler and the linear heat detecting wire
- Strong desire to eliminate in-rack sprinklers



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Challenges of Cold Storage - Fire Protection

- The use of ESFR systems in combination with an antifreeze agent was a logical solution to the problem
- The implementation of this solution has proven to be problematic, as all antifreeze agents exhibit one or more undesirable traits
  - Combustible
  - Corrosive
  - Toxic
  - Difficult to contain (leaks)
  - Cost and maintenance

There are no currently listed ESFR sprinklers for use with an antifreeze solution.

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A Performance Based Option

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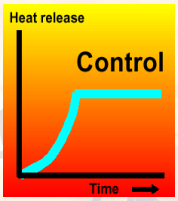
What about Control Mode?

- Sprinklers have been previously listed for the purpose of providing ceiling only protection for storage configurations that would otherwise require in-rack sprinklers
  - Large Drop Sprinklers
  - TFBP Ultra K17
- *Would it be possible to use specific application control mode technology to avoid in-racks or antifreeze systems?*



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The Plan - Ultra K17 Sprinklers

- Cold storage facilities were being built taller, and the classification of the commodity was going up
  - 40 ft (12.2) m of storage in 48 ft (13.7 m) building and higher common
  - Class III Commodity Common
- Expand the application of dry pipe, ceiling only protection to cover current needs by testing the Ultra K17 with a water delivery delay

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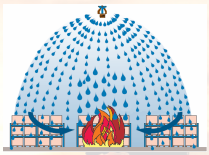
Ultra K17 Sprinklers - Selection Criteria

- A high challenge fire can have an upward draft equivalent to 30 – 35 mph (50 – 56 km/h)
- The Larger K-factor Ultra K17 produces larger water droplets at lower pressures than Large Drop
- Large flow rates might be required for some high challenge applications



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Quell™ - Performance Based Design

- The Quell™ design method and resulting system are allowed as an Alternate Method & Material (AMM) using Performance Based Design (PBD) & the equivalency clauses in NFPA 13 & the IFC
- All of the components used in a system designed in accordance with the Quell™ technical datasheet carry a minimum of UL listing & FM approval
- As with all fire protection systems, final acceptance is at the discretion of the Authority Having Jurisdiction

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Quell™ - Basis for Equivalency

- Full-scale Fire tests at UL & FM (15 published tests to date)
- Tested Commodity:
  - Class II (x3)
  - Class III (x7)
  - Group A Plastics (x5)
- Building Heights:
  - Up to 48 ft (14.6 m) of Class III
  - Up to 35 ft (10.6) of Group A

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Quell™ Design Method

- Quell™ is NOT a sprinkler system
- Quell™ IS a method of designing a sprinkler system
- The Quell™ design method can only be practiced when specific sprinkler system components are used
  - UltraK17 Sprinkler (to date)
  - QRS Electronic Accelerator
- Quell™ relies on other specific technologies
  - SprinkFDT-Q
  - Extensive Full Scale Fire Test Database

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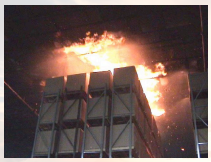
Protection Concept = "Surround and Drown"



Allow the fire to operate a target number of heads to "surround" the fire

Discharge a significant volume of water from these operated sprinkler to "drown" the fire

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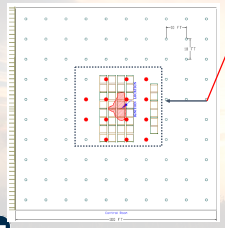
Surround & Drown



Allowing sprinklers around the fire to operate prior to water discharge minimizes the likelihood of sprinkler skipping, and limits the ability of the fire to travel inside the storage array over time.

As a result, a properly configured dry system can perform BETTER than a wet system

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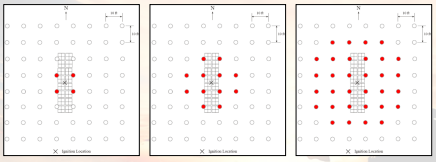
Quell™ Design Area- Minimum & Maximum



First Ring - 4

Minimum Quell™ Area

Second Ring - 12

Ideal Quell™ Area between 12 and 16 sprinklers

Third Ring - 32

Water delivery delay too long

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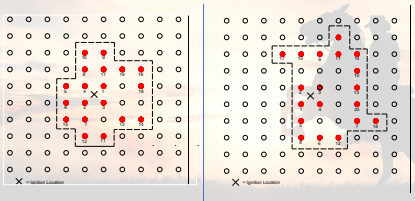
Design Criteria - Minimum Water Delivery Time

40 ft (12.2 m) Class III – 45 ft (13.7 m) Ceiling Height



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Quell™ Design Method

- Recommended design criteria in Quell™ is described in TFP370
- Criteria provided for Class II, Class III and Group A Commodities
- All fire test data provided as Appendix material
  - Support performance based design method
  - Support TFBP suggested design criteria
  - Provide raw data for use in alternate design criteria by knowledgeable designers & engineers

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Quell™ Design Method

- Basic criteria to be met when utilizing the Quell™ design criteria include;
  - Building & storage geometry
  - Commodity classification
  - Typical hydraulic pressure/volume requirements
  - Minimum water delivery time
  - Maximum water delivery time
  - Fire detection system activation relative to sprinklers
- Additional parameters which must be addressed include
  - Startup of fire pumps
  - Shutdown of mechanical ventilation & air handling

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Quell™ Design Criteria – Class II

Storage Ht./ Ceiling Ht.[a], ft/ft (m/m)	Design Pressure, psi (bar)	Minimum Recommended No. of Design Sprinklers[b], Ref. (Appendix, Test No.)	Maximum Water Delivery Time (Operating Time), Seconds[c]	Minimum Water Delivery Time (Operating Time), Seconds[d]	Sequential Sprinkler Opening Times, Seconds[c,d]			
					1st	2nd	3rd	4th
20/30 (6,1/9,1)	22 (1,5)	25 (App. B, T1)	30	9	0	3	6	8
25/30 (7,6/9,1)	22 (1,5)	25 (App. B, T1)	30	9	0	3	6	8
20/35 (6,1/10,7)	22 (1,5)	25 (App. B, T1)	30	9	0	3	6	8
25/35 (7,6/10,7)	22 (1,5)	25 (App. B, T1)	30	9	0	3	6	8
30/35 (9,1/10,7)	22 (1,5)	25 (App. B, T1)	30	9	0	3	6	8
20/40 (6,1/12,2)	22 (1,5)	25 (App. B, T1)	30	9	0	3	6	8
25/40 (7,6/12,2)	22 (1,5)	25 (App. B, T1)	30	9	0	3	6	8
30/40 (9,1/12,2)	22 (1,5)	25 (App. B, T1)	30	9	0	3	6	8
35/40 (10,7/12,2)	22 (1,5)	25 (App. B, T1)	30	9	0	3	6	8
20/45 (6,1/13,7)	30 (2,1)	25 (App. A, T7)	25	9	0	3	6	8
25/45 (7,6/13,7)	30 (2,1)	25 (App. A, T7)	25	9	0	3	6	8
30/45 (9,1/13,7)	30 (2,1)	25 (App. A, T7)	25	9	0	3	6	8
35/45 (10,7/13,7)	30 (2,1)	25 (App. A, T7)	25	9	0	3	6	8
40/45 (12,2/13,7)	30 (2,1)	25 (App. A, T6)	25	9	0	3	6	8
40/48 (12,2/14,6)	30 (2,1)	25 (App. C)	25	8	0	3	5	7

Notes:
a. For FM Global locations' design and installation guidelines, refer to FM Global Property Loss Prevention Data Sheet 8-9.
b. The minimum recommended number of design sprinklers is to be confirmed with the authority having jurisdiction. When sprinkler coverage areas of 100 ft² (9,3 m²) are used for all 25 design sprinklers, the resulting design area is 2250 ft² (232 m²). If sprinkler coverage areas less than 100 ft² (9,3 m²) are utilized, the design area is not to be less than 2250 ft² (209 m²); therefore, the number of design sprinklers may need to be increased accordingly.
c. The maximum water delivery time (operating time per SprinkFDT-Q) shall be calculated so as to assure the minimum sprinkler design pressure is available at each of the most hydraulically demanding four sprinklers within the noted time. When applying the water delivery calculation enter the sequential sprinkler opening times for each of the four sprinklers.
d. The minimum water delivery time (operating time per SprinkFDT-Q) shall be calculated so as to assure the minimum sprinkler design pressure is not available at any of the least hydraulically demanding four sprinklers within the noted time. When applying the water delivery calculation enter the sequential sprinkler opening times for each of the four sprinklers.

TABLE A
ULTRA K17 HYDRAULIC DESIGN AND WATER DELIVERY (OPERATING TIME) CRITERIA TO PROVIDE PERFORMANCE BASED DESIGN CEILING ONLY PROTECTION OF CLASS II COMMODITIES

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Quell™ Design Criteria – Class III

Storage Ht./ Ceiling Ht.[a], ft/ft (m/m)	Design Pressure, psi (bar)	Minimum Recommended No. of Design Sprinklers[b], Ref. (Appendix, Test No.)	Maximum Water Delivery Time (Operating Time), Seconds[c]	Minimum Water Delivery Time (Operating Time), Seconds[d]	Sequential Sprinkler Opening Times, Seconds[c,d]			
					1st	2nd	3rd	4th
20/30 (6,1/9,1)	22 (1,5)	25 (App. A, T4)	25	8	0	3	5	7
25/30 (7,6/9,1)	22 (1,5)	25 (App. A, T4)	25	8	0	3	5	7
20/35 (6,1/10,7)	22 (1,5)	25 (App. A, T4)	25	8	0	3	5	7
25/35 (7,6/10,7)	22 (1,5)	25 (App. A, T4)	25	8	0	3	5	7
30/35 (9,1/10,7)	22 (1,5)	25 (App. A, T4)	25	8	0	3	5	7
20/40 (6,1/12,2)	30 (2,1)	25 (App. A, T7)	25	8	0	3	5	7
25/40 (7,6/12,2)	30 (2,1)	25 (App. A, T7)	25	8	0	3	5	7
30/40 (9,1/12,2)	30 (2,1)	25 (App. A, T7)	25	8	0	3	5	7
35/40 (10,7/12,2)	30 (2,1)	25 (App. A, T7)	25	8	0	3	5	7
20/45 (6,1/13,7)	30 (2,1)	25 (App. A, T7)	25	8	0	3	5	7
25/45 (7,6/13,7)	30 (2,1)	25 (App. A, T7)	25	8	0	3	5	7
30/45 (9,1/13,7)	30 (2,1)	25 (App. A, T7)	25	8	0	3	5	7
35/45 (10,7/13,7)	30 (2,1)	25 (App. A, T7)	25	8	0	3	5	7
40/45 (12,2/13,7)	30 (2,1)	25 (App. A, T6)	25	8	0	3	5	7
40/48 (12,2/14,6)	30 (2,1)	30 (App. C)	25	8	0	3	5	7

Notes:
a. The Quell Methodology is not FM approved for the protection of Class III commodities per FM Global Property Loss Prevention Data Sheet 8-9. Contact FM Global for more information.
b. The minimum recommended number of design sprinklers is to be confirmed with the authority having jurisdiction. When sprinkler coverage areas of 100 ft² (9,3 m²) are used for all 25 design sprinklers, the resulting design area is 2250 ft² (232 m²). If sprinkler coverage areas less than 100 ft² (9,3 m²) are utilized, the design area is not to be less than 2250 ft² (209 m²); therefore, the number of design sprinklers may need to be increased accordingly.
c. The maximum water delivery time (operating time per SprinkFDT-Q) shall be calculated so as to assure the minimum sprinkler design pressure is available at each of the most hydraulically demanding four sprinklers within the noted time. When applying the water delivery calculation enter the sequential sprinkler opening times for each of the four sprinklers.
d. The minimum water delivery time (operating time per SprinkFDT-Q) shall be calculated so as to assure the minimum sprinkler design pressure is not available at any of the least hydraulically demanding four sprinklers within the noted time. When applying the water delivery calculation enter the sequential sprinkler opening times for each of the four sprinklers.

TABLE B
ULTRA K17 HYDRAULIC DESIGN AND WATER DELIVERY (OPERATING TIME) CRITERIA TO PROVIDE PERFORMANCE BASED DESIGN CEILING ONLY PROTECTION OF CLASS III COMMODITIES

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Quell™ Design Criteria – Class IV/Cartoned Unexpanded Plastic

- water supply duration – 120 minutes minimum

Storage Ht./ Ceiling Ht.[a], ft/ft (m/m)	Design Pressure, psi (bar)	Minimum Recommended No. of Design Sprinklers[b], Ref. (Appendix, Test No.)	Maximum Water Delivery Time (Operating Time), Seconds[c]	Minimum Water Delivery Time (Operating Time), Seconds[d]	Sequential Sprinkler Opening Times, Seconds[c,d]			
					1st	2nd	3rd	4th
20/30 (6,1/9,1)	22 (1,5)	25 (App. D)	25	8	0	3	6	8
25/30 (7,6/9,1)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
20/35 (6,1/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
25/35 (7,6/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
30/35 (9,1/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8

Notes:
a. The Quell Methodology is not FM approved for the protection of Class IV commodities/Group A plastics per FM Global Property Loss Prevention Data Sheet 8-9. Contact FM Global for more information.
b. The minimum recommended number of design sprinklers is to be confirmed with the authority having jurisdiction. When sprinkler coverage areas of 100 ft² (9,3 m²) are used for all 25 design sprinklers, the resulting design area is 2250 ft² (232 m²). If sprinkler coverage areas less than 100 ft² (9,3 m²) are utilized, the design area is not to be less than 2250 ft² (209 m²); therefore, the number of design sprinklers may need to be increased accordingly.
c. The maximum water delivery time (operating time per SprinkFDT-Q) shall be calculated so as to assure the minimum sprinkler design pressure is available at each of the most hydraulically demanding four sprinklers within the noted time. When applying the water delivery calculation, enter the sequential sprinkler opening times for each of the four sprinklers.
d. The minimum water delivery time (operating time per SprinkFDT-Q) shall be calculated so as to assure the minimum sprinkler design pressure is not available at any of the least hydraulically demanding four sprinklers within the noted time. When applying the water delivery calculation, enter the sequential sprinkler opening times for each of the four sprinklers.

TABLE C
ULTRA K17 HYDRAULIC DESIGN AND WATER DELIVERY (OPERATING TIME) CRITERIA TO PROVIDE PERFORMANCE BASED DESIGN CEILING ONLY PROTECTION OF CLASS IV AND CARTONED, UNEXPANDED GROUP A PLASTIC COMMODITIES

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Hydraulic Design & Water Delivery – Group A Plastics

Storage Ht./ Ceiling Ht.[H], ft/ft (m/m)	Design Pressure, psi (bar)	Minimum Recommended No. of Design Sprinklers[R], Ref. (Appendix, Test No.)	Maximum Water Delivery Time (Operating Time), Seconds[D]	Minimum Water Delivery Time (Operating Time), Seconds[M]	Sequential Sprinkler Opening Times, Seconds[L,4]			
					1st	2nd	3rd	4th
20/30 (6,1/9,1)	22 (1,5)	25 (App. D)	25	8	0	3	6	8
25/30 (7,6/9,1)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
20/35 (6,1/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
25/35 (7,6/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
30/35 (9,1/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8

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Quell™ Method- Requirements

Storage Ht./ Ceiling Ht.[H], ft/ft (m/m)	Design Pressure, psi (bar)	Minimum Recommended No. of Design Sprinklers[R], Ref. (Appendix, Test No.)	Maximum Water Delivery Time (Operating Time), Seconds[D]	Minimum Water Delivery Time (Operating Time), Seconds[M]	Sequential Sprinkler Opening Times, Seconds[L,4]			
					1st	2nd	3rd	4th
20/30 (6,1/9,1)	22 (1,5)	25 (App. D)	25	8	0	3	6	8
25/30 (7,6/9,1)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
20/35 (6,1/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
25/35 (7,6/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
30/35 (9,1/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8

- Minimum pressure verified to provide an acceptable level of fire control at the maximum water delivery time
- Corresponds to the minimum dynamic pressure at the hydraulically most remote sprinkler
- During full scale testing, systems were maintained at this pressure independent of number of operated sprinklers. For virtually all "real" systems, this pressure would only occur when the entire design area at the hydraulically most remote portion of the system operated

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Quell™ Method- Requirements

Storage Ht./ Ceiling Ht.[H], ft/ft (m/m)	Design Pressure, psi (bar)	Minimum Recommended No. of Design Sprinklers[R], Ref. (Appendix, Test No.)	Maximum Water Delivery Time (Operating Time), Seconds[D]	Minimum Water Delivery Time (Operating Time), Seconds[M]	Sequential Sprinkler Opening Times, Seconds[L,4]			
					1st	2nd	3rd	4th
20/30 (6,1/9,1)	22 (1,5)	25 (App. D)	25	8	0	3	6	8
25/30 (7,6/9,1)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
20/35 (6,1/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
25/35 (7,6/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
30/35 (9,1/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8

- Recommended number of sprinklers to be included in the hydraulic design area when
  - The recommended maximum water delivery time is used
  - Sprinkler coverage area is at or near 100 ft² (9.3 m²)
- The suggested maximum water delivery time generally is based on the time to operate 16-20 sprinklers as determined from the fire test data, allowing a safety factor of an additional 5-9 sprinklers to account for operations after water delivery

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Quell™ Method- Requirements

Storage Ht./ Ceiling Ht.[H], ft/ft (m/m)	Design Pressure, psi (bar)	Minimum Recommended No. of Design Sprinklers[R], Ref. (Appendix, Test No.)	Maximum Water Delivery Time (Operating Time), Seconds[D]	Minimum Water Delivery Time (Operating Time), Seconds[M]	Sequential Sprinkler Opening Times, Seconds[L,4]			
					1st	2nd	3rd	4th
20/30 (6,1/9,1)	22 (1,5)	25 (App. D)	25	8	0	3	6	8
25/30 (7,6/9,1)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
20/35 (6,1/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
25/35 (7,6/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
30/35 (9,1/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8

- Suggested maximum water delivery time at the pneumatically most remote area
- Does not necessarily exactly match the times recorded during full scale fire testing
- Water Delivery Time is defined as the elapsed time between operation of the first sprinkler, and the sprinkler system reaching the design pressure. This is different than the NFPA 13 definition of water delivery.

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Quell™ Method- Requirements

Storage Ht./ Ceiling Ht.[H], ft/ft (m/m)	Design Pressure, psi (bar)	Minimum Recommended No. of Design Sprinklers[R], Ref. (Appendix, Test No.)	Maximum Water Delivery Time (Operating Time), Seconds[D]	Minimum Water Delivery Time (Operating Time), Seconds[M]	Sequential Sprinkler Opening Times, Seconds[L,4]			
					1st	2nd	3rd	4th
20/30 (6,1/9,1)	22 (1,5)	25 (App. D)	25	8	0	3	6	8
25/30 (7,6/9,1)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
20/35 (6,1/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
25/35 (7,6/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
30/35 (9,1/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8

- Suggested minimum water delivery time at the pneumatically LEAST remote area
- Time necessary to establish the minimum "surround and drown" area of four sprinklers
- Values developed from full scale fire test data and computational modeling. Does not always perfectly match the full scale fire test data

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Quell™ Method- Requirements

Storage Ht./ Ceiling Ht.[H], ft/ft (m/m)	Design Pressure, psi (bar)	Minimum Recommended No. of Design Sprinklers[R], Ref. (Appendix, Test No.)	Maximum Water Delivery Time (Operating Time), Seconds[D]	Minimum Water Delivery Time (Operating Time), Seconds[M]	Sequential Sprinkler Opening Times, Seconds[L,4]			
					1st	2nd	3rd	4th
20/30 (6,1/9,1)	22 (1,5)	25 (App. D)	25	8	0	3	6	8
25/30 (7,6/9,1)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
20/35 (6,1/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
25/35 (7,6/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8
30/35 (9,1/10,7)	35 (2,4)	25 (App. E)	25	8	0	3	6	8

- For the Minimum and Maximum water delivery times, it is necessary to include the actual operation sequence to accurately predict water delivery time
- These are the sequential time values to be entered in FDT-Q
- Values developed from full scale fire test data and computational modeling. Does not always perfectly match the full scale fire test data

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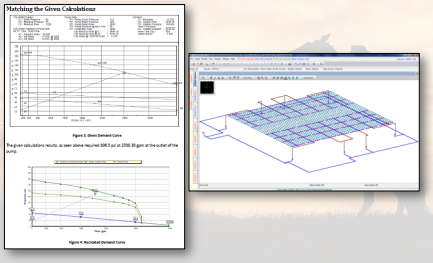
Sprink FDT-Q



40

Quell™ - Mechanical Systems

- The fire detection system must be designed to shut fans down in powered ventilation systems or to close dampers in natural ventilation systems upon actuation
- Systems which are likely to impact the operation of the sprinklers, primarily air handling equipment, should be shut down to minimize impact on fire detection and sprinkler operation

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Quell™ - Fire Pump Startup

- It is recommended that fire pump be started remotely upon activation of linear detection system
- Early start-up of pump allows for pump to be brought to full speed at time of system valve operation
- Avoids need to include pump startup time in water delivery time calculations

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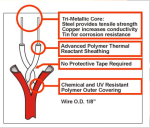
Quell™ - Fire Detection

- Linear Heat Detection, fastened to every branch line, was evaluated as part of the Quell™ development program and is recommended
- Alternate detection methods are allowable, but it is the responsibility of the designer to verify that detection will always activate prior to the sprinklers



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Quell™ - Basic System Components

- Automatic Sprinklers
- System Riser
  - Automatic Control Valve
  - Riser Check Valve
  - Valve Trim
  - Quick Opening Device (QRS)
  - Releasing Panel (Potter 4410)
  - Automatic Air (Nitrogen) Supply
- System Piping & Fittings
- Fire Detection

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Ultra K17 Upright
Control Mode Specific Application

- Style: Upright
- Nominal K-factor:
  - 16.8 gpm/psi$^{1/2}$ (240 lpm/bar$^{1/2}$)
- Temperature:
  - High – 286°F (141°C)
- Orifice & Tread Size
  - 0.78 in (20 mm)
  - 3/4 in NPT or ISO 7-R3/4
- Finish: Plain Brass with Chrome Deflector

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Quell™ K34 Methodology

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Quell™ Methodology Limitations

Commodity Classification	Max. Bldg. Height (ft.)	Max. Storage Height (ft.)	Sprinkler K-Factor	Design Guidelines	Notes[2]
I-III	48	40	16.8[1]	Performance Based	Use TFP370 datasheet
	55	50	34[1,3]	FM	Use TFP373 datasheet and FM data sheets 2-0, 8-1, 8-9, and 8-29
IV-Cartoned Non-expanded Group A	35	30	16.8[1]	Performance Based	Use TFP370 datasheet

1. Must use 286°F rated sprinkler (only sold to Quell licensees)
2. For Quell datasheets, contact either Technical Services at (800) 381-9312 or visit TechXchange at www.onlinetechxchange.com
3. K34 option was only tested using Class III commodity

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FM Data sheet 8-9 – Table 1

Table 1. Spacing of Ceiling-Level Storage Sprinklers Under Unobstructed Ceiling Construction

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FM Data sheet 8-9 – Table 14b

Table 14b. Ceiling-Level Sprinkler System Designs for Class 3 Commodities Protected by Dry-Pipe and Similar Sprinkler Systems

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NFPA 13 Table 24.3.3

Pin Header

Table 24.3.3 Standard Response Upright Sprinkler Design Criteria for Open Rack Storage of Class I Through Class III Commodities Using High-Temperature-Rated Sprinklers

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K34 Quell Methodology Design Guidelines

FM QUELL SYSTEM - Ultra K34
CLASS III COMMODITIES

GENERAL GUIDELINES:
Ultra K34 (TYP970) Sprinklers with a 286°F (141°C) temperature rating must be installed in double interlock preaction systems or dry systems for the protection of high piled storage occupancies including solid-piled, palletized, shelf, bin-box, and open-framed racks, of up to Class III commodities as defined by FM Data Sheet 8-1 (no open top containers). For ceiling only protection (no in-rack sprinklers), the installation criteria is as follows:

- Minimum ceiling to thermal sensing element distance of 2 in. (51 mm) for smooth ceilings and 4 in. (102 mm) for non-smooth ceilings
- Maximum ceiling to thermal sensing element of 12 in. (305 mm)

Storage Ht./ Ceiling Ht., ft (m)	Minimum Aisle Width, ft (m)	Design Pressure, psi (bar)	Minimum Recommended No. of Design Sprinklers	Maximum Water Delivery Time (Operating Time), Seconds[a,b]	Minimum Water Delivery Time (Operating Time), Seconds	Hose Demand, gpm (Lpm)	System Duration, Minutes
35/40 (10,5/12,0)	6 (1,8)	50 (3,4)	12	20	0	500 (1900)	90
40/45 (12,0/13,7)	6 (1,8)	50 (3,4)	12	20	0	500 (1900)	90
45/50 (13,7/15,2)	8 (2,4)	50 (3,4)	15	20	0	500 (1900)	90
50/55 (15,2/16,8)	8 (2,4)	50 (3,4)	16	20	0	500 (1900)	120

Notes:
a. The maximum operating time per SprinkFDT-Q shall be calculated so as to assure the minimum sprinkler design pressure is available at each of the most hydraulically demanding four sprinklers within the noted time.

TABLE A
ULTRA K34 HYDRAULIC DESIGN AND WATER DELIVERY (OPERATING TIME) CRITERIA TO PROVIDE FM APPROVED CEILING ONLY PROTECTION OF CLASS III COMMODITIES

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K34 Quell Methodology Design Guidelines

Storage Ht. / Ceiling Ht. (ft)	No. of Design Sprinklers	Design Pressure (psi)	Max. Water Delivery Time (Operating Time) (sec)	Min. Water Delivery Time (Operating Time) (sec)	Sequential Operating Time (sec)	Hose Stream Allowance (gpm)	Water Duration (min)
45/50	15	50	20	N/A	N/A	500	90
50/55	16						120

- Ceiling System Demand (16 sprinklers) = ~ 4,225 gpm
  - 10% safety factor included for over discharge
  - Approximately 1,200 gpm more than most demanding K17 option
- Total System Demand = ~ 4,725 gpm
  - (includes 500 gpm hose)
- Tank Size = ~ 567,000 gallons
  - Approximately 145,000 gallons more than most demanding K17 option

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Ultra K34 Sprinkler

- K34 sprinkler data sheet = TFP334
- Sprinkler Identification Number (SIN) = TY9101
- K34 has 1-1/4 inch NPT
- Temperature rating = 286oF
- Obstruction rules = (FMDS 2-0: 2.2.3.5)
- Minimum deflector to top of storage clearance = 36 inches
- Maximum pipe diameter without sprig = 4 inches
- Coverage area per sprinkler = (FMDS 8-9: Table 1)
  - Maximum = 100 sq.ft.
  - Minimum = 80 sq.ft.
- Allowable distance from deck to operating element = (FMDS 2-0: 2.2.3.4.1)
  - Minimum
    - Smooth Ceilings = 2 inches
    - Non-Smooth Ceilings = 4 inches
  - Maximum
    - All Ceiling Types = 12 inches
- Minimum aisle width = 8 feet (TFP373)

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Quell™ - Poorly Executed Adoption Process

- System specified by the Owner/Architect/Engineer
  - AHJ not informed until plans are submitted, initial reaction is negative
  - Architect/Engineer does not understand the basic functional requirements of Quell™ technology and does not consider requirements in overall design.
- G.C. places Fire Protection package out to bid
  - Bids solicited without requirement that the contractor be a Quell™ license holder
  - Poorly defined bid scope resulting from limited understanding of Quell™ requirements
- Fire Protection contractor identifies 100,000 problems that need to be addressed…
  - AHJ, A/E, Contractor point fingers

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Quell™ Application - The Ideal Process

- Technology is most beneficial and easiest to adopt when
  - A Fire Protection Professional is involved in the earliest planning stages of the process
  - Works with the A/E to identify critical structural and mechanical design decisions that significantly impact the protection scheme
  - Involves the AHJ as a key stakeholder as early in the design process as practical
  - Works with TFBP early in the design process to resolve any outstanding issues, instead of "the pipe is going up tomorrow…help!"
- The biggest challenge is education of the AHJ community
  - "It's not in the book (NFPA 13, UL Listing etc.), so I'm not going to approve it"
  - Reluctance to accept *Alternative Materials and Methods*

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Questions

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REQUIRED

FOR CEU CREDIT:

- ✓ Badge scanned at start of seminar
- ✓ Attend full seminar
- ✓ Complete survey 1 of 2 ways:
  - ✓ Survey link is emailed to attendees with scanned badges
  - ✓ Event app by EventsAir
    - Login to app
    - Navigate to seminar survey
  - ✓ Surveys close 10/31/26

Thank you!

Melisa Rodriguez
Johnson Controls
(612) 213-7982
Melisa.rodriguez@jci.com

Scan QR code to submit questions for **Ask the Experts!**

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2027 Training Schedule

WEBINARS

1/6	Updates to NFPA 20
1/20	Calculating Pressure Reducing Hose Valves
2/3	Consumer Alert: Nitrogen in Sprinkler Systems
2/17	Reviewing Hydraulic Calculations
3/3	Updates to NFPA 13, 2028 Ed.
3/17	Updates to NFPA 13R & 13D, 2028 Eds.
4/7	Topic Coming Soon
4/21	NFPA 25: Roles & Responsibilities
5/5	Standpipe Flow Test Procedures
5/19	Storage 101
6/2	NFPA Technical Meeting - Voting Guide
6/16	Topic Coming Soon
6/30	Topic Coming Soon
7/7	Updates to NFPA 14, 2027 Edition
7/21	Adjacent Hazards & Design Methods
8/4	Acceptance Testing
8/18	Modifications to Existing Systems
9/22	Topic Coming Soon
10/6	Seismic 101
10/20	Proposed Updates to NFPA 25, 2029 Ed.
11/3	Evaluating Fire Pump Flow Tests
11/17	Top 10 Tech Reviews
12/1	Designing Water Storage Tanks
12/15	Pump Room Layout

PROGRAMS

Feb 9 - Mar 5 Apr 20 - May 14 Aug 3 - Aug 27** Oct 26 - Nov 19	Beginning Design School*
Apr 26 - May 7 Nov 1 - 12	Intermediate Design School*
Feb 8 - 10** Apr 12 - 14 Jul 12 - 14 Oct 11 - 13	Sprinkler Hydraulics Calculations Workshop
Apr 19 - 21 Oct 18 - 20	Advanced Hydraulics Calculations Workshop
Feb 11** Apr 30 Jul 23 Sep 24	Introduction to the Fire Sprinkler Industry
Mar 1 - 3 May 17 - 19 Aug 16 - 18 Oct 18 - 20**	NFPA 25 Essentials Workshop
Jun 7 - 10 Sep 20 - 23	Experienced Inspector Skills Lab
Mar 4 - 5 May 20 - 21 Aug 19 - 20 Oct 21 - 22**	NFPA 25 Fire Pump Workshop
Spring Summer Fall	ITM Inspector Development Program* *This program is 20 months.*

** Hybrid course **At General Air Products Lab, Exton, PA*

AFSA46

September 8-11	Manchester Grand Hyatt San Diego, CA

For More Details Visit:
firesprinkler.org

AFSA
American Fire Sprinkler Association

Dates subject to change. Programs subject to minimum registrations.

rev 9/14/2026

Virtual Instruction Path (VIP)

for Sprinkler Fitting Apprentices

Level 1 - Begins January 2027

Level 2 - Begins February 2027

Level 3 - Begins January 2027

Level 4 - Begins March 2027

www.firesprinkler.org/VIP

AFSA
American Fire Sprinkler Association

HANDS-ON WORKSHOPS FOR 2027

FEATURING AFSA'S TRAINING LAB

NFPA 25 Essentials Workshop

Mar | May | Aug | Oct

Description: Understand roles, responsibilities, and NFPA 25 ITM procedures through hands-on testing of wet systems, dry systems, and fire pumps.

NFPA 25 Fire Pump Workshop

Mar | May | Aug | Oct

Description: Develop practical NFPA 25 fire pump ITM skills, including no-flow and full-flow testing, water supply graphing, and performance evaluation.

Introduction to the Fire Sprinkler Industry

Feb | Apr | Jul | Sep

Description: This course is designed for those new to the industry. An introductory, wide-ranging 8-hour course that provides a broad overview of core fire sprinkler industry concepts for those new to the field.

Experienced Inspector Skills Lab NEW

Mar | Sep

Description: Take your ITM expertise beyond the basics. Designed for experienced technicians, this course combines focused classroom instruction with hands-on system lab training to strengthen your application of current NFPA 25 inspection, testing, and maintenance requirements. Refine fire sprinkler testing practices, improve documentation, deliver more consistent service, and help reduce liability while reinforcing knowledge commonly covered on certification exams.

Learn more about AFSA's fire sprinkler lab featuring functional risers, a spray room, fire pumps, and an interactive classroom.

firesprinkler.org/lab