

A close-up photograph of a fire burning brightly, with yellow and orange flames rising from a dark base. The background is dark, making the fire stand out.

Challenges of Fluorine Free Foam in Sprinkler Systems

**Fire Sprinkler International
2022 Conference**

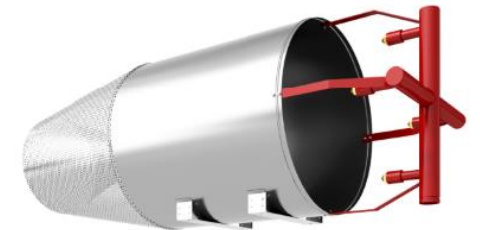


Date: 31st May 2022
Speaker: Simon Barratt (Foam Product Manager)
Place: London

1) Foam Organisation Background

Viking Foam Organisation Background

- **Viking is an own manufacturer and distributor of fixed foam system equipment.**
- Extensive line of FM and UL Listed products under our Viking and KCA brands.
- **Additionally, many local approvals and certifications.**
- Own manufacturing facilities in Europe and USA.
- **Strategic supply and development partnership with Fomtec of Sweden.**
- Core foam concentrates sold and Listed under the Viking brand.



R&D Capability

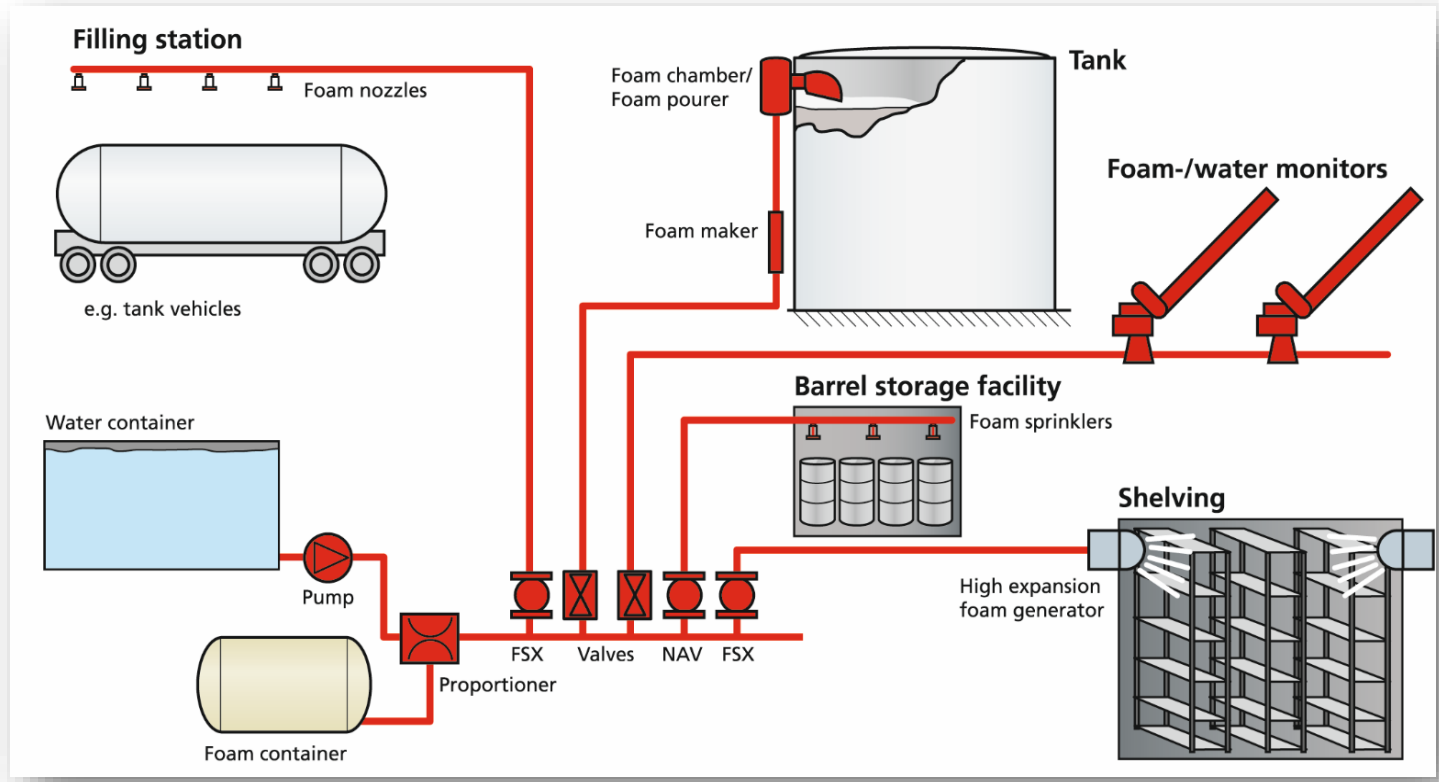
- **Move to SFFF has and will continue to be about learning and defining limits.**
- We have a network of internal and external testing facilities to ensure that we place products on the market with defined usage criteria.
- **We invested pre-SFFF to bring product and solutions to market in the shortage time possible.**
- Focus on working with industry to assist in verifying what will and will not work as they transition from fluorinated to non fluorinated product.



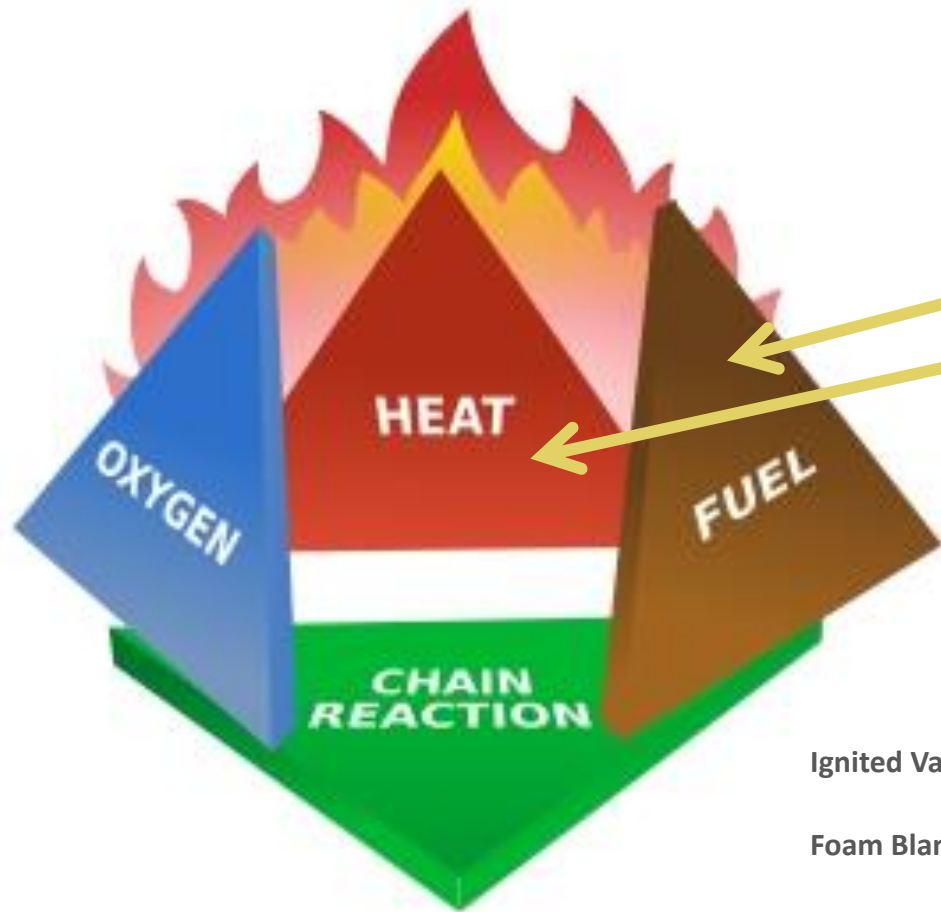
2) Foam Basics - Refresher

Where do we use foam?

- Fire fighting foam in fixed fire protection systems is predominantly used where ignitable (Class B) liquids are present.
- This is because water alone is often ineffective in suppression or extinction or because adequate drainage and containment of spilt fuel is not present.
- -Foam concentrate is mixed with water to produce a foam solution.
-This solution is distributed around the fire protection system.
-It is then transformed into finished foam once it is discharged from specific devices in the fire area.



Why do we use foam?



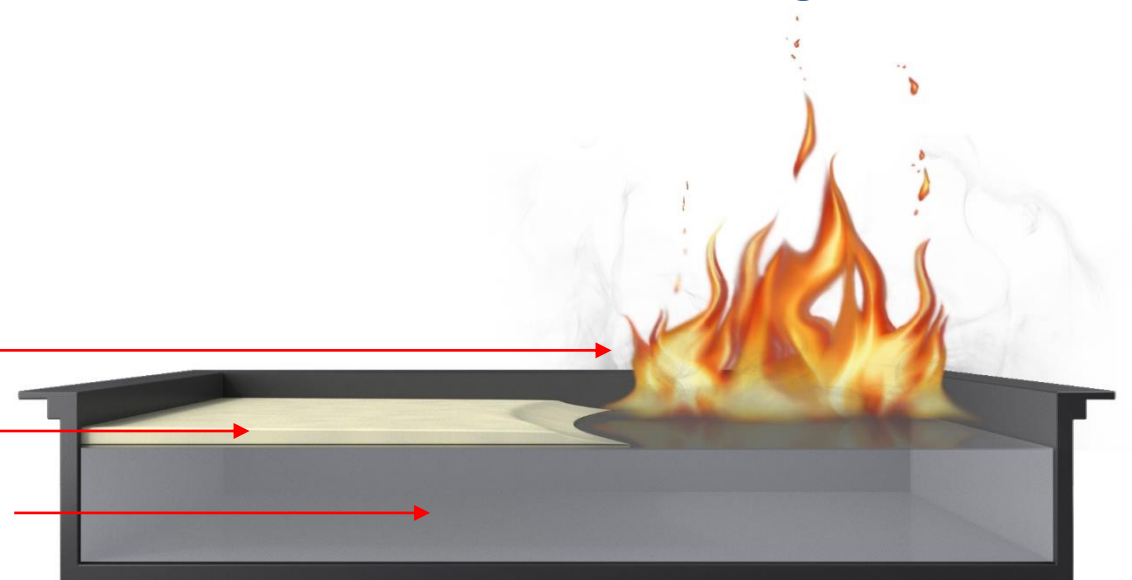
The extinguishment mechanism is physical due to the foam “blanket” that is produced.

The foam blanket prevents vapor escaping thereby removing fuel from the fire and the water draining out of the foam has a cooling effect on the fuel and surrounding structure.

Ignited Vapors

Foam Blanket

Ignitable Liquid (Class B Fire)



3) Approvals Background

Why Approvals/Listings are important

- Approvals are more important than ever to verify the suitability of SFFF foam concentrates and hardware for a particular application.
- **SFFF's generally work, however, with the change of chemistry and loss of film formation, the safety margin and fire performance are closer to the limit.**
- This could result in increased densities, proportioning rate, discharge pressures or application time for example.
- **With so much change occurring, it is important to have system approvals to ensure an holistic approach to the fire protection system been installed – it is not just about the foam concentrate...**
- Factory Mutual (FM) and Underwriters Laboratories (UL) are recognised internationally as providing a system approach to product testing and application. A core system is generally considered to be;
1) Foam Concentrate, 2) Proportioning System, 3) Discharge Device.



Approval/Listing – System Example

Viking ARK FM Approval -Hardware

Foam Concentrates

Used as a component of foam systems. Concentrates are only Approved for use with the specific proportioning, bladder tank, foam water sprinklers, and discharge devices listed below.

Use of a concentrate with other devices or outside the listed ranges may result in solutions too lean or rich or may produce foam unable to provide the required extinguishing or sealing performance.

The concentrate listed below was evaluated for compatibility with fresh water only, except as noted.

Product	Concentrate Type	Concentrate % in Water	Configuration	Approved Fuel Hazards	Footnote
Viking ARK	SFFF	3%	For use with Viking Corp. proportioners and bladder tanks specifically tested with this concentrate, pre-mixed solution, or other proportioning equipment Approved for a range of viscosities and which is determined to be compatible with the concentrate specified in this listing. For use with discharge devices evaluated with the specific concentrate only.	Heptane, IPA, Acetone	1

¹ Evaluated for compatibility with fresh water and salt water for hydrocarbon applications only.

GREEN - Foam concentrate formulations are in accordance with the US EPA Stewardship Program 2010/15, EU Directive 2006/122/EC, and amended Council Directive 76/769/EEC.

Bladder Tanks

For use with the concentrate specified in this listing within the specifications identified in the table below.

Product	Type of Equipment	Concentrate % in Water	Configuration	Approved Fuel Hazards	CCV Part No	CCV Valve Size		CCV Min Actuator Pressure		CCV Max Operating Pressure		Type	Max Operating Pressure		Sizes	
						in	(mm)	psi	(bar)	psi	(bar)		psi	(bar)	gal	(L)
Vertical Bladder Tank Model VFT	Bladder Tank	3%	Vertical	Hydrocarbon, IPA, Acetone	Viking Corp Model E2, F2, H2, J2 Deluge Valve	1 1/2, 2, 2 1/2, 3, 4	(40, 50, 65, 80, 100)	20	(1.4)	250	(17)	ASME Section VIII Division 1, EN13445, Epoxy Coating (Any Color) or Stainless Steel	175 or 235	(12 or 16)	25-4000	(95-15142)
Horizontal Bladder Tank Model VFT	Bladder Tank	3%	Horizontal	Hydrocarbon, IPA, Acetone	Viking Corp Model E2, F2, H2, J2 Deluge Valve	1 1/2, 2, 2 1/2, 3, 4	(40, 50, 65, 80, 100)	20	(1.4)	250	(17)	ASME Section VIII Division 1, EN13445, Epoxy Coating (Any Color) or Stainless Steel	175 or 235	(12 or 16)	50-5250	(189-19873)

Proportioners

For use with the concentrate specified in this listing within the specifications identified in the table below.

Product	Type of Equipment	Concentrate % in Water	Configuration	Approved Fuel Hazards	Approved Flow Range		Approved Pressure Range		Connection	Construction Material	Sizes	
					gpm	(Lpm)	psi	(bar)			in	(mm)
Model VNR Wide Range Proportioner	Wide Range Proportioner	3%	For use with Viking Corp. bladder tanks and discharge devices as appear in the FM Approval Guide only.	Hydrocarbon, IPA, Acetone	50-1895	(189-7173)	30-175	(2-12)	Wafer	Brass	6	(150)
Model VNR Wide Range Proportioner	Wide Range Proportioner	3%	For use with Viking Corp. bladder tanks and discharge devices as appear in the FM Approval Guide only.	Hydrocarbon, IPA, Acetone	50-3003	(189-11366)	30-175	(2-12)	Wafer	Brass	8	(200)

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Approval/Listing – System Example

Foam Water Sprinkler Discharge Devices

Foam water sprinklers are Approved with the concentrate specified in this listing and at the application rates specified in the table below. The use of foam water sprinklers with other concentrates or at other application rates may result in foam of significantly different fire extinguishing capabilities and burn back/reignition resistance.

Product	Type of Equipment	Concentrate % in Water	Configuration	Approved Fuel Hazards	Min Solution Application Rate		Max Subsequent Water Application Rate		Min Installat Height		Viking ARK FM Approval -Sprinklers				
					gpm/ft ²	(mm/min)	gpm/ft ²	(mm/min)	ft	(m)	ft	(m)	ft	(m)	ft
VK1001, VK3001	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	Hydrocarbon, IPA, Acetone	0.3	(12.2)	0.3	(12.2)	6	(1.8)	24.8	(7.6)	1/2"	Upright	5.6
VK1021, VK3021	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	Hydrocarbon	0.3	(12.2)	0.3	(12.2)	6	(1.8)	20	(6.1)	1/2"	Pendant	5.6
VK1021, VK3021	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	IPA, Acetone	0.3	(12.2)	0.3	(12.2)	6	(1.8)	24	(7.3)	1/2"	Pendant	5.6
VK200, VK204, VK350, VK351	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	Heptane	0.4	(16.3)	0.4	(16.3)	9	(2.7)	45	(13.7)	3/4"	Upright	8.0
VK200, VK204, VK350, VK351	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	IPA	0.4	(16.3)	0.4	(16.3)	6.5	(2.0)	45	(13.7)	3/4"	Upright	8.0
VK200, VK204, VK350, VK351	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	Acetone	0.3	(12.2)	0.3	(12.2)	6.5	(2.0)	45	(13.7)	3/4"	Upright	8.0
VK200, VK204, VK350, VK351	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	Ethanol	0.3	(12.2)	0.3	(12.2)	6.5	(2.0)	45	(13.7)	3/4"	Upright	8.0
VK2021	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	Heptane	0.3	(12.2)	0.3	(12.2)	8.5	(2.6)	44	(13.4)	3/4"	Pendant	8.0
VK2021	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	IPA	0.3	(12.2)	0.3	(12.2)	6	(1.8)	44	(13.4)	3/4"	Pendant	8.0
VK2021	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	Acetone	0.3	(12.2)	0.3	(12.2)	6	(1.8)	44	(13.4)	3/4"	Pendant	8.0
VK377, VK536	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	Hydrocarbon	0.4	(16.3)	0.4	(16.3)	6	(1.8)	25.17	(7.7)	3/4"	Pendant	11.2
VK377, VK536	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	IPA	0.4	(16.3)	0.4	(16.3)	6	(1.8)	45	(13.7)	3/4"	Pendant	11.2
VK377, VK536	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	Acetone	0.3	(12.2)	0.3	(12.2)	6	(1.8)	25.17	(7.7)	3/4"	Pendant	11.2
VK530, VK531	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	Heptane	0.4	(16.3)	0.4	(16.3)	9	(2.7)	45	(13.7)	3/4"	Upright	11.2
VK530, VK531	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	IPA	0.4	(16.3)	0.4	(16.3)	6	(1.8)	45	(13.7)	3/4"	Upright	11.2
VK530, VK531	Automatic Foam Water Sprinkler	3%	For use with proportioners specifically tested with this concentrate, pre-mixed solution or Water Motor-Powered Positive Displacement Pumps within acceptable viscosity range only.	Acetone	0.3	(12.2)	0.3	(12.2)	6	(1.8)	45	(13.7)	3/4"	Upright	11.2

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4) Understanding the challenges of transitioning to SFFF

- 1. Current experience and research is demonstrating that foam qualities play an important role in fire performance of SFFF's. The lack of fluorinated film formation needs to be compensated by the foam blanket.**
- 2. In Europe, we see a lot of focus on EN1568 ratings (1A, 1B etc) but these tests are run with a hose nozzle tuned to deliver good foam qualities as standard – this may not be achieved with some discharge devices and bears no resemblance to the foam produced from a sprinkler discharge !**
- 3. The UL listing and FM approvals for discharge devices (EG. Monitors, Foam Makers, Chambers) require that the product foam qualities (Expansion Ratio & 25% Drain Time) obtained correlate to those used during “top-side” fire performance tests.**
- 4. Non-aspirated sprinklers cannot give dependable foam qualities so are tested 1:1 in a fire scenario.**
Foam sprinkler tests are more difficult to run due to the indoor and height requirements. There is also a lot of waste foam solution created. This reduces the number of facilities available and increases costs.



Typical EN1568 top-side test



Non-aspirated sprinkler test failure after water deluge

- 1) Fire protection sprinklers and sprinkler nozzles are a simple but effective form of active fire protection used in many different applications globally.
- 2) They are deployed in closed head systems with a fusible element or as sprinkler nozzles in open deluge systems with the fusible element removed.
- 3) For many years, we have been enhancing these systems with foam to tackle more challenging fire scenarios such as those posed by ignitable liquids.
- 4) Typical applications are warehouses, aircraft hangars, manufacturing plants and storage areas where ignitable liquids are prevalent but where water alone is less or non effective or drainage/containment is not adequate.
- 5) These standard fire sprinklers are not designed with foam use in mind.
- 6) They are small, discreet and due to the high volume used throughout the world, have a sensitive, almost commodity based price point.
- 7) Despite this, used with the correct combination of system components and specialty developed foam concentrate, they can perform well in foam enhanced non-aspirated sprinkler systems.



Viking Fluorine Free Foam Systems – FM5130 Fire Test



Viking Fluorine Free Foam Systems – Fire Test - Comparison

Exact same test run immediately after the last video. The only parameter changed was the model of the K115 sprinkler.

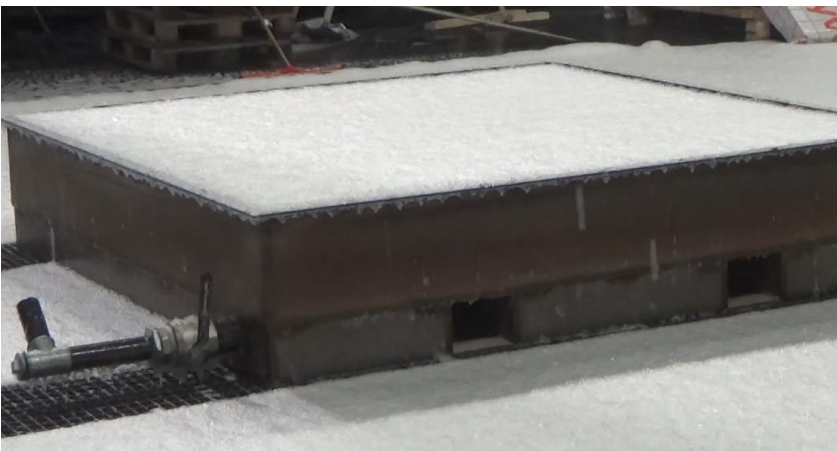
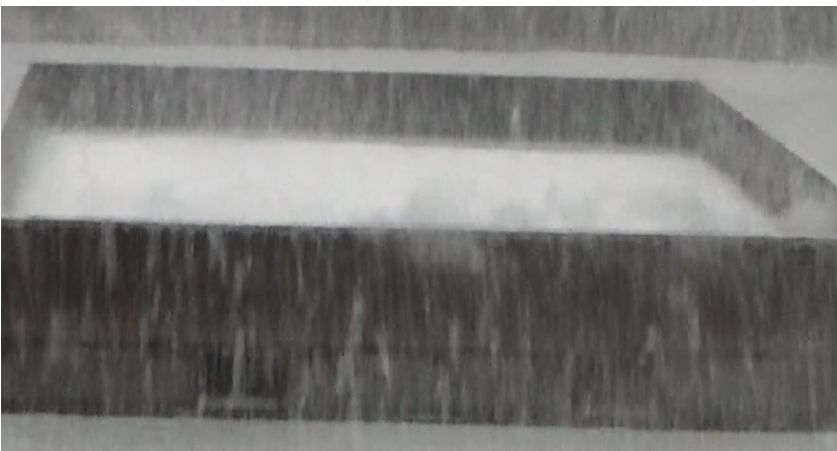
3 Minutes



5 Minutes



Burn back



5) Standards Situation

Standards related to non-aspirated foam sprinkler use

FM Data Sheets

FM occupancy data sheets give clear design guidance. They are free of charge and a wide range of applications are covered. Only FM Approved equipment as per their Approval Listing shall be used.

NFPA Standards

All NFPA foam standards require the use of listed or approved equipment be used in accordance with their approved data range/configuration etc.

EN13565-2 (Foam System Design)

2018 edition dropped the link between EN1568 1 A,B,C ratings and sprinkler use.

Move to a “consult manufacturer” clause (foam type, application rate).

This is too loose and will hopefully be addressed – Viking and Fomtec maneuvering to ensure future committee input.

EN12845-1:2021 (DRAFT)

Will add FM5130 and UL162 as a normative references.

Will add new section (11.4) Flammable liquid storage - several foam requirements.

Will add specific SFFF requirement in system design.....



EN12845-1:2021 (DRAFT) continued...

22 Water Supplies

22.3.1 Connection for foam fire-fighting systems

“System design of the foam application rate and duration shall be in accordance with 10.4 and EN13565-2:2018+AC:2019, 4.1.2, 6.2.1, 6.2.2, 6.2.3, 6.3.2, and Table 8. The minimum duration time shall be 30 minutes if no other guidance is given. **Where fluorine free foam concentrate is to be used, automatic sprinklers and aspiration devices shall be tested in combination with the specific foam solution to protect the risk. UL162 or FM5130 can be used as procedures to prove the system performance”**

7) FAQ's

Common question when discussing SFFF sprinkler projects?

- **What does drop in replacement mean?**
- **What are my legal obligations?**
- **Is there a different impact between new installations and existing?**
- **I need to follow NFPA, FM design standards. What impact does that have?**
- **Can I use the existing discharge device density?**
- **Can I keep my existing Sprinkler Heads?**
- **Can I use the existing pump and water supply capacity?**
- **Can I use my current proportioning system?**



Questions?

