

# Fire Protection Systems

## SFPE Great Plains Chapter Meeting



Date: October 21st, 2020

Speaker: Joe Donato

Business Development Special Hazards and  
Detection Systems

Presentation Information:

**SFPE  
Vacuum Technology  
October 21, 2020**

Duration: 60 Minutes



<https://bit.ly/31malHC>

**Presenters: Joe Donato**

Viking Corporation  
5150 Beltway Drive  
Caledonia, Michigan 49316  
[jdonato@vikingcorp.com](mailto:jdonato@vikingcorp.com)

# Agenda

- Dry Pipe Sprinkler Systems.
- Preaction Sprinkler Systems.
  - Single Interlock Preaction.
  - Double Interlock Preaction.
- Negative Pressure Based (Vacuum) Systems.
- Applications for Negative Pressure Based Systems.

# Dry Pipe Sprinkler Systems

- Used in areas where the Temperature cannot be maintained at or above 40° F
- Consists of water being held back by air or nitrogen pressure until a sprinkler operates.
- Dry Valves use a surface area differential, which allows a smaller amount of air pressure to hold back a larger water pressure.
- Sometimes dry pipe systems require a Water Delivery time.
- Dry Systems require an increase in the design area as compared to Wet Systems.
- Small Auxiliary Dry Systems

# Dry Pipe Sprinkler Systems

## Water Delivery Time

- System Size 500 gallon capacity or less shall be permitted w/o a quick opening device and shall not be required to meet any specific water delivery requirement to the inspector test connection.
- System Size over 500 gallon capacity up to 750 gallon shall be permitted with a quick opening device and shall not be required to meet any specific water delivery requirement to the inspector test connection.

**If a water delivery time is required,  
what are my options?**



# Dry Pipe Sprinkler Systems

## Water Delivery Time

- Dwelling Unit Protection – 15 seconds (no exceptions).
- NFPA 13 limits **water delivery time** to the most remote **sprinkler** from 40 to 60 seconds depending on hazards in non-residential environments.
- System size can be calculated for water delivery.



# Dry Pipe Sprinkler Systems

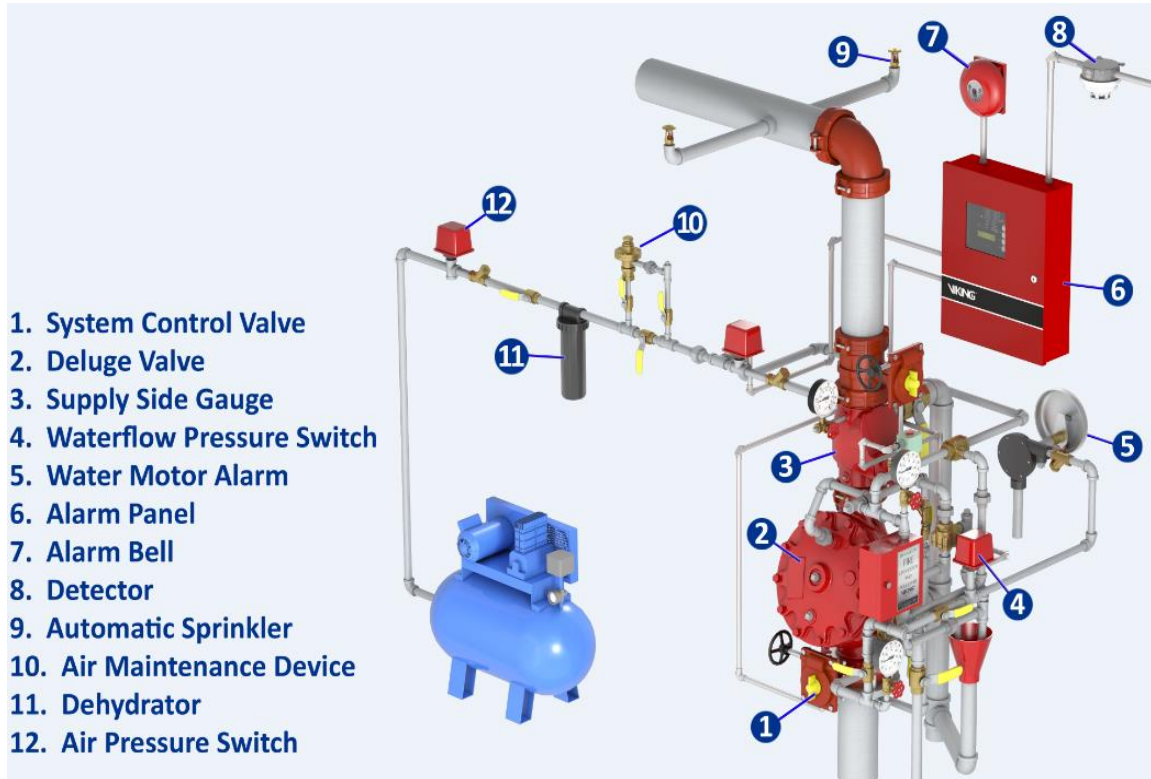
## Small Auxiliary Dry Systems

- Downstream of Wet System Riser





# Pre-Action Systems



**Pre-action systems are fixed fire protection systems with closed sprinkler heads.**

**The water supply is held back by a deluge valve, which is controlled by a release system.**

**When the release system operates, the deluge valve opens and water discharges from all open outlets connected to the sprinkler piping.**



# Pre-Action Systems

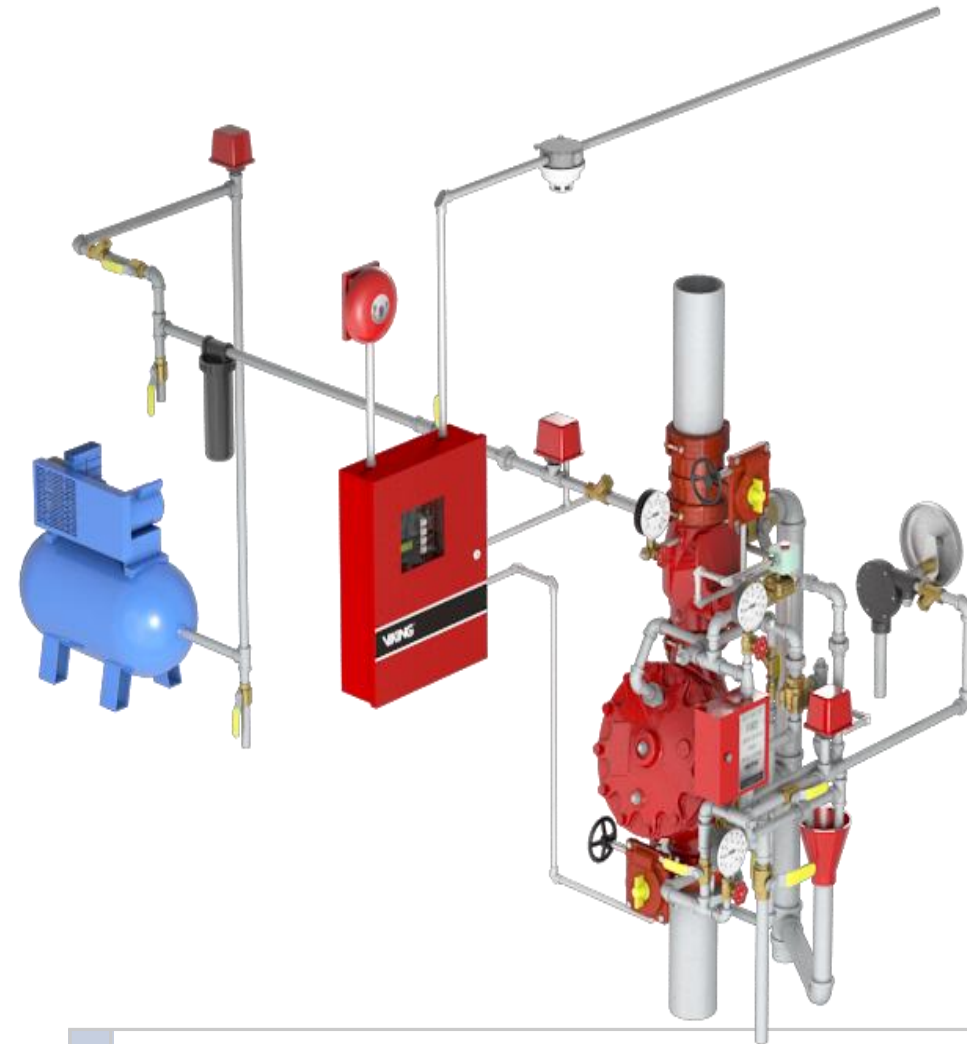


**The “Pre” part of pre-action means that the release or the detection system is required to operate prior to the sprinklers on the sprinkler piping.**

**The idea of pre-action is that the detection operates prior to the sprinkler system, allowing the water in the supply to be at or near the open sprinkler when the system operates.**

**Some pre-action systems only operate after the sprinkler opens, meaning the delay in water application would be the same as a dry pipe system.**

# Pre-Action Systems



**Pre-action systems are generally installed where there is a fear of water entering the sprinkler system or entering the space where the sprinklers are located.**

**Applications where pre-action systems are installed:**

**Freezers**

**Coolers**

**Flammable liquid storage (areas subject to Freezing)**

**Airports**

**Computer Rooms**

**Rare Book Storage**

**Historical Records**

**Historical Buildings**

**Gymnasium Floors**

**Record Storage Areas**

## Single Interlock Pre-Action System

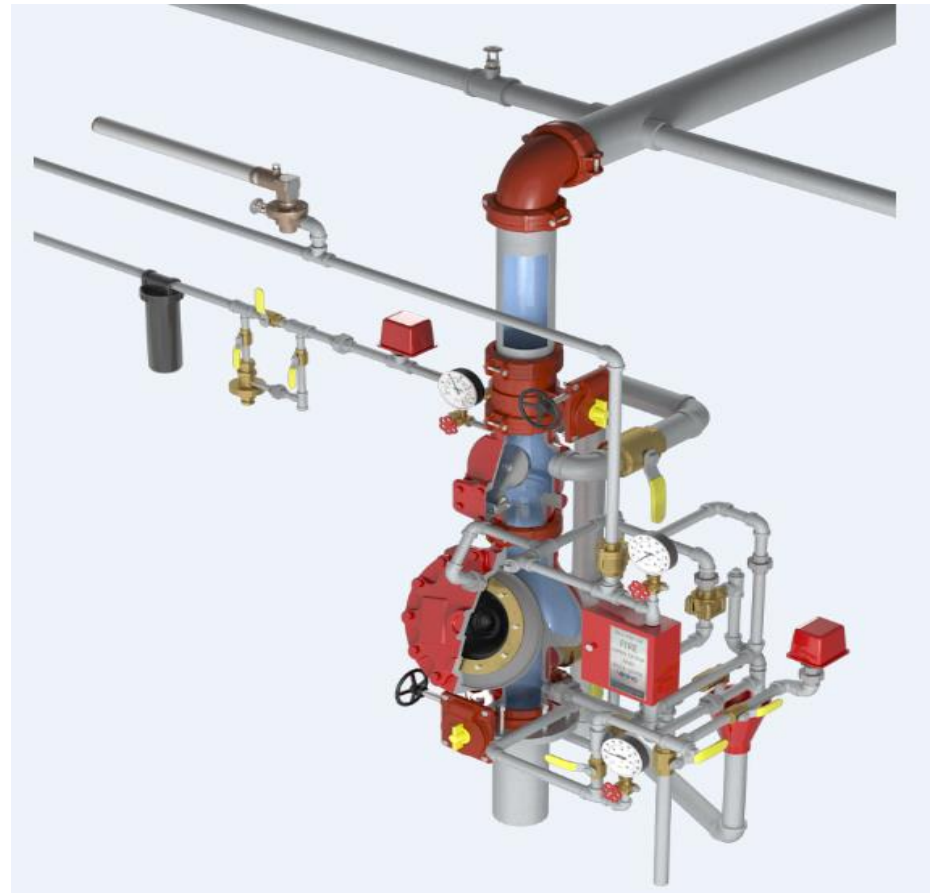
“Single” – Only (1) specific action has to happen to open the Deluge Valve.

Activation of Detection opens Release

Air Pressure in piping is for Supervisory purposes only!

There is no minimum required air pressure for a Single Interlock System.

Not all Single Interlock Pre-action Systems require the Supervisory Air Pressure.



## Double Interlock Pre-Action System

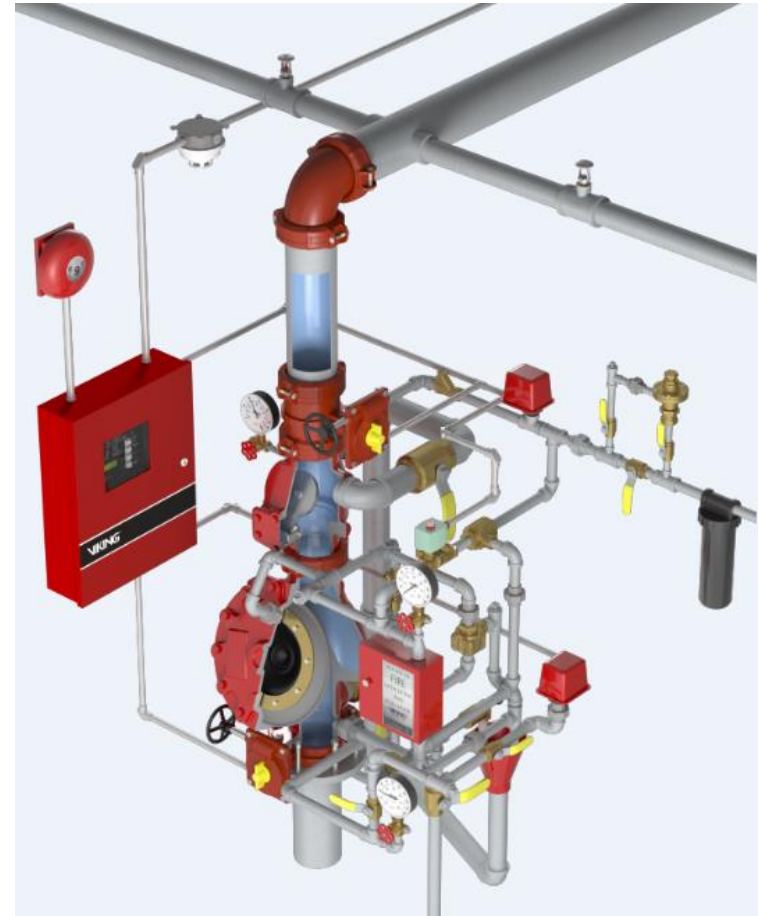
“Double” – (2) specific actions have to happen to open the Deluge Valve

Activation of Detection and loss of air pressure in the system piping open the release(s)

Minimum 7 psi Air Pressure in piping network

30 psi/ 50 psi Air Pressure recommended

Possible Accelerator Installation



# Negative Pressure Based Systems

## Vacuum Fire Protection Systems

Vacuum Fire Protection System is a complete FM approved integrated system that offers unique features and benefits such as corrosion mitigation. Considered an equal to systems utilizing FM approved nitrogen systems.

Fully assembled, factory tested and ready to be connected to the water supply and piping network, system includes all control valves, a vacuum pump, release control panel and the unique **FireFlex FLX-PC** (Patent Pending) Vacuum Pressure Controller which constitutes the heart of the system.



# Negative Pressure Based Systems

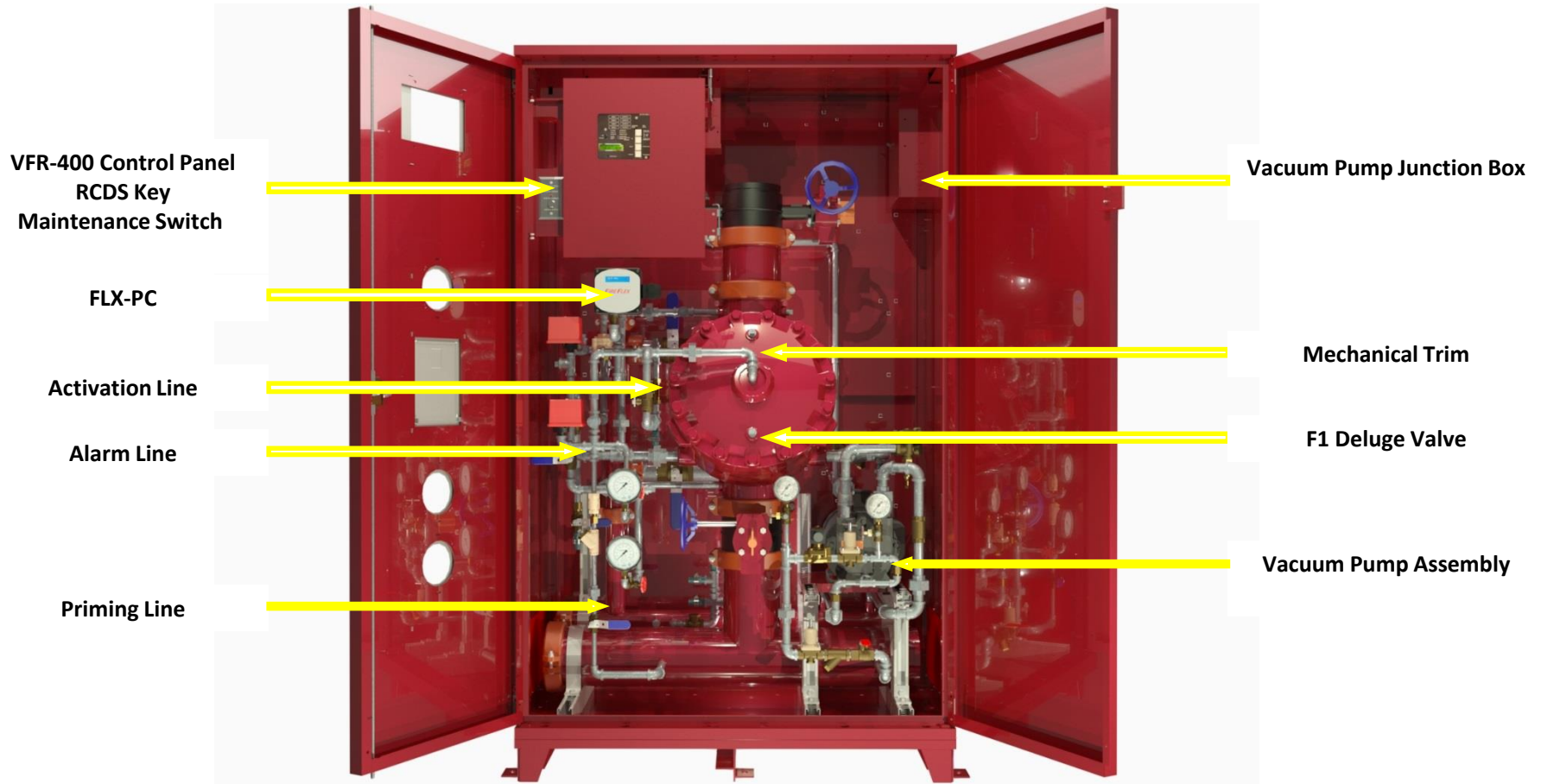
## Vacuum Fire Protection Systems





# Negative Pressure Based Systems

## Vacuum Fire Protection Systems





# Negative Pressure-based System

## Vacuum Fire Protection Systems

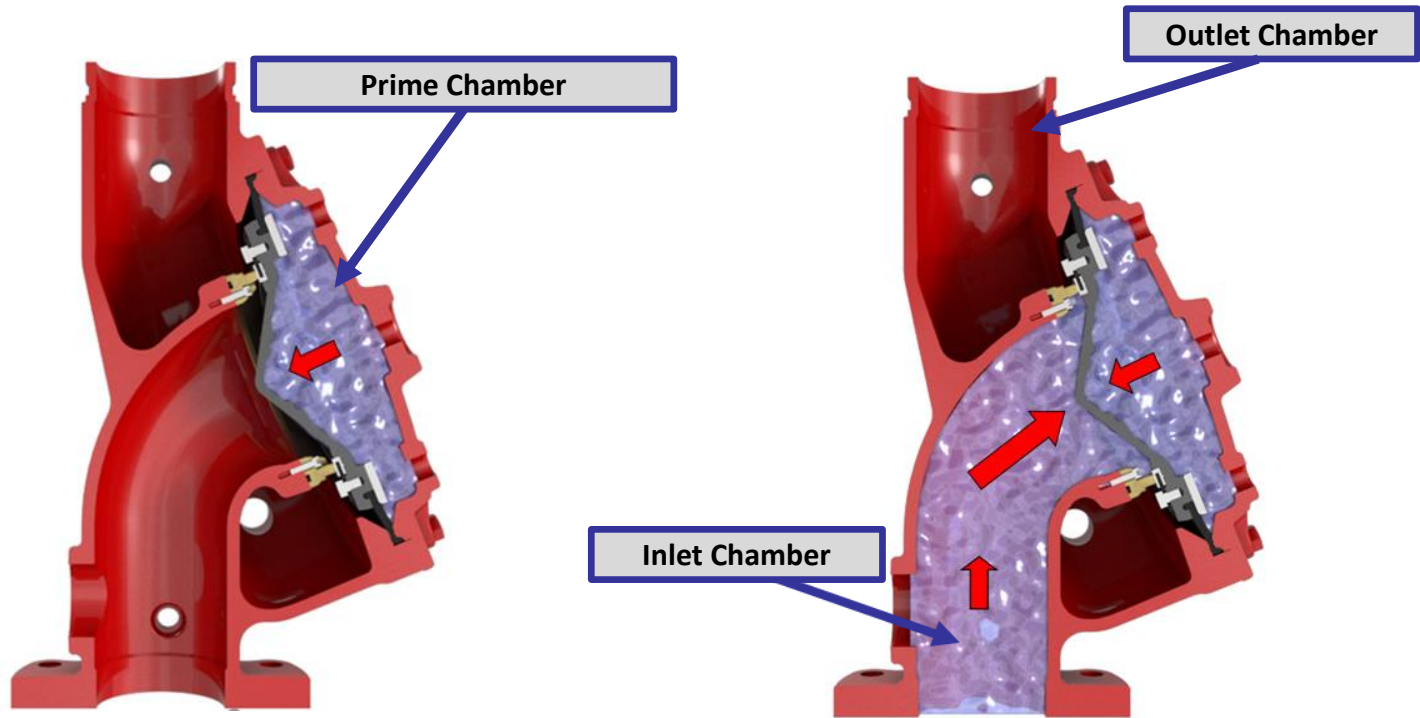


### System Orientation:

- **Left**
  - Sprinkler system trim piping
    - Used for valve setup
    - Essential for system activation
- **Right**
  - Vacuum pump trim piping
    - Essential for system activation

# *Negative Pressure-based System*

## Vacuum Fire Protection Systems



# *Negative Pressure-based System*

## Vacuum Fire Protection Systems

### Main Features:

#### Corrosion Inhibition

Corrosion is a major topic as fire protection systems efficiency may be heavily impacted by corrosion damages

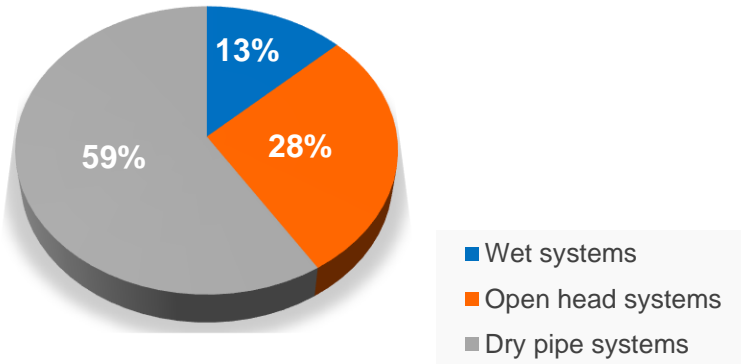
- FM photography of corrosion
- Extracts from FM Report on Corrosion Damages



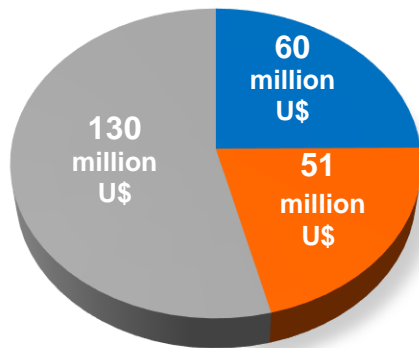
# Negative Pressure-based System

## Corrosion Inhibition

Sprinkler systems involved in obstructed-pipe fires  
(reported to FM global 1982-2001)



Losses

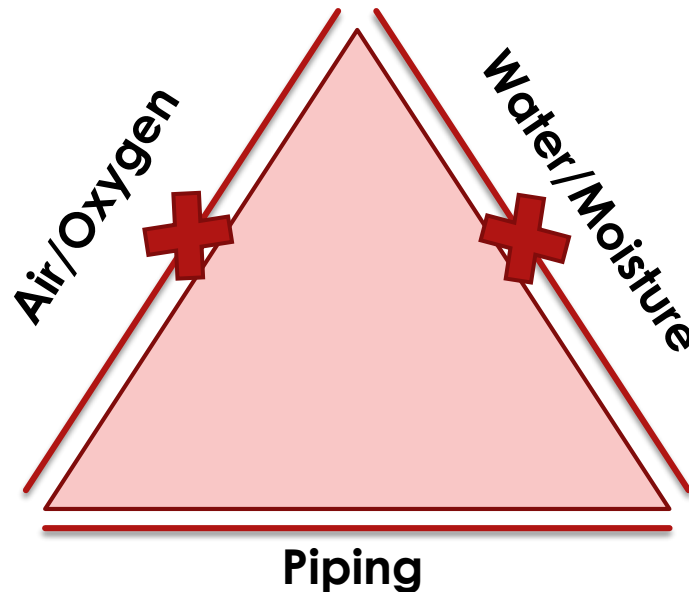


Plywood mill (59,7 million us loss)  
An obstructed sprinkler system allowed the fire to burn freely

# *Negative Pressure-based System*

## Corrosion in Sprinkler Pipes

**Air + Water/Moisture + Piping = Corrosion**



Corrosion is inhibited by removing water/moisture & oxygen



# *Negative Pressure-based System*

## **Vacuum Fire Protection Systems**

### **Main Features:**

#### **Ice Plug Prevention**

- Condensation leads to ice plugs in freezers
- Moisture develops as warm air cools down
- Moisture is constantly injected in the piping network



# *Negative Pressure-based System*

## **Vacuum Fire Protection Systems**

### **System Configurations:**

#### ➤ **Dry-pipe Vacuum**

The system will operate when a sprinkler operates and water will flow through the open sprinkler. No detection is required or used.

#### ➤ **Vacuum Non-interlock Preaction**

The system will operate when a sprinkler operates and water will flow through the open sprinkler.

**OR**

The system will operate when the Fire Alarm detection is activated and the piping network will be filled with water. No water will flow until the sprinkler is activated.

***Note: Both Dry-Pipe Vacuum and Vacuum Non-interlock Preaction are offered with a Failsafe Option***



# *Negative Pressure-based System*

## Vacuum Fire Protection Systems

### System Configurations:

#### ➤ Vacuum Single-interlock Preaction

The system will operate when the Fire Alarm detection is activated and the piping network will be filled with water. No water will flow until the sprinkler is activated.

If a sprinkler operates without the Fire Alarm detection, only a **Supervisory** signal (Low vacuum) will be activated. The system will not activate.

**Note:** Cross zoned Fire Alarm detection is available with this configuration.

#### ➤ Vacuum Double-Interlock Preaction

The system will operate when Fire Alarm detection is activated **AND** a sprinkler activates. Water will then flow through the open sprinkler.

The system will **NOT** operate when the Fire Alarm detection is activated; only an alarm signal will be activated.

If a sprinkler activates without the Fire Alarm detection, only an **Alarm** signal will be activated and the system will not operate.

# Negative Pressure-based System

## Vacuum Fire Protection Systems

### System Configurations:

#### ➤ System Valve Sizes

All systems use the same components and are available in sizes from 3" to 8"

#### ➤ Water Pressure

The Integrated Vacuum Fire Protection systems have been approved and tested for water inlet pressures ranging from 20 psi to 175 psi.

#### ➤ Mechanical Options

The only options that are available with the Vacuum Fire Protection systems is the Semi-flanged and Full-flanged configurations.

***Note: The Shut-off valve and sight glass is not an option it comes standard with the system***

# Negative Pressure-based System

## Vacuum Fire Protection Systems

### FLX-PC

- The **FLX-PC**® control unit is equipped with a microcontroller based circuit that uses a piezoelectric type pressure sensor to analyze the pressure in real time in a piping network.
- It includes a LCD type display with 2 lines of 16 characters that displays the status of the system.
- A single push-button on the side is used to perform the various commands.
- The **FLX-PC**® unit is powered by the release control panel and consumes very little energy.
- Various pre-established parameters allow to conduct supervisory and fire protection system release via connections to the release control panel.
- The **FLX-PC**® unit allows the control of the start-stop cycle of the vacuum pump according to pre-established parameters.



# Negative Pressure-based System

## Vacuum Fire Protection Systems

### FLX-PC

System Pressure

- 0 . 1 8 0 B A R  
1 6 8 : 3 0 : 2 5      5 : 2 0

Pump Hour Meter  
(time between two starts)

Pump Operation Time  
(time the pump is on)



# *Negative Pressure Based Systems*

## **Vacuum Fire Protection Systems**

### **Vacuum Pump Assembly**

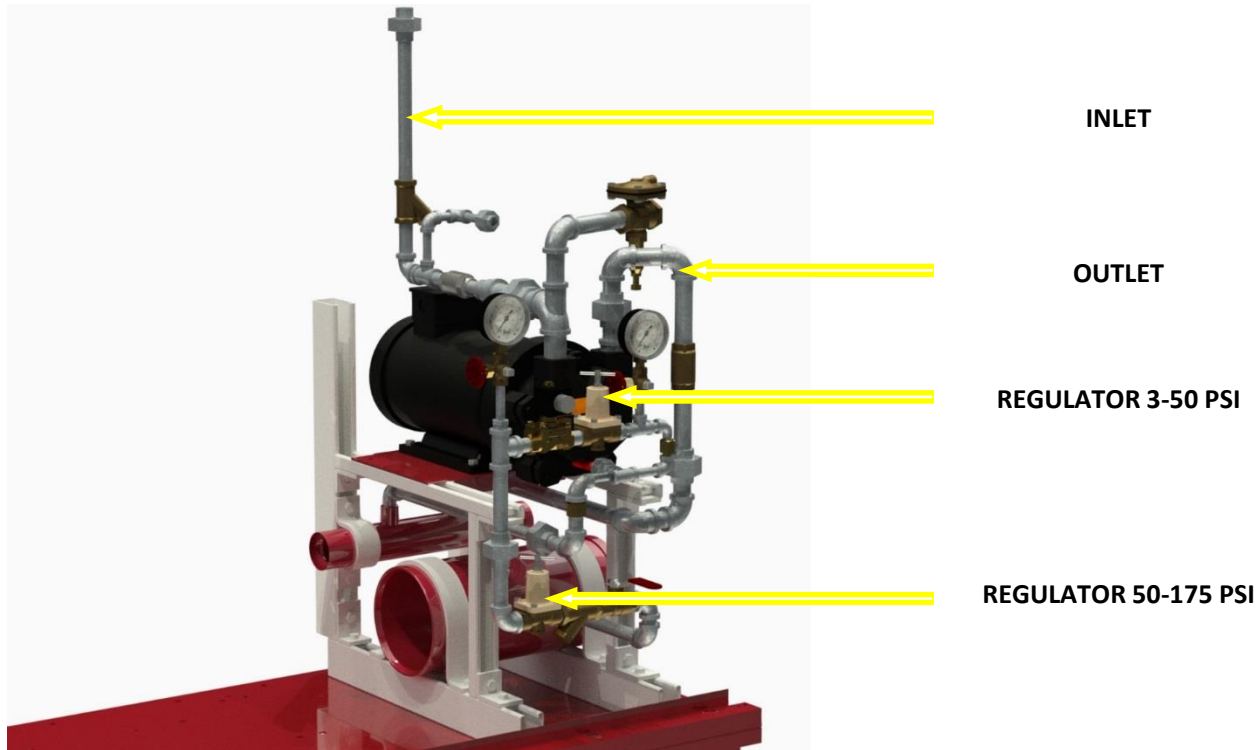
- The vacuum is created using a (1.5 HP, 220V/50-60Hz/7 Amps) water ring seal vacuum pump controlled by the FLX-PC
- The vacuum pump used in the system allows for very quick start-ups. The required time to establish maximum supervisory vacuum level in the piping network is less than 4 minutes for a 1000 gallon system thus saving start-up and maintenance time in the field
- Quiet running and requiring minimal maintenance vacuum pumps offer significant advantages compared to air compressors



# *Negative Pressure-based System*

## Vacuum Fire Protection Systems

### Vacuum Pump Assembly



# Negative Pressure-based System

## Vacuum Fire Protection Systems

### Control Panel

- The Viking VFR-400 is a cULus Listed, FM approved and meets UL 864-9 requirements.
- Onboard menu-driven programming.
- Available for use with either 120VAC – 60Hz or 220/240 VAC-50Hz
- Compatible with multiple initiating devices such as: linear heat detection, smoke and heat detectors, waterflow indicators as well as manual pull stations.
- Releasing Circuit Disconnect Switch (RCDS) included required for maintenance in the NFPA 72-2010 Edition





# Negative Pressure-based System

## Vacuum Fire Protection Systems

### Sprinklers for Vacuum System

Sprinklers must be approved and tested for use under vacuum condition



#### K25.2 (K360 metric) Vacuum System Upright



Vacuum system sprinklers are automatic sprinklers that have been categorized by FM Global as acceptable for use with FM Approved vacuum based dry sprinkler systems. These sprinklers have been evaluated under vacuum pressure to ensure proper operation in a vacuum system. Consult the occupancy-specific FM Global Property Loss Prevention Data Sheet to confirm that vacuum system sprinklers are compatible for the occupancy hazard to be protected.

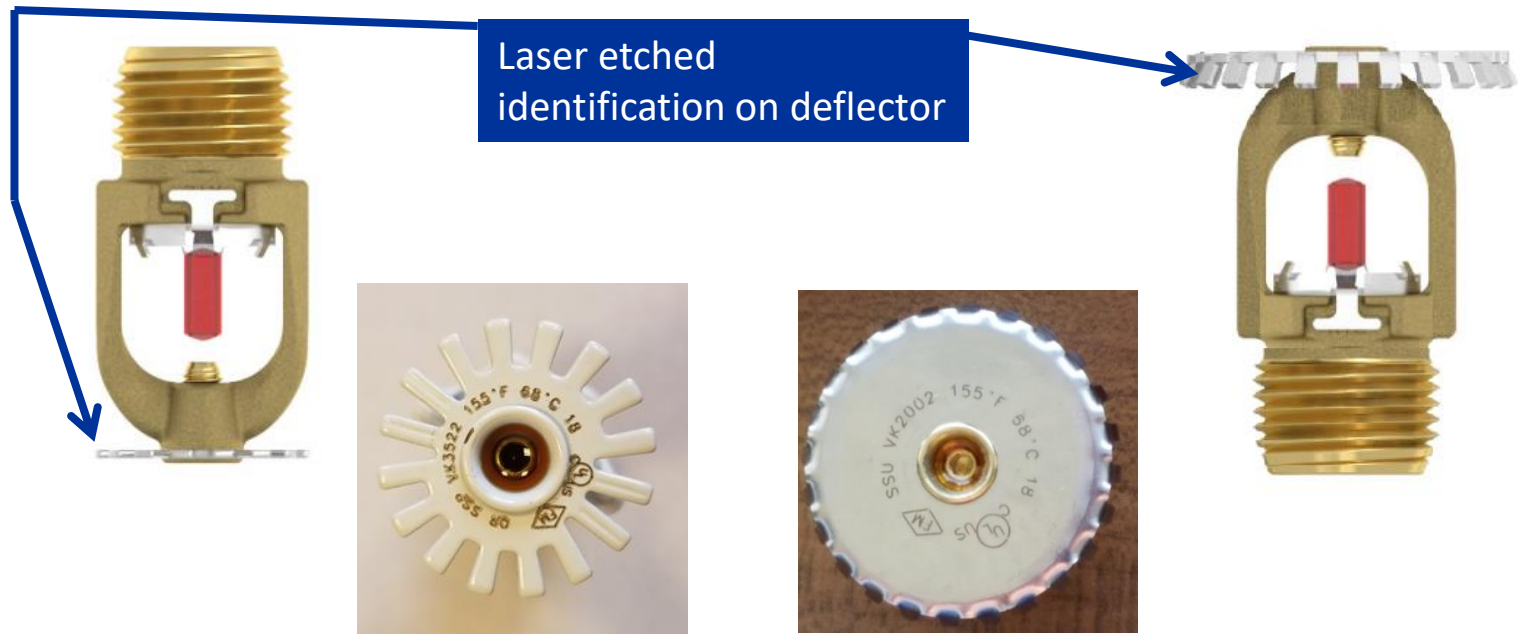
☒ Group Products by Company

The Viking Corporation  
210 N Industrial Park Dr, Hastings, Michigan 49058, USA

Product		Primary Class of Work	Listing Country	Sprinkler Category	K	Type	Response	Element	NPT (in.)	Finish	Temp. Rating (°F)	Temp. Rating (°C)	Certification Type
VK598 *	<b>NEW</b>	2029-AS Ctrl Md Spec App (K=25.2)	United States of America	Storage	25.2	Upright	SR - Standard Response	5 mm	1	Brass	155, 175, 200, 286	68, 79, 93, 141	FM Approved

\*Approved for use in FM Approved vacuum sprinkler systems with a maximum supervisory vacuum pressure of -3 psi (-207 mbar)

# Compatible Sprinkler



# *Compatible Sprinklers*

## Approved Sprinklers for use with Vacuum Technology



- **VK1001 5.6K** Standard Response Upright
- **VK2001 8K** Standard Response Upright
- **VK3001 5.6K** Quick Response Upright
- **VK3501 8.0K** Quick response Upright
- **VK598 25K** Standard Response Upright



## **SEISMIC - OPTIONAL FEATURE**

OSHPD PRE-APPROVED

### **SEISMIC CONSTRUCTION**

TOTALPAC®3 has been shake-table tested by OSHPD to the worse earthquake found, ensuring normal system operation after an earthquake, with no falling parts, thus maximizing safety.

### **QUALIFICATIONS**

The TOTALPAC®3 seismic construction is tested and qualified in accordance with:

- International Building Code, 2009 Edition
- California Building Code, 2007 Edition
- ASCE Standard 7, 2005 Edition
- OSHPD CAN-21708A.5, Rev. 3
- ICC-ES AC-156

# Releasing Circuit Disconnect

## NEW STANDARD FEATURE

### Releasing Circuit Disconnect Switch

#### NFPA 72, 2010 Edition

**23.13.5** Releasing service fire alarm systems used for fire suppression—releasing service shall be provided with a **disconnect switch** to allow the system to be tested without actuating the fire suppression systems.

**23.13.5.1** Operation of a disconnect switch or a disable function shall cause a supervisory signal at the releasing service fire alarm control unit.

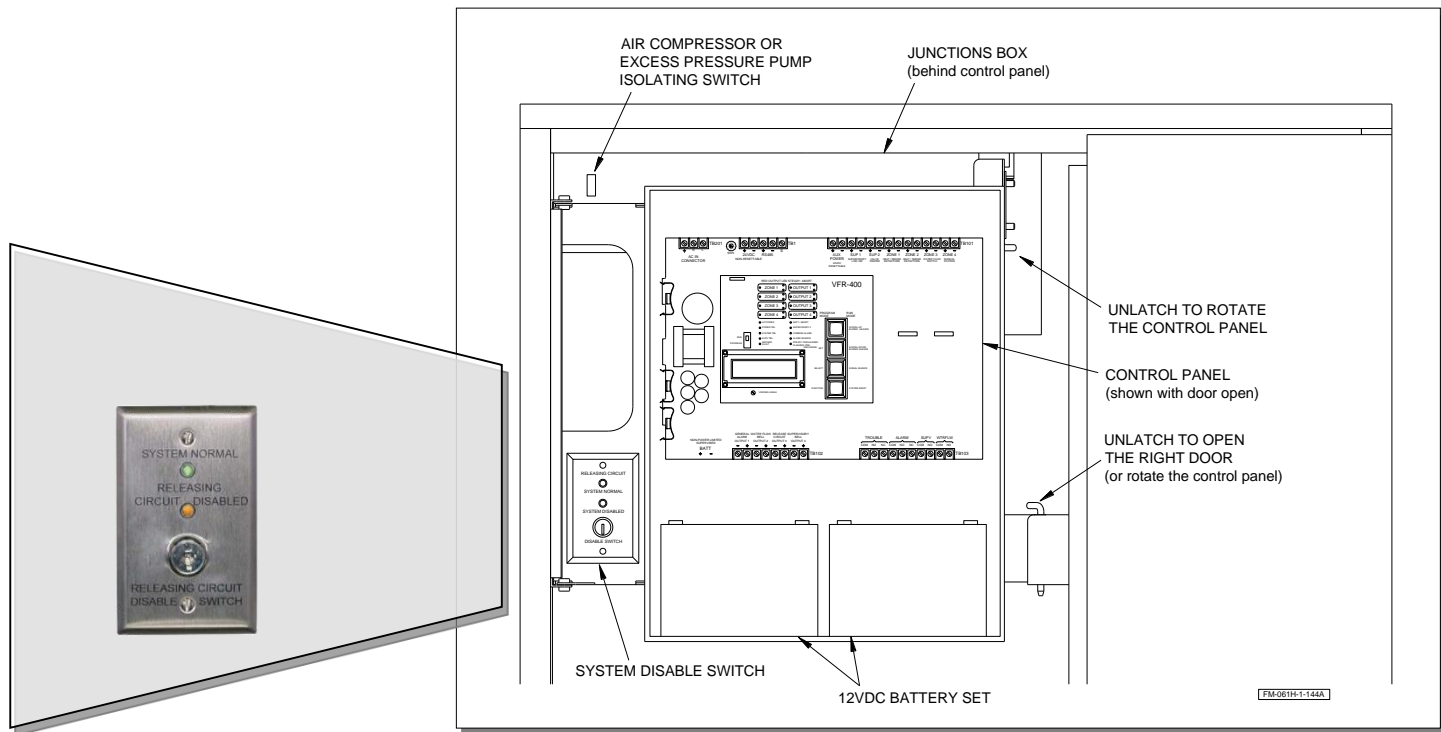
**23.13.5.2** The disconnect shall be a physical switch and not be accomplished by using software.

**A.23.13.7** Automatic fire suppression systems referred to in 23.13.7 include, but are not limited to, preaction and deluge sprinkler systems, carbon dioxide systems, Halon systems, and dry chemical systems.

# Releasing Circuit Disconnect

## NEW STANDARD FEATURE

### Releasing Circuit Disconnect Switch



# *Negative Pressure-based System*

## **Vacuum Fire Protection Systems**

### **System Design**

#### **C Factor**

C value of 120 can be used for design purposes when corrosion mitigation measures are able to be fully implemented.

Corrosion mitigation measures:

- Pipe pitched as outlined in FM Data Sheet 2-0 or NFPA standards
- Cut-grooved or similar sprinkler pipe used
- Use of rigid grooved couplings and gap seal type coupling gaskets
- Water removal within the riser above the valve is provided (standard characteristic in the FireFlex/Vactec integrated vacuum systems).

#### **Note:**

For corrosion mitigation measures, it is important to be sure that water is not keep in the piping network during its normal operation or supervisory mode. For example, with roll grooved pipe, there will always be some water retained in the piping network between two roll grooves. With cut grooves, rigid couplings and gap seal gaskets, water will drain naturally to the low points.

For installations where these mitigation steps cannot be fully implemented, galvanized pipe would be needed for a C value of 120 otherwise a C value of 100 would be recommended for design purposes.



# *Negative Pressure-based System*

## **Vacuum Fire Protection Systems**

### **System Design**

#### **Standard Hydraulic Calculations**

You must perform your Hydraulic calculations using your standard Hydraulic calculations software. The results of your calculations will be used as inputs for the Vacuum System Calculator.

# Negative Pressure-based System

## Vacuum Fire Protection Systems

### System Design

#### Calculation Software

FireFlex provides a Vacuum System Calculator free of charge to help calculate the time to fill the entire volume of piping in the prescribed time. A water delivery time software can also be used to perform these calculations.

#### Calculator Input

**FIREFLEX** Vacuum Fire Protection System calculator  
ADVANCED INTEGRATED FIRE PROTECTION SYSTEMS

Standard Hydraulic Calculation		
Project Name	<input type="text" value="FireFlex"/>	
Project Reference	<input type="text" value="Example"/>	
Units	<input type="text" value="US units"/>	▼
Sprinkler	<input type="text" value="VK200 K8"/>	▼
System Pressure Demand	<input type="text" value="81.6"/>	PSI
System Flow Demand	<input type="text" value="1535"/>	USGPM
Most remote Sprinkler Pressure	<input type="text" value="39"/>	PSI
Elevation	<input type="text" value="21"/>	FEET
System Volume	<input type="text" value="950"/>	USG

Calculator input

Water Delivery Time Requirement	<input type="text" value="Other"/>	▼	Heads	<input type="text" value="1"/>	Max. time (sec.)	<input type="text" value="60"/>
Trip Time	<input type="text" value="5"/>					SEC.
Time for Full flow	<input type="text" value="5"/>					SEC.
Maximum Pressure	<input type="text" value="90"/>					PSI
<a href="#">Water Supply Calculations</a>						
Available water flow	<input type="text" value="1390"/>					USGPM
<a href="#">Time Calculations</a>						
FM-080P-0-5A						

# Negative Pressure-based System

## Vacuum Fire Protection Systems

### System Design

The calculator output indicates the minimum flow requirement to meet your time requirement and also the maximum possible flow (for this calculator) for the maximum pressure that you entered. With the maximum possible flow information, the calculator provides the estimated time to fill the piping network with that specific flow.

**FIREFLEX** Systems Inc.  
ADVANCED INTEGRATED FIRE PROTECTION SYSTEMS

Vacuum Fire Protection System calculator

Calculation summary - [US units]

Standard hydraulic calculations

Project Name	FireFlex
Project Reference	Example
Sprinkler	VK200 KB
System Pressure Demand	81.6 PSI
System Flow Demand	1535 USGPM
Most remote Sprinkler Pressure	39 PSI
Elevation	21 FEET
System volume	950 USG

Calculator inputs

Water delivery time requirement	Other, 1 head(s), 60 sec.
Trip Time	5 SEC.
Time for Full Flow	5 SEC.
Maximum pressure	90 PSI

Calculator outputs

Water supply requirement to fully fill the piping network with water within the time requirement

Estimated filling time: 60 SEC.  
Water flow requirement: 1,390 USGPM, 37 PSI (Refer to the Water Supply Requirements graph for detailed information.)

Maximum possible Flow of 2470 USGPM for selected Maximum pressure  
with Estimated Filling Time of 42 sec

# *Negative Pressure-based System*

## **Vacuum Fire Protection Systems**

### **Applications**

The corrosion mitigation properties of the Vacuum technology make this technology suitable for all applications where piping corrosion or pipe clogging is a concern.

Large parking garages where corrosion is often a concern.



# *Negative Pressure-based System*

## **Vacuum Fire Protection Systems**

### **Applications**

Storage applications where not heating the building can significantly reduce operational costs.



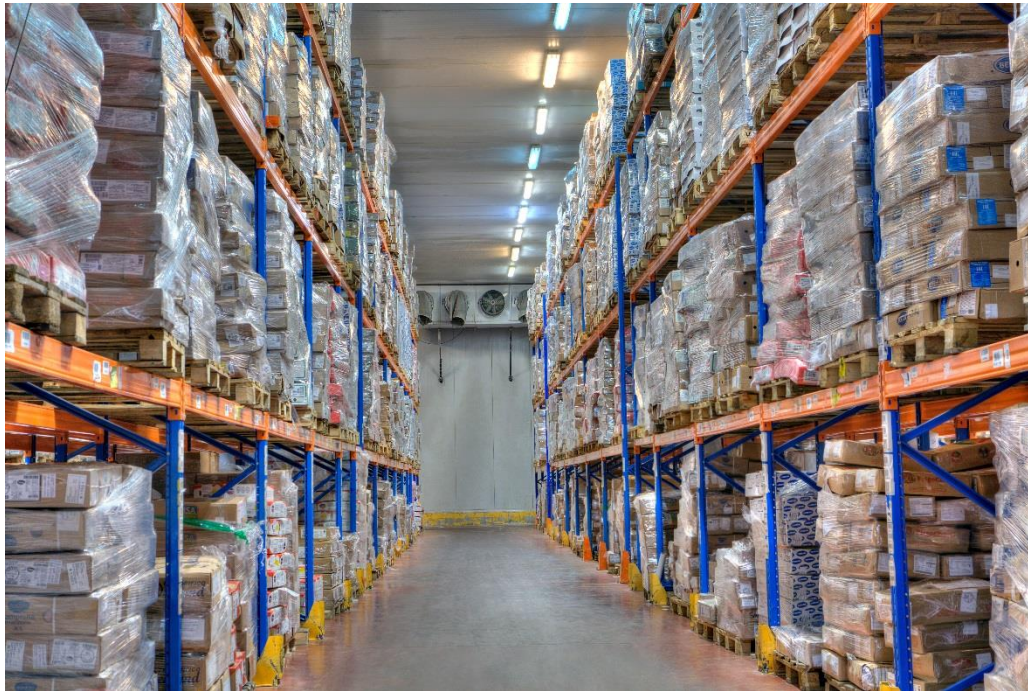


# *Negative Pressure-based System*

## **Vacuum Fire Protection Systems**

### **Applications**

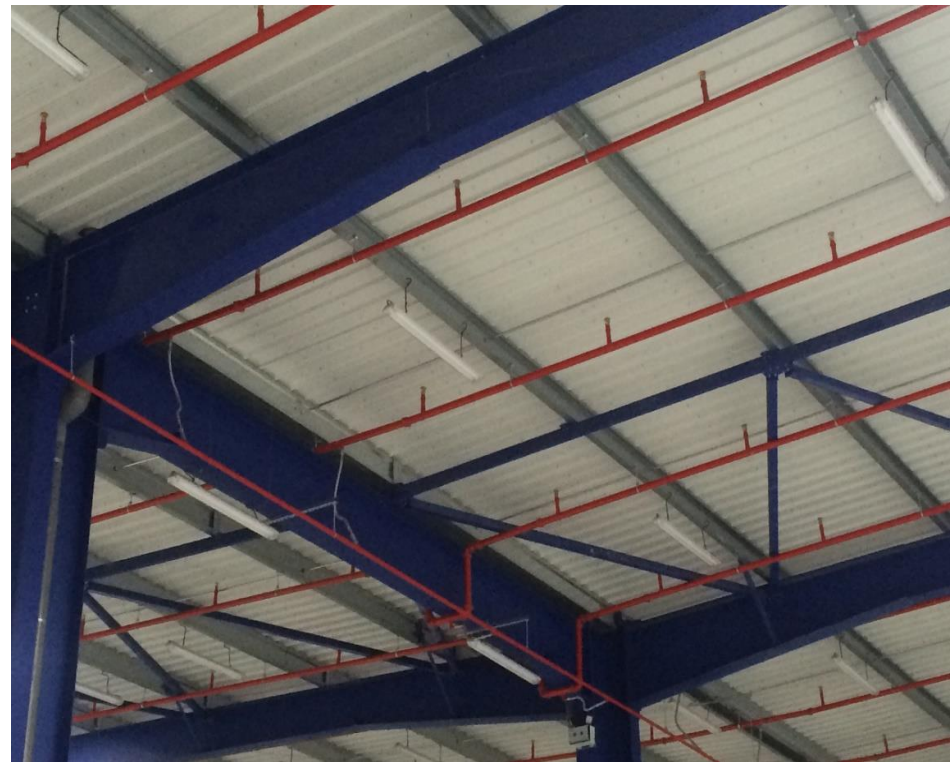
Freezer protection is also a suitable application, where no ice plugs are formed in the piping network. The vacuum pump removes residual water in the riser each time it operates to maintain the proper vacuum level. No condensation problems occur, and no special additional equipment is required.



# *Negative Pressure-based System*

## Vacuum Technology Fire Protection Systems

### Reference Installations





# *Negative Pressure-based System*

## **Vacuum Fire Protection Systems**

### **Summary – Main Features**

- Inhibits corrosion by removing oxygen and moisture
- Inhibiting atmosphere quickly created as you start the system
- Automatically removes residual water preventing ice plug formations
- Roughness factor of  $C=120$  on dry systems using black pipe possible
- Ensures quick filling time thru FLX-PC Controller
- Real-time Vacuum Pressure monitoring
- Free calculation software to estimate filling time

# Sprinkler Assistance

## Sprinkler Selector

Head Selector

webtools.vikingcorp.com/sprinklerselector/

VIKING®

Trusted above all.™

Hazard

Ordinary Hazard

Application

Standard

Orientation

All

Response Type

All


K-Factor

All

Approvals

All

Clear Inputs



**VK130, VK132 - Micromatic Stainless Steel Sprinkler (K5.6)** [Data Sheet](#) - [Product Website](#)

Model: VK130

Application: Standard

Response: Standard

Temperature: 155 °F (68 °C)

Element: 5mm GLASS BULB

Orientation: Upright

Style: Standard

Orifice: 1/2" (15mm) NPT

Finish: Stainless Steel

Hazard: Light Hazard; Ordinary Hazard; Extra Hazard

K-Factor: K5.6 (80)

Part Number: 05012BB

Approvals: cULus; FM; LPC; CE

Type: Wet

**Hazard Details**

Hazard	Max Pressure	Minimum Spacing	Maximum Spacing
Light Hazard	175 psi (12.07 bar)	Per NFPA, FM	Per NFPA, FM
Ordinary Hazard	175 psi (12.07 bar)	Per NFPA, FM	Per NFPA, FM
Extra Hazard	175 psi (12.07 bar)	Per NFPA, FM	Per NFPA, FM

**Accessory Details**

Tape	Guard	Shield
No	No	No

Advanced Search +

Part Number	Model	Description	Finish	Application	Element	Orientation	K-Factor	Response Type	Thread Size	Temperature
Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter
05012BB	VK130	VK130, VK132 - Micromatic Stainless Steel Sprinkler (K5.6)	Stainless Steel	Standard	5mm GLASS BULB	Upright	K5.6 (80)	Standard	1/2" (15mm) NPT	155 °F (68 °C)
05012BCB	VK130	VK130, VK132 - Micromatic Stainless Steel Sprinkler (K5.6)	Wax Coated	Standard	5mm GLASS BULB	Upright	K5.6 (80)	Standard	1/2" (15mm) NPT	155 °F (68 °C)
05012BCD	VK130	VK130, VK132 - Micromatic Stainless Steel Sprinkler (K5.6)	Wax Coated	Standard	5mm GLASS BULB	Upright	K5.6 (80)	Standard	1/2" (15mm) NPT	175 °F (79 °C)
05012BCE	VK130	VK130, VK132 - Micromatic Stainless Steel Sprinkler (K5.6)	Wax Coated	Standard	5mm GLASS BULB	Upright	K5.6 (80)	Standard	1/2" (15mm) NPT	200 °F (93 °C)

VIKING

# *Viking Mobile App*

## Virtual Technical Support



Viking's new "Valve & System Support" smart phone app. The mobile app is now publicly available in both the Apple (iOS) and Google Play (Android) app stores.

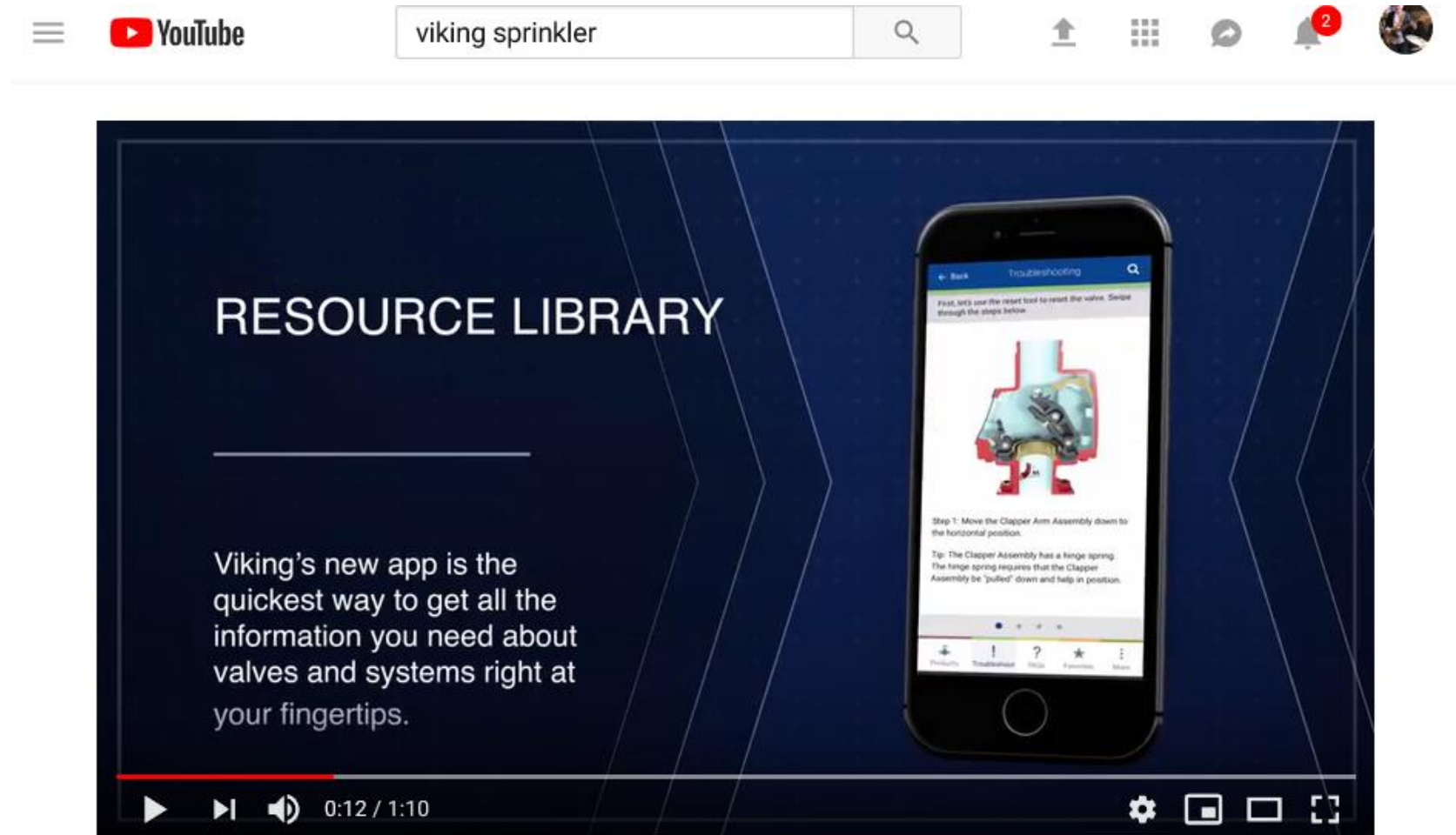
"Virtual Technical Support" for wet, dry pipe systems, deluge and preaction systems

- Access product and technical information, including 21 new "Product Maintenance and Repair Videos."
- Follow detailed, step-by-step troubleshooting for a wide variety of service and maintenance topics.
- Identify replacement parts for wet and dry valves, and then place a request to order parts.
- Watch additional videos and animations for Model G and Model F dry pipe systems.

<https://youtu.be/kTUdi7IUcYA>

# *iPhone and Android App*

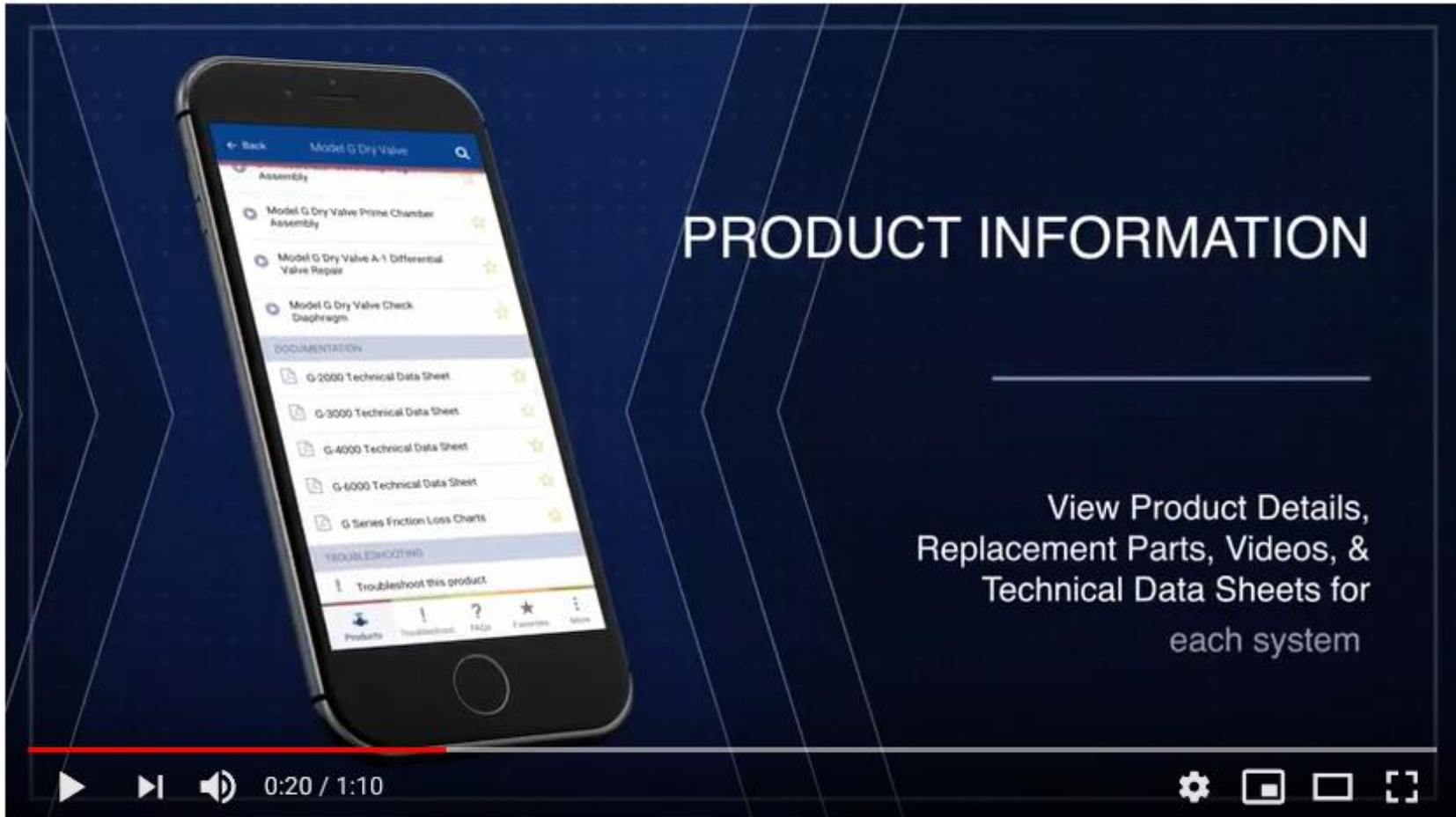
## Viking Mobile App Resource



Viking Valve and Systems Mobile App Overview

# *iPhone and Android App*

## Viking Mobile App for Product Information



# *iPhone and Android App*

## Viking Mobile App for Valve Repair Videos



Viking Valve and Systems Mobile App Overview

# *iPhone and Android App*

## Viking Mobile App for Valve Trouble Shooting



**TROUBLESHOOT**

View step-by-step walkthroughs for common valve system maintenance operations

0:48 / 1:10



# Thank You!



**Refer to the latest Viking Sprinkler “Quick Reference Guides” for up to date product information**

