EQUIPMENT, DESIGN & SERVICE MANUAL

FIRE EXTINGUISHING SYSTEM
ENGINEERED FOR USE WITH
3M™ NOVEC™ 1230 FIRE PROTECTION FLUID

DOT / TC CONTAINERS

IMPULSE VALVE OPERATOR (IVO) OR
IMPULSE ENERGETIC ACTUATOR (IEA)

UL / ULC LISTINGS
FM APPROVAL

NFPA 2001 STANDARD

U.S. & Foreign Patents
Doc. P/N 06-917
Rev. 1 / September, 2019

Fike®

SOLUTIONS

- Fire Protection
- Explosion Protection
- Overpressure Protection
- Pressure Activation

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1. INTRODUCTION

The information presented in this manual represents the most up-to-date information available for Fike's fire suppression system, engineered for use with 3M™ Novec™ 1230 Fire Protection Fluid. This manual also provides the information necessary to properly design, install and maintain the fire suppression system using Novec 1230 fluid in accordance with the requirements of NFPA Standard 2001, Underwriters Laboratories Inc. and FM Approvals.

Enough information is provided in this manual to allow those responsible for designing a Fike fire suppression system to properly do so, and for the parties responsible for verifying the system design to determine if the design parameters have in deed been met.

Fike fire suppression systems may be UL/ULC Listed and/or FM Approvals Approved depending on where and how the system containers where filled. Special codes following the container part number designate which approval your system has, but the governing indicator is whether the system container labels bear the agency's official markings.

Systems bearing the UL and ULC mark have been designed, tested and filled per UL 2166, Halocarbon Clean Agent Extinguishing System Units.

Systems bearing the FM Approved mark have been designed, tested and filled to meet FM 5600, Approval Standard for Clean Agent Extinguishing Systems.

If any of these marks are absent from the container label, the system containers, while still designed and tested per relevant UL and FM standards, were not filled at a UL/ULC Listed and/or FM Approved fill location.

Any questions concerning the information presented in this manual should be addressed to:

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2. SYSTEM COMPONENTS

2.1. 3M™ Novec™ 1230 Fire Protection Fluid

Novec 1230 fluid is an odorless, colorless, liquefied compressed gas. See Physical Properties for additional information. It is stored as a liquid and dispensed into the hazard as an electrically non-conductive gaseous vapor (due to its relatively low boiling point) that is clear and does not obscure vision. It leaves no residue and has acceptable toxicity for use in occupied spaces at design concentration.

Extinguishing Method

Novec 1230 fluid extinguishes a fire primarily through heat absorption. The gaseous mixture created when Novec 1230 fluid discharges into air has a much higher heat capacity than air alone. The gaseous mixture absorbs large amounts of heat due to the high heat capacity and extinguishes fires by sufficiently cooling the combustion zone. It is important to note, Novec 1230 fluid does not use the depletion of oxygen to extinguish a fire.

Approvals

Approvals include, but are not limited to:

- Factory Mutual Approved (FM)
- Underwriters Laboratories Inc. (UL) Recognized Component
- Underwriters Laboratories of Canada (ULC)
- US EPA Significant New Alternative Policy (SNAP) report

Use and Limitations

Novec 1230 fluid shall be used on the following class of hazards:

- Class A and C hazards including electrical and electronic hazards, telecommunication facilities and high value assets where the associated down-time would be costly
- Class B hazards containing flammable liquids and gases

Novec 1230 fluid shall **NOT** be used on fire involving the following materials:

- Chemicals or mixtures of chemicals capable of rapid oxidation in the absence of air, such as cellulose nitrate and gunpowder
- Reactive metals such as lithium, sodium, potassium, magnesium, titanium, zirconium, uranium and plutonium
- Metal hydrides such as sodium hydride and lithium aluminum hydride
- Chemicals capable of undergoing auto-thermal decomposition, such as organic peroxides, pyrophoric materials, and hydrazine

Exposure Limitations

The discharge of clean agent systems to extinguish a fire can result in potential hazard to personnel from the natural form of the clean agent or from the products of combustion that result from exposure of the agent to the fire or hot surfaces. Unnecessary exposure of personnel either to the natural agent or to the products of decomposition shall be avoided. See the table below for maximum exposure times based on system design concentration.

Hazard Type	Design Concentration	Maximum Human Expose Time
Normally Occupied Space	4.5% to 10.0%	5 minutes

NOTE: Fike does not recommend this system to be used in any normally occupied spaces where the design concentration required is above 10.0%.

Physical Properties of 3M™ Novec™ 1230 Fire Protection Fluid

Chemical Name	Dodecafluoro-2-methylpentan-3-one
Chemical Formula	$CF_3CF_2C(O)CF(CF_3)_2$
CAS No.	756-13-8
Molecular Wt.	316.04
Boiling Point @ 1 atm (760 mmHg), °C (°F)	49.2 (120.6)
Melting Point, °C (°F)	-108 (-162.4)
Critical Temperature, °C (°F)	168.66 (335.6)
Critical Pressure, kPa (psig)	1865 (270.44)
Critical Density, kg/m3 (lb/ft3)	639.1 (39.91)
Density, Sat. Liquid, g/ml (lb/ft3)	1.60 (99.9)
Density, Gas @ 1 atm, g/ml (lb/ft3)	0.0136 (0.851)
Specific Heat, Liquid (Cp) @ 25°C (77°F), kJ/kg-°C (Btu/lb-°F)	1.103 (0.2634)
Specific Heat, Vapor (Cp) @ 25°C (77°F), kJ/kg-°C (Btu/lb-°F) and 1 ATM	0.891 (0.2127)
Vapor Pressure @ 25°C (77°F), kPa (psig)	40.4 (5.85)
Heat of Vaporization @ Boiling Point, kJ/kg (Btu/lb)	88 (37.8)
Thermal Conductivity, Liquid @ 25°C (77°F),W/m-°C (Btu/hr-ft-°F)	0.059 (0.034)
Viscosity, Liquid (lb/ft-hr) @ 25°C (77°F), cP (lb/ft-hr)	0.56 (1.39)
Relative Dielectric Strength @ 1 atm, 25°C (N2 =1)	2.3
Solubility of Water in Novec 1230 fluid @ 70°F, ppm	< 0.001
Ozone Depletion Potential	0
Global Warming Potential, GWP (100 yr. ITH. For CO2, GWP = 1)	≤1

2.2. Agent Storage Containers

The agent storage containers are painted steel containers available in various sizes and varying fill densities. Each container is fitted with an internal siphon tube, Fike Impulse Valve assembly, pressure gauge, liquid level indicator (LLi), container nameplate and applicable mounting hardware.

The Impulse Valve contains a fast-acting rupture disc that retains the agent within the container until the disc is ruptured by an electric or pneumatic actuator (ordered separately), which allows the agent to be released from the container.

Each container is factory filled with 3M™ Novec™ 1230 Fire Protection Fluid in 1 lb. (0.5 kg.) increments up to their maximum capacity and is then super-pressurized with dry nitrogen to 500 psig at 70°F (34.5 bar at 21°C). Fill density must be specified when ordering. Containers sharing the same manifold must be equal in size and fill density.

Specifications

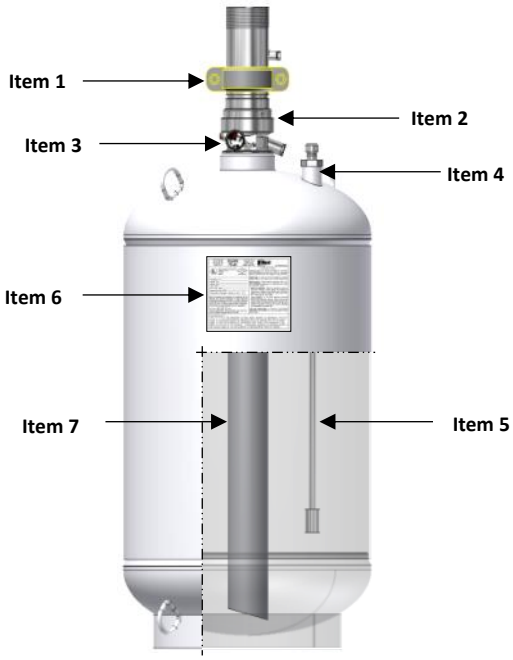
Super – Pressurization Level	500 psig at 70°F (34.5 bar at 21°C) after filling with dry nitrogen
Storage Temperature Limitation	32°F (0°C) Minimum to 130°F (54.4°C) Maximum (see note)
Safety Relief Range	If the container pressure reaches 720 to 800 psi (49.6 to 55.2 bar), valve will open automatically. This fulfills the pressure relief valve requirements in accordance with DOT regulations.
Container Rating	DOT 4BW500 / TC 4BWM534
Actuation Methods	Electric / Pneumatic / Manual
Color Options	White (default) or Red, Baked Enamel Finish
Fill Increments	1.0 lbs.(0.5 kg)
Fill Range	30 to 70 lbs/ft^3 (481 to 1121 kg/m^3)
Approvals	P/N ending in **-3P**: UL/ULC Listed and FM Approved P/N ending in **-UL**: UL/ULC Listed Only

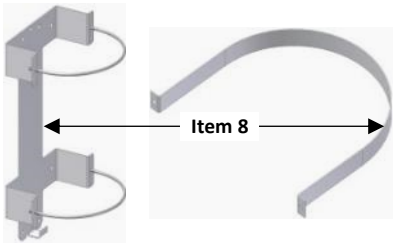
Note: If container temperature exceeds 130°F (54.5°C), system performance may be affected.

Container		Fill Range		Tare Weight (approximate)	Dimensions (approximate)		Valve Size
Size	Base P/N	Minimum	Maximum		Diameter	Height	
Lb. (L)		lbs. (kg)	lbs. (kg)	lbs. (kg)	in. (mm)	in. (mm)	in. (mm)
5 (2)	70-357	3 (1.0)	5 (2.0)	11 (5.0)	4.2 (105)	16.2 (411)	1 (25)
10 (4)	70-358	5 (2.5)	10 (4.5)	15 (6.8)	4.2 (105)	27.3 (693)	1 (25)
20 (8.5)	70-359	9 (4.5)	21 (9.5)	19 (8.6)	7.0 (178)	21.7 (551)	1 (25)
35 (15)	70-360	17 (7.5)	38 (17.0)	28 (12.7)	7.0 (178)	32.9 (836)	1 (25)
60 (27)	70-361	30 (13.5)	68 (30.5)	53 (24.0)	10.8 (273)	27.5 (699)	1 (25)
100 (44)	70-362	47 (21.5)	108 (49.0)	77 (34.9)	10.8 (273)	38.8 (986)	1 (25)
150 (61)	70-363	65 (29.5)	150 (68.0)	123 (55.8)	20.0 (508)	23.4 (594)	3 (80)
215 (88)	70-364	93 (42.5)	216 (98.0)	150 (68.0)	20.0 (508)	29.2 (742)	3 (80)
375 (153)	70-365	163 (74.0)	378 (171.5)	216 (98.0)	20.0 (508)	42.4 (1077)	3 (80)
650 (267)	70-366	283 (128.5)	660 (299.0)	364 (165.1)	24.0 (610)	49.7 (1262)	3 (80)
1000 (423)	70-367	449 (203.5)	1045 (474.0)	525 (238.1)	24.0 (610)	71.3 (1811)	3 (80)

Items Supplied with Container Assembly

Item Number	Description
1	Grooved Coupling & Nipple
2	Impulse Valve
3	Pressure Gauge
4	LLi Boss (see note 1)
5	Liquid Level Indicator (LLi)
6	Nameplate (see note 2)
7	Siphon Tube
8	Mounting Straps & Brackets





NOTES:

1) 100 through 1000 lb. (44 through 423 L) containers are equipped with a LLi Boss.

2) Fike nameplate provides the information that is specific to each container: Assembly and serial number of the container, weight information (tare, gross, and agent), and installation, operation, and safety information. All containers filled either by the factory, or by an Approved Initial Fill Station, are provided with a nameplate bearing the UL and FM markings.

2.3. Impulse Valve

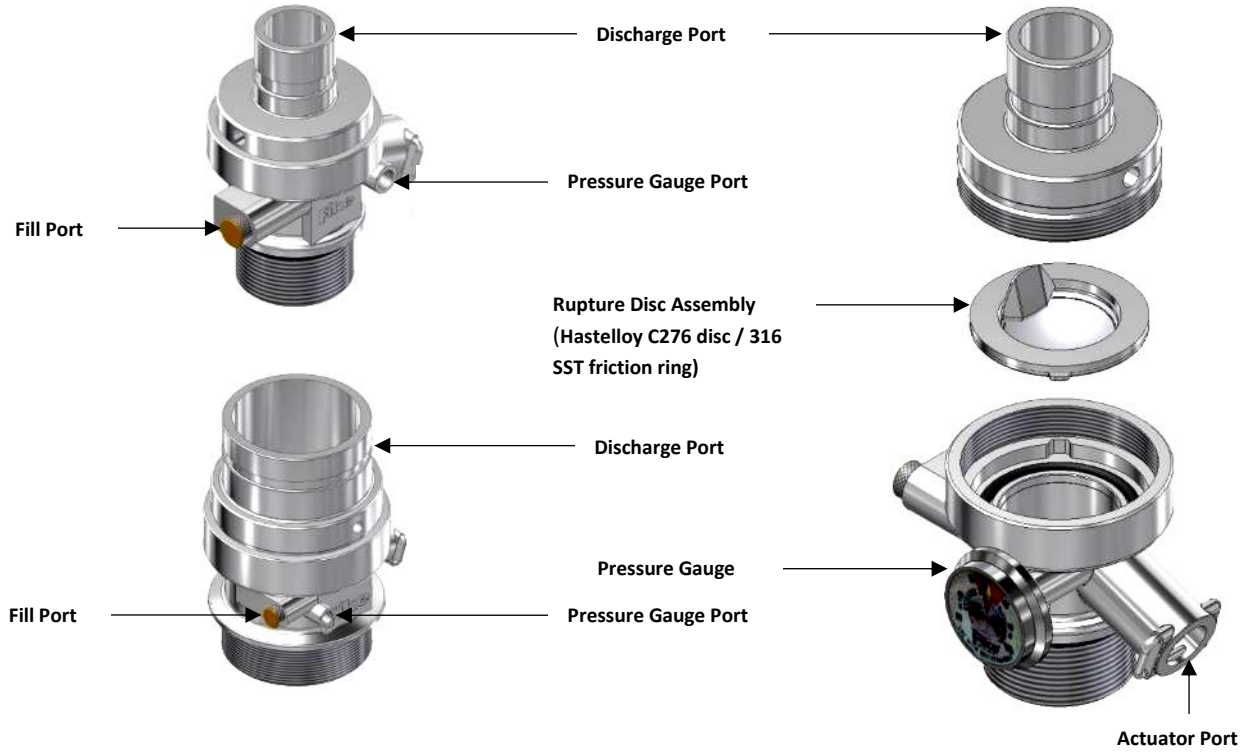
The 1" (25 mm) and 3" (80 mm) Impulse Valve Assemblies consists of a fast-acting rupture disc assembly housed in a brass valve body. The valve is designed to retain the agent within the container until the disc is ruptured by an electric or pneumatic actuator (ordered separately) allowing the agent to be released from the container. The valve is factory fitted to each clean agent container and is supplied pre-assembled with a pressure gauge.

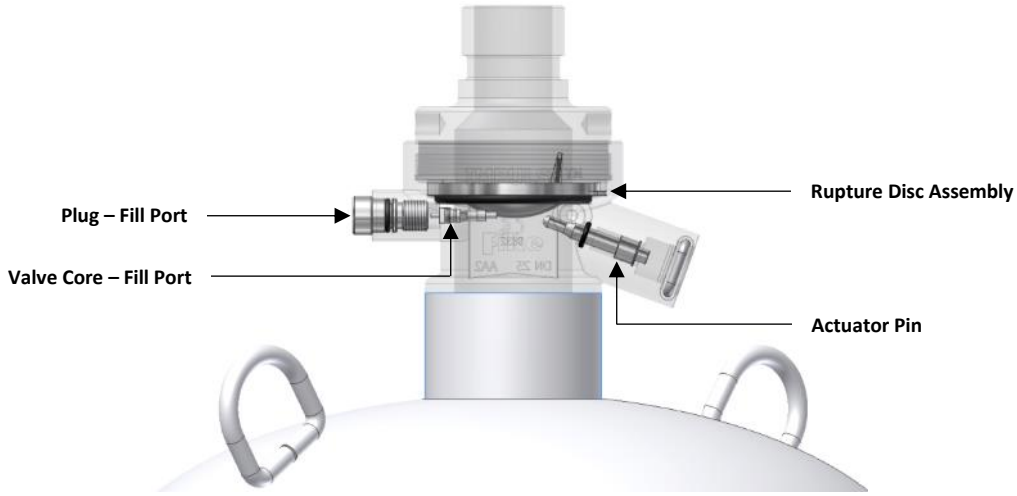
The valve's rupture disc assembly also acts as the pressure relief device for the container in accordance with DOT regulations by automatically opening if the container temperature exceeds 130°F (54.4°C).

Impulse Valve

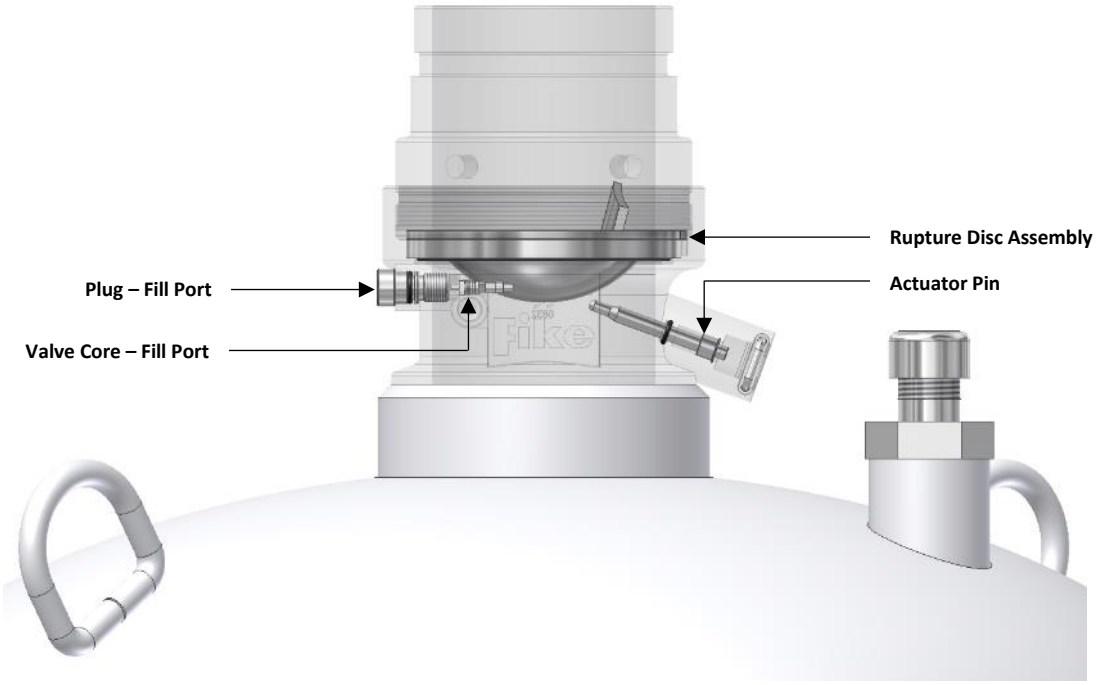
Each Impulse Valve is equipped with the following ports:

- Agent Discharge Port allows agent release from container and also fulfills the pressure relief valve requirements in accordance with DOT regulations.
- Agent Fill Port used to fill (refill) and pressurize the container and also used for the Low Pressure Switch.
- Actuator Port used to connect an Impulse Valve Operator (IVO) with Manual Strike Button for electric and manual actuation of the container or an Impulse Valve Pneumatic Operator (IVPO) for pneumatic operation.
- Pressure Gauge Port is used to connect a Pressure Gauge that will monitor internal container pressure, also equipped with an orifice plug that allows the pressure gauge to be removed safely when the container is pressurized.





Internal View – 1" (25 mm) Impulse Valve



Internal View – 3" (80 mm) Impulse Valve

2.3.1. Valve Recharge Kits

After a system has been discharged, the containers rupture disc valve must be rebuilt before the container can be recharged and placed back into service. The recharge kits below contain all of the items required to rebuild the valve.

1" (25mm) Recharge Kit, P/N 85-049

Item	Description	Part Number
1	Friction Ring (316 SST)	70-2060
2	Disc Assembly (Hastelloy C276)	70-352
3	O-Ring (Nitrile)	02-11987
4	Valve Core-Fill Port (not shown)	02-4161
5	Reconditioning Instructions (not shown)	06-567

Note: 1" recharge kit is used on 5, 10, 20, 35, 60 and 100 lb. (2, 4, 8, 15, 27 and 44 L) containers.

3" (80mm) Recharge Kit, P/N 85-050

Item	Description	Part Number
1	Friction Ring (316 SST)	70-2063
2	Disc Assembly (Hastelloy C276)	70-353
3	O-Ring (Nitrile)	02-11989
4	Valve Core-Fill Port (not shown)	02-4161
5	Reconditioning Instructions (not shown)	06-567

Note: 3" recharge kit is used on 150, 215, 375, 650 and 1000 lb. (61, 88, 153, 267 and 423 L) containers

For a detailed procedure on recharging a Fike container with an Impulse Valve refer to Fike's Recharge Manual, P/N 06-852.

2.4. Pressure Gauge

Each Fike Clean Agent fire suppression container with 3M™ Novec™ 1230 Fire Protection Fluid is fitted with a pressure gauge (P/N 02-17003) prior to being filled and shipped to indicate the internal container pressure. The pressure gauge scale is calibrated to show the actual pressure and is color-coded to show operating range, under-pressure range, and over-pressure range.

Pressure Gauge

The pressure gauge port on the Impulse Valve is designed to allow the gauge to be removed/replaced on a charged container without removing the agent first. The port allows a small controlled amount of leakage past its internal threads. This provides enough flow to operate the pressure gauge while being small enough to allow the gauge to be removed and replaced safely without excessive pressure or agent loss.

Specifications

Type:	Bourdon Tube Pressure Gauge
Diameter:	1.6 in. (40 mm)
Pressure Range:	0 to 760 psi (0 to 52.4 bar)
Connection:	1/8 in. NPT
Accuracy:	±4% at charge (±20 psi)

Temperature VS Pressure Chart

The gauge should read 500 psig at 70°F (34.5 bar at 21°C). For temperatures other than 70°F (21°C), see the chart below.

US Standard		**Metric**	
Temperature (°F)	**Pressure** (psig)	**Temperature** (°C)	**Pressure** (bar)
32	453	0	30.3
40	463	10	32.1
50	475	15	32.9
60	488	20	33.8
70	500	25	34.7
80	513	30	35.6
90	525	35	36.5
100	538	40	37.4
110	550	45	38.2
120	563	50	39.1
130	575	55	40.0

2.5. Liquid Level Indicator (LLi)

A Liquid Level Indicator (LLi) device is fitted to every container. The device is used to measure the level of liquid agent in container without having to remove the container and weigh it on a calibrated scale. The agent weight can be determined with the container safely secured in its installed position. The LLi is factory installed on the 100, 150, 215, 375, 650 and 1000 lb. (44, 61, 88, 153, 267 and 423 L) containers prior to filling.

The liquid level is found by lifting the measuring tape from inside the tube to the end above the anticipated liquid level and slowly lowering the tape until a magnetic interlock with the float is felt. The tape will then remain in the locked position, allowing a reading to be taken at the top of the LLi boss. The weight of the agent in the container is determined by converting the level measurement into a weight measurement using the tables provided in the Liquid Level Indicator manual (P/N 06-869).

Liquid Level Indicator

CONTAINER SIZE lb. (L)	LLi PART NUMBER	APPROXIMATE LENGTH in. (mm)
100 (44)	70-1353-27	27 (686)
150 (61)	70-1353-14	14 [356)
215 (88)	70-1353-18	18 (457)
375 (153)	70-1353-27	27 (686)
650 (267)	70-1353-38	38 (965)
1000 (423)	70-1353-49	49 (1245)

Specifications

Mounting Thread	1 5/16-12UN-2A NPT
Stem Material	Brass
Mounting Material	Brass
Float Material	Buna-N
Accuracy	±4% at charge (±14 psi)

NOTE: Liquid Level Indicator (LLi) must be installed while the container is empty.

2.6. Low Pressure Switch (LPS)

The Low Pressure Switch (P/N 02-15801) is an optional item that can be added to Impulse Valve containers for the purpose of continuously monitoring the container pressure for a low-pressure condition. If the pressure inside the container drops below 450 psig (31 bar) the LPS contacts will transfer and invoke a "Supervisory" indication on the control panel.

The LPS may be ordered along with a configured Impulse Valve container or as a separate item that can be installed on a fully pressurized container without loss of agent or pressure.

Low Pressure Switch (LPS)

Specifications

Temperature Limits	+32°F to +130°F (0°C to 54.4°C)
Enclosure Classification	NEMA 4
Contact Rating	Single pole, double throw; 5 amps resistive, 3 amps inductive @ 30 VDC (can be wired for normally open or normally closed operation)
Body Material	Aluminum with irridite finish
Weight	6.5 oz (184 g)
Pressure Connection	M10 x 1-6G
Electrical Connection	1/2 in. NPT (15 mm)
LPS Length (approximate)	4.375 in. (111 mm) Long (including both connectors)
Wire Leads	Thee, 18 gauge x 48 in. (1.2 m) Long Violet (Common), Blue (N.O.), Black (N.C.)
Pressure Setting	450 psig (31 bar), decreasing

2.7. Mounting Straps and Brackets

The container mounting straps and brackets are constructed of carbon steel and are designed to rigidly support the installed suppression containers. Each container is supplied with the appropriate mounting strap or bracket when ordered.

The straps and brackets must be securely mounted to a rigid surface with the container resting fully on the floor or vertical surface. Anchoring into plaster, sheetrock wall or any other facing material is NOT acceptable. Mounting hardware is supplied by system installer.

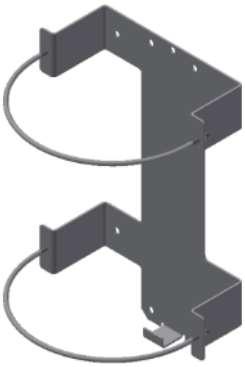
Ordering

Part Number	Description
70-2135-X	Bracket for 5 lb. (2 L) and 10 lb. (4 L) containers
70-1372-X	Bracket for 20 lb. (8.5 L) and 35 lb. (15 L) containers
70-1070-X	Bracket for 60 lb. (27 L) container
70-1345-X	Strap for 100 lb. (44 L) container
70-2146-X	Bracket for 150 lb. (61 L) container
70-1310-X	Strap for 215 lb. (88 L) and 375 lb. (153 L) containers
70-1384-X	Strap for 650 lb. (267 L) and 1000 lb. (423 L) containers

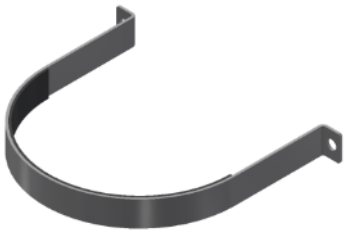
Notes:

1. -X = paint option. Container brackets can be painted white or red. When ordering a container bracket the paint option must be specified (-W for white or -R for red).

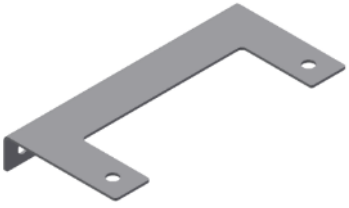
5, 10, 20 and 35 lb. (2, 4, 8.5 and 15 L) Container Bracket



60 lb. (27 L) Container Bracket



100, 215, 375, 650 and 1000 lb. (44, 88, 153, 267 and 423 L) Container Strap



150 lb. (61 L) Container Bracket

2.8. Impulse Valve Operator (IVO)

The Impulse Valve Operator (P/N 02-12728) provides a means to activate a Fike Impulse Valve container via an electric signal from a Fike control panel. The IVO can also be manually activated by removing the safety cotter pin and depressing the red strike button.

Activation of the IVO provides the force required to extend its stainless steel piston through the base of the actuator where it will impact the container's rupture disc valve causing it to open, allowing the agent to be released from the container. The IVO can easily be reset after activation to return it to normal operation.

Electrical activation of the IVO requires it to be connected to a Fike Impulse Releasing Module (P/N 10-2748). The IRM provides the interface between the IVO and the releasing circuit of the Fike control panel. Refer to Fike document 06-552 for IRM details.

Connection of the IVO to the container's actuator port must be continuously supervised. This is accomplished by using a Fike Impulse Valve Operator Supervisor (P/N 02-14263) to secure the IVO to the container's actuator port. See Section 2.11 for IVOS details.

Impulse Valve Operator (IVO)

Specifications

Construction	Stainless Steel Body Brass End Cap Stainless Steel Piston
Electrical Connection	1/2 in. NPT conduit connection
Wires	Two, 20 AWG Black Wires, 36 in. (914 mm) long
Temperature	32 to 130°F (0 to 54.4°C), 93% maximum humidity
Normal Supply Voltage	24 VDC
Current Consumption (for battery calculations)	0 Amps Standby 0 Amps Active (3 Amp momentary pulse from IRM capacitors)

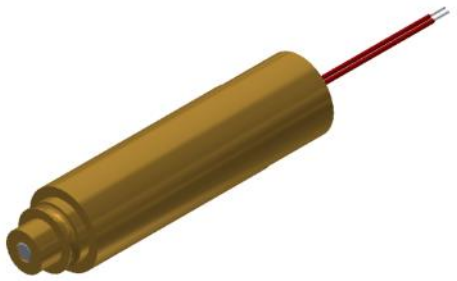
Ordering Information

The IVO can be ordered separately or it can be ordered as part of the following kit.

IVO Kit (P/N 70-279)	
Component P/N	**Description**
02-12728	Impulse Valve Operator (IVO)
02-14263	Impulse Valve Operator Supervisor (IVOS)
10-2748	Impulse Releasing Module (IRM)
02-2213	Security Tie

2.9. Impulse Energetic Actuator (IEA)

The Impulse Energetic Actuator (P/N 70-374) provides a means to activate a Fike Impulse Valve container via an electric signal from a Fike control panel. Activation of the IEA provides the force required to extend its stainless steel piston through the base of the actuator where it will impact the container's rupture disc valve causing it to open, allowing the agent to be released from the container. The IEA is a single shot device that must be replaced after activation.



Impulse Energetic Actuator (IEA)

Electrical activation of the IEA requires it to be connected to a Fike Impulse Releasing Module (P/N 10-2748). The IRM provides the interface between the IEA and the releasing circuit of the Fike control panel. Refer to Fike document 06-552 for IRM details.

Connection of the IEA to the container's actuator port must be continuously supervised. This is accomplished by using a Fike Impulse Valve Operator Supervisor (P/N 02-14263) to secure the IEA to the container's actuator port. See Section 2.11 for IVOS details.

Specifications

Construction	Brass
Conduit Connection	1/2 in. NPT Male threads
Wires	Two, 20 AWG Red Wires, 36 in. (914 mm) long
Normal Supply Voltage	24 VDC
Monitoring Current	0.01 Amps (battery calculations)
Firing Current	1 Amp max.
Auto Ignition Temp.	≥ 170°C (338 °F)
Storage Temp.	Min. 5°C (41 °F), max 25°C (77 °F)
Shelf Life	1 year
Service Life (ambient)	10 years
Approvals	UL Listed Only

Ordering Information

The IEA can be ordered separately or it can be ordered as part of the following kit.

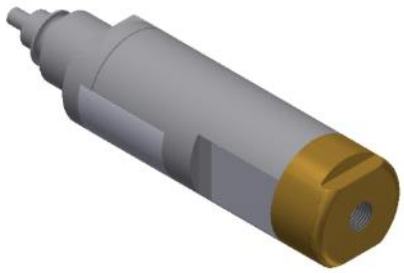
IEA Kit (P/N 70-390)	
Component P/N	**Description**
70-374	Impulse Energetic Actuator (IEA)
02-14263	Impulse Valve Operator Supervisor (IVOS)
10-2748	Impulse Releasing Module (IRM)

2.10. Impulse Valve Pneumatic Operator (IVPO)

The Impulse Valve Pneumatic Operator (P/N 02-12729) provides a means to pneumatically activate a Fike Impulse valve container utilizing the discharge pressure from a Primary Impulse Valve container or Nitrogen Actuator Assembly.

The pneumatic pressure fed into the IVPO provides the force required to extend its stainless steel piston through the base of the actuator where it will impact the container's rupture disc valve causing it to open, allowing the agent to be released from the container. The IVPO can be easily reset after activation to return it to normal operation.

Connection of the IVPO to the container's actuator port must be continuously supervised. This is accomplished by using a Fike Impulse Valve Operator Supervisor (P/N 02-14263) to secure the IVPO to the container's actuator port. See Section 2.11 for IVOS details.



Impulse Valve Pneumatic Operator (IVPO)

Specifications

Construction	Stainless Steel Body Brass End Cap Stainless Steel Piston
Temperature	32 to 130°F (0 to 54.4°C) 93% maximum humidity
Pneumatic Connection	1/8 in. NPT, Female
IVPO Limitations	A maximum of 6 containers equipped with IVPOs can be pneumatically activated from an electrically activated Impulse Valve container

Ordering Information

The IVPO can be ordered separately or it can be ordered as part of the following kit.

IVPO Kit (P/N 70-280)	
Component P/N	**Description**
02-12729	Impulse Valve Pneumatic Operator (IVPO)
02-4543	1/8 in. NPT x 1/4 in. JIC Adapter
02-4977	1/4 in. JIC x 36 in. (914 mm) Actuation Hose

2.11. Impulse Valve Operator Supervisor (IVOS)

The Impulse Valve Operator Supervisor (P/N 02-14263) provides the means to secure and electrically supervise the connection of an electric actuator or pneumatic operator to the discharge valve on a Fike Impulse Valve container.

The IVOS has a built-in Form-C push-button switch that supervises the connection of the electric actuator or pneumatic actuator to the containers discharge valve. Removal of the IVOS from the discharge valve will trigger the IVOS switch causing a visual and audible "Trouble or Supervisory" indication at the Fike control panel signaling that the container's actuator has been removed.

Impulse Valve Operator Supervisor (IVOS)

Specifications

Construction	– Plastic housing with insert molded SST clip and sealed push-button switch (Form C)
	– SST flexible conduit, 0.25 in. (6.4 mm) ID, 33.5 in. (850.9 mm) long
	– 3/8 in. electrical connector for 1/2 in. knockout
	– 22 AWG wire leads, 44 in. (1117.6 mm) long; Black (NC) / White (NO) / Red (Common)
Temperature	32 to 130°F (0 to 54.4°C), 93% maximum humidity

Ordering Information

The IVOS can be ordered separately or it can be ordered as part of the following kits.

IVO Kit (P/N 70-279)	
Component P/N	**Description**
02-12728	Impulse Valve Opeator (IVO)
02-14263	Impulse Valve Operator Supervisor (IVOS)
10-2748	Impulse Releasing Module (IRM)
02-2213	Security Tie

IEA Kit (P/N 70-390)	
Component P/N	**Description**
70-374	Impulse Energetic Actuator (IEA)*
02-14263	Impulse Valve Operator Supervisor (IVOS)
10-2748	Impulse Releasing Module (IRM)

*The IEA is UL Listed only.

2.12. Discharge Pressure Switch (DPS)

Discharge Pressure Switch (P/N 02-12534) is used to provide a positive confirmation to the control system that the Fike fire suppression system has been discharged manually via the strike button on the Impulse Valve Operator (IVO) or Nitrogen Actuator. The switch is operated pneumatically using the agent pressure in the discharge piping network. In response, the control panel will activate various audio/visual warning devices and auxiliary relays to notify occupants that the system has been discharged.

Discharge Pressure Switch

Specifications

Temperature Limits	32 to 130°F (0 to 54°C)
Enclosure Classification	NEMA 4
Contact Rating	Single pole, double throw; 5 amps resistive @ 30 VDC (can be wired for normally open or normally closed operation)
Body Material	Aluminum with irridite finish
Pressure Connection	1/4 in. (6 mm) NPT
Approximate Length	4.125 in. (105 mm) (including both connectors)
Electrical Connection	1/2 in. (15 mm) NPT
Wire Leads	Three, 18 gauge x 20 in. (508 mm) long Violet (C), Blue (NO), Black (NC)
Pressure Setting	40 psig (3 bar), increasing
Weight	6.5 oz (184 g)

NOTE: NFPA 2001 requires the installation of a discharge pressure switch on all systems where mechanical system actuation is possible. The discharge pressure switch shall provide an alarm-initiating signal to the releasing panel. The discharge pressure switch can be omitted if the hazard being protected is unoccupiable and is in a remote location where personnel are not normally present.

2.13. Discharge Nozzles

The discharge nozzles are made of brass and are available in a 180° and 360° discharge patterns. The nozzles are designed to control the agent flow and to distribute the agent throughout the protected enclosure in a uniform, predetermined pattern and concentration.

Seven sizes of discharge nozzles are available, 1/2" (15 mm) through 2" (50 mm). The size refers to the size of schedule 40 or 80 pipe that the nozzle can be connected to. Each nozzle has NPT female threads for connection to the pipe network.

Each discharge nozzle comes with a brass orifice plate that controls the flow of agent through the nozzle. The hole diameter of the orifice plate is determined by performing a hydraulic calculation using Fike's Flow Calculation Program. Engineered nozzle(s) should not be ordered until the clean agent system pipe network is installed and an "As Built" hydraulic calculation is performed. Orifice plate drilling must be done at the Fike factory, or at a UL listed nozzle drill station.

360° Nozzle

180° Nozzle

Ordering

Part Number	Description
80-124-50-XXXX	1/2 in. (15 mm) 360° nozzle
80-124-75-XXXX	3/4 in. (20 mm) 360° nozzle
80-124-100-XXXX	1 in. (25 mm) 360° nozzle
80-124-125-XXXX	1 1/4 in. (32 mm) 360° nozzle
80-124-150-XXXX	1 1/2 in. (40 mm) 360° nozzle
80-124-200-XXXX	2 in. (50 mm) 360° nozzle
80-122-50-XXXX	1/2 in. (15 mm) 180° nozzle
80-122-75-XXXX	3/4 in. (20 mm) 180° nozzle
80-122-100-XXXX	1 in. (25 mm) 180° nozzle
80-122-125-XXXX	1 1/4 in. (32 mm) 180° nozzle
80-122-150-XXXX	1 1/2 in. (40 mm) 180° nozzle
80-122-200-XXXX	2 in. (50 mm) 180° nozzle

NOTE: -XXXX in part number is the orifice code designation.

2.14. Check Valves

Check Valves are used to prevent agent loss from the open end of a manifold and/or piping system in the event that one or more containers are removed for servicing / maintenance.

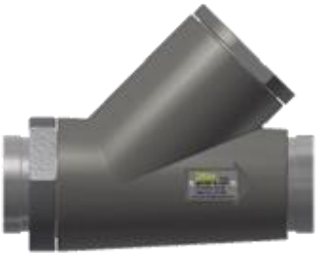
Check Valves are required for multiple containers connected in a manifold arrangement and for containers used in a main / reserve system, without the need for redundant piping systems, to prevent agent loss and reduce the risk of injury if the system is operated when any containers are removed for maintenance. All containers must be the same size and same weight.

Images are for reference only. Actual product may vary.

02-2980-1, 02-4158-1 and 70-317 Check Valves

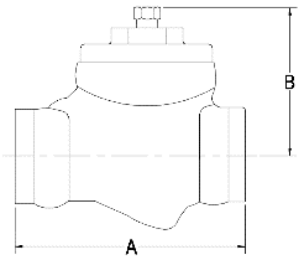
Specifications

Part No.	02-2980-1	02-4158-1	70-317	02-16557	02-16558	70-356
Type	Swing Gate	Swing Gate	Swing Gate	Ball Check	Ball Check	Ball Check
Size	1 in. (25 mm)	2 in. (50 mm)	3 in. (80 mm)	1 in. (25 mm)	2 in. (50 mm)	3 in. (80 mm)
Length (A)	4.3 in. (108 mm)	6.0 in. (152 mm)	8.0 in. (203 mm)	4.2 in. (107 mm)	6.4 in. (162 mm)	11.0 in. (281 mm)
Height (B)	3.6 in. (91 mm)	4.4 in. (111 mm)	5.8 in. (147 mm)	2.8 in. (70 mm)	1.8 in. (46 mm)	6.5 in. (165 mm)
Weight	5 lbs. (2.3 kg)	13 lbs. (5.9 kg)	28 lbs. (12.7 kg)	5 lbs. (2.3 kg)	16 lbs. (7.3 kg)	37 lbs. (16.8 kg)
Equivalent Length	2.0 ft. (0.61 m)	4.0 ft. (1.22 m)	4.0 ft. (1.22 m)	Sch. 40 15.8 ft. (4.82 m) Sch. 80 10.1 ft. (3.08 m)	Sch. 40 50.0 ft. (15.24 m) Sch. 80 36.6 ft. (11.16 m)	14.0 ft. (4.27 m)
Material	Carbon Steel	Carbon Steel	Ductile Iron	Carbon Steel	Carbon Steel	Ductile Iron
Ends	NPT Female	NPT Female	NPT Female	NPT Female	NPT Female	Grooved
Working Pressure	750 psi (50 bar)	750 psi (50 bar)	750 psi (50 bar)	2000 psi (138 bar)	2000 psi (138 bar)	750 psi (50 bar)
Mounting	Horizontal or Vertical (with flow arrow up)					

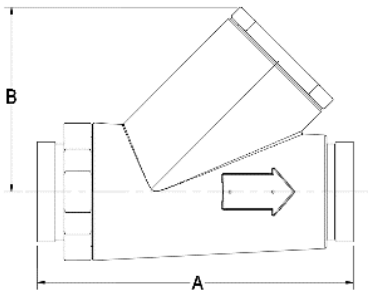


70-356 Check Valve

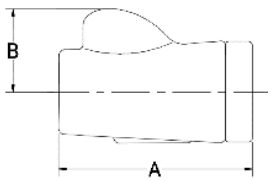
02-16557 and 02-16558 Check Valves



02-2980-1, 02-4158-1 and 70-317 Check Valves



70-356 Check Valve



02-16557 & 02-16558 Check Valves

2.15. Caution/Advisory Signs

Instructional signs are used to provide the necessary information to personnel in the area and to comply with NFPA 2001 requirements. The caution lettering and backgrounds meet the requirements of ANSI Z535. The signs are made from flame retardant, Lexan™ polycarbonate material. Each sign has an adhesive backing mounting purposes. These signs are an optional item and must be ordered separately.

CAUTION – AREA PROTECTED SIGN (P/N 02-17005)

Provided to alert personnel that the room is protected with a fire suppression system using 3M™ Novec™ 1230 Fire Protection Fluid and that they should not enter the area during or after discharge.

The sign also indicates the requirement that all doors serving the protected area must be kept closed at all times.

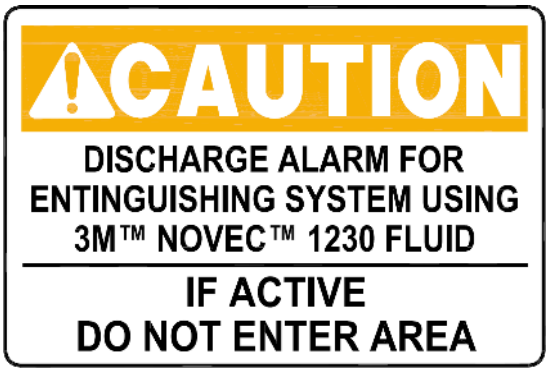
The sign is 13 in. (330 mm) x 10 in. (254 mm), with black lettering on a yellow background for Caution and black lettering on a white background for Sign text.

CAUTION – SYSTEM DISCHARGE ALARM SIGN (P/N 02-17006)

Provided to alert personnel that the room is protected with a fire suppression system using Novec 1230 fluid and to evacuate the area when the alarms sound.

This sign is provided to also alert personnel that they should not enter the area when the alarm sounds.

The sign is 9 in. (229 mm) x 6 in. (154 mm), with black lettering on a yellow background for Caution and black lettering on a white background for Sign text.

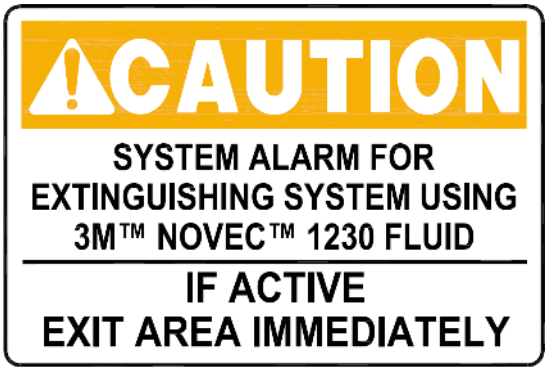


CAUTION – EXIT AREA (P/N 02-17007)

Provided to explain the presence of notification devices that are located inside the protected space.

This sign explains that a fire suppression system will soon be discharged if the strobe light is flashing, and appropriate actions should be taken. This sign should be placed at each strobe light location.

The sign is 9 in. (229 mm) x 6 in. (154 mm), with black lettering on a yellow background for Caution and black lettering on a white background for Sign text.



NOTICE – MANUAL ACTUATION SIGN (P/N 02-16306)

Provided to inform personnel that the manual release button on the container cannot be used to activate the container. Manual release switch(s) located at the hazard exit must be used to activate the system.

This sign should be placed at each container where the manual release button on the container has been disabled to prevent manual activation.

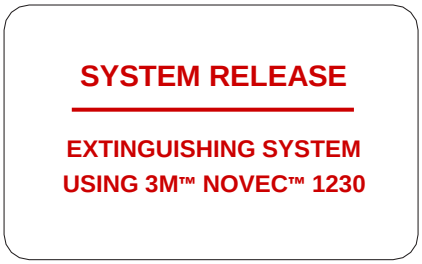
The sign is 13 in. (330 mm) x 10 in. (254 mm), with white lettering on a blue backgound for NOTICE and black lettering on a white background for instructional text.

SYSTEM RELEASE SIGN (P/N 02-17008)

Provided to identify each system release station associated with the fire suppression system. This reduces the risk of a manual discharge station being mistaken for a fire alarm pull station.

This sign should be placed at each manual release station location for positive identification.

This sign is 4 in. (102 mm) x 2.25 in. (57 mm), with red lettering on a white background.



MAIN / RESERVE SIGN (P/N 02-17009)

Provided to identify each system main/reserve station associated with the fire suppression system. This sign clearly identifies the purpose of the switch.

This sign should be placed at each main/reserve station location for positive identification.

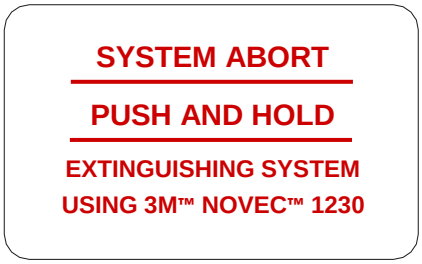
This sign is 4 in. (102 mm) x 2.25 in. (57 mm), with white lettering on a red background.

SYSTEM ABORT SIGN (P/N 02-17010)

Provided to identify each system abort station associated with the fire suppression system. This reduces the risk of an abort station being mistaken for a manual release or fire alarm pull station.

This sign should be placed at each abort station location for positive identification.

The sign is 4 in. (102 mm) x 2.25 in. (57 mm), with red lettering on a white background.



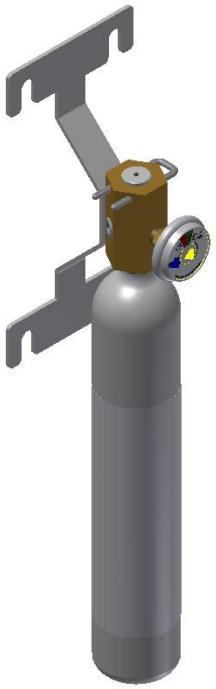
2.16. Nitrogen Actuator Assembly

The Nitrogen Actuator Assembly consists of a rechargeable nitrogen cylinder, brass valve assembly, pressure gauge and mounting bracket. The stored pressure contained within the assembly's nitrogen cylinder can be used to pneumatically active the following system components:

- Up to five containers equipped with Impulse Valve Pneumatic Operators (IVPO)
- Secondary Nitrogen Actuators
- Selector Valves

A completer kit must be purchased separately and installed onto the Nitrogen Actuator Assembly to facilitate electrical/manual, electric or pneumatic activation of the assembly. See Section 2.17, 2.18 and 2.19 for completer kit details.

NOTE: When used for selector valve activation, the nitrogen actuator assembly and completer kit are furnished with the selector valve.



Nitrogen Actuator Assembly

Specifications

Nitrogen Cylinder	
Fill Pressure	1800 psig (124 barg)
Volume	28 in^3 (460 ml)
Classification	DOT 3E1800 / TC-3EM 124
Temperature Range	-4°F to 130°F (-20°C to 54°C)
Valve	
Body	Brass
Retaining Clip	SST
Fill Valve Plug	SST
ERD Plug	SST
O-Ring	Polyurethane
Pressure Gauge	
Housing	SST Case, Polycarbonate Lens, Brass Adaptor
Contact Rating	Contacts rated at 333 mA / 30V DC
Electrical Connection	18 AWG, 12 in. Leads
Switch Setting	1621 psi (112 bar) decreasing (Normally Open at Operating Pressure)

Ordering

Part Number	Description
70-325-1	Nitrogen Actuator Assembly (Cylinder Pressurized)
70-325-3	Nitrogen Actuator Assembly (Cylinder not Pressurized)

2.17. UVO Primary Completer Kit

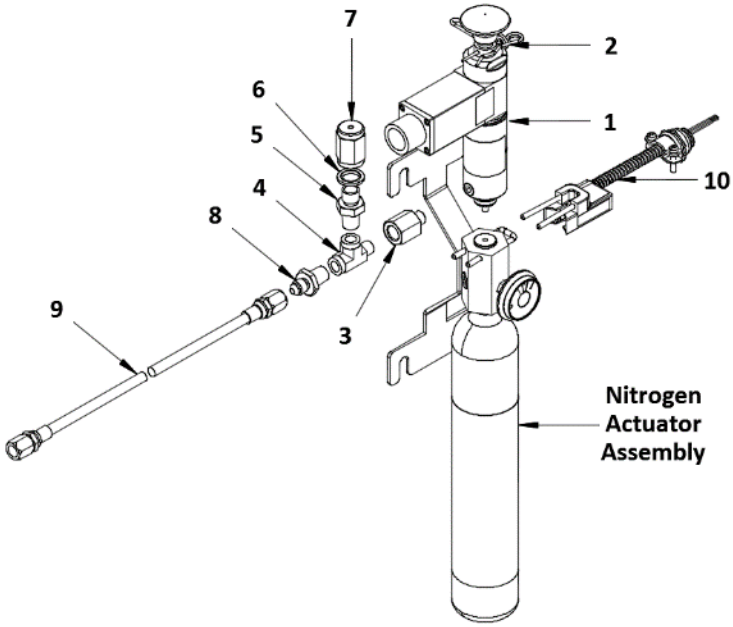
The UVO Primary Completer Kit (P/N 70-335) provides a means to electrically and manually activate the Nitrogen Actuator Assembly. A UVO, included in the kit, is fitted to the top of the Nitrogen Actuator Assembly. See Section 2.16

The UVO provides a means to electrically activate the Nitrogen Actuator Assembly via a 24 VDC signal from the Fike control panel and to manually activate the assembly by pressing the red manual strike button on the UVO. Activation of the UVO allows pressure from the Nitrogen Actuator Assembly to flow through a stainless steel pneumatic actuation line to the controlled system component resulting in activation.

The following parts are included in the UVO Primary Completer Kit. See diagram below.

Item No.	Part Number	Description
1	02-13571	Universal Valve Operator (UVO)
2	02-2213	Security Tie
3	02-13640	1/8 in. NPT x 1/4 in. NPT Adapter
4	C02-1335	1/4 in. NPT Street Tee
5	02-11766	1/4 in. NPT x G1/4 Adapter
6	02-10926	1/4 in. Sealing Washer
7	IG71-026	Vent Valve Assembly
8	02-4530	1/4 in. NPT x 1/4 in. JIC Adapter
9	02-4977	35 in. Hose (1/4 JIC x 1/4 JIC)
10	02-14627	Universal Valve Operator Supervisor (UVOS)

Nitrogen Actuator Assembly with UVO (Primary)



UVO Primary Completer Kit Components

2.18. UEA Primary Completer Kit

The UEA Primary Completer Kit (P/N 70-400) provides a means to electrically activate the Nitrogen Actuator Assembly. A UEA, included in the kit, is fitted to the top of the Nitrogen Actuator Assembly. See Section 2.16.

The UEA provides a means to electrically activate the Nitrogen Actuator Assembly with a 24 VDC signal from the Fike control panel. The UEA does not provide a means to manually activate the Nitrogen Actuator. Activation of the UEA allows pressure from the Nitrogen Actuator Assembly to flow through a stainless steel pneumatic actuation line to the controlled system component resulting in activation.

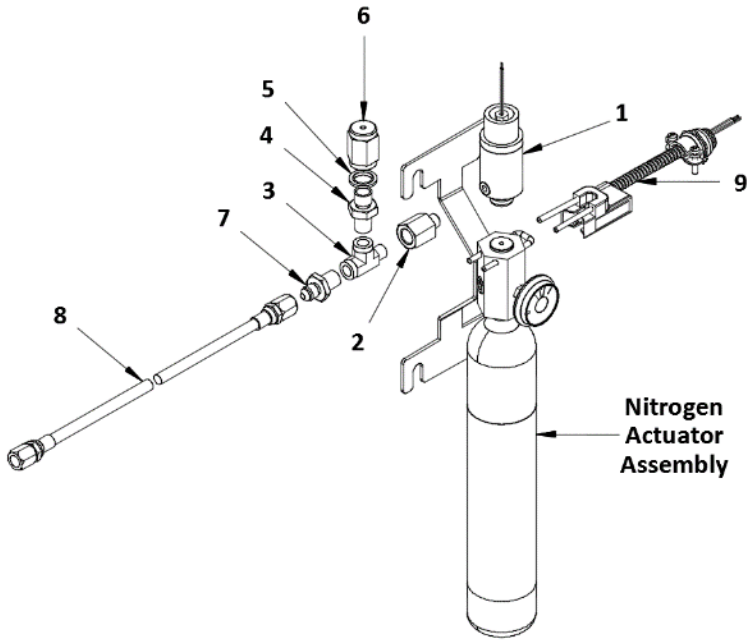
Electrical activation of the UEA requires it to be connected to a Fike Impulse Releasing Module (P/N 10-2748). The IRM provides the interface between the UEA and the releasing circuit of the Fike control panel. Refer to Fike document 06-552 for IRM details.

NOTE: Use of the UEA with the Nitrogen Actuator Assembly is **NOT** FM approved.

The following parts are included in the UEA Primary Completer Kit. See diagram below.

Item No.	Part Number	Description
1	IG71-247	Universal Energetic Actuator (UEA)
2	02-13640	1/8 in. NPT x 1/4 in. NPT Adapter
3	C02-1335	1/4 in. NPT Street Tee
4	02-11766	1/4 in. NPT x G1/4 Adapter
5	02-10926	1/4 in. Sealing Washer
6	IG71-026	Vent Valve Assembly
7	02-4530	1/4 in. NPT x 1/4 in. JIC Adapter
8	02-4977	35 in. Hose (1/4 JIC x 1/4 JIC)
9	02-14627	Universal Valve Operator Supervisor (UVOS)
10	02-11902	1/8 BSPT Plug (not shown)
11	10-2748	Impulse Releasing Module (IRM)

Nitrogen Actuator Assembly with UEA (Primary)



UEA Primary Completer Kit Components

2.19. Secondary Completer Kit

The Secondary Completer Kit (P/N 70-336) provides a means to pneumatically activate the Nitrogen Actuator Assembly. See Section 2.16. A Pneumatic Relay, included in the kit, is fitted to the top of the Nitrogen Actuator Assembly. Pressure from a 'Primary' Nitrogen Actuator Assembly (See Section 2.17 and 2.18) is used to activate the Pneumatic Relay, which allows pressure from the Nitrogen Actuator Assembly to flow through a stainless steel pneumatic actuation line to the controlled system component resulting in activation.

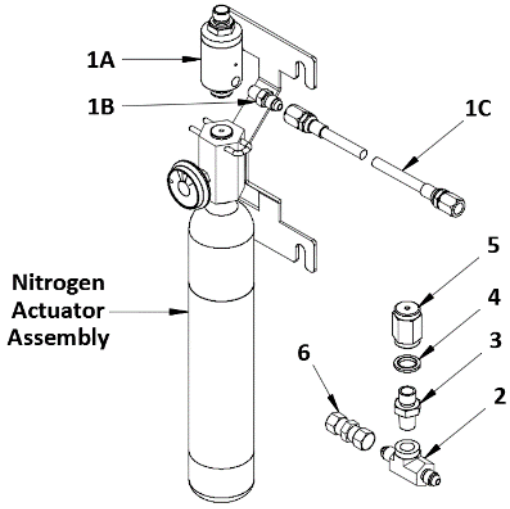
Multiple Nitrogen Actuator Assemblies with Secondary Completer Kits can be daisy chained together to increase the allowable length of the pneumatic actuation line. The Pneumatic Relay does not provide a means to manually activate the Nitrogen Actuator Assembly.

The following components are included in the Secondary Completer Kit. See diagram below.

Item No.	Part Number	Description
1A*	IG71-120	Pneumatic Relay
1B*	02-11243	1/8 in. x 1/4 in. JIC Hex Nipple
1C*	02-4977	1/4 in. JIC x 1/4 in. JIC Braided Hose, 36 in. long
2	02-14721	1/4 in. JIC x 1/4 in. FNPT Branch Tee
3	02-11766	1/4 in. NPT x G1/4 Adapter
4	02-10926	1/4 in. Sealing Washer
5	IG71-026	Vent Valve Assembly
6	02-11346	1/4 in. JIC Coupling

*Part of pneumatic relay assembly (P/N 70-334)

Nitrogen Actuator Assembly with Pneumatic Relay (Secondary)

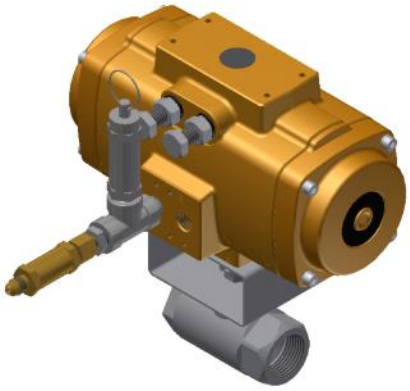


Secondary Completer Kit Components

2.20. Selector Valve Assembly

Selector Valves allow a single agent supply to be utilized for protection of multiple hazards of similar volume by directing the flow of agent into one specific hazard. This reduces the total amount of agent required to protect multiple hazards. *Selector valve systems can only be used to protect one hazard at a time and will not be effective if two or more hazards are involved in a fire simultaneously.*

Selector valves are closed during normal operation, blocking the flow of agent through the piping network. A nitrogen actuator with compatible actuator must be installed and connected to each selector valve actuator via a stainless steel pilot line connection. This connection allows the pressure from the nitrogen actuator to be delivered to the selector valve actuator for valve activation. After activation, the selector valve must be manually closed (reset).



Selector Valve Assembly
(Actuation Components not Shown)

Specifications

Valve	▪ Standard Port Ball Valve ▪ NPT Threads ▪ Body: Carbon Steel or Stainless Steel ▪ Ball: Stainless Steel ▪ Pressure Rating: 1 in. (25 mm) = 2000 psi (138 bar) All others = 1500 psi (103 bar)
Actuator	▪ Rack and Pinion Pneumatic Actuator, ¼ turn, Double Acting ▪ Pressure Rating: 80 – 142 psi (5.5 – 9.8 bar) ▪ Factory Installed on Ball Valve
Pop-Off Valve	▪ 1/4 in. NPT ASME Relief Valve for Air or Gas Service ▪ Set Pressure: 100 psi (6.9 bar) ▪ Relief Capacity: 92 SCFM ▪ Body, Nozzle, Stem and Spring Material: Stainless Steel ▪ Seat Material: Silicone ▪ Conforms to ASME Section VIII Pressure Vessel Code

Ordering

The base selector valve can be ordered seperately for replacement purposes as identified in the following table.

Part Number	Description
02-15708-10	Selector Valve, Carbon Steel, 1 in. NPT
02-15708-15	Selector Valve, Carbon Steel, 1.5 in. NPT
02-15708-20	Selector Valve, Carbon Steel, 2 in. NPT
02-15708-30	Selector Valve, Carbon Steel, 3 in. NPT
02-15708-40*	Selector Valve, Carbon Steel, 4 in. NPT
02-15709-10	Selector Valve, Stainless Steel, 1 in. NPT
02-15709-15	Selector Valve, Stainless Steel, 1.5 in. NPT
02-15709-20	Selector Valve, Stainless Steel, 2 in. NPT
02-15709-30	Selector Valve, Stainless Steel, 3 in. NPT
02-15709-40*	Selector Valve, Stainless Steel, 4 in. NPT

*Selector valve is not UL Listed or FM Approved.

Selector Valve Assembly Ordering Format

The following ordering format must be used to order the selector valve as part of an assembly that includes the components required to install and activate the valve.

Part Number: 70-396-XX-XXX **A BCD**	
A =	**10** – 1 in. NPT (25 mm) **15** – 1-1/2 in. NPT (40 mm) **20** – 2 in. NPT (50 mm) **30** – 3 in. NPT (80 mm) **40** – 4 in. NPT (100 mm)
B =	**C** – Carbon Steel Body **S** – Stainless Steel Body
C =	**D** – UVO Completer Kit **S** – Pneumatic Relay Completer Kit **M** – UEA Completer Kit
D =	**F** – Nitrogen Actuator Assembly (Filled) **U** – Nitrogen Actuator Assembly (Unfilled)

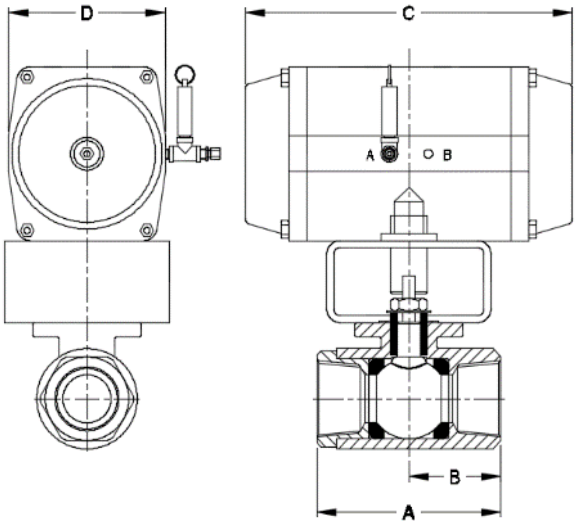
Each selector valve assembly may include the following parts depending upon the part number ordered.

Part Number	Description	Notes
02-15708-XX-CX	Carbon Steel Selector Valve	Valve material supplied is based on selector valve assembly part number.
02-15709-XX-SX	Stainless Steel Selector Valve	
70-325-X	Nitrogen Actuator Assembly	X indicates filled (1) or unfilled (3)
70-335	Universal Valve Operator (UVO) Primary Completer Kit	Completer kit furnished is based on selector valve assembly part number.
70-336	Pneumatic Relay Secondary Completer Kit	
70-400	Universal Energetic Actuator (UEA) Primary Completer Kit	

Dimension and Weight Information

Part Number	Size In. (mm)	Type	A	B	C	D	Wt. lb. (kg.)
			In. (mm)				
70-396-10-XXX	1 (25)	Threaded	3.4 (86)	1.7 (43)	7.6 (192)	3.7 (95)	7.8 (3.5)
70-396-15-XXX	1 ½ (40)	Threaded	4.4 (111)	2.2 (55)	8.5 (217)	4.1 (104)	11.8 (5.3)
70-396-20-XXX	2 (50)	Threaded	5.5 (140)	2.8 (70)	9.7 (247)	4.5 (115)	16.7 (7.6)
70-396-30-XXX	3 (80)	Threaded	6.8 (171)	3.4 (86)	8.8 (234)	5.0 (127)	30.1 (13.7)
70-396-40-XXX*	4 (100)	Threaded	9.1 (231)	4.6 (116)	10.6 (269)	6.5 (165)	69.8 (31.7)

*Selector valve is not UL Listed or FM Approved.



2.21. Suppression Disconnect Switch

The Suppression Disconnect Switch is used to electrically isolate the releasing device from the associated control panel's releasing circuit. This allows work to be performed in the area protected by the suppression system or on the suppression system itself without the potential for accidental discharge.

The assembly consists of a stainless steel faceplate with etched black text, two-position keyed switch, and normally open and/or normally closed contact blocks. The switch key can only be removed in the ARMED position.

The assembly can be ordered with or without status LEDs (Green – ARMED and Red – DISARMED). The LEDs provide positive indication of the status of the releasing circuit. LEDs require 24 VDC auxiliary power from the associated control panel for operation.

Disconnect Switch with LEDs

Refer to Fike document 06-472 for switch installation instructions.

NOTE: NFPA requires that a listed disconnect switch be installed on all electrically activated suppression systems to prevent false discharges when the system is being tested or serviced. Upon activation, the switch shall cause a supervisory signal at the control panel.

Specifications

Input Voltage	15 – 30 VDC
Current	0 mA (no LEDs) / 13.1 mA (LED active)
Circuit Limitations	Class B only
Contact Ratings	8A @ 24 VDC resistive / 4A @ 24 VDC inductive
Operating Temperature	32 to 120°F (0 to 49°C)
Operating Humidity	93% RH
Weight	0.55 lb. (0.25 kg)
Dimensions (LxH)	4.50 in. x 4.5 in. (114.4 mm x 114.4 mm)

Ordering

Part Number	Description
10-2698	Suppression Disconnect Switch, no LEDs
10-2699	Suppression Disconnect Switch, with LEDs
02-2153	Two-gang masonry box, 2.5 in. deep (RACO 691 or equal) used with 10-2698 switch
02-11881	Two-gang masonry box, 3 in. deep (RACO 696 or equal) used with 10-2699 switch

Spare Parts

Part Number	Description	Part Number	Description
02-12294	Double contact block (2 NC)	02-12315	3 block switch
02-12295	Double contact block (2 NO)	02-12316	Single contact block (NC)
02-12296	Replacement keys	02-12318	Locking ring wrench
02-12298	5 block switch	10-2714	Cover plate, no LED holes
02-12300	Single contact block (NO)	-	-

3. SYSTEM DESIGN

The following is a summary of the steps necessary to design a Fike Fire Suppression System using 3M™ Novec™ 1230 Fire Protection Fluid within the limitations established by Fike's UL / ULC listing, FM approval and in compliance with NFPA 2001.

3.1. Evaluate Enclosure Integrity

When designing a total flooding fire suppression system using Novec 1230 fluid, the integrity of the protected enclosure(s) shall be considered. Integrity refers to the ability of the enclosure to retain the discharged Novec 1230 fluid. For a total flooding suppression system to be effective, the design concentration must be achieved and then maintained for at least ten minutes or for a period of time that is sufficient for emergency personnel to respond, as determined by the Authority Having Jurisdiction (AHJ).

The general guidelines for maintaining room integrity are as follows:

1. Doors - All doors entering and/or existing from the perimeter of the protected space(s) should have drop seals on the bottom, weather-stripping around the jams, latching mechanisms and door closure hardware. In addition, double doors should have a weather-stripped astragal to prevent leakage between doors and a coordinator to assure the proper sequence of closure. Doors that cannot be kept normally closed shall be equipped with door closure hardware and magnetic door holders that will release the door(s) prior to system discharge.
2. Ductwork - All ductwork leading into or out of the protected space(s) should be isolated with sealed "low smoke" dampers. Dampers should be spring loaded or motor operated to provide 100% air shutoff upon activation to ensure an adequate seal and prevent leakage.
3. Air Handling/Ventilation - Forced air ventilation systems, others than those necessary to ensure safety, shall be shut down or closed automatically where their continued operation would adversely affect the performance of the fire extinguishing system or result in propagation of the fire. Self-contained air recirculation systems, if not shut down or closed automatically, shall have the volume of the associated ductwork and components mounted below the ceiling height of the protected space considered as part of the total hazard volume when determining the quantity of agent.
4. Penetrations - To prevent the loss of agent through openings to adjacent hazards or work areas, openings (e.g., holes, cracks, gaps, pipe chases, cable trays, floor drains, etc.) shall be permanently sealed or equipped with automatic closures. Floor drains should be equipped with traps filled with non-evaporating product to prevent leakage.
5. Walls Construction - All perimeter walls of the protected space(s) that define the hazard should extend slab-to-slab and each should be sealed at the top and bottom on the interior side. Where walls do not extend slab-to-slab, bulkheads will have to be installed to achieve the desired sealing characteristics. Porous block walls must be sealed to prevent agent leakage through the wall.
6. Pressurization – The protected enclosure(s) shall have the structural strength and integrity necessary to contain the agent discharge. The designer shall take into consideration the pressures developed by the agent discharge into the enclosure and determine if venting is required to prevent excessive pressures that could present a threat to the structure strength of the enclosure.

At the discretion of the AHJ, a room integrity fan pressurization test may be required to determine how long the protected enclosure will hold the agent after a discharge. The room integrity fan pressurization test must be performed in accordance with the equipment manufacturer's requirements and NFPA 2001, Annex C.

Where reasonable confinement of the agent discharge is not achievable or practical, protection shall be expanded to include the adjacent connected hazards or work areas.

3.2. Subfloor Protection

Where the system is being installed to protect a room with a raised or sunken floor, the room and the raised floor shall be simultaneously protected. 3M™ Novec™ 1230 Fire Protection Fluid shall not be used to provide total flooding protection of a raised floor area only. Where a room and raised or sunken floor is to be protected by a total flooding system, each area shall be provided with detectors, piping network, and nozzles.

3.3. Determine Hazard Classification

Hazard classification generally falls into one of the three following categories and sometimes a combination thereof. The hazard classification for each protected hazard must be determined in order to select the correct minimum design concentration for determining agent quantity.

Class A Fires involving ordinary combustible materials, such as wood, cloth, paper, rubber and many plastics (i.e., anything that leaves an ash residue after combustion).

Class B Fires involving flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.

Class C Fires involving energized electrical equipment.

3.4. Determine Enclosure Volume

The volume of each hazard to be protected must be calculated by multiply the enclosure length times the enclosure width to determine the area, and then multiply the area times the enclosure height to determine the volume for each hazard area. If any area is an odd shape, it may need to be divided up into regular shapes that will allow volume calculations. Then, total all of the volumes together to determine the actual volume of the entire area to be protected. If the odd shape of the area will affect the distribution of agent, it may be best to calculate sections of the hazard as separate areas and include nozzles for each of these areas. Volumes that are open to the area being protected (e.g., non-dampered ductwork, uncloseable openings, etc.) must be added to the calculated volume.

If the ceiling height exceeds the maximum allowable ceiling height allowed for the nozzle selected, multiple levels of nozzles must be designed into the system. In this case, it is usually beneficial to treat each level as a separate protected area so that proper agent distribution is achieved.

3.5. Calculate Reduced Volume

As a general rule, the enclosure volume should be based on the empty (gross) volume. However, the volume of solid, non-permeable objects in each hazard area that are not removable can be deducted from the volume of the hazard. This includes columns, beams, normally closed closets, ducts that pass completely through the hazard area without any openings, and any other permanently fixed objects that cannot be removed from the hazard enclosure. Any object that can be removed from the hazard area CANNOT be deducted from the total hazard volume.

Calculate the volume of all solid, permanent objects and add them together for each hazard area to determine the volume that can be deducted from the total volume of the hazard area. Subtract the Solid Object Volume from the Total Volume to determine the Reduced Volume.

3.6. Determine Minimum Design Concentration

Minimum Design Concentration is defined by NFPA 2001 as the extinguishing concentration for the specific fuel plus a 20% safety factor for Class A fuel. Extinguishing Concentration is the agent concentration required to extinguish a test fire.

Using the Hazard Classification (Class A, B or C) determined for each protected hazard, use the following table to determine the minimum design concentration that must be used for a particular hazard.

Hazard Classification	Minimum Design Concentration	NOTES
Class A	4.5%	Clean Agent System incorporates Detection & Control System to automatically discharge agent.
Class A	4.7%	Recommendation, when protecting multiple hazards w/ single agent supply.
Class C	4.5%	When energized electrical hazard remains powered during/after agent discharge and Clean Agent System incorporates Detection & Control System to automatically discharge agent.
Class C	4.7%	Recommendation, when protecting multiple hazards w/ single agent supply.
Class B (Heptane)	5.85%	For design concentrations of other Class B (flammable liquids), consult Fike's Product Support group.

NOTES:

1. When 3M™ Novec™ 1230 Fire Protection Fluid is used in a "Normally Occupied" area, a maximum design concentration of 10.0% is allowed.
2. Concentrations greater than 10.0% can only be used in unoccupied areas.
3. See Section 3.21 for Exposure Limitations.

3.7. Determine Minimum Quantity of Agent Required

To determine the minimum quantity of agent required, determine the minimum design temperature for each hazard being protected and determine the minimum design concentration required for the material to be extinguished. Minimum design temperature is defined as the minimum anticipated temperature in the enclosure during normal conditions and is usually determined by the environmental conditions or the air handling system. This temperature is used in the design because it typically represents the worst case scenario, requiring the highest amount of agent.

Plug the temperature and design concentration values into the following formula to determine the minimum design quantity of agent required for the hazard. The amount of agent in the system must always be at least this much and may be exceeded. Failure to supply the minimum amount of agent calculated may inhibit the system from suppressing a fire.

The minimum design quantity of agent needed can be determined using the following formula:

$$W = \frac{V}{S}\left(\frac{C}{100 - C}\right)$$

Where: W = Quantity of agent [lbs. (kg)]

V = net volume of hazard, calculated as the gross volume minus the volume of fixed structures impervious to clean agent vapor [ft^3 (m^3)]

C = agent design concentration [vol%]

S = specific volume of superheated agent vapor at 1 atm and the minimum anticipated temperature [°F (°C)] of the protected volume [ft^3/lb (m^3/kg)]

The second option for calculating the minimum quantity of agent required is to use the Flooding Factors Table below. To use these tables, start by locating the Minimum Design Temperature in the left column, follow this line across until you reach the column for the Minimum Design Concentration needed for the design. The number listed in the cell where the temperature line and concentration column meet is the Flooding Factor to be used.

To determine the minimum quantity of agent required, multiply the hazard volume by the Flooding Factor determined from the tables below. Repeat this step for each area protected by the system.

FLOODING FACTORS – Agent vs. Temperature Charts (English Units)									
Temp. (*t*) (°F)[c]	Specific Vapor Volume(*s*) (ft^3/lb)[d]	Weight Requirements of Hazard Volume, W/V (lb/ft^3)[b] (English Units)							
		3M™ Novec™ 1230 Fire Protection Fluid Design Concentration (% by Volume)[e]							
		4.5	4.7	5.0	6.0	7.0	8.0	9.0	10.0
30	1.05883	0.0445	0.0466	0.0497	0.0603	0.0711	0.0821	0.0934	0.1049
40	1.08324	0.0435	0.0455	0.0486	0.0589	0.0695	0.0803	0.0913	0.1026
50	1.10765	0.0425	0.0445	0.0475	0.0576	0.0680	0.0785	0.0893	0.1003
60	1.13206	0.0416	0.0436	0.0465	0.0564	0.0665	0.0768	0.0874	0.0981
70	1.15647	0.0407	0.0426	0.0455	0.0552	0.0651	0.0752	0.0855	0.0961
80	1.18088	0.0399	0.0418	0.0446	0.0541	0.0637	0.0736	0.0838	0.0941
90	1.20529	0.0391	0.0409	0.0437	0.0530	0.0624	0.0721	0.0821	0.0922
100	1.22970	0.0383	0.0401	0.0428	0.0519	0.0612	0.0707	0.0804	0.0904
110	1.25411	0.0376	0.0393	0.0420	0.0509	0.0600	0.0693	0.0789	0.0886
120	1.27852	0.0369	0.0386	0.0412	0.0499	0.0589	0.0680	0.0774	0.0869
130	1.30293	0.0362	0.0379	0.0404	0.0490	0.0578	0.0667	0.0759	0.0853

FLOODING FACTORS – Agent vs. Temperature Charts (Metric Units)									
Temp. (*t*) (°C)[c]	Specific Vapor Volume(*s*) (m^3/kg)[d]	Weight Requirements of Hazard Volume, W/V (kg/m^3)[b] (Metric Units)							
		3M™ Novec™ 1230 Fire Protection Fluid Design Concentration (% by Volume)[e]							
		4.5	4.7	5.0	6.0	7.0	8.0	9.0	10.0
0	0.0664000	0.7096	0.7427	0.7926	0.9613	1.1336	1.3096	1.4895	1.6734
5	0.0677715	0.6953	0.7277	0.7766	0.9418	1.1106	1.2831	1.4593	1.6395
10	0.0691430	0.6815	0.7133	0.7612	0.9232	1.0886	1.2576	1.4304	1.6070
15	0.0705145	0.6682	0.6994	0.7464	0.9052	1.0674	1.2332	1.4026	1.5757
20	0.0718860	0.6555	0.6861	0.7322	0.8879	1.0471	1.2096	1.3758	1.5457
25	0.0732575	0.6432	0.6732	0.7184	0.8713	1.0275	1.1870	1.3500	1.5167
30	0.0746290	0.6314	0.6608	0.7052	0.8553	1.0086	1.1652	1.3252	1.4888
35	0.0760005	0.6200	0.6489	0.6925	0.8399	0.9904	1.1442	1.3013	1.4620
40	0.0773720	0.6090	0.6374	0.6802	0.8250	0.9728	1.1239	1.2783	1.4361
45	0.0787435	0.5984	0.6263	0.6684	0.8106	0.9559	1.1043	1.2560	1.4111
50	0.0801150	0.5882	0.6156	0.6570	0.7967	0.9395	1.0854	1.2345	1.3869
55	0.0814865	0.5783	0.6052	0.6459	0.7833	0.9237	1.0671	1.2137	1.3636

[a] The manufacturer's listing specifies the temperature range for operation.

[b] W/V [agent weight requirements (lb/ft^3) or (kg/m^3)] = pounds of agent required per ft^3 (m^3) of protected volume needed to produce the indicated concentration at the temperature specified.

[c] t [temperature (°F) or (°C)] = the design temperature in the hazard area.

[d] s [specific volume (ft^3/lb)] = specific volume of superheated Novec 1230 fluid as approximated by the formula: $s = 0.9856 + 0.002441(t)$
s [specific volume (m^3/kg)] = specific volume of superheated Novec 1230 fluid as approximated by the formula: $s = 0.0664 + 0.0002741(t)$

[e] c [concentration (%)] = volumetric concentration of Novec 1230 fluid in air at the temperature indicated.

3.8. Apply Altitude Correction Factor

The design quantity of clean agent shall be adjusted to compensate for ambient pressures that vary more than 11% (equivalent to approximately 3000 ft. (915 m) of elevation change) from standard sea level pressures. An increase in altitude causes the agent to expand and occupy more space, which will lead to a higher concentration if the agent quantity is not adjusted accordingly. A decrease in altitude will cause the opposite effect, increasing the quantity of agent required.

To make the necessary adjustments, first look up the altitude or pressure of the hazard in the following Altitude Correction Factors table; then, multiply the quantity of agent required for each hazard, as determined in the previous steps, by the Altitude Correction Factor.

ALTITUDE CORRECTION FACTORS				
Equivalent Altitude		Enclosure Pressure (Absolute)		Atmospheric Correction Factor
Feet	Kilometer	PSI	mm Hg	
-3,000	-0.92	16.25	840	1.11
-2,000	-0.61	15.71	812	1.07
-1,000	-0.30	15.23	787	1.04
0	0.00	14.71	760	1.00
1,000	0.30	14.18	733	0.96
2,000	0.61	13.64	705	0.93
3,000	0.91	13.12	679	0.89
4,000	1.22	12.58	650	0.86
5,000	1.52	12.04	622	0.82
6,000	1.83	11.53	596	0.78
7,000	2.13	11.03	570	0.75
8,000	2.45	10.64	550	0.72
9,000	2.74	10.22	528	0.69
10,000	3.05	9.77	505	0.66

NOTE: Fike's Flow Calculation Program will automatically calculate the agent required based on the altitude correction factor entered.

3.9. Select System Design Concept

The fire suppression system using 3M™ Novec™ 1230 Fire Protection Fluid can be designed to deliver the agent to the protected area(s) using one or more of the following piping distribution methods. The method used may depend on several factors including: installation time, the quantity of agent involved, economic factors, number of hazard areas, available space for placement of storage containers and customer preferences. Larger projects may require the use of more than one method to address the challenges presented. Therefore, the designer should be familiar with each of these methods and the advantages and disadvantages of each for any particular application.

1) Engineered System – Engineered systems are more complex and flexible configurations that enable the designer to create a custom piping network to suit the individual needs of the project. The piping configurations can be balanced or unbalanced, and the flow splits within the system can vary from point to point. Engineered systems require the use of a computerized hydraulic flow calculation program to model the system and verify its performance in accordance with NFPA 2001 requirements prior to installation.

> **NOTE:** Engineered systems can be designed with the containers arranged in a Modular or Central Storage or Manifold configuration.

2) Modular System – Individual containers are strategically located throughout or around the protected area(s) with each having a dedicated piping system and nozzles to distribute the clean agent supply. This arrangement keeps the discharge piping requirements down to a minimum, but increases the electrical materials necessary to reach each individual container location.

   A modular approach is often desirable (or necessary) for larger applications to reduce the amount of piping materials and installation labor necessary to complete the project. In some instances, this approach will be necessary in order to make the system flow the agent required within the design guidelines identified for an Engineered system.

3) Central Storage System – All containers are located in one location with each having a dedicated piping system and nozzles to distribute the clean agent supply to the protected space(s) from this location. This concept often requires more discharge piping, but it decreases the electrical materials necessary to reach the singular container(s) location. This concept may be more difficult to design due to the increased piping runs involved and the installation labor will tend to be more costly.

4) Selector Valve System – A single agent supply is provided to protect multiple hazards by utilizing selector valves and dedicated piping systems to direct the flow of agent into the affected hazard area. By providing a central agent supply sized to protect the largest hazard area, the total amount of agent required to protect multiple hazards is reduced. All containers are located in one location and are connected together via a manifold. All containers connected to the manifold must be the same size with the same fill density. This concept often requires more discharge piping, but it decreases the electrical materials necessary to reach the singular container(s) location. This concept may be more difficult to design due to the increased piping runs involved and the installation labor will tend to be more costly. Selector Valve systems can only provide protection for a single hazard at a time and will not be effective if more than one hazard is involved in a fire. See Section 4.3.4 for container manifold configurations.

5) Main/Reserve System – A connected reserve agent supply is installed to provide immediate protection of the hazard should the primary supply be discharged. The main/reserve container(s) are manifolded together with check valves to allow either container to be removed from service without impacting the operation of the suppression system. Main and reserve containers must be the same size with the same fill density. See Section 4.3.4 for container manifold configurations.

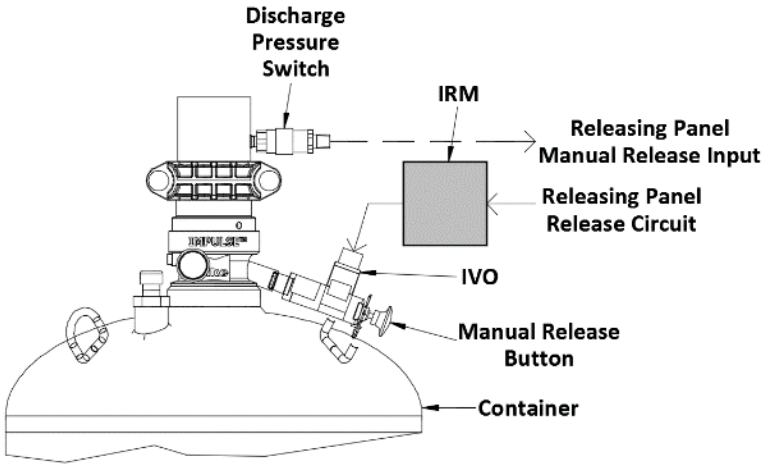
3.10. Select System Actuation Method

There are three basic methods of actuation for a Fike fire suppression system: electrical, pneumatic, and mechanical manual. Systems can be actuated using any one of these methods or a combination thereof as shown in the following diagrams. The selection of the actuation method typically depends upon the chosen system design concept and the classification of the hazard being protected.

3.10.1. Single Container with IVO

This actuation method utilizes a Fike releasing panel to release a single suppression container. The IVO connected to the container is electrically actuated by the releasing panel. An Impulse Release Module (IRM) installed adjacent to the container provides the interface between the panel's release circuit and the IVO to facilitate automatic release of the suppression agent.

With this method, manual activation of the suppression container can be accomplished either electrically or mechanically. *Electric manual* activation is accomplished by the activation of a manual release switch connected to the panel. *Mechanical manual* activation is accomplished by striking the red strike button on the IVO. This method of activating the container does not require an electric power source. Where mechanical manual activation of the system is possible, NFPA 2001 requires that a discharge pressure switch must be installed to provide an indication to the releasing panel that the system has been manually activated. Connect the discharge pressure switch to a "Manual Release" input on the releasing panel.



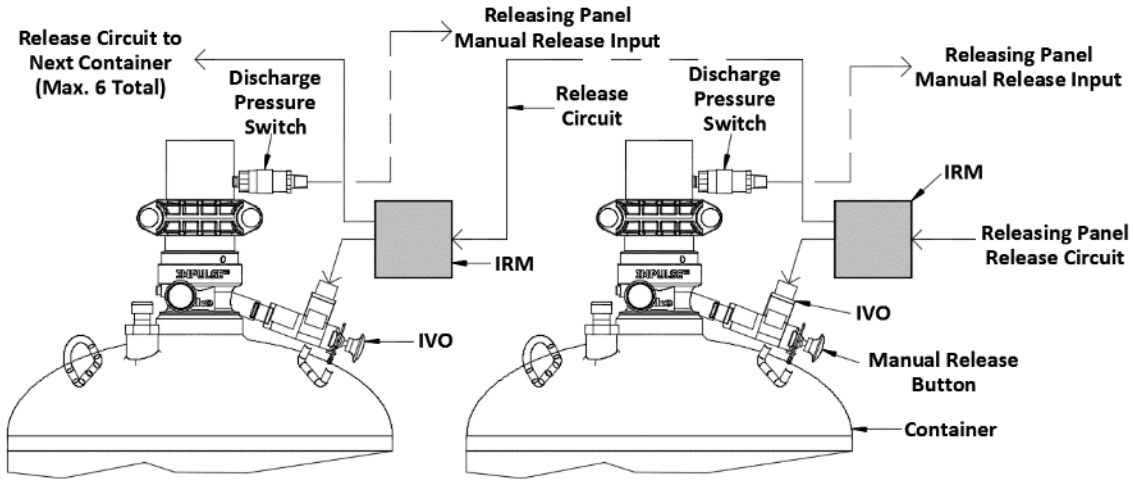
Single Container Connected to Fike Releasing Panel

NOTE: The IVO shown in the diagram above can be replaced with an IEA; however, there is no strike button provided on the IEA to permit mechanical manual activation of the container as described above. Electric manual activation must be used to manually activate the container. System actuation using the IEA is not FM approved as it does not provide a true mechanical means of activating the container.

3.10.2. Multiple Containers with IVOs

This actuation method utilizes a Fike releasing panel to release up to six suppression containers protecting a common hazard. With this method, the containers are not required to be located in close proximity to each other. They can be located strategically throughout the hazard (modular system). The IVOs connected to the containers are electrically actuated by the releasing panel. An Impulse Release Module (IRM) installed adjacent to each container provides the interface between the release circuit and the IVOs to facilitate automatic release of the suppression agent.

With this method, discharge pressure switches must be installed on each container. The switches must be connected to the manual release input on the releasing panel in order to cause the activation of the remaining containers serving the hazard.



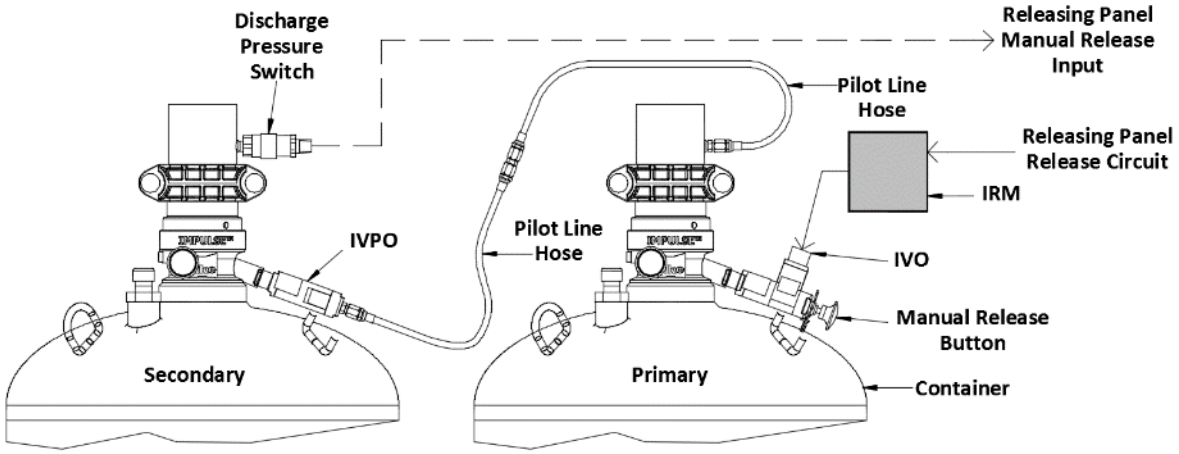
Maximum Six Containers Connected to Fike Releasing Panel

NOTE: The IVO shown in the diagram above can be replaced with an IEA; however, there is no strike button provided on the IEA to permit mechanical manual activation of the container. Electric manual activation must be used to manually activate the container. System actuation using the IEA is not FM approved as it does not provide a true mechanical means of activating the container.

3.10.3. Two Containers with IVO and IVPO

This actuation method utilizes a Fike releasing panel to release up to two suppression containers protecting a common hazard. With this method, the containers are required to be located in close proximity to each other to facilitate connection of the pilot line hoses. The IVO connected to the Primary container is electrically actuated by the releasing panel. An Impulse Release Module (IRM) installed adjacent to the Primary container provides the interface between the release circuit and the IVO to facilitate automatic release of the suppression agent. The Secondary container is equipped with an Impulse Valve Pneumatic Operator (IVPO) that allows the container to be pneumatically activated by the discharge pressure supplied by the primary container through the pilot line hoses.

With this method, manual activation of the suppression containers can be accomplished either electrically or mechanically. *Electric manual* activation is accomplished by the activation of a manual release switch connected to the releasing panel. *Mechanical manual* activation is accomplished by striking the red button on the IVO connected to the primary container. This method of activating the container does not require an electric power source. Where mechanical manual activation of the system is possible, NFPA 2001 requires that a discharge pressure switch must be installed to provide an indication to the releasing panel that the system has been manually activated. Connect the discharge pressure switch to a "Manual Release" input on the releasing panel.



Maximum Two Containers Connected to Fike Releasing Panel

Pilot Line Limitations:
1) Pilot line hoses supplied by Fike.

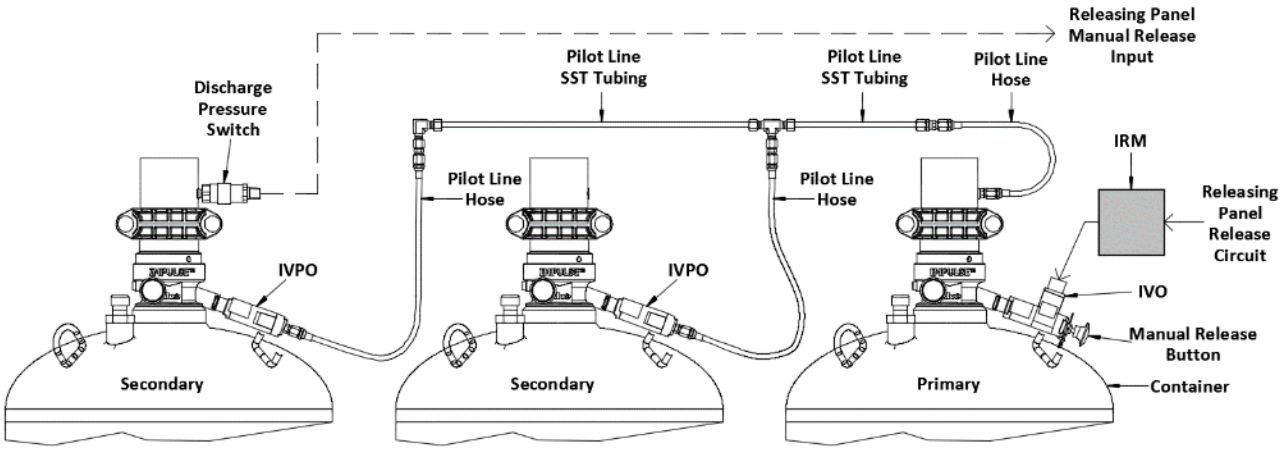
NOTE: The IVO shown in the diagram above can be replaced with an IEA; however, there is no strike button provided on the IEA to permit mechanical manual activation of the container as described above. Electric manual activation must be used to manually activate the container. System actuation using the IEA is not FM approved as it does not provide a true mechanical means of activating the container.

See Section 4.8 for pilot line installation.

3.10.4. Multiple Containers with Single IVO and Multiple IVPOs

This actuation method utilizes a Fike releasing panel to release up to seven suppression containers protecting a common hazard. With this method, the containers are required to be located in close proximity to each other to facilitate connection of the pilot line hoses. The IVO connected to the Primary container is electrically actuated by the releasing panel. An Impulse Release Module (IRM) installed adjacent to the Primary container provides the interface between the release circuit and the IVO to facilitate automatic release of the suppression agent. The Secondary containers (six maximum) are equipped with Impulse Valve Pneumatic Operators (IVPO) that allow the containers to be pneumatically activated by the discharge pressure supplied by the primary container through the pilot line.

With this method, manual activation of the suppression containers can be accomplished either electrically or mechanically. *Electric manual* activation is accomplished by the activation of a manual release switch connected to the releasing panel. *Mechanical manual* activation is accomplished by striking the red button on the IVO connected to the primary container. This method of activating the container does not require an electric power source. Where mechanical manual activation of the system is possible, NFPA 2001 requires that a discharge pressure switch must be installed to provide an indication to the releasing panel that the system has been manually activated. Connect the discharge pressure switch to a "Manual Release" input on the releasing panel.



Maximum Seven Containers Connected to Fike Releasing Panel

Pneumatic Actuation Line Limitations:

1) Maximum 50 ft. (15.2 m) total length including hoses.
2) Maximum six IVPOs activated by primary container.
3) Tubing (supplied by others) shall be 1/4 in. x 0.035 in. wall stainless steel.
4) Pilot line hoses supplied by Fike.

NOTE: The IVO shown in the diagram above can be replaced with an IEA; however, there is no strike button provided on the IEA to permit mechanical manual activation of the container as described above. Electric manual activation must be used to manually activate the container. System actuation using the IEA is not FM approved as it does not provide a true mechanical means of activating the container.

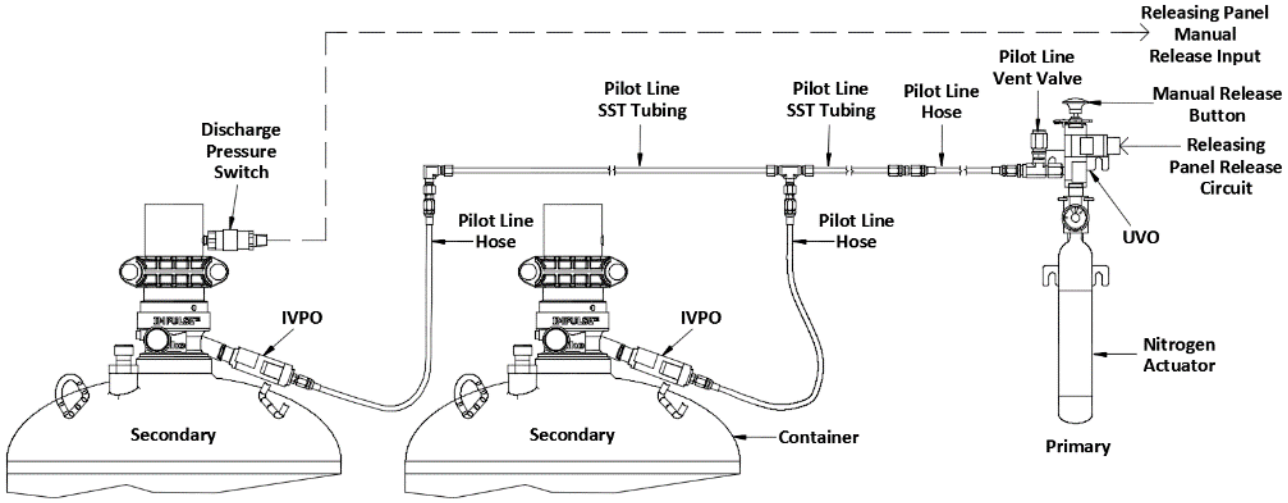
See Section 4.8 for pilot line installation.

3.10.5. Multiple Containers with Primary Nitrogen Actuator

This actuation method utilizes a Primary Nitrogen Actuator to release up to six suppression containers protecting a common hazard. With this method, the containers are not required to be located in close proximity to each other. They can be located strategically throughout the hazard (modular system) and are connected together via a pilot line for actuation. The UVO connected to the Primary Nitrogen Actuator is electrically actuated by the releasing panel. The secondary containers are equipped with Impulse Valve Pneumatic Operators (IVPO) that allow the containers to be pneumatically activated by the discharge pressure supplied by the primary nitrogen actuator through the pilot line.

With this method, manual activation of the suppression containers can be accomplished either electrically or mechanically. *Electric manual* activation is accomplished by the activation of a manual release switch connected to the releasing panel. *Mechanical manual* activation is accomplished by striking the red button on the UVO connected to the Nitrogen Actuator. This method of activating the container does not require an electric power source. Where mechanical manual activation of the system is possible, NFPA 2001 requires that a discharge pressure switch must be installed to provide an indication to the releasing panel that the system has been manually activated. Connect the discharge pressure switch to a "Manual Release" input on the releasing panel.

NOTE: This actuation method is commonly used for system actuation in hazardous locations; however, the discharge pressure switch cannot be installed in the hazardous location.



Maximum Six Containers Connected to Primary Nitrogen Actuator

Pneumatic Actuation Line Limitations:

1) Minimum 100 ft. (30.5 m) between Primary Nitrogen Actuator and first IVPO.
2) Maximum 300 ft. (91.5 m) between Primary Nitrogen Actuator and last IVPO.
3) Maximum 160 ft. (48.8 m) between first and last IVPO.
4) Maximum six IVPOs activated by primary nitrogen actuator.
5) Tubing (supplied by others) shall be 1/4 in. x 0.035 in. wall stainless steel.
6) Pilot line hoses supplied by Fike.

NOTE: The UVO shown in the diagram above that is connected to the Primary Nitrogen Actuator Assembly can be replaced with a Universal Energetic Actuator (UEA); however, there is no strike button provided on the UEA to permit mechanical manual activation of the containers as described above. Electric manual activation must be used to manually activate the container. Activation of the Primary Nitrogen Actuator using the UEA is not FM approved as it does not provide a true mechanical means of activating the system.

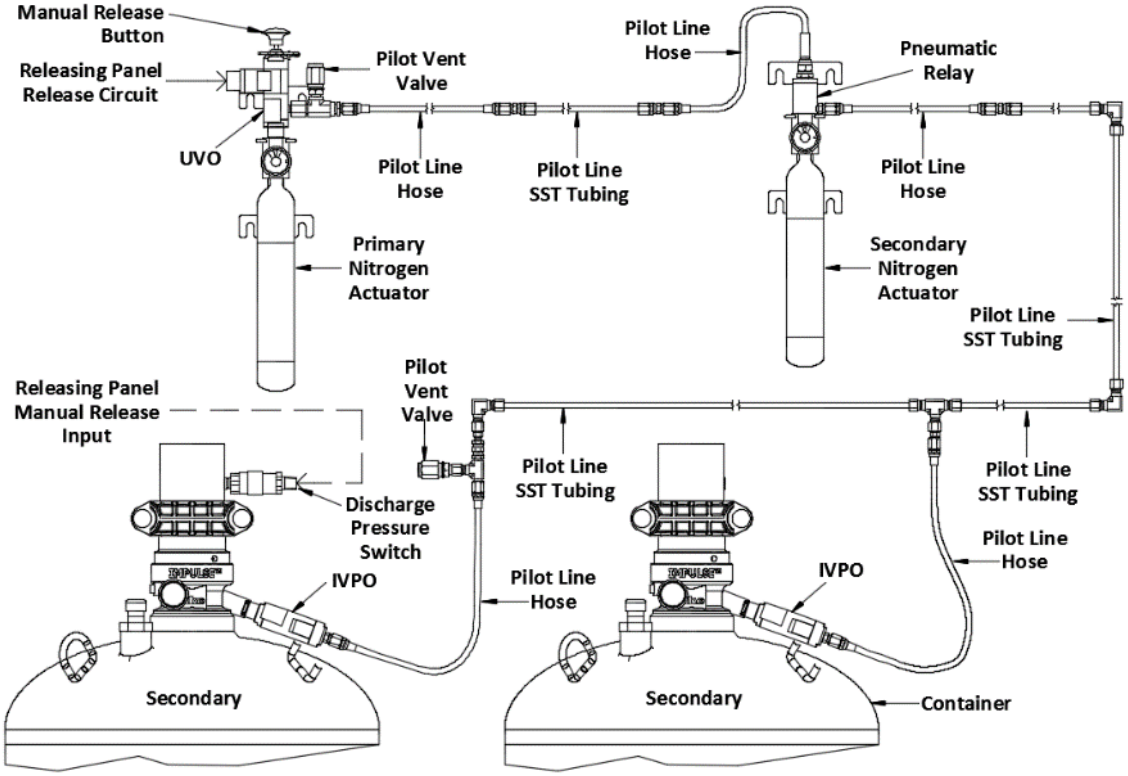
See Section 4.8 for pilot line installation.

3.10.6. Multiple Containers with Primary and Secondary Actuators

This actuation method utilizes a Primary Nitrogen Actuator and one or more Secondary Nitrogen Actuators to release up to six suppression containers protecting a common hazard. With this method, the containers are not required to be located in close proximity to each other. They can be located strategically throughout the hazard (modular system) and are connected together via a pilot line for actuation. The UVO connected to the Primary Nitrogen Actuator is electrically actuated by the releasing panel. The secondary containers are equipped with Impulse Valve Pneumatic Operators (IVPO) that allow the containers to be pneumatically activated by the discharge pressure supplied by the secondary nitrogen actuator through the pilot line.

With this method, manual activation of the suppression containers can be accomplished either electrically or mechanically. *Electric manual* activation is accomplished by the activation of a manual release switch connected to the releasing panel. *Mechanical manual* activation is accomplished by striking the red button on the IVO connected to the Primary Nitrogen Actuator Assembly. This method of activating the container does not require an electric power source. Where mechanical manual activation of the system is possible, NFPA 2001 requires that a discharge pressure switch must be installed to provide an indication to the releasing panel that the system has been manually activated. Connect the discharge pressure switch to a "Manual Release" input on the releasing panel.

NOTE: This actuation method is commonly used for system actuation in hazardous locations; however, the discharge pressure switch cannot be installed in the hazardous location



Maximum Six Containers Connected to Primary and Secondary Nitrogen Actuators

Pilot Line Limitations:

1) Maximum 150 ft. (45.0 m) between Primary Nitrogen Actuator and Secondary Nitrogen Actuator.
2) Minimum 100 ft. (30.5 m) between Secondary Nitrogen Actuator and first IVPO.
3) Maximum 300 ft. (91.5 m) between Secondary Nitrogen Actuator and last IVPO.
4) Maximum 160 ft. (48.8 m) between first and last IVPO.
5) Maximum six IVPOs activated by secondary nitrogen actuator.
6) Tubing (supplied by others) shall be 1/4 in. x 0.035 in. wall stainless steel.
7) Pilot line hoses supplied by Fike.

NOTE: The UVO shown in the diagram that is connected to the Primary Nitrogen Actuator Assembly can be replaced with a Universal Energetic Actuator (UEA); however, there is no strike button provided on the UEA to permit mechanical manual activation of the containers as described above. Electric manual activation must be used to manually activate the container. Activation of the Primary Nitrogen Actuator using the UEA is not FM approved as it does not provide a true mechanical means of activating the system.

See Section 4.8 for pilot line installation.

3.11. Select Container Size and Fill Range

The selection of containers is generally determined by the total amount of agent required versus the approved fill ranges for the various container sizes. Additional factors such as the System Design Concept, container storage location, and flow calculation limitations may impact container selection.

To estimate the number of containers required, divide the Final Design Quantity required for each protected hazard by the actual container capacity listed in the Container Size and Fill Range table below. The container size(s) selected must be equal to or greater than the weight of the total agent quantity required. Containers are filled to the nearest lb. (kg).

CONTAINER SIZE AND FILL RANGE

Size lb. (L)	**Part Number**	**Minimum Fill Range** lbs. (kg)	**Maximum Fill Range** lbs (kg)	**Fill Increments** lbs. (kg)	**Mounting Position**	**Valve Size** in. (mm)	**Approx. Tare Weight** lbs. (kg)
5 (2)	70-357	3 (1.0)	5 (2.0)	1 (0.5)	Upright (Valve Up)	1 (25)	11 (5.0)
10 (4)	70-358	5 (2.5)	10 (4.5)	1 (0.5)	Upright (Valve Up)	1 (25)	15 (6.8)
20 (8.5)	70-359	9 (4.0)	21 (9.5)	1 (0.5)	Upright (Valve Up)	1 (25)	19 (8.6)
35 (15)	70-360	17 (8.0)	38 (17.0)	1 (0.5)	Upright (Valve Up)	1 (25)	28 (12.7)
60 (27)	70-361	30 (13.5)	68 (30.5)	1 (0.5)	Upright (Valve Up)	1 (25)	53 (24.0)
100 (44)	70-362	47 (21.5)	108 (49.0)	1 (0.5)	Upright (Valve Up)	1 (25)	77 (34.9)
150 (68)	70-363	65 (32.5)	150 (68.0)	1 (0.5)	Upright (Valve Up)	3 (80)	123 (55.8)
215 (87)	70-364	93 (42.5)	216 (98.0)	1 (0.5)	Upright (Valve Up)	3 (80)	150 (68.0)
375 (153)	70-365	163 (74.0)	378 (171.5)	1 (0.5)	Upright (Valve Up)	3 (80)	216 (98.0)
650 (267)	70-366	283 (128.5)	660 (299.0)	1 (0.5)	Upright (Valve Up)	3 (80)	364 (165.1)
1000 (423)	70-367	449 (203.5)	1045 (474.0)	1 (0.5)	Upright (Valve Up)	3 (80)	525 (238.1)

3.12. Consider Container Manifold Options

For systems that require more agent than a single container can provide, multiple containers can be connected together via a common manifold arrangement to provide the required agent quantity to the protected hazard. Main and reserve supplies of agent are also connected together in this manner.

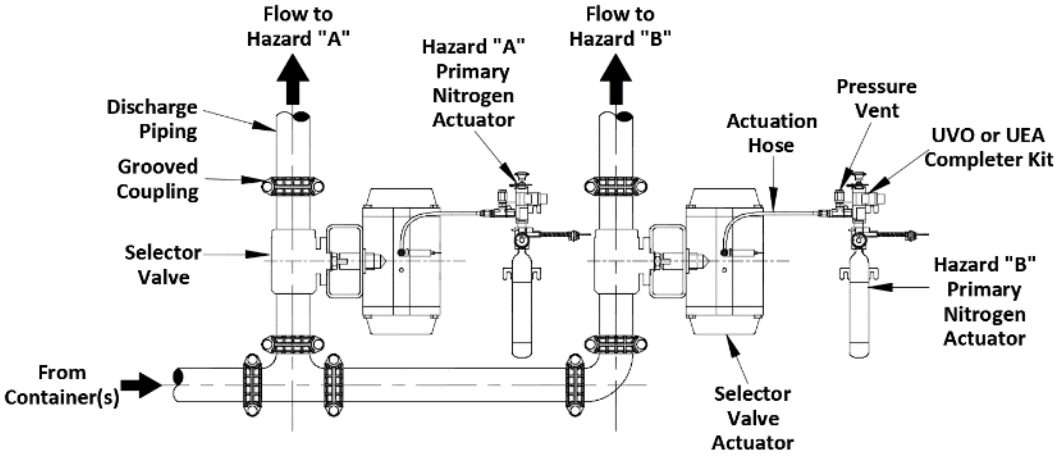
Manifolds are assembled using a combination of grooved pipe and fittings, or threaded pipe and fittings that meet the pressure requirements of NFPA 2001. When containers are manifolded together, every container must be the same size and fill weight in accordance with NFPA 2001.

See Section 4.3.4 for manifold configuration options.

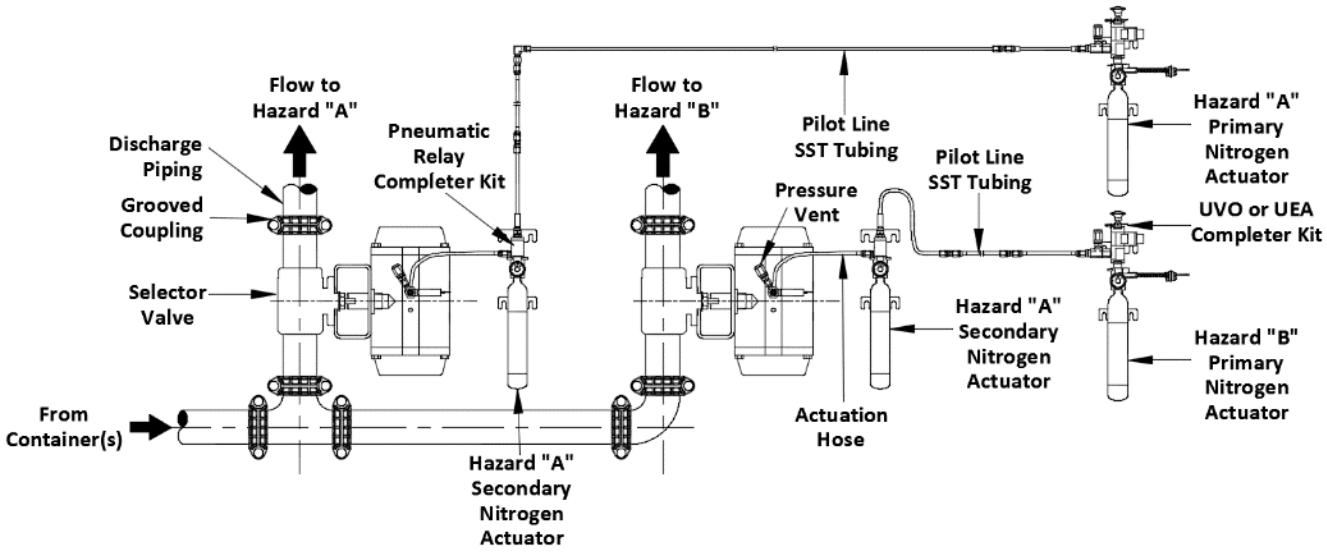
3.13. Selector Valve Option

To reduce the total amount of agent required for protection of multiple hazards of similar or like volumes, the designer may want to consider using a selector valve system. The selector valve system utilizes a common agent supply that is sized to protect the largest hazard volume the suppression system serves. A dedicated piping network is connected to each selector valve to direct the agent flow to each individual hazard area. When the system activates, the appropriate selector valve will open to allow the agent flow to the affected hazard.

Activation of individual selector valves is accomplished using the discharge pressure provided by a Nitrogen Actuator Assembly through a stainless steel pilot line connection. See diagrams below.



Selector Valve Activation using Primary Nitrogen Actuator Assembly



Selector Valve Activation using Primary and Secondary Nitrogen Actuator Assemblies

CAUTION: Selector valve systems can only be used to protect one hazard at a time and will not be effective if two or more hazards are involved in a fire simultaneously.

CAUTION: When using selector valves to protect hazards with similar volumes, it is extremely important that the system designer evaluate the final design concentration that will be reached in each hazard area served by the selector valve system to determine the impact on exposure limitations. See Section 3.21.

3.14. Determine Container Locations

The location of the agent container(s) must be based on the following considerations:

1) Container(s) must be installed in area that is capable of maintaining an ambient temperature of 32-130°F (0-54.4°C). At temperatures outside this range, the system may not supply the desired quantity of agent or may accidentally discharge due to over-pressure. The flow calculation program predictions are based on a container storage temperature range of 60-80°F (16-27°C).

2) The gross weight of the container must be considered when selecting the container location. The floor must be able to support the total weight of the container(s) as they are moved into position. Excessive floor loading may require relocating the container(s) to a more suitable location.

3) Container(s) should be located as close as possible to or within the hazard(s) that they protect in order to reduce the length of the distribution piping. For large systems, it may be necessary to sub-divide the piping network into small configurations with separate containers.

4) Container(s) should be located in a clean, dry, and relatively vibration free area. Avoid aisle ways and other high traffic areas where physical damage or tampering is more likely.

5) Container(s) should not be located where they would be subject to physical damage, exposure to corrosive chemicals, or harsh weather conditions. Container(s) should not be located where they could potentially be splashed or submerged with any liquid.

6) Container(s) should be located where they can be easily accessed for maintenance and service.

3.15. Determine Nozzle Quantity and Placement

Nozzle quantity and placement within each hazard being protected will be determined by many factors, such as size and configuration of the hazard area, height of the ceiling, flow rates through the nozzles, nozzle area coverage, etc. At a minimum, at least one nozzle shall be provided for each hazard area.

All nozzles used for the fire suppression system using 3M™ Novec™ 1230 Fire Protection Fluid are required to discharge the agent into the protected hazard within 6 to 10 seconds; therefore, the number of nozzles provided for any area must be capable of delivering the flow rate required to meet this timing criteria.

Each size nozzle is capable of delivering a defined flow rate. To estimate the minimum number and size of nozzles required for each area, divide the total quantity of agent required for the protected hazard by 10 seconds to determine the hazards total flow rate; then, use the Nozzle Flow Rate table below to select the nozzle(s) size best suited to provide the required flow rate. More than one nozzle may be required for each protected hazard.

If the flow rate approaches the top end of the allowable flow rate for a given size pipe, it may be in the designer's best interest to increase the pipe size.

NOZZLE FLOW RATES		
Nominal Pipe Size In. NPT (mm)	**Minimum Design Flow Rate** (System Limitation) lbs./sec (kg/sec)	**Maximum Design Flow Rate** (Estimate Only) lbs./sec (kg/sec)
1/2 (15)	1.29 (0.59)	3.23 (1.46)
3/4 (20)	2.43 (1.10)	6.08 (2.75)
1 (25)	4.12 (1.87)	10.30 (4.68)
1 ¼ (32)	7.40 (3.36)	18.50 (8.40)
1 ½ (40)	10.25 (4.65)	25.63 (11.63)
2 (50)	13.00 (5.90)	33.00 (14.97)

NOTE: The values listed in the table are provided for estimation purposes only. The final system design MUST be verified using Fike's Flow Calculation Program.

NOTE: A maximum nozzle flow rate of 17 lbs/sec (7.7 kg/sec) is recommended for all areas with false ceilings or delicate operations where a higher flow rate may dislodge objects or affect a process.

3.15.1. Evaluate Nozzle Area Coverage

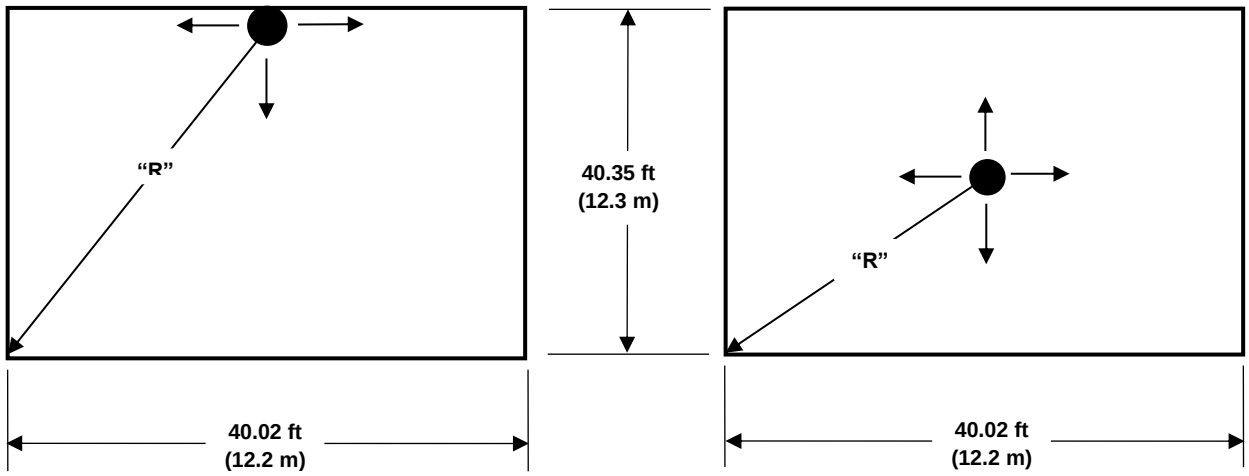
When determining the required quantity of nozzles for each protected hazard, the designer must consider the area coverage limitations of each nozzle. Each nozzle type (180° or 360°) has been UL Listed and FM Approved for the maximum area coverage limitations listed below.

The maximum area coverage is expressed as a radius ("R") of coverage along the discharge axis for both nozzle types.

Nozzle Size – 1/2 in. to 2 in. (15 mm to 50 mm)		
Nozzle Type	**Radius "R" Dimension** ft. (m)	**Ceiling Height Range** ft. (m)
180°	44.91 (13.69)	1.32 to 16.00 (0.40 to 4.88)
360°	28.41 (8.66)	1.32 to 16.00 (0.40 to 4.88)

NOTE: Enclosure heights <1.32' (0.4 m) shall be ½ of the nozzle area coverage.

Maximum Distance	**180° Nozzle** ft. (m)	**360° Nozzle** ft. (m)	**Note**
Below Ceiling	1.0 (0.3)	1.0 (0.3)	Maximum distance above highest point of protection when stacking nozzles.
Away from Sidewall	1.0 (0.3)	---	

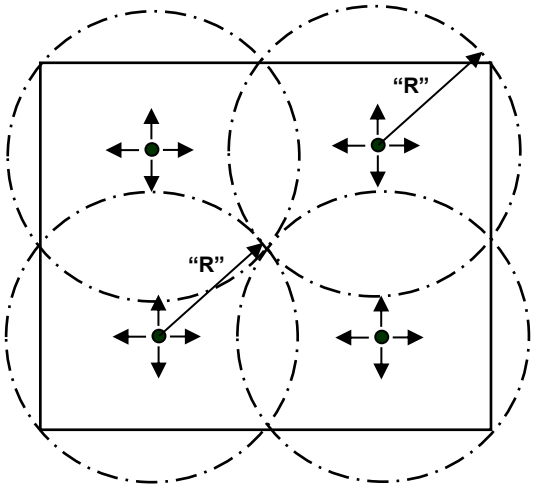


Nozzle Area Coverage

Nozzle Placement Recommendations

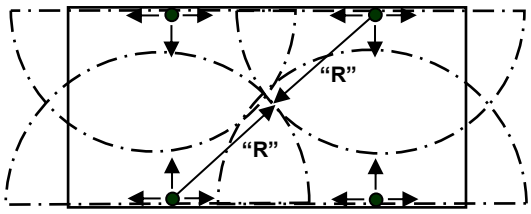
Nozzles must be located at the top of the hazard area, aimed up or down. Nozzle located in a subfloor can also be aimed upward or downward.

360° Nozzle(s) should be located on or near the centerline of the protected area, discharging toward the perimeter of the area being protected. Nozzle coverage patterns need to overlap to adequately cover the area without any "blind spots" due to nozzle locations.



360° Nozzle Placement

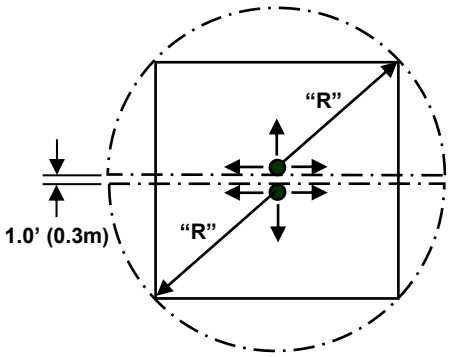
180° Nozzle(s) should be located along the perimeter of the protected area, discharging toward the opposite side. Nozzle coverage patterns need to overlap to adequately cover the area without any "blind spots" due to nozzle locations. The nozzles can be located a maximum of 1 ft. (0.3 m) out from the wall.



180° Nozzle Placement

180° Nozzle(s) in a back-to-back application should be located on or near the centerline of the protected area, discharging toward the perimeter of the area being protected. Maximum distance between nozzles is 1 ft. (0.3 m). Nozzle coverage patterns need to overlap to adequately cover the area without any "blind spots" due to nozzle locations.

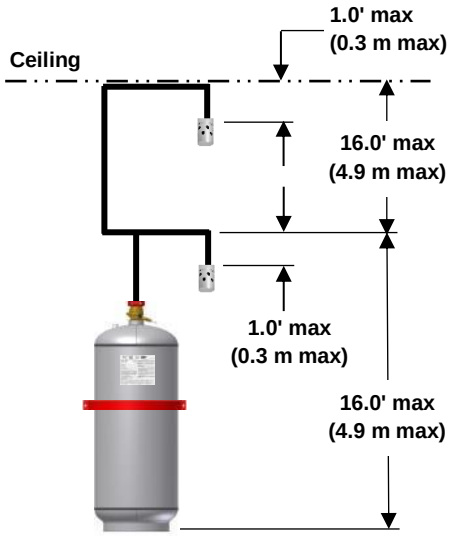
NOTE: The use of 180° nozzles in a back-to-back configuration is UL Listed but not FM Approved.



180° Nozzle Placement (Back-to-Back)

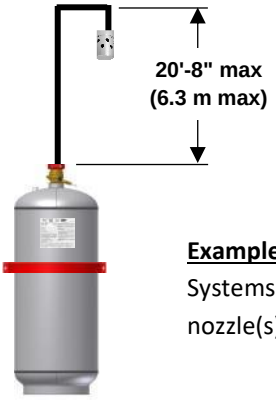
3.15.2. Evaluate Nozzle Quantity Based on Enclosure Ceiling Height

When determining the required quantity of nozzles for each protected hazard, the designer must consider the ceiling height limitations for the nozzles. Each nozzle type (180° or 360°) has been UL Listed and FM Approved for enclosures with a ceiling height of 16.0 ft. (4.9 m). Ceiling heights greater than 16.0 ft. (4.9 m) to 20.66 ft. (6.3 m) require nozzles to be placed at multiple levels (elevations) in segments no greater than 16.0 ft. (4.1 m) in elevation. See 3.15.3 for maximum elevation differences between pipe runs.

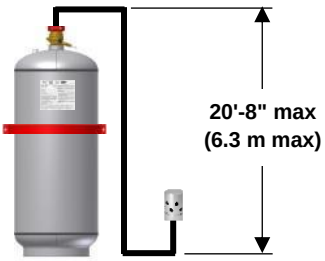


Nozzle Levels for Enclosure Greater than 16.0 ft. (4.9 m)

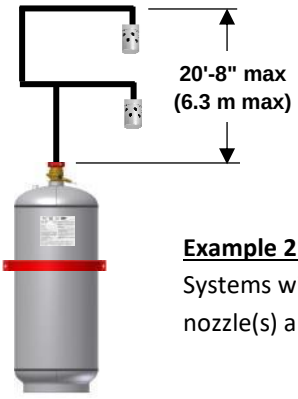
3.15.3. Evaluate Elevation Differences between Pipe Runs



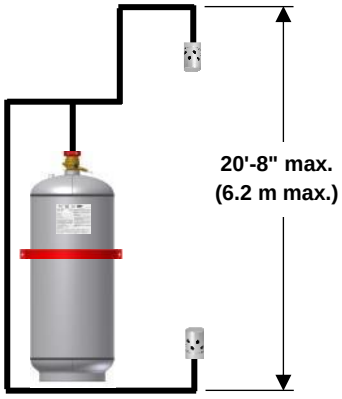
Example 1:
Systems with a single level of nozzle(s) above container outlet



Example 3:
Systems with a single level of nozzle(s) below container outlet



Example 2:
Systems with a multiple level of nozzle(s) above container outlet

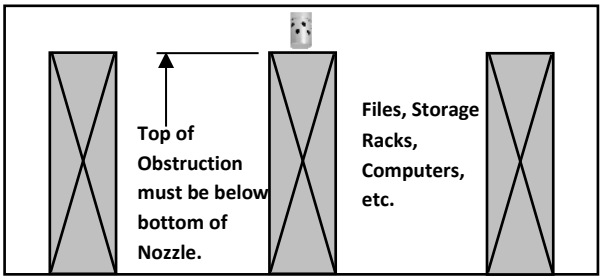


Example 4:
Systems with levels of nozzle(s) above and below container outlet

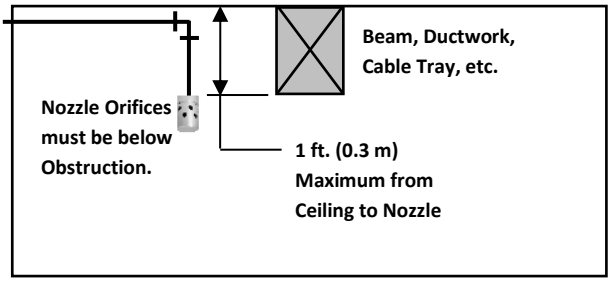
NOTE: These limitations only apply to system where multiple hazards are protected by a single piping network.

3.15.4. Evaluate Nozzle Discharge Obstructions

When solid obstructions, such as walls, partitions, equipment racks, and tall equipment, interfere with the nozzle discharge path they should be treated as separate areas. All nozzles should be located in a manner that will provide a clear discharge path that reaches all of the outer extremes for the protected space.



Side View



Side View

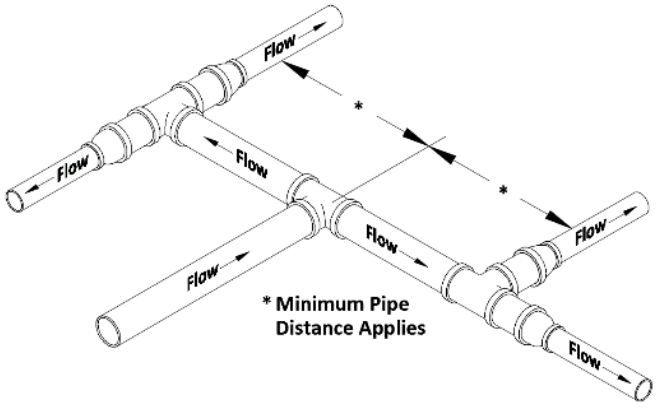
3.16. Determine Piping Layout

Using a plan view drawing of the protected areas, locate each nozzle(s) and container(s); then connect the nozzles together with piping.

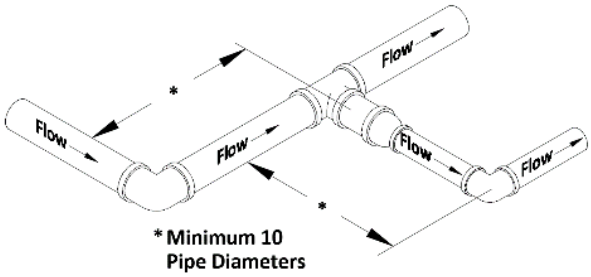
3.16.1. Evaluate Minimum Piping Distances

In order to stabilize the flow and maintain the accuracy of the tee splits the following pipe design rules must be adhered to:

A minimum of 2.41 feet (0.73 m) must be maintained between tees for pipe sizes 2-1/2 inch (65 mm) and smaller. For pipe sizes 3 inch (80 mm) and larger, a minimum of ten (10) pipe diameters must be maintained between tees.



A minimum of ten (10) pipe diameters must be maintained between an elbow and a tee or a tee and an elbow.



The ten (10) pipe diameter rule does not apply when using back-to-back 180° nozzle configurations as long as:

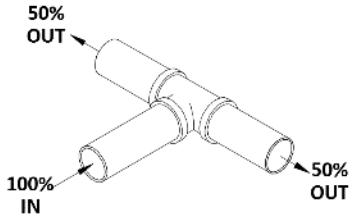
1) Agent supplied and flow rate from both nozzles are the same.
2) Pipe size from tee to both nozzles is the same.
3) Pipe lengths from tee to each nozzle are within 10% of each other.

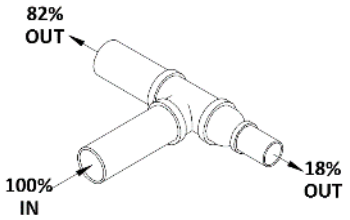
3.16.2. Evaluate Tee Split Ratios

Engineered systems using 3M™ Novec™ 1230 Fire Protection Fluid have been tested to define the maximum degree of imbalance that can be predicted at piping tee splits. This value is expressed in terms of a split ratio of one outlet branch versus the other as illustrated below.

TEE CONFIGURATION – BULLHEAD

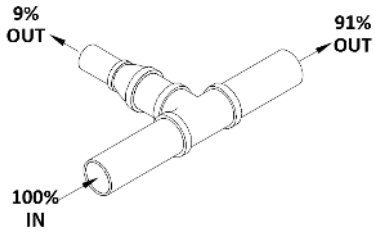
Definition: Where the two-outlet branches change direction from the incoming piping inlet.

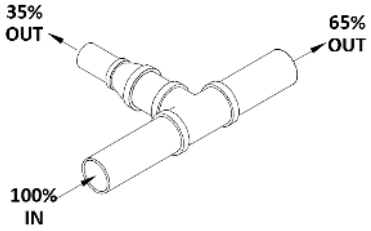




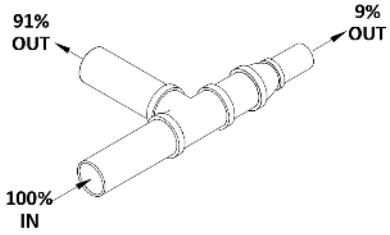
TEE CONFIGURATION – SIDE-THRU

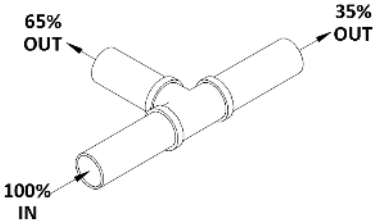
Definition: Where one outlet branch changes direction from the inlet and the other continues straight through in the same direction as the inlet.





Correct T-Split Ratios

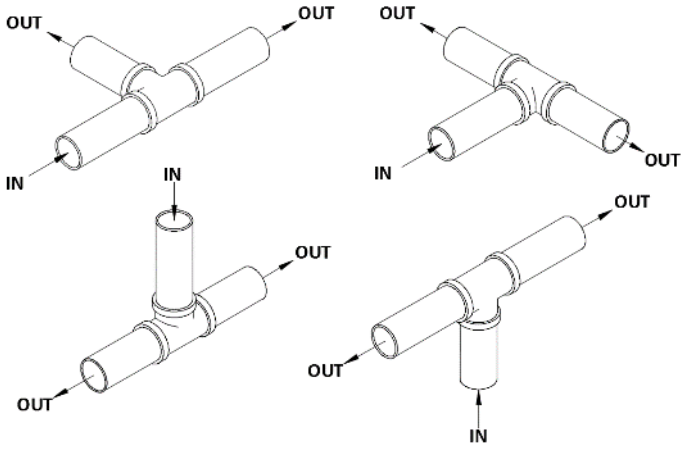




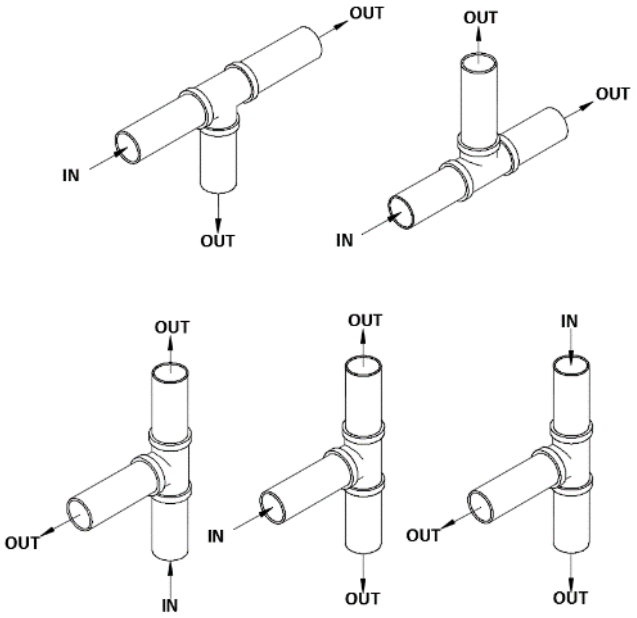
Incorrect T-Split Ratios

3.16.3. Evaluate Tee Orientation

Tee orientation plays an important characteristic in maintaining the consistency of the flow split percentages at tees; therefore, a simple rule must be observed concerning the orientation of tees. ***Every outlet of every tee must be orientated in the horizontal plane.***



Correct Tee Orientation



Incorrect Tee Orientation

3.17. Estimate Pipe Sizes

Fike's Flow Calculation Program will estimate pipe sizes automatically; therefore, this step is optional. However, the designer may wish to use the following pipe size estimation chart to estimate the nozzle pipe sizes for quotation purposes.

Pipe size estimations are based on the design flow rate for each pipe section. To determine the flow rate of a pipe section, divide the amount of agent flowing through the pipe section by the discharge time (10 seconds).

Pipe Size In. NPT (mm)	**Pipe Schedule**	**Minimum Design Flow Rate** lbs/sec (kg/sec) (System Limitation)	**Maximum Design Flow Rate** lbs/sec (kg/sec) (Estimate)
1/2 (15)	40	1.50 (0.68)	3.76 (1.71)
3/4 (20)	40	2.65 (1.21)	6.65 (3.02)
1 (25)	40	4.33 (1.96)	10.83 (4.91)
1 1/4 (32)	40	7.55 (3.42)	18.88 (8.56)
1 1/2 (40)	40	10.31 (4.68)	25.78 (11.69)
2 (50)	40	17.10 (7.76)	42.75 (19.39)
2 1/2 (65)	40	24.51 (11.12)	61.28 (27.80)
3 (80)	40	38.05 (17.26)	95.13 (43.15)
4 (100)	40	65.95 (29.91)	164.88 (74.79)
6 (150)	40	151.16 (68.57)	377.90 (171.41)
8 (200)	40	263.51 (119.53)	658.78 (298.82)

Pipe Size estimations are based on Schedule 40 pipe.

Generally, the size selection should be based on the smallest pipe size that will handle the design flow rate for the branch lines supplying the discharge nozzles and the next to smallest for trunk lines. If the flow rate approaches the top end of the allowable flow rate for a given pipe size, it may be necessary to increase the pipe size.

WARNING: DO NOT install the piping system based on the pipe size estimates from the chart above. The pipe system design must be verified using Fike's Flow Calculation Program prior to installing the system.

3.18. Apply Tee Design Factor

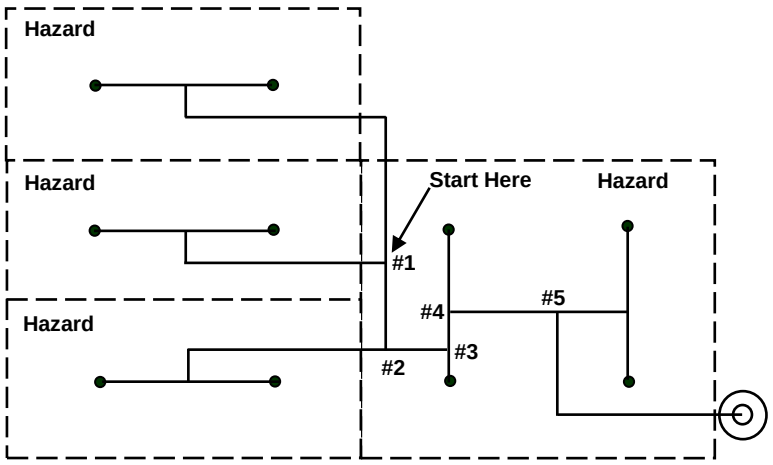
When a single agent supply is being used to protect multiple hazards, a tee design factor is applied when more than four tees are used. The tee design factor is meant to compensate for the uncertainty in the quantity of agent flowing through a pipe as the agent passes through an increasing number of tees. The design factor tee count shall be determined for each hazard the system protects, using the following guidelines:

1) Starting from the point where the piping enters the hazard that is located farthest (hydraulically) from the agent container(s), count the number of tees in the direct flow path as it returns to the agent container(s). Do not include tees that are used in the manifold (if applicable). If you are not sure which hazard is farther away, count the tees in the flow path from each hazard and use the highest number.
2) Any tee within the hazard that supplies agent to another hazard shall be included in the tee count for the hazard.
3) After determining the tee count, use the chart below to determine the Tee Design Factor.
4) Apply the Tee Design Factor to the Agent Quantity calculations by multiplying the Tee Design Factor by the amount of agent previously determined in the volumetric calculations.

Design Factors for Piping Tees			
Tee Count	**Design Factor**	**Tee Count**	**Design Factor**
0 - 4	0.00	12	0.07
5	0.01	13	0.08
6	0.02	14	0.09
7	0.03	15	0.09
8	0.04	16	0.10
9	0.05	17	0.11
10	0.06	18	0.11
11	0.07	19	0.12

EXAMPLE:

This example shows a multi-hazard area arrangement. Starting at the point where the piping enters the hazard farthest away, count the number of tees leading back to the agent container. With a tee count of five (5), an additional 1% (0.01) of agent is required. Therefore, the base quantity of agent is multiplied by 1.01 (1%) to determine the adjusted quantity of agent required



NOTE: Fike recommends increasing the design concentration to 4.7% for Class A or Class C when protecting multiple hazards with single agent supply. This will satisfy the tee design factor requirement.

3.19. Determine the Final Design Quantity Required

Add the agent quantities required for all areas together to determine the Final Design Quantity required for the entire system adjusted to account for design factors and pressure adjustments.

3.20. Determine Design Concentration at Maximum Temperature

This step is necessary to properly evaluate the exposure and egress time limitations discussed in Section 3.21 in order to avoid over-concentrating the area due to the additional agent being supplied to the area and the increased volume of agent caused by increased temperature. To determine the expected agent concentration at Maximum Ambient Temperature, the following formula must be used:

$$C = \frac{100WS}{V + WS}$$

Where:

W = Agent Weight in lbs. (kg)

V = Hazard Volume / ft^3 (m^3)

C = Design Concentration, % by volume

S = Specific Vapor in ft^3/lb (m^3/kg)

See Flooding Factor Table on page 31 to determine the "S" value

NOTE: It is important to verify that the worst case design concentration will not exceed the limits for fire suppression on the low end and life safety on the high end.

NOTE: Fike's Flow Calculation Program will automatically calculate the design concentration at the maximum ambient temperature entered.

3.21. Evaluate Exposure Limitations

Unnecessary exposure to 3M™ Novec™ 1230 Fire Protection Fluid at and above the no observable adverse effects level (NOAEL) and decomposition products produced by the fire shall be avoided. The following provisions shall apply:

1. When Novec 1230 fluid is used in a "Normally Occupied" area, a maximum design concentration of 10% is allowed. Concentrations greater than 10% can only be used in "Unoccupied" areas.
2. When Novec 1230 fluid is used in a "Normally Occupied" area and is designed to concentrations up to the NOAEL, the maximum exposure time shall not exceed 5 minutes.
3. When Novec 1230 fluid is used in a "Not Normally Occupied" area and is designed to concentrations above the LOAEL, the following provisions shall apply:
   A. Where egress takes long than 30 seconds but less than 1 minute, the agent concentration shall not exceed its LOAEL.
   B. Concentrations exceeding the LOAEL shall be permitted provided that any personnel in the area can escape within 30 seconds.
   C. A pre-discharge alarm and time delay shall be provided.

3.22. Perform Flow Calculations

With the information developed in previous sections, run Fike's Flow Calculation Program to determine the final pipe sizes and nozzle orifices. Refer to Appendix A. The program will flag most errors and prevent a completed flow calculation until all errors have been corrected. The following are common errors generated by the flow calculation program.

3.22.1. Percent Agent in Pipe

Fike containers filled with 3M™ Novec™ 1230 Fire Protection Fluid are pressurized with nitrogen to expel the extinguishing agent through the piping network and into the protected space; therefore, the total agent weight (liquid) that may reside in the piping network during discharge is limited to 88% maximum. This is to ensure that enough pressure is available in the pipe network to deliver the agent to the protected space within the maximum discharge time of 10 seconds.

This error indicates that the piping network is too large and that the piping network must be decreased by reducing pipe sizes, reducing pipe lengths, or a combination of both to correct this error. The flow calculation program will indicate the following error message "Percent of Agent Greater Than 88%".

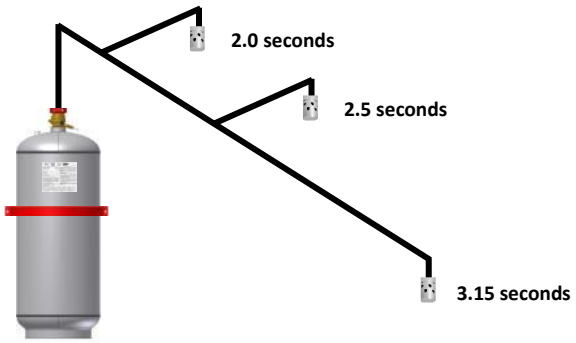
3.22.2. Location of First Tee

Some piping configurations can present timing problems for the flow calculation program due to the degree of hydraulic imbalance created due to the location of the first tee. For example, a system that splits and supplies agent for the room nozzles and underfloor nozzles is unbalanced because of the difference in pipe size and agent quantities. Therefore, the flow calculation program must try to manipulate the nozzle orifice hole diameters in an attempt to satisfy all of the timing requirements for the system. When the timing criteria cannot be met, the location of the first tee becomes critical.

To eliminate this problem, a minimum distance of 18 inches (457 mm) or 15 pipe diameters, whichever is larger, must be maintained from the container to the first tee in the piping network.

3.22.3. Liquid Arrival Time

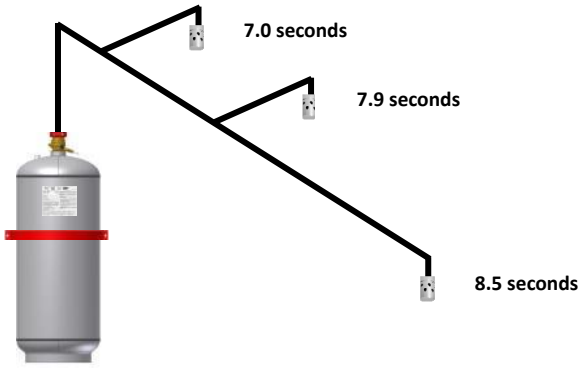
The time necessary for liquid agent to arrive at each nozzle must be within 1.15 second of each other, as shown in the example below.



In the example above, if liquid agent takes 2 seconds to arrive at the first nozzle (the closest nozzle to the container) after system discharge, liquid agent must arrive at the remaining nozzles within 1.15 second (3.15 seconds maximum after system discharge).

3.22.4. Liquid Runout Time

The time necessary for liquid agent to discharge (runout) at each nozzle must be within 1.5 seconds of each other, as shown in the example below.



In the example above, if liquid runout time for the first nozzle (the closest nozzle to the container) takes 7 seconds after system discharge, the liquid runout time for the remaining nozzles must not exceed 8.5 seconds.

3.22.5. Nozzle Orifice Area Limitations (180° and 360°)

Minimum Orifice Area	Maximum Orifice Area	Minimum Pressure
15% – Pipe cross sectional area	75% – Pipe cross sectional area	82 psia / 67.3 psig (5.65 bar absolute)

3.23. Verify System Performance

Once the flow calculation has been completed, it is important that the designer review all results to verify system performance. The designer must review the "System Acceptance" report generated by the flow calculation program to verify that the minimum design concentrations have been achieved in all hazard enclosures.

Refer to Appendix A for Engineered System design example.

3.24. Evaluate Selector Valve Pipe Design

On a selector valve system, only one selector valve will activate at a time to direct the agent to flow to the protected hazard it serves. The remaining valves will remain closed. This creates a situation where a considerable quantity of agent can become entrapped in the discharge piping leading up to the closed selector valves.

To account for this loss of agent flow, the layout of the piping network supplying the selector valves must be evaluated to verify that the piping network will not allow more than 10% of the supplied agent quantity to become trapped in the piping, regardless of which selector valve activates.

Use the following steps to perform the evaluation.

Step 1. Perform flow calculations for each hazard to determine the required pipe sizes and schedule for the pipe network.

Step 2. Using the determined pipe size and schedule from the flow calculations, refer to the table on the following page to determine the multiplier that must be used to calculate the maximum allowable length of pipe in feet for each pipe size and schedule.

Step 3. Multiply the total agent quantity required by the hazard by the chosen multiplier to determine the maximum length of pipe allowed so as not exceed the 10% limitation.

Step 4. Evaluate the piping network to determine which selector valve (if activated) would cause the greatest amount of agent to become entrapped in the pipe network. This is done by totaling the length of each pipe section where the agent will be entrapped with no flow. If in doubt as to which selector valve presents the worst case scenario, evaluate each selector valve individually.

Step 5. Compare the allowable pipe length determined in Step 3 against the designed pipe network that serves the selector valves. As long as the quantity of pipe that allows the entrapment of agent does not exceed the value calculated in Step 3, the piping network is acceptable. If exceeded, the piping network must be modified.

Refer to Appendix C for example.

Selector Valve Multipliers		
Pipe Size In.	**Pipe Schedule**	**Multiplier**
1/2	40	0.474621
	80	0.615945
3/4	40	0.270441
	80	0.333518
1	40	0.166869
	80	0.200495
1 1/4	40	0.096420
	80	0.112426
1 1/2	40	0.070840
	80	0.081610
2	40	0.042978
	80	0.048840
2 1/2	40	0.030122
	80	0.034027
3	40	0.019508
	80	0.021834

3.25. Equivalent Length Values

The following table lists the equivalent length values used by Fike's Flow Calculation Program for various pipe fittings. Values are based on Schedule 40 pipe.

Pipe Size In. NPT (mm)	**Union** ft. (m)	**45° Elbow** ft. (m)	**90° Elbow** ft. (m)	**Thru Tee** ft. (m)	**Side Tee** ft. (m)	**Check Valve** ft. (m)
1/2 (15)	0.4 (0.12)	0.8 (0.24)	1.7 (0.52)	1.0 (0.30)	3.4 (1.04)	- - -
3/4 (20)	0.5 (0.15)	1.0 (0.30)	2.2 (0.67)	1.4 (0.43)	4.5 (1.37)	- - -
1 (25)	0.6 (0.18)	1.3 (0.40)	2.8 (0.85)	1.8 (0.55)	5.7 (1.74)	2.0 (0.61)
1-1/4 (32)	0.8 (0.24)	1.7 (0.52)	3.7 (1.13)	2.3 (0.70)	7.5 (2.29)	- - -
1-1/2 (40)	0.9 (0.27)	2.0 (0.61)	4.3 (1.31)	2.7 (0.82)	8.7 (2.65)	- - -
2 (50)	1.2 (0.37)	2.6 (0.79)	5.5 (1.68)	3.5 (1.07)	11.2 (3.41)	4.0 (1.22)
2-1/2 (65)	1.4 (0.43)	3.1 (0.94)	6.6 (2.01)	4.1 (1.25)	13.4 (4.08)	- - -
3 (80)	1.8 (0.55)	3.8 (1.16)	8.2 (2.50)	5.1 (1.55)	16.6 (5.06)	4.0 (1.22)
4 (100)	2.4 (0.73)	5.0 (1.52)	10.7 (3.26)	6.7 (2.04)	21.8 (6.64)	- - -
6 (150)	3.5 (1.07)	7.6 (2.32)	16.2 (4.94)	10.1 (3.08)	32.8 (10.00)	- - -

The following table lists equivalent length values for the container Impulse valves.

Impulse Valve Size	**1 in. (25 mm)**	**3 in. (80 mm)**
Equivalent Length	6.03 ft. (1.84 m)	30.90 ft. (9.42 m)

4. INSTALLATION

The system installation shall be performed by an Authorized Fike Distributor in accordance with the requirements of this manual and all appropriate codes and standards adopted by the AHJ.

Specific installation drawings must be prepared for the hazard area in accordance with the system design as calculated by Fike's Flow Calculation Program. System installation shall closely follow the drawings to ensure the system meets its design criteria. The piping network is designed to obtain correct discharge time, nozzle pressures, agent quantity and various other design considerations. If for any reason, the pipe network requires modifications, the system must be recalculated before proceeding with installation.

4.1. Agent Storage Container Floor Loading

Floor loading must be considered when installing the agent storage containers. The floor must be able to support the total weight of the Fike container(s) as they are moved into position and set in their final mounting place. Where the container is to be mounted onto a raised floor, it is extremely important that the raised floor manufacturer be consulted for floor loading limitations. Fike cannot assume responsibility for determining the suitability of a particular raised floor system to support the suppression container(s); however, the following guidelines provide information to help determine installation requirements:

- When clean agent containers are located on a raised floor, floor integrity must be considered to determine if the type of tile and vertical floor support can handle the increased load. If necessary, additional floor supports can be added.
- To help distribute the container weight over a greater area, a 1/4 inch thick steel plate sized to span multiple floor supports can be placed under the container(s). If the container spans multiple floor tiles, add additional floor supports in the area where the container(s) are installed. Minimum of four floor supports, one at each corner of floor tile, must be used. Excessive floor loading may require relocating the container(s) to a more suitable location. See the floor loading information table below for container floor loading information.

Floor Loading/Area By Container Size										
Container Size	Total Container Weight (Note 1)		Container Floor Area		Container Floor Loading		Container Floor Area w/ Plate (Note 2)		Container Floor Loading w/ Plate (Note 3)	
lb. (L)	lbs.	kg	ft^2	m^2	lbs/ft^2	kg/m^2	ft^2	m^2	lbs/ft^2	kg/m^3
1000 (423)	1570	712	3.14	0.29	500	2440	4.0	0.36	398	2007
650 (267)	1024	464	3.14	0.29	326	1591	4.0	0.36	262	1319
375 (153)	594	269	2.18	0.20	272	1329	4.0	0.36	154	777
215 (88)	366	166	2.18	0.20	168	819	4.0	0.36	97	490
150 (61)	273	124	2.18	0.20	125	611	4.0	0.36	74	372
100 (44)	185	84	0.63	0.06	294	1433	4.0	0.36	52	261
60 (27)	121	55	0.63	0.06	192	937	4.0	0.36	36	181
35 (15)	66	30	0.27	0.02	247	1206	4.0	0.36	22	112
20 (8.5)	40	18	0.27	0.02	150	731	4.0	0.36	16	79
10 (4)	25	11	0.09	0.009	266	1299	4.0	0.36	12	60
5 (2)	16	7	0.09	0.009	170	832	4.0	0.36	10	49

NOTES:

1) Total container weight is based on container tare weight + maximum fill weight.
2) Plate size = 1/4 in. x 2 ft. x 2 ft. plate (6.4 mm x 0.6 mm x 0.6 mm).
3) Total container weight + 22.5 lbs. (10.2 kg) for plate used to calculate container w/ plate floor loading.

4.2. Installing Agent Storage Containers

Fike containers are supplied with a mounting bracket that must be securely mounted to a solid, load-bearing surface that will support the container load. Anchoring into plaster, sheetrock wall or any other facing material is NOT acceptable. As an option, some brackets may be welded into place. Some installations may require additional mounting support not supplied by Fike.

Before mounting the container, check the container label to verify the container part number against the system installation drawings to make sure that the correct container is being installed.

4.2.1. Mounting Detail for 5, 10, 20 and 35 lb. (2, 4, 8.5 and 15 L) Containers

Step 1. Secure the container mounting bracket to the wall or floor using suitable hardware (not supplied).

> **WARNING:** Containers shall NOT be mounted horizontally. Mounting in the horizontal position will result in an incomplete discharge.

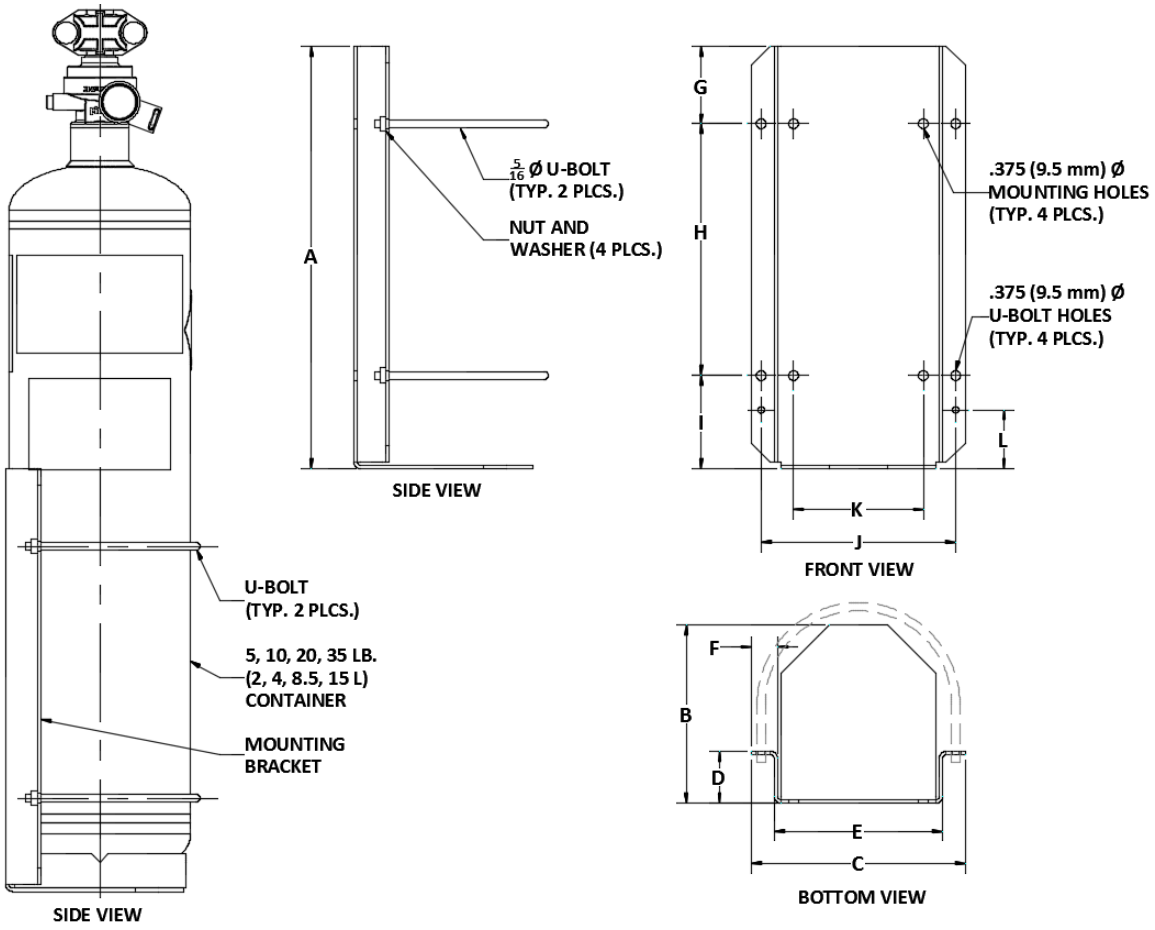
Step 2. Install the container into the mounting bracket making sure that the container foot-ring is resting on the bracket seat.

Step 3. Position the container within the mounting bracket so the pressure gauge and actuator port are easily visible and accessible.

Step 4. Insert the top and bottom container U-bolts through the holes provided in the mounting bracket and secure with the washers and nuts provided.

DIMENSION	CONTAINER SIZE			
	5 lb. (2 L) in. (mm)	**10 lb. (4 L)** in. (mm)	**20 lb. (8.5 L)** in. (mm)	**35 lb. (15 L)** in. (mm)
A	12.3 (312)	12.3 (312)	16.3 (414)	16.3 (414)
B	4.0 (102)	4.0 (102)	6.9 (175)	6.9 (175)
C	5.7 (145)	5.7 (145)	7.5 (191)	7.5 (191)
D	1.4 (35)	1.4 (35)	2.0 (51)	2.0 (51)
E	4.0 (102)	4.0 (102)	6.5 (165)	6.5 (165)
F	1.0 (25)	1.0 (25)	1.0 (25)	1.0 (25)
G	2.5 (64)	2.5 (64)	3.0 (75)	3.0 (75)
H	8.0 (203)	8.0 (203)	9.7 (246)	9.7 (246)
I	1.8 (45)	1.8 (45)	3.6 (91)	3.6 (91)
J	5.0 (127)	5.0 (127)	7.5 (191)	7.5 (191)
K	3.0 (76)	3.0 (76)	5.0 (127)	5.0 (127)
L	N/A	N/A	2.3 (58)	2.3 (58)

All dimensions are approximate.



4.2.2. Mounting Detail for 60 lb. (27 L) Container

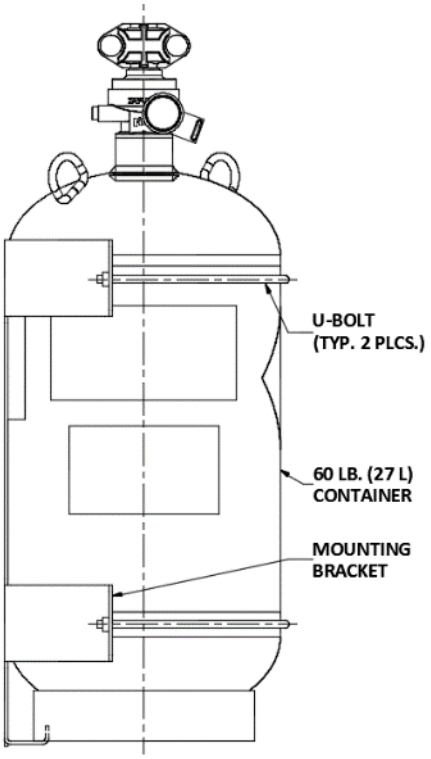
Step 1. Secure the container mounting bracket (supplied with container) to the wall or floor using suitable hardware (not supplied).

> **WARNING:** Containers shall NOT be mounted horizontally. Mounting in the horizontal position will result in an incomplete discharge.

Step 2. Install the container into the mounting bracket making sure that the container foot-ring is resting on the bracket seat.

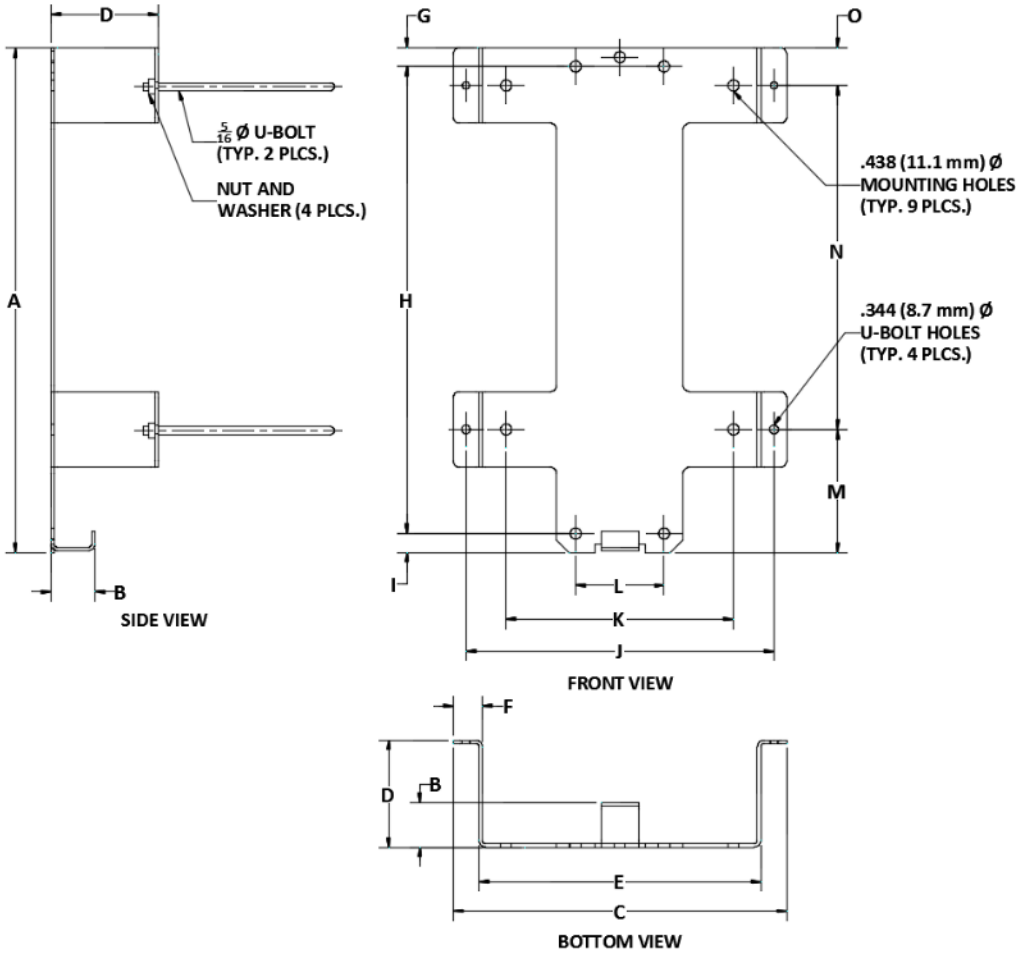
Step 3. Position the container within the mounting bracket so the pressure gauge and actuator port are easily visible and accessible.

Step 4. Insert the top and bottom container U-bolts through the holes provided in the mounting bracket and secure with the washers and nuts provided.



DIMENSION	in. (mm)
A	20.00 (508.0)
B	1.75 (44.6)
C	13.19 (335.0)
D	4.25 (107.9)
E	11.16 (283.4)
F	1.15 (29.3)
G	0.75 (19.1)
H	18.50 (469.9)
I	0.75 (19.1)
J	12.19 (309.8)
K	9.00 (228.6)
L	3.50 (88.9)
M	4.88 (123.8)
N	13.63 (346.1)
O	1.50 (38.1)

All dimensions are approximate.



4.2.3. Mounting Detail for 150 lb. (61 L) Container

Step 1. Secure the container mounting bracket (supplied with container) to the container with the washer and nuts provided.

> **WARNING:** Containers shall NOT be mounted horizontally. Mounting in the horizontal position will result in an incomplete discharge.

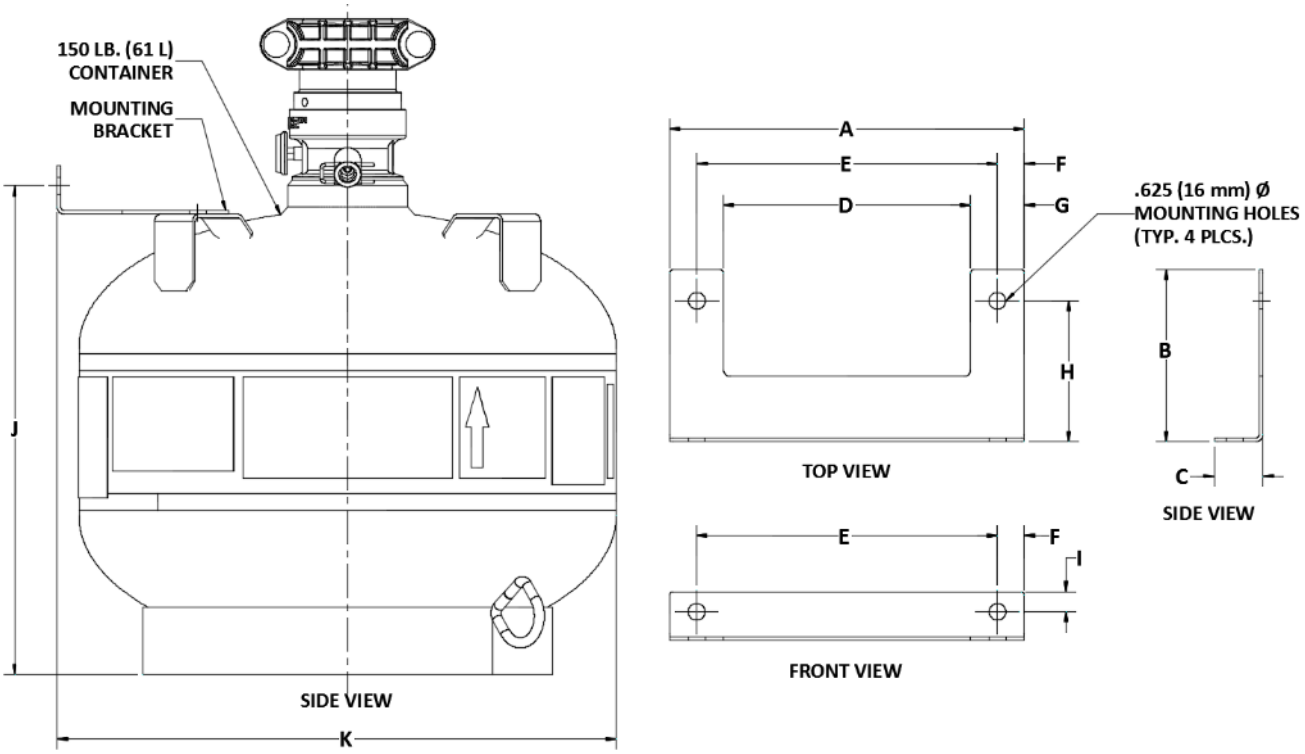
Step 2. Move the container to its correct mounting location.

Step 3. Position the container so the pressure gauge and actuator port are easily visible and accessible.

Step 4. Secure the mounting bracket to the wall using suitable hardware (not supplied).

DIMENSION	in. (mm)
A	13.19 (335.3)
B	6.41 (162.4)
C	1.81 (46.1)
D	9.19 (233.7)
E	11.19 (284.2)
F	1.00 (25.6)
G	2.00 (50.8)
H	5.22 (132.8)
I	0.75 (19.1)
J	18.18 (461.8)
K	20.81 (528.6)

All dimensions are approximate.



4.2.4. Mounting Detail for 100, 215, 375, 650 and 1000 lb. (44, 88, 153, 267 and 423 L) Containers

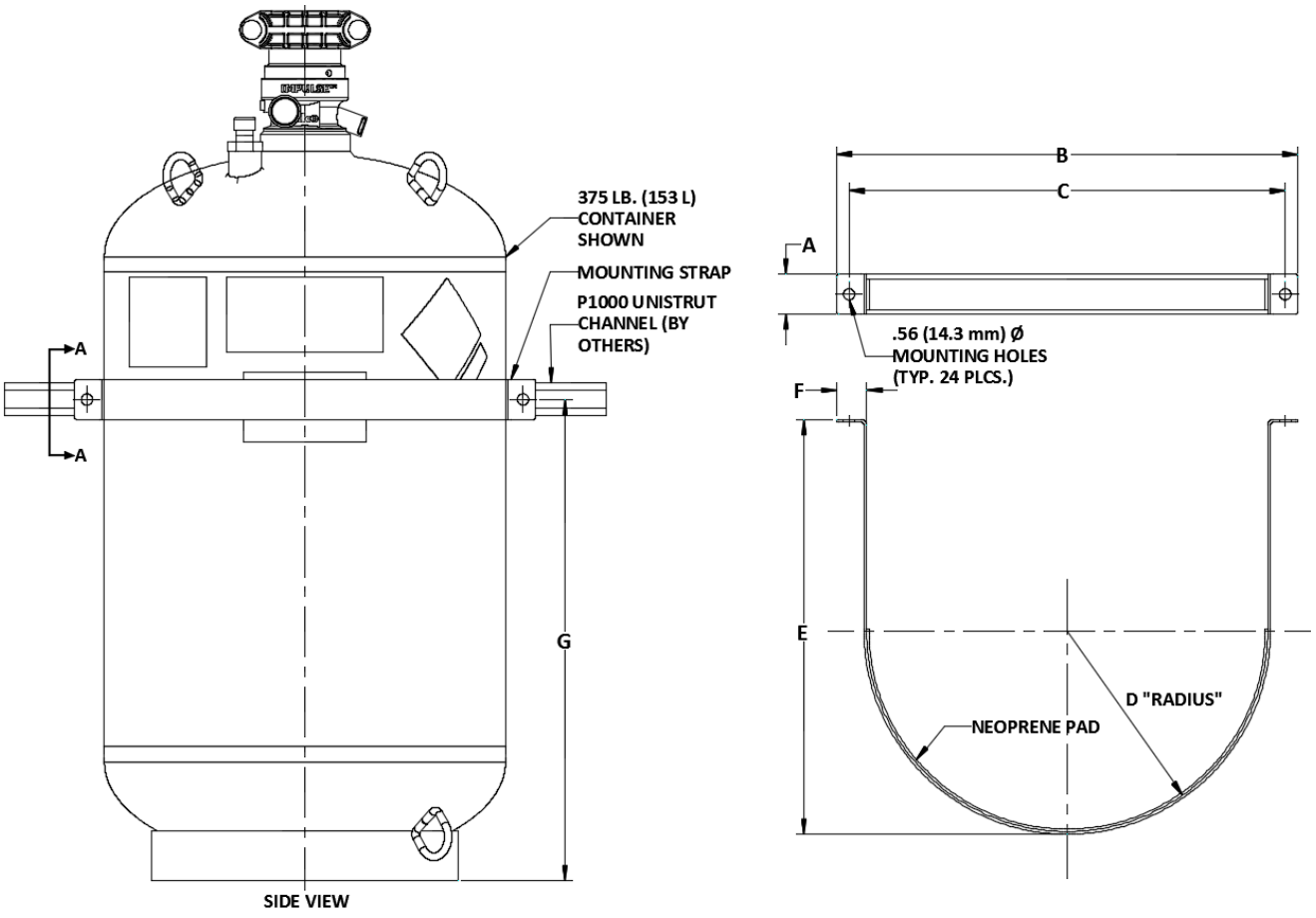
Step 1. Cut the P1000 Unistrut channel to the appropriate length and secure to the wall using suitable hardware (not supplied). See the following table for required channel mounting height.

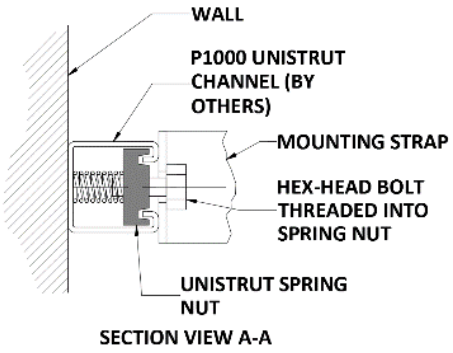
Step 2. Insert the Unistrut spring nut into the channel roughly where the container mounting bracket mounting holes will be located; then turn the nut 90° clockwise to align the grooves in the spring nut with the edges of the channel to hold the spring nut in place.

Step 3. Install the container into position against the Unistrut in the upright (valve up) position making sure that the pressure gauge and actuator port are easily visible and accessible.

> **WARNING:** Containers shall NOT be mounted horizontally. Mounting in the horizontal position will result in an incomplete discharge.

Step 4. Install the mounting bracket around the container and secure it to the Unistrut channel using the Unistrut hex-head bolt.





"A-A" Unistrut Mounting Detail

DIMENSION	CONTAINER SIZE				
	100 lb. (44 L) in. (mm)	**215 lb. (88 L)** in. (mm)	**375 lb. (153 L)** in. (mm)	**650 lb. (267 L)** in. (mm)	**1000 lb. (423 L)** in. (mm)
A	1.50 (38.1)	2.00 (51.0)	2.00 (51.0)	2.00 (51.0)	2.00 (51.0)
B	13.26 (336.8)	23.00 (584.2)	23.00 (584.2)	27.38 (696.5)	27.38 (696.5)
C	12.25 (311.2)	21.74 (522.2)	21.74 (522.2)	26.12 (663.5)	26.12 (663.5)
D	5.50 (139.7)	10.00 (254.0)	10.00 (254.0)	12.19 (309.6)	12.19 (309.6)
E	11.00 (279.8)	20.42 (518.7)	20.42 (518.7)	24.00 (610.0)	24.00 (610.0)
F	1.13 (28.7)	1.50 (38.1)	1.50 (38.1)	1.50 (38.1)	1.50 (38.1)
G	20.00 (508.0)	11.00 (279.0)	24.00 (609.6)	28.00 (711.0)	40.00 (1016.0)

All dimensions are approximate.

4.3. Installing Distribution Piping

In general, distribution piping should be installed in strict accordance to the requirements of NFPA 2001, requirements of the local AHJ and in accordance with the design drawings and calculations prepared for the project. If piping changes are necessary, the system must be recalculated using Fike's Flow Calculation Program.

NOTE: For additional information on pressure rating of pipe and fittings, plus recommended pipe supports and hangers, refer to FSSA's Pipe Design Handbook, FSSA PDH-01.

4.3.1. Pipe and Fittings Materials

Piping materials must conform to the requirements as outlined in NFPA 2001, latest edition. The thickness of the piping wall shall be calculated in accordance with ASME B31.1 Power Piping Code. For Fike Clean Agent Systems, with an agent container charging pressure of 500 psig (34.5 bar) at 70°F (21°C), use a minimum piping design pressure of 460 psig (31.7 bar). Black or galvanized steel pipe shall conform to ASTM A-53, Type E, F, or S, Grade A or B, or ASTM A-106, Type S, Grade A, B, or C. 1/2" to 6" Schedule 40 and Schedule 80 Threaded, Welded, and Cut Grooved or Rolled Grooved configurations are acceptable.

CAUTION: Cast iron pipe, steel pipe conforming to ASTM A120, or nonmetallic pipe shall not be used.

Fitting materials must conform to the requirements outlined in NFPA 2001. Fitting sizes up to and including six inch NPT shall be Class 300 malleable or ductile iron. Fittings over six inch NPT shall be Class 300 flanged fitting.

All grooved fittings must be UL Listed and conform to the pressure requirements outlined in NFPA 2001, latest edition. Cast iron or Class 150 fittings shall not be used.

4.3.2. Pipe Size Changes

Pipe size changes, to increase or decrease the size, can be done at three different locations in the piping network:

- Pipe Size Change at a Tee - When the change in pipe size is done at a tee, it is accomplished by using either a reducing tee or a standard tee and reducing fittings. All reducers must be concentric bell reducers or concentric reducing couplings.
- Pipe Size Change at an Elbow - When the change in pipe size is done at an elbow, it is accomplished by using reducing elbows, a standard elbow with concentric bell reducers, or concentric reducing couplings.
- Pipe Size Change at a Coupling - When the change in pipe size is done at a coupling, only concentric bell reducers or concentric reducing couplings can be used.

CAUTION: Reducing bushings, weld-o-let, and hole-cut fittings shall not be used.

4.3.3. General Piping Requirements

- All pipe lengths are measured center-to-center of fittings.
- Before installation, the pipe and fittings shall be carefully reamed, blown clear of chips and scale, and cleaned internally with a nonflammable cleaner such as Perchlorethylene in accordance with NFPA 2001, latest edition. The inside of the pipe and fittings must be free of oil and dirt.
- PTFE tape, thread sealant or compound shall be used on male threads only. If using tape, do NOT allow it to overlap the pipe opening as this could cause possible blockage of the agent
- All grooved coupling gaskets shall be lubricated per the manufacturer's specifications.
- A dirt trap consisting of a tee with a capped nipple, at least 2 inches (50 mm) long, shall be installed at the end of each pipe run.

4.3.4. Manifolds

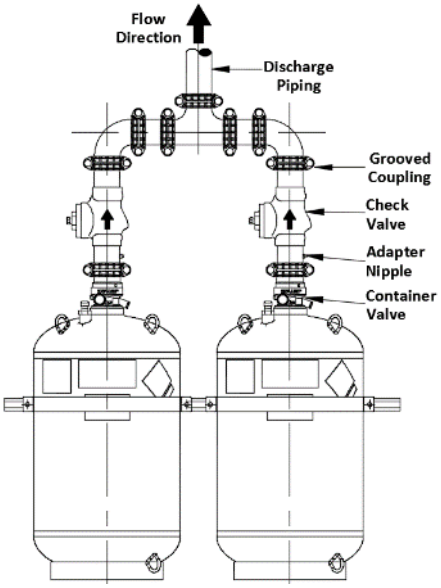
Manifolds are supplied by others and are commonly assembled using grooved fittings; however, threaded, welded or flanged fittings can also be used. They allow multiple containers to be connected to a common pipe network. They may also be used in a system where Main/Reserve container arrangements are required.

The number of containers that can be connected to a single manifold is determined (calculated) by Fike's Flow Calculation Program. Every container connected to the same manifold must be the same type, size, and identical fill weight. Check valves are required for each container being connected to the manifold.

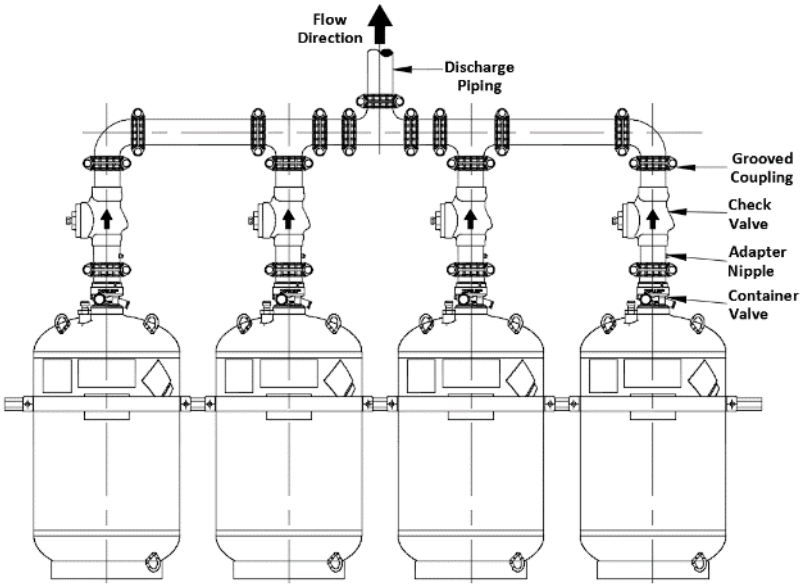
Manifolds should not be supported by the containers. The manifold should be secured with pipe hangers or brackets to support the "dead load" of the manifold should the container(s) be removed for service.

NOTE: The General Piping Requirements outlined in Section 4.3.3 must be adhered to when constructing manifolds.

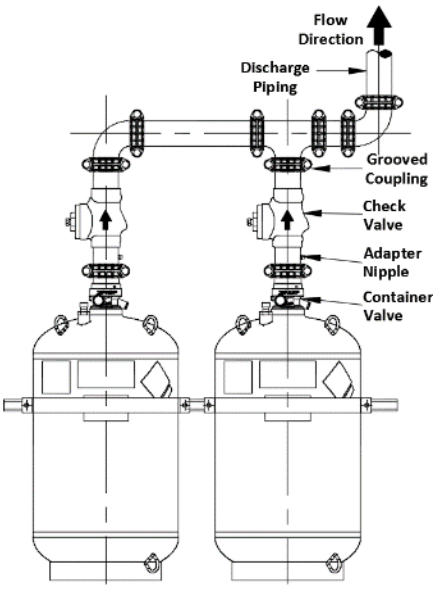
TYPICAL MANIFOLD CONFIGURATION OPTIONS



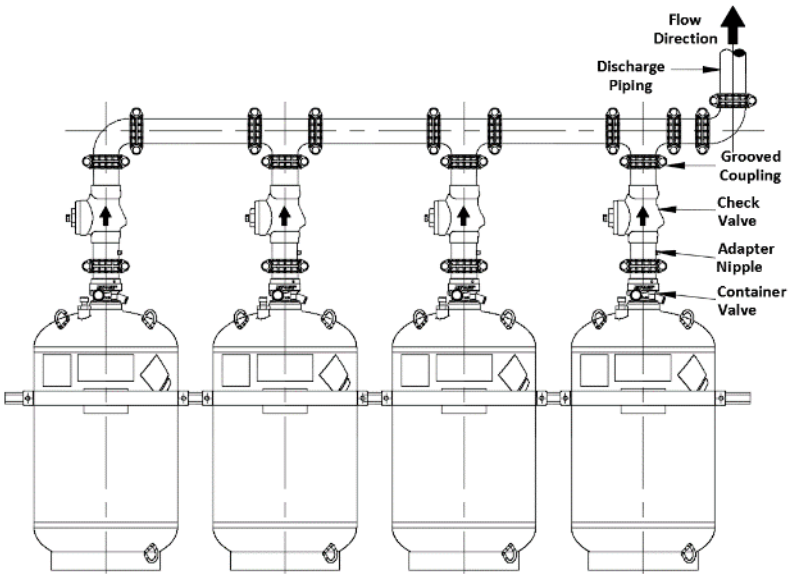
Center Exit Manifold or Main/Reserve System



Center Exit Manifold or Main/Reserve System with Multiple Containers



End Exit Manifold or Main/Reserve System



End Exit Manifold or Main/Reserve System with Multiple Containers

4.3.5. Pipe Hangers and Supports

The following general guidelines provide information for the selection and application of pipe hangers and supports utilized to support the pipe network in all conditions of operation, including shock loads or thrusts created during system operation. These guidelines are not intended to provide all information necessary to determine equipment and material requirements for specific installation or applications.

NOTE: Refer to FSSA Pipe Design Guide (PDH-01) for addition guidance on pipe hangers and supports.

General Guidelines:

- Pipe hangers and supports shall be installed in accordance with recognized industry practices and manufacturer's instructions.
- All pipe hangers and supports shall be attached directly to a rigid fixed structure.
- All hangers and components shall be steel.
- Ordinary cast-iron hangers/supports, conduit clamps, or "C" clamps shall not be used.
- Rigid hangers shall be installed wherever a change in elevation or direction occurs.
- Nozzles shall be supported so as to prevent movement of the nozzle of the nozzle during discharge.
- Where seismic bracing is required, bracing shall be in accordance with local codes and the AHJ.
- All pipe supports shall be designed and installed to prevent lateral movement of supported pipe during system discharge while permitting longitudinal movement to accommodate expansion and contraction caused by temperature changes.
- Pipe hangers must be spaced according to the size of pipe as indicated in the following table.

Pipe Size in. (mm)	**Maximum Distance Between Supports** ft. (m)	**Rod Diameter** in. (mm)
1/2 (15)	7 (2.1)	3/8 (9.5)
3/4 (20)	7 (2.1)	3/8 (9.5)
1 (25)	7 (2.1)	3/8 (9.5)
1 1/4 (32)	7 (2.1)	3/8 (9.5)
1 1/2 (40)	9 (2.7)	3/8 (9.5)
2 (50)	10 (3.0)	3/8 (9.5)
2 1/2 (65)	11 (3.4)	1/2 (12.7)
3 (80)	12 (3.7)	1/2 (12.7)
4 (100)	14 (4.3)	5/8 (15.9)
6 (150)	17 (5.2)	3/4 (19.0)

- Hangers must be placed within 12 in. (300 mm) of each discharge nozzle and between elbows that are more than 24 in. (600 mm) apart.

4.3.6. Selector Valves

Selector Valves are activated pneumatically using the pressure provided by a nitrogen actuator assembly. Two methods for activating the selector valve and the components required are shown below.

4.3.6.1. Selector Valve Activated by Primary Nitrogen Actuator Assembly

Step 1. Install item 1 in the piping network. Fike recommends that threaded unions or grooved couplings be installed on each side of the valve to facilitate easy removal of the valve. Supports shall be installed on each side of the selector valve to support its dead load. The pipe network shall NOT be used to support the selector valve.

Step 2. Install item 2 in close proximity to the selector valve to allow connection of item 3J. See Section 4.7.5 for installation instructions.

Step 3. Apply PTFE tape to the NPT male threads of items 3C, 3D, 3E and 3H. Do NOT allow tape to overlap the end of the fitting as this could cause possible blockage of the pressure port.

Step 4. Assemble items 3C, 3D and 3H together. Secure wrench tight.

Step 5. Remove plug from item 3A. Retain for future use.

Step 6. Screw the items assembled in Step 4 into the threaded port on item 3A. Secure wrench tight. Orient the assembly so the side outlet of item 3D is positioned horizontally.

Step 7. Screw item 3E into the side outlet of item 3D. Secure wrench tight.

Step 8. Install item 3F onto item 3E.

Step 9. Screw item 3G onto item 3E. Secure wrench tight.

Step 10. Connect one end of item 3J to item 3H. Secure wrench tight.

Step 11. Connect the other end of item 3J to the JIC fitting on the selector valve. Secure wrench tight.

Step 12. Check to ensure that item 3A is armed (firing pin retracted).

CAUTION: Do NOT install the actuator to the nitrogen actuator with the firing pin extended as this may cause accidental discharge.

Step 13. Connect item 3A wire leads to the host control panel or module. See 4.7.6.1.

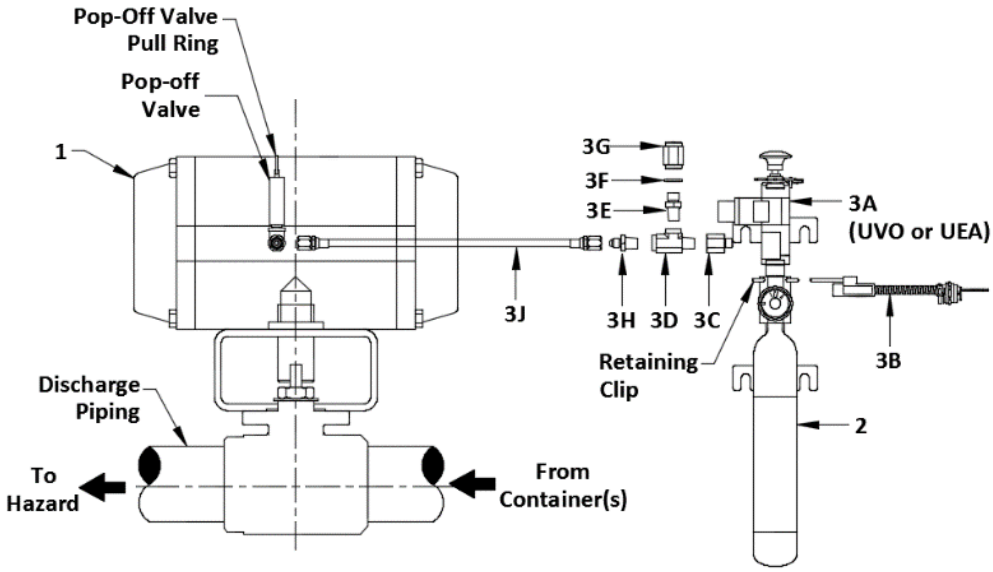
Step 14. Connect item 3B wire leads to the host control panel or module. See 4.7.9.1.

Step 15. Remove the retaining clip and valve plug from item 2. Keep these items for future use should the container have to be removed for service.

Step 16. Connect item 3A to item 2 and secure in place with item 3B. See 4.7.9.

CAUTION: Installation of the system actuation components should be the last item completed before the system is placed into service.

The selector valve is now armed.



Selector Valve Activation by Primary Nitrogen Actuator Assembly

Item No.	Part Number	Description	Notes
1	02-15708-XX	Carbon Steel Selector Valve[1]	Part of 70-396 Selector Valve Assembly
	02-15709-XX	Stainless Steel Selector Valve[1]	
2	70-325-X	Nitrogen Actuator Assembly	
3A	02-13571	Universal Valve Operator (UVO)	
	IG71-247	Universal Energetic Actuator (UEA)	
3B	02-14627	Universal Valve Operator Supervisor (UVOS)	
3C	02-13640	1/8 in. NPT x 1/4 in. NPT Adapter	
3D	C02-1335	1/4 in. NPT Street Tee	
3E	02-11766	1/4 in. NPT x G1/4 Adapter	
3F	02-10926	1/4 in. Sealing Washer	
3G	IG71-026	Vent Valve Assembly	
3H	02-4530	1/4 in. NPT x 1/4 in. JIC Adapter	
3J	02-4977	1/4 in. JIC x 1/4 in. JIC Hose, 35 in. (889 mm) Long	

[1]Valve material supplied is based on selector valve assembly part number.

4.3.6.2. Selector Valve Activated by Secondary Nitrogen Actuator Assembly

Step 1. Install item 1 in the piping network. Fike recommends that threaded unions or grooved couplings be installed on each side of the valve to facilitate easy removal of the valve. Supports shall be installed on each side of the selector valve to support its dead load. The pipe network shall NOT be used to support the selector valve.

Step 2. Install item 2 (secondary nitrogen actuator) in close proximity to the selector valve to allow connection of item 3C. See Section 4.7.5 for installation instructions.

Step 3. Apply PTFE tape to the NPT male threads of items 3B, 3E, 4C, 4D, 4E and 4G. Do NOT allow tape to overlap the end of the fitting as this could cause possible blockage of the pressure port.

Step 4. Assemble items 3D, 3E, 3F, 3G and 3H together. Wrench tight.

Step 5. Connect items assembled in Step 4 to the JIC connector on the selector valve. Secure wrench tight.

Step 6. Remove the plug from item 3A. Retain for future use.

Step 7. Screw item 3B into the threaded port. Secure wrench tight.

Step 8. Install item 2 (primary nitrogen actuator) at the location indicated on the installation drawings. See Section 4.7.5 for installation instructions.

Step 9. Assemble item 4C, item 4D and item 4E together. Secure wrench tight.

Step 10. Remove the plug from item 4A.

Step 11. Screw the items assembled in Step 9 into the threaded port on item 4A. Secure wrench tight. Orient the assembly so the side outlet of item 4D is positioned horizontally.

Step 12. Screw item 4G into the side outlet of item 4D. Secure wrench tight.

Step 13. Install item 4H onto item 4G.

Step 14. Screw item 4J onto item 4G. Secure wrench tight.

Step 15. Install the pilot line components items 5, 6 and 7. Apply PTFE tape to all NPT male threads. Do NOT allow tape to overlap the end of the fitting as this could cause possible blockage of the pressure port. The pilot line between the primary and secondary nitrogen actuator shall not exceed a maximum length of 150 ft. (45 m) including hoses. Secure all connections wrench tight.

Step 16. Connect one end of item 4F to item 4E. Secure wrench tight.

Step 17. Connect the other end of item 4F to the pilot line item 5. Secure wrench tight.

Step 18. Connect the G1/4 end of item 8 to item 3A. Secure wrench tight.

Step 19. Connect the other end of item 8 to the pilot line item 5. Secure wrench tight.

Step 20. Check to ensure that items 3A and 4A are armed (firing pin retracted).

CAUTION: Do NOT install the actuator to the nitrogen actuator with the firing pin extended as this may cause accidental discharge.

Step 21. Connect item 4A wire leads to the host control panel or module. See 4.7.6.1.

Step 22. Connect item 4B wire leads to the host control panel or module. See 4.7.9.1.

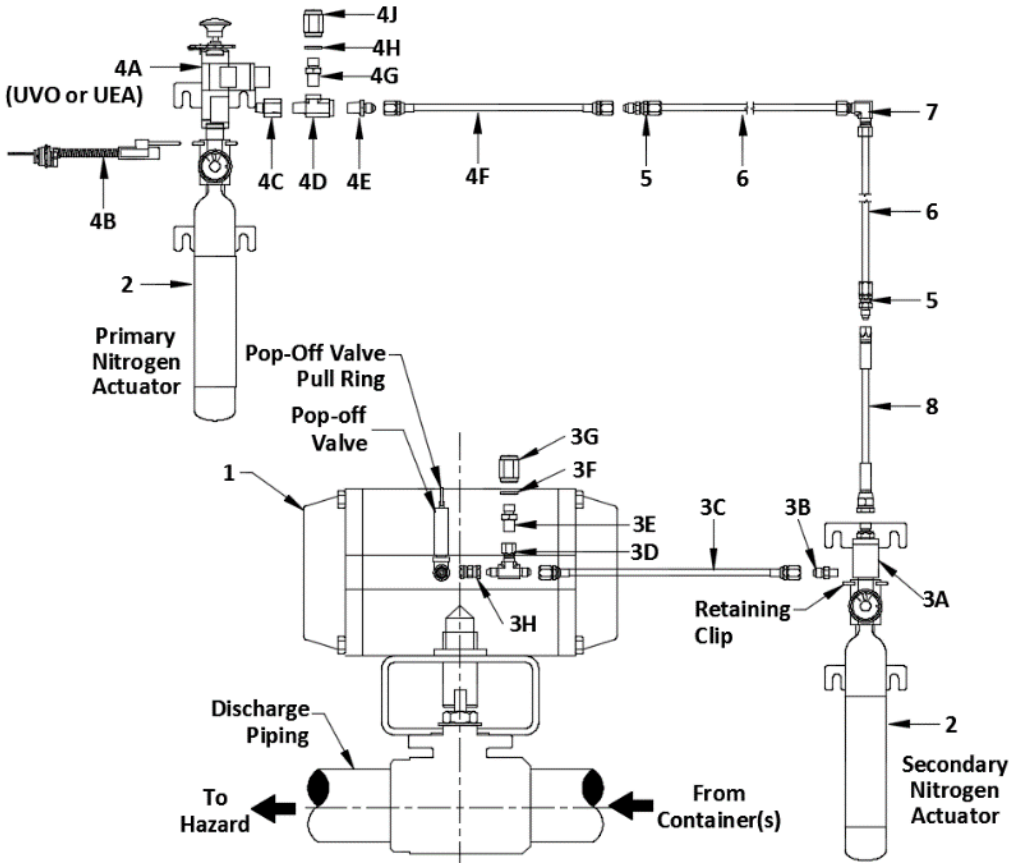
Step 23. Remove the retaining clip and plug from the Primary nitrogen actuator assembly. Keep these items for future use should the container have to be removed for service.

Step 24. Connect item 4A to item 2 (primary nitrogen actuator) and secure in place with item 4B. See 4.7.9.

Step 25. Remove the retaining clip and plug from item 2 (secondary nitrogen actuator).

Step 26. Insert item 3A into the nitrogen actuator valve and secure in place with the retaining clip removed in Step 25.

The selector valve is now armed.



Selector Valve Activation with Primary and Secondary Nitrogen Actuator Assembly

See next page for description of the numerical callouts shown in the diagram above.

NOTE: Primary nitrogen actuator and pilot line components shown above are not included in the selector valve assembly and must be purchased separately.

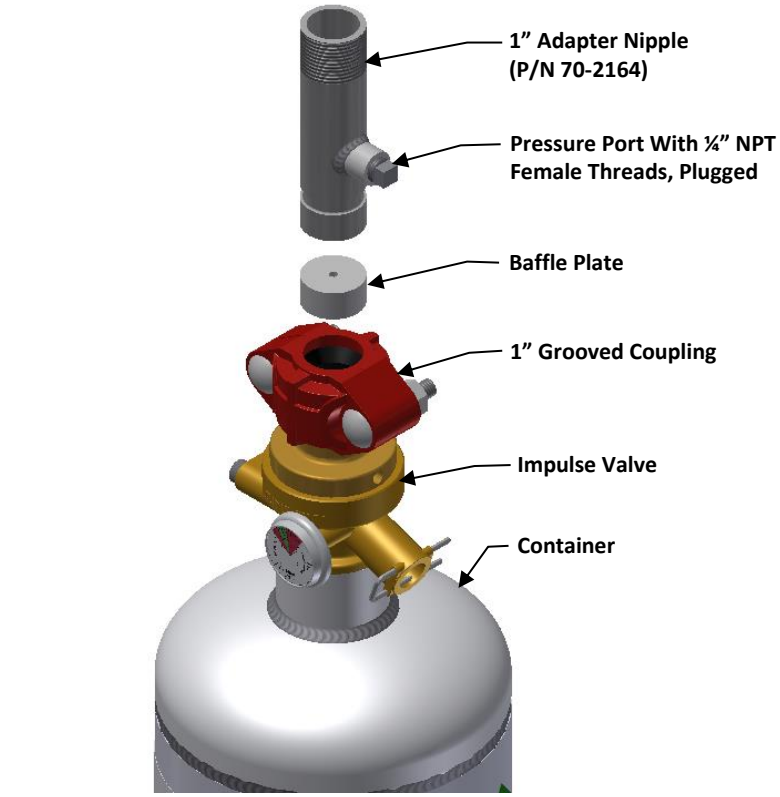
Item No.	Part Number	Description	Notes
1	02-15708-XX	Carbon Steel Selector Valve[1]	Part of 70-396 Selector Valve Assembly
	02-15709-XX	Stainless Steel Selector Valve[1]	
2	70-325-X	Nitrogen Actuator Assembly	
3A	IG71-120	Pneumatic Relay	
3B	02-11243	R 1/8 in. x 1/4 in. JIC Hex Nipple	
3C	02-4977	1/4 in. JIC x 36 in. (0.9 m) Long Actuation Hose	
3D	02-14721	1/4 in. JIC x 1/4 in. FNPT Branch Tee	
3E	02-11766	1/4 in. NPT x G1/4 Adapter	
3F	02-10926	1/4 in. Sealing Washer	
3G	IG71-026	Vent Valve Assembly	
3H	02-11346	1/4 in. JIC Coupling	
4A	02-13571	Universal Valve Operator (UVO)	Part of 70-335 Completer Kit
	IG71-247	Universal Energetic Actuator (UEA)	Part of 70-400 Completer Kit
4B	02-14627	Universal Valve Operator Supervisor (UVOS)	Part of 70-335 and 70-400 Primary Completer Kits
4C	02-13640	1/8 in. NPT x 1/4 in. NPT Adapter	
4D	C02-1335	1/4 in. NPT Street Tee	
4E	02-4530	1/4 in. NPT x 1/4 in. JIC Adapter	
4F	02-4977	1/4 in. JIC x 36 in. (0.9 m) Long Actuation Hose	
4G	02-11766	1/4 in. NPT x G1/4 Adapter	
4H	02-10926	1/4 in. Sealing Washer	
4J	IG71-026	Vent Valve Assembly	
5	02-12695	1/4 in. Tube x 1/4 in. JIC Adapter	
6	N/A	1/4 in. x 0.035 in. Wall, Stainless Steel Tubing, Cut to Length	Supplied by others
7	02-12696	1/4 in. Tube 90° Elbow	
8	02-10801	G1/4 x 1/4 in. JIC x 39 in. (1 m) Long Actuation Hose	

4.3.7. Connect Distribution Piping to Container

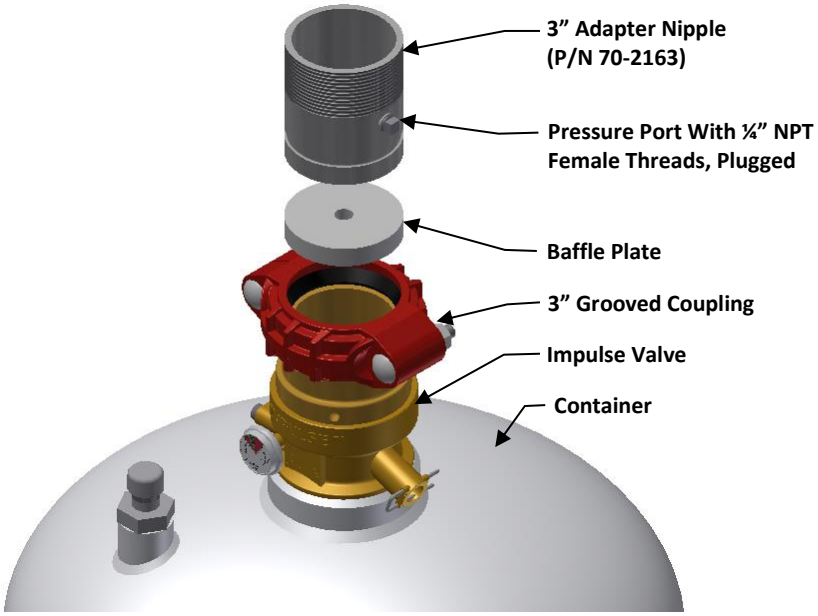
Each container is shipped with a removable baffle plate installed inside the grooved coupling connected to the Impulse valve. The baffle plate is an anti-recoil device that must be installed to the container whenever it is not connected to the discharge piping. However, before connecting the discharge piping to the container, the baffle plate must be removed.

Each impulse valve is equipped with a groove connection on the outlet. Piping systems with a groove connection can be attached directly to the impulse valve.

When using a discharge pressure switch or secondary container activation, there are two adapter nipple options available; groove to groove and groove to thread. The adapter nipple is equipped with a 1/4 inch NPT female hub that provides a connection point for these options. See following figures.



1” (25 mm) Discharge Valve Piping Connection
(5, 10, 20, 35, 60 and 100 lb. [2, 4, 8.5, 15, 27 and 44 L] Containers)



3” (80 mm) Discharge Valve Piping Connection
(150, 215, 375, 650 and 1000 lb. [61, 88, 153, 267 and 423 L] Containers)

4.4. Installing Low Pressure Switch

All Impulse valves have the option to add a low pressure switch to monitor container pressure. The switch can be installed with the container fully filled and pressurized. The switch is installed into the Impulse valve fill port, as shown in the illustration below.

Step 1. Lubricate the LPS O-Ring with Molykote 55 or equivalent. Use care not to get lubricant into the end of the switch. Do NOT apply PTFE tape to LPS threads.

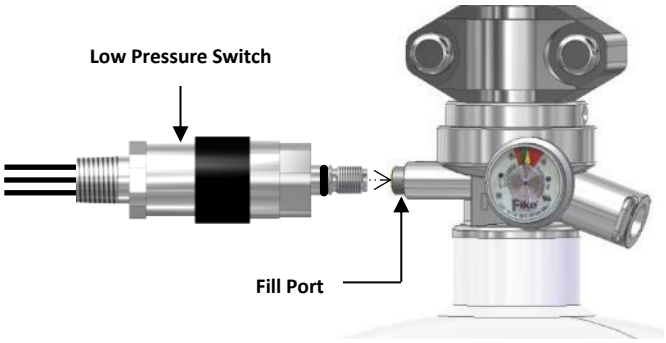
Step 2. Remove plug from valve fill port and retain for future use.

Step 3. Remove the rubber cap from the LPS and screw it into the fill valve port until the switch bottoms out (hand tight). Do NOT cross thread the LPS during installation. Switch installation will open the ports internal check valve allowing internal container pressure to reach the switch.

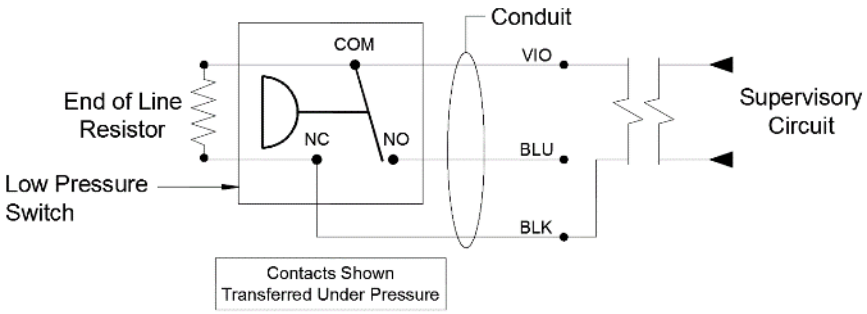
Step 4. Use leak test fluid to leak check around the pressure gauge port. If a leak is detected, remove the LPS from the fill port and remove the lubricant and contaminants from the O-Ring, threads, and valve port using isopropyl alcohol and a soft clean cloth. Lubricate the O-Ring with Molykote 55 or equivalent and reinstall. Leak test around the fill port. If a leak is still detected, remove the LPS from the fill port, remove and replace the O-Ring, lubricate the O-Ring with Molykote 55 or equivalent, install the LPS in the fill port and leak test around the fill port.

Step 5. Connect conduit connector to the low pressure switch. Secure hand tight only. Over tightening may cause damage to the switch or to the fill port threads.

Step 6. Connect the low pressure switch wire leads to a supervisory input on the host control panel. See wiring diagram below. Refer to control panel manual for specific wiring criteria.



Low Pressure Switch Installation



Low Pressure Switch Wiring Diagram

4.5. Installing Discharge Pressure Switch

A discharge pressure switch is required where mechanical system actuation is possible. A single discharge pressure switch is required for each pipe distribution system. The switch is installed in the pressure port machined into the containers adapter nipple, as shown in the illustration below.

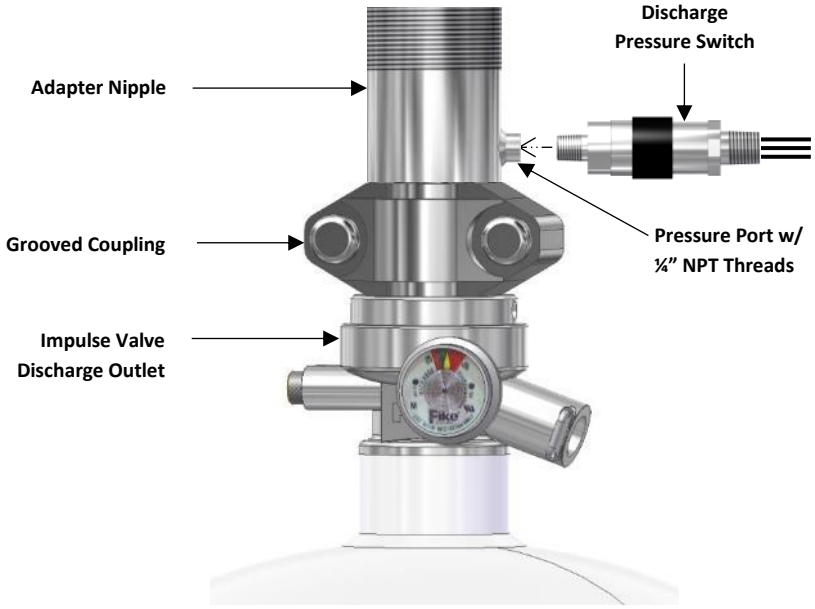
Step 1. Remove the rubber cap from the discharge pressure switch and apply PTFE tape to the male threads of the switch.

Step 2. Remove the ¼" pipe plug from the adapter nipple.

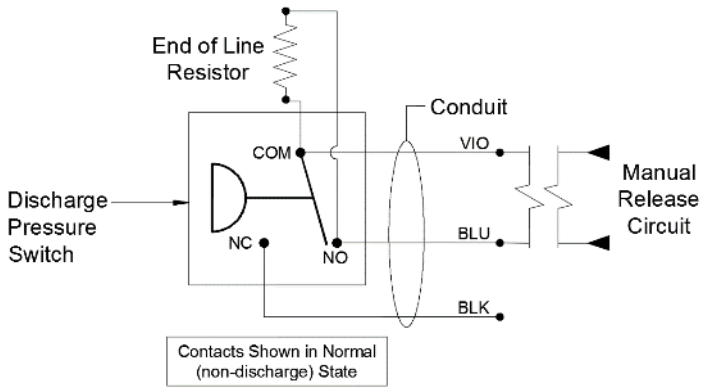
Step 3. Thread the discharge pressure switch into the ¼" NPT port on adaptor nipple (wrench tight). Only use the wrench on the brass hex flats.

Step 4. Connect conduit connector to the discharge pressure switch. Secure hand tight only. Over tightening may cause damage to the switch or to the adapter nipple pressure port.

Step 5. Connect the discharge pressure switch wire leads to a manual release input on the host control panel. See wiring diagram below. Refer to control panel manual for specific wiring criteria.



Discharge Pressure Switch Installation



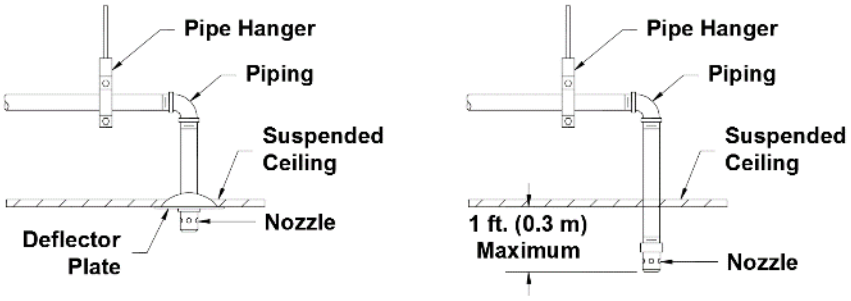
Discharge Pressure Switch Wiring Diagram

4.6. Installing Discharge Nozzles

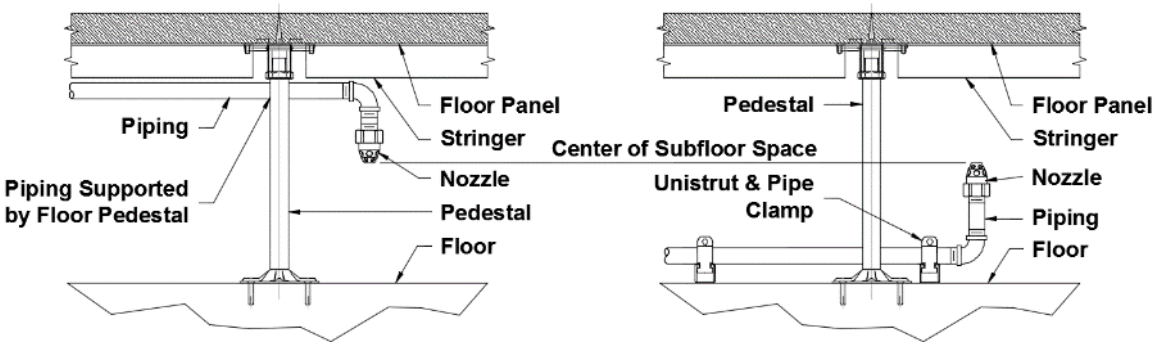
Prior to installing the discharge nozzle(s), the following checks shall be performed:

- Compare the part number that is stamped on the closed end of the nozzle to be installed with the nozzle part number listed on the system installation plans. It is extremely important that the nozzle part numbers match in order to ensure that proper agent design quantities and concentrations are achieved.
- Verify that there are no obstructions located in the nozzles discharge path that could obstruct the distribution of the agent during discharge.
- Verify that the position of each discharge nozzle is located within 1 ft. (0.3 m) of its intended location as indicated on the system installation plans.
- Verify that piping discharge nozzles are properly braced to prevent movement during discharge. 180° nozzles require back bracing.
- Verify that the distribution piping network has been blown clear to remove chips, mill scale, or metal shavings, and has been cleaned to remove dirt and cutting oil before installing nozzles.
- Verify that discharge nozzles are mounted in a vertical position, facing either up or down, as depicted in the following diagrams.

Ceiling Mount



Subfloor Mount



Step 1. Apply PTFE tape or joint compound to the male threads of the distribution piping. Do NOT allow tape to overlap the pipe opening as this could cause possible blockage of the nozzle.

Step 2. Thread the nozzle onto the pipe. Secure wrench tight.

Step 3. If installing 180° discharge nozzles, verify that the nozzle orifice holes are correctly orientated to allow proper agent discharge.

4.7. Installing System Actuation Components

Prior to installing system actuation components, the electrical control system must be thoroughly checked out to verify that there are no issues present on the system that could accidentally cause inadvertent activation of the suppression system. Installation of the system actuation components should be the last item completed before the system is placed into service.

4.7.1. Installing Impulse Valve Operator (IVO)

Step 1. Check to ensure that the Impulse Valve Operator (IVO) is armed (firing pin retracted) and the safety pin is in place.

CAUTION: Do NOT install the IVO to the container with the firing pin extended as this may cause accidental discharge.

Step 2. Install conduit (rigid or flexible) from the Impulse Release Module (IRM) electrical box to the IVO. The IVO is equipped with ½" NPT female threads for conduit connection.

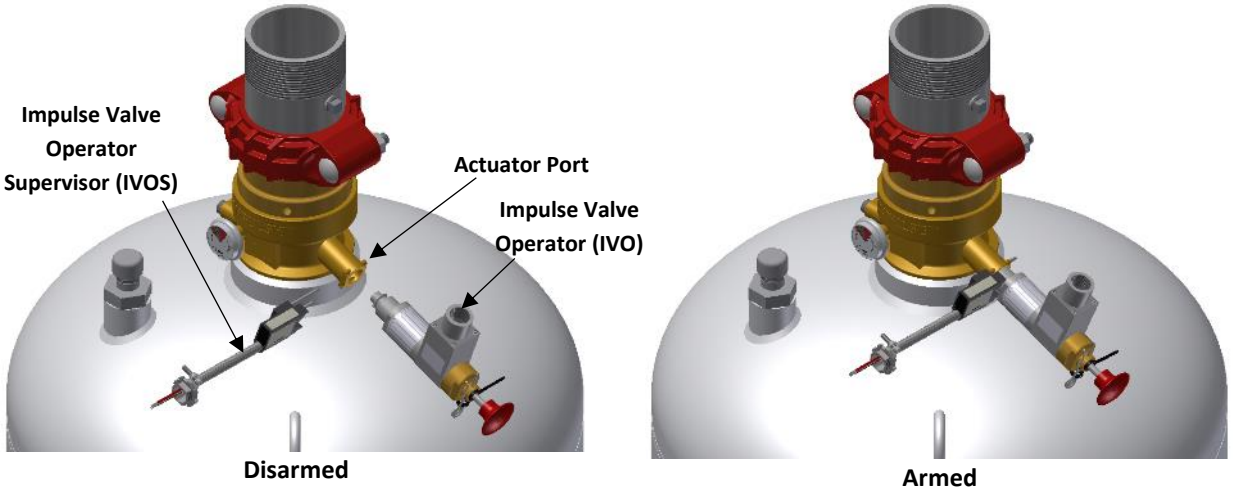
Step 3. Pull the IVO wire leads through the conduit.

Step 4. Connect the IVO wire leads to the IRM. See 4.7.1.1.

Step 5. Remove the plug from the container's actuator port. Keep for future use should the container have to be removed for service.

Step 6. Insert the IVO into the actuator port and secure in place with the IVOS retaining clip. See 4.7.4.

The container is now armed.

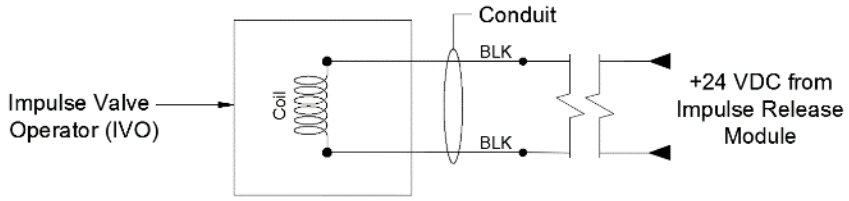


NOTE: An IVOS must be installed to supervise the connection of an IVO to a container.

See Section 3.10 for specific details on the various system activation methods using the IVO.

4.7.1.1. Impulse Valve Operator (IVO) Wiring

The IVO is wired to an Impulse Release Module (IRM), which is connected to a compatible Fike releasing panel (SHP-Pro or Cheetah Xi). Refer to Fike document 06-552 for IRM wiring details



Impulse Valve Operator Wiring Diagram

4.7.2. Installing Impulse Energetic Actuator (IEA)

Step 1. Check to ensure that the IEA firing pin is retracted (i.e., flush with actuator body).

> **CAUTION:** Do NOT install the IEA to the container with the firing pin extended as this indicates that the IEA has been activated and must be replaced. Installing the IEA with the firing pin extended may cause accidental discharge.

Step 2. Install conduit (rigid or flexible) from the Impulse Release Module (IRM) electrical box to the IEA. The IEA adapter body provides a connection point for ½" rigid conduit compression fitting.

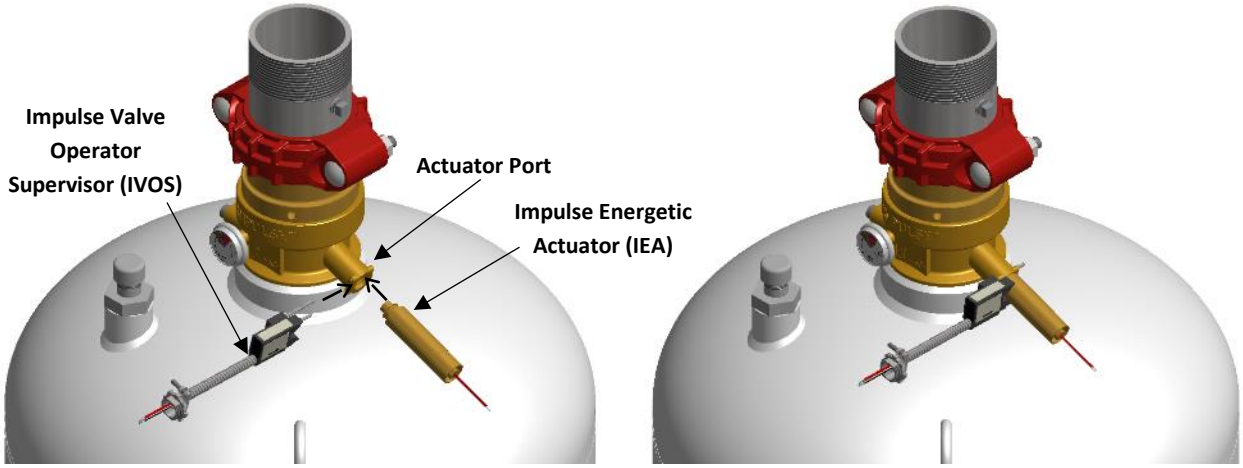
Step 3. Pull the IEA wire leads through the conduit.

Step 4. Connect the IEA wire leads to the IRM. See 4.7.2.1.

Step 5. Remove the retaining clip and plug from the container's actuator port. Keep these items for future use should the container have to be removed for service.

Step 6. Insert the IEA into the actuator port and secure in place with the IVOS retaining clip. See Section 4.7.4.

The container is now armed.



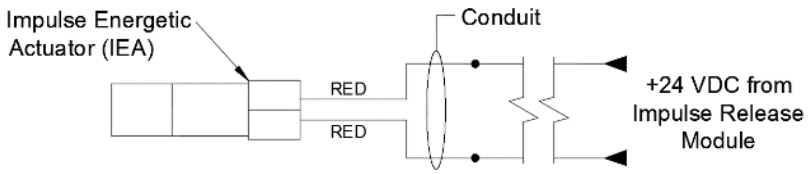
Disarmed **Armed**

> **NOTE:** An IVOS must be installed to supervise the connection of the IEA to each container.

See Section 3.10 for specific details on the various system activation methods using the IEA.

4.7.2.1. Impulse Energetic Actuator (IEA) Wiring

The IEA is wired to an Impulse Release Module (IRM), which is connected to a compatible Fike releasing panel (SHP-Pro or Cheetah Xi). Refer to Fike document 06-552 for IRM wiring details



Impulse Energetic Actuator Wiring Diagram

4.7.3. Installing Impulse Valve Pneumatic Operator (IVPO)

Step 1. Check to ensure that the Impulse Valve Pneumatic Operator (IVPO) is armed (firing pin retracted).

> **CAUTION:** Do NOT install the IVPO to the container with the firing pin extended as this may cause accidental discharge.

Step 2. Apply PTFE tape to the male threads of the adapter. Do NOT allow tape to overlap the end of the adapter as this could cause possible blockage of the pressure port.

Step 3. Screw the R1/8 x ¼ JIC adapter into the threaded port on the IVPO. Secure wrench tight.

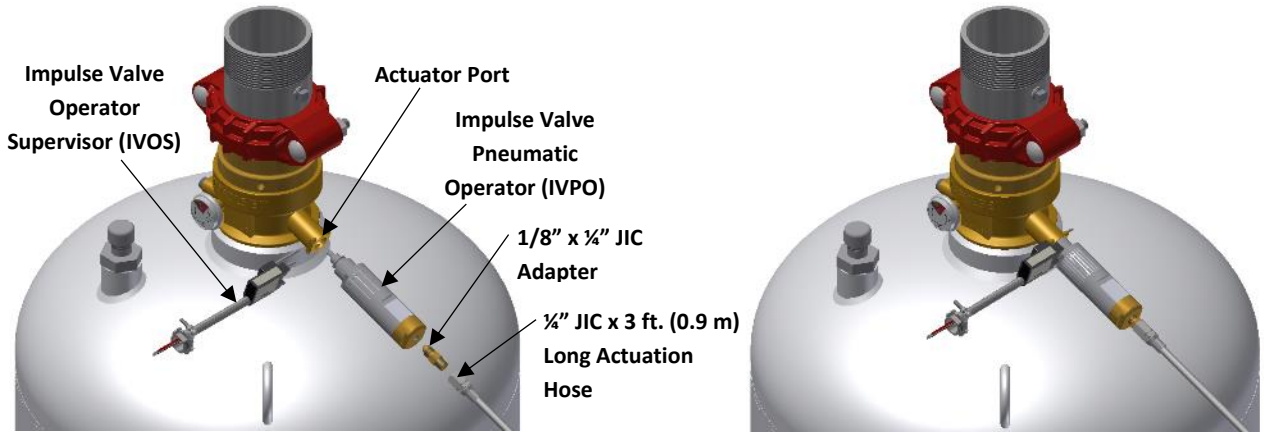
Step 4. Screw one end of the pilot line hose supplied with the IVPO to the ¼ JIC end of the adapter installed in Step 3. Secure wrench tight.

Step 5. Connect the other end of the pilot line hose to the pilot line tubing from the previous container or nitrogen actuator assembly. See Section 3.10 for specific details on the various system activation methods using the IVPO.

Step 6. Remove the retaining clip and plug from the container's actuator port. Keep the plug for future use should the container have to be removed for service.

Step 7. Insert the IVPO into the actuator port and secure in place with the IVOS retaining clip. See Section 4.7.4.

The container is now armed.



Disarmed **Armed**

> **NOTE:** An IVOS must be installed to supervise the connection of the IVPO to each container.

4.7.4. Installing Impulse Valve Operator Supervisor (IVOS)

Step 1. Connect the IVOS to the electrical box using the electrical connector integrated into the IVOS.

Step 2. Connect the IVOS wire leads to a “Supervisory” input on a Fike releasing panel. See 4.7.4.1.

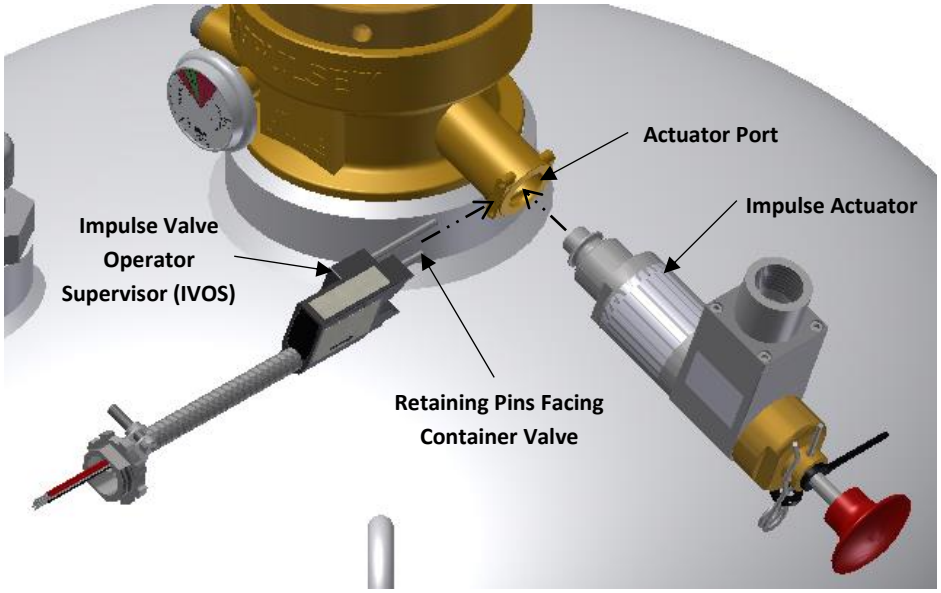
Step 3. Install the actuator (IVO, IEA or IVPO) into the valve actuator port.

Step 4. Position the IVOS so the retaining pins are facing the valve, as shown below.

Step 5. Align the IVOS retaining pins with the holes provided in the valve actuator port.

Step 6. Gently squeeze the IVOS retaining pins together and insert them into the holes provided in the actuator port body until the IVOS is fully seated.

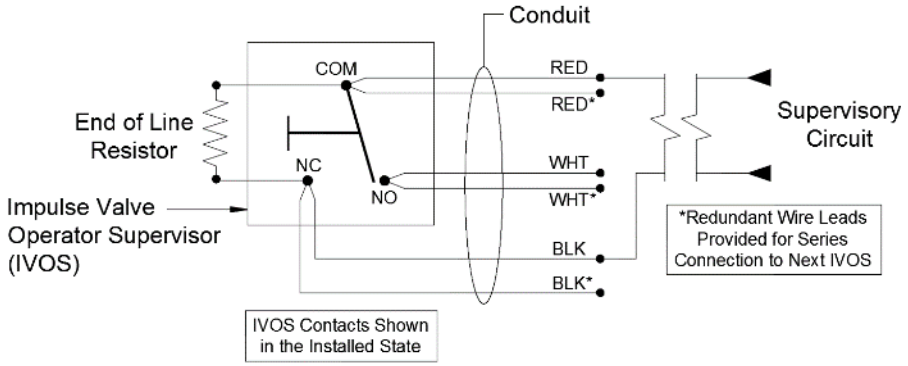
Step 7. Verify that the IVOS pushbutton switch is fully depressed and that the actuator is securely held in place.



Impulse Valve Operator Supervisor (IVOS) Installation to Cylinder Valve

4.7.4.1. Impulse Valve Operator Supervisor (IVOS) Wiring

The IVOS is wired to a “Supervisory” input on the compatible Fike releasing panel (SHP-Pro or Cheetah Xi). Refer to the appropriate control panel manual for further information.



Impulse Valve Operator Supervisor Wiring Diagram

4.7.5. Installing Nitrogen Actuator Assembly

Prior to installing the Nitrogen Actuator Assembly, the following items shall be verified.

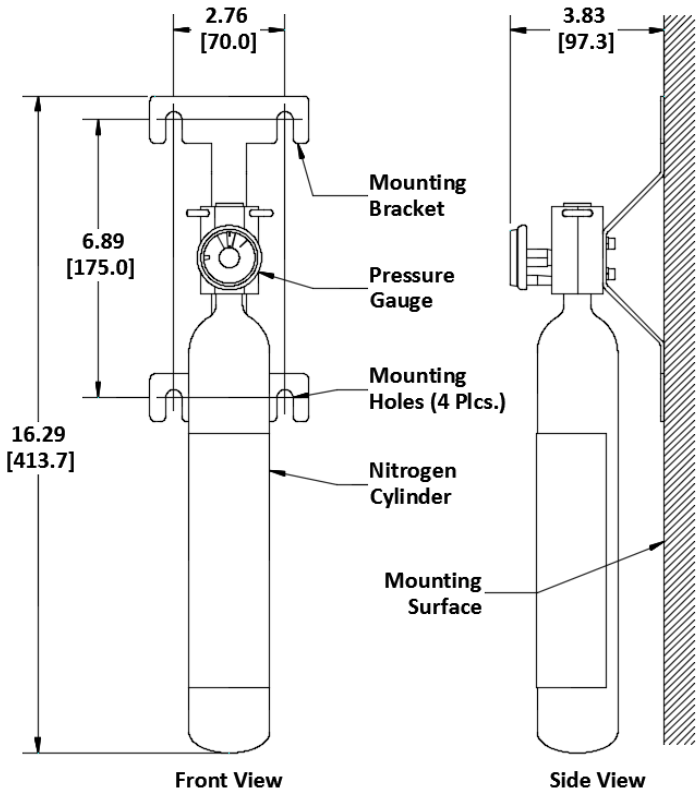
- The Nitrogen Actuator Assembly should be the last component installed on the system.
- Verify that the location for installing the Nitrogen Actuator Assembly is suitably protected so that it is not subject to mechanical, chemical, or other damage that would render it inoperable.
- Verify that the location for installing the Nitrogen Actuator Assembly is easily accessible at all times, including at the time of a fire.
- When used as a Primary Actuator, verify that signage has been installed to identify the hazard that each Nitrogen Actuator Assembly serves.

Step 1. Use the Nitrogen Actuator Assembly mounting bracket as a template to mark and drill the mounting holes.

> **NOTE:** When using a Universal Valve Operator (UVO) with manual strike button to activate the Nitrogen Actuator Assembly, the UVO strike button shall NOT be located greater than 4 ft. (1.2 m) above the floor.

Step 2. Secure the Nitrogen Actuator Assembly to the mounting surface using suitable anchors, provided by others.

Step 3. Attach the chosen actuator (UVO, UEA or Pneumatic Relay) to the Nitrogen Actuator Assembly valve following the steps indicated in Sections 4.7.6, 4.7.7, and 4.7.8.



Nitrogen Actuator Assembly (Without Actuator)

See Section 3.10 for specific details on the various system activation methods using the Nitrogen Actuator Assembly.

4.7.6. Installing UVO Primary Completer Kit (P/N 70-335)

See the following page for an assembly drawing of the Nitrogen Actuator Assembly with UVO Primary Completer Kit.

Step 1. Apply PTFE tape to the NPT male threads of item 7, item 8, item 9, and item 12. Do NOT allow tape to overlap the end of the fitting as this could cause possible blockage of the pressure port.

Step 2. Assemble item 7, item 8, and item 12 together. Secure wrench tight.

Step 3. Remove item 5 from item 4. Retain for future use.

Step 4. Screw the items assembled in Step 2 into the threaded port on item 4. Secure wrench tight. Orient the assembly so the side outlet of item 8 is positioned horizontally.

Step 5. Screw item 9 into the side outlet of item 8. Secure wrench tight.

Step 6. Install item 10 onto item 9.

Step 7. Screw item 11 onto item 9. Secure wrench tight.

Step 8. Connect one end of item 13 to item 12. Secure wrench tight.

Step 9. Connect the other end of item 13 to the pilot line tubing (not shown). Secure wrench tight.

Step 10. Check to ensure that item 4 is armed (firing pin retracted).

CAUTION: Do NOT install the UVO to the container with the firing pin extended as this may cause accidental discharge.

Step 11. Connect item 4 wire leads to the host control panel or module. See 4.7.6.1.

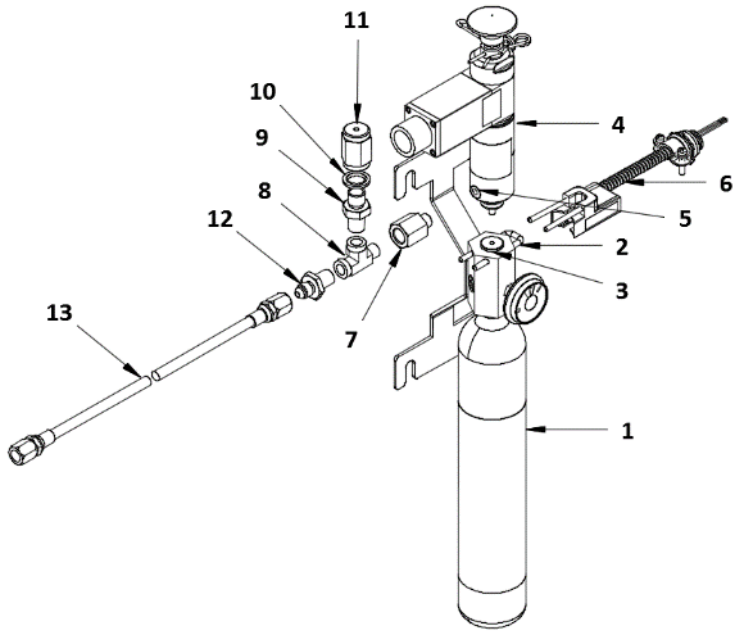
Step 12. Connect item 6 wire leads to the host control panel or module. See 4.7.9.1.

Step 13. Remove item 2 and item 3 from item 1. Keep these items for future use should the container have to be removed for service.

Step 14. Connect item 4 to item 1 and secure in place with item 6. See 4.7.9.

CAUTION: Installation of the system actuation components should be the last item completed before the system is placed into service.

The Nitrogen Actuator is now armed.

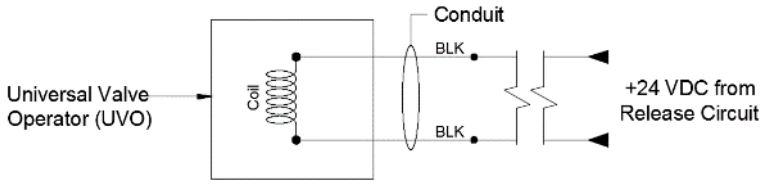


Nitrogen Actuator Assembly with UVO Primary Completer Kit

Item No.	Part Number	Description	Notes
1	70-325-X	Nitrogen Actuator Assembly	Part of 70-325 Nitrogen Actuator Assembly
2	02-11755	Retaining Clip	
3	IG71-0151	Valve Fill Adapter Plug	
4	02-13571	Universal Valve Operator (UVO)	Part of 70-335 Primary Completer Kit
5	02-14053	Pipe Plug	
6	02-14627	Universal Valve Operator Supervisory (UVOS)	
7	02-13640	1/8 in. NPT x 1/4 in. NPT Adapter	
8	C02-1335	1/4 in. Street Tee	
9	02-11766	1/4 in. NPT x G1/4 Adapter	
10	02-10926	1/4 in. Sealing Washer	
11	IG71-026	Vent Valve Assembly	
12	02-4530	1/4 in. NPT x 1/4 in. JIC Adaptor	
13	02-4977	1/4 in. JIC x 36 in. (0.9 m) Long Actuation	

4.7.6.1. Universal Valve Operator (UVO) Wiring

The UVO is wired directly to the releasing circuit of a Fike releasing panel (SHP-Pro or Cheetah Xi) and MUST not be connected to an Impulse Release Module (IRM). Refer to the appropriate control panel manual for further information.



Universal Valve Operator Wiring Diagram

CAUTION: If the UVO is to be connected to a Fike Cheetah Xi Releasing Control Module, a Solenoid Supervision and Protection Assembly (P/N 10-2360) must be installed. Refer to Fike document 06-344.

4.7.7. Installing UEA Primary Completer Kit (P/N 70-400)

See the following page for an assembly drawing of the Nitrogen Actuator Assembly with UEA Primary Completer Kit.

Step 1. Apply PTFE tape to the NPT male threads of item 7, item 8, item 9, and item 12. Do NOT allow tape to overlap the end of the fitting as this could cause possible blockage of the pressure port.

Step 2. Assemble item 7, item 8, and item 12 together. Secure wrench tight.

Step 3. Remove item 5 from item 4. Retain for future use.

Step 4. Screw the items assembled in Step 2 into the threaded port on item 4. Secure wrench tight. Orient the assembly so the side outlet of item 8 is positioned horizontally.

Step 5. Screw item 9 into the side outlet of item 8. Secure wrench tight.

Step 6. Install item 10 onto item 9.

Step 7. Screw item 11 onto item 9. Secure wrench tight.

Step 8. Connect one end of item 13 to item 12. Secure wrench tight.

Step 9. Connect the other end of item 13 to the pilot line tubing (not shown). Secure wrench tight.

Step 10. Check to ensure that item 4 is armed (firing pin retracted).

CAUTION: Do NOT install the UEA to the container with the firing pin extended as this may cause accidental discharge.

Step 11. Connect item 4 wire leads to the host control panel or module. See 4.7.7.1.

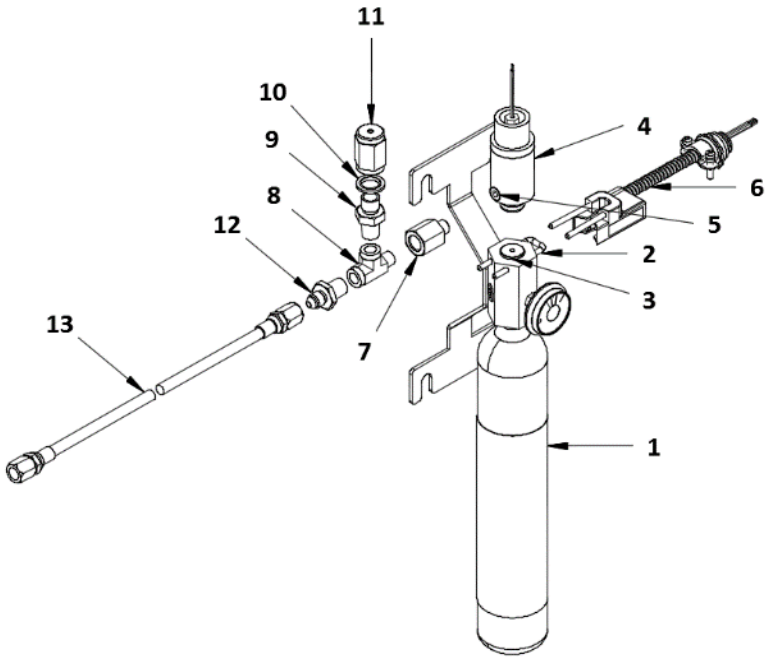
Step 12. Connect item 6 wire leads to the host control panel or module. See 4.7.9.1.

Step 13. Remove item 2 and item 3 from item 1. Keep these items for future use should the container have to be removed for service.

Step 14. Connect item 4 to item 1 and secure in place with item 6. See 4.7.9.

CAUTION: Installation of the system actuation components should be the last item completed before the system is placed into service.

The Nitrogen Actuator is now armed.

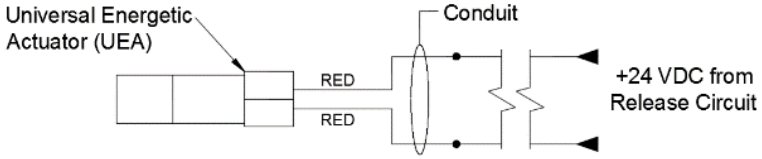


Nitrogen Actuator Assembly with UEA Primary Completer Kit

Item No.	Part Number	Description	Notes
1	70-325-X	Nitrogen Actuator Assembly	Part of 70-325 Nitrogen Actuator Assembly
2	02-11755	Retaining Clip	
3	IG71-0151	Valve Fill Adapter Plug	
4	IG71-247	Universal Energetic Actuator (UEA)	Part of 70-400 Primary Completer Kit
5	02-14053	Pipe Plug	
6	02-14627	Universal Valve Operator Supervisory (UVOS)	
7	02-13640	1/8 in. NPT x 1/4 in. NPT Adapter	
8	C02-1335	1/4 in. Street Tee	
9	02-11766	1/4 in. NPT x G1/4 Adapter	
10	02-10926	1/4 in. Sealing Washer	
11	IG71-026	Vent Valve Assembly	
12	02-4530	1/4 in. NPT x 1/4 in. JIC Adaptor	
13	02-4977	1/4 in. JIC x 36 in. (0.9 m) Long Actuation Hose	
14	10-2748	Impulse Releasing Module (IRM), *not shown*	

4.7.7.1. Universal Energetic Actuator (UEA) Wiring

The UEA is wired to an Impulse Release Module (IRM), which is connected to a compatible Fike releasing panel (SHP-Pro or Cheetah Xi). Refer to Fike document 06-552 for IRM wiring details



Universal Energetic Actuator Wiring Diagram

4.7.8. Installing Pneumatic Relay Secondary Completer Kit (P/N 70-336)

See the following page for an assembly drawing of the Nitrogen Actuator Assembly with Pneumatic Relay Secondary Completer Kit.

Step 1. Apply PTFE tape to the G1/4 male threads of item 3. Do NOT allow tape to overlap the end of the fitting as this could cause possible blockage of the pressure port.

Step 2. Connect item 3 to item 2A. Secure wrench tight.

Step 3. Connect the other end of item 3 to the pilot line tubing (not shown). Secure wrench tight.

Step 4. Check to ensure that item 2A is armed (firing pin retracted).

CAUTION: Do NOT install the pneumatic relay to the container with the firing pin extended as this may cause accidental discharge.

Step 5. Remove item 1C and item 1B from item 1A. Keep these items for future use should the container have to be removed for service.

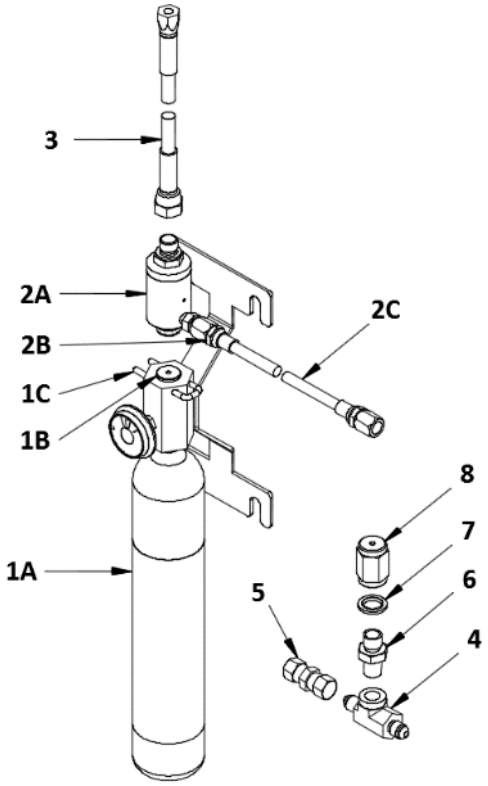
Step 6. Connect item 2A to item 1A and secure in place with item 1C.

CAUTION: Installation of the system actuation components should be the last item completed before the system is placed into service.

Step 7. Connect free end of item 2C to the pilot line, IVPO or selector valve. Secure wrench tight.

Step 8. Install pilot line vent components (items 5 thru 8) as shown in Section 4.3.6.2 or 4.8.4.

The Nitrogen Actuator is now armed.



Nitrogen Actuator Assembly with Pneumatic Relay Secondary Completer Kit

Item No.	Part Number	Description	Notes
1A	70-325-X	Nitrogen Actuator Assembly	Part of 70-325 Nitrogen Actuator Assembly
1B	IG71-0151	Valve Fill Adapter Plug	
1C	02-11755	Retaining Clip	
2A	70-334	Pneumatic Relay Assembly	Part of 70-334 Pneumatic Relay Assembly
2B	02-11243	R1/8 in. x 1/4 in. JIC Hex Nipple	
2C	02-4977	1/4 in. JIC x 36 in. (0.9 m) Long Actuation	
3	02-10801	G1/4 x 1/4 in. JIC x 39 in (1 m) Long Actuation Hose	Ordered separately
4	02-14721	1/4 in. JIC x 1/4 in. FNPT Branch Tee	
5	02-11346	1/4 in. JIC Coupling, Swivel	
6	02-11766	1/4 in. NPT x G1/4 Adapter	
7	02-10926	1/4 in. Sealing Washer	
8	IG71-026	Vent Valve Assembly	

4.7.9. Installing Universal Valve Operator Supervisor (UVOS)

Step 1. Connect the UVOS to the electrical box using the electrical connector integrated into the UVOS.

Step 2. Connect the UVOS wire leads to a “Supervisory” input on a Fike releasing panel. See 4.7.9.1.

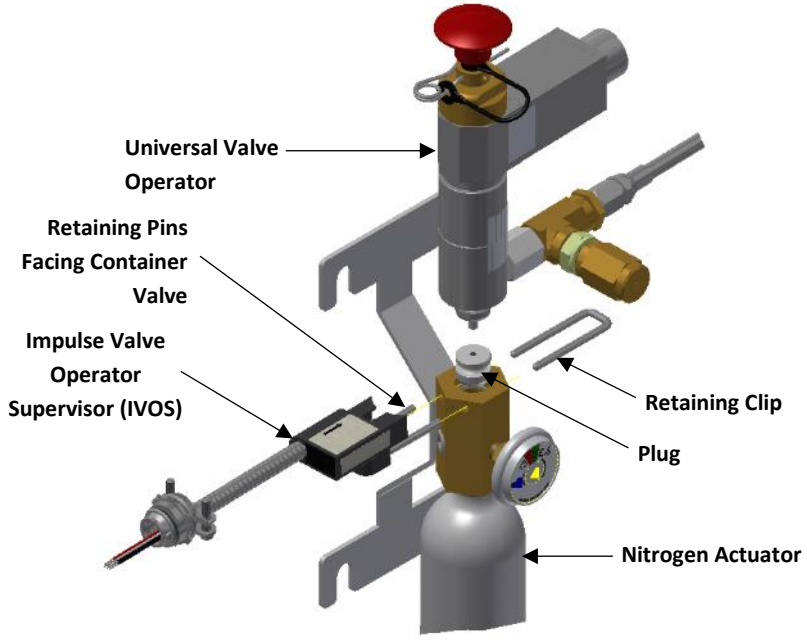
Step 3. Install the actuator (UVO, UEA or Pneumatic Relay) into the valve actuator port.

Step 4. Position the UVOS so the retaining pins are facing the brass valve, as shown below.

Step 5. Align the UVOS retaining pins with the holes provided in the valve actuator port.

Step 6. Gently squeeze the UVOS retaining pins together and insert them into the holes provided in the actuator port body until the UVOS is fully seated.

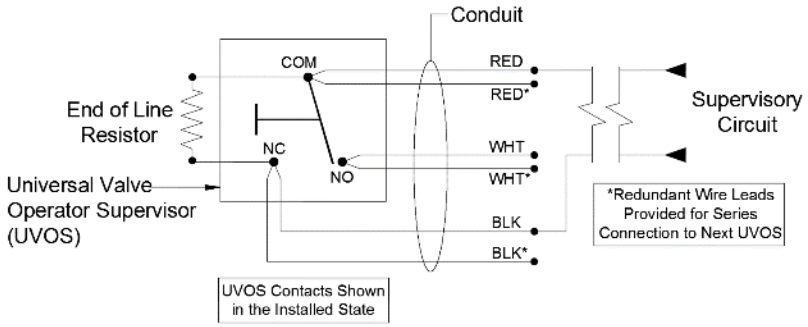
Step 7. Verify that the UVOS pushbutton switch is fully depressed and that the actuator is securely held in place.



Universal Valve Operator Supervisor (UVOS) Installation to Nitrogen Actuator

4.7.9.1. Universal Valve Operator Supervisor (UVOS) Wiring

The UVOS is wired to a “Supervisory” input on the compatible Fike releasing panel (SHP-Pro or Cheetah Xi). Refer to the appropriate control panel manual for further information.



Universal Valve Operator Supervisor Wiring Diagram

4.8. Installing Pneumatic Actuation Lines

Pneumatic actuation lines are used to allow simultaneous pneumatic activation of multiple containers. Pneumatic actuation lines shall be installed in a manner that protects them against crimping or mechanical damage. Where the pneumatic actuation line could be exposed to conditions that could lead to loss of integrity, special precautions shall be taken to ensure that no loss of integrity will occur. Pneumatic actuation lines shall be secured to a solid surface. Anchoring into plaster, sheetrock wall or any other facing material is NOT acceptable.

4.8.1. Two Containers with IVO and IVPO

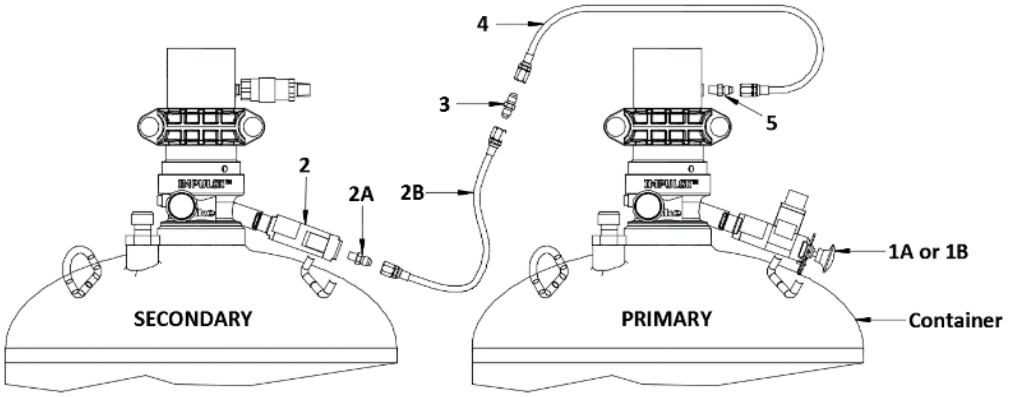
Step 1. Apply PTFE tape or thread sealant to all items (parts) equipped male NPT threads. Do NOT allow tape or sealant to overlap end of fitting.

Step 2. Assemble items as shown in the diagram below. Secure wrench tight.

Step 3. Remove 1/4" NPT plug from the primary container's adapter nipple and thread item 5 into port. Secure wrench tight.

Step 4. Connect system actuation components (IVO, IEA, IVPO) to the containers. See Section 4.7 for details.

The containers are now armed.



Maximum Two Containers Connected to Fike Releasing Panel

Pilot Line Limitations:

1) Pilot line hoses supplied by Fike.

Item No.	Part Number	Description	Notes
1A	02-12728	Impulse Valve Operator (IVO)*	Part of 70-279 Kit
1B	70-374	Impulse Energetic Actuator (IEA)	Part of 70-390 Kit
2	02-12729	Impulse Valve Pneumatic Operator (IVPO)	Part of 70-280 IVPO Kit
2A	02-4535	1/8 in. NPT x 1/4 in. JIC Adaptor	
2B	02-4977	1/4 in. JIC x 36 in. (0.9 m) Long Actuation Hose	
3	02-12926	1/4 in. JIC Male Adaptor	
4	02-4977	1/4 in. JIC x 36 in. (0.9 m) Long Actuation Hose	
5	02-4530	1/4 in. NPT x 1/4 in. JIC Adaptor	

* The IVO shown can be replaced with a IEA (Item 1B); however, there is no strike button provided on the IEA to permit mechanical manual activation of the container. Electric manual activation must be used to manually activate the container.

4.8.2. Multiple Containers with IVO and IVPO

Step 1. Install pneumatic tubing between the containers. See pilot line limitations below. Terminate tubing within 2 feet (0.61 m) of the container valve.

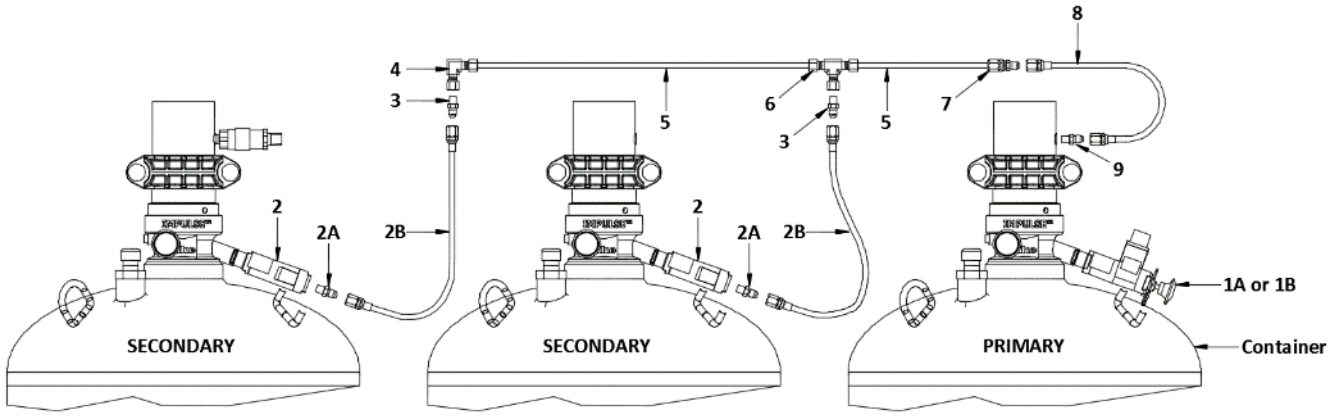
Step 2. Apply PTFE tape or thread sealant to all items (parts) equipped male NPT threads. Do NOT allow tape or sealant to overlap end of fitting.

Step 3. Assemble items as shown in the diagram below. Secure wrench tight.

Step 4. Remove ¼" NPT plug from the primary container's adapter nipple and thread item 9 into port. Secure wrench tight.

Step 5. Connect system actuation components (IVO, IEA, IVPO) to the containers. See Section 4.7 for details.

The containers are now armed.



Maximum Seven Containers Connected to Fike Releasing Panel

Pilot Line Limitations:

1) Maximum 50 ft. (15.2 m) total length including hoses.
2) Tubing (supplied by others) shall be 1/4 in. x 0.035 in. wall stainless steel.
3) Pilot line hoses supplied by Fike.

Item No.	Part Number	Description	Notes
1A	02-12728	Impulse Valve Operator (IVO)*	Part of 70-279 Kit
1B	70-374	Impulse Energetic Actuator (IEA)	Part of 70-390 Kit
2	02-12729	Impulse Valve Pneumatic Operator (IVPO)	Part of 70-280 IVPO Kit
2A	02-4535	1/8 in. NPT x 1/4 in. JIC Adaptor	
2B	02-4977	1/4 in. JIC x 36 in. (0.9 m) Long Actuation Hose	
3	C02-1356	1/4 in. Male JIC x 1/4 in. Male Tube Adaptor	
4	02-12696	1/4 in. Tube 90° Elbow	
5	N/A	1/4 in. x 0.035 in. Wall, Stainless Steel Tubing	Supplied by others
6	C02-1359	1/4 in. Tube Tee	
7	02-12695	1/4 in. Tube x 1/4 in. JIC Adaptor	
8	02-4977	1/4 in. JIC x 36 in. (0.9 m) Long Actuation Hose	
9	02-4530	1/4 in. NPT x 1/4 in. JIC Adaptor	

* The IVO shown can be replaced with a IEA (Item 1B); however, there is no strike button provided on the IEA to permit mechanical manual activation of the container. Electric manual activation must be used to manually activate the container.

4.8.3. Multiple Containers with Primary Nitrogen Actuator

Step 1. Install Nitrogen Actuator Assembly (item 1). See sections 4.7.5 for installation instructions.

Step 2. Install pneumatic tubing between the containers and the nitrogen actuator. See pilot line limitations below. Terminate tubing within 2 feet (0.61 m) of the container valve and nitrogen actuator.

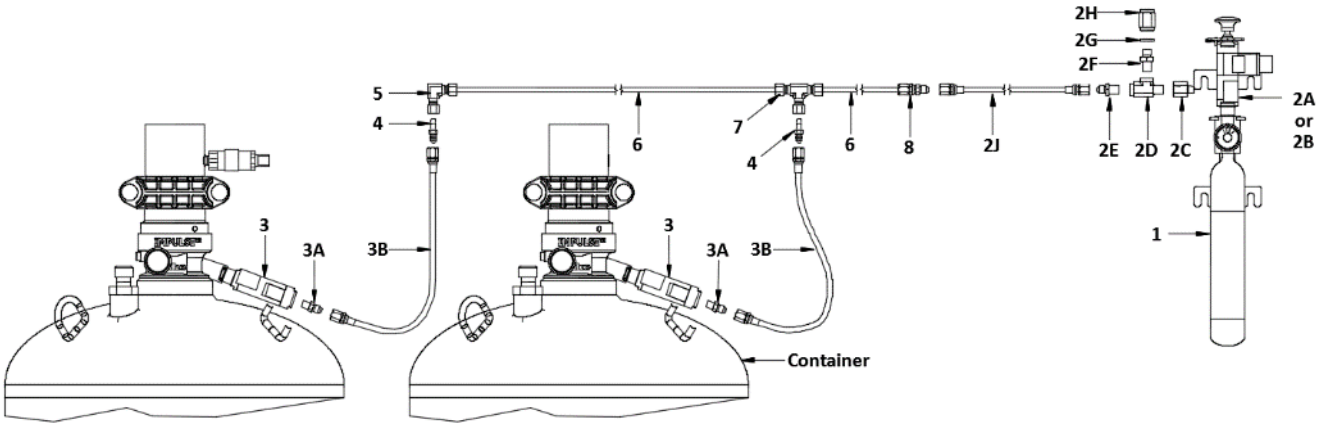
Step 3. Apply PTFE tape or thread sealant to all items (parts) equipped male NPT threads. Do NOT allow tape or sealant to overlap end of fitting.

Step 4. Assemble items as shown in the diagram below. Secure wrench tight.

Step 5. Install the UVO or UEA primary completer kit to the nitrogen actuator. See Sections 4.7.6 or 4.7.7 for installation instructions.

Step 6. Connect IVPO to the containers. See Section 4.7 for details.

The containers are now armed.



Maximum Five Containers Connected to Primary Nitrogen Actuator

Pilot Line Limitations:

1) Minimum 100 ft. (30.5 m) between Primary Nitrogen Actuator and first IVPO.
2) Maximum 300 ft. (91.5 m) between Primary Nitrogen Actuator and last IVPO.
3) Maximum 160 ft. (48.8 m) between first and last IVPO.
4) Maximum of six IVPOs can be activated by the Primary Nitrogen Actuator.
5) Tubing (supplied by others) shall be 1/4 in. x 0.035 in. wall stainless steel.
6) Pilot line hoses supplied by Fike.

See next page for a description of numerical callouts shown in the diagram above.

Item No.	Part Number	Description	Notes
1	70-325-X	Nitrogen Actuator Assembly	
2A	02-13571	Universal Valve Operator (UVO)*	Part of 70-335 Primary Completer Kit
2B	IG71-247	Universal Energetic Actuator (UEA)	Part of 70-400 Primary Completer Kit
2C	02-13640	1/8 in. NPT x 1/4 in. NPT Adapter	Part of Primary Completer Kit (Item 2A or 2B)
2D	C02-1335	1/4 in. Street Tee	
2E	02-4530	1/4 in. NPT x 1/4 in. JIC Adaptor	
2F	02-11766	1/4 in. NPT x G1/4 Adapter	
2G	02-10926	1/4 in. Sealing Washer	
2H	IG71-026	Vent Valve Assembly	
2J	02-4977	1/4 in. JIC x 36 in. (0.9 m) Long Actuation Hose	
3	02-12729	Impulse Valve Pneumatic Operator (IVPO)	Part of 70- 280 IVPO Kit
3A	02-4535	1/8 in. NPT x 1/4 in. JIC Adaptor	
3B	02-4977	1/4 in. JIC x 36 in. (0.9 m) Long Actuation Hose	
4	C02-1356	1/4 in. Male JIC x 1/4 in. Male Tube Adaptor	
5	02-12696	1/4 in. Tube 90° Elbow	
6	N/A	1/4 in. x 0.035 in. Wall, Stainless Steel Tubing	Supplied by others
7	C02-1359	1/4 in. Tube Tee	
8	02-12695	1/4 in. Tube x 1/4 in. JIC Adaptor	

* The UVO shown can be replaced with a UEA (Item 2B); however, there is no strike button provided on the IEA to permit mechanical manual activation of the container. Electric manual activation must be used to manually activate the container.

4.8.4. Multiple Containers with Primary and Secondary Nitrogen Actuators

Step 1. Install Nitrogen Actuator Assemblies. See Sections 4.7.5 for installation instructions.

Step 2. Install pneumatic tubing between the containers and the nitrogen actuators. See pilot line limitations below. Terminate tubing within 2 feet (0.61 m) of the container valve and nitrogen actuators.

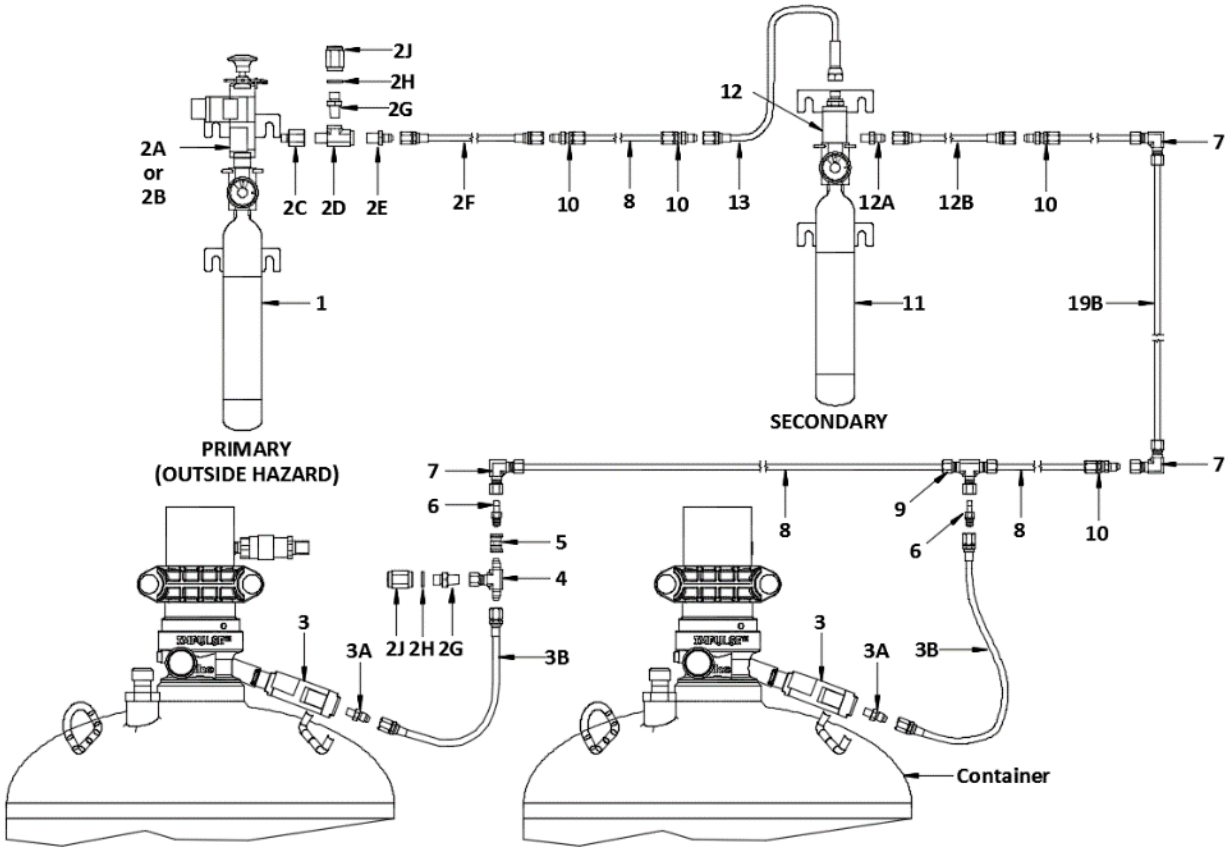
Step 3. Apply PTFE tape or thread sealant to all items (parts) equipped male NPT threads. Do NOT allow tape or sealant to overlap end of fitting.

Step 4. Assemble items as shown in the diagram below, wrench tight.

Step 5. Install the UVO, UEA or relay actuator completer kit to the nitrogen actuator. See Sections 4.7.6, 4.7.7 or 4.7.8 for installation instructions.

Step 6. Connect IVPO to the containers. See Section 4.7 for details.

The containers are now armed.



Maximum Five Containers Connected to Primary and Secondary Nitrogen Actuators

Pilot Line Limitations:

1) Maximum 150 ft. (45 m) between Primary Nitrogen Actuator and Secondary Nitrogen Actuator.
2) Minimum 100 ft. (30.5 m) between Secondary Nitrogen Actuator and first IVPO.
3) Maximum 300 ft. (91.5 m) between Secondary Nitrogen Actuator and last IVPO.
4) Maximum 160 ft. (48.8 m) between first and last IVPO.
5) Maximum of six IVPOs can be activated by the Secondary Nitrogen Actuator.
6) Tubing (supplied by others) shall be 1/4 in. x 0.035 in. wall stainless steel.
7) Pilot line hoses supplied by Fike.

See next page for description of numerical callouts shown in the diagram above.

Item No.	Part Number	Description	Notes
1	70-325-X	Nitrogen Actuator Assembly	
2A	02-13571	Universal Valve Operator (UVO)*	Part of 70-335 Primary Completer Kit
2B	IG71-247	Universal Energetic Actuator (UEA)	Part of 70-400 Primary Completer Kit
2C	02-13640	1/8 in. NPT x 1/4 in. NPT Adapter	Part of Primary Completer Kit (Item 2A or 2B)
2D	C02-1335	1/4 in. Street Tee	
2E	02-4530	1/4 in. NPT x 1/4 in. JIC Adaptor	
2F	02-11766	1/4 in. NPT x G1/4 Adapter	
2G	02-10926	1/4 in. Sealing Washer	
2H	IG71-026	Vent Valve Assembly	
2J	02-4977	1/4 in. JIC x 36 in. (0.9 m) Long Actuation Hose	
3	02-12729	Impulse Valve Pneumatic Operator (IVPO)	Part of 70- 280 IVPO Kit
3A	02-4535	1/8 in. NPT x 1/4 in. JIC Adaptor	
3B	02-4977	1/4 in. JIC x 36 in. (0.9 m) Long Actuation Hose	
4	02-14721	1/4 in. JIC x 1/4 in. FNPT Branch Tee	
5	02-11346	1/4 in. JIC Coupling	
6	C02-1356	1/4 in. Male JIC x 1/4 in. Male Tube Adaptor	
7	02-12696	1/4 in. Tube 90° Elbow	
8	N/A	1/4 in. x 0.035 in. Wall, Stainless Steel Tubing	Supplied by others
9	C02-1359	1/4 in. Tube Tee	
10	02-12695	1/4 in. Tube x 1/4 in. JIC Adaptor	
11	70-325-X	Nitrogen Actuator Assembly	
12	IG71-120	Pneumatic Relay	Part of 70-334 Pneumatic Relay Assembly
12A	02-11243	R1/8 in. x 1/4 in. JIC Hex Nipple	
12B	02-4977	1/4 in. JIC x 36 in. (0.9 m) Long Actuation Hose	
13	02-10801	G1/4 x 1/4 in. JIC x 39 in. (1 m) Long Actuation Hose	

* The UVO shown can be replaced with a UEA (Item 2B); however, there is no strike button provided on the IEA to permit mechanical manual activation of the container. Electric manual activation must be used to manually activate the container.

5. ACCEPTANCE TESTING

The completed system shall be reviewed and tested by qualified personnel that have knowledge and experience of the testing requirements contained in this manual and NFPA 2001. Testing personnel shall follow all safety procedures during system testing. The following acceptance testing procedures are intended to represent the minimum requirement for the extinguishing portion of the system. Additional testing may be required by the AHJ.

If the system is connected to an alarm receiving office, notify the alarm receiving office that a fire system test is to be conducted and that emergency response by the fire department or alarm station personnel is not required. Notify all personnel in the areas that could be affected by the testing that a test is to be conducted and instruct them as to the events that could occur during the test.

CAUTION: The releasing mechanism on each storage container or nitrogen actuator **must** be disconnected from the container prior to conducting the acceptance test in order to prevent activation of the suppression system during testing.

5.1. Pre-Checks and Visual Inspections

When the installation is complete and before making the final connections, the following system checks should be made:

Enclosure Checks

____ 1. Check the hazard area dimensions against those shown on the system plan(s). If the area volume has changed, the agent weight should be recalculated and compared with the agent weight supplied.

____ 2. Check the hazard area for walls or movable partitions that may have been added or changed. If walls or partitions have been added, check to see that all areas within the hazard still receive adequate nozzle coverage and agent distribution.

____ 3. Thoroughly examine the enclosure to verify that it has been properly constructed and sealed to eliminate any significant air leaks that could result in failure of the enclosure to hold the agent concentration.

____ 4. Perform an Enclosure Integrity Test on all protected enclosures. A Door Fan Test is the accepted method to estimate worst-case room leakage and agent (concentration) hold time. Refer to NFPA Standard 2001, latest edition for additional information and door fan test procedures.

Mechanical Checks

____ 1. Inspect the piping distribution system(s) to verify that it has been installed in compliance with the design drawings. Nozzle locations, nozzle orientation, pipe sizes, pipe size reductions and orientation of tees shall be checked against the design drawings. If piping system as installed differs from the design drawings, the system MUST be recalculated to reflect the piping system as installed.

____ 2. Visually inspect all components for signs of damage (i.e., corrosion, dents, twisted, etc.).

____ 3. Check that all agent storage containers are properly located in accordance with the design drawings

____ 4. Check that all agent storage containers are securely fastened with supplied brackets.

____ 5. Check that all piping joints, discharge nozzles, and piping supports are securely fastened to prevent unacceptable vertical or lateral movement during discharge.

____ 6. Check that all warning and instruction signs are mounted where required.

____ 7. Check that all nozzles are the proper type, correctly placed in accordance with the design drawings, and properly oriented. Make certain there are no obstructions that could block the discharge of agent from the nozzle(s).

____ 8. Make sure all nozzle set screws are in place.

____ 9. Check the container gauge to confirm container pressure is in operable range. Pressure should read 500 PSIG at 70°F (34.5 BAR at 21°C). For temperatures other than 70°F (21°C), reference Temperature vs. Pressure Chart on Page 9.

____ 10. Check the model and agent weight markings on the container nameplate to verify that the correct container has been installed in accordance with the design drawings.

____ 11. Verify the amount of agent in the container(s) by either weighing the container or by using the container's Liquid Level Indictor (LLi), if installed. This information should be recorded and affixed to the container so it can be used during container maintenance.

____ 12. Verify the operation of auxiliary functions such as door closures, damper closures, air handling shutdown, etc. should be verified when the control system is activated, both manually and automatically.

____ 13. Verify that the Low Pressure Switch (if installed) is properly secured to the container and wired properly to control panel.

____ 14. Check the system actuators (IVO, IEA or Nitrogen Actuator) are disconnected from the suppression containers or pneumatic actuation lines to prevent false activation of the system.

____ 15. Check all pipe joints for mechanical tightness.

____ 16. Perform a pressure test on the piping network in accordance with NFPA 2001, latest edition.

____ 17. Verify that all check valves (if used) are installed with the "Flow Arrow" pointing in the correct direction.

Pneumatic Checks

Where pneumatic system actuation components are used (i.e., IVPO, Nitrogen Actuator Assembly), the following pneumatic checks should be made:

____ 1. Remove all Impulse Valve Pneumatic Operators (IVPO) from container valves.

____ 2. Disconnect actuation hose from the master container valve or Nitrogen Actuator Assembly.

____ 3. Provide 100 psi (6.9 bar) pressure to the disconnected actuation hose.

____ 4. Verify all IVPOs are in the fired (piston extended) position. Reset IVPO(s) upon completion of testing.

Electrical Checks

The information contained in this document does not cover service and maintenance procedures for the Detection and Control System (electrical portion). The electrical portion of the system must be thoroughly checked out according to the manufacturer's recommendations and the requirements of the AHJ.

IMPORTANT NOTE: Do not arm the Fike Clean Agent Fire Suppression system before the Detection and Control System has been checked out and all circuits are free of trouble and ground fault conditions. If control panel checks out, install the releasing mechanism to the container(s).

The results of the system checkout shall be documented in a test report. The test report shall be maintained by the system owner for the life of the suppression system.

6. MAINTENANCE

The completed system shall be maintained by qualified personnel that have knowledge and experience of the maintenance and service requirements contained in this manual and NFPA 2001. Testing personnel shall follow all safety procedures during system testing. The following maintenance procedures are intended to represent the minimum requirement for the extinguishing portion of the system. Additional maintenance procedures may be required by the AHJ.

IMPORTANT NOTE: This information **does not** cover maintenance procedures for the electrical and control portions of the system. The control portion of the system should be thoroughly checked out according to the manufacturer's recommendations and the requirements of the AHJ.

CAUTION: The releasing mechanism on each storage container **must** be disconnected from the container prior to conducting the acceptance test in order to prevent activation of the suppression system container during testing.

Monthly Inspection

____ 1. Check that the releasing panel is powered and is free of supervisory, trouble, or alarm conditions.

____ 2. Check that all manual controls (i.e., manual release, abort, pneumatic actuators, etc.) are unobstructed.

____ 3. Check that the system components show no signs of physical damage, corrosion or a condition that could prevent operation.

____ 4. Check all piping supports to make sure they are tight and all piping is properly supported.

____ 5. Check all nozzle orifices for signs of corrosion.

____ 6. Check all nozzles to make certain there are no obstructions that could block the discharge of agent from the nozzles.

____ 7. Check the container gauge to confirm container pressure is in operable range. Pressure should read 500 PSIG at 70°F (34.5 BAR at 21°C). In the range of 50°F to 80°F (10°C to 27°C), the difference is approximately 2 PSIG (15 kPa) per degree. For temperatures other than 70°F (21°C), reference Temperature vs. Pressure Chart on Page 9. If the pressure loss indicated exceeds 10% of the nominal pressure, check the container for leaks and repair as necessary.

____ 8. Check that the protected equipment or hazard area has not been changed or modified.

____ 9. Check that all penetrations made through the protected enclosure are properly sealed. Any new penetration shall be sealed immediately maintaining the original fire resistance rating of the enclosure.

____ 10. Verify that any previously noted deficiencies have been corrected.

If any deficiencies are found, appropriate corrective action shall be taken immediately. When the corrective action involves maintenance or repair, it shall be conducted by a qualified fire protection service technician.

Semiannual Inspection and Service

____ 1. Verify the amount of agent in the container(s) matches the agent weight stamped on the container label, by either weighing the container or by using the container's Liquid Level Indictor (LLi), if installed. This information should be recorded and affixed to the container so it can be used during container maintenance. If the weight indicates a shortage exceeding 5% of required weight, the container must be removed from service for repair and/or recharge.

____ 2. Check the container gauge to confirm container pressure is in operable range. Pressure should read 500 PSIG at 70°F (34.5 BAR at 21°C). In the range of 50°F to 80°F (10°C to 27°C), the difference is approximately 2 PSIG (15 kPa) per degree. For temperatures other than 70°F (21°C), reference Temperature vs. Pressure Chart on Page 9. If the pressure loss indicated exceeds 10% of the nominal pressure, check the container for leaks and repair as necessary.

____ 3. The following information should be recorded and affixed to the container so it can be used during container maintenance.

a. Date of Inspection
b. Person performing the inspection
c. Type of agent
d. Gross weight and net weight of container
e. Container pressure and temperature

____ 4. Check the pressure gauge on the nitrogen actuator assembly valve (if applicable) to confirm cylinder pressure is in the operable range. Pressure should read 1800 psi at 70°F (124 bar at 21°C). Pressure may vary with temperature. If the pressure loss indicated exceeds 10% of the nominal pressure (adjusted for temperature), the cylinder must be recharged.

If any deficiencies are found, appropriate corrective action shall be taken immediately. When the corrective action involves maintenance or repair, it shall be conducted by a qualified fire protection service technician.

Annual Inspection and Service

____ 1. The checks listed in Section 5, Acceptance Testing should be performed.

____ 2. Check the hazard area dimensions against those shown on the system plan(s). If the area volume has changed, the agent weight should be recalculated and compared with the agent weight supplied to determine if the correct amount of agent is being supplied to protect the hazard.

____ 3. Thoroughly examine the enclosure to verify that the integrity of the enclosure has been maintained. Any new penetrations into the enclosure have been properly sealed to eliminate any significant air leaks that could result in failure of the enclosure to hold the agent concentration. If hazard conditions indicate the inability to maintain the agent concentration, a door fan test should be performed in accordance with NFPA 2001, latest edition.

If any deficiencies are found, appropriate corrective action shall be taken immediately. When the corrective action involves maintenance or repair, it shall be conducted by a qualified fire protection service technician.

5 Year Inspection and Service

____ 1. Perform a complete external visual inspection of each container in accordance with the Code of Federal Regulations, Title 49 and Compressed Gas Association (CGA) Pamphlet C-6, Section 3. The container does not need to be emptied or stamped while under pressure for this inspection. The inspection shall be performed by a CGA/DOT approved inspector only.

Where the external visual inspection indicates that the container has been damaged, addition strength tests shall be required.

____ 2. All hoses shall be detached from the system and a hydrostatic pressure test shall be performed in accordance with NFPA 2001, latest edition. Hoses failing the test must be marked and destroyed and replaced. Hoses passing the test shall be marked to show the date of test prior to reinstallation.

If any deficiencies are found, appropriate corrective action shall be taken immediately. When the corrective action involves maintenance or repair, it shall be conducted by a qualified fire protection service technician.

After System Discharge

____ 1. Recharge discharged containers. See Section 6.1 for instructions.

____ 2. Recharge discharged nitrogen actuator cylinders. See Section 6.2 for instructions.

____ 3. Replace damper in all 3-inch check valves. See Section 6.3 for instructions.

____ 4. Reset the actuators (IVO, IVPO, and UVO) where used. See Section 6.4 for instructions.

____ 5. Replace all Impulse Energetic Actuators (IEA) where used. The IEA is a single use device that MUST be replaced after system discharge.

____ 6. Reset Selector Valves, if applicable. See Section 6.5 for instructions.

6.1. Container Recharge Procedure

After a system discharge, it is imperative that the clean agent suppression containers be recharged and returned to service as soon as possible (24 hours maximum) to ensure continued protection. Empty containers can be returned to Fike for valve refurbishment and recharge or they can be sent to any Fike authorized Field Recharge Station. Containers must be refurbished and recharged following the procedures outlined in the Clean Agent Recharge Manual, P/N 06-852. Containers must be refilled with 3M™ Novec™ 1230 Fire Protection Fluid only.

For system recharge, contact you system installer or Fike's Customer Service Department at +001-816-229-3405.

CAUTION: Under no circumstances should personnel, other than a Fike Authorized Service Representative, attempt to disarm and remove a container for recharge.

The following procedure shall be used to recharge discharged containers.

____ 1. Use the main-reserve switch to engage the reserve agent supply, if provided.

____ 2. Remove the Impulse Valve Operator Supervisor (IVOS) and disconnect the actuator (i.e., IVO, IVPO, IEA) from the actuator port on the empty container(s).

____ 3. Disconnect and remove the Pressure Gauge from the container fill port on the empty container. Reinstall the threaded port plug retained during switch installation.

____ 4. Disconnect the empty container from the suppression piping.

____ 5. Remove the container from its mounting bracket or strap.

____ 6. Install the container baffle plate and safety shipping cap to prepare the container for shipping.

____ 7. Return the container to Fike or to an authorized container fill station for container rebuild and recharge. Refer to Fike document P/N 06-852 for container recharge procedure.

____ 8. Reinstall the recharged container making sure that the correct container is installed in the correct location.

____ 9. Reconnect the discharge piping to the recharged container.

____ 10. Reinstall the Pressure Gauge to the container fill port. See Section 4.4 for instructions.

____ 11. Reconnect the actuator (IVO, IVPO, IEA) to the valve actuator port. Make sure that the actuator has been reset or replaced, where applicable.

____ 12. Reinstall the IVOS to secure the actuator to the actuator port.

6.2. Nitrogen Actuator Cylinder Recharge Procedure

____ 1. Disconnect the actuator (UVO, UEA or Pneumatic Relay) from the Nitrogen Actuator Assembly.

____ 2. Remove the Nitrogen Actuator Assembly from the mounting surface.

____ 3. Recharge the nitrogen cylinder. Refer to Nitrogen Actuator Recharge Manual 06-721 for recharge instructions.

____ 4. Reinstall the recharged Nitrogen Actuator Assembly to the mounting surface.

____ 5. Reconnect the actuator (UVO, UEA or Pneumatic Relay) to the Nitrogen Actuator Assembly. Make sure that the actuator has been reset or replaced, where applicable.

____ 6. Reinstall the IVOS to secure the actuator to the actuator port.

6.3. 3 Inch Check Valve Damper Replacement Procedure

IMPORTANT NOTE:	This procedure only applies to the 3 inch check valves that have opened due to agent pressure. Dampers DO NOT need to be replaced in 1 inch and 2 inch check valves.

The following procedure shall be used to replace the valve damper.

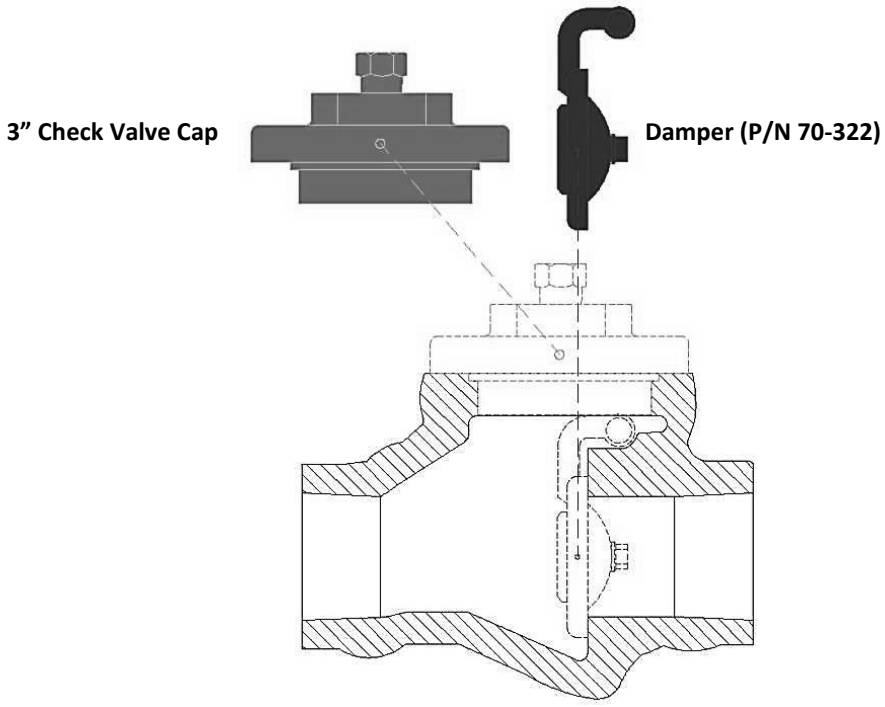
____ 1. Remove the check valve cap.

____ 2. Remove old damper.

____ 3. Insert new damper (P/N 70-322)

____ 4. Reinstall the check valve cap, wrench tight.

____ 5. Rearm the system after all 3 inch check valve dampers have been replaced.

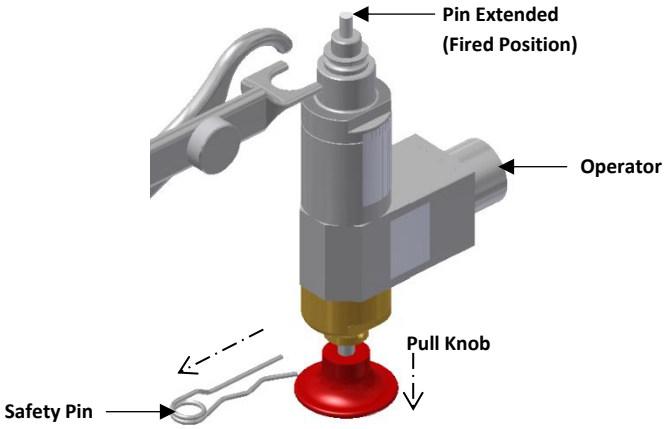


3 Inch Check Valve (P/N 70-317)

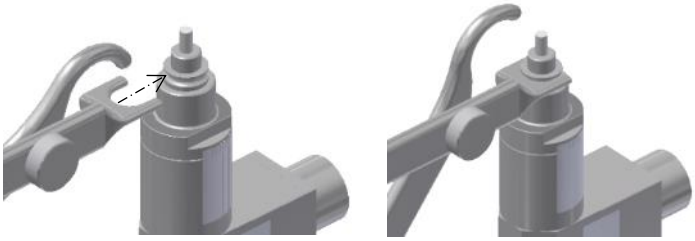
6.4. IVO, IVPO and UVO Reset Instructions

Reset Instructions using the 02-14782 Reset Multi Tool

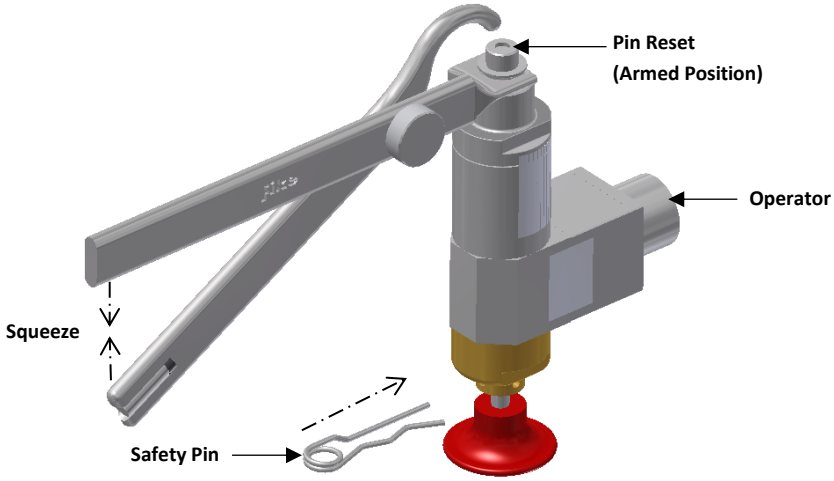
1. Disconnect the valve operator from the Impulse Valve actuator port by removing the operator supervisor (IVOS or UVOS) or retaining clip that secures the operator in place.
2. Remove the Safety Cotter Pin and pull the Manual Strike Button until a slight click is heard when the internal components are realigned. This step does not apply to the IVPO.



3. Align the forked end of the anvil handle around the grooved end of the Operator tip.

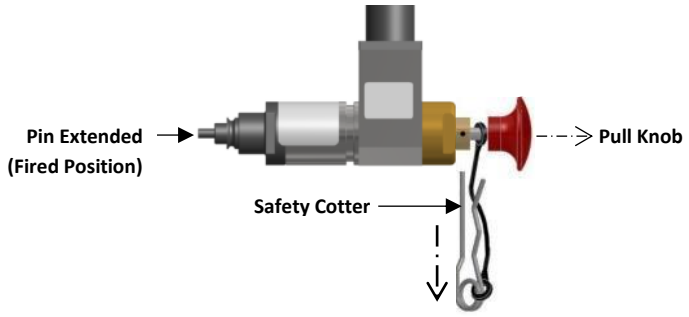


4. Squeeze reset tool handles until Operator Pin resets (clicks into place); then, reinsert the Safety Pin. The operator is reset and ready to be installed.

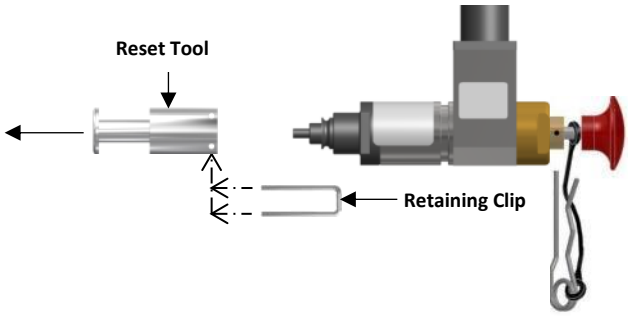


Reset Instructions using the 70-286 Reset Tool

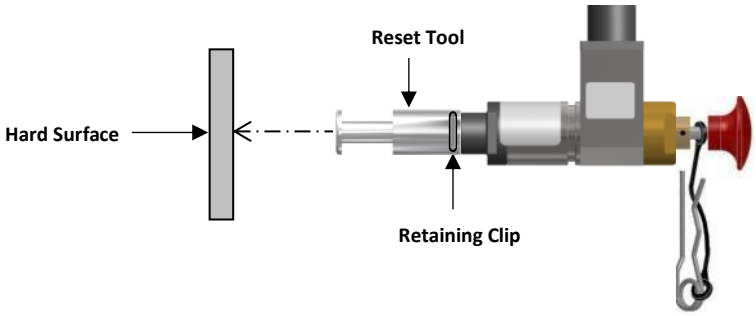
1. Disconnect the valve operator from the Impulse Valve actuator port by removing the operator supervisor (IVOS or UVOS) or retaining clip that secures the operator in place.
2. Remove the Safety Cotter Pin and pull the Manual Strike Button until the operator resets (clicks into place). This step does not apply to the IVPO.



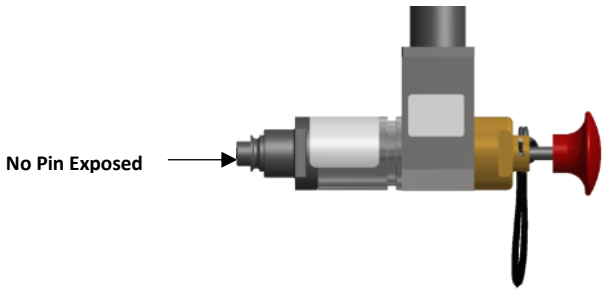
3. Insert the valve operator (IVO or UVO) into the end of the Reset Tool and secure in place with the retaining clip provided.



4. With the Reset Tool resting firmly against a hard surface, push on the valve operator until the firing pin resets (clicks into place).

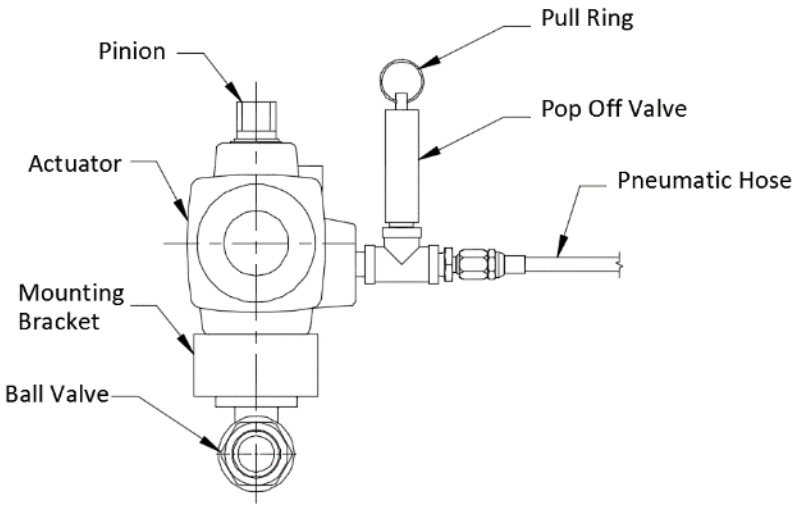


5. Reinsert the Safety Cotter Pin; then remove the Retaining Clip and the Reset Tool. The operator is reset and ready to be installed.



6.5. Selector Valve Reset Procedure

After a system discharge, the activated selector valve must be reset using the following procedure prior to returning the suppression system to normal operation.



Typical Selector Valve Configuration

Step 1. Insert a finger into the pop off valve pull ring mounted to the side of the selector valve actuator.

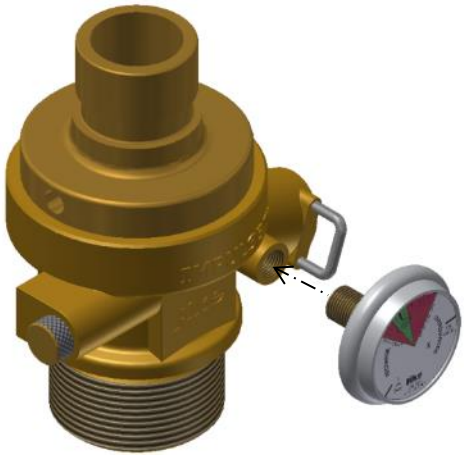
Step 2. Pull the ring up to open the valve to allow any stored pressure in the selector valve actuator or pneumatic actuation line to be released.

Step 3. Using a wrench, turn the actuator pinion clockwise (CW) to close the ball valve.

NOTE: This procedure must be performed for each activated selector valve.

6.6. Pressure Gauge Replacement Procedure

The following procedure is used to replace the pressure gauge on a charged container.



CAUTION: When replacing a pressure gauge, do not allow the pressure port to remain open (disconnected) for an extended period of time. A significant quantity of agent could be lost from the container.

Step 4. Place Teflon tape on the male thread connection of the replacement pressure gauge. DO NOT overlap the end of the connection - the first thread should be uncovered.

Step 5. Remove the old pressure gauge.

Step 6. Install the new pressure gauge.

Step 7. Check the assembly for leaks using a suitable leak test device.

Refer to Recharge Manual P/N 06-852 for recommendations and leak test procedures.

APPENDIX A – Engineered System Design Example

The following is an example of a Fike fire suppression system utilizing 3M™ Novec™ 1230 Fire Protection Fluid designed within the limitations established by Fike's UL listing and FM approval, and in compliance with NFPA 2001 using Fike's Flow Calculation Program reflecting the inputs required and showing the computer program output information.

HAZARD INFORMATION

Design Concentration: 4.5% (Minimum)

Temperature Range: 70° F. to 85° F.

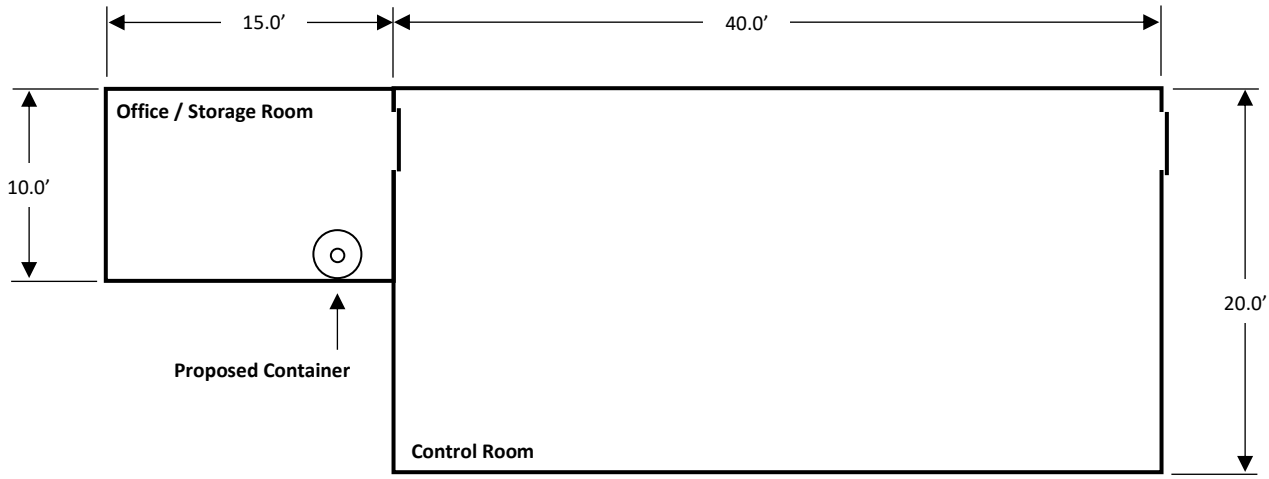
Enclosure Elevation: 0 Feet (Sea Level)

Room Height: 8.0'

Uncloseable Openings: None

No. of Nozzles:

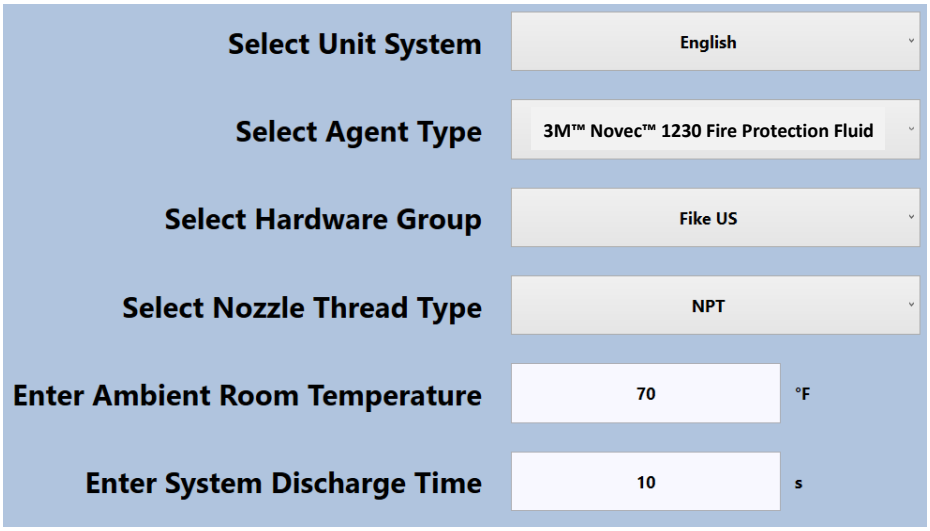
- Control Room: 2 - 360° Nozzles
- Office / Storage Room: 1 - 180° Nozzles



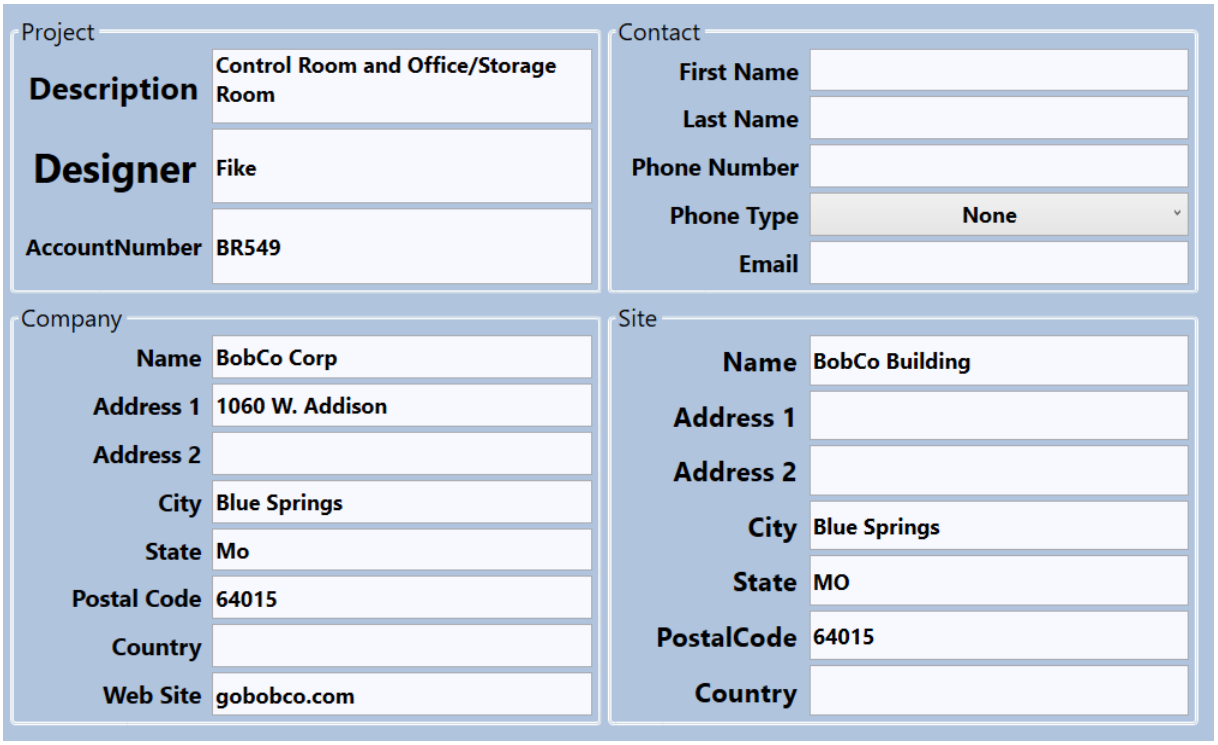
Floor Plan

INPUTS – FIKE'S FLOW CALCULATION PROGRAM

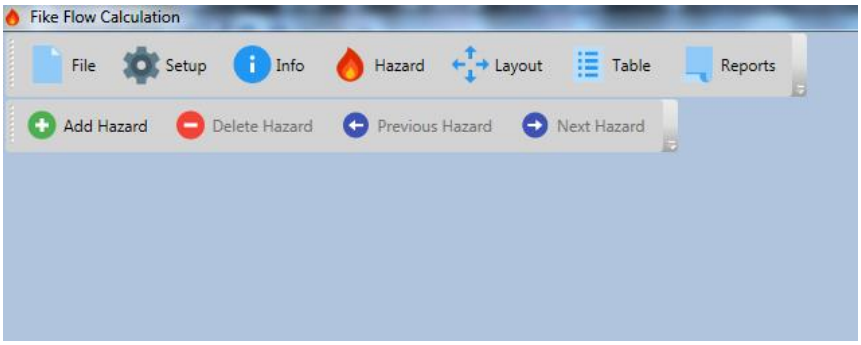
1) SETUP SCREEN FOR SELECTING UNITS OF MEASURE, TEMPERATURE AND DISCHARGE TIME



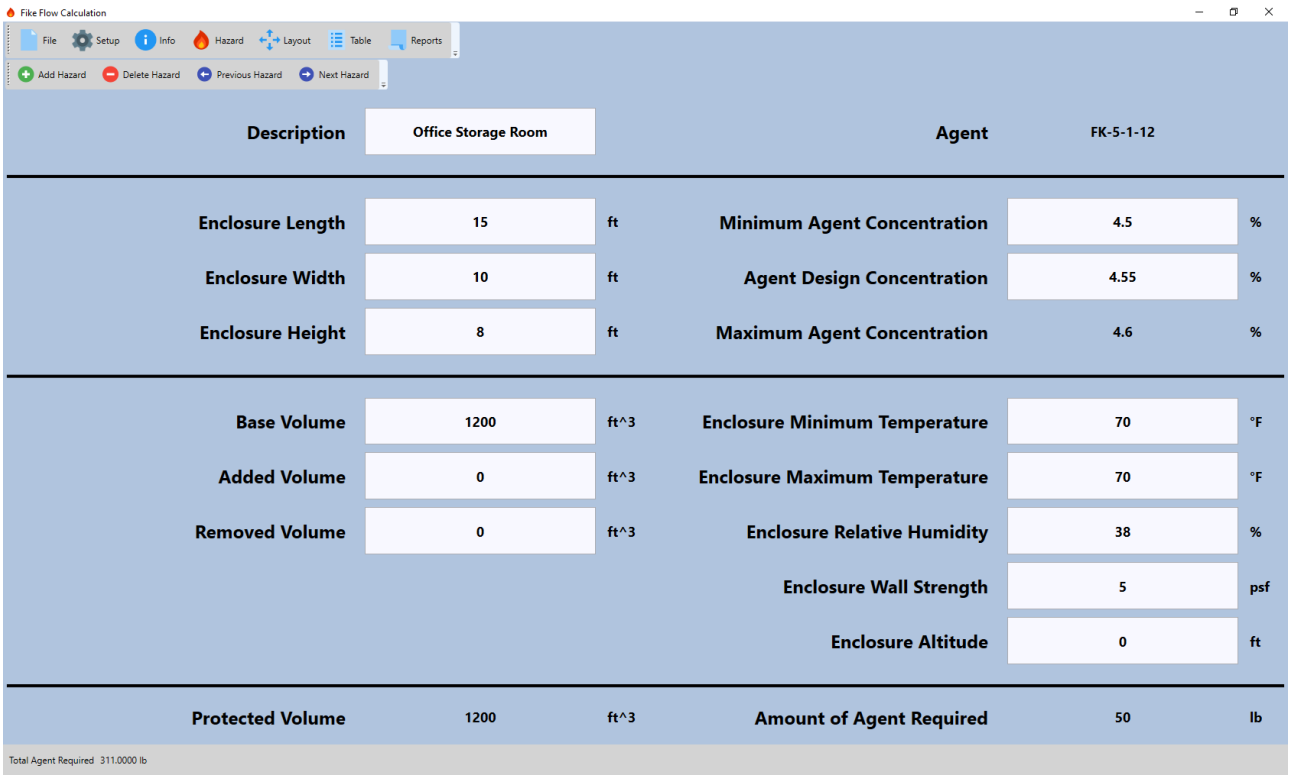
2) PROJECT INFORMATION SCREEN FOR SETTING UP CONTACT INFORMATION, JOB NAME, ETC.

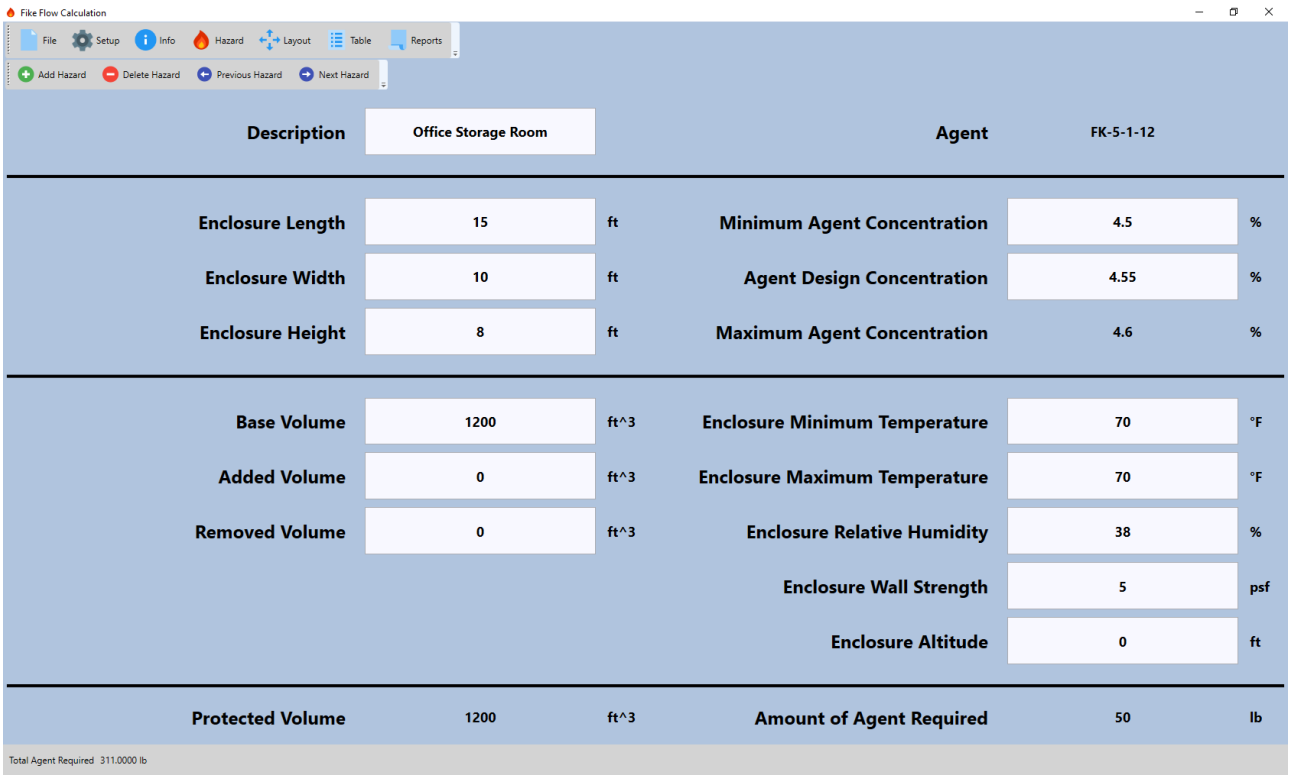


3) UTILIZE THE “ADD HAZARD” ICON TO ADD PROTECTED ENCLOSURES

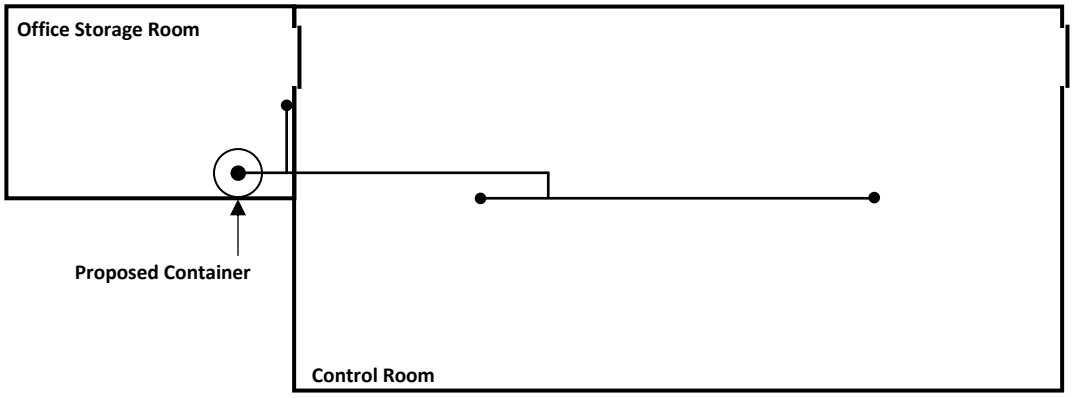


4) DEFINE THE HAZARDS



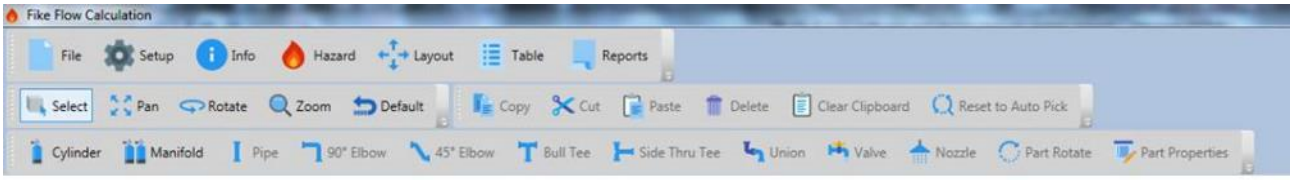


5) DEFINE THE PIPE NETWORK

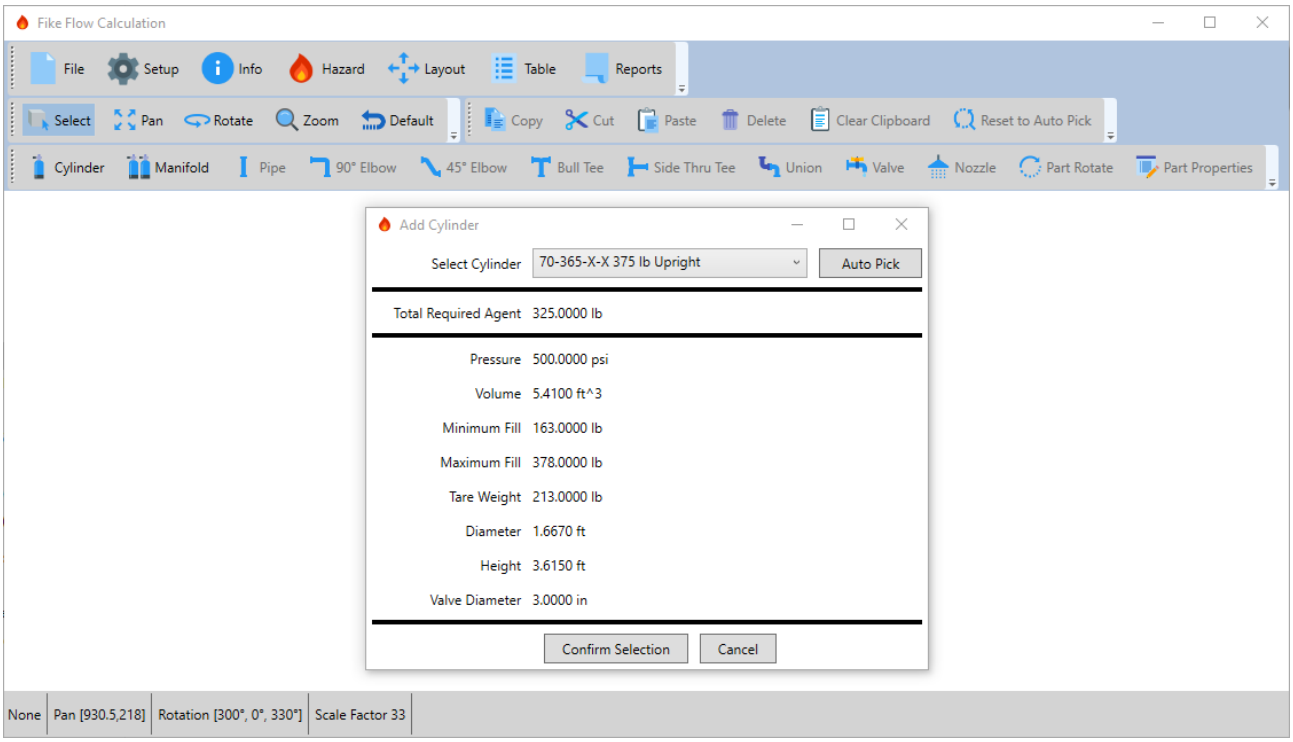


Pipe and Nozzle Network Layout

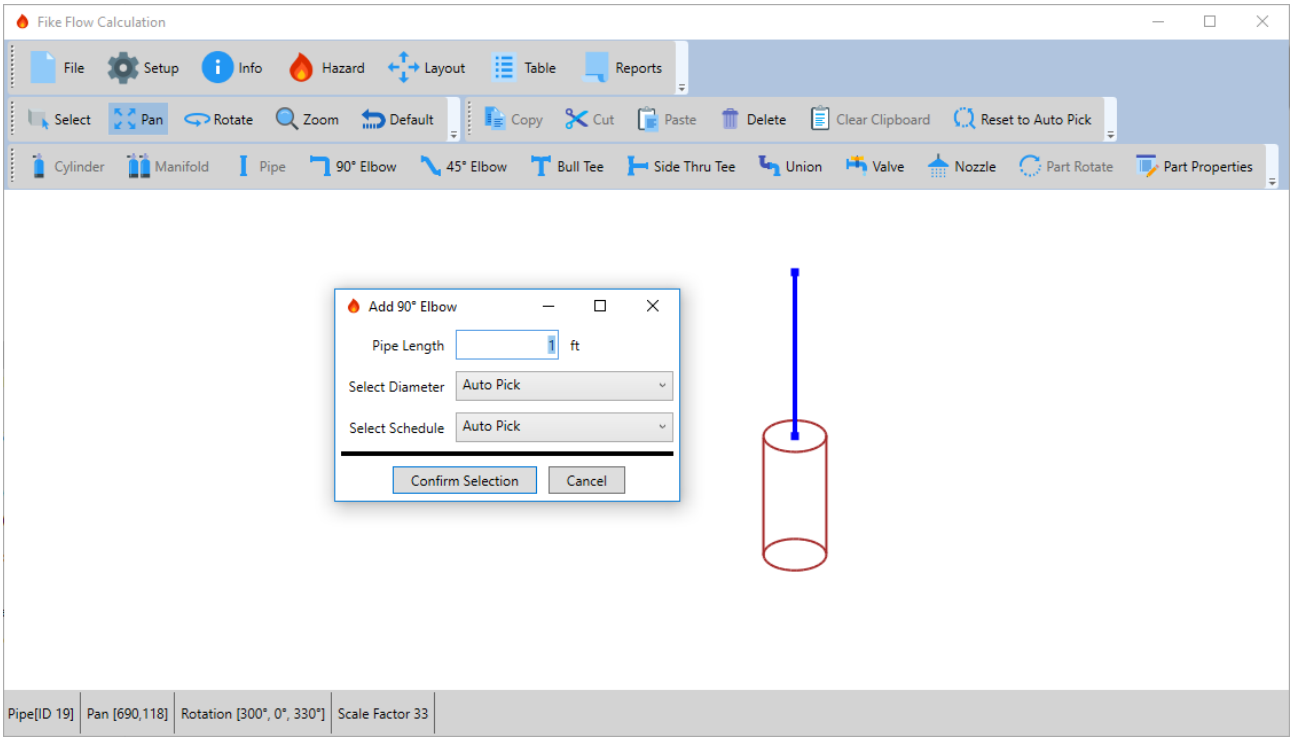
6) USE THE "LAYOUT" SCREEN TO DEFINE THE PIPE NETWORK



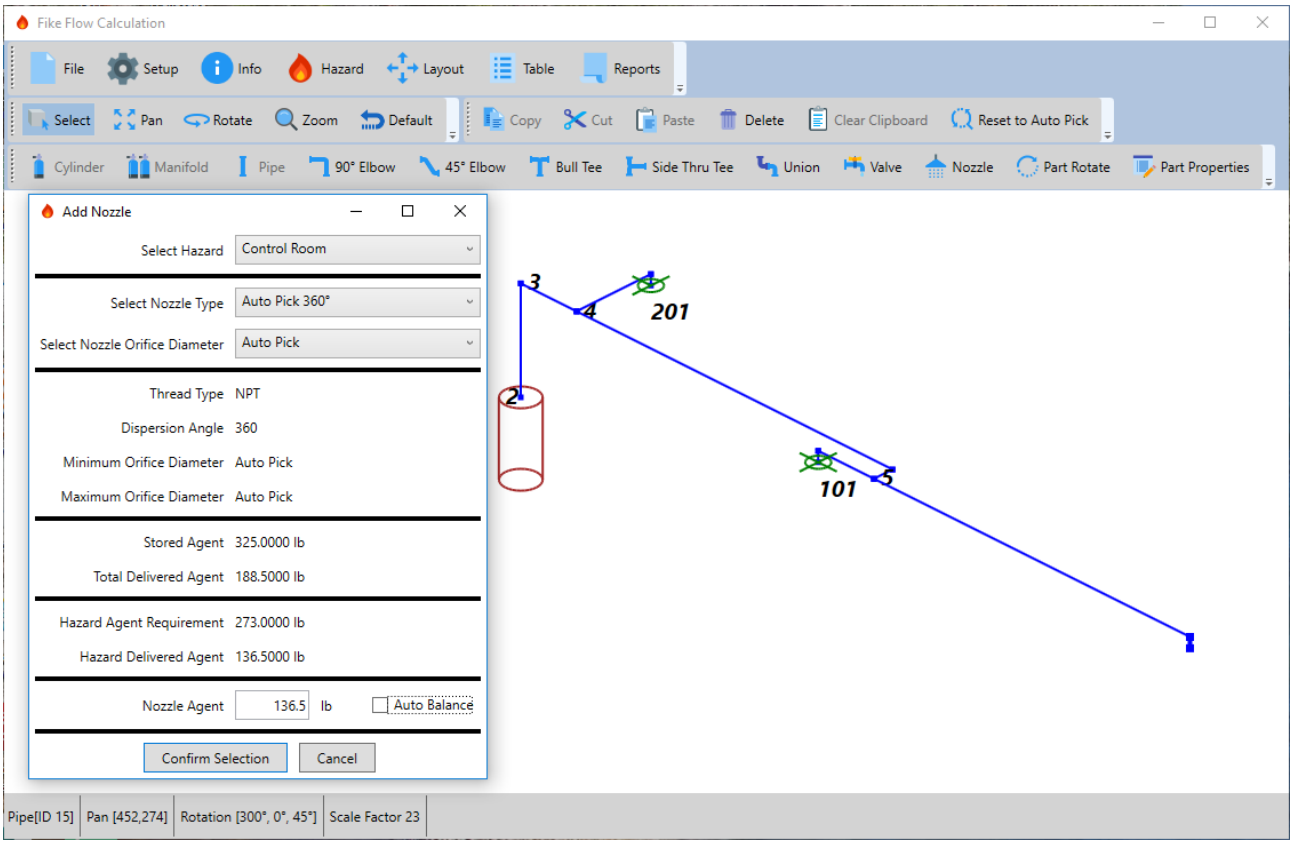
7) USE THE “CYLINDER” ICON TO DEFINE AND CONFIRM THE CYLINDER SIZE



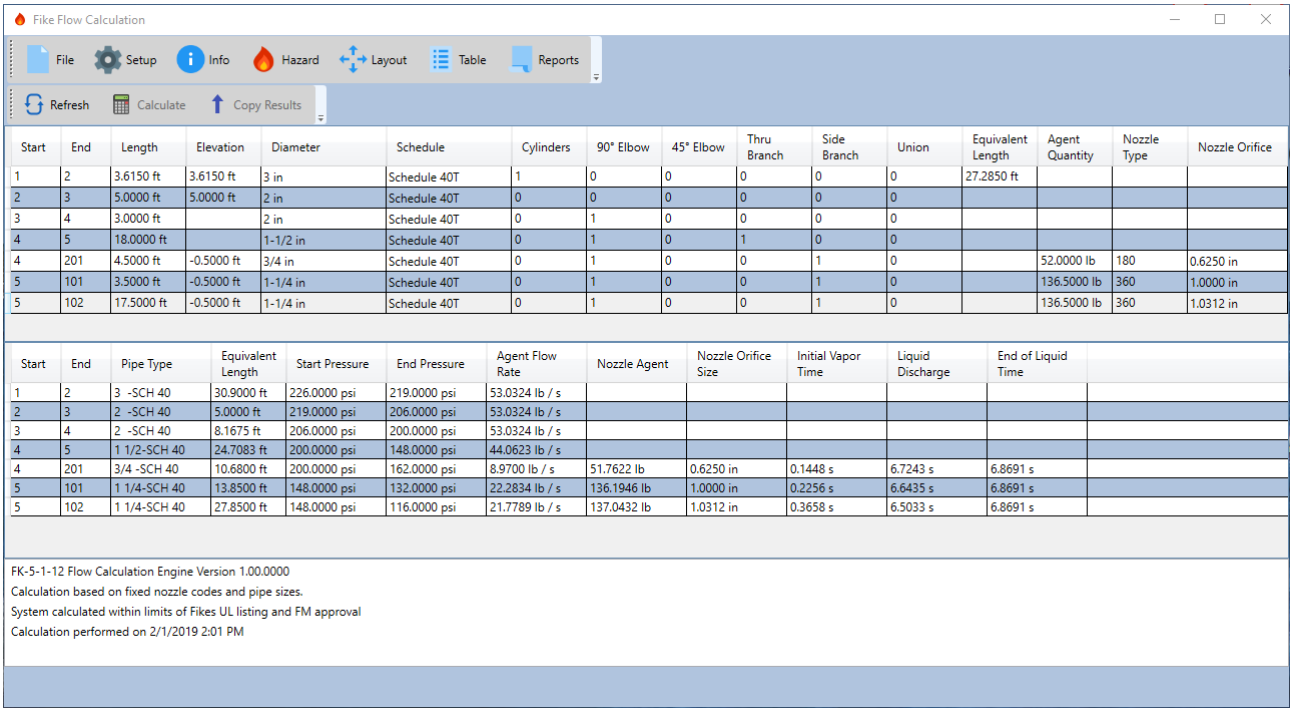
8) USE THE “PIPE”, “ELBOW” AND “TEE” ICONS TO LAYOUT THE PIPE NETWORK



9) USE THE “NOZZLE” ICON TO SELECT THE NOZZLE TYPE AND ASSIGN THE AGENT FLOW AMOUNT



10) USE THE “TABLE” SCREEN TO PREPARE TO RUN THE FLOW CALCULATION BY AUTOMATICALLY POPULATING THE INPUT TABLE



Start	End	Length	Elevation	Diameter	Schedule	Cylinders	90° Elbow	45° Elbow	Thru Branch	Side Branch	Union	Equivalent Length	Agent Quantity	Nozzle Type	Nozzle Orifice
1	2	3.6150 ft	3.6150 ft	3 in	Schedule 40T	1	0	0	0	0	0	27.2850 ft			
2	3	5.0000 ft	5.0000 ft	2 in	Schedule 40T	0	0	0	0	0	0				
3	4	3.0000 ft		2 in	Schedule 40T	0	1	0	0	0	0				
4	5	18.0000 ft		1-1/2 in	Schedule 40T	0	1	0	1	0	0				
4	201	4.5000 ft	-0.5000 ft	3/4 in	Schedule 40T	0	1	0	0	1	0		52.0000 lb	180	0.6250 in
5	101	3.5000 ft	-0.5000 ft	1-1/4 in	Schedule 40T	0	1	0	0	1	0		136.5000 lb	360	1.0000 in
5	102	17.5000 ft	-0.5000 ft	1-1/4 in	Schedule 40T	0	1	0	0	1	0		136.5000 lb	360	1.0312 in

Start	End	Pipe Type	Equivalent Length	Start Pressure	End Pressure	Agent Flow Rate	Nozzle Agent	Nozzle Orifice Size	Initial Vapor Time	Liquid Discharge	End of Liquid Time
1	2	3 -SCH 40	30.9000 ft	226.0000 psi	219.0000 psi	53.0324 lb / s					
2	3	2 -SCH 40	5.0000 ft	219.0000 psi	206.0000 psi	53.0324 lb / s					
3	4	2 -SCH 40	8.1675 ft	206.0000 psi	200.0000 psi	53.0324 lb / s					
4	5	1 1/2-SCH 40	24.7083 ft	200.0000 psi	148.0000 psi	44.0623 lb / s					
4	201	3/4 -SCH 40	10.6800 ft	200.0000 psi	162.0000 psi	8.9700 lb / s	51.7622 lb	0.6250 in	0.1448 s	6.7243 s	6.8691 s
5	101	1 1/4-SCH 40	13.8500 ft	148.0000 psi	132.0000 psi	22.2834 lb / s	136.1946 lb	1.0000 in	0.2256 s	6.6435 s	6.8691 s
5	102	1 1/4-SCH 40	27.8500 ft	148.0000 psi	116.0000 psi	21.7789 lb / s	137.0432 lb	1.0312 in	0.3658 s	6.5033 s	6.8691 s

11) SELECT THE “CALCULATE” ICON TO RUN THE FLOW CALCULATION

12) UPON COMPLETION OF THE CALCULATIONS, A PRINTABLE REPORT CAN BE GENERATED BY SELECTING THE "REPORTS" ICON

Flow Calculation Report

06-873 Fike Flow Calculation Version 2.2.0.11

Calculation Engine Version 1.00.0000

Project: C:\TEMP\Demo Calc-revised.ffc

Date Printed: 2/1/2019

System Acceptance Report

Nozzle Performance

Nozzle Number	Orifice Diameter	Agent Requested	Agent Predicted	Nozzle Pressure
201	0.6250 in	52.0000 lb	51.7622 lb	162.0000 psi
101	1.0000 in	136.5000 lb	136.1946 lb	132.0000 psi
102	1.0312 in	136.5000 lb	137.0432 lb	116.0000 psi

Agent Concentration Per Hazard

Hazard	Minimum Concentration	Design Concentration	Min Predicted Concentration	Max Predicted Concentration	Discharge Time
Control Room	4.5 %	4.7 %	4.7051 %	4.7051 %	6.8691 s
Office Storage Room	4.5 %	4.7 %	4.7514 %	4.7514 %	6.8691 s

Hazard Venting Requirements

Hazard	Positive (Flow Out) ELA	Negative (Flow In) ELA
Control Room	19.6865 in^2	296.0095 in^2
Office Storage Room	3.7276 in^2	56.0488 in^2

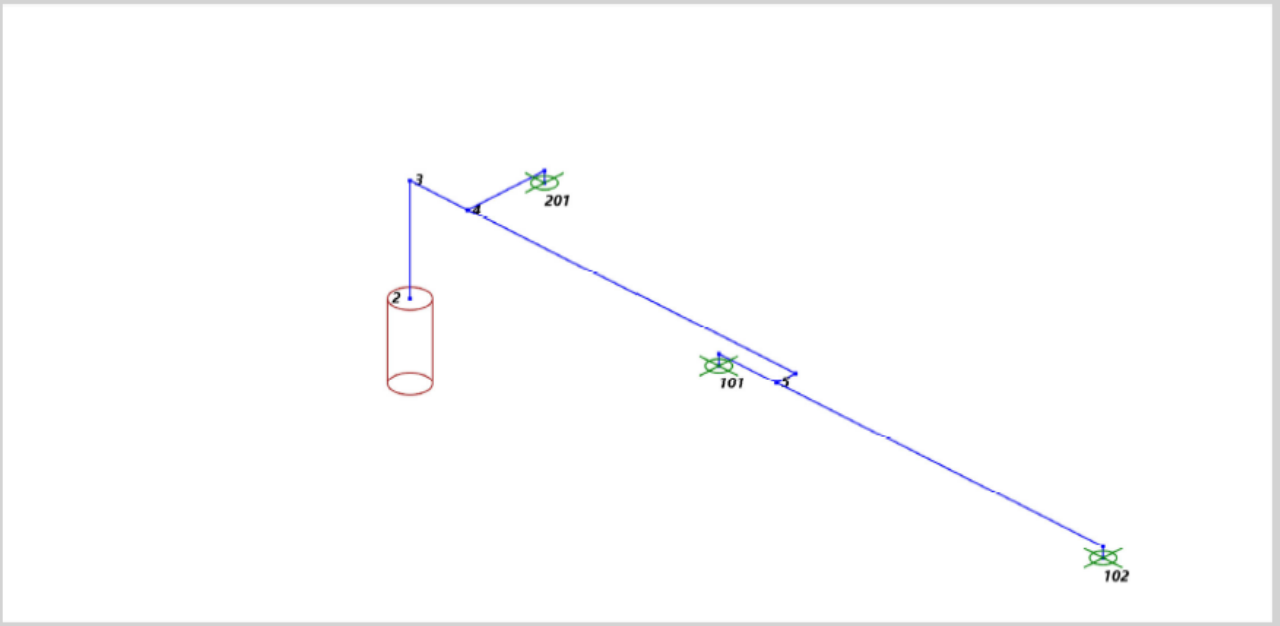
Project Setup	
Selected Agent Type:	3M™ Novec™ 1230 Fire Protection Fluid
Selected Hardware Group:	Fike US
Ambient Room Temperature:	70 °F
Discharge Time:	10 s
Project Information	
Description:	Control Room and Office/Storage Room
Designer:	Fike
Account Number:	BR549
Company Information	
Name:	BobCo Corp
Address:	1060 W. Addison
City:	Blue Springs
State/Province:	Mo
Postal Code:	64015
Country:	
Web Site:	gobobco.com
Site Information	
Name:	BobCo Building
Address:	
City:	Blue Springs
State/Province:	MO
Postal Code:	64015
Country:	

Hazard Information	
Description:	Control Room
Protecting Agent:	3M™ Novec™ 1230 Fire Protection Fluid
Protected Volume:	6400.00 ft^3
Minimum Temperature:	70 °F
Maximum Temperature:	70 °F
Altitude:	0 ft
Minimum Agent Concentration:	4.5 %
Agent Design Concentration:	4.7 %
Maximum Agent Concentration:	4.7 %
Agent Required:	273.0 lb

Hazard Information	
Description:	Office Storage Room
Protecting Agent:	3M™ Novec™ 1230 Fire Protection Fluid
Protected Volume:	1200.00 ft^3
Minimum Temperature:	70 °F
Maximum Temperature:	70 °F
Altitude:	0 ft
Minimum Agent Concentration:	4.5 %
Agent Design Concentration:	4.7 %
Maximum Agent Concentration:	4.8 %
Agent Required:	52.0 lb

Total Agent Required	
Agent Required for all Hazards:	325.0 lb

Pipe Network Layout



Cylinder Information

Description	Agent Qty	Pressure	Volume	Diameter	Height
70-365-X-X 375 lb Upright	325.0 lb	500 psi	5.4100 ft^3	1.6670 ft	3.6150 ft

Nozzle Information

Description	Requested Agent	Orifice	Thread	Dispersion Angle
80-122-075-X 3/4 in (20 mm)	52.0 lb	0.6250 in	NPT	180
80-124-125-X 1-1/4 in (32 mm)	136.5 lb	1.0000 in	NPT	360
80-124-125-X 1-1/4 in (32 mm)	136.5 lb	1.0312 in	NPT	360

Table Input Data

Start	End	Length	Elevation Change	Diameter	Schedule	Cylinder	90° Elbows	45° Elbows	Thru Branch	Side Branch	Union	Equiv Length	Agent Quantity	Nozz Type	Nozz Orifice
1	2	3.6150 ft	3.6150 ft	3 in	Schedule 40T	1	0	0	0	0	0	27.2850 ft			
2	3	5.0000 ft	5.0000 ft	2 in	Schedule 40T	0	0	0	0	0	0				
3	4	3.0000 ft		2 in	Schedule 40T	0	1	0	0	0	0				
4	5	18.0000 ft		1-1/2 in	Schedule 40T	0	1	0	1	0	0				
4	201	4.5000 ft	-0.5000 ft	3/4 in	Schedule 40T	0	1	0	0	1	0		52.0000 lb	180	0.6250 in
5	101	3.5000 ft	-0.5000 ft	1-1/4 in	Schedule 40T	0	1	0	0	1	0		136.5000 lb	360	1.0000 in
5	102	17.5000 ft	-0.5000 ft	1-1/4 in	Schedule 40T	0	1	0	0	1	0		136.5000 lb	360	1.0312 in

Table Results Data

Start	End	Pipe Type	Equivalent Length	Start Pressure	End Pressure	Agent Flow Rate	Nozzle Agent	Nozzle Orifice Size	Initial Vapor Time	Liquid Discharge Time	End of Liquid Time
1	2	3 -SCH 40	30.9000 ft	226.0000 psi	219.0000 psi	53.0324 lb / s					
2	3	2 -SCH 40	5.0000 ft	219.0000 psi	206.0000 psi	53.0324 lb / s					
3	4	2 -SCH 40	8.1675 ft	206.0000 psi	200.0000 psi	53.0324 lb / s					
4	5	1 1/2-SCH 40	24.7083 ft	200.0000 psi	148.0000 psi	44.0623 lb / s					
4	201	3/4 -SCH 40	10.6800 ft	200.0000 psi	162.0000 psi	8.9700 lb / s	51.7622 lb	0.6250 in	0.1448 s	6.7243 s	6.8691 s
5	101	1 1/4-SCH 40	13.8500 ft	148.0000 psi	132.0000 psi	22.2834 lb / s	136.1946 lb	1.0000 in	0.2256 s	6.6435 s	6.8691 s
5	102	1 1/4-SCH 40	27.8500 ft	148.0000 psi	116.0000 psi	21.7789 lb / s	137.0432 lb	1.0312 in	0.3658 s	6.5033 s	6.8691 s

Table Results Messages

Flow Calculation Engine Version 1.00.0000
Calculation based on fixed nozzle codes and pipe sizes.
System calculated within limits of Fikes UL listing and FM approval
Calculation performed on 2/1/2019 2:01 PM

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APPENDIX B – Safety Data Sheets

- **3M™ Novec™ 1230 Fire Protection Fluid**
- **Nitrogen**

These data sheets are only controlled while on the manufacturer's website. The controlled version is available for download from the manufacturer's website. The manufacturers cannot assure the integrity or accuracy of the SDS information contained in this document after it has been downloaded from their respective websites.

www.3M.com

www.praxair.com

Safety Data Sheet

Document Group:	16-3425-2	**Version Number:**	28.00
Issue Date:	02/05/15	**Supercedes Date:**	11/11/14

SECTION 1: Identification

1.1. Product identifier
3M™ Novec ™ 1230 Fire Protection Fluid [FK-5-1-12]

Product Identification Numbers
98-0212-3031-7, 98-0212-3203-2, 98-0212-3217-2, 98-0212-3371-7, 98-0212-3414-5, 98-0212-3588-6

1.2. Recommended use and restrictions on use

Recommended use
Streaming and Flooding Fire Protection

1.3. Supplier's details

MANUFACTURER:	3M
DIVISION:	Electronic Materials Solutions Division
ADDRESS:	3M Center, St. Paul, MN 55144-1000, USA
Telephone:	1-888-3M HELPS (1-888-364-3577)

1.4. Emergency telephone number
1-800-364-3577 or (651) 737-6501 (24 hours)

SECTION 2: Hazard identification

2.1. Hazard classification
Not classified as hazardous according to OSHA Hazard Communication Standard, 29 CFR 1910.1200.

2.2. Label elements
Signal word
Not applicable.

Symbols
Not applicable.

Pictograms
Not applicable.

2.3. Hazards not otherwise classified
None.

SECTION 3: Composition/information on ingredients

Ingredient	C.A.S. No.	% by Wt
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	756-13-8	> 99.9

SECTION 4: First aid measures

4.1. Description of first aid measures

Inhalation:
No need for first aid is anticipated.

Skin Contact:
Wash with soap and water. If signs/symptoms develop, get medical attention.

Eye Contact:
Flush with large amounts of water. Remove contact lenses if easy to do. Continue rinsing. If signs/symptoms persist, get medical attention.

If Swallowed:
Rinse mouth. If you feel unwell, get medical attention.

4.2. Most important symptoms and effects, both acute and delayed
See Section 11.1. Information on toxicological effects.

4.3. Indication of any immediate medical attention and special treatment required
Not applicable

SECTION 5: Fire-fighting measures

5.1. Suitable extinguishing media
Product is a fire-extinguishing agent. Material will not burn.

5.2. Special hazards arising from the substance or mixture
Exposure to extreme heat can give rise to thermal decomposition.

Hazardous Decomposition or By-Products

Substance	Condition
Carbon monoxide	During Combustion
Carbon dioxide	During Combustion
Toxic Vapor, Gas, Particulate	During Combustion

5.3. Special protective actions for fire-fighters
When fire fighting conditions are severe and total thermal decomposition of the product is possible, wear full protective clothing, including helmet, self-contained, positive pressure or pressure demand breathing apparatus, bunker coat and pants, bands around arms, waist and legs, face mask, and protective covering for exposed areas of the head.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures
Evacuate area. Ventilate the area with fresh air. Refer to other sections of this SDS for information regarding physical and

health hazards, respiratory protection, ventilation, and personal protective equipment.

6.2. Environmental precautions
Avoid release to the environment. For larger spills, cover drains and build dikes to prevent entry into sewer systems or bodies of water.

6.3. Methods and material for containment and cleaning up
Contain spill. Working from around the edges of the spill inward, cover with bentonite, vermiculite, or commercially available inorganic absorbent material. Mix in sufficient absorbent until it appears dry. Remember, adding an absorbent material does not remove a physical, health, or environmental hazard. Collect as much of the spilled material as possible. Place in a closed container approved for transportation by appropriate authorities. Clean up residue with an appropriate solvent selected by a qualified and authorized person. Ventilate the area with fresh air. Read and follow safety precautions on the solvent label and SDS. Seal the container. Dispose of collected material as soon as possible.

SECTION 7: Handling and storage

7.1. Precautions for safe handling
Do not breathe thermal decomposition products. For industrial or professional use only. Do not use in a confined area with minimal air exchange. Do not eat, drink or smoke when using this product. Wash thoroughly after handling. Avoid release to the environment.

7.2. Conditions for safe storage including any incompatibilities
Protect from sunlight. Store in a well-ventilated place. Store away from strong bases. Store away from other materials.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational exposure limits
If a component is disclosed in section 3 but does not appear in the table below, an occupational exposure limit is not available for the component.

Ingredient	C.A.S. No.	Agency	Limit type	Additional Comments
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	756-13-8	Manufacturer determined	TWA:150 ppm(1940 mg/m3)	

ACGIH : American Conference of Governmental Industrial Hygienists
AIHA : American Industrial Hygiene Association
CMRG : Chemical Manufacturer's Recommended Guidelines
OSHA : United States Department of Labor - Occupational Safety and Health Administration
TWA: Time-Weighted-Average
STEL: Short Term Exposure Limit
CEIL: Ceiling

8.2. Exposure controls

8.2.1. Engineering controls
Provide appropriate local exhaust when product is heated. For those situations where the material might be exposed to extreme overheating due to misuse or equipment failure, use with appropriate local exhaust ventilation sufficient to maintain levels of thermal decomposition products below their exposure guidelines. Use general dilution ventilation and/or local exhaust ventilation to control airborne exposures to below relevant Exposure Limits and/or control dust/fume/gas/mist/vapors/spray. If ventilation is not adequate, use respiratory protection equipment.

8.2.2. Personal protective equipment (PPE)

Eye/face protection

Eye protection not required.

Skin/hand protection
No protective gloves required.

Respiratory protection

Use a positive pressure supplied-air respirator if there is a potential for over exposure from an uncontrolled release, exposure levels are not known, or under any other circumstances where air-purifying respirators may not provide adequate protection. If thermal degradation products are expected, use a full facepiece supplied-air respirator.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

General Physical Form:	Liquid
Specific Physical Form:	Liquid
Odor, Color, Grade:	Clear colorless liquid with low odor
Odor threshold	*No Data Available*
pH	*Not Applicable*
Melting point	-108 ºC
Boiling Point	49 ºC [@ 760 mmHg]
Flash Point	No flash point
Evaporation rate	> 1 [*Ref Std:* BUOAC=1]
Flammability (solid, gas)	Not Applicable
Flammable Limits(LEL)	None detected
Flammable Limits(UEL)	None detected
Vapor Pressure	40.4 kPa [@ 25 ºC]
Vapor Density	11.6 [*Ref Std:* AIR=1]
Specific Gravity	1.6 [@ 68 ºF] [*Ref Std:* WATER=1]
Solubility in Water	Nil
Solubility- non-water	*No Data Available*
Partition coefficient: n-octanol/ water	*No Data Available*
Autoignition temperature	*Not Applicable*
Decomposition temperature	*No Data Available*
Viscosity	0.6 centipoise [@ 25 ºC]
Volatile Organic Compounds	1600 g/l [*Test Method:* calculated SCAQMD rule 443.1]
Percent volatile	100 %
VOC Less H2O & Exempt Solvents	1600 g/l [*Test Method:* calculated SCAQMD rule 443.1]

SECTION 10: Stability and reactivity

10.1. Reactivity
This material may be reactive with certain agents under certain conditions - see the remaining headings in this section.

10.2. Chemical stability
Stable.

10.3. Possibility of hazardous reactions
Hazardous polymerization will not occur.

10.4. Conditions to avoid
Light

10.5. Incompatible materials
Strong bases
Amines
Alcohols
Water

10.6. Hazardous decomposition products

Substance	Condition
Hydrogen Fluoride	At Elevated Temperatures - extreme conditions of heat

Refer to section 5.2 for hazardous decomposition products during combustion.

If the product is exposed to extreme condition of heat from misuse or equipment failure, toxic decomposition products that include hydrogen fluoride and perfluoroisobutylene can occur. Extreme heat arising from situations such as misuse or equipment failure can generate hydrogen fluoride as a decomposition product.

SECTION 11: Toxicological information

The information below may not be consistent with the material classification in Section 2 if specific ingredient classifications are mandated by a competent authority. In addition, toxicological data on ingredients may not be reflected in the material classification and/or the signs and symptoms of exposure, because an ingredient may be present below the threshold for labeling, an ingredient may not be available for exposure, or the data may not be relevant to the material as a whole.

11.1. Information on Toxicological effects

Signs and Symptoms of Exposure

Based on test data and/or information on the components, this material may produce the following health effects:

Inhalation:
No known health effects.

Skin Contact:
Contact with the skin during product use is not expected to result in significant irritation.

Eye Contact:
Contact with the eyes during product use is not expected to result in significant irritation.

Ingestion:
May be harmful if swallowed.

Toxicological Data
If a component is disclosed in section 3 but does not appear in a table below, either no data are available for that endpoint or the data are not sufficient for classification.

Acute Toxicity

Name	Route	Species	Value
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Dermal	Rat	LD50 > 2,000 mg/kg
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation-Vapor (4 hours)	Rat	LC50 > 1,227 mg/l
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Ingestion	Rat	LD50 > 2,000 mg/kg

ATE = acute toxicity estimate

Skin Corrosion/Irritation

Name	Species	Value
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Rabbit	No significant irritation

Serious Eye Damage/Irritation

Name	Species	Value
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Rabbit	No significant irritation

Skin Sensitization

Name	Species	Value
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Guinea pig	Not sensitizing

Respiratory Sensitization

For the component/components, either no data are currently available or the data are not sufficient for classification.

Germ Cell Mutagenicity

Name	Route	Value
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	In Vitro	Not mutagenic
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	In vivo	Not mutagenic

Carcinogenicity

For the component/components, either no data are currently available or the data are not sufficient for classification.

Reproductive Toxicity

Reproductive and/or Developmental Effects

Name	Route	Value	Species	Test Result	Exposure Duration
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation	Not toxic to female reproduction	Rat	NOAEL 3,000 ppm	premating & during gestation
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation	Not toxic to male reproduction	Rat	NOAEL 3,000 ppm	premating & during gestation
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation	Not toxic to development	Rat	NOAEL 3,000 ppm	premating & during gestation

Target Organ(s)

Specific Target Organ Toxicity - single exposure

Name	Route	Target Organ(s)	Value	Species	Test Result	Exposure Duration
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation	nervous system	All data are negative	Rat	NOAEL 100,000 ppm	2 hours
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation	cardiac sensitization	All data are negative	Dog	Sensitization Negative	17 minutes

Specific Target Organ Toxicity - repeated exposure

Name	Route	Target Organ(s)	Value	Species	Test Result	Exposure Duration
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation	liver | kidney and/or bladder	Some positive data exist, but the data are not sufficient for classification	Rat	NOAEL 3,000 ppm	90 days

1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	Inhalation	heart | endocrine system | hematopoietic system | muscles | nervous system | respiratory system | vascular system	All data are negative	Rat	NOAEL 3,000 ppm	90 days

Aspiration Hazard
For the component/components, either no data are currently available or the data are not sufficient for classification.

Please contact the address or phone number listed on the first page of the SDS for additional toxicological information on this material and/or its components.

SECTION 12: Ecological information

Ecotoxicological information

Test Organism	Test Type	Result
Green algae, Selenastrum capricornutum	72 hours Effect Concentration 50%	7.7 mg/l
Zebra Fish, Brachydanio rerio	96 hours Lethal Concentration 50%	>1200 mg/l
Water flea, Daphnia magna	48 hours Effect Concentration 50%	>1200 mg/l
Green algae, Selenastrum capricornutum	72 hours No obs Effect Conc	1.2 mg/l

Please contact the address or phone number listed on the first page of the SDS for additional ecotoxicological information on this material and/or its components.

Chemical fate information

Please contact the address or phone number listed on the first page of the SDS for additional chemical fate information on this material and/or its components.

SECTION 13: Disposal considerations

13.1. Disposal methods
Dispose of contents/ container in accordance with the local/regional/national/international regulations.

Dispose of waste product in a permitted industrial waste facility. As a disposal alternative, incinerate in a permitted waste incineration facility. Proper destruction may require the use of additional fuel during incineration processes. Combustion products will include halogen acid (HCl/HF/HBr). Facility must be capable of handling halogenated materials. Empty drums/barrels/containers used for transporting and handling hazardous chemicals (chemical substances/mixtures/preparations classified as Hazardous as per applicable regulations) shall be considered, stored, treated & disposed of as hazardous wastes unless otherwise defined by applicable waste regulations. Consult with the respective regulating authorities to determine the available treatment and disposal facilities.

EPA Hazardous Waste Number (RCRA): Not regulated

SECTION 14: Transport Information

For Transport Information, please visit **http://3M.com/Transportinfo** or call 1-800-364-3577 or 651-737-6501.

SECTION 15: Regulatory information

15.1. US Federal Regulations
Contact 3M for more information.

311/312 Hazard Categories:

Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No Immediate Hazard - No Delayed Hazard - No

15.2. State Regulations
Contact 3M for more information.

15.3. Chemical Inventories
The components of this product are in compliance with the new substance notification requirements of CEPA.

The components of this material are in compliance with the China "Measures on Environmental Management of New Chemical Substance". Certain restrictions may apply. Contact the selling division for additional information.

The components of this material are in compliance with the provisions of the Korean Toxic Chemical Control Law. Certain restrictions may apply. Contact the selling division for additional information.

The components of this material are in compliance with the provisions of Japan Chemical Substance Control Law. Certain restrictions may apply. Contact the selling division for additional information.

The components of this material are in compliance with the provisions of Philippines RA 6969 requirements. Certain restrictions may apply. Contact the selling division for additional information.

The components of this product are in compliance with the chemical notification requirements of TSCA.

Contact 3M for more information.

15.4. International Regulations
Contact 3M for more information.

This SDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 16: Other information

NFPA Hazard Classification
Health: 3 **Flammability:** 0 **Instability:** 1 **Special Hazards:** None

National Fire Protection Association (NFPA) hazard ratings are designed for use by emergency response personnel to address the hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies. Hazard ratings are primarily based on the inherent physical and toxic properties of the material but also include the toxic properties of combustion or decomposition products that are known to be generated in significant quantities.

HMIS Hazard Classification
Health: 1 **Flammability:** 0 **Physical Hazard:** 1 **Personal Protection:** X - See PPE section.

Hazardous Material Identification System (HMIS® III) hazard ratings are designed to inform employees of chemical hazards in the workplace. These ratings are based on the inherent properties of the material under expected conditions of normal use and are not intended for use in emergency situations. HMIS® III ratings are to be used with a fully implemented HMIS® III program. HMIS® is a registered mark of the American Coatings Association (ACA).

Document Group:	16-3425-2	**Version Number:**	28.00
Issue Date:	02/05/15	**Supercedes Date:**	11/11/14

DISCLAIMER: The information in this Safety Data Sheet (SDS) is believed to be correct as of the date issued. 3M MAKES

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3M USA SDSs are available at www.3M.com

SECTION: 1. Product and company identification

1.1. Product identifier

Product form	:	Substance
Name	:	Nitrogen, compressed
CAS No	:	7727-37-9
Formula	:	N2
Other means of identification	:	Dinitrogen, Refrigerant R728, Nitrogen, Medipure Nitrogen, Extendapak Nitrogen, Nitrogen - Diving Grade

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture	:	Industrial use Medical applications. Food applications. Diving Gas (Underwater Breathing)

1.3. Details of the supplier of the safety data sheet

Praxair, Inc.
39 Old Ridgebury Road
Danbury, CT 06810-5113 - USA
T 1-800-772-9247 (1-800-PRAXAIR) - F 1-716-879-2146
www.praxair.com

1.4. Emergency telephone number

Emergency number	:	Onsite Emergency: 1-800-645-4633 CHEMTREC, 24hr/day 7days/week — Within USA: 1-800-424-9300, Outside USA: 001-703-527-3887 (collect calls accepted, Contract 17729)

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification (GHS-US)

Compressed gas H280

2.2. Label elements

GHS-US labeling

Hazard pictograms (GHS-US) :

GHS04

Signal word (GHS-US)	:	WARNING
Hazard statements (GHS-US)	:	H280 - CONTAINS GAS UNDER PRESSURE; MAY EXPLODE IF HEATED OSHA-H01 - MAY DISPLACE OXYGEN AND CAUSE RAPID SUFFOCATION.
Precautionary statements (GHS-US)	:	P202 - Do not handle until all safety precautions have been read and understood P271+P403 - Use and store only outdoors or in a well-ventilated place. CGA-PG05 - Use a back flow preventive device in the piping. CGA-PG10 - Use only with equipment rated for cylinder pressure. CGA-PG06 - Close valve after each use and when empty. CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C (125°F).

2.3. Other hazards

No additional information available

2.4. Unknown acute toxicity (GHS-US)

No data available

SECTION 3: Composition/information on ingredients

3.1. Substance

Name : Nitrogen, compressed

CAS No : 7727-37-9

Name	Product identifier	%
Nitrogen	(CAS No) 7727-37-9	99.5 - 100

3.2. Mixture

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : Immediately remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, qualified personnel may give oxygen. Call a physician.

First-aid measures after skin contact : Adverse effects not expected from this product.

First-aid measures after eye contact : Adverse effects not expected from this product. In case of eye irritation: Rinse immediately with plenty of water. Consult an ophthalmologist if irritation persists.

First-aid measures after ingestion : Ingestion is not considered a potential route of exposure.

4.2. Most important symptoms and effects, both acute and delayed

No additional information available

4.3. Indication of any immediate medical attention and special treatment needed

None.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Use extinguishing media appropriate for surrounding fire.

5.2. Special hazards arising from the substance or mixture

Reactivity : Under certain conditions, nitrogen can react violently with lithium, neodymium, titanium (above 1472°F/800°C), and magnesium to form nitrides. At high temperature, it can also combine with oxygen and hydrogen.

5.3. Advice for firefighters

Firefighting instructions : Evacuate all personnel from the danger area. Use self-contained breathing apparatus (SCBA) and protective clothing. Immediately cool containers with water from maximum distance. Stop flow of gas if safe to do so, while continuing cooling water spray. Remove ignition sources if safe to do so. Remove containers from area of fire if safe to do so. On-site fire brigades must comply with OSHA 29 CFR 1910.156 and applicable standards under 29 CFR 1910 Subpart L—Fire Protection.

Protection during firefighting : Compressed gas: asphyxiant. Suffocation hazard by lack of oxygen.

Special protective equipment for fire fighters : Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters.

Specific methods : Use fire control measures appropriate for the surrounding fire. Exposure to fire and heat radiation may cause gas containers to rupture. Cool endangered containers with water spray jet from a protected position. Prevent water used in emergency cases from entering sewers and drainage systems.

Stop flow of product if safe to do so.

Use water spray or fog to knock down fire fumes if possible.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : Evacuate area. Ensure adequate air ventilation. Wear self-contained breathing apparatus when entering area unless atmosphere is proven to be safe. Stop leak if safe to do so.

6.1.1. For non-emergency personnel

No additional information available

6.1.2. For emergency responders

No additional information available

6.2. Environmental precautions

No additional information available

6.3. Methods and material for containment and cleaning up

No additional information available

6.4. Reference to other sections

See also sections 8 and 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Wear leather safety gloves and safety shoes when handling cylinders. Protect cylinders from physical damage; do not drag, roll, slide or drop. While moving cylinder, always keep in place removable valve cover. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Never insert an object (e.g., wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Slowly open the valve. If the valve is hard to open, discontinue use and contact your supplier. Close the container valve after each use; keep closed even when empty. Never apply flame or localized heat directly to any part of the container. High temperatures may damage the container and could cause the pressure relief device to fail prematurely, venting the container contents. For other precautions in using this product, see section 16.

Safe use of the product : **The suitability of this product as a component in underwater breathing gas mixtures** is to be determined by or under the supervision of personnel experienced in the use of underwater breathing gas mixtures and familiar with the physiological effects, methods employed, frequency and duration of use, hazards, side effects, and precautions to be taken.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Store in a cool, well-ventilated place. Store and use with adequate ventilation. Store only where temperature will not exceed 125°F (52°C). Firmly secure containers upright to keep them from falling or being knocked over. Install valve protection cap, if provided, firmly in place by hand. Store full and empty containers separately. Use a first-in, first-out inventory system to prevent storing full containers for long periods.

OTHER PRECAUTIONS FOR HANDLING, STORAGE, AND USE: When handling product under pressure, use piping and equipment adequately designed to withstand the pressures to be encountered. Never work on a pressurized system. Use a back flow preventive device in the piping. Gases can cause rapid suffocation because of oxygen deficiency; store and use with adequate ventilation. If a leak occurs, close the container valve and blow down the system in a safe and environmentally correct manner in compliance with all international, federal/national, state/provincial, and local laws; then repair the leak. Never place a container where it may become part of an electrical circuit.

7.3. Specific end use(s)

None.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Nitrogen, compressed (7727-37-9)	
ACGIH	Not established
USA OSHA	Not established

Nitrogen (7727-37-9)	
ACGIH	Not established
USA OSHA	Not established

8.2. Exposure controls

Appropriate engineering controls	: Use a local exhaust system with sufficient flow velocity to maintain an adequate supply of air in the worker's breathing zone. Mechanical (general): General exhaust ventilation may be acceptable if it can maintain an adequate supply of air.
Eye protection	: Wear safety glasses with side shields.
Skin and body protection	: Wear metatarsal shoes and work gloves for cylinder handling, and protective clothing where needed. Wear appropriate chemical gloves during cylinder changeout or wherever contact with product is possible. Select per OSHA 29 CFR 1910.132, 1910.136, and 1910.138.
Respiratory protection	: When workplace conditions warrant respirator use, follow a respiratory protection program that meets OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable). Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure that the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure (e.g., an organic vapor cartridge). For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA).

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	: Gas
Appearance	: Colorless gas.
Molecular mass	: 28 g/mol
Color	: Colorless.
Odor	: No odor warning properties.
Odor threshold	: No data available
pH	: Not applicable.
Relative evaporation rate (butyl acetate=1)	: No data available
Relative evaporation rate (ether=1)	: Not applicable.
Melting point	: -210 °C
Freezing point	: No data available
Boiling point	: -195.8 °C
Flash point	: No data available
Critical temperature	: -149.9 °C
Auto-ignition temperature	: Not applicable.
Decomposition temperature	: No data available
Flammability (solid, gas)	: No data available
Vapor pressure	: Not applicable.
Critical pressure	: 3390 kPa
Relative vapor density at 20 °C	: No data available
Relative density	: No data available
Density	: 1.16 kg/m³
Relative gas density	: 0.97
Solubility	: Water: 20 mg/l
Log Pow	: Not applicable.
Log Kow	: Not applicable.
Viscosity, kinematic	: Not applicable.
Viscosity, dynamic	: Not applicable.
Explosive properties	: Not applicable.
Oxidizing properties	: None.
Explosion limits	: No data available

9.2. Other information

Gas group	: Compressed gas
Additional information	: None.

SECTION 10: Stability and reactivity

10.1. Reactivity

Under certain conditions, nitrogen can react violently with lithium, neodymium, titanium (above 1472°F/800°C), and magnesium to form nitrides. At high temperature, it can also combine with oxygen and hydrogen.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

May occur.

10.4. Conditions to avoid

None under recommended storage and handling conditions (see section 7).

10.5. Incompatible materials

None.

10.6. Hazardous decomposition products

None.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Not classified

Skin corrosion/irritation : Not classified

pH: Not applicable.

Serious eye damage/irritation : Not classified

pH: Not applicable.

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Reproductive toxicity : Not classified

Specific target organ toxicity (single exposure) : Not classified

Specific target organ toxicity (repeated exposure) : Not classified

Aspiration hazard : Not classified

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : No ecological damage caused by this product.

12.2. Persistence and degradability

Nitrogen, compressed (7727-37-9)	
Persistence and degradability	No ecological damage caused by this product.

Nitrogen (7727-37-9)	
Persistence and degradability	No ecological damage caused by this product.

12.3. Bioaccumulative potential

Nitrogen, compressed (7727-37-9)	
Log Pow	Not applicable.
Log Kow	Not applicable.
Bioaccumulative potential	No ecological damage caused by this product.

Nitrogen (7727-37-9)	
Log Pow	Not applicable for inorganic gases.
Log Kow	Not applicable.
Bioaccumulative potential	No ecological damage caused by this product.

12.4. Mobility in soil

Nitrogen, compressed (7727-37-9)	
Mobility in soil	No data available.
Ecology - soil	No ecological damage caused by this product.

Nitrogen (7727-37-9)	
Mobility in soil	No data available.
Ecology - soil	No ecological damage caused by this product.

12.5. Other adverse effects

Effect on ozone layer : None.

Effect on the global warming : None.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

SECTION 14: Transport information

In accordance with DOT

Transport document description : UN1066 Nitrogen, compressed, 2.2

UN-No.(DOT) : UN1066

Proper Shipping Name (DOT) : Nitrogen, compressed

Transport hazard class(es) (DOT) : 2.2 - Class 2.2 - Non-flammable compressed gas 49 CFR 173.115

Hazard labels (DOT) : 2.2 - Non-flammable gas

Additional information

Emergency Response Guide (ERG) Number : 121 (UN1066);120 (UN1977)

Other information : No supplementary information available.

Special transport precautions : Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers: - Ensure there is adequate ventilation. - Ensure that containers are firmly secured. - Ensure cylinder valve is closed and not leaking. - Ensure valve outlet cap nut or plug (where provided) is correctly fitted. - Ensure valve protection device (where provided) is correctly fitted.

Transport by sea

UN-No. (IMDG) : 1066

Proper Shipping Name (IMDG) : NITROGEN, COMPRESSED

Class (IMDG) : 2 - Gases

MFAG-No : 121

Air transport

UN-No.(IATA) : 1066

Proper Shipping Name (IATA) : Nitrogen, compressed

Class (IATA)	: 2
Civil Aeronautics Law	: Gases under pressure/Gases nonflammable nontoxic under pressure

SECTION 15: Regulatory information

15.1. US Federal regulations

Nitrogen, compressed (7727-37-9)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
SARA Section 311/312 Hazard Classes	Sudden release of pressure hazard

15.2. International regulations

CANADA

Nitrogen, compressed (7727-37-9)
Listed on the Canadian DSL (Domestic Substances List)

Nitrogen (7727-37-9)
Listed on the Canadian DSL (Domestic Substances List)

EU-Regulations

Nitrogen, compressed (7727-37-9)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

15.2.2. National regulations

Nitrogen, compressed (7727-37-9)
Listed on the AICS (Australian Inventory of Chemical Substances) Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on the Korean ECL (Existing Chemicals List) Listed on NZIoC (New Zealand Inventory of Chemicals) Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances)

15.3. US State regulations

Nitrogen, compressed(7727-37-9)	
U.S. - California - Proposition 65 - Carcinogens List	No
U.S. - California - Proposition 65 - Developmental Toxicity	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Female	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No
State or local regulations	U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List

Nitrogen (7727-37-9)				
U.S. - California - Proposition 65 - Carcinogens List	U.S. - California - Proposition 65 - Developmental Toxicity	U.S. - California - Proposition 65 - Reproductive Toxicity - Female	U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No significance risk level (NSRL)
No	No	No	No	

Nitrogen (7727-37-9)
U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List

SECTION 16: Other information

Revision date : 6/24/2015 12:00:00 AM

Other information : When you mix two or more chemicals, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Before using any plastics, confirm their compatibility with this product.

Praxair asks users of this product to study this SDS and become aware of the product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this SDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Safety Data Sheet. Since the use of this information and the conditions of use are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.

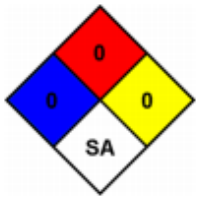
Praxair SDSs are furnished on sale or delivery by Praxair or the independent distributors and suppliers who package and sell our products. To obtain current SDSs for these products, contact your Praxair sales representative, local distributor, or supplier, or download from www.praxair.com. If you have questions regarding Praxair SDSs, would like the document number and date of the latest SDS, or would like the names of the Praxair suppliers in your area, phone or write the Praxair Call Center (Phone: 1-800-PRAXAIR/1-800-772-9247; Address: Praxair Call Center, Praxair, Inc., P.O. Box 44, Tonawanda, NY 14151-0044).

NFPA health hazard : 0 - Exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials.

NFPA fire hazard : 0 - Materials that will not burn.

NFPA reactivity : 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.

NFPA specific hazard : SA - This denotes gases which are simple asphyxiants.



HMIS III Rating

Health : 0 Minimal Hazard - No significant risk to health

Flammability : 0 Minimal Hazard

Physical : 3 Serious Hazard

SDS US (GHS HazCom 2012) - Praxair

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

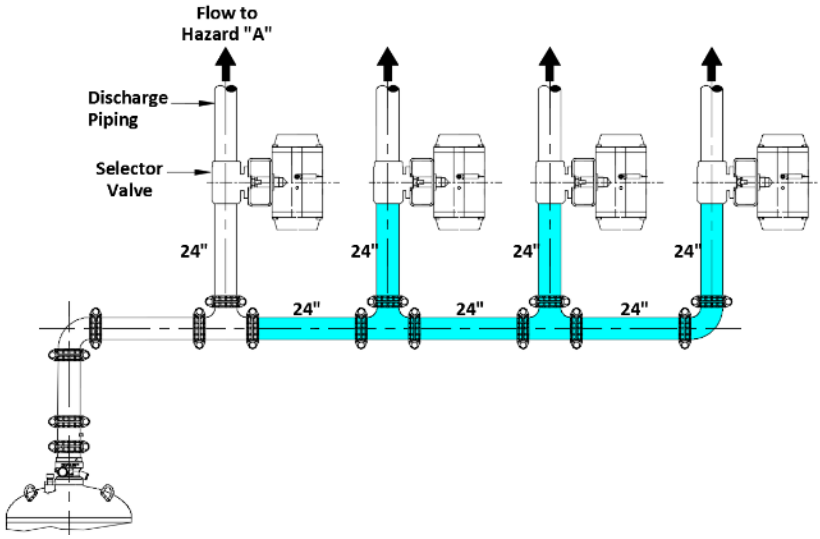
APPENDIX C – Selector Valve Calculation Example

In the following example, selector valves are being utilized to protect four rooms of equal size requiring 326 lbs. of agent. Individual flow calculations have been run for each hazard and 1 ¼" schedule 40 pipe has been selected for the piping leading up to the selector valves.

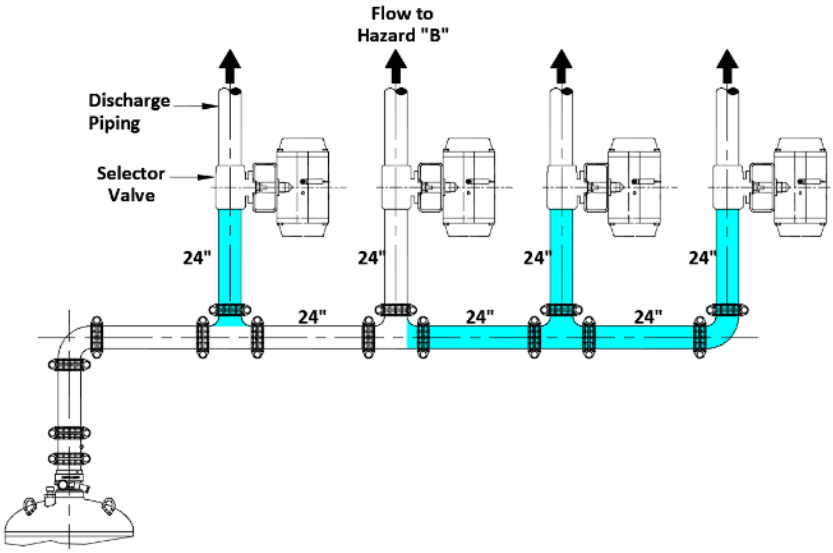
To determine the maximum total length of 1 ¼" pipe allowed to entrap agent during discharge, multiply the agent quantity (i.e., 326 lbs.) by the multiplier taken from the table on Page 55 for 1 ¼" schedule 40 pipe.

326 lbs. x 0.096420 = 31.43 feet allowed

Evaluate the piping network to determine which selector valve (if activated) would cause the greatest amount of agent to become entrapped in the pipe network. This is done by totaling the length of each pipe section where the agent will be entrapped with no flow. If in doubt as to which selector valve presents the worst case scenario, evaluate each selector valve individually.

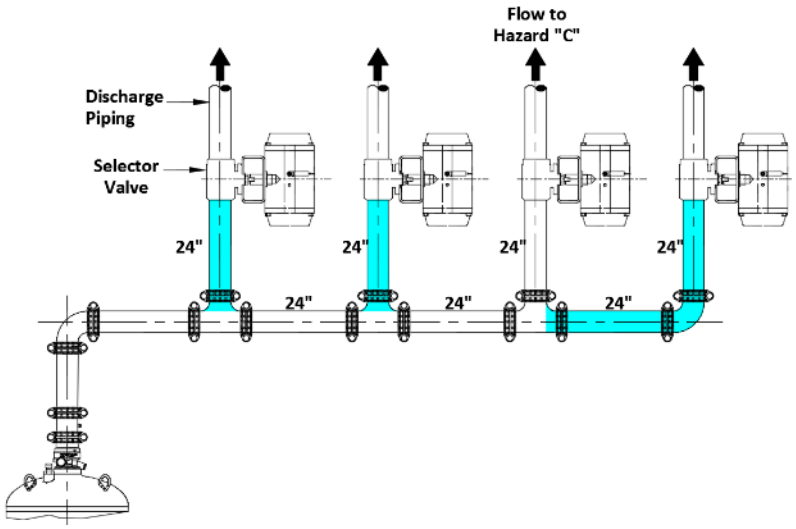


Agent Flow to Hazard "A"
(24 inches x 6 = 12 feet of 1 ¼" pipe)

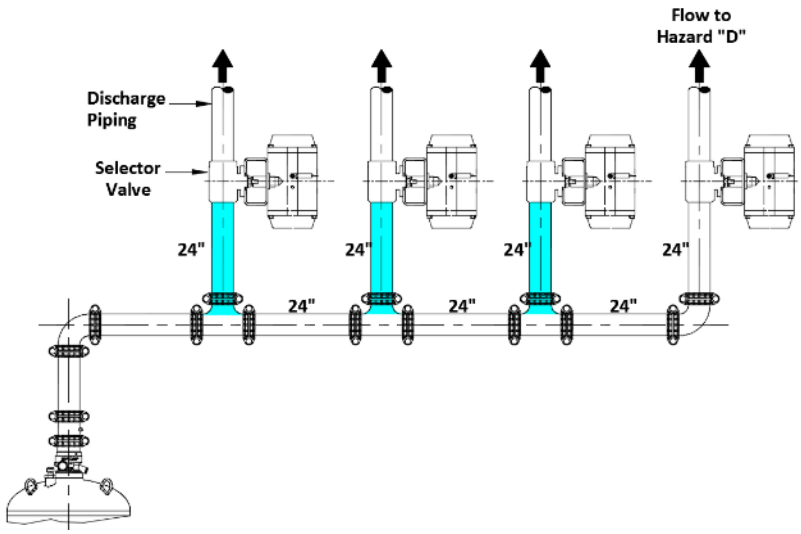


Agent Flow to Hazard "B"
(24 inches x 5 = 10 feet of 1 ¼" pipe)

NOTE: Shaded pipe indicates areas of agent entrapment.



Agent Flow to Hazard "C"
(24 inches x 4 = 8 feet of 1 ¼" pipe)



Agent Flow to Hazard "D"
(24 inches x 3 = 6 feet of 1 ¼" pipe)

NOTE: Shaded pipe indicates areas of agent entrapment.

Compare the allowable pipe length against the designed pipe network that serves the selector valves.

Hazard "A" = 12 feet of pipe allowing agent entrapment
Hazard "B" = 10 feet of pipe allowing agent entrapment
Hazard "C" = 8 feet of pipe allowing agent entrapment
Hazard "D" = 6 feet of pipe allowing agent entrapment

As long as the quantity of pipe that allows the entrapment of agent does not exceed the allowable pipe length of 31.43 feet, the piping network serving the selector valve is acceptable. If exceeded, the piping network must be modified.

REVISION HISTORY

ORIGINAL RELEASE DATE: ..... June, 2019

REVISION / DESCRIPTION OF CHANGE **REVISION DATE**

Revision 1..... September, 2019

1) Revised container weights and heights in Sections 2.2, 3.11 and 4.1.
2) Updated IVO Kit 70-279 in Sections 2.8 and 2.11 (removed plastic cap and cotter pin).
3) Increased ceiling height maximum from 13.45 ft to 16.00 ft in Sections 3.15.1 and 3.15.2.
4) Added FM note in Section 2.18.

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