

EQUIPMENT, DESIGN & SERVICE MANUAL



FIRE EXTINGUISHING SYSTEM

W/ HFC-125 AGENT

DOT / TC CONTAINERS

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

UL / ULC LISTINGS

FM APPROVALS

NFPA 2001 STANDARD



U.S. & Foreign Patents

Doc. P/N 06-431

Rev. 10 / March, 2020

Fike[®]

SOLUTIONS

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

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TABLE OF CONTENTS

Section	Page No.
1. Introduction	1
2. System Components	2
2.1. ECARO-25 Extinguishing Clean Agent	2
2.2. Agent Storage Containers	4
2.3. Impulse Valve	6
2.3.1. Valve Recharge Kits	8
2.4. Pressure Gauge	9
2.5. Liquid Level Indicator (LLi)	10
2.6. Low Pressure Switch (LPS)	11
2.7. Mounting Straps and Brackets	12
2.8. Impulse Valve Operator (IVO)	13
2.9. Impulse Energetic Actuator (IEA)	14
2.10. Impulse Valve Pneumatic Operator (IVPO)	15
2.11. Impulse Valve Operator Supervisor (IVOS)	16
2.12. Discharge Pressure Switch (DPS)	17
2.13. Discharge Nozzles	18
2.14. Check Valves	19
2.15. Caution/Advisory Signs	20
2.16. Nitrogen Actuator Assembly	22
2.17. UVO Primary Completer Kit	23
2.18. UEA Primary Completer Kit	24
2.19. Secondary Completer Kit	25
2.20. Selector Valve Assembly	26
2.21. Suppression Disconnect Switch	28
3. System Design	28
3.1. Evaluate Enclosure Integrity	29
3.2. Subfloor Protection	30
3.3. Determine Hazard Classification	30
3.4. Determine Enclosure Volume	30
3.5. Calculate Reduced Volume	30
3.6. Determine Minimum Design Concentration	31
3.7. Determine Minimum Quantity of Agent Required	31
3.8. Apply Altitude Correction Factor	33

TABLE OF CONTENTS

Section	Page No.
3.9. Select System Design Concept.....	34
3.10. Select System Actuation Method	35
3.10.1. Single Container with IVO	35
3.10.2. Multiple Containers with IVOs	36
3.10.3. Two Containers with IVO and IVPO	37
3.10.4. Multiple Containers with Single IVO and Multiple IVPOs	38
3.10.5. Multiple Containers with Primary Nitrogen Actuator	39
3.10.6. Multiple Containers with Primary and Secondary Actuators.....	40
3.11. Select Container Size and Fill Range	41
3.12. Consider Container Manifold Options	41
3.13. Selector Valve Option	42
3.14. Determine Container Locations.....	43
3.15. Determine Nozzle Quantity and Placement	44
3.15.1. Evaluate Nozzle Area Coverage.....	45
3.15.2. Evaluate Nozzle Quantity Based on Enclosure Height.....	47
3.15.3. Evaluate Elevation Differences Between Pipe Runs	47
3.15.4. Evaluate Nozzle Discharge Obstructions	48
3.16. Determine Piping Layout.....	49
3.16.1. Evaluate Tee Split Ratios.....	49
3.16.2. Evaluate Tee Orientation	50
3.17. Estimate Pipe Sizes	51
3.18. Apply Tee Design Factor.....	52
3.19. Determine the Final Design Quantity Required.....	53
3.20. Determine Design Concentration at Maximum Temperature.....	53
3.21. Evaluate Exposure Limitations.....	53
3.22. Perform Flow Calculations	54
3.22.1. Percent Agent in Pipe	54
3.22.2. Location of First Tee	54
3.22.3. Liquid Arrival Time	54
3.22.4. Liquid Runout Time	55
3.22.5. Nozzle Orifice Area Limitations.....	55
3.23. Verify System Performance.....	55
3.24. Evaluate Selector Valve Pipe Design	55
3.25. Equivalent Length Values	56

TABLE OF CONTENTS

Section	Page No.
4. Installation	57
4.1. Agent Storage Container Floor Loading	57
4.2. Installing Agent Storage Containers.....	58
4.2.1. Mounting Detail for 5, 10, 20 and 35 lb. (2 , 4, 8.5 and 15 L) Containers	58
4.2.2. Mounting Detail for 60 lb. (27 L) Container	59
4.2.3. Mounting Detail for 150 lbs. (61 L) Container.....	61
4.2.4. Mounting Detail for 150i lb. (61 L) Container	62
4.2.5. Mounting Detail for 100, 215, 375, 650 and 1000 lb. (44, 88, 153, 267 and 423 L) Containers.....	63
4.3. Installing Distribution Piping	65
4.3.1. Pipe and Fitting Materials.....	65
4.3.2. Pipe Size Changes.....	65
4.3.3. General Piping Requirements	65
4.3.4. Manifolds.....	66
4.3.5. Pipe Hangers and Supports.....	68
4.3.6. Selector Valves.....	69
4.3.6.1. Selector Valve Activated by Primary Nitrogen Actuator Assembly.....	69
4.3.6.2. Selector Valve Activated by Secondary Nitrogen Actuator Assembly.....	71
4.3.7. Connect Distribution Piping to Container.....	73
4.4. Installing Low Pressure Switch	75
4.5. Installing Discharge Pressure Switch.....	76
4.6. Installing Discharge Nozzles	77
4.7. Installing System Actuation Components	78
4.7.1. Installing Impulse Valve Operator (IVO)	78
4.7.1.1. Impulse Valve Operator (IVO) Wiring	79
4.7.2. Installing Impulse Energetic Actuator (IEA)	79
4.7.2.1. Impulse Energetic Actuator (IEA) Wiring.....	80
4.7.3. Installing Impulse Valve Pneumatic Operator (IVPO)	80
4.7.4. Installing Impulse Valve Operator Supervisor (IVOS)	81
4.7.4.1. Impulse Valve Operator Supervisor (IVOS) Wiring	81
4.7.5. Installing Nitrogen Actuator Assembly	82
4.7.6. Installing UVO Primary Completer Kit	83
4.7.6.1. Universal Valve Operator (UVO) Wiring.....	84

TABLE OF CONTENTS

Section	Page No.
4.7.7. Installing UEA Primary Completer Kit	85
4.7.7.1. Universal Energetic Actuator (UEA) Wiring	86
4.7.8. Installing Pneumatic Relay Completer Kit	87
4.7.9. Installing Universal Valve Operator Supervisor (UVOS)	89
4.7.9.1. Universal Valve Operator Supervisor Wiring Diagram	89
4.8. Installing Pneumatic Actuation Lines	90
4.8.1. Two Containers with IVO and IVPO	90
4.8.2. Multiple Containers with IVO and IVPO	91
4.8.3. Multiple Containers with Primary Nitrogen Actuator	92
4.8.4. Multiple Containers with Primary and Secondary Nitrogen Actuators	94
5. Acceptance Testing	96
5.1. Pre-Checks and Visual Inspections	96
6. Maintenance	98
6.1. Container Recharge Procedure	100
6.2. Nitrogen Actuator Cylinder Recharge Procedure	101
6.3. 3 Inch Check Valve Damper Replacement Procedure	101
6.4. IVO, IVPO and UVO Reset Instructions	102
6.5. Selector Valve Reset Procedure	104
6.6. Pressure Gauge Replacement Procedure	104
Appendix A – Engineered System Design Example	105
Appendix B – Pre-Engineered Piping Limitations	117
Appendix C – Safety Data Sheets	120
Appendix D – Selector Valve Calculation Example	142
Revision History	

1. INTRODUCTION

The information presented in this manual represents the most up-to-date information available for Fike's ECARO-25 (HFC-125) suppression system. This manual also provides the information necessary to properly design, install and maintain the HFC-125 system 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 HFC-125 Clean Agent 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.

System Approvals

Fike HFC-125 systems may be UL/ULC Listed and/or FM 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. ECARO-25 Extinguishing Clean Agent

ECARO-25 (ASHRAE Designation HFC-125) 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

HFC-125 extinguishes a fire primarily through heat absorption that occurs as the agent changes from a liquid to a vapor during discharge. In addition, HFC-125 disrupts the combustion reaction which aids in the extinguishment of a fire. It is important to note that HFC-125 does not use oxygen displacement to extinguish a fire, therefore is safe for use in occupied spaces.

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

HFC-125 shall be used on the following class of hazards:

- Class A & C hazards including electrical and electronic hazards, telecommunication facilities and high value assets where the associated down-time would be costly

HFC-125 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 on the next page for maximum exposure times based on system design concentration.

Hazard Type	Design Concentration	Maximum Human Expose Time
Normally Occupied Space	8.0% to 11.5%	5 minutes
Not Normally Occupied Space	>11.5%	30 seconds

NOTE: Fike does not recommend HFC-125 systems to be used in any normally occupied spaces where the design concentration required is above 11.5%.

Physical Properties of HFC-125

Chemical Name/Formula	Pentafluoroethane / CHF ₂ CF ₃
CAS Number	354-33-6
Molecular Weight	120.02
Vapor Density @ 25°C (77°F) and atm, kg/m ³ (lb/ft ³)	4.982 m ³ (0.3111)
Vapor Pressure, Saturated at 25°C (77°F), bar (psia)	13 bar (200.4)
Boiling Point, 1 atm, °C (°F)	-48.14 (-54.7)
Freezing Point, °C (°F)	-103 (-153)
Solubility in Water in FE-25 at 25°C (77°F), ppm	700
Critical Temperature, °C (°F)	66.25 (151.25)
Critical Pressure, bar (psia)	36 (526.6)
Critical Volume, cc/mole	210
Critical Density, kg/m ³ (lb/ft ³)	571.9 (35.70)
Specific Heat, Liquid (CP) at 25°C (77°F), KJ/Kg- °C (Btu/lb°F)	1.37 (0.327)
Specific Heat, Vapor at (CP) at 25°C (77°F), KJ/Kg- °C (Btu/lb°F) and 1 atm	0.809 (0.193)
Heat of Vaporization @ Boiling Point KJ/Kg (Btu/lb)	164.4 (70.7)
Thermal Conductivity, Liquid at 25°C (77°F), W/m- °C (Btu/hr-ft°F)	0.0652 (0.0377)
Thermal Conductivity, Vapor at 25°C (77°F), W/m- °C (Btu/hr-ft°F)	0.0166 (0.0096)
Viscosity, Liquid at 25°C (77°F), cP (lb/ft-hr)	0.137
Viscosity, Vapor at 25°C (77°F), cP (lb/ft-hr)	0.013
Ozone Depletion Potential	0
Global Warming Potential (based on a 100-yr horizon relative to CO ₂)	2800
Inhalation Exposure Limit (AEL-8 and 12 hr. TWA), ppm	1000

2.2. Agent Storage Containers

The agent storage containers are painted steel containers available in various sizes and varying fill densities. Each container (except the 150 lb. inverted) 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 ECARO-25 fire extinguishing agent in 1 lb. (0.5 kg.) increments up to their maximum capacity and is then super-pressurized with dry nitrogen to 360 psig at 70°F (24.8 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	360 psig at 70°F (24.8 bar at 21°C) after filling with dry nitrogen
Storage Temperature Limitation ¹	32°F (0°C) Minimum to 120°F (48.9°C) Maximum
Safety Relief Range	If container pressure reaches 650 to 750 psi (44.8 to 51.7 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 lb.(0.5 kg)
Fill Range	25 to 56 lbs/ft ³ (400 to 897 kg/m ³)
Approvals ²	P/N ending in -3P : UL/ULC Listed and FM Approved P/N ending in -UL : UL/ULC Listed only

¹If container temperature exceeds 120°F (48.9°C), system performance may be affected.

²Fike containers may be UL/ULC Listed and/or FM Approved depending on where and how the containers were filled. Part number suffix on the container label, in addition to the agency's official markings, indicate what approvals a specific container has.

Container		Fill Range		Tare Weight	Dimensions (approximate)		Valve Size
Size	Base	Minimum	Maximum		Diameter	Height	
Lb. (L)	P/N	lbs. (kg)	lbs. (kg)	lbs. (kg)	in. (mm)	in. (mm)	in. (mm)
5 (2)	70-272	4 (2.0)		11 (5.0)	4.2 (102)	16.2 (411.5)	1 (25)
10 (4)	70-273	4 (2.0)	8 (3.5)	15 (6.8)	4.2 (102)	27.24 (691.9)	1 (25)
20 (8.5)	70-263	8 (3.5)	16 (7.5)	22 (10.0)	7.0 (178)	22.50 (571.5)	1 (25)
35 (15)	70-264	14 (6.5)	30 (13.5)	32.5 (14.7)	7.0 (178)	33.75 (857.3)	1 (25)
60 (27)	70-265	25 (11.5)	54 (24.5)	52.5 (23.8)	10.75 (273)	28.13 (714.4)	1 (25)
100 (44)	70-266	39 (18.0)	87 (39.0)	77 (34.9)	10.75 (273)	39.63 (1006.5)	1 (25)
150 (61)	70-267	54 (24.5)	120 (54.5)	118 (53.5)	20.0 (508)	24.25 (616.0))	3 (80)
150i (61)	70-267	54 (24.5)	120 (54.5)	114 (51.7)	20.0 (508)	24.25 (616.0))	3 (80)
215 (88)	70-268	78 (35.5)	173 (78.5)	146 (66.2)	20.0 (508)	30.13 (765.2)	3 (80)
375 (153)	70-269	136 (61.5)	302 (137.0)	213 (96.6)	20.0 (508)	43.38 (1101.7)	3 (80)
650 (267)	70-270	236 (107.0)	528 (239.5)	373 (169.2)	24.0 (610)	50.50 (1282.7)	3 (80)
1000 (423)	70-271	374 (169.5)	836 (379.5)	535 (242.7)	24.0 (610)	71.88 (1825.6)	3 (80)

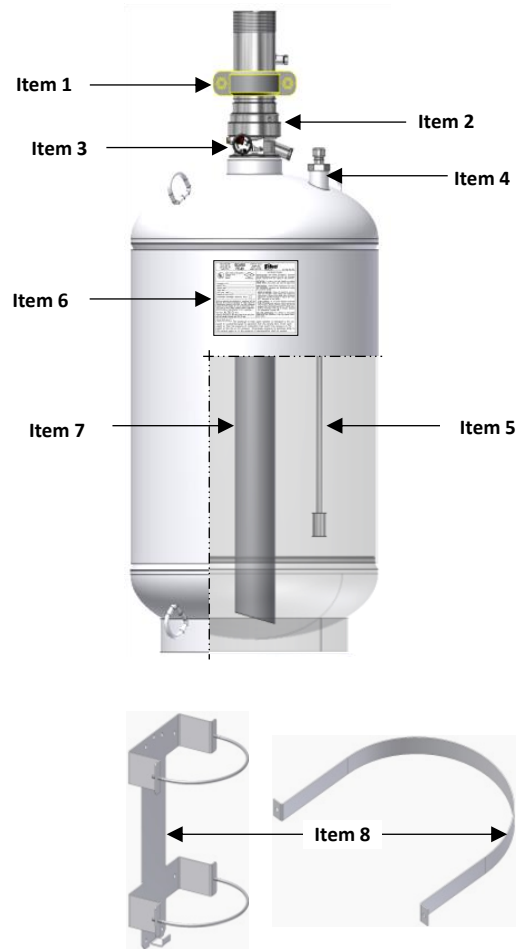
NOTE: 5 – 100 lb. containers can be used for Pre-engineered systems. 5 and 10 lb. containers can be used for Pre-engineered systems only. See Appendix B.

Items Supplied with Container Assembly

Item Number	Description
1	Groove 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 & 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.

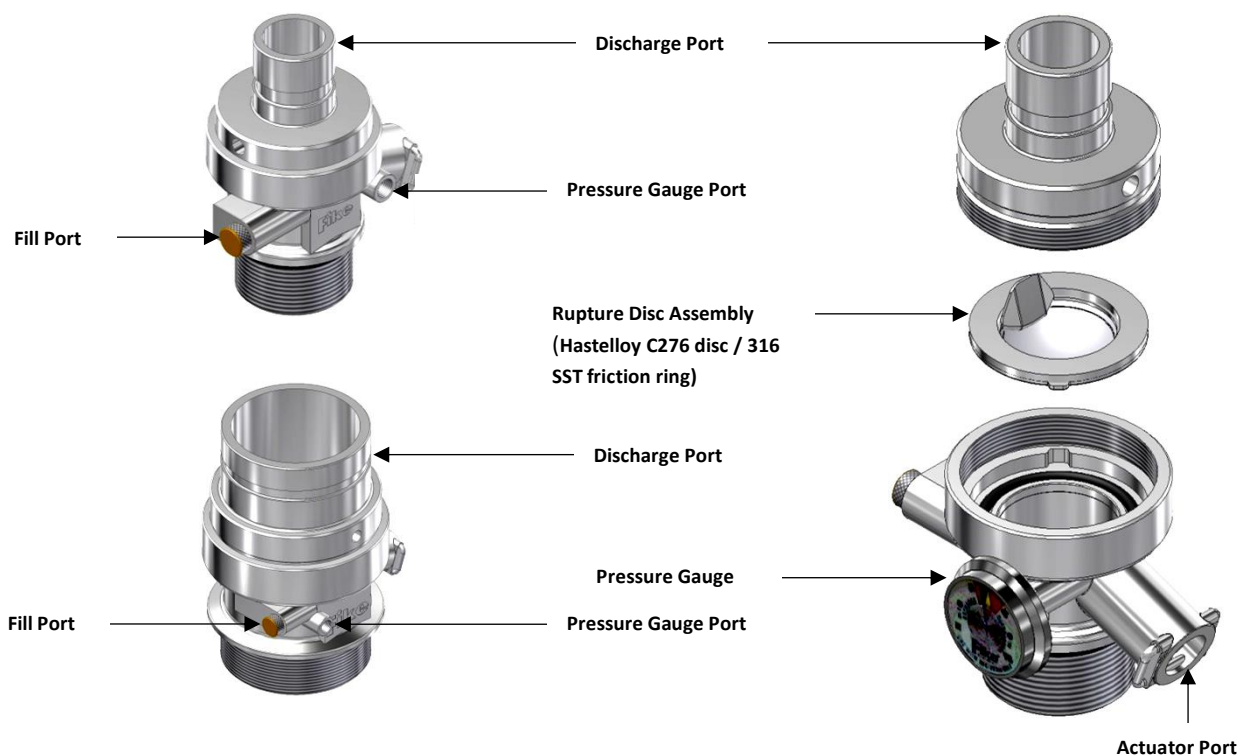
The valve's rupture disc assembly also acts as the pressure relief device for the container in accordance with DOT regulations by automatically opening if the container temperature exceeds 120°F (48.9°C).

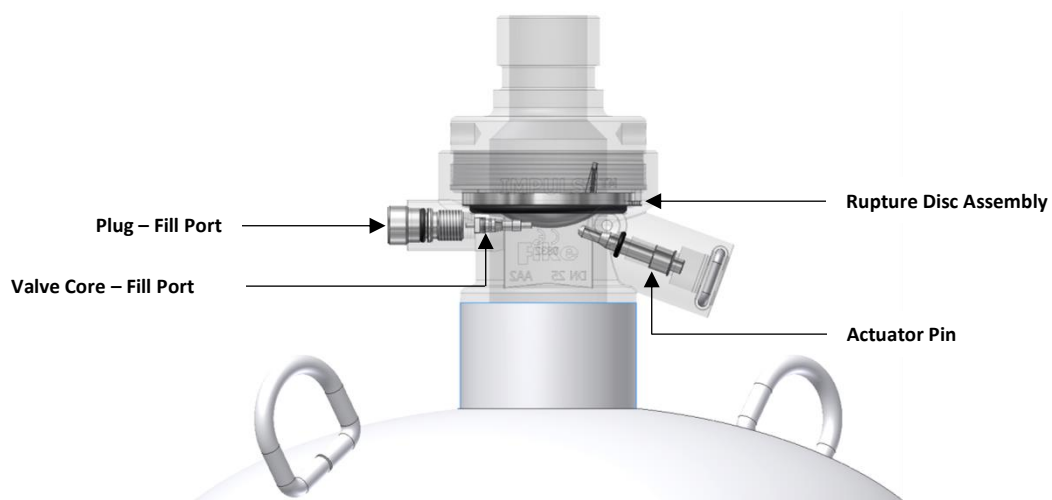


Impulse Valve

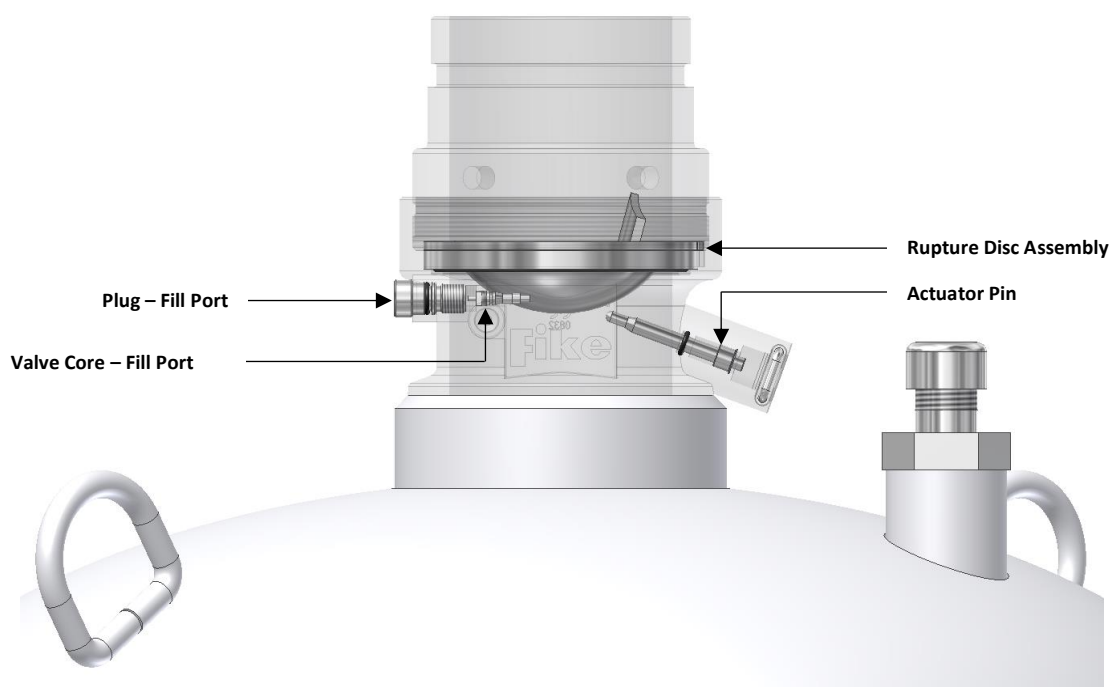
Each Impulse Valve is equipped with the following ports:

- 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 IN (25mm) Recharge Kit, P/N 85-047

Item	Description	Part Number
1	Friction Ring (316 SST)	70-2060
2	Disc Assembly (Hastelloy C276)	70-247
3	O-Ring (Nitrile)	02-11987
4	Valve Core-Fill Port (not shown)	02-4161
5	Reconditioning Instructions (not shown)	06-567

Note: 1 inch (25 mm) recharge kit is used on 5, 10, 20, 35, 60 & 100 lb. (2, 4, 8, 15, 27 & 44 L) containers.

3 IN (80mm) Recharge Kit, P/N 85-048

Item	Description	Part Number
1	Friction Ring (316 SST)	70-2063
2	Disc Assembly (Hastelloy C276)	70-248
3	O-Ring (Nitrile)	02-11989
4	Valve Core-Fill Port (not shown)	02-4161
5	Reconditioning Instructions (not shown)	06-567

Note: 3 inch (80 mm) recharge kit is used on 150, 150i, 215, 375, 650 & 1000 lb. (61, 61i, 88, 153, 267 & 423 L) containers

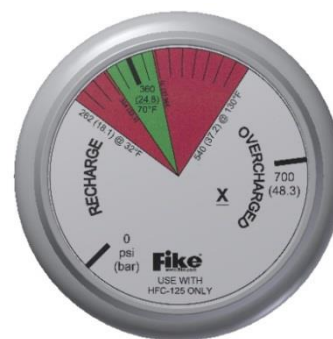


For a detailed procedure on recharging a Fike container w/ an Impulse Valve, refer to Fike's Recharge Manual (P/N 06-290).

2.4. Pressure Gauge

Each Fike Clean Agent fire suppression container with HFC-125 agent is fitted with a pressure gauge (P/N 02-10279) 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.

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.



Pressure Gauge

Specifications

Type:	Bourdon Tube Pressure Gauge
Diameter:	1.6 in. (40 mm)
Pressure Range:	0 to 700 psi (0 to 48 bar)
Connection:	1/8 in. NPT
Accuracy:	±4% at charge (±14 PSI)

Temperature VS Pressure Chart

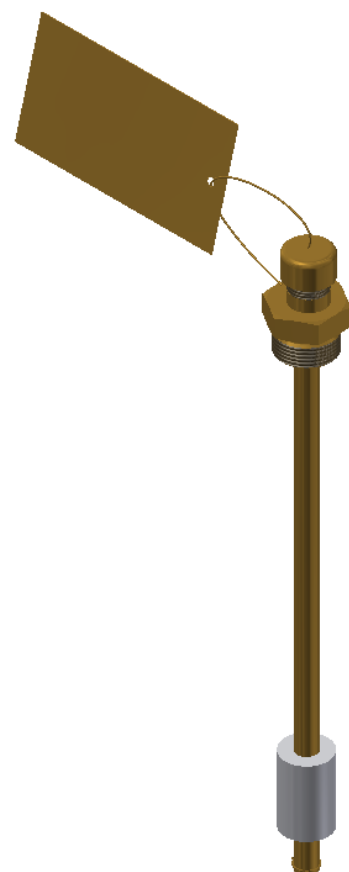
The gauge should read 360 psig at 70°F (24.8 bar at 21°C). For temperatures other than 70°F (21°C), see chart below.

US Standard		Metric	
Temperature (°F)	Pressure (psig)	Temperature (°C)	Pressure (bar)
32	261	0	18
40	279	4	19
50	303	10	21
60	330	16	23
70	360	21	25
80	393	27	26
90	428	32	28
100	466	38	32
110	507	43	34
120	551	49	38

2.5. Liquid Level Indicator (LLi)

A Liquid Level Indicator 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 06-548).



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)

NOTE: LLi is not available for 150 lb. inverted container.

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 02-12533) 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 288 psig (1986 kPa) 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	½ in. NPT (15 mm)
LPS Length (approximate)	4.375 in. (111 mm) Long, including both connectors
Wire Leads	(3) 18 gauge x 48 in. (1.2 m) long Violet (Common), Blue (N.O.), Black (N.C.)
Pressure Setting	288 psig (20 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

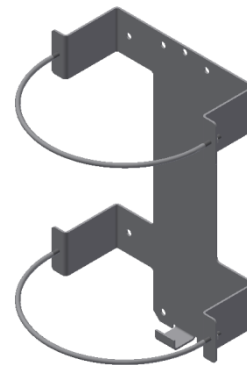
Part Number	Description
70-2135-X	Bracket for 5 lb. (2 L) and 10 lb. (4 L) containers
70-1372-X	Bracket for 20 lb. (8.5 L) and 35 lb. (15 L) containers
70-1070-X	Bracket for 60 lb. (27 L) container
70-1345-X	Strap for 100 lb. (44 L) container
70-2146-X	Bracket for 150 lb. (61 L) container
70-2147-X	Bracket for 150 lb. (61 L) inverted 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:

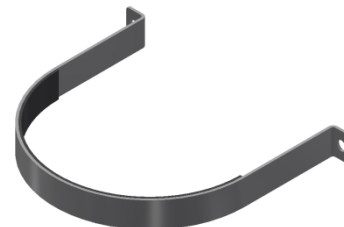
1. -X = paint option. Container brackets can be painted White or Red. When ordering a container bracket the paint option must be specified (-W for white or -R for red).



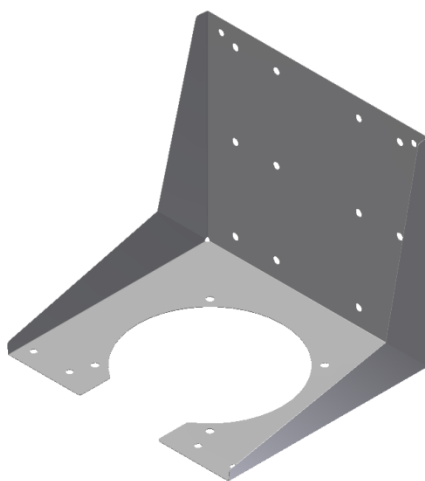
**5, 10, 20 and 35 lb.
(2, 4, 8.5 and 15 L)
Container Bracket**



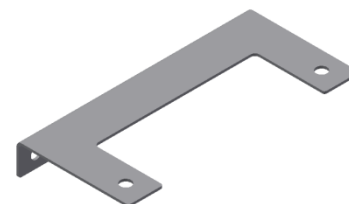
**60 lb. (27 L)
Container Bracket**



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



**150 lb. (61 L) Inverted
Container Bracket**



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	½ 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.

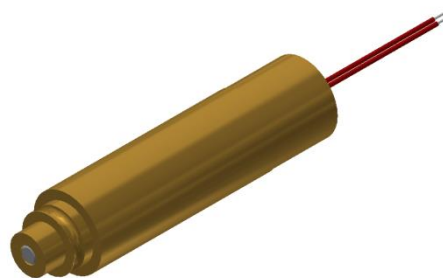
IVO Kit (P/N 70-279)	
Component P/N	Description
02-12728	Impulse Valve Operator (IVO)
02-14263	Impulse Valve Operator Supervisor (IVOS)
10-2748	Impulse Releasing Module (IRM)
02-2213	Security Ties

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.

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.



Impulse Energetic Actuator (IEA)

Specifications

Construction	Brass
Conduit Connection	3/4 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 maximum
Auto Ignition Temp.	$\geq 170^{\circ}\text{C}$ (338 $^{\circ}\text{F}$)
Storage Temp.	Min. 5°C (41 $^{\circ}\text{F}$), max 25°C (77 $^{\circ}\text{F}$)
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.

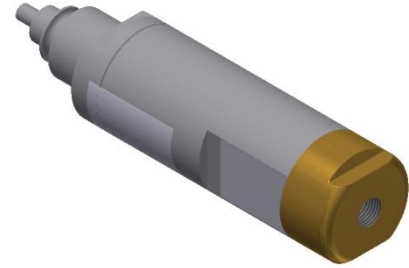
IEA Kit (P/N 70-390)	
Component P/N	Description
70-374	Impulse Energetic Actuator (IEA)
02-14263	Impulse Valve Operator Supervisor (IVOS)
10-2748	Impulse Releasing Module (IRM)

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

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. (851 mm) long
	– 3/8 in. electrical connector for ½ in. knockout
	– 22 AWG wire leads, 44 in. (112 cm) 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.

Component P/N	Description
IVO Kit (P/N 70-279)	
02-12728	Impulse Valve Opeator (IVO)
02-14263	Impulse Valve Operator Supervisor (IVOS)
10-2748	Impulse Releasing Module (IRM)
02-2213	Security Ties
IEA Kit (P/N 70-390)	
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	¼ in. (6 mm) NPT
Approximate Length	4.125 in. (105 mm), including both connectors
Electrical Connection	½ 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 (Pre-Engineered and Engineered) 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, 3/8 inch (10 mm) through 2 inch (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.

When ordering nozzles, the orifice size must be specified. For Pre-engineered nozzles, the orifice size for each nozzle is predetermined according to the limitations established during the system listing and approvals process. For Engineered nozzles, the orifice area is determined by performing a hydraulic calculation using the Fike Engineered 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. Nozzle orifice drilling must be done at the Fike factory, or at a UL listed nozzle drill station.

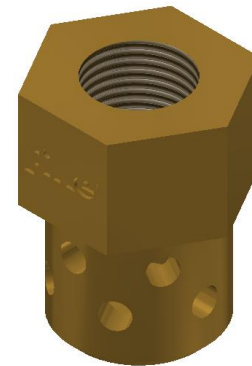
Ordering

Part Number	Description
80-077-XXXX	3/8 in. (10 mm) 360° nozzle
80-078-XXXX	1/2 in. (15 mm) 360° nozzle
80-079-XXXX	3/4 in. (20 mm) 360° nozzle
80-080-XXXX	1 in. (25 mm) 360° nozzle
80-081-XXXX	1 1/4 in. (32 mm) 360° nozzle
80-082-XXXX	1 1/2 in. (40 mm) 360° nozzle
80-083-XXXX	2 in. (50 mm) 360° nozzle
80-084-XXXX	3/8 in. (10 mm) 180° nozzle
80-085-XXXX	1/2 in. (15 mm) 180° nozzle
80-086-XXXX	3/4 in. (20 mm) 180° nozzle
80-087-XXXX	1 in. (25 mm) 180° nozzle
80-088-XXXX	1 1/4 in. (32 mm) 180° nozzle
80-089-XXXX	1 1/2 in. (40 mm) 180° nozzle
80-090-XXXX	2 in. (50 mm) 180° nozzle

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



360° Nozzle (6 orifices)



180° Nozzle (7 orifices)

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.

Specifications

Part No.	02-2980-1	02-4158-1	70-317	02-16557	02-16558	70-356
Type	Swing Gate			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	4.25 in. (108 mm)	6.00 in. (152 mm)	8.00 in. (203 mm)	4.21 in. (107 mm)	6.38 in. (162 mm)	11.00 in. (281 mm)
Height (Center-to-Top)	3.75 in. (95 mm)	4.50 in. (144 mm)	6.00 in. (152 mm)	1.87 in. (47 mm)	3.28 in. (83 mm)	6.50 in. (165 mm)
Approximate Weight	9 lbs. (4 kg)	12 lbs. (5 kg)	31 lbs. (14 kg)	5 lbs. (2 kg)	16 lbs. (7 kg)	37 lbs. (17 kg)
Equivalent Length	2.0 ft. (0.61 m)	4.0 ft. (1.22 m)	4.0 ft. (1.22 m)	15.8 ft. (4.82 m)	50.0 ft. (15.24 m)	14.0 ft. (4.27 m)
Material	Carbon Steel		Ductile Iron	Carbon Steel		Ductile Iron
Ends	NPT Female			NPT Female		Grooved
Working Pressure	750 psi (50 bar)			2000 psi (138 bar)		750 psi (50 bar)
Mounting	Horizontal or Vertical (with flow arrow up)			Horizontal or Vertical (with flow arrow up)		



Swing Gate Check Valve
(1", 2" and 3")



Ball Check Valve
(1" and 2")



Ball Check Valve
(3")

2.15. Caution/Advisory Signs

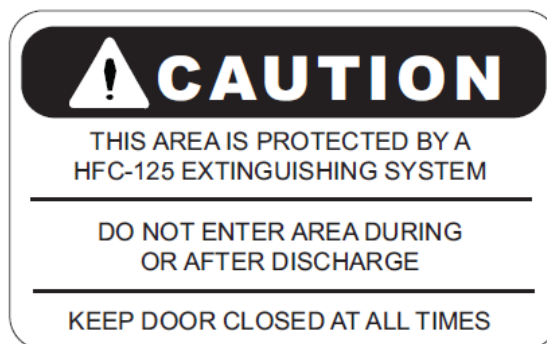
Instructional signs are used to provide the necessary information to personnel in the area and to comply with NFPA 2001 requirements. The caution lettering and backgrounds meet the requirements of ANSI Z535. The signs are made from flame retardant, Lexan™ polycarbonate material. Each sign has an adhesive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

CAUTION – AREA PROTECTED BY HFC-125 SIGN (P/N 02-10314)

Provided to alert personnel that the room is protected with an HFC-125 system 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 inches (330 mm) x 10 inches (254 mm), with black lettering on a yellow background for Caution and black lettering on a white background for sign text.

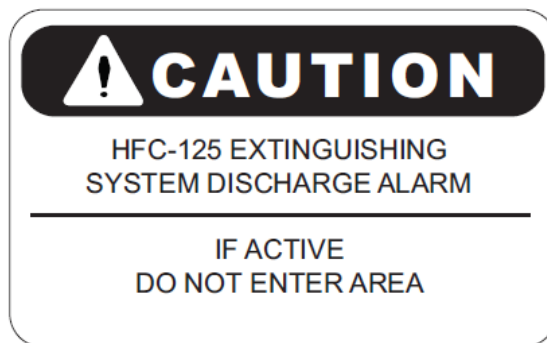


CAUTION – SYSTEM DISCHARGE ALARM SIGN (P/N 02-10313)

Provided to alert personnel that the room is protected with an HFC-125 system and to evacuate the area when the alarms sound.

This sign is provided to alert personnel that the room is protected with an HFC-125 system and that they should not enter the area when the alarm sounds.

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

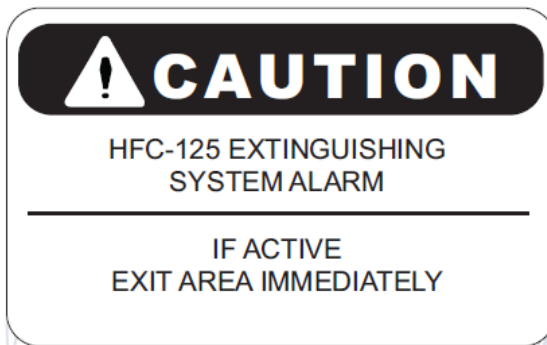


CAUTION - EXIT AREA (P/N 02-10309)

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

This sign explains that the HFC-125 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 inches (229 mm) x 6 inches (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 inches (330 mm) x 10 inches (254 mm), with white lettering on a blue background for NOTICE and black lettering on a white background for instructional text.

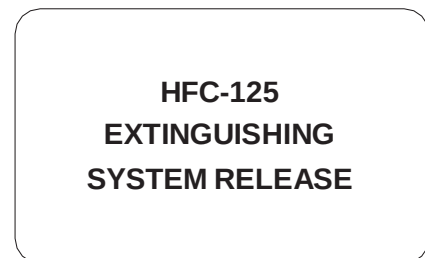


SYSTEM RELEASE SIGN (P/N 02-10312)

Provided to identify each system release station associated with the HFC-125 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 inches (102 mm) x 2.25 inches (57 mm), with red lettering on a white background.

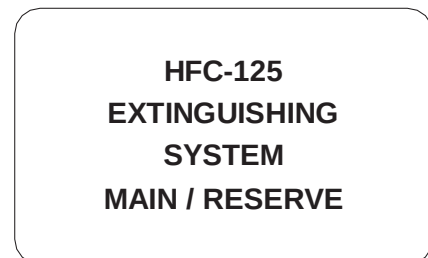


MAIN / RESERVE SIGN (P/N 02-10311)

Provided to identify each system main/reserve station associated with the HFC-125 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 inches (102 mm) x 2.25 inches (57 mm), with white lettering on a red background.

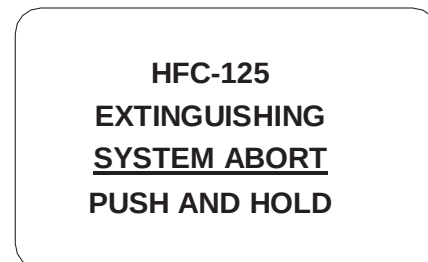


SYSTEM ABORT SIGN (P/N 02-10310)

Provided to identify each system abort station associated with the HFC-125 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 inches (102 mm) x 2.25 inches (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 provides a means to pneumatically activate 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.

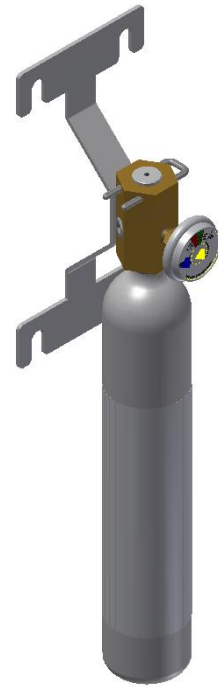
NOTE: When used for selector valve activation, the nitrogen actuator assembly and completer kit are furnished with the selector valve.

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. (305 mm) Long 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)



**Nitrogen Actuator
Assembly**

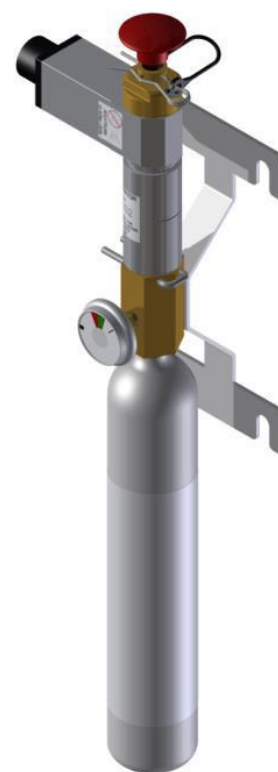
2.17. UVO Primary Completer Kit

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.

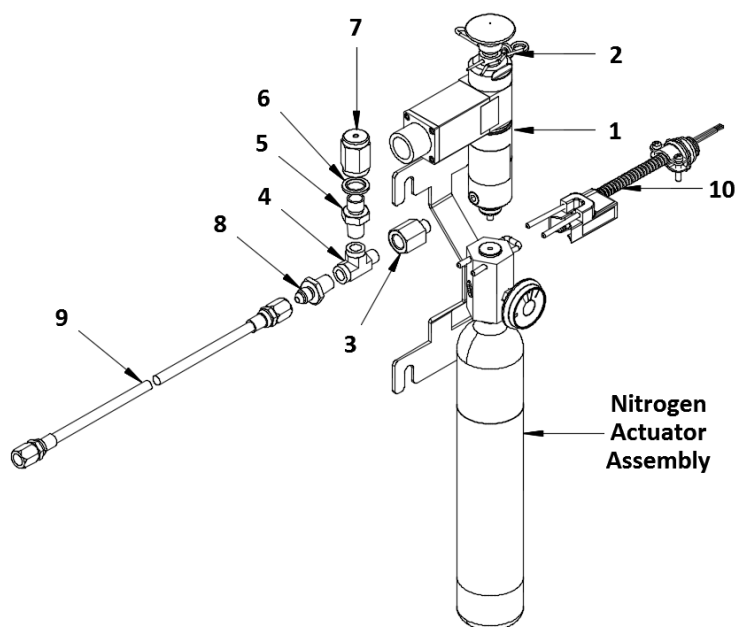
The UVO provides a means to electrically activate the Nitrogen Actuator Assembly via a 24 VDC signal from the control panel and to manually activate the assembly by pressing the red manual strike button on the UVO. Activation of the UVO allows pressure from the Nitrogen Actuator Assembly to flow through 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. (889 mm) 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.

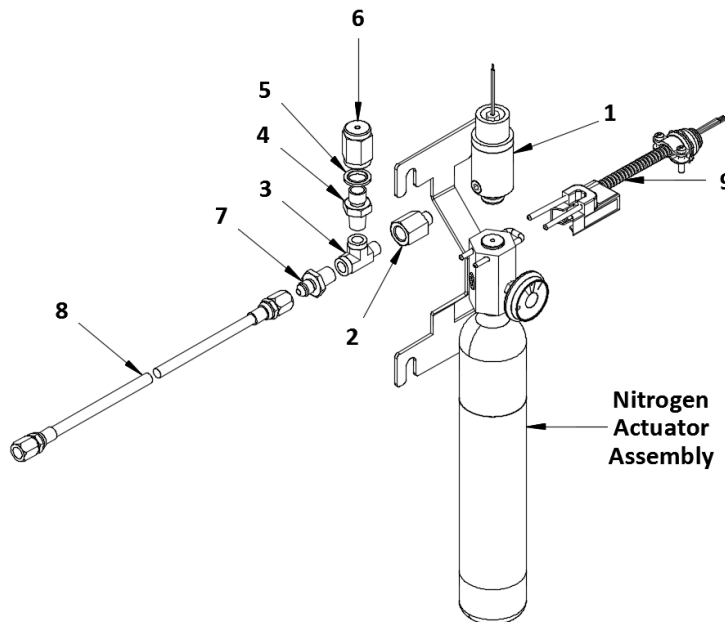
Electrical activation of the UEA requires it to be connected to a Fike Impulse Releasing Module. The IRM provides the interface between the UEA and the releasing circuit of the Fike control panel. Refer to Fike document 06-552 for IRM details.

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 JIC Adapter
8	02-4977	35 in. (889 mm) Hose (1/4 JIC x 1/4 JIC)
9	02-14627	Universal Valve Operator Supervisor (UVOS)
10	02-11902	1/8 in. 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.

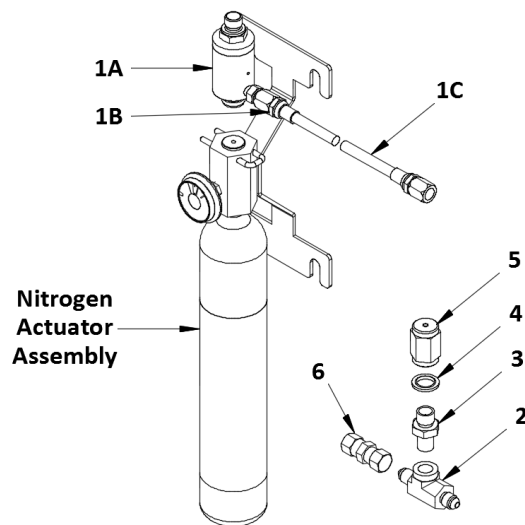
The following components are included in the Secondary Completer Kit. See diagram below.

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. (914 mm) 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, Swivel

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



**Nitrogen Actuator Assembly
with Pneumatic Relay
(Secondary)**

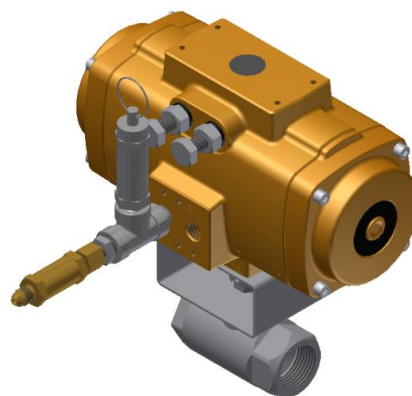


Secondary Completer Kit Components

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" (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	¼" 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 separately 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 inch NPT (25 mm) 15 – 1 ½ inch NPT (40 mm) 20 – 2 inch NPT (50 mm) 30 – 3 inch NPT (80 mm) 40 – 4 inch 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)

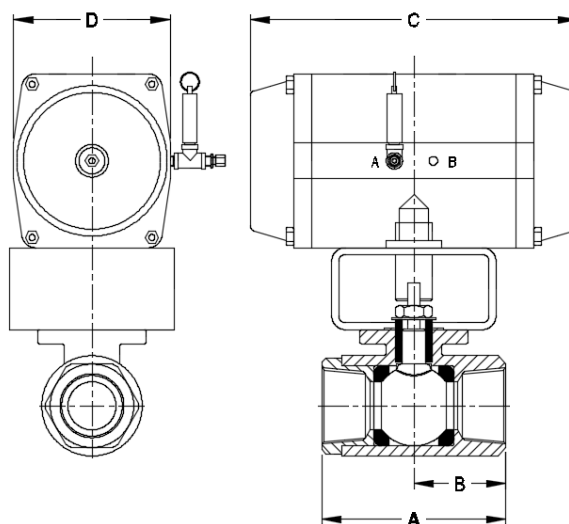
Each selector valve assembly may include the following parts depending upon the part number ordered.

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	3.37 (86)	1.68 (43)	7.55 (192)	3.74 (95)	7.80 (3.54)
70-396-15-XXX	1 ½ (40)	Threaded	4.37 (111)	2.18 (55)	8.53 (217)	4.09 (104)	11.76 (5.33)
70-396-20-XXX	2 (50)	Threaded	5.50 (140)	2.75 (70)	9.72 (247)	4.53 (115)	16.67 (7.56)
70-396-30-XXX	3 (80)	Threaded	6.75 (171)	3.37 (86)	8.80 (234)	5.00 (127)	30.10 (13.65)
70-396-40-XXX*	4 (100)	Threaded	9.09 (231)	4.55 (116)	10.58 (269)	6.50 (165)	69.80 (31.66)

*Selector valve is not UL Listed or FM Approved.



Selector Valve Dimensions

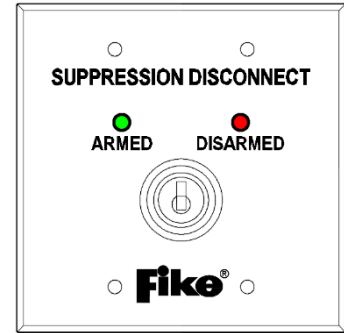
2.21. Suppression Disconnect Switch

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.

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



Disconnect Switch with LEDs

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 (LxWxD)	4.5 in. x 4.5 in. x 2.125 in. (114 mm x 114 mm x 54 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 ECARO-25 Clean Agent Fire Suppression System 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 ECARO-25 system, the integrity of the protected enclosure(s) shall be considered. Integrity refers to the ability of the enclosure to retain the discharged ECARO-25 fire extinguishing agent. 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 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. ECARO-25 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 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-dampened 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 percent safety factor for Class A fuel. Extinguishing Concentration is the agent concentration required to extinguish a test fire.

Using the Hazard Classification (Class A 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	8.7%	Clean Agent System incorporates Detection & Control System to automatically discharge agent.
Class A	8.9%	Recommendation, when protecting multiple hazards w/ single agent supply.
Class C	9.0%	When energized electrical hazard remains powered during/after agent discharge and Clean Agent System incorporates Detection & Control System to automatically discharge agent.
Class C	9.2%	Recommendation, when protecting multiple hazards w/ single agent supply.

NOTES:

1. When ECARO-25 is used in a "Normally Occupied" area, a maximum design concentration of 11.5% is allowed.
2. Concentrations greater than 11.5% 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 [ft³ (m³)]
 - 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 [ft³/lb (m³/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)						
		HFC-125 Design Concentration (% by Volume) ^e						
		8.0	8.7	8.9	9.0	9.2	10.0	11.5
30	2.9162	0.0298	0.0327	0.0335	0.0339	0.0347	0.0381	0.0446
40	2.9803	0.0292	0.0320	0.0328	0.0332	0.0340	0.0373	0.0436
50	3.0441	0.0286	0.0313	0.0321	0.0325	0.0333	0.0365	0.0427
60	3.1077	0.0280	0.0307	0.0314	0.0318	0.0326	0.0358	0.0418
70	3.1712	0.0274	0.0300	0.0308	0.0312	0.0320	0.0350	0.0410
80	3.2344	0.0269	0.0295	0.0302	0.0306	0.0313	0.0344	0.0402
90	3.2975	0.0264	0.0289	0.0296	0.0300	0.0307	0.0337	0.0394
100	3.3605	0.0259	0.0284	0.0291	0.0294	0.0302	0.0331	0.0387
110	3.4233	0.0254	0.0278	0.0285	0.0289	0.0296	0.0325	0.0380
120	3.4859	0.0249	0.0273	0.0280	0.0284	0.0291	0.0319	0.0373

FLOODING FACTORS – Agent vs. Temperature Charts (Metric Units)								
Temp. (t) (°C) ^c	Specific Vapor Volumes(s) (m ³ /kg) ^d	Weight Requirements of Hazard Volume, W/V (kg/m ³) ^b (Metric Units)						
		HFC-125 Design Concentration (% by Volume) ^e						
		8.0	8.7	8.9	9.0	9.2	10.0	11.5
0	0.1829	0.4756	0.5210	0.5341	0.5409	0.5540	0.6077	0.7105
5	0.1865	0.4664	0.5109	0.5238	0.5304	0.5433	0.5959	0.6967
10	0.1900	0.4576	0.5015	0.5142	0.5204	0.5333	0.5847	0.6839
15	0.1936	0.4491	0.4922	0.5046	0.5108	0.5234	0.5739	0.6712
20	0.1972	0.4410	0.4832	0.4954	0.5016	0.5138	0.5635	0.6589
25	0.2007	0.4332	0.4748	0.4868	0.4927	0.5048	0.5535	0.6475
30	0.2043	0.4257	0.4664	0.4782	0.4841	0.4959	0.5439	0.6360
35	0.2078	0.4184	0.4586	0.4701	0.4759	0.4876	0.5347	0.6253
40	0.2114	0.4114	0.4508	0.4621	0.4679	0.4793	0.5257	0.6147
45	0.2149	0.4047	0.4434	0.4546	0.4603	0.4715	0.5171	0.6047
50	0.2184	0.3982	0.4363	0.4473	0.4528	0.4639	0.5088	0.5950

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

^b W/V [agent weight requirements (lb/ft³) or (kg/m³)] = pounds of agent required per ft³ (m³) 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 (ft³/lb)] = specific volume of HFC-125 vapor can be approximated: $s = 2.7208 + 0.0064(t)$, where t = temperature (°F)
s [specific volume (m³/kg)] = specific volume of HFC-125 vapor can be approximated: $s = 0.1826 + 0.0007(t)$, where t = temperature (°C)

^e c [concentration (%)] = volumetric concentration of HFC-125 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 percent [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: The ECARO-25 flow calculation program will automatically calculate the agent required based on the altitude correction factor entered.

3.9. Select System Design Concept

The ECARO-25 system 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) Pre-Engineered System – A Pre-Engineered system minimizes the engineering effort required to design an effective system by utilizing a fixed series of nozzles and a tightly defined set of design criteria (e.g., piping layout). As long as the nozzle selection, pipe size, and pipe length limitations are adhered to, computerized flow calculations are not required.

Pre-Engineered systems can be designed with the containers arranged in a Modular or Central Storage configuration as described in this step. For more information regarding Pre-Engineered systems design requirements, Refer to Appendix B.

- 2) 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. This type of system will generally take longer to design as compared to a Pre-Engineered system due to greater flexibility.

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

- 3) 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 a Pre-Engineered or Engineered system.

- 4) 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.
- 5) 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.
- 6) 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.

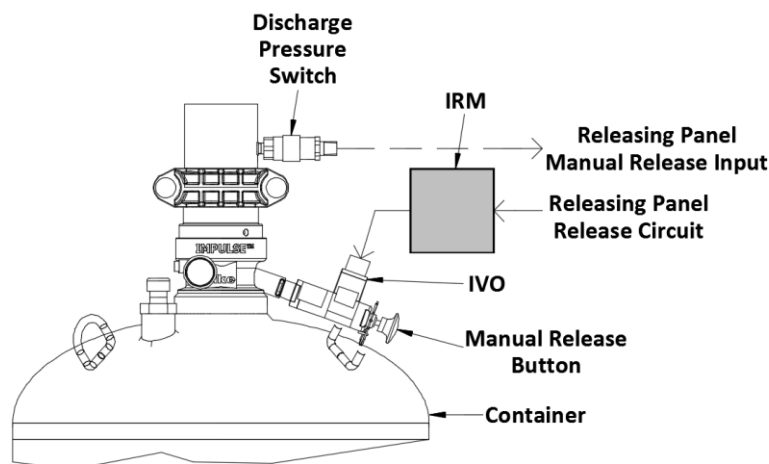
3.10. Select System Actuation Method

There are three basic methods of actuation for the Fike ECARO-25 systems: 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.



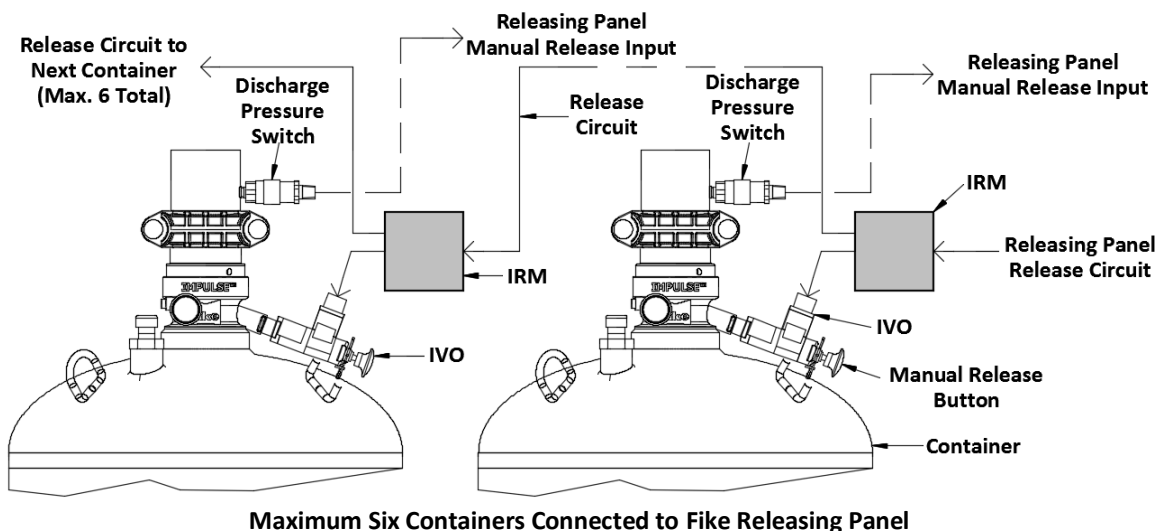
Single Container Connected to Fike Releasing Panel

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.

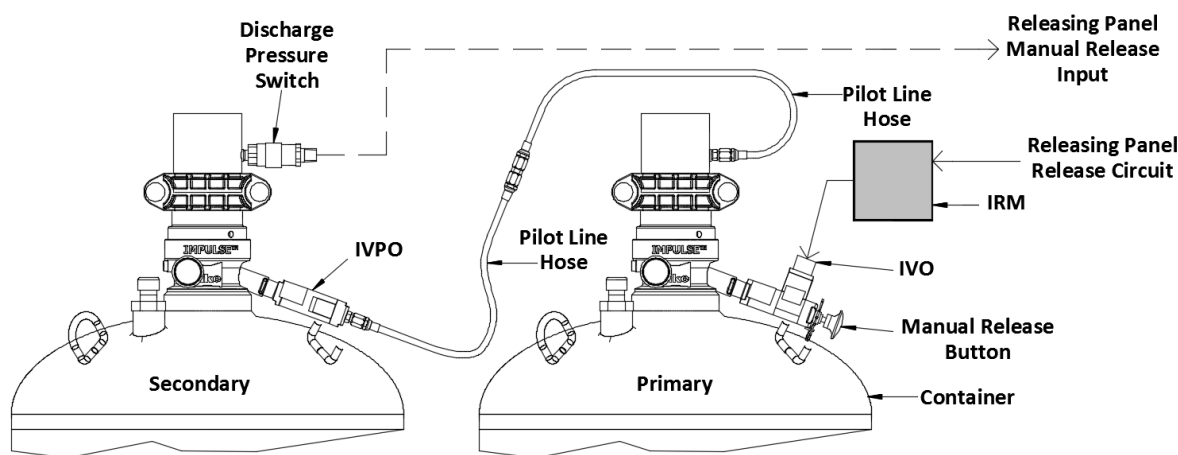


NOTE: The IVO shown in the diagram above can be replaced with an IEA; however, there is no strike button provided on the IEA to permit mechanical manual activation of the container. Electric manual activation must be used to manually activate the container. System actuation using the IEA is not FM approved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

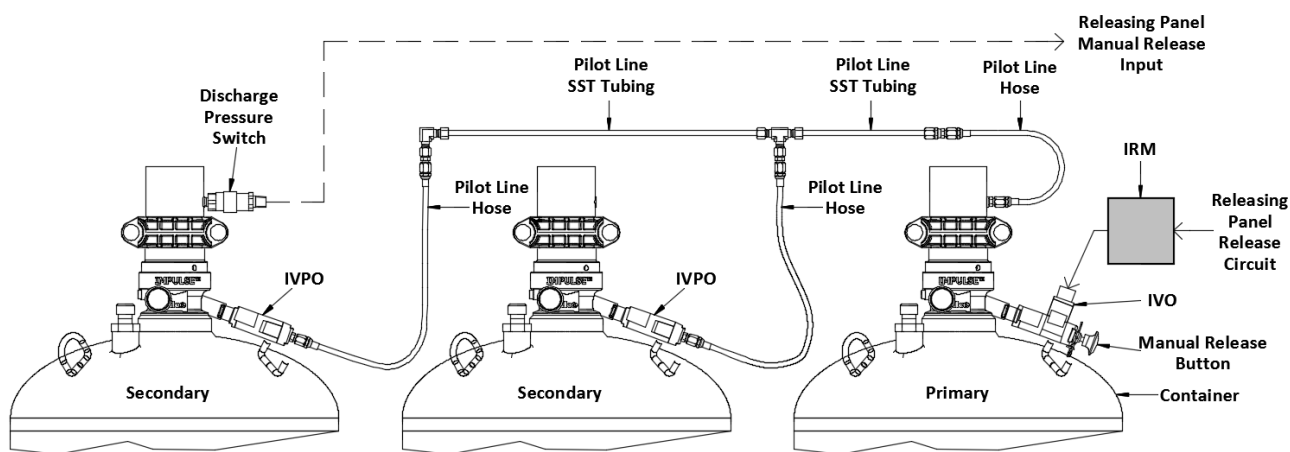
NOTE: The IVO shown in the diagram above can be replaced with an IEA; however, there is no strike button provided on the IEA to permit mechanical manual activation of the container as described above. Electric manual activation must be used to manually activate the container. System actuation using the 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 ¼ 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.

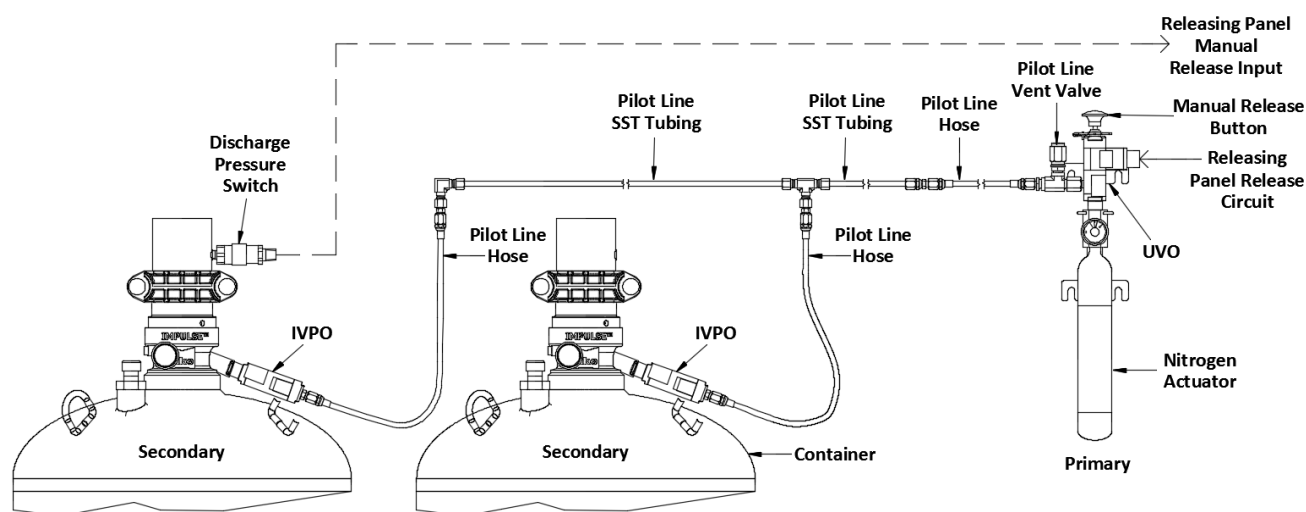
See Section 4.8 for pilot actuation line installation.

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 ¼ 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.

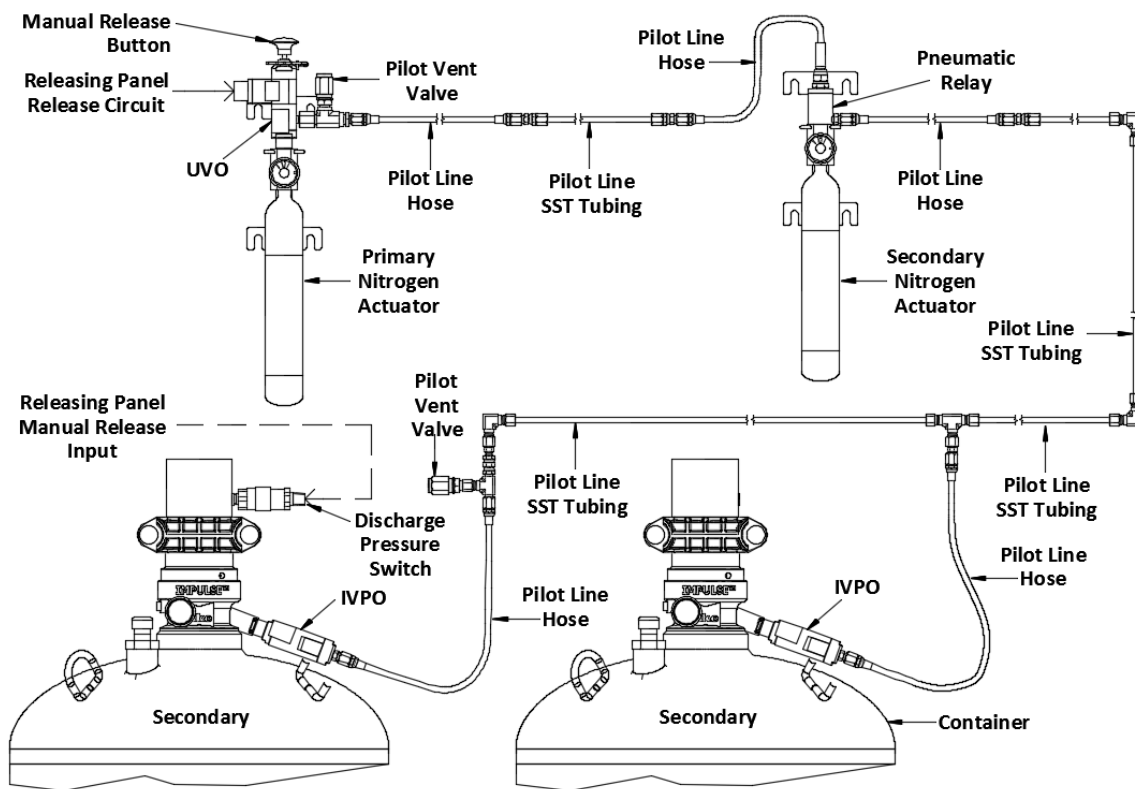
See Section 4.8 for pilot actuation line installation.

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 UVO 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 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 ¼ 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 pound (kilogram).

CONTAINER SIZE AND FILL RANGE							
Size lb. (L)	Part Number	Minimum Fill Range 25 lbs/ft ³ (400 kg/m ³)	Maximum Fill Range 56 lbs/ft ³ (897 kg/m ³)	Fill Increments lbs. (kg)	Mounting Position	Valve Size in. (mm)	Approx. Tare Weight lbs. (kg)
5 (2)	70-272	4 (2.0)		N/A	Upright (Valve Up)	1 (25)	11 (5.0)
10 (4)	70-273	4 (2.0)	8 (3.5)	1 (0.5)	Upright (Valve Up)	1 (25)	15 (6.8)
20 (8.5)	70-263	8 (3.5)	16 (7.5)	1 (0.5)	Upright or Horizontal	1 (25)	21 (10.0)
35 (15)	70-264	14 (6.5)	30 (13.5)	1 (0.5)	Upright or Horizontal	1 (25)	31 (14.0)
60 (27)	70-265	25 (11.5)	54 (24.5)	1 (0.5)	Upright or Horizontal	1 (25)	52 (24.0)
100 (44)	70-266	39 (18.0)	87 (39.0)	1 (0.5)	Upright (Valve Up)	1 (25)	77 (35.0)
150 (68)	70-267	54 (24.5)	120 (54.0)	1 (0.5)	Upright or Inverted	3 (80)	118 (68.0)
215 (87)	70-268	78 (35.5)	173 (78.5)	1 (0.5)	Upright (Valve Up)	3 (80)	155 (70.0)
375 (153)	70-269	136 (61.5)	302 (137.0)	1 (0.5)	Upright (Valve Up)	3 (80)	225 (102.0)
650 (267)	70-270	236 (107.0)	528 (239.5)	1 (0.5)	Upright (Valve Up)	3 (80)	385 (175.0)
1000 (423)	70-271	374 (169.5)	836 (379.5)	1 (0.5)	Upright (Valve Up)	3 (80)	550 (249.0)

NOTE: 5 – 100 lb. containers can be used for Pre-engineered systems. 5 and 10 lb. containers can be used for Pre-engineered systems only. See Appendix B.

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.

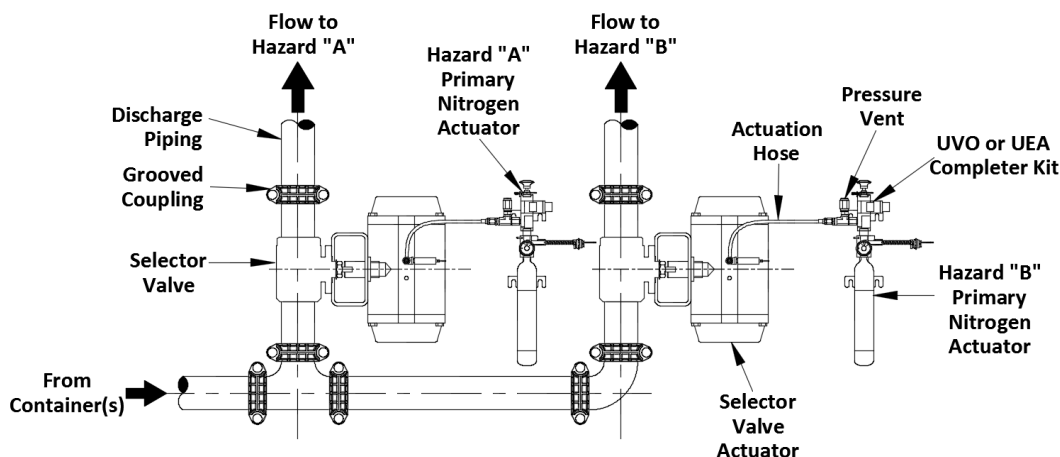
Manifolds are assembled using a combination of grooved pipe and fittings, or threaded pipe and fittings that meet the pressure requirements of NFPA 2001. When containers are manifolded together, every container must be the same size and fill weight in accordance with NFPA 2001.

See Section 4.3.4 for manifold configuration options.

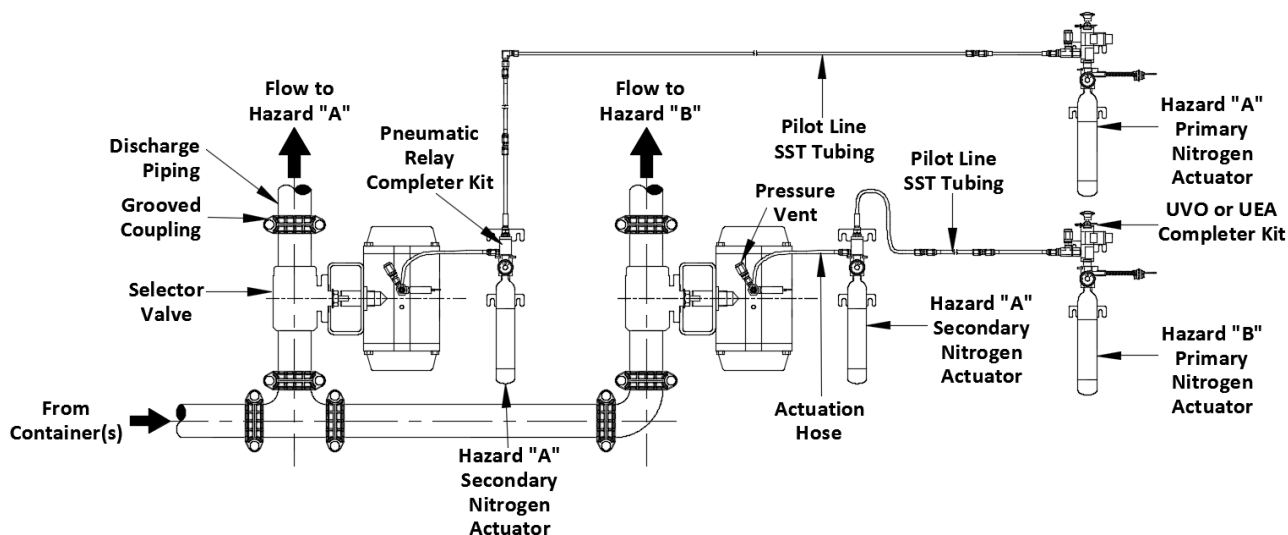
3.13. Evaluate Selector Valve Option

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 – 120°F (0 – 49°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 ECARO-25 flow calculation program predictions are based on a container storage temperature range of 60 – 80°F (16 – 27°C).

NOTE: Pre-Engineered system have been pre-tested and verified for the full operating range of 32 to 130°F (0 to 54°C).
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- 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. See Section 4.1 for more information regarding floor loading.
- 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 on the ECARO-25 system 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, see 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)
3/8 (10)	0.75 (0.34)	1.88 (0.85)
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 the Fike ECARO-25 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.

NOTE: The data listed in the Nozzle Flow Rates table above shall not be used when designing a Pre-Engineered system. The flow rates have already been pre-determined (established) and are reflected in the design limitations.

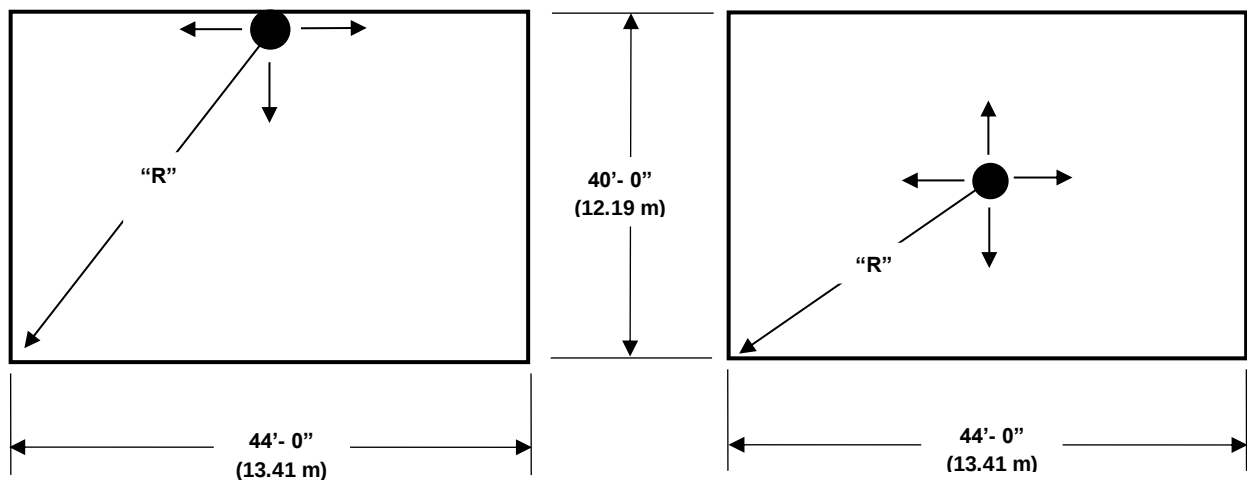
3.15.1. Evaluate Nozzle Area Coverage

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 area coverage values are the same for Pre-Engineered and Engineered nozzles.

Nozzle Size – 3/8" (10 mm)			Nozzle Size – 1/2" – 2" (15 – 50 mm)		
Nozzle Type	Radius "R" Dimension Ft. (m)	Ceiling Height Range Ft. (m)	Nozzle Type	Radius "R" Dimension Ft. (m)	Ceiling Height Range Ft. (m)
180°	22.75 (6.93)	1 to 16 (0.30 to 4.90)	180°	45.67 (13.92)	1 to 16 (0.30 to 4.90)
360°	14.50 (4.5)	1 to 16 (0.30 to 4.90)	360°	29.67 (9.04)	1 to 16 (0.30 to 4.90)

Maximum Distance	180° Nozzle Ft. (m)	360° Nozzle Ft. (m)	Note
Below Ceiling	1 (0.30)	1 (0.30)	Maximum distance above highest point of protection when stacking nozzles.
Away from Sidewall	1 (0.30)	---	

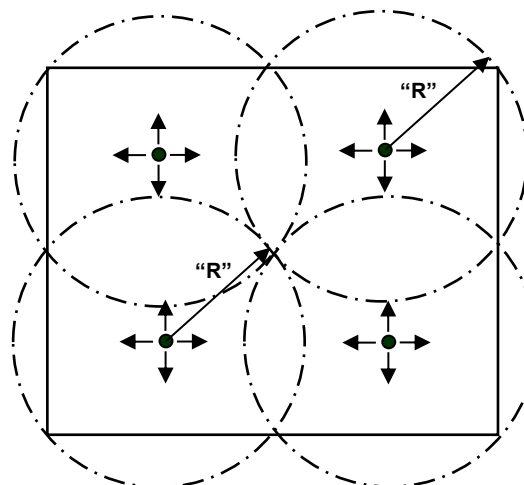


Nozzle Area Coverage

Nozzle Placement Recommendations

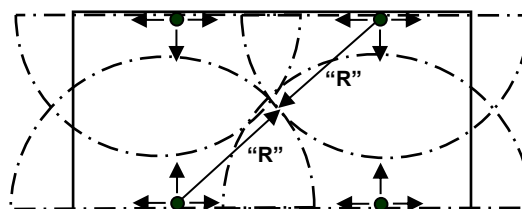
Nozzles must be located at the top of the hazard area, aimed up or down. Nozzle located in a subfloor can also be aimed upward or downward.

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

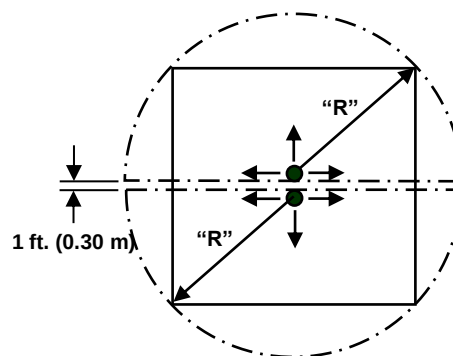
180° Nozzle(s) should be located along the perimeter of the protected area, discharging toward the opposite side. Nozzle coverage patterns need to overlap to adequately cover the area without any “blind spots” due to nozzle locations.



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 foot (0.30 meter). Nozzle coverage patterns need to overlap to adequately cover the area without any “blind spots” due to nozzle locations.

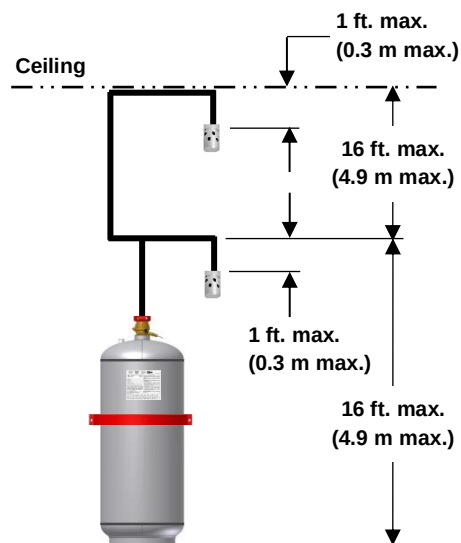
NOTE: The use of 180° nozzles in a back-to-back configuration is UL Listed but not FM Approved.



180° Nozzle Placement
(Back-to-Back)

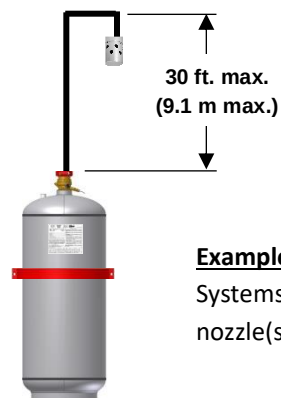
3.15.2. Evaluate Nozzle Quantity Based on Enclosure Ceiling Height

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 feet (4.9 meters). Ceiling heights greater than 16 feet (4.9 meters) to 32 feet (9.75 meters) require nozzles to be placed at multiple levels (elevations) in segments no greater than 16 feet (4.9 meters) in elevation. See 3.15.3 for maximum elevation differences between pipe runs.

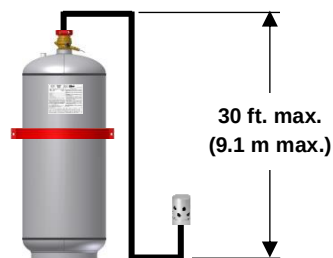


Nozzle Levels for Enclosure Greater than 16 ft. (4.9 m)

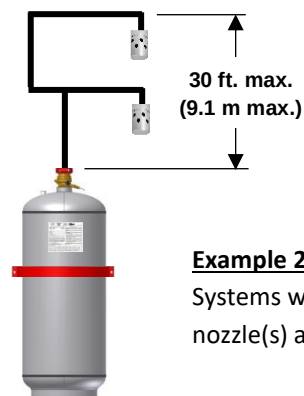
3.15.3. Evaluate Elevation Differences between Pipe Runs



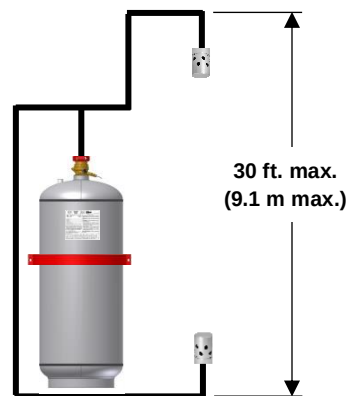
Example 1:
Systems with a single level of nozzle(s) above container outlet



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

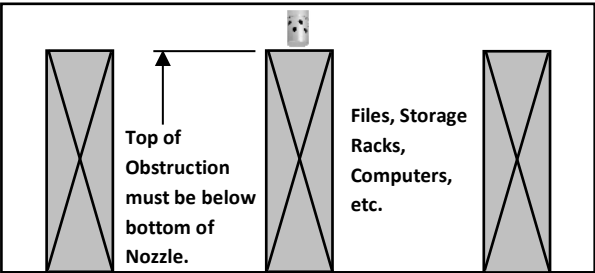


Example 4:
Systems with levels of nozzle(s) above and below container outlet

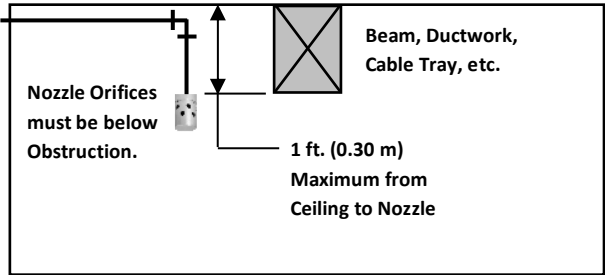
NOTE: These limitations only apply to systems where multiple hazards are protected by a single piping network.

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

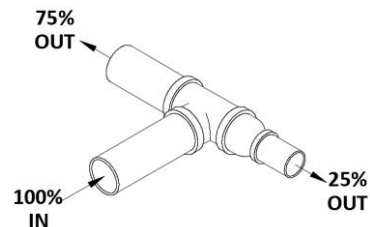
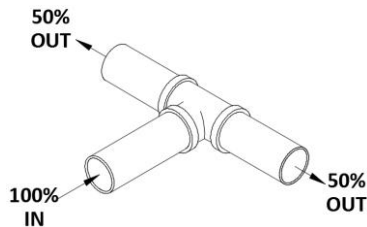
Using a plan view drawing of the protected areas, locate each nozzle(s) and container(s). Connect the nozzles with piping adhering to the following piping guidelines. This step is not applicable to Pre-engineered systems. Refer to Appendix B for Pre-engineered piping system design limitations.

3.16.1. Evaluate Tee Split Ratios

Engineered ECARO-25 systems 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.

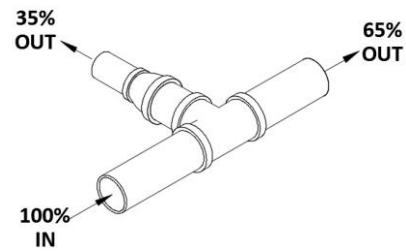
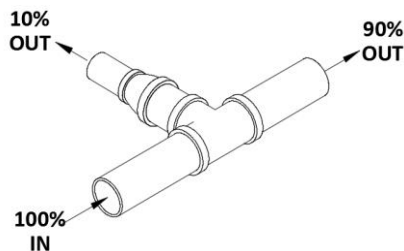
TEE CONFIGURATION – BULLHEAD

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

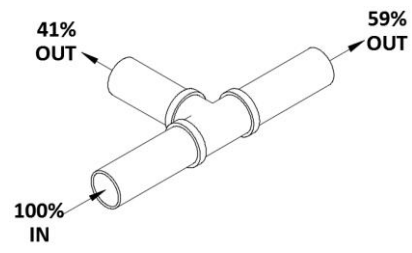
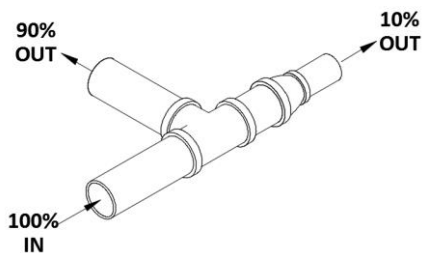


TEE CONFIGURATION – SIDE-THRU

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



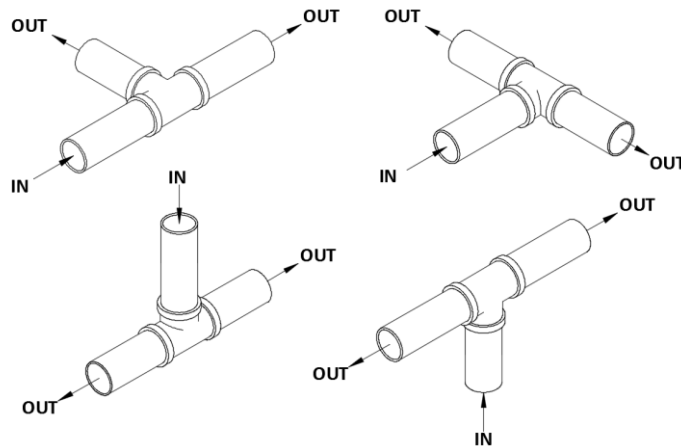
Correct T-Split Ratios



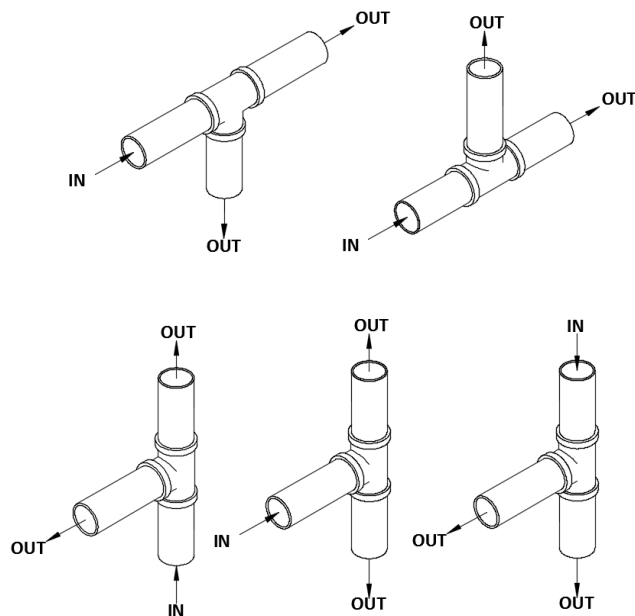
Incorrect T-Split Ratios

3.16.2. 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

The ECARO-25 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. This step is not applicable to Pre-engineered systems. Refer to Appendix B for Pre-engineered piping system design limitations.

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)	Minimum Design Flow Rate lbs/sec (kg/sec) (System Limitation)	Maximum Design Flow Rate lbs/sec (kg/sec) (Estimate)
3/8 (10)	0.75 (0.34)	1.88 (0.85)
½ (15)	1.29 (0.59)	3.23 (1.46)
¾ (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)
2 ½ (65)	17.26 (7.83)	43.15 (19.58)
3 (80)	39.00 (17.70)	97.50 (44.25)
4 (100)	68.00 (30.80)	170.00 (77.00)
6 (150)	156.00 (70.70)	390.00 (176.75)

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 the ECARO-25 Flow Calculation program prior to installing the system.

3.18. Apply Tee Design Factor

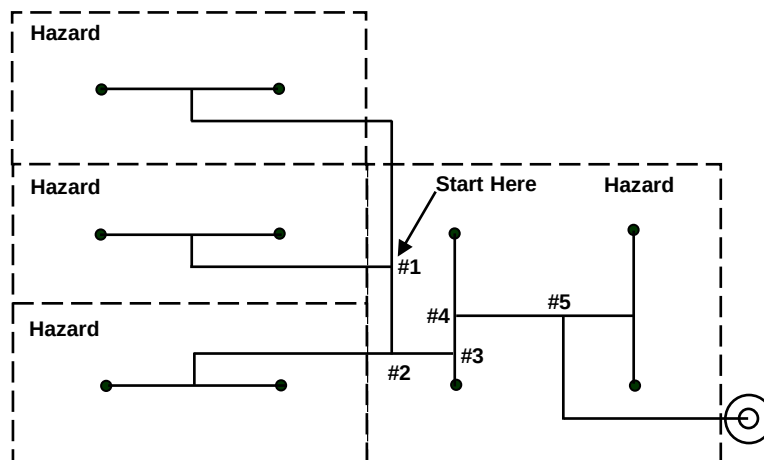
When a single agent supply is being used to protect multiple hazards, a tee design factor is applied when more than four tees are used. This step is not applicable to Pre-Engineered systems. Refer to Appendix B. The tee design factor is meant to compensate for the uncertainty in the quantity of agent 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, see 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 8.9% for Class A or 9.2% for Class C when protecting multiple hazards w/ 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 3.5 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 / ft³ (m³)
- C = Design Concentration, % by volume
- S = Specific Vapor in ft³/lb (m³/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: The ECARO-25 flow calculation program will automatically calculate the design concentration at the maximum ambient temperature entered.

3.21. Evaluate Exposure Limitations

Unnecessary exposure to ECARO-25 at and below the no observable adverse effects level (NOAEL) and decomposition products produced by the fire shall be avoided. The following provisions shall apply:

1. When ECARO-25 is used in a “Normally Occupied” enclosure or space, a maximum design concentration of 11.5% is allowed.
2. Maximum human exposure time shall not exceed 5 minutes for ECARO-25 systems utilized in any occupiable enclosure or space.
3. Design concentrations greater than 11.5% can only be used in enclosures or spaces that are not normally occupied.
4. ECARO-25 systems protecting occupiable enclosures or spaces where the clean agent design concentration exceeds 11.5%, shall include the following:
 - A. Supervised system lockout valves
 - B. Pneumatic pre-discharge alarms
 - C. Pneumatic time delays
 - D. Warning signs

3.22. Perform Flow Calculations

With the information developed in previous sections, run the ECARO-25 Flow Calculation program to determine the final pipe sizes and nozzle orifices. This step is not applicable to Pre-Engineered systems. Refer to Appendix B. The ECARO-25 Flow Calculation 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 ECARO-25 containers 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 51% 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 51%”.

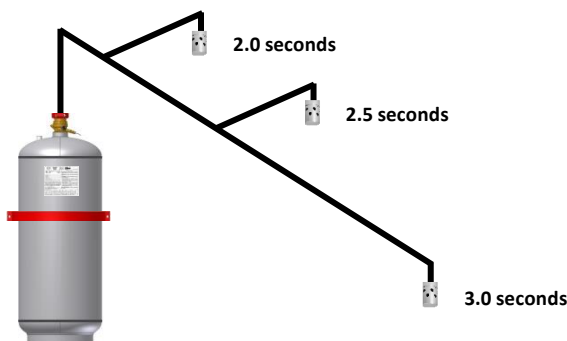
3.22.2. Location of First Tee

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.

The first tee of the piping system must be located a minimum distance which will allow for a 4% pressure drop from the outlet of the container to the first tee.

3.22.3. Liquid Arrival Time

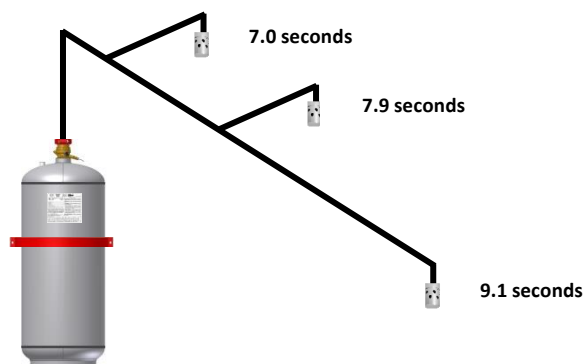
The time necessary for liquid agent to arrive at each nozzle must be within 1 second of each other, as shown in the example below.



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 second (3 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 2.1 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 9.1 second.

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

Minimum Orifice Area	Maximum Orifice Area	Minimum Pressure
20% – Pipe cross sectional area	80% – Pipe cross sectional area	95 psia / 80.3 psig (6.6 bar)

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 D for example.

Selector Valve Multipliers		
Pipe Size In. (mm)	Pipe Schedule	Multiplier
1/2 (15)	40	0.638408
	80	0.828503
3/4 (20)	40	0.363768
	80	0.448613
1 (25)	40	0.224455
	80	0.269684
1 1/4 (32)	40	0.129694
	80	0.151223
1 1/2 (40)	40	0.095286
	80	0.109773
2 (50)	40	0.057809
	80	0.065694
2 1/2 (65)	40	0.040517
	80	0.045770
3 (80)	40	0.026240
	80	0.029369

3.25. Equivalent Length Values

The following table lists the equivalent length values used by the ECARO-25 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)
3/8 (10)	0.3 (0.09)	0.6 (0.18)	1.3 (0.40)	0.8 (0.24)	2.7 (0.82)	---
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 (10.0)	---

The following table lists equivalent length values for the ECARO-25 container Impulse valves.

Impulse Valve Size	1 in. (25 mm)	3 in. (80 mm)	3 in. (80 mm) Inverted 150i
Equivalent Length	6.03 ft. (1.84 m)	30.90 ft. (9.42 m)	35.93 ft. (10.95 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 Authorities Having Jurisdiction (AHJ).

Specific installation drawings must be prepared for the hazard area in accordance with the system design as calculated by the Fike ECARO-25 System 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 ¼" 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)	1371	623	3.14	0.29	437	2148	4.0	0.36	348	1759
650 (267)	901	409	3.14	0.29	287	1410	4.0	0.36	231	1164
375 (153)	515	234	2.18	0.20	236	1170	4.0	0.36	134	678
215 (88)	319	145	2.18	0.20	146	725	4.0	0.36	85	431
150 (61)	238	109	2.18	0.20	109	545	4.0	0.36	65	331
100 (44)	164	74	0.63	0.06	260	1233	4.0	0.36	47	234
60 (27)	107	49	0.63	0.06	170	817	4.0	0.36	32	164
35 (15)	63	29	0.27	0.03	233	967	4.0	0.36	21	109
20 (8.5)	38	18	0.27	0.03	141	600	4.0	0.36	15	78
10 (4)	23	11	0.10	0.009	230	1222	4.0	0.36	11	59
5 (2)	15	7	0.10	0.009	150	778	4.0	0.36	9	48

NOTES:

- 1) Total container weight is based on container tare weight + maximum fill weight.
- 2) Plate size = ¼" 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).

Mounting Note: The 5 and 10 lb. (2 and 4 L) containers must be mounted in the vertical (valve up) position. Mounting in the horizontal position will result in an incomplete discharge. The 20 and 35 lb. (8.5 and 15 L) containers can be mounted in the vertical (valve-up) position or horizontal position.

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

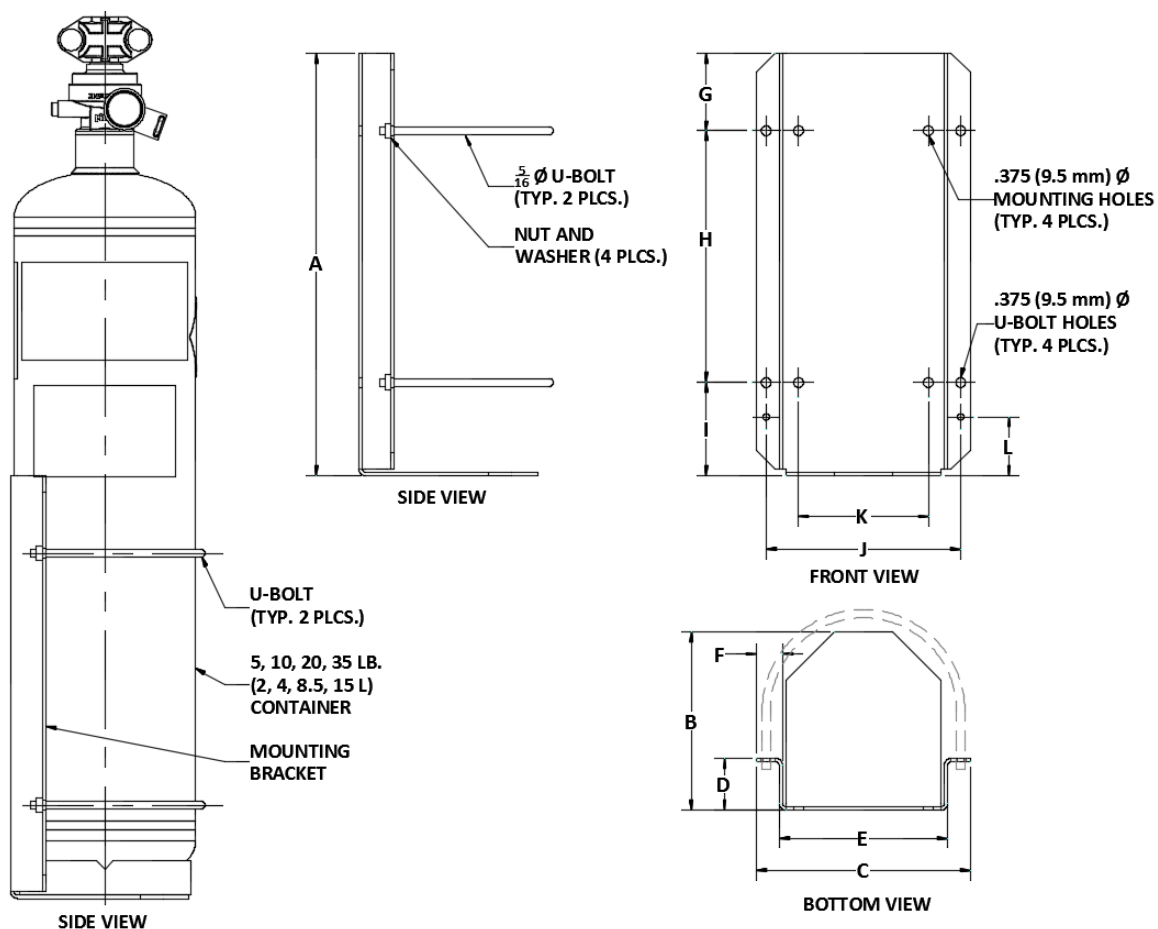
Step 3. Position the container within the mounting bracket so the pressure gauge and actuator port are easily visible and accessible.

Step 4. If installing the container horizontally, verify that the valve's pressure gauge is facing up. Failure to comply with this requirement will result in an incomplete discharge.

Step 5. 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	12.30 (313.0)	12.30 (313.0)	16.25 (413.0)	16.25 (413.0)
B	4.00 (102.0)	4.00 (102.0)	6.88 (174.6)	6.88 (174.6)
C	5.72 (145.0)	5.72 (145.0)	7.50 (190.5)	7.50 (190.5)
D	1.38 (35.0)	1.38 (35.0)	2.00 (50.8)	2.00 (50.8)
E	4.00 (102.0)	4.00 (102.0)	6.50 (165.0)	6.50 (165.0)
F	1.00 (25.4)	1.00 (25.4)	1.00 (25.4)	1.00 (25.4)
G	2.50 (63.5)	2.50 (63.5)	2.97 (75.4)	2.97 (75.4)
H	8.00 (203.2)	8.00 (203.2)	9.70 (246.0)	9.70 (246.0)
I	1.78 (45.2)	1.78 (45.2)	3.60 (91.3)	3.60 (91.3)
J	5.00 (127.0)	5.00 (127.0)	7.50 (190.5)	7.50 (190.5)
K	3.00 (76.2)	3.00 (76.2)	5.00 (127.0)	5.00 (127.0)
L	N/A	N/A	2.27 (57.7)	2.27 (57.7)

All dimensions are approximate.

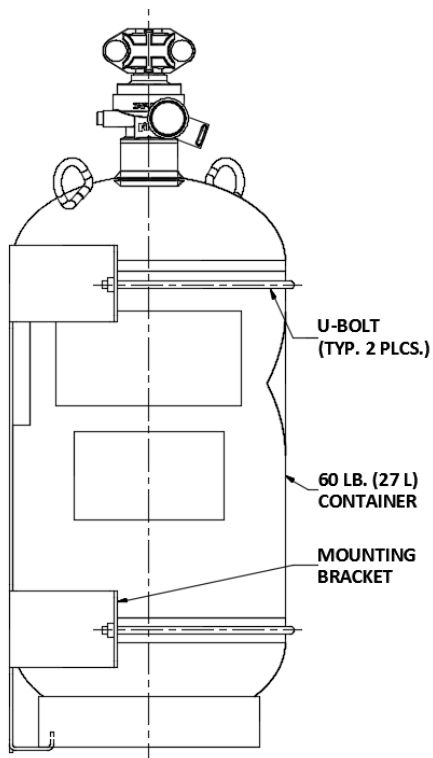


4.2.2. Mounting Detail for 60 lb. (27 L) Container

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

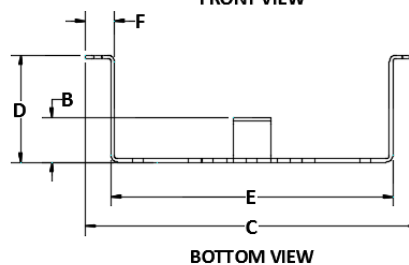
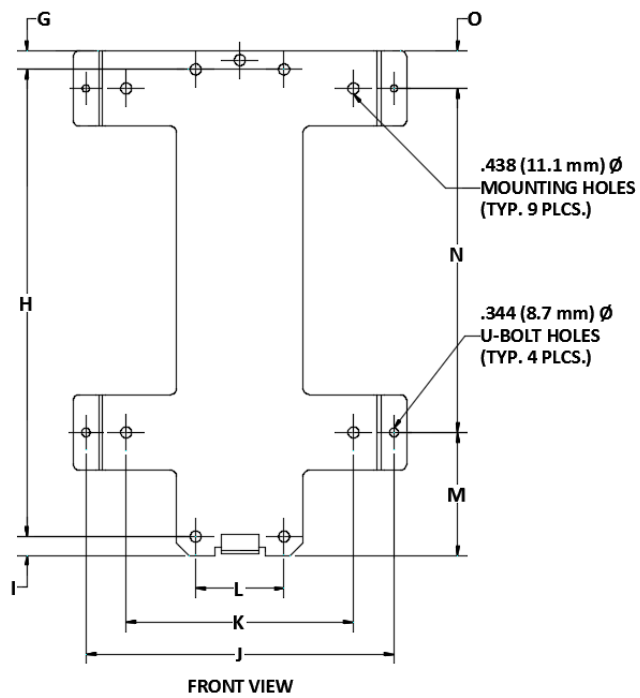
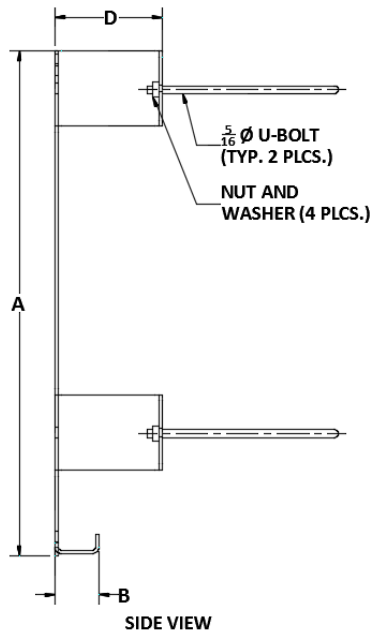
Mounting Note: The container can be mounted in the vertical (valve-up) position or horizontal position. When mounting the container in the horizontal position (wall or Subfloor), the container valve pressure gauge must point up. Failure to comply with this requirement will result in incomplete discharge.

- 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. If installing the container horizontally, verify that the valve's pressure gauge is facing up. Failure to comply with this requirement will result in an incomplete discharge.
- Step 5. 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)
B	1.75 (44.6)
C	13.19 (335)
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

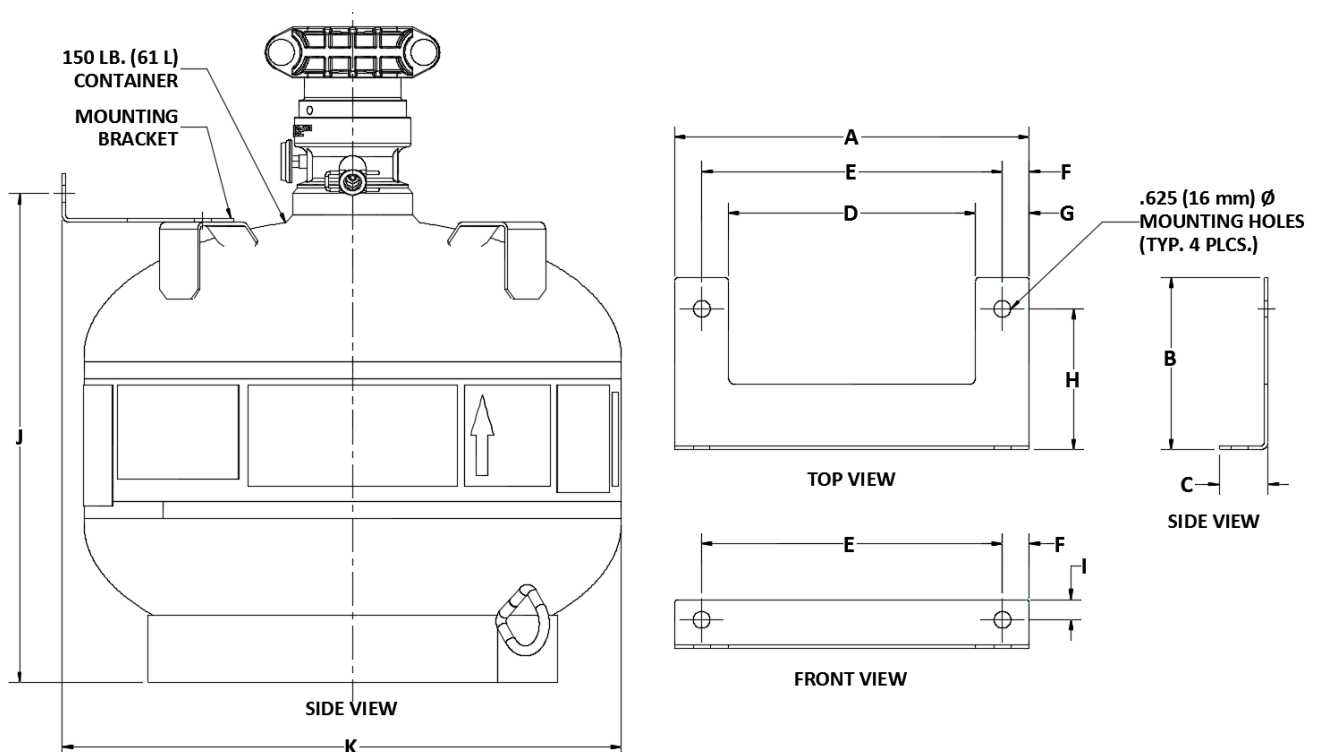
- Step 1. Secure the container mounting bracket (supplied with container) to the container with the washer and nuts provided.

Mounting Note: The container is equipped with a siphon tube and **MUST** be mounted in the upright (valve up) position. Failure to comply with this requirement 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)
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.

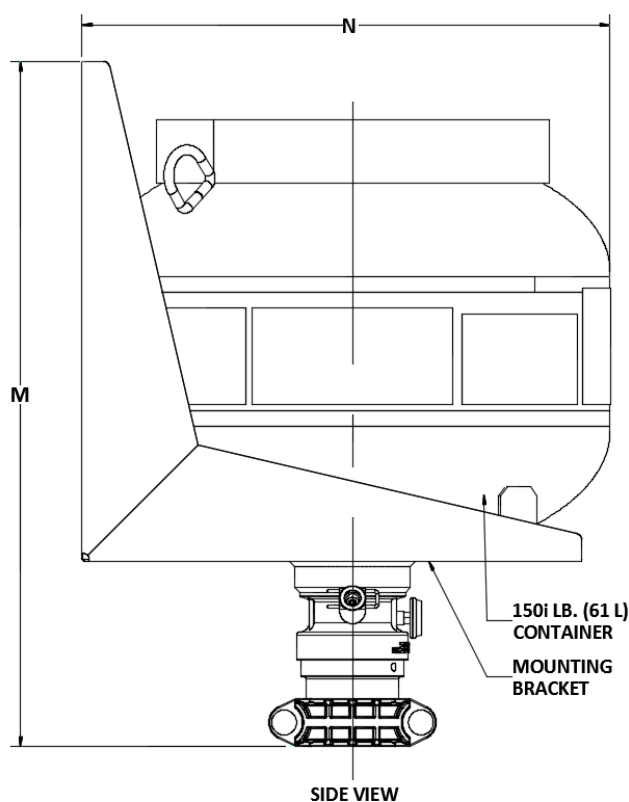


4.2.4. Mounting Detail for 150i lb. (61 L) Container

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

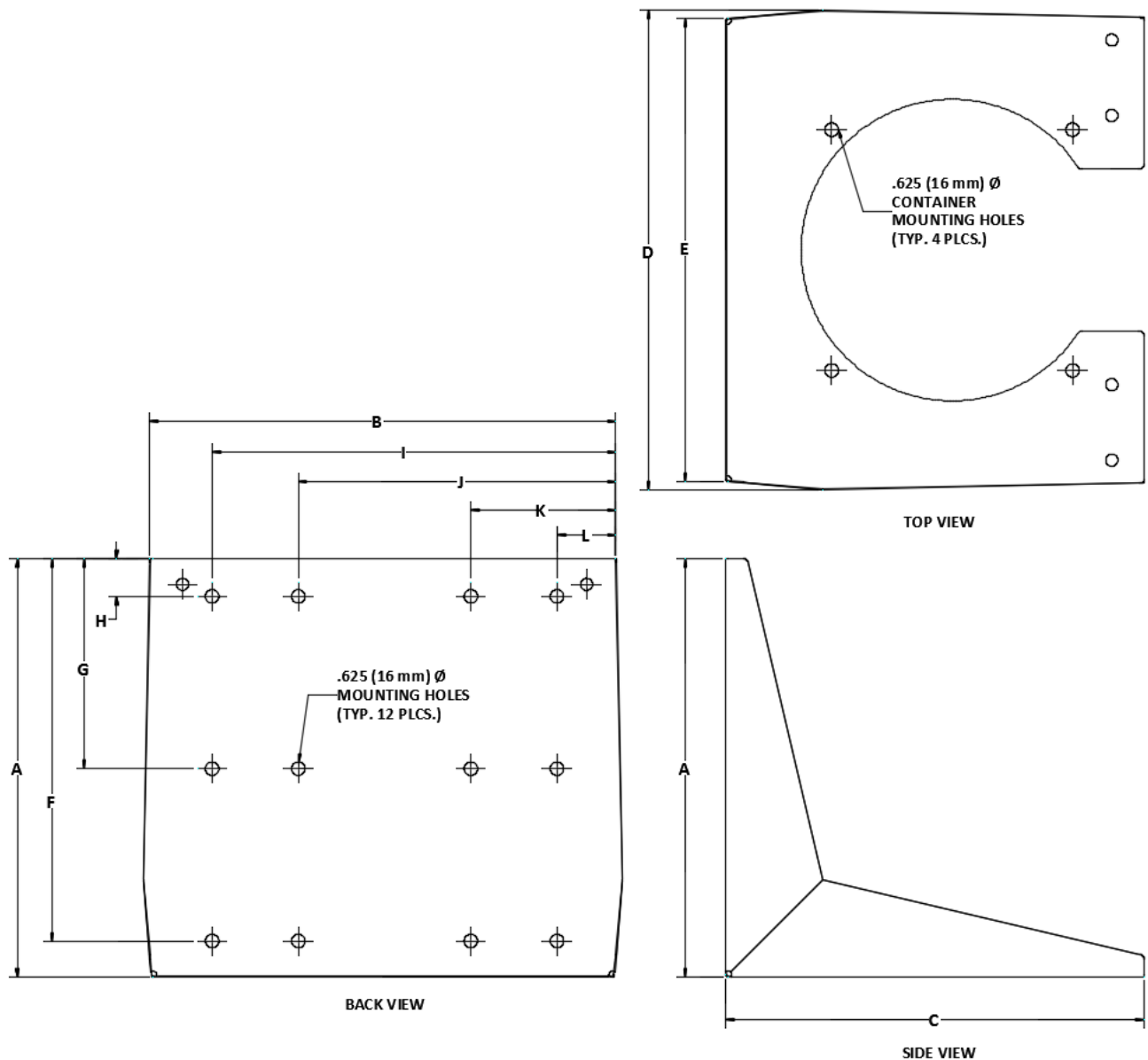
Mounting Note: The 150i LB. container is not equipped with a siphon tube and must be mounted in the inverted (valve down) position. Failure to comply with this requirement will result in an incomplete discharge.

- Step 2. Install the container onto the mounting bracket.
- Step 3. Position the container so the pressure gauge and actuator port are easily visible and accessible.
- Step 4. Align the container support brackets with the four mounting holes provided in the bracket.
- Step 5. Secure the container to the mounting bracket with the washer and nuts provided.
- Step 6. Secure the mounting bracket to the wall using suitable hardware (not supplied).



DIMENSION	In. (mm)	DIMENSION	In. (mm)
A	19.42 (493.2)	H	1.75 (44.5)
B	21.62 (549.3)	I	18.73 (475.8)
C	19.42 (493.2)	J	14.73 (374.2)
D	22.27 (565.6)	K	6.73 (171)
E	21.50 (546)	L	2.73 (69.4)
F	17.75 (451)	M	26.63 (676.4)
G	9.75 (247.7)	N	20.51 (521)

All dimensions are approximate.

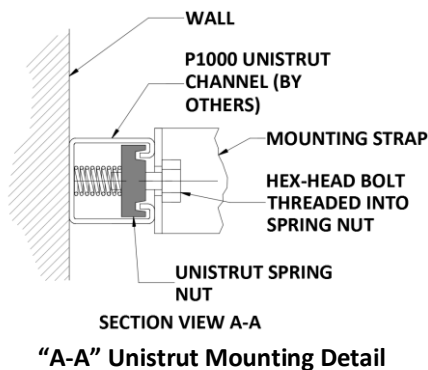
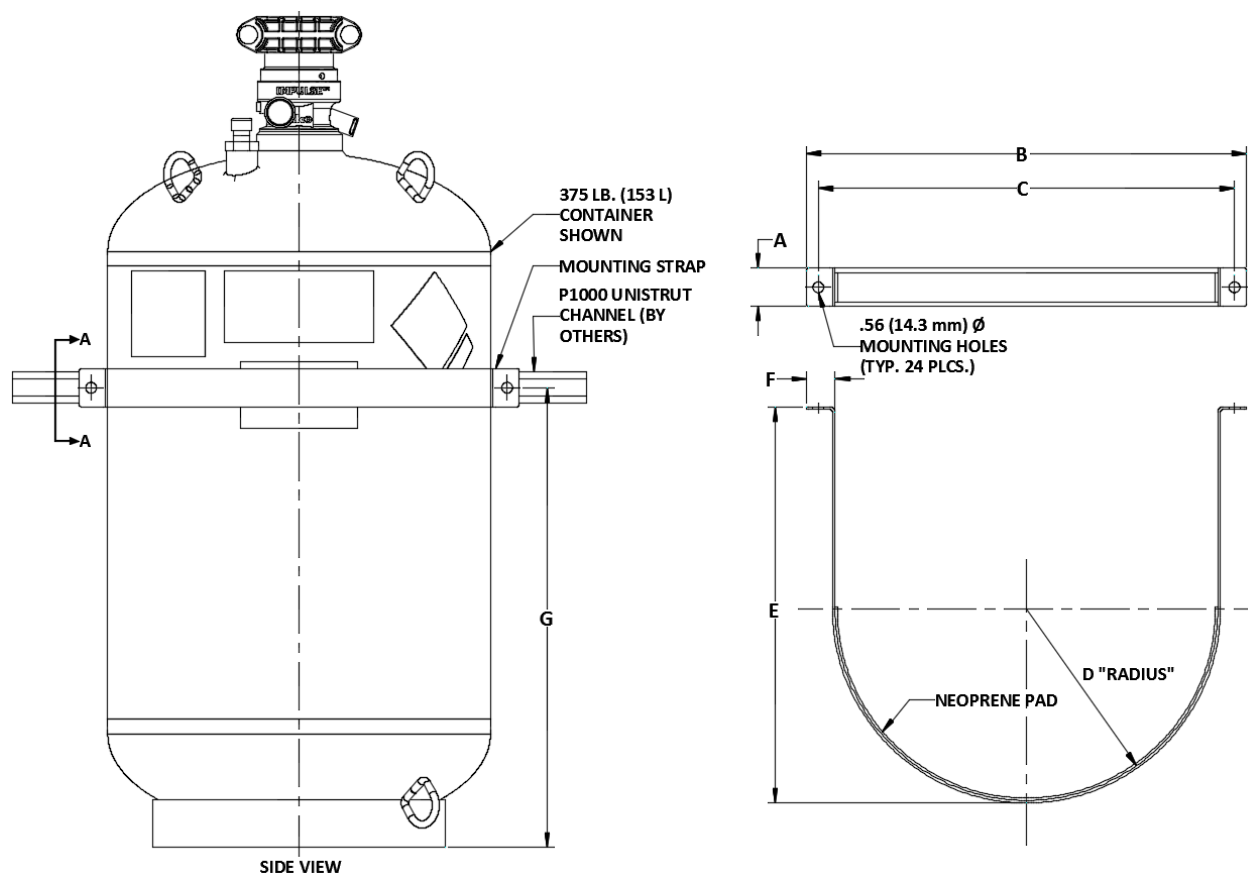


4.2.5. Mounting Detail for 100, 215, 375, 650 and 1000 lb. (44, 88, 153, 267 and 423 L) Containers

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

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)	2.00 (51)	2.00 (51)	2.00 (51)
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)	10.00 (254)	12.19 (309.6)	12.19 (309.6)
E	11.00 (279.8)	20.42 (518.7)	20.42 (518.7)	24.00 (610)	24.00 (610)
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)	11.00 (279)	24.00 (609.6)	28.00 (711)	40.00 (1016)

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 360 psig (24.8 bar) at 70°F (21°C), use a minimum piping design pressure of 492 psig (33.9 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. 3/8" 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 1000 lb. ductile or forged steel. Any size Class 300 flanged fitting can be used.

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

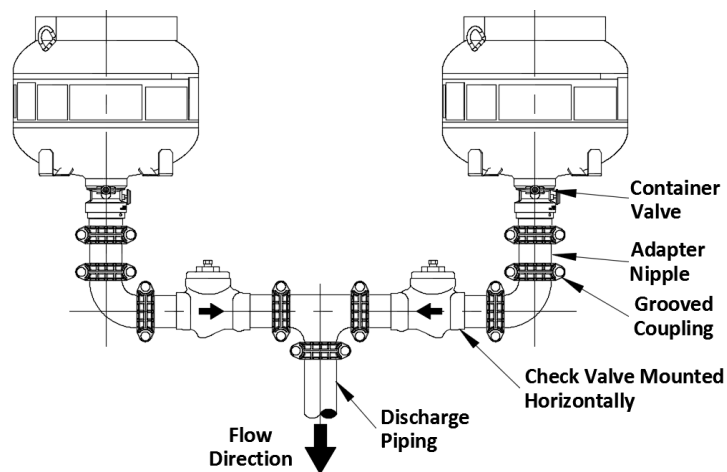
Manifolds are supplied by others and are commonly assembled using grooved fittings; however, threaded, welded or flanged fittings can also be used. They allow multiple containers to be connected to a common pipe network. They may also be used in system where Main/Reserve container arrangements are required.

The number of containers that can be connected to a single manifold is determined (calculated) by Fike's ECARO-25 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.

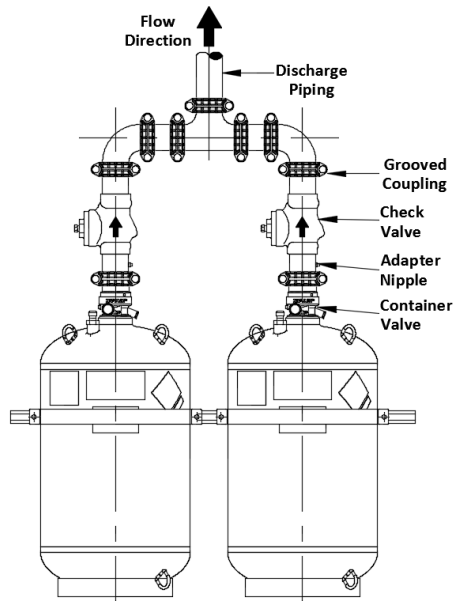
NOTE: The General Piping Requirements outlined in Section 4.3.3 must be adhered to when constructing manifolds.

TYPICAL MANIFOLD CONFIGURATION OPTIONS

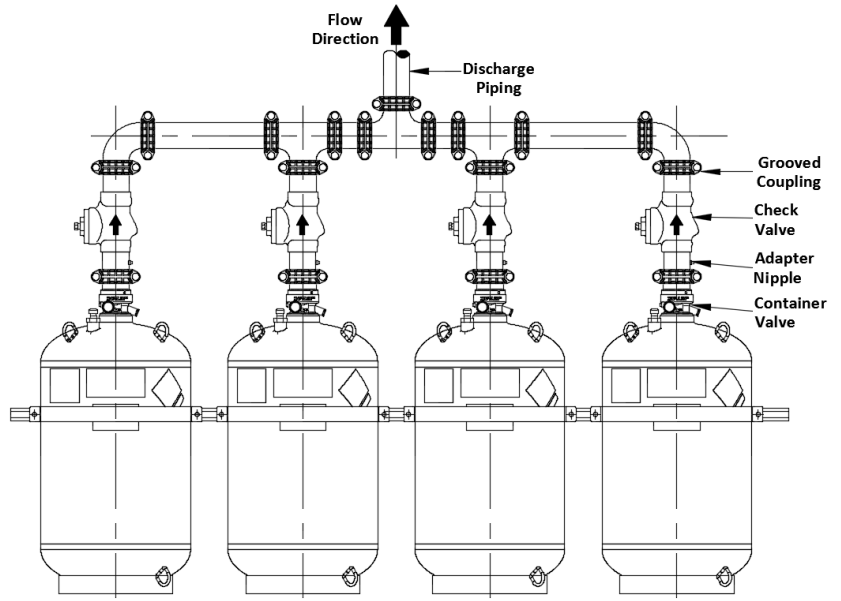


Center Exit Manifold or Main/Reserve System using 150i Inverted Containers

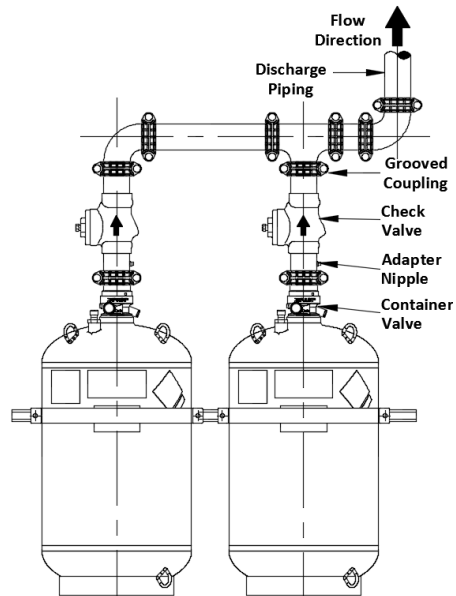
IMPORTANT NOTE: When used with 150i (Inverted) containers, the check valve must be installed in the horizontal position. Do NOT install check valve in the vertical down position or check valve flipper will be left in the open position and will NOT function as intended.



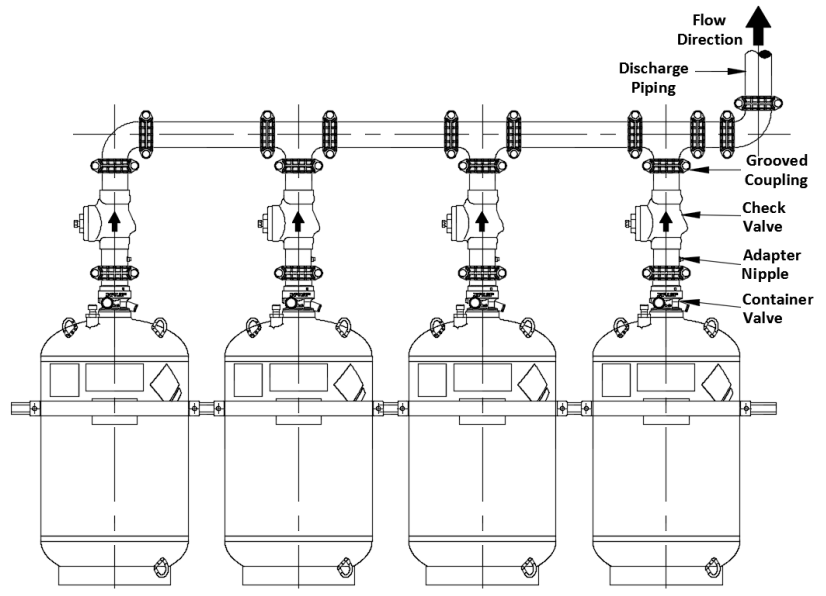
**Center Exit Manifold or
Main/Reserve System**



**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. NPT (mm)	Maximum Distance Between Supports ft. (m)	Rod Diameter in. (mm)
3/8 (12)	7 (2.1)	3/8 (9.5)
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

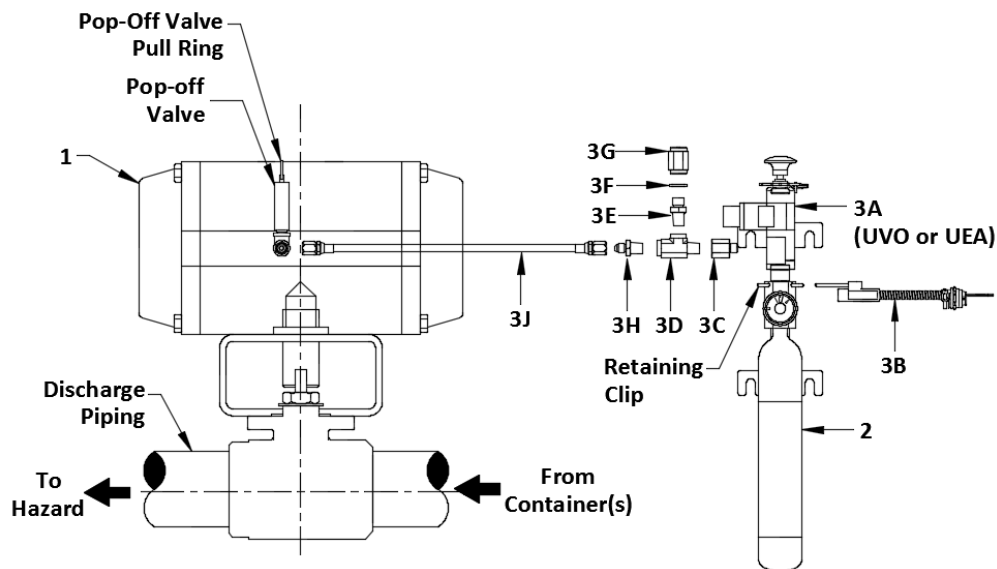
- Step 1. Install item 1 in the piping network. Fike recommends that threaded unions or grooved couplings be installed on each side of the valve to facilitate easy removal of the valve. Supports shall be installed on each side of the selector valve to support its dead load. The pipe network shall NOT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

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

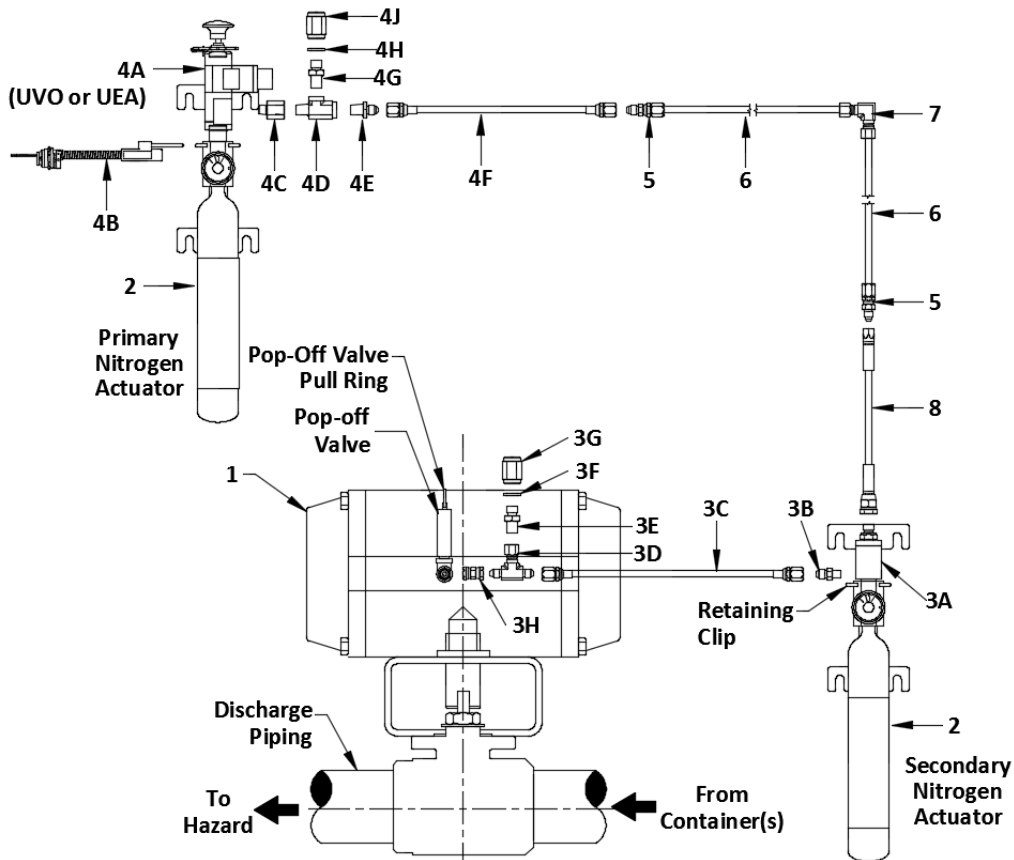
4.3.6.2. Selector Valve Activated by Secondary Nitrogen Actuator Assembly

- 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 x 1/4 JIC Hex Nipple	
3C	02-4977	1/4 in. JIC x 36 in. (914 mm) 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. (914 mm) 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	Supplied by others
6	N/A	1/4 in. x 0.035 in. Wall, Stainless Steel Tubing, Cut to Length	
7	02-12696	1/4 in. Tube 90° Elbow	
8	02-10801	G1/4 x 1/4 in. JIC x 39 in. (991 mm) Long Actuation Hose	

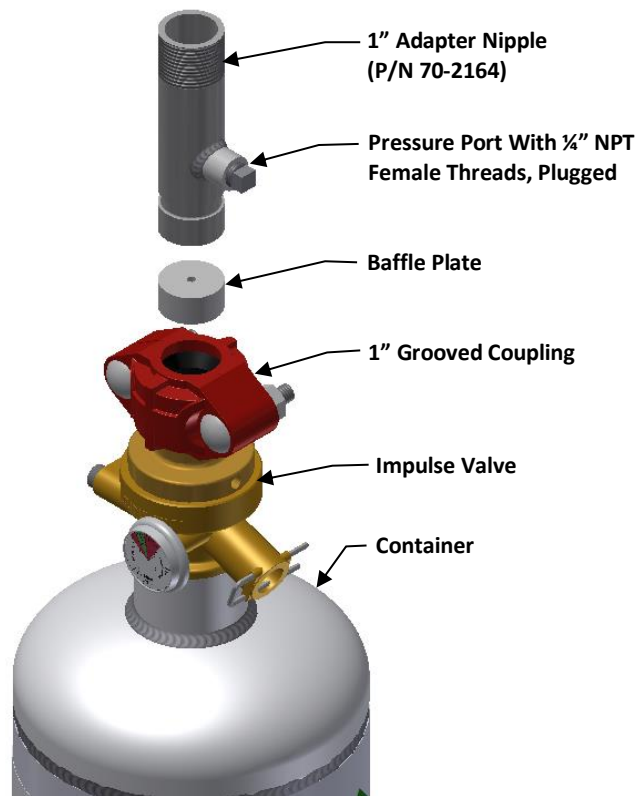
¹Valve material supplied is based on selector valve assembly part number.

4.3.7. Connect Distribution Piping to Container

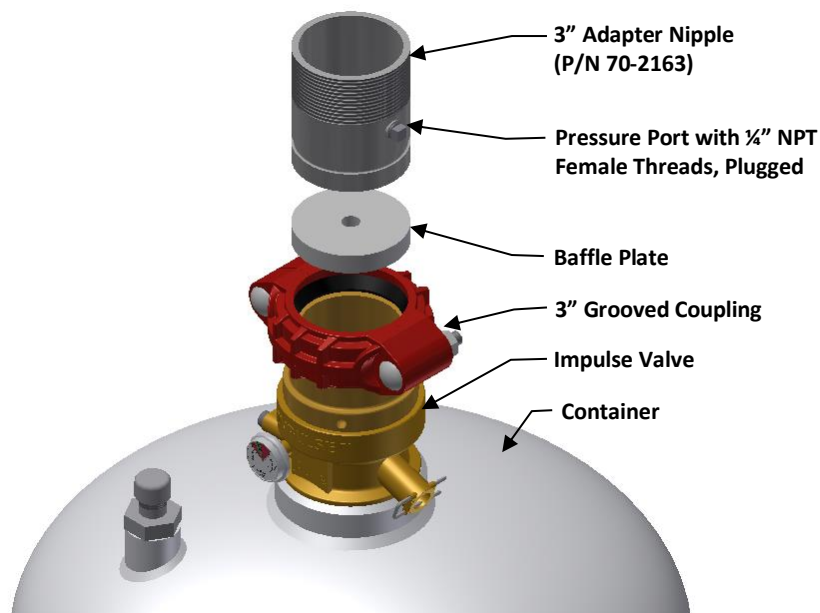
Each ECARO-25 container is shipped with a removable baffle plate installed inside the grooved coupling connected to the Impulse valve. The baffle plate is an anti-recoil device that must be installed to the ECARO-25 container whenever it is not connected to the discharge piping. However, before connecting 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" 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)

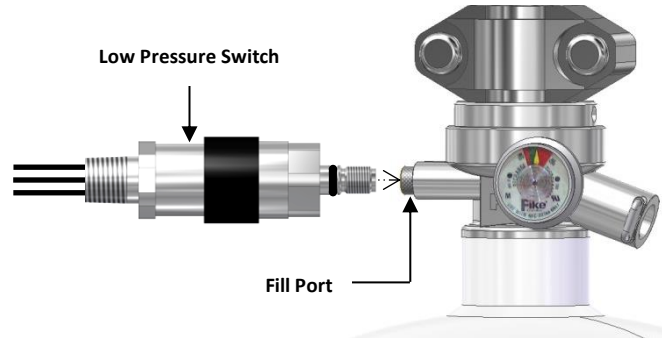


3" (80 mm) Discharge Valve Piping Connection
(150, 150i, 215, 375, 650 and 1000 lb. [61, 61i, 88, 153, 267 and 423 L] Containers)

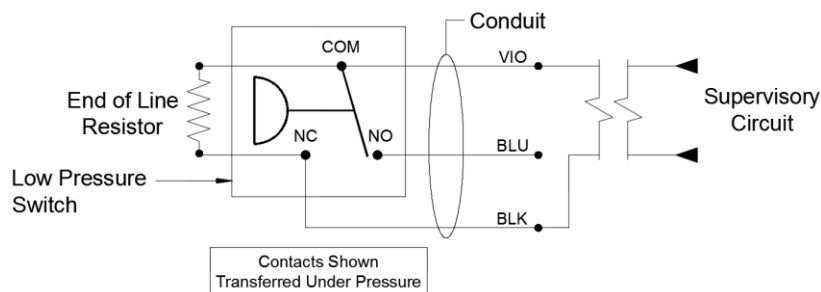
4.4. Installing Low Pressure Switch

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 the manual for the control panel being used for specific wiring criteria.



Low Pressure Switch Installation

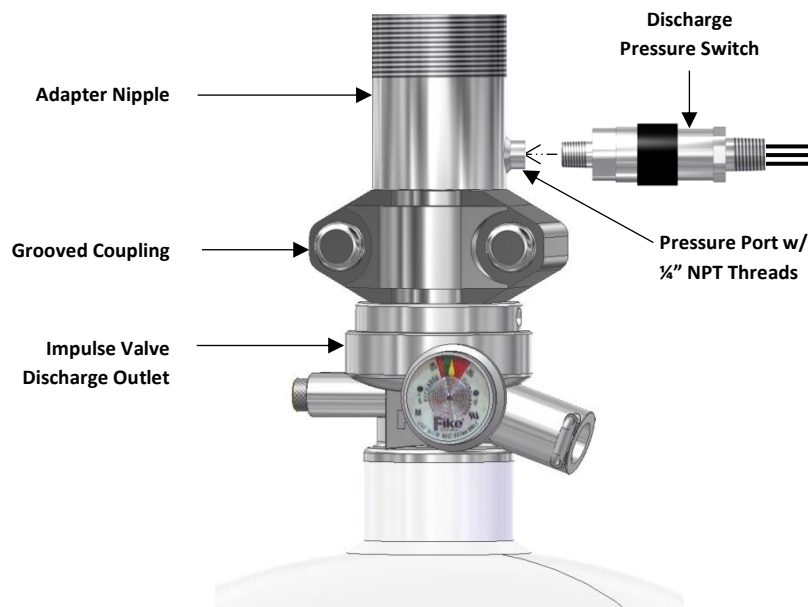


Low Pressure Switch Wiring Diagram

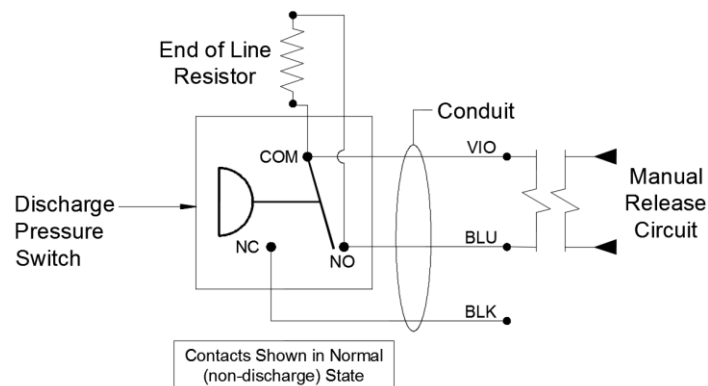
4.5. Installing Discharge Pressure Switch

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 1/4" pipe plug from the adapter nipple.
- Step 3. Screw the discharge pressure switch into the 1/4" 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 the manual for the control panel being used for specific wiring criteria.



Discharge Pressure Switch Installation



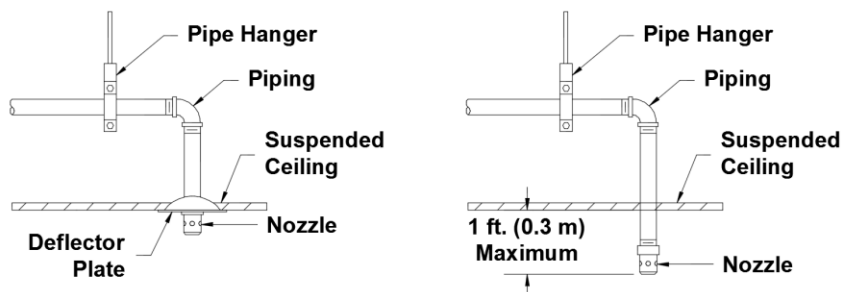
Discharge Pressure Switch Wiring Diagram

4.6. Installing Discharge Nozzles

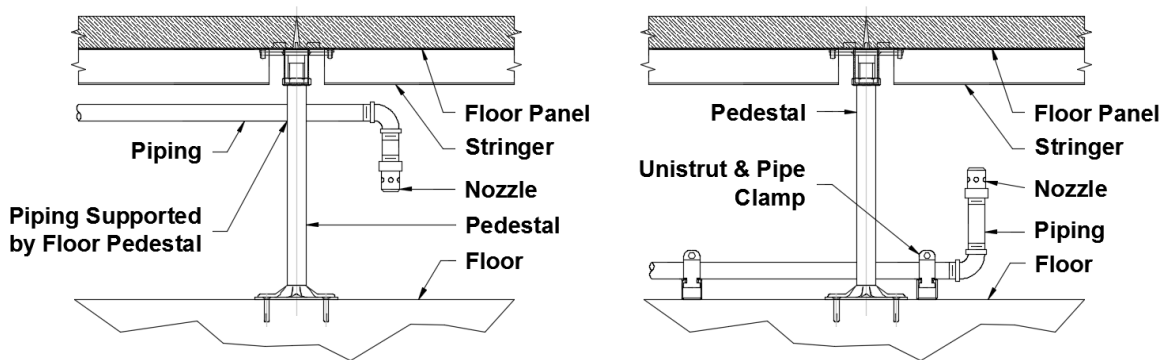
Prior to installing the discharge nozzle(s), the following checks shall be performed:

- 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. Screw the nozzle onto the pipe and 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.

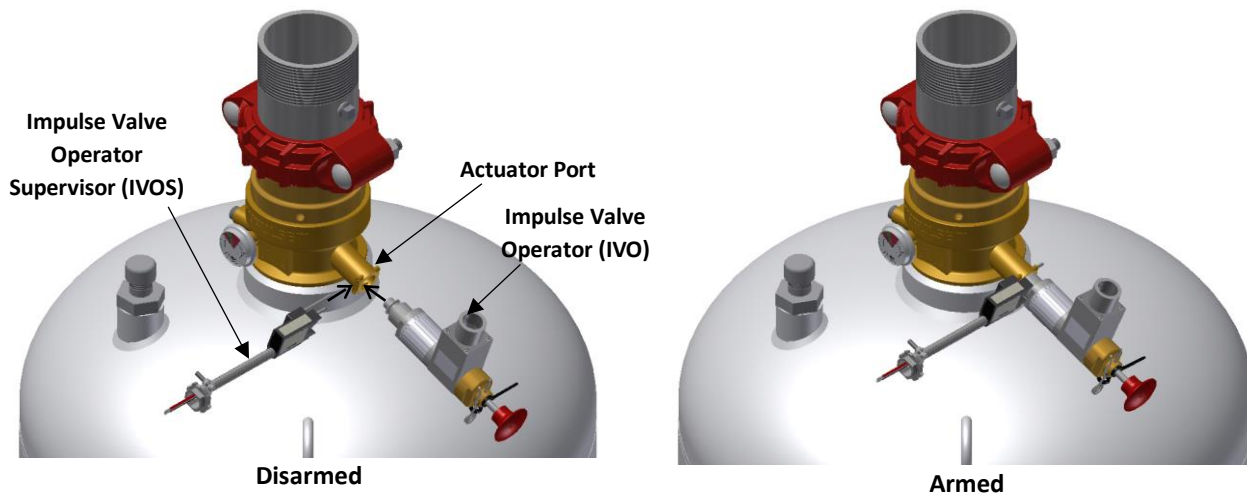
Step 3. Pull the IVO wire leads through the conduit.

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.

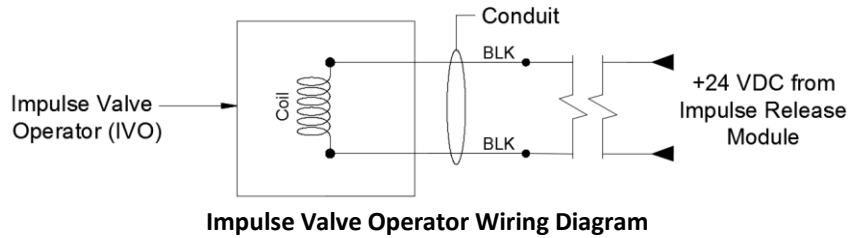


NOTE: An IVOS must be installed to supervise the connection of the IVO to a container.

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.



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 3/4" NPT conduit fitting.

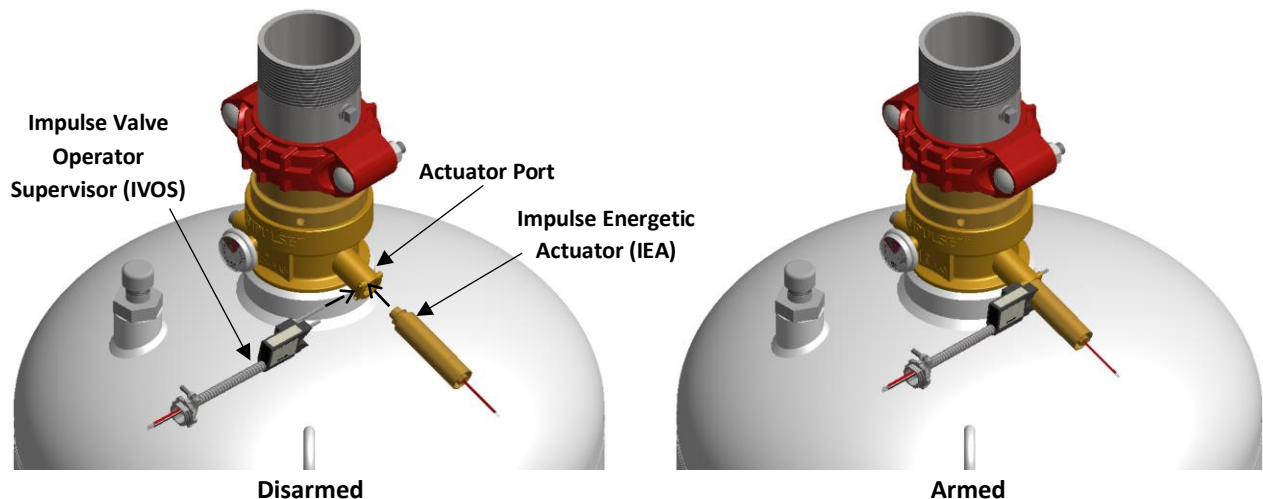
Step 3. Pull the IEA wire leads through the conduit.

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.

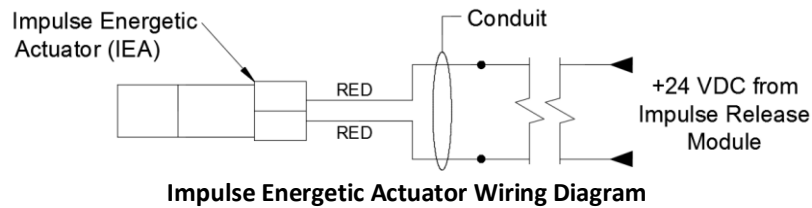


NOTE: An IVOS must be installed to supervise the connection of the IEA to each container.

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.



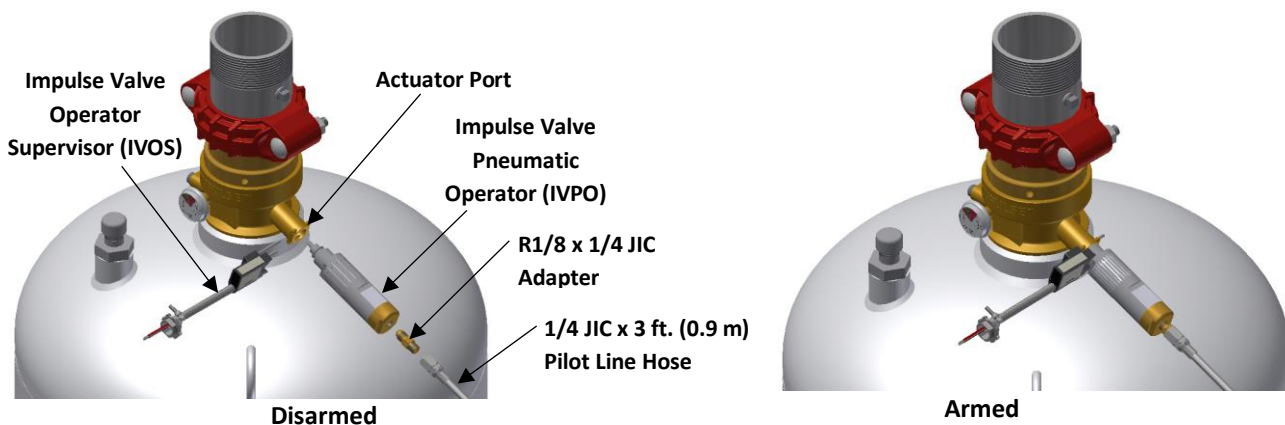
4.7.3. Installing Impulse Valve Pneumatic Operator (IVPO)

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 1/4 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 1/4 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.

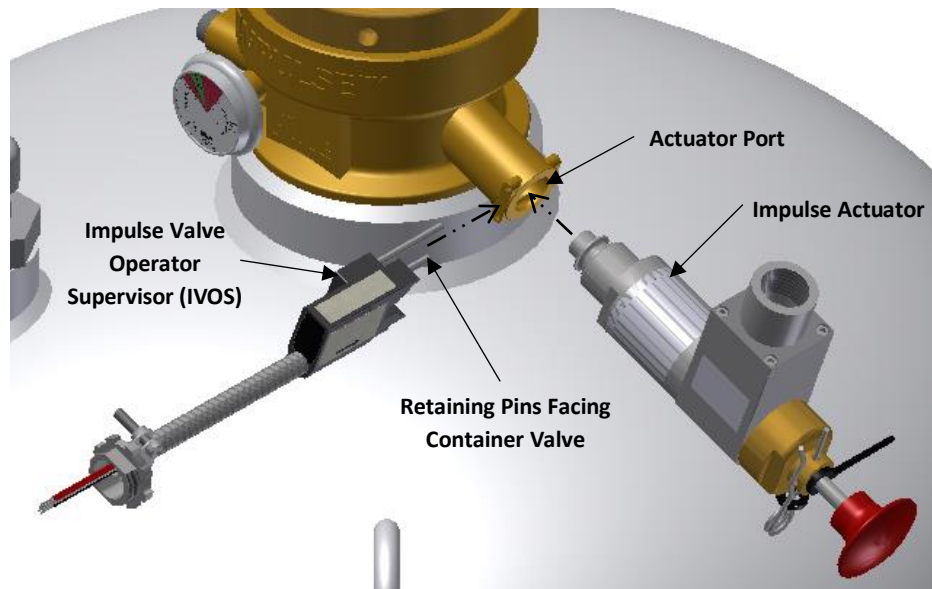
The container is now armed.



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)

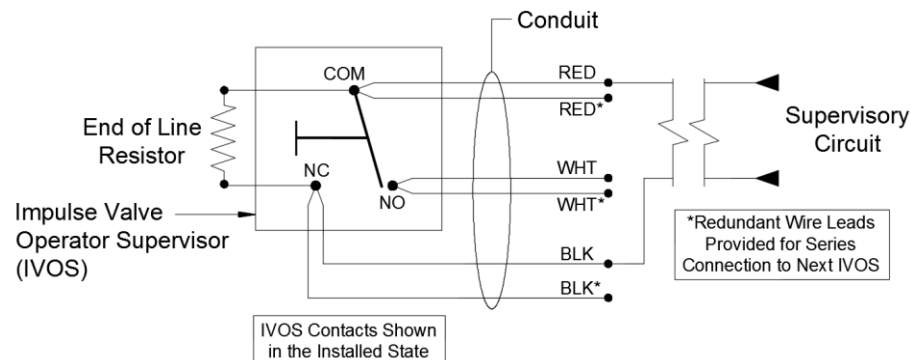
- Step 1. Connect the IVOS to the electrical box using the electrical connector integrated into the IVOS.
- Step 2. Connect the IVOS wire leads to a “Supervisory” input on a Fike releasing panel. See 4.7.4.1.
- Step 3. Install the actuator (IVO, IEA or IVPO) into the valve actuator port.
- Step 4. Position 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.

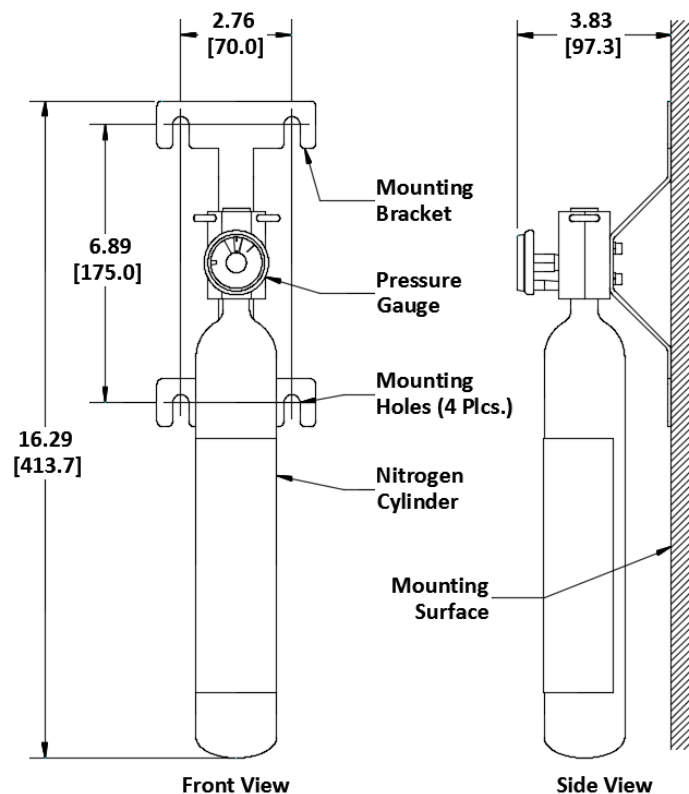
- The Nitrogen Actuator Assembly should be the last component installed on the system.
- Verify that the location for installing the Nitrogen Actuator Assembly is suitably protected so that it is not subject to mechanical, chemical, or other damage that would render it inoperable.
- Verify that the location 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.

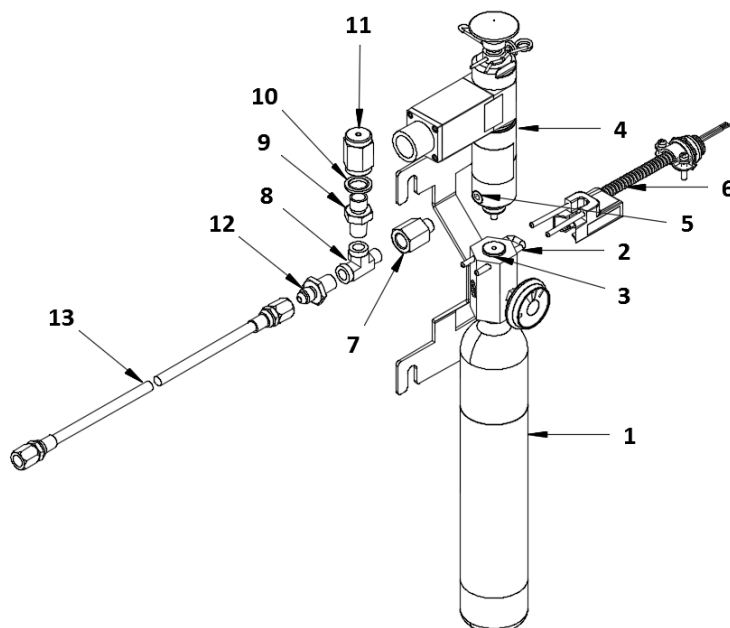
- Step 1. Apply PTFE tape to the NPT male threads of item 7, item 8, item 9, and item 12. Do NOT allow tape to overlap the end of the fitting as this could cause possible blockage of the pressure port.
- Step 2. Assemble item 7, item 8, and item 12 together. Secure wrench tight.
- Step 3. Remove item 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.

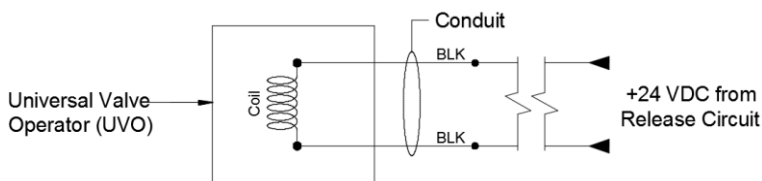


Nitrogen Actuator Assembly with UVO Primary Completer Kit

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. (914 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.

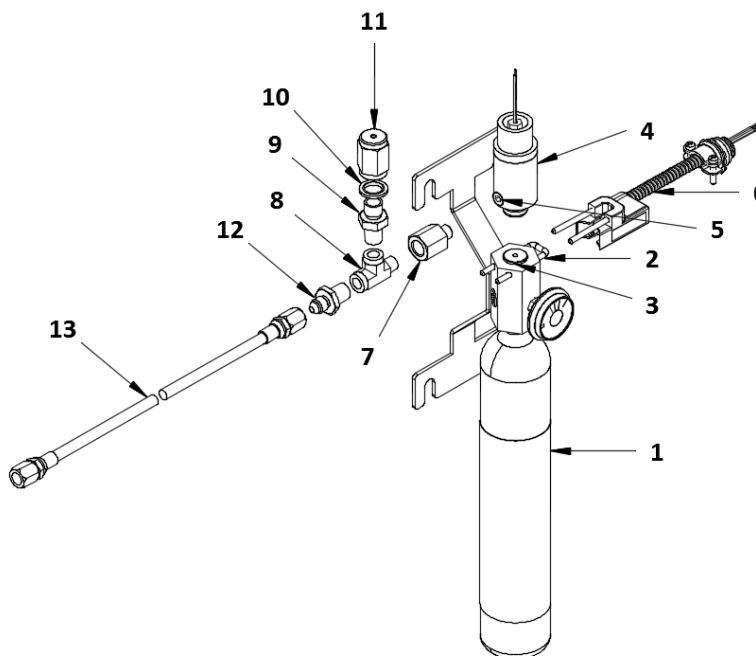
- Step 1. Apply PTFE tape to the NPT male threads of item 7, item 8, item 9, and item 12. Do NOT allow tape to overlap the end of the fitting as this could cause possible blockage of the pressure port.
- Step 2. Assemble item 7, item 8, and item 12 together. Secure wrench tight.
- Step 3. Remove item 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.

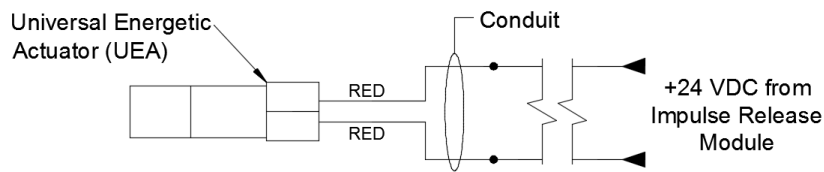


Nitrogen Actuator Assembly with UEA Primary Completer Kit

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. (914 mm) Long Actuation Hose	
14	10-2748	Interface Firing Module (IFM), <i>not shown</i>	

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).

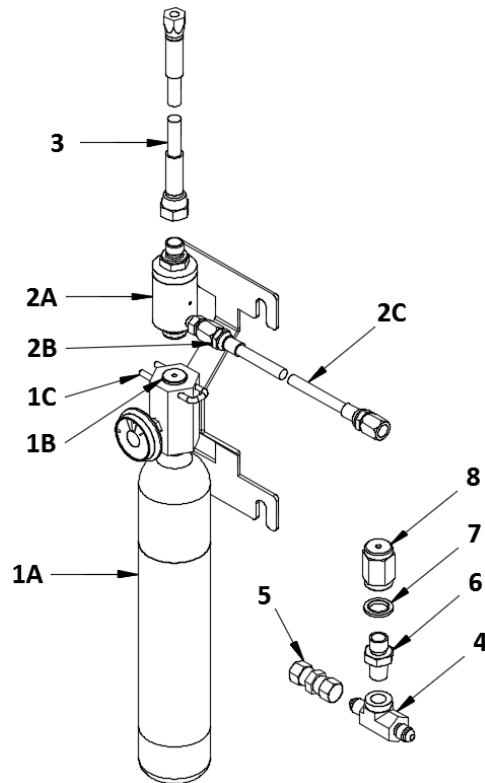
CAUTION: Do NOT install the pneumatic relay to the container with the firing pin extended as this may cause accidental discharge.

- 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.

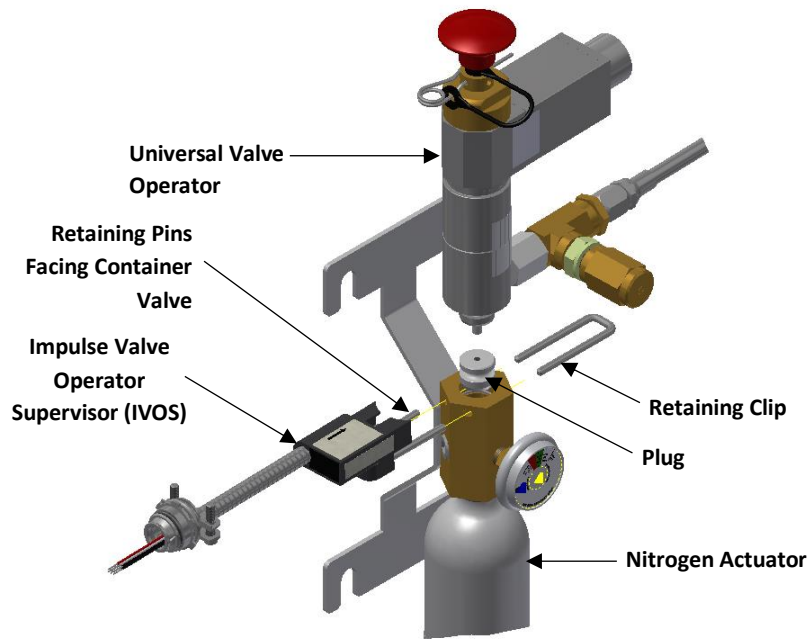


Nitrogen Actuator Assembly with Pneumatic Relay Secondary Completer Kit

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. (914 mm) Long Actuation	
3	02-10801	G1/4 x 1/4 in. JIC x 39 in. (991 mm) 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)

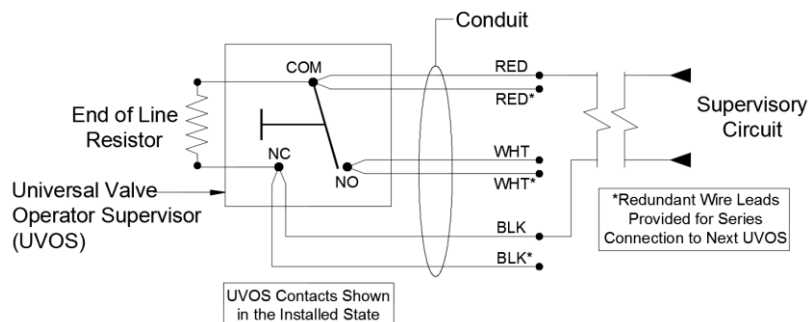
- Step 1. Connect the UVOS to the electrical box using the electrical connector integrated into the UVOS.
- Step 2. Connect the UVOS wire leads to a “Supervisory” input on a Fike releasing panel. See 4.7.9.1.
- Step 3. Install the actuator (UVO, UEA or Pneumatic Relay) into the valve actuator port.
- 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

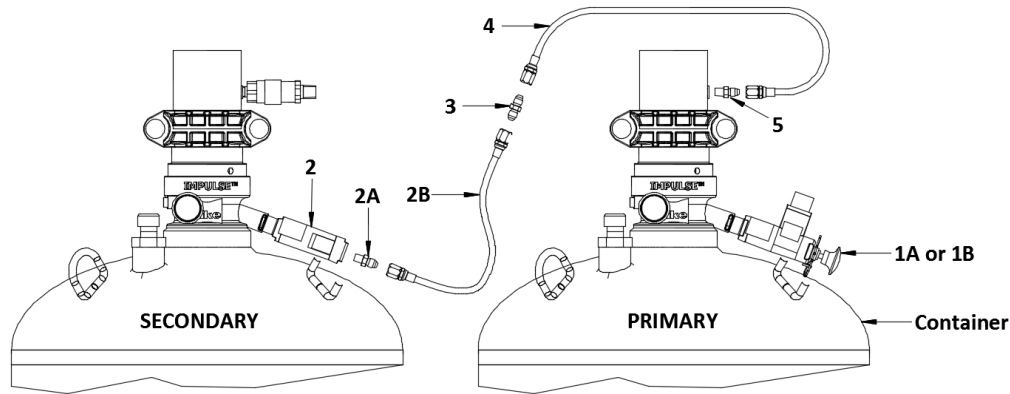
4.8. Installing Pneumatic Actuation Lines

Pilot line hoses are used to allow simultaneous pneumatic activation of multiple containers. The pilot line shall be installed in a manner that protects it against crimping or mechanical damage. Where the pilot 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. Pilot 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, wrench tight.
- Step 3. Remove 1/4" NPT plug from the primary container's adapter nipple and thread item 5 into port, 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.

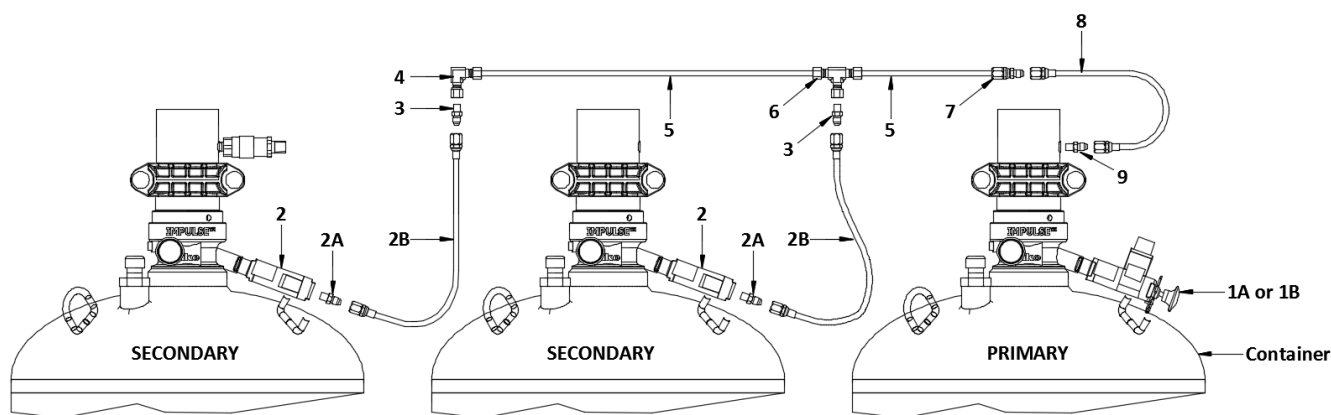
Item No.	Part Number	Description	Notes
1A	02-12728	Impulse Valve Operator (IVO)*	Part of 70-279 Kit
1B	70-374	Impulse Energetic Actuator (IEA)	Part of 70-390 Kit
2	02-12729	Impulse Valve Pneumatic Operator (IVPO)	Part of 70-280 IVPO Kit
2A	02-4535	1/8 in. NPT x 1/4 in. JIC Adaptor	
2B	02-4977	1/4 in. JIC x 36 in. (914 mm) Long Actuation Hose	
3	02-12926	1/4 in. JIC Male Adaptor	
4	02-4977	1/4 in. JIC x 36 in. (914 mm) 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, wrench tight.
- Step 4. Remove ¼" NPT plug from the primary container's adapter nipple and thread item 9 into port, 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 ¼ in. x 0.035 in. wall stainless steel.
- 3) Pilot line hoses supplied by Fike.

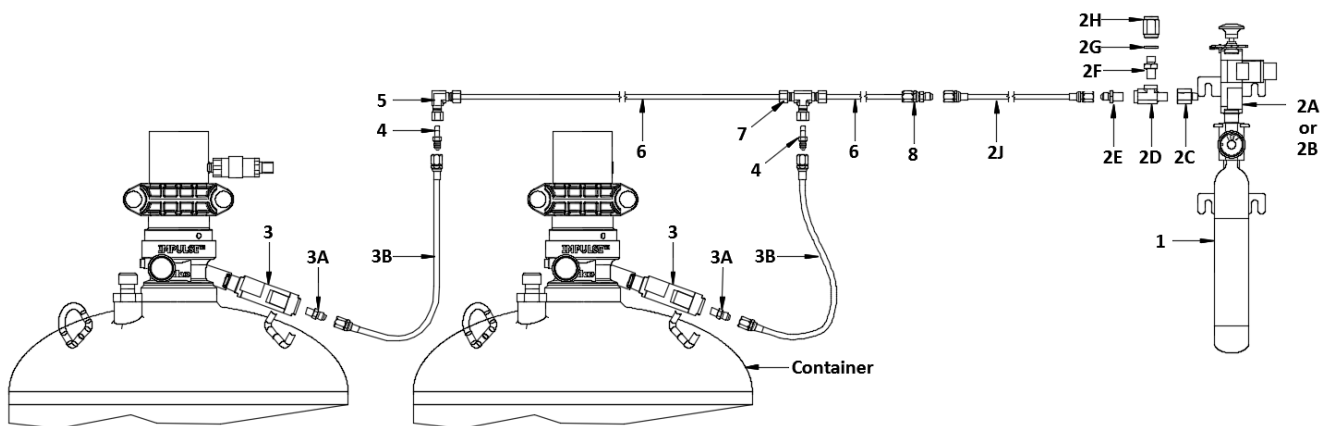
Item No.	Part Number	Description	Notes
1A	02-12728	Impulse Valve Operator (IVO)*	Part of 70-279 Kit
1B	70-374	Impulse Energetic Actuator (IEA)	Part of 70-390 Kit
2	02-12729	Impulse Valve Pneumatic Operator (IVPO)	Part of 70-280 IVPO Kit
2A	02-4535	1/8 in. NPT x 1/4 in. JIC Adaptor	
2B	02-4977	1/4 in. JIC x 36 in. (914 mm) 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. (914 mm) 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, 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 ¼ 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.

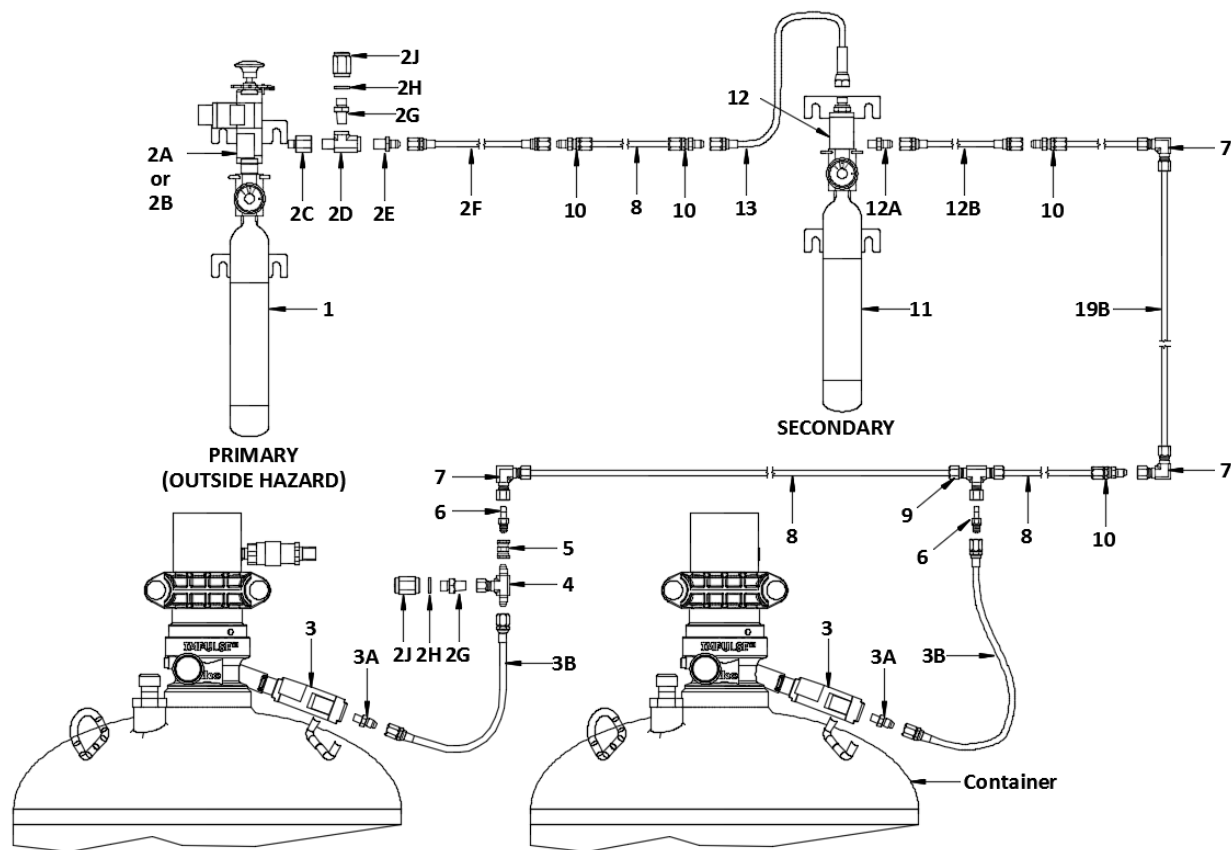
Item No.	Part Number	Description	Notes
1	70-325-X	Nitrogen Actuator Assembly	
2A	02-13571	Universal Valve Operator (UVO)*	Part of 70-335 Primary Completer Kit
2B	IG71-247	Universal Energetic Actuator (UEA)	Part of 70-400 Primary Completer Kit
2C	02-13640	1/8 in. NPT x 1/4 in. NPT Adapter	Part of Primary 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. (914 mm) 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. (914 mm) 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 ¼ 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. (914 mm) 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. (914 mm) 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. (914 mm) Long Actuation Hose	
13	02-10801	G1/4 x 1/4 in. JIC x 39 in. (991 mm) 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 360 PSIG at 70°F (24.8 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 Indicator (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 360 PSIG at 70°F (24.8 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 Indicator (LLi), if installed. 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 360 PSIG at 70°F (24.8 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, additional 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 recharge following the procedures outlined in the Clean Agent Recharge Manual, P/N 06-290.

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 06-290 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

After a system discharge, the nitrogen actuator cylinder(s) must be recharged and returned to service as soon as possible (24 hours maximum) to ensure continued protection.

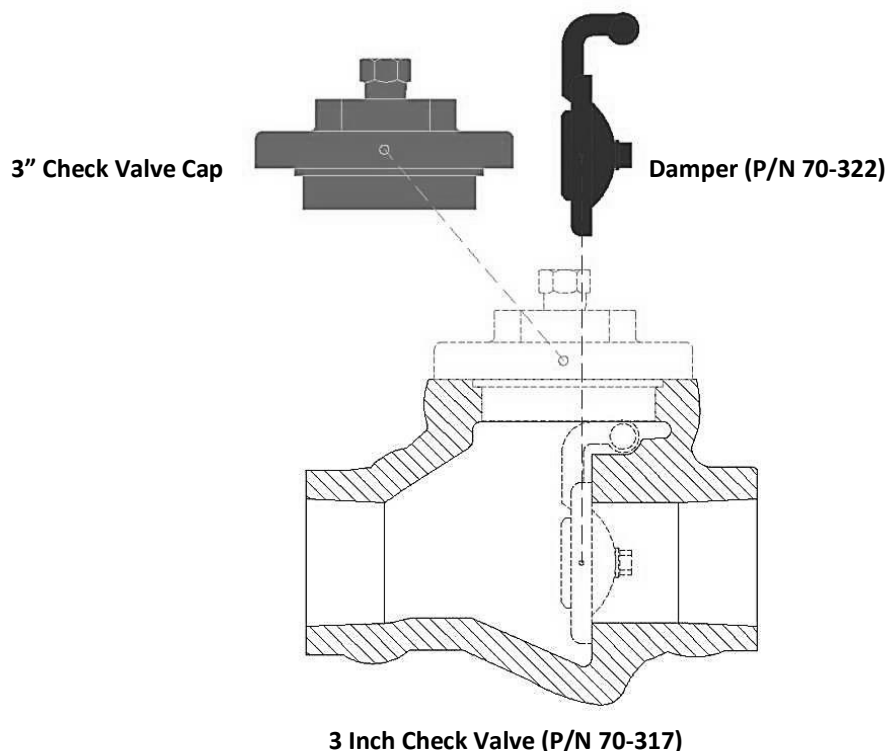
- ___ 1. Disconnect the actuator (UVO, UEA or Pneumatic Relay) from the Nitrogen Actuator Assembly.
- ___ 2. Remove the Nitrogen Actuator Assembly from the mounting surface.
- ___ 3. Recharge the nitrogen cylinder. Refer to Nitrogen Actuator Recharge Manual 06-721 for recharge instructions.
- ___ 4. 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.

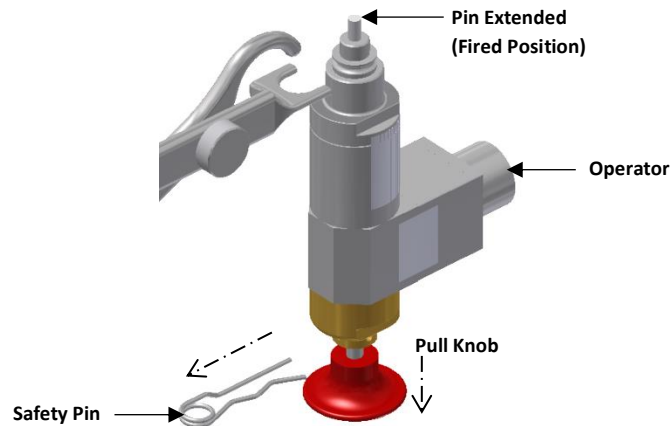
- ___ 1. Remove the check valve cap.
- ___ 2. Remove old damper.
- ___ 3. Insert new damper (P/N 70-322)
- ___ 4. Reinstall the check valve cap, wrench tight.
- ___ 5. Rearm the system after all 3 inch check valve dampers have been replaced.



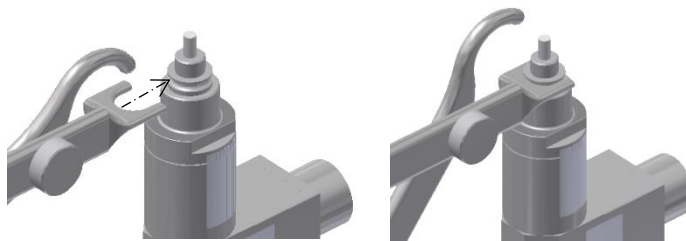
6.4. IVO, IVPO and UVO Reset Procedure

Reset Instructions using the 02-14782 Reset Multi Tool

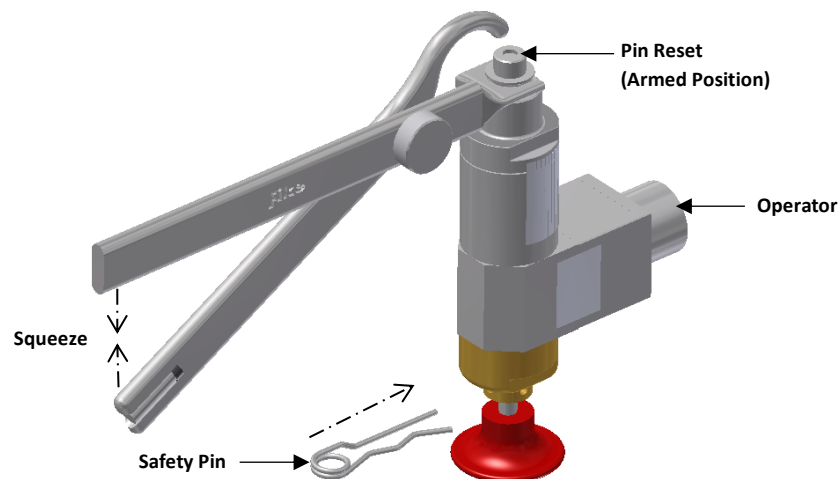
1. Disconnect the valve operator from the Impulse Valve actuator port by removing the operator supervisor (IVOS or UVOS) or retaining clip that secures the operator in place.
2. Remove the Safety Cotter Pin and pull the Manual Strike Button until a slight click is heard indicating that the internal components 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.

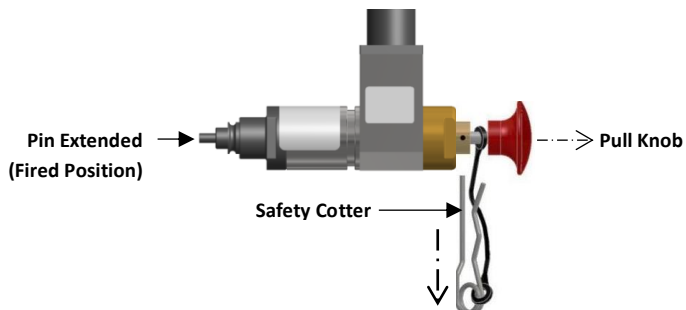


4. Squeeze reset tool handles until Operator Pin resets (clicks into place); then, reinsert the Safety Pin. The operator is reset and ready to be installed.

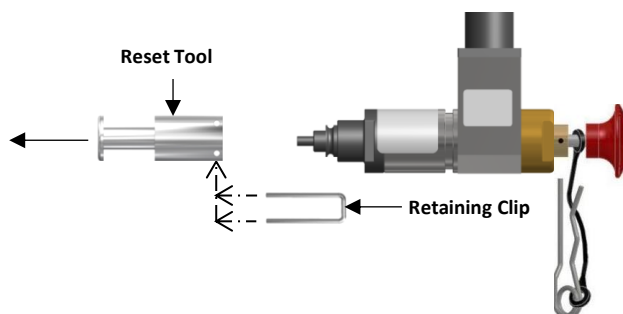


Reset Instructions using the 70-286 Reset Tool

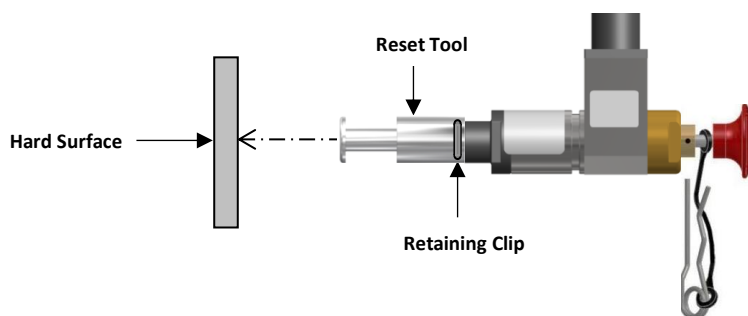
1. Disconnect the valve operator from the Impulse Valve actuator port by removing the operator supervisor (IVOS or UVOS) or retaining clip that secures the operator in place.
2. Remove the Safety Cotter Pin and pull the Manual Strike Button until the operator resets (clicks into place). This step does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



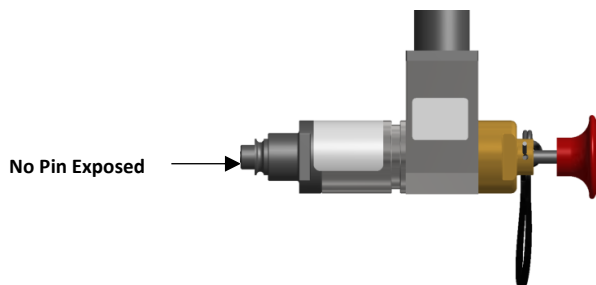
3. Insert the valve operator (IVO or UVO) into the end of the Reset Tool and secure in place with the retaining clip provided.



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

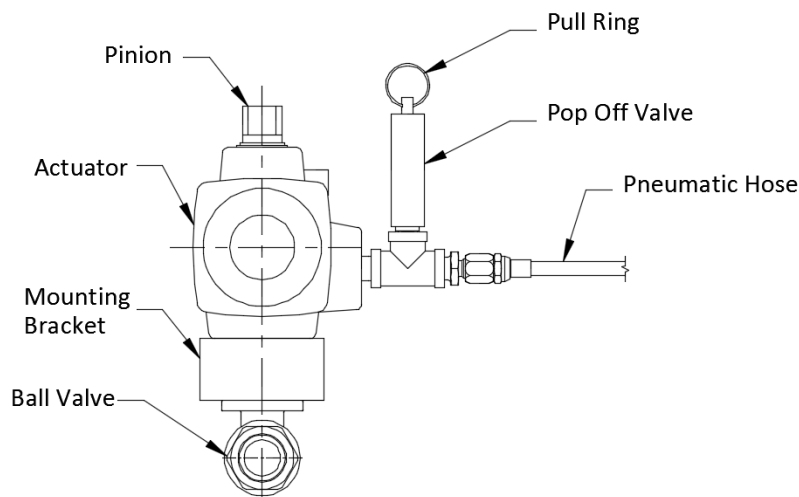


5. Reinsert the Safety Cotter Pin; then remove the Retaining Clip and the Reset Tool. The operator is reset and ready to be installed.



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.

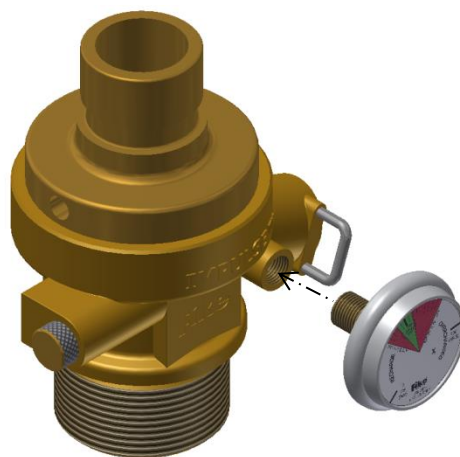
6.6. Pressure Gauge Replacement Procedure

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 the Recharge Manual, P/N 06-290 for recommendations and leak test procedures.



APPENDIX A – Engineered System Design Example

The following is an example of a Fike ECARO-25 suppression system designed within the limitations established by Fike's UL listing and FM approval, and in compliance with NFPA 2001 using Fike Flow Calculation Program reflecting the inputs required and showing the computer program output information.

HAZARD INFORMATION

Design Concentration: 9.0% (Minimum)

Temperature Range: 70° F. to 85° F.

Enclosure Elevation: 0 Feet (Sea Level)

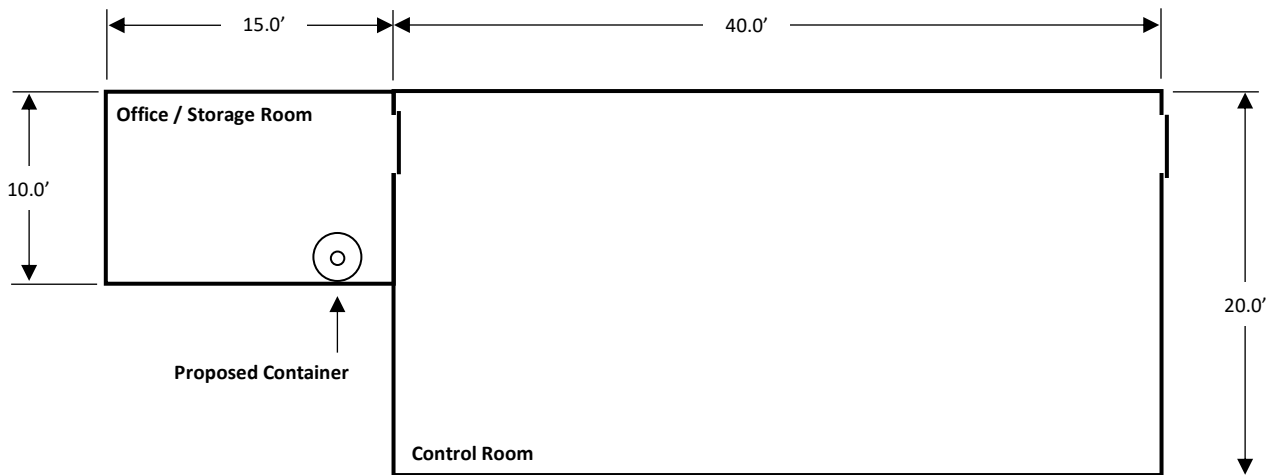
Room Height: 8.0'

Uncloseable Openings: None

No. of Nozzles:

- Control Room: 2 - 360° Nozzles

- Office / Storage Room: 1 - 180° Nozzles



Floor Plan

INPUTS – FIKE ECARO-25 FLOW CALCULATION PROGRAM

Project Setup

Select Unit System:
☐ SI Units (MKS)
☒ English Units (FPS)

Select Cylinder Hardware Group:
☐ DOT Cylinders with GCA
☐ DOT Cylinders with Solenoid
☒ DOT Cylinders with Impulse
☐ European Cylinders with Impulse
☐ European Cylinders with Solenoid
☐ OEM Cylinders

Pipe Temp: Enter Pipe Temperature: °F

Flow Calculation Parameters:
☒ Auto Input Update Enabled

Select Default Pipe Schedule/Nozzle Type:
Pipe Schedule:
Nozzle Type:

Select System Discharge Time:
 sec

Project Information

Customer Information:
Company Name:
Phone:
Fax:
Company Address:
Contact Information:

Project Information:
Project Name:
Project Location:
Project Designer:
Project Account:
Project Description:

Define Enclosures

Enclosure Number:
Enclosure Name:
Add New Enclosure | Delete Enclosure

Enclosure Volume:
Enclosure Length = ft
Enclosure Width = ft
Enclosure Height = ft
Maximum Volume = ft³
Added Enclosure Volume = ft³
Subtracted Enclosure Volume = ft³
Protected Volume = ft³
☐ Use Enclosure Layout to Calculate Volume

Agent Requirements:
Minimum Required Concentration = %
Agent Design Concentration = %
Enclosure Minimum Temp = °F
Enclosure Maximum Temp = °F
Enclosure Elevation = ft
Maximum Agent Concentration = %
Amount of Agent Required = lbs

Define Enclosures

Enclosure Number:
Enclosure Name:
Add New Enclosure | Delete Enclosure

Enclosure Volume:
Enclosure Length = ft
Enclosure Width = ft
Enclosure Height = ft
Maximum Volume = ft³
Added Enclosure Volume = ft³
Subtracted Enclosure Volume = ft³
Protected Volume = ft³
☐ Use Enclosure Layout to Calculate Volume

Agent Requirements:
Minimum Required Concentration = %
Agent Design Concentration = %
Enclosure Minimum Temp = °F
Enclosure Maximum Temp = °F
Enclosure Elevation = ft
Maximum Agent Concentration = %
Amount of Agent Required = lbs

Specify Nozzles

Enclosure:
Nozzle Specification Unlocked

Enclosure Summary:

Num	Name	Agent	Area
0001	Control Room	205 lbs	800.00 ft²
0002	Office / Storage Room	39 lbs	150.00 ft²

Estimated Number of Nozzles to Cover Area = 1

Select Number of Nozzles:
Auto Calc Agent

Nozzle	Type	Agent (lbs)	Flow
0101	360	102.5	10 lbs/s
0102	360	102.5	10 lbs/s

Agent Remaining = 0 lbs

Specify Nozzles

Enclosure:
Nozzle Specification Unlocked

Enclosure Summary:

Num	Name	Agent	Area
0001	Control Room	205 lbs	800.00 ft²
0002	Office / Storage Room	39 lbs	150.00 ft²

Estimated Number of Nozzles to Cover Area = 1

Select Number of Nozzles:
Auto Calc Agent

Nozzle	Type	Agent (lbs)	Flow
0201	360	39.0	4 lbs/s

Agent Remaining = 0 lbs

Specify Cylinders (DOT Cylinders with Impulse Valve)

Pipe Network:
Cylinder Specification Unlocked

Select Number of Cylinders:
Total Required Agent = lbs
Agent Per Cylinder = lbs
Total Stored Agent = lbs

Select Cylinder Type:
Auto Pick Cylinder (Min Fill) | Auto Pick Cylinder (Max Fill)

Cylinder Volume	Min Fill Weight	Max Fill Weight	Cylinder Diameter	Cylinder Height	Valve Diameter
5.4100 ft³	136.0 lbs	302.0 lbs	1.6670 ft	3.5420 ft	3.0 in

Cylinder Fill Density = 45.1 lbs / ft³

Select Manifold Type:
☒ No Manifold
☐ Center Exit Manifold
☐ End Exit Manifold

Enter Manifold Parameters:
Cylinder Spacing = ft
Valve to Manifold = ft
Check Valve Equ = ft
Cylinder to Exit = ft

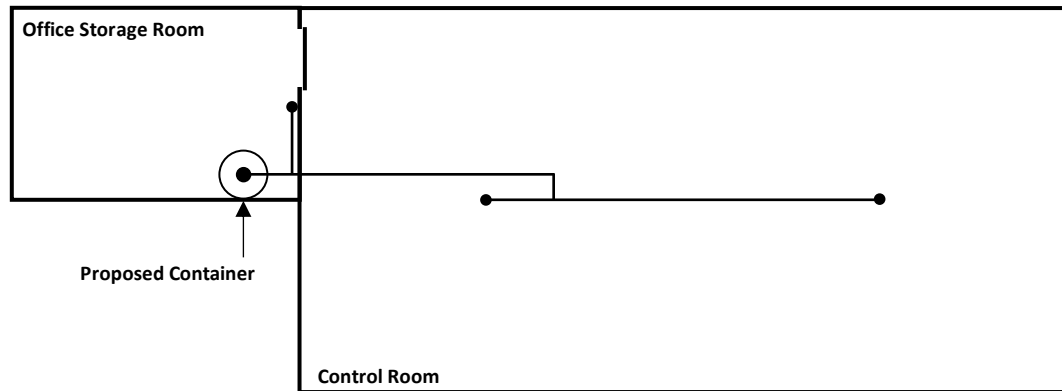


FIGURE 2 – Pipe and Nozzle Layout

ECARO-25 Flow Calculation - [Pipe Network Table]														
File Input Data Window Help														
New Open Save Preview Back Forward Setup Info Enclosure Nozzle Groups Cylinder Layout Table														
Pipe Network: 0001 - Pipe Network: 0001 Restore Pipe Section Data Perform Flow Calculation														
Pipe Sections														
Start	End	Pipe Length	Elevation Change	Selected Pipe Diameter	Selected Pipe Schedule	90° Elbow	Thru Tee Branch	Side Tee Branch	Union	Equivalent Length Added	Cylinders	Nozzle Type	Selected Nozzle Agent	Selected Nozzle Orifice
1	2	3.54 ft	3.54 ft	3 in	SCH 40 T					27.36 ft	1			
2	3	4.50 ft	4.50 ft	Auto Pick	Auto Pick									
3	4	3.00 ft		Auto Pick	Auto Pick	1								
4	5	17.50 ft		Auto Pick	Auto Pick	1								
4	201	4.50 ft	-0.50 ft	Auto Pick	Auto Pick	1		1				180	34.0 lbs	Auto Pick
4	102	17.50 ft	-0.50 ft	Auto Pick	Auto Pick	1		1				360	90.5 lbs	Auto Pick
5	101	4.00 ft	-0.50 ft	Auto Pick	Auto Pick	1		1				360	90.5 lbs	Auto Pick

ECARO-25 Flow Calculation - L:\Tech\Design Control Corp Eng\Masters FireSupp\VE-ECARO-25\06-431 EcARO25V EquipDesign\ServiceMan\sample problem.125 - [Pipe Net]														
File Input Data Window Help														
New Open Save Preview Back Forward Setup Info Enclosure Nozzle Groups Cylinder Layout Table														
Pipe Network: 0001 - Pipe Network: 0001 Restore Pipe Section Data Perform Flow Calculation														
Pipe Sections														
Start	End	Pipe Length	Elevation Change	Selected Pipe Diameter	Selected Pipe Schedule	90° Elbow	Thru Tee Branch	Side Tee Branch	Union	Equivalent Length Added	Cylinders	Nozzle Type	Selected Nozzle Agent	Selected Nozzle Orifice
1	2	3.54 ft	3.54 ft	3 in	SCH 40 T					27.36 ft	1			
2	3	4.50 ft	4.50 ft	1 1/4 in	SCH 40 T									
3	4	3.00 ft		1 1/4 in	SCH 40 T	1								
4	5	17.50 ft		1 1/4 in	SCH 40 T	1		1						
4	201	4.50 ft	-0.50 ft	3/4 in	SCH 40 T	1		1				180	29.0 lbs	0.1910 in
4	102	17.50 ft	-0.50 ft	1 in	SCH 40 T	1		1				360	102.5 lbs	0.3770 in
5	101	4.00 ft	-0.50 ft	1 in	SCH 40 T	1		1				360	102.5 lbs	0.3770 in

Flow Calculation Results														
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					
3 SCH 40	30.90 ft	261 psia	259 psia	24.5 lbs/s										
1 1/4 SCH 40	4.50 ft	255 psia	240 psia	24.5 lbs/s										
1 1/4 SCH 40	6.45 ft	240 psia	228 psia	24.5 lbs/s										
1 1/4 SCH 40	22.75 ft	228 psia	202 psia	20.3 lbs/s										
3/4 SCH 40	10.00 ft	1226 psia	313 psia	4.2 lbs/s	41.3 lbs	0.1910 in	0.24 s	9.16 s	9.40 s					
1 SCH 40	25.37 ft	202 psia	159 psia	9.5 lbs/s	95.5 lbs	0.3770 in	0.62 s	3.72 s	10.34 s					
1 SCH 40	11.67 ft	202 psia	176 psia	10.8 lbs/s	107.2 lbs	0.3770 in	0.36 s	9.57 s	9.93 s					

ECARO-25 Flow Calculation Software Version 4.10.0000
Calculation based on fixed nozzle codes and pipe sizes.
Calculation performed on 8/25/2011 3:04:31 PM
System calculated within limits of Fikes UI, listing and FM approval

OUTPUTS – FIKE ECARO-25 FLOW CALCULATION PROGRAM

ECARO-25 Flow Calculation Software

Fike Corporation



ECARO-25 Flow Calculation Software Version 4.10.0000
Copyright © 2002-2011 Fike Corporation
UL Ex4623, FM 3014476
Licensed to EDN, Fike
Results Printed on 9/22/2011

PROJECT INFORMATION

Project Name: KAF Building
Project Designer: EDN
Project Location:
Project Account:
Project Description: Control Room and Office / Storage Room
Project Filename: L:\Tech\Design-Control-Corp Eng\Master s-FireSupp\0-Ecaro-25\06-431
Ecaro25\IV EquipDesign&ServiceMan\sample problem.125

CUSTOMER INFORMATION

Company Name: Kolten A. Ferrier Corporation
Company Address: 11 KAF Avenue
Blue Springs, MO 64015
Company Phone:
Company Fax:
Contact Information:

Agent Requirements - Enclosure 0001 (Control Room)

<i>Enclosure Area</i>		<i>Enclosure Height</i>	<i>Volume Added</i>	<i>Volume Subtracted</i>	<i>Protected Volume</i>
40.00 ft L X 20.00 ft W		8.00 ft	None	None	6400.00 ft ³
<i>Design Concentration</i>	<i>Maximum Concentration</i>	<i>Minimum Temperature</i>	<i>Maximum Temperature</i>	<i>Elevation</i>	<i>Agent Required</i>
9.20 %	9.21 % at 70 °F	70 °F	70 °F	0 ft	205.0 lbs

Agent Requirements - Enclosure 0002 (Office / Storage Room)

<i>Enclosure Area</i>		<i>Enclosure Height</i>	<i>Volume Added</i>	<i>Volume Subtracted</i>	<i>Protected Volume</i>
15.00 ft L X 10.00 ft W		8.00 ft	None	None	1200.00 ft ³
<i>Design Concentration</i>	<i>Maximum Concentration</i>	<i>Minimum Temperature</i>	<i>Maximum Temperature</i>	<i>Elevation</i>	<i>Agent Required</i>
9.20 %	9.33 % at 70 °F	70 °F	70 °F	0 ft	39.0 lbs

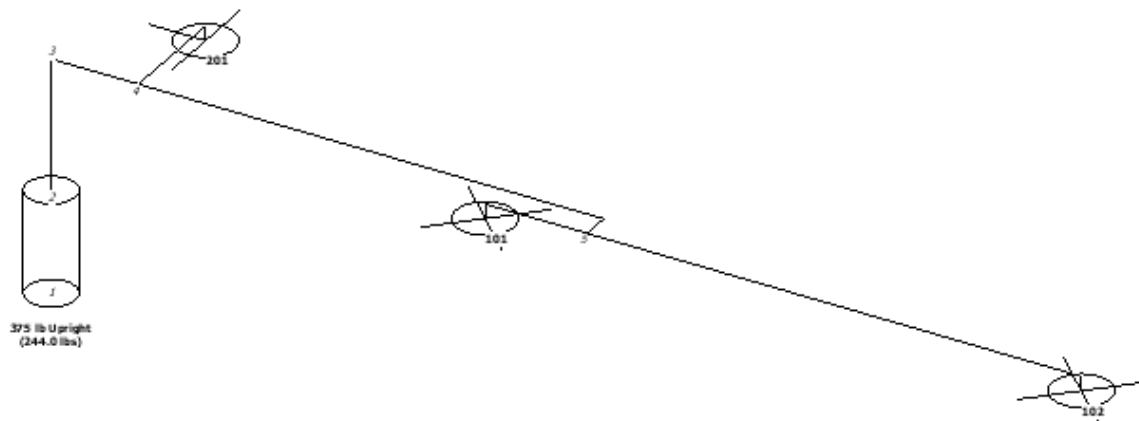
Nozzle Information - Pipe Network 0001 (Pipe Network 0001)

<i>Nozzle Number</i>	<i>Type</i>	<i>Enclosure Name</i>	<i>Requested Agent</i>
0101	360°	Control Room	102.5 lbs
0102	360°	Control Room	102.5 lbs
0201	180°	Office / Storage Room	39.0 lbs

Total Agent Distributed Through Pipe Network: 244.0 lbs

Cylinder Information - Pipe Network 0001 (Pipe Network 0001)

<i>Cylinder Type</i>	<i>Agent Per Cylinder</i>	<i>Manifold Type</i>	<i>Cylinder Spacing</i>	<i>Valve to Manifold</i>	<i>Cylinder to Exit</i>
70-269 375 lb Upright	1 X 244 lbs	No Manifold	-	-	-
<i>Fill Density</i>	<i>Empty Weight</i>	<i>Floor Area</i>		<i>Floor Loading</i>	
45.1 lbs / ft ³	218 lbs	2.18 ft ²		212 lbs / ft ²	



375 lb Upright
(244.0 lbs)

Flow Calculation Input Data - Pipe Network 0001 (Pipe Network 0001)

Start	End	Length	Elevation	Select Pipe Dia	Select Pipe Sch	90°	Thru	Side	Union	Equ Length	Cyl	Nozz Type	Select Agent	Select Orifice
1	2	3.54 ft	3.54 ft	3 in	SCH 40 T					27.36 ft	1			
2	3	4.50 ft	4.50 ft	1-1/4 in	SCH 40 T									
3	4	3.00 ft		1-1/4 in	SCH 40 T	1								
4	5	17.00 ft		1-1/4 in	SCH 40 T	1	1							
4	201	4.50 ft	-0.50 ft	3/4 in	SCH 40 T	1		1				180	39.0 lbs	0.1900 in
5	102	17.50 ft	-0.50 ft	1 in	SCH 40 T	1		1				360	102.5 lbs	0.3770 in
5	101	4.00 ft	-0.50 ft	1 in	SCH 40 T	1		1				360	102.5 lbs	0.3770 in

Flow Calculation Output Data - Pipe Network 0001 (Pipe Network 0001)

Start	End	Pipe Type	Equ Length	Start Pressure	End Pressure	Flow Rate	Agent Discharged	Orifice Diameter
1	2	3 -SCH 40	30.90 ft	261 psia	259 psia	24.5 lbs/s		
2	3	1 1/4-SCH 40	4.50 ft	259 psia	240 psia	24.5 lbs/s		
3	4	1 1/4-SCH 40	6.45 ft	240 psia	228 psia	24.5 lbs/s		
4	5	1 1/4-SCH 40	22.75 ft	228 psia	202 psia	20.3 lbs/s		
4	201	3/4 -SCH 40	10.68 ft	228 psia	213 psia	4.2 lbs/s	41.3 lbs	0.7910 in
5	102	1 -SCH 40	25.37 ft	202 psia	159 psia	9.5 lbs/s	95.5 lbs	0.3770 in
5	101	1 -SCH 40	11.87 ft	202 psia	176 psia	10.8 lbs/s	107.2 lbs	0.3770 in
Flow Calculation Messages								
ECARO-25 Flow Calculation Software Version 4.10.0000								
Calculation based on fixed nozzle codes and pipe sizes.								
Calculation performed on 8/25/2011 3:04:31 PM								
System calculated within limits of Fikes UL listing and FM approval								

Bill of Materials - Pipe Network 0001 (Pipe Network 0001)

Cylinder List

<i>Qty</i>	<i>Part Number</i>	<i>Cylinder Description</i>	<i>Agent Fill Amount</i>
1	70-269	375 lb Upright	244 lbs

Nozzle List

<i>Num</i>	<i>Part Number</i>	<i>Nozzle Size</i>	<i>Nozzle Type</i>	<i>Drill Diameter</i>
101	80-039-3770	1 -SCH 40	360°	0.3770 in
102	80-039-3770	1 -SCH 40	360°	0.3770 in
201	80-046-1910	3/4 -SCH 40	180°	0.1910 in

Pipe List

<i>Section</i>	<i>Pipe Length</i>	<i>Pipe Type</i>
1 - 2	3.54 ft	3 -SCH 40
2 - 3	4.50 ft	1 1/4 -SCH 40
3 - 4	3.00 ft	1 1/4 -SCH 40
4 - 5	17.00 ft	1 1/4 -SCH 40
4 - 201	4.50 ft	3/4 -SCH 40
5 - 102	17.50 ft	1 -SCH 40
5 - 101	4.00 ft	1 -SCH 40

System Acceptance Report

Pipe Network Discharge Time

<i>Pipe Network</i>	<i>Discharge Time</i>	<i>%Agent in Pipe Network</i>	<i>Pipe Temperature</i>
0001 - Pipe Network 0001	9.89 s	15.23%	70 °F

Enclosure 0001 (Control Room) - Nozzle Performance

<i>Nozzle Number</i>	<i>Orifice Diameter</i>	<i>Agent Requested</i>	<i>Agent Predicted</i>	<i>Nozzle Pressure</i>
101	0.3770 in	102.5 lbs	107.2 lbs	176 psia
102	0.3770 in	102.5 lbs	95.5 lbs	159 psia
<i>Minimum Required Concentration</i>	<i>Design Concentration</i>	<i>Minimum Predicted Concentration</i>	<i>Maximum Predicted Concentration</i>	
9.00 %	9.20 %	9.12 % at 70 °F	9.12 % at 70 °F	

Enclosure 0002 (Office / Storage Room) - Nozzle Performance

<i>Nozzle Number</i>	<i>Orifice Diameter</i>	<i>Agent Requested</i>	<i>Agent Predicted</i>	<i>Nozzle Pressure</i>
201	0.1910 in	39.0 lbs	41.3 lbs	213 psia
<i>Minimum Required Concentration</i>	<i>Design Concentration</i>	<i>Minimum Predicted Concentration</i>	<i>Maximum Predicted Concentration</i>	
9.00 %	9.20 %	9.83 % at 70 °F	9.83 % at 70 °F	

APPENDIX B – Pre-Engineered Piping Limitations

Pre-Engineered systems are simple one or two nozzle configurations that have been pre-tested in accordance with NFPA 2001, UL / ULC listing (UL Ex4623) and FM approval (FM 3014476). The Pre-Engineered concept minimizes the engineering effort required to design an effective system. As long as nozzle selection, pipe size and pipe length limitations are adhered to, hydraulic flow calculations are not required. The designer will only need to perform a simple hand calculation.

The following table lists the container sizes available for use with Pre-Engineered systems.

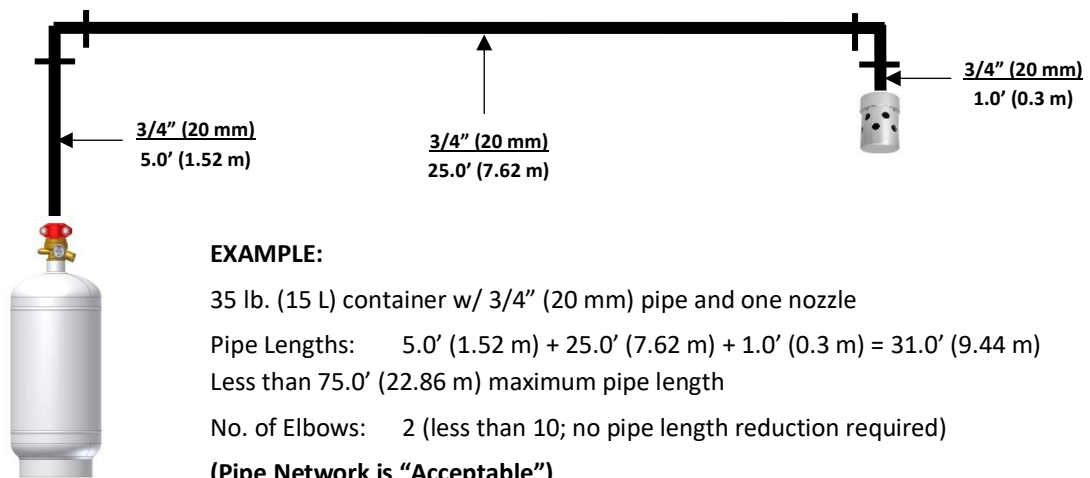
Container Size lb. (L)	Container Part Number	Minimum Fill Range (25 lbs/ft ³ – 400 kg/m ³) lbs. (kg)	Maximum Fill Range (56 lbs/ft ³ – 896 kg/m ³) lbs. (kg)	Fill Increments lbs. (kg)	Mounting Position Position	Valve Size in. (mm)
5 (2)	70-272	4 (2.0)		1 (0.5)	Upright (Valve Up)	1 (25)
10 (4)	70-273	4 (2.0)	8 (3.5)	1 (0.5)	Upright (Valve Up)	1 (25)
20 (8.5)	70-263	8 (3.5)	16 (7.5)	1 (0.5)	Upright – Horizontal	1 (25)
35 (15)	70-264	14 (6.5)	30 (13.5)	1 (0.5)	Upright – Horizontal	1 (25)
60 (27)	70-265	25 (11.5)	54 (24.5)	1 (0.5)	Upright – Horizontal	1 (25)
100 (44)	70-266	39 (18.0)	87 (39.0)	1 (0.5)	Upright (Valve Up)	1 (25)

The 180° or 360° nozzles can be used on a Pre-Engineered system using the same design limitations described in Section 3.15.

Single Nozzle System Design

When designing a single nozzle system, the designer simply needs to use the following table to determine the pipe network limitations associated with each container size. As long as the proposed pipe network does not exceed any of the limitation listed in the table, the pipe network is acceptable.

Pre-Engineered Pipe Network Limitations – Single Nozzle Systems						
Container Size lb. (L)	Pipe Size in. (mm)	Maximum Pipe Length ft. (m)	Elbows included in Max. Pipe Length	Deduct value from Max. Pipe Length for each additional Elbow over 10 ft. (m)	Nozzle Type	
					360° Nozzle	180° Nozzle
5 (2)	3/8 (10)	26 (7.92)	10	1.3 (0.4)	80-077-1015	80-084-0935
10 (4)	3/8 (10)	56 (17.07)	10	1.3 (0.4)	80-077-1495	80-084-1405
20 (8.5)	½ (15)	60 (18.29)	10	1.7 (0.52)	80-078-1935	80-085-1800
35 (15)	¾ (20)	75 (22.86)	10	2.2 (0.67)	80-079-2969	80-086-2770
60 (27)	1 (25)	75 (22.86)	10	2.8 (0.85)	80-080-3770	80-087-3480
100 (44)	1 ½ (40)	100 (30.48)	10	4.3 (1.31)	80-082-5781	80-089-5312



Single Nozzle System Design Example

Two Nozzle System Design

When designing a two nozzle Pre-Engineered System, the nozzle and piping layout **MUST** be installed in a balanced configuration. To accomplish this, the flow path from the container to each nozzle must be the same length, using the same pipe sizes, the same quantity and type of fittings, and the nozzles must discharge the same amount of agent from each nozzle. A piping network is considered to be balanced if the total length from the container to each nozzle is within 10% of each other.

In addition, all tee splits **MUST** be made using a Bullhead Tee configuration, and each outlet must be oriented in the horizontal plane.

Pre-Engineered Pipe Network Limitations – Two Nozzle Systems								
Container Size lb. (L)	Total Pressure Drop (TPD)	Section A		Section B			Nozzle Type	
		Pipe Size in. (mm)	Deduct value from TPD for each Elbow over 6 ft. (m)	Pipe Size in. (mm)	Deduct value from TPD for each Elbow over 4 ft. (m)	Maximum Pipe Length ft. (m)	360° Nozzle	180° Nozzle
10 (4)	30	1/2 (15)	1.7 (0.52)	3/8 (10)	1.3 (0.4)	16 (4.9)	80-077-1015	80-084-0960
20 (8.5)	60	1/2 (15)	1.7 (0.52)	3/8 (10)	1.3 (0.4)	32 (9.8)	80-077-1610	80-084-1610
35 (15)	75	3/4 (20)	2.2 (0.67)	1/2 (15)	1.7 (0.52)	32 (9.8)	80-078-2130	80-085-2090
60 (27)	75	1 (25)	2.8 (0.85)	3/4 (20)	2.2 (0.67)	32 (9.8)	80-079-2969	80-086-2770
100 (44)	90	1 1/2 (40)	4.3 (1.31)	1 (25)	2.8 (0.85)	32 (9.8)	80-080-3770	80-087-3480

35 lb. (15 L) container w/ 3/4" (20 mm) pipe [Section A] & 1/2" (15 mm) pipe [Section B] w/ 2 nozzles
Actual Pipe Lengths + (No. of Elbows x Equivalent Length) = TPD per Section

Section A

4.0' (1.22 m) + 14.0' (4.27 m) + 2.0' [0.61 m] + 19.0' (5.79 m) + 3 elbows¹ (0) = **39.0' (11.89 m)**

Section B

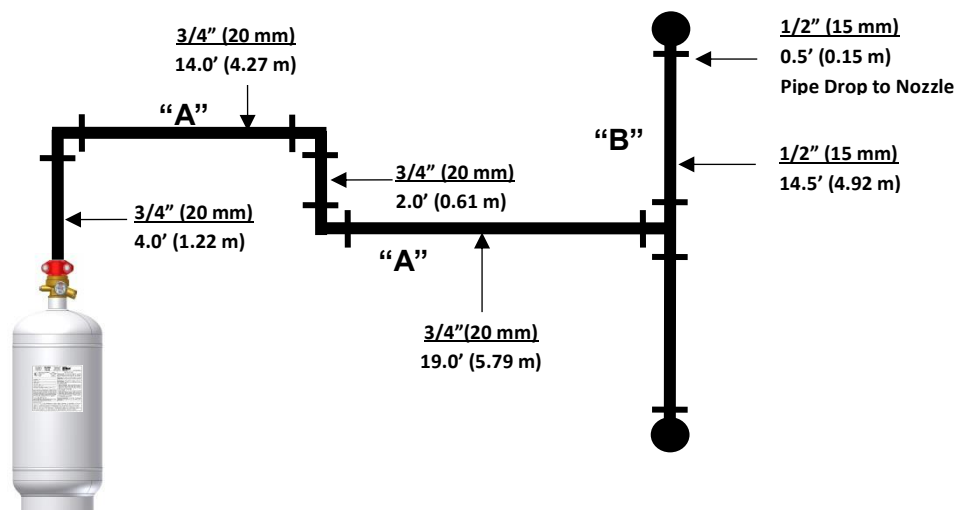
14.5' (4.42 m) + 0.5' (0.15 m) + 1 elbow² (0) = **15.0' (4.57 m)**

Total TPD = 39.0' (11.89 m) + 15.0' (4.57 m)

54.0 (less than 75 maximum TPD) **(Pipe network is "Acceptable")**

¹ The 3 elbows in Section A is less than 6 therefore no pressure drop compensation required

² The 1 elbow in Section B is less than 4 therefore no pressure drop compensation required



Two Nozzle System Design Example

APPENDIX C – Safety Data Sheets

- **HFC-125 Agent**
- **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 manufacturer's cannot assure the integrity or accuracy of the SDS information contained in this document after it has been downloaded from their website.

SAFETY DATA SHEET

Honeywell**Genetron® FS125****000000020820**

Version 1.0

Revision Date 08/15/2016

Print Date 02/07/2018

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name : Genetron® FS125

Number : 000000020820

Product Use Description : Fire extinguishing agent

Manufacturer or supplier's details : Honeywell Specialty Chemicals Seelze GmbH
Wunstorfer Straße 40
Seelze, 30926

For more information call : 800-522-8001
+1-973-455-6300
(Monday-Friday, 9:00am-5:00pm)

In case of emergency call : **Medical: 1-800-498-5701 or +1-303-389-1414**
: **Transportation (CHEMTREC): 1-800-424-9300 or**
: **+1-703-527-3887**
:
: (24 hours/day, 7 days/week)

SECTION 2. HAZARDS IDENTIFICATION**Emergency Overview**

Form : Liquefied gas

Color : colourless

Odor : slight

Classification of the substance or mixture

Classification of the substance or mixture : Gases under pressure, Liquefied gas
Simple Asphyxiant

GHS Label elements, including precautionary statements

Page 1 / 13

SAFETY DATA SHEET

Honeywell**Genetron® FS125****000000020820**

Version 1.0

Revision Date 08/15/2016

Print Date 02/07/2018

Symbol(s)

:



Signal word

: Warning

Hazard statements

: Contains gas under pressure; may explode if heated.
May displace oxygen and cause rapid suffocation.

Precautionary statements

: **Prevention:**
Use personal protective equipment as required.**Storage:**

Protect from sunlight. Store in a well-ventilated place.

Hazards not otherwise
classified: May cause eye and skin irritation.
May cause frostbite.
May cause cardiac arrhythmia.**Carcinogenicity**

No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP, IARC, or OSHA.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Formula

: CHF₂CF₃

Chemical nature

: Substance

Chemical name	CAS-No.	Concentration
Pentafluoroethane	354-33-6	100.00 %

SECTION 4. FIRST AID MEASURES

General advice

: First aider needs to protect himself. Move out of dangerous area. Take off all contaminated clothing immediately.

Page 2 / 13

SAFETY DATA SHEET

**Genetron® FS125****000000020820**

Version 1.0

Revision Date 08/15/2016

Print Date 02/07/2018

- Inhalation : Move to fresh air. If breathing is irregular or stopped, administer artificial respiration. Use oxygen as required, provided a qualified operator is present. Call a physician. Do not give drugs from adrenaline-ephedrine group.
- Skin contact : After contact with skin, wash immediately with plenty of water. If there is evidence of frostbite, bathe (do not rub) with lukewarm (not hot) water. If water is not available, cover with a clean, soft cloth or similar covering. If symptoms persist, call a physician.
- Eye contact : Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. In case of frostbite water should be lukewarm, not hot. If symptoms persist, call a physician.
- Ingestion : As this product is a gas, refer to the inhalation section. Do not induce vomiting without medical advice. Call a physician immediately.

Notes to physician

- Treatment : Because of the possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, should be used with special caution and only in situations of emergency life support. Treatment of overexposure should be directed at the control of symptoms and the clinical conditions. Treat frost-bitten areas as needed.

SECTION 5. FIREFIGHTING MEASURES

- Suitable extinguishing media : The product is not flammable.
ASHRAE 34
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
- Specific hazards during firefighting : Contents under pressure.
This product is not flammable at ambient temperatures and atmospheric pressure.
However, this material can ignite when mixed with air under pressure and exposed to strong ignition sources.
Container may rupture on heating.
Cool closed containers exposed to fire with water spray.
Do not allow run-off from fire fighting to enter drains or water courses.

SAFETY DATA SHEET

Honeywell**Genetron® FS125****000000020820**

Version 1.0

Revision Date 08/15/2016

Print Date 02/07/2018

Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.

In case of fire hazardous decomposition products may be produced such as:

Hydrogen halides

Hydrogen fluoride

Carbon monoxide

Carbon dioxide (CO₂)

Carbonyl halides

Special protective equipment for firefighters : In the event of fire and/or explosion do not breathe fumes. Wear self-contained breathing apparatus and protective suit. No unprotected exposed skin areas.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal precautions : Immediately evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Wear personal protective equipment. Unprotected persons must be kept away. Remove all sources of ignition. Avoid skin contact with leaking liquid (danger of frostbite). Ventilate the area. After release, disperses into the air. Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing. Avoid accumulation of vapours in low areas. Unprotected personnel should not return until air has been tested and determined safe. Ensure that the oxygen content is $\geq 19.5\%$.

Environmental precautions : Prevent further leakage or spillage if safe to do so. The product evaporates readily.

Methods for cleaning up : Ventilate the area.

SECTION 7. HANDLING AND STORAGE**Handling**

Handling : Handle with care. Avoid inhalation of vapour or mist. Do not get in eyes, on skin, or on clothing.

Page 4 / 13

SAFETY DATA SHEET

Honeywell**Genetron® FS125****000000020820**

Version 1.0

Revision Date 08/15/2016

Print Date 02/07/2018

Wear personal protective equipment.
Use only in well-ventilated areas.
Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 50 °C.
Follow all standard safety precautions for handling and use of compressed gas cylinders.
Use authorized cylinders only.
Protect cylinders from physical damage.
Do not puncture or drop cylinders, expose them to open flame or excessive heat.
Do not pierce or burn, even after use. Do not spray on a naked flame or any incandescent material.
Do not remove screw cap until immediately ready for use.
Always replace cap after use.

Advice on protection against fire and explosion : The product is not flammable.
Can form a combustible mixture with air at pressures above atmospheric pressure.

Storage

Requirements for storage areas and containers : Pressurized container: protect from sunlight and do not expose to temperatures exceeding 50 °C. Do not pierce or burn, even after use.
Keep containers tightly closed in a dry, cool and well-ventilated place.
Storage rooms must be properly ventilated.
Ensure adequate ventilation, especially in confined areas.
Protect cylinders from physical damage.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Protective measures : Do not breathe vapour.
Avoid contact with skin, eyes and clothing.
Ensure that eyewash stations and safety showers are close to the workstation location.

Engineering measures : General room ventilation is adequate for storage and handling.
Perform filling operations only at stations with exhaust ventilation facilities.

Eye protection : Wear as appropriate:
Safety glasses with side-shields
If splashes are likely to occur, wear:

Page 5 / 13

SAFETY DATA SHEET

Honeywell**Genetron® FS125****000000020820**

Version 1.0

Revision Date 08/15/2016

Print Date 02/07/2018

- Goggles or face shield, giving complete protection to eyes
- Hand protection : Leather gloves
In case of contact through splashing:
Protective gloves
Neoprene gloves
Polyvinyl alcohol or nitrile- butyl-rubber gloves
- Skin and body protection : Avoid skin contact with leaking liquid (danger of frostbite).
Wear cold insulating gloves/ face shield/ eye protection.
- Respiratory protection : In case of insufficient ventilation, wear suitable respiratory equipment.
Wear a positive-pressure supplied-air respirator.
Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.
For rescue and maintenance work in storage tanks use self-contained breathing apparatus.
- Hygiene measures : Handle in accordance with good industrial hygiene and safety practice.
Ensure adequate ventilation, especially in confined areas.
Avoid contact with skin, eyes and clothing.
Remove and wash contaminated clothing before re-use.
Keep working clothes separately.

Exposure Guidelines

Components	CAS-No.	Value	Control parameters	Update	Basis
Pentafluoroethane	354-33-6	TWA : Time weighted average	4,900 mg/m3 (1,000 ppm)	2007	WEEL:US. OARS. WEELs Workplace Environmental Exposure Level Guide
Pentafluoroethane	354-33-6	TWA : Time weighted average	(1,000 ppm)		Honeywell:Limit established by Honeywell International Inc.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state : Liquefied gas

Page 6 / 13

SAFETY DATA SHEET

Honeywell**Genetron® FS125****000000020820**

Version 1.0

Revision Date 08/15/2016

Print Date 02/07/2018

Color	: colourless
Odor	: slight
Melting point/range	: -103 °C
Boiling point/boiling range	: -48.5 °C
Flash point	: Note: Not applicable
Evaporation rate	: > 1 Method: Compared to CCl4.
Lower explosion limit	: Note: None
Upper explosion limit	: Note: None
Vapor pressure	: 12,438 hPa at 21.1 °C(70.0 °F) 28,110 hPa at 54.4 °C(129.9 °F)
Vapor density	: 4.2 Note: (Air = 1.0)
Density	: 1.21 g/cm3 at 21.1 °C
Water solubility	: 0.9 g/l
Partition coefficient: n-octanol/water	: log Pow: 1.48 Note: The product is more soluble in octanol.
Ignition temperature	: > 750 °C

SAFETY DATA SHEET

Honeywell**Genetron® FS125****000000020820**

Version 1.0

Revision Date 08/15/2016

Print Date 02/07/2018

Decomposition temperature : > 250 °C
Note: To avoid thermal decomposition, do not overheat.

Molecular weight : 120.03 g/mol

SECTION 10. STABILITY AND REACTIVITY

Chemical stability : Stable under normal conditions.

Possibility of hazardous reactions : Hazardous polymerisation does not occur.

Conditions to avoid : Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 50 °C.
Decomposes under high temperature.
Some risk may be expected of corrosive and toxic decomposition products.
Can form a combustible mixture with air at pressures above atmospheric pressure.
Do not mix with oxygen or air above atmospheric pressure.

Incompatible materials to avoid : Finely divided aluminium
Potassium
Calcium
Powdered metals
Aluminium
Magnesium
Zinc

Hazardous decomposition products : In case of fire hazardous decomposition products may be produced such as:
Halogenated compounds
Hydrogen fluoride
Carbonyl halides
Carbon monoxide
Carbon dioxide (CO₂)

SECTION 11. TOXICOLOGICAL INFORMATION

Acute oral toxicity : Note: Not applicable

Page 8 / 13

SAFETY DATA SHEET

Honeywell**Genetron® FS125****000000020820**

Version 1.0

Revision Date 08/15/2016

Print Date 02/07/2018

Acute inhalation toxicity	: Exposure time: 4 h Species: Rat
Sensitisation	: Cardiac sensitization Species: dogs Note: No-observed-effect level 75 000 ppm Lowest observed effect level 100 000 ppm
Repeated dose toxicity	: Species: Rat Application Route: Inhalation Exposure time: 4 Weeks NOEL: 50000 ppm Note: Subchronic toxicity
Genotoxicity in vitro	: Test Method: Ames test Result: negative : Cell type: Human lymphocytes Result: negative : Cell type: Chinese Hamster Ovary Cells Result: negative
Teratogenicity	: Species: Rabbit Application Route: Inhalation exposure NOAEL, Teratog: 50,000 ppm NOAEL, Maternal: 50,000 ppm Note: Did not show teratogenic effects in animal experiments. : Species: Rat Application Route: Inhalation exposure NOAEL, Teratog: 50,000 ppm NOAEL, Maternal: 50,000 ppm Note: Did not show teratogenic effects in animal experiments.
Further information	: Note: Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing. Irritating to eyes and skin. Rapid evaporation of the liquid may cause frostbite. Avoid skin contact with leaking liquid (danger of frostbite). May cause cardiac arrhythmia.

Page 9 / 13

SAFETY DATA SHEET

Honeywell**Genetron® FS125****000000020820**

Version 1.0

Revision Date 08/15/2016

Print Date 02/07/2018

SECTION 12. ECOLOGICAL INFORMATION**Elimination information (persistence and degradability)**

Biodegradability : Result: Not readily biodegradable.
Value: 5 %
Method: OECD 301 D

Further information on ecology

Additional ecological information : Accumulation in aquatic organisms is unlikely.
This product contains greenhouse gases which may contribute to global warming. Do NOT vent to the atmosphere. To comply with provisions of the U.S. Clean Air Act, any residual must be recovered.

SECTION 13. DISPOSAL CONSIDERATIONS

Disposal methods : Observe all Federal, State, and Local Environmental regulations.

Note : This product is subject to U.S. Environmental Protection Agency Clean Air Act Regulations Section 608 in 40 CFR Part 82 regarding refrigerant recycling.

SECTION 14. TRANSPORT INFORMATION

DOT UN/ID No. : UN 3220
Proper shipping name : Pentafluoroethane
Class : 2.2
Packing group
Hazard Labels : 2.2

IATA UN/ID No. : UN 3220
Description of the goods : Pentafluoroethane
Class : 2.2
Hazard Labels : 2.2
Packing instruction (cargo) : 200

Page 10 / 13

SAFETY DATA SHEET

Honeywell**Genetron® FS125****000000020820**

Version 1.0

Revision Date 08/15/2016

Print Date 02/07/2018

	aircraft)	
	Packing instruction	: 200
	(passenger aircraft)	
IMDG	UN/ID No.	: UN 3220
	Description of the goods	: Pentafluoroethane
	Class	: 2.2
	Hazard Labels	: 2.2
	EmS Number	: F-C, S-V
	Marine pollutant	: no

SECTION 15. REGULATORY INFORMATION**Inventories**

US. Toxic Substances Control Act	: On TSCA Inventory
Australia. Industrial Chemical (Notification and Assessment) Act	: On the inventory, or in compliance with the inventory
Canada. Canadian Environmental Protection Act (CEPA). Domestic Substances List (DSL)	: All components of this product are on the Canadian DSL
Japan. Kashin-Hou Law List	: On the inventory, or in compliance with the inventory
Korea. Toxic Chemical Control Law (TCCL) List	: On the inventory, or in compliance with the inventory
Philippines. The Toxic Substances and Hazardous and Nuclear Waste Control Act	: On the inventory, or in compliance with the inventory
China. Inventory of Existing Chemical Substances	: On the inventory, or in compliance with the inventory
New Zealand. Inventory of Chemicals (NZIoC), as published by ERMA New Zealand	: Not in compliance with the inventory
	: Pentafluoroethane
	354-33-6

SAFETY DATA SHEET

Honeywell**Genetron® FS125****000000020820**

Version 1.0

Revision Date 08/15/2016

Print Date 02/07/2018

National regulatory information

- SARA 302 Components** : No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.
- SARA 313 Components** : This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.
- SARA 311/312 Hazards** : Acute Health Hazard
Sudden Release of Pressure Hazard
- California Prop. 65** : This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

SECTION 16. OTHER INFORMATION

	HMIS III	NFPA
Health hazard	: 1	2
Flammability	: 1	1
Physical Hazard	: 0	
Instability	:	0

Hazard rating and rating systems (e.g. HMIS® III, NFPA): This information is intended solely for the use of individuals trained in the particular system.

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process,

SAFETY DATA SHEET



Genetron® FS125

000000020820

Version 1.0

Revision Date 08/15/2016

Print Date 02/07/2018

unless specified in the text. Final determination of suitability of any material is the sole responsibility of the user. This information should not constitute a guarantee for any specific product properties.

Changes since the last version are highlighted in the margin. This version replaces all previous versions.

Prepared by Honeywell Performance Materials and Technologies Product Stewardship Group

Nitrogen, compressed

Safety Data Sheet P-4631

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

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

Nitrogen, compressed

Safety Data Sheet P-4631

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

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.

EN (English US)

SDS ID: P-4631

2/8

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Nitrogen, compressed

Safety Data Sheet P-4631

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

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

EN (English US)

SDS ID: P-4631

3/8

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Nitrogen, compressed

Safety Data Sheet P-4631

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

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.

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SDS ID: P-4631

4/8

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Nitrogen, compressed

Safety Data Sheet P-4631

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

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, compressed

Safety Data Sheet P-4631

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

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

EN (English US)

SDS ID: P-4631

6/8

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Nitrogen, compressed

Safety Data Sheet P-4631

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

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

Nitrogen, compressed

Safety Data Sheet P-4631

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1980 Revision date: 06/24/2015 Supersedes: 04/23/2015

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.

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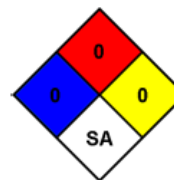
PRAXAIR and the Flowing Airstream design are trademarks or registered trademarks of Praxair Technology, Inc. in the United States and/or other countries.

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.

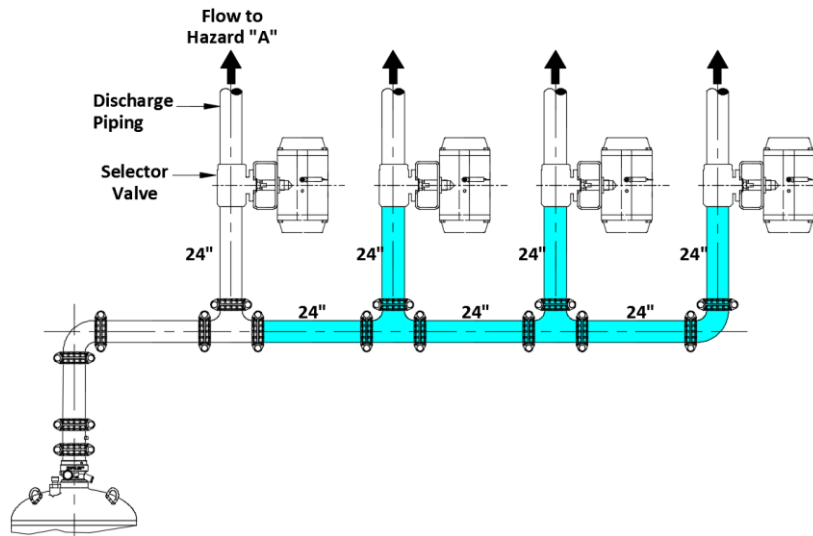
APPENDIX D – Selector Valve Calculation Example

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.

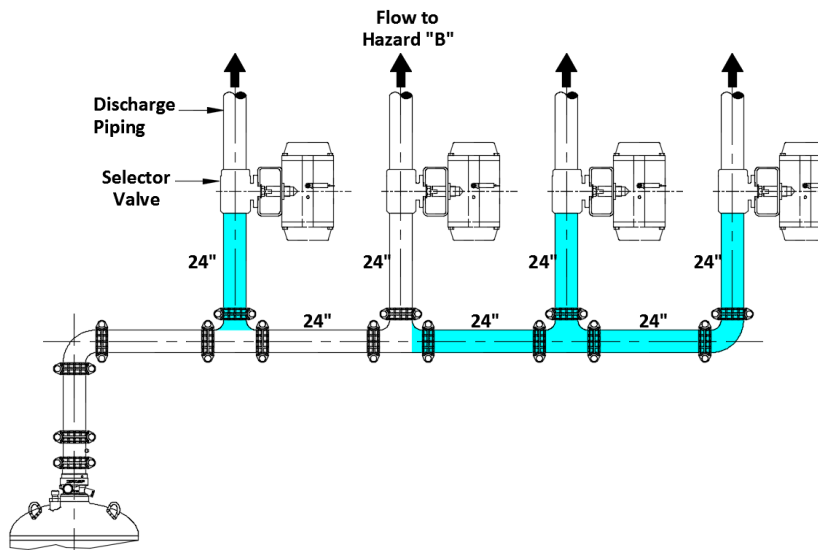
To determine the maximum total length of 1 ¼" pipe allowed to entrap agent during discharge, multiply the agent quantity (i.e., 326 lbs.) by the multiplier taken from the table on Page 55 for 1 ¼" schedule 40 pipe.

326 lbs. x 0.129694 = 42.28 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.

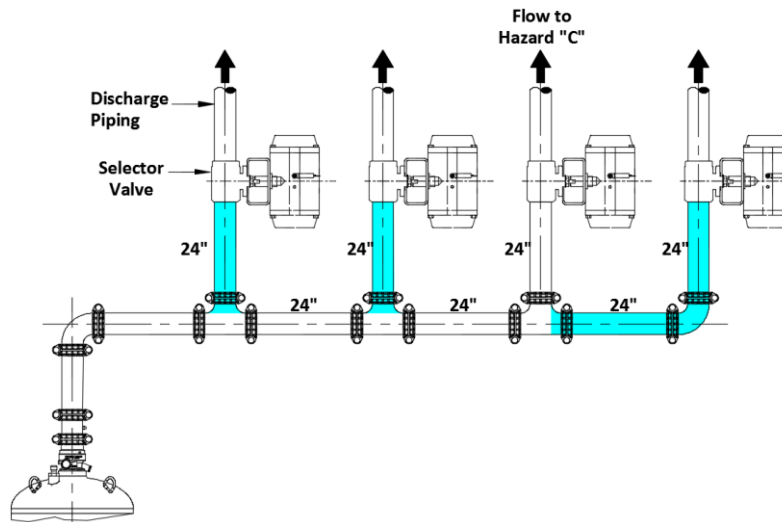


Agent Flow to Hazard "A"
(24 inches x 6 = 12 feet of 1 ¼" pipe)

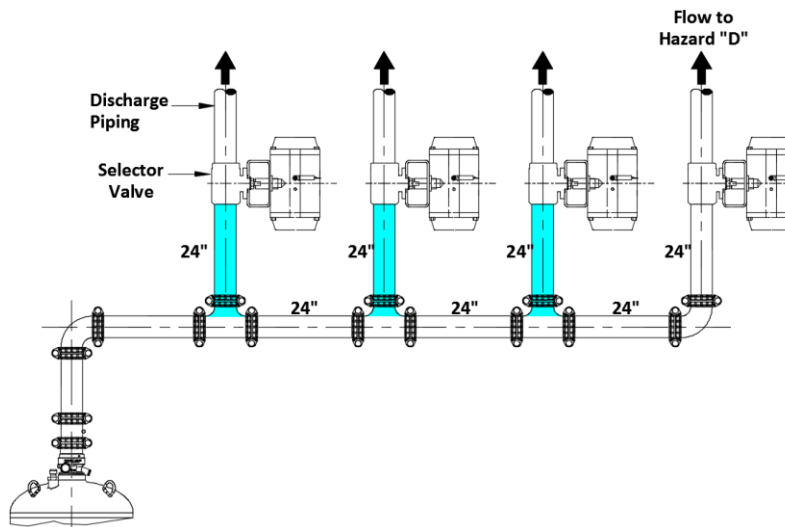


Agent Flow to Hazard "B"
(24 inches x 5 = 10 feet of 1 ¼" pipe)

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 42.28 feet, the piping network serving the selector valve is acceptable. If exceeded, the piping network must be modified.

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REVISION HISTORY

ORIGINAL RELEASE DATE:December, 2009

REVISION / DESCRIPTION OF CHANGE

REVISION DATE

Revision 1July, 2010

Equipment Section

- 1) Add LLI information for the 100 lb. container on:
 - Agent Storage Container – Ecaro-25 Component Sheet (p/n 06-490 rev 1)
 - Liquid Level Indicator (LLi) Component Sheet (p/n 06-494 rev 1)
- 2) Update information on Impulse Valve Pneumatic Operator (IVPO) Component Sheet (p/n 06-551 rev 1)
- 3) Deleted minimum / maximum orifice areas and added minimum / maximum drill diameters on Discharge Nozzles – HFC-125 Component Sheet (p/n 06-496 rev 1)
- 4) Updated information on Pipe & Fittings Component Sheet (p/n 06-495 rev 1)
- 5) Corrected equivalent length for 3" check valve from 4.5' to 4.0' on Check Valve Component Sheet (p/n 06-497 rev 1)
- 6) Change 20 & 35 lb. container bracket on Mounting Straps & Brackets Component Sheet (p/n 06-491 rev 1)

Design Section

- 1) Corrected nozzle part numbers for 100 lb. container in Table 1 on page 24 of 25

Revision 2November, 2010

Equipment Section

- 1) Add information on 5 and 10 lb. containers on:
 - Agent Storage Container – Ecaro-25 Component Sheet (p/n 06-490 rev 2)
 - Mounting Straps & Brackets – Component Sheet (p/n 06-491 rev 2)
 - Pipe and Fittings – Component Sheet (p/n 06-495 rev 2)

Design Section

- 1) Added information on 5 & 10 lb. containers on pages 6 & 23
- 2) Added pre-engineering piping limitations for 5 & 10 lb. containers on pages 24 & 25

Revision 3November, 2011

Equipment Section

- 1) Renumbered component sheets

Design Section

- 1) Changed minimum design concentration required on page 1

Service Section

- 1) Revised sample problem to reflect new minimum design concentration starting on page 15 Service Section
- 2) Formatting changes

Revision 4August, 2013

Equipment Section

- 1) Add reference to ULC listed to entire document
- 2) Changed part number of 3" check valve from 02-4157 to 70-317 on Comp Spec 06-432-1-9 rev 3

Design Section

- 1) Add reference to ULC listed to entire document

Service Section

- 1) Added information to replace damper in 3" check valve

Revision 5November, 2015

Equipment Section

- 1) Added Impulse Valve Operator Supervisor (IVOS) information

Revision 6May, 2016

Equipment Section

- 1) Updated pressure information in Figure 1 – Temperature vs. Pressure Chart on page 12.

Revision 7June, 2016

Equipment Section

- 1) Updated IVO Kit information on pages 23, 24 & 28.
- 2) Updated IVPO Kit information on pages 31 & 32.
- 3) Updated information & illustrations for Manifold Options on pages 43 & 44.
- 4) Editorial change: updated IVOS conduit length from 34.75" to 33.5" on pages 23 and 29.

REVISION HISTORY

Revision 8..... February, 2017

Equipment Section

- 1) Added "Reset Instructions – Multi-Tool" section on page 28.
- 2) Reordered Component Specifications for IVO & IVPO, Equipment Section.
- 3) Made general error corrections throughout the manual.

Revision 9..... May, 2019

Revised entire document to comply with current Fike Document Standards

- 1) Added Impulse Energetic Actuator (IEA)
- 2) Added Selector Valves
- 3) Added Nitrogen Actuator
- 4) Removed all references to Class B fires.

Revision 10..... March, 2020

Equipment Section

- 1) Removed plastic cap and cotter pin from IVO Kit 70-279 in Sections 2.8 and 2.11.
- 2) Changed 1/2 NPT to 3/4 NPT in Section 2.9.
- 3) Added 1" and 2" Ball Check Valves (02-16557 and 02-16558) to Section 2.14.
- 4) Changed "rigid conduit compression fitting" to "NPT conduit fitting" in Section 4.7.2.



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