Sv Series, Mv Series, and Lv Series Engineered Fire Suppression Systems

Designed For Use With

FK-5-1-12

Operation, Design, & Service Manual

FM APPROVED UL LISTED 40YE ULC LISTED

Issued June 21, 2010
DOC108 REV G
(Revised 27-Mar-2025)

CLEAN AGENT EXTINGUISHING
SYSTEM UNITS
UL FILE # EX15398

JANUS FIRE SYSTEMS®

Contents

Diagram Index

Table Index

Revision History

Revision	Description of Change	Date
---	Initial Printing	6/21/2010
A	Section 2.5 Discharge Nozzles changed to Section 2.6. Section 2.4.4 through Section 2.5.4 added.	10/13/2010
B	Figure 2.5 revised. Section 7.2.1 phrase "from cylinder valve" added to end of sentence beginning "For Mv and Lv Series cylinders, remove the low-pressure supervisory switch and...". Caution added to Section 2.2.1.2 and Section 2.2.2.2. Sentence beginning with "The electric valve actuator is shipped with a plastic threaded cap..." added to Section 2.2.3. Paragraph beginning "Dirt traps and blow-outs" added to Section 4.1.3. Statement "Refer to Table 2.3.9 for P/N" added to Section 2.3.9. 5 inch pipe removed from Table 3.6. Section 2.2.2.3, Figure 2.2.2.3a and Figure 2.2.2.3b added. Section 2.2.3.1, Figure 2.2.3.1a, and Figure 2.2.3.1b added. Phrase "Grade A-53 F" changed to "Grade A-53 F - 3/8" (10 mm) to 4" (100 mm) Pipe Sizes" in Table 4.1.2. Phrase "Grade A-106 C" removed from Table 4.1.2. Phrase "Grade A-106 A or B" changed to Grade A-106 A or B or C" in Table 4.1.2. Size 5" pipe removed from Table 3.6. Appendix E added. Paragraph in Section 3.5 beginning "The 90° corner nozzle can cover an area that is up to..." replaced with paragraph beginning "The 90° corner nozzle can cover a maximum area...". Paragraph in Section 3.5 beginning "The 180° corner nozzle can cover an area that is up to..." replaced with paragraph beginning "The 180° corner nozzle can cover a maximum area...". Paragraph in Section 3.5 beginning "The 360° corner nozzle can cover an area that is up to..." replaced with paragraph beginning "The 360° corner nozzle can cover a maximum area...". Figure 3.5a, 3.5b, and 3.5c revised. Sentence beginning "It operates between 17 and 30 VDC" in Section 2.2.3 changed to "It operates between 20.4 and 26.4 VDC".	4/7/2011
C	Material Safety Datasheet located in Appendix A replaced with latest revision. UL Listed/FM Approved symbols added to cover and page footers. Sentence "The Sv Series switch has 18 inch (457 mm) leads" added to Section 2.2.2.1. Lead length corrected from 36 inch to 18 inch in Figure 2.2.2.1. Sentence "The Mv and Lv Series switch has 36 inch (914 mm) leads" added to Section 2.2.2.2. CE Cylinder Part Numbers added to Table 2.1.1. Warning in Section 2.2.1.1 beginning "The Sv Series pressure gauge is mounted to the cylinder valve" changed to warning beginning "The Sv Series pressure gauge is mounted directly to the cylinder valve". Caution beginning "The Mv and Lv Series pressure gauge assembly shall not be removed" and added to Section 2.2.1.2. Phrases "The pressure gauge connections" and "when the gauge is removed" in Section 2.2.1.2 changed to "The pressure gauge ports" and "when the gauge is absent" respectively. Warning in Section 2.2.2.1 beginning "The Sv Series low-pressure supervisory switch is mounted to the cylinder valve" changed to warning beginning "The Sv Series low-pressure supervisory switch is mounted directly to the cylinder valve". Phrases "The low-pressure supervisory switch connections" and "when the switch is removed" in Section 2.2.2.2 changed to "The low-pressure supervisory switch ports" and "when the gauge is absent" respectively. Caution beginning "The Mv and Lv Series low-pressure supervisory switch assembly shall not be removed" added to Section 2.2.2.2. Section 5.11 added. Note beginning "Note: Janus Fire System® Fire Extinguishing Systems are designed" added to Preface, Section 1, Section 3, and Section 3.1.3. Sentence in Section 3.1.1 beginning "NFPA 2001 requires the minimum design concentration" changed to sentence reading "NFPA 2001 (2012 edition) requires the minimum design concentration".	11/11/2011

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Revision History

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C	Sentence in Section 3.1.1 beginning "The minimum design concentration for a Class C fire shall be at least" changed to sentence beginning "The minimum design concentration for a Class C fire shall be 4.7%". Paragraphs beginning "For a manual-only system" and "The design concentration for a manual-only Class B" removed from Section 3.1.1. Paragraph beginning "If only the space under the raised floor is to be protected by a total flooding system" added to Section 3.1.2. Table 3.2A and 3.2B changed to reflect revisions to NFPA 2001, 2012 Edition. Section B.1 and B.2 changed to reflect revisions to NFPA 2001, 2012 Edition. Phrase "minimum concentration of 4.2%" in Section 1 changed to "minimum concentration of 4.5%" to reflect revisions to NFPA 2001, 2012 Edition. Calculation examples in Section 3.2 changed to reflect revision to NFPA 2001, 2012 Edition. Note added to Section 2.2.3.1. All references to "Dow Corning No. 4" replaced with "Molykote 55 by Dow Corning (P/N 19056)". Section 2.5 rewritten. Figure 2.5 changed to Figure 2.5b and Figure 2.5a added. Maximum fill of Sv Series 40 lb corrected to 43 lbs. Figure 2.5 changed to Figure 2.5b and Figure 2.5a added. Maximum fill of Sv Series 40 lb corrected to 43 lbs. Sentences beginning "Refer to Section" added to Sections 2.1.2.2 and 2.2.2.2. Paragraphs beginning "Prior to installation" and "Every time the" added to Sections 4.1.4.1 and 4.1.4.2. Sentence beginning "Typically a combination of" removed from Section 3.7.2.	11/11/2011
D	All references to Material Safety Datasheet changed to Safety Data Sheet. Section 1.3 NOAEL corrected to ">10%". Table 2.1.1 capacities corrected. Pressure Gauge and Low-Pressure Switch in Section 2.1.3.1 amended to "permanently mounted" and phrase "while under pressure" removed. Warnings added to Sections 2.1.3.1, 2.1.3.2, and 2.1.3.3. Warnings and Cautions in Section 2.2.1 and 2.2.2 amended for clarity. Sentence "See also notes in Section 2.2.3.1" added to Section 2.2.3. Section 2.2.3 moved to Appendix. Figure 2.2.3.1a revised. 2012 Edition removed from note in Section 2.2.3.1 and "will become effective" changed to "is in effect". P/N 99655 in Section 2.2.3.1 corrected to 20722. Sentence "The electric valve actuator has a life span of 25 years from date of manufacture" added to Section 2.2.3.1. Note beginning "Electric Valve Actuators with" added to Section 2.2.3.1. Phrase "and complete loss of agent" added to Warnings for Section 2.2.3.1, 2.2.4, 2.3.1, 4, 5.2, 5.3, 5.4, 5.5. Figures 2.2.5.1, 2.2.5.2, 2.2.5.3 updated. NPS descriptor added to conduit connections on Figure 2.2.2.3a, 2.2.3, and 2.2.3.1a. Caution added to Section 2.2.5. Section 2.4.2: Model 18773 replaced with Model 97428, Model 18773 moved to Appendix F. Section 2.4.2.1 added. Lengths corrected in Figure 2.4.3c and 2.4.3d. Figure 2.5a and 2.5b revised. Explosion-Proof solenoid option already in Section 2.5.1.1 added to Appendix C. Section 2.5.1.1 correct reversed DC and AC consumption values. Sentence beginning "A 1/2 in (15 mm) stainless steel strainer" added to Section 2.5.3. Add information about pipe-away adapter to Section 2.5.4. Note "FM Approval pending" removed from Section 2.6. Section 3.1.1 revised to incorporate FM Global Data Sheet 4-9. Table 3.1.1a updated to latest Cup Burner values where applicable. First caution Section 3.4 amended for clarity. Section 3.1.2 paragraph beginning "If only the space under" removed. Text on back-to-back nozzles added to Section 3.5 paragraphs three and four. Additional values added to Table 3.5b. Figure 3.5d, Table 3.5c, and corresponding diagrams and text added to Appendix E. Caution Section 3.6 amended for clarity. Caution beginning "All clean agent cylinders for a single hazard" added to Section 4.1.1. Location for measuring H1 value in Figure 4.1.1a, 4.1.1b, and 4.1.1c changed for clarity. Paragraph beginning "Dirt traps" in Section 4.1.3 rewritten as paragraph beginning "NFPA 2001".	9/16/2020

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Revision History

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D	Phrase "Every time the pressure gauge" in Section 4.1.4.1 changed to "Any time the pressure gauge". Phrase "to 10 lb*ft" in Section 4.1.4.1 and 4.1.4.2 changed to "until it mates with the valve face". Phrase "Every time the low-pressure" in Section 4.1.4.2 changed to "Any time the low-pressure". Figure 5.6a and 5.6a rotated for clarity. Figure 5.10 updated. Section 6.2.4 added. Warning in Section 7.2 modified for clarity. Section 7.2.2 revised method for servicing valve including revision to Table 7.2.2. Note "refer to www.janusfiresystems.com for latest Safety Data Sheet" added to Appendix A. Safety Data Sheet in Appendix A updated. Appendix F added. References to "system equipment has been verified" changed to "system has been verified" throughout manual. Appendix G added. All references to "NFPA, 2012 Edition" revised to "2018 Edition". Paragraphs beginning 'In addition', 'Multiple remote', and 'Each cylinder is' added to Section G.1.1. Figure G.1.1b and Figure G.1.1.1c added. Part Numbers added to Tables G.2a, G.2b, and G.2c for clarity. Note and paragraph beginning "If a clean agent system" added to Section 3.6.1.	9/21/2020
E	Agent name changed to generic. "Teflon tape shall not be used" added to Section 4.1.4.1 and Section 4.1.4.2. Add footnote to Section 5.11. All illustrations of cylinder valve and/or rupture disc updated. Figure 5.10 updated. Class C concentration clarified throughout manual. Second Caution in Section 3.6 updated, and statement beginning 'A minimum distance equal to' added.	3/24/2023
F	Sv XP cylinders added to Table 2.1.1. XP part numbers added to Figures 2.1.3.1b, 2.1.3.2b, and 2.1.3.3b. Section 2.2.3 Explosion-Proof Low-Pressure Supervisory Switch added, all relevant sections renumbered. P/N 95184, P/N 95130, and P/N 95113 added. Class C Hazards clarified Section 3.1.1. Stainless steel tubing added to Sections 4.1.6.2 and 4.1.6.4. References to 95184 and 95130 added to Section G.1.1 and Figures G.1.1.1b and G.1.1.1c. Note in Section G.1.2 removed. 99109 corrected to 40 micron. Maximum inlet pressure corrected Section 2.5.3. Discharge Relief Valve 19316 added to Section 2.5.4. Phrase 'and in accordance with NFPA 2001' added to Section 6.2.1. Section 6.2.1.2 updated for clarity. Relief Valve 19317 added to Figures G.1.2 and G.1.2.1.	5/15/2024
G	'Maximum Nozzle Height (Rise) Above Discharge Outlet' removed from Table 1. Table 2.1.1 empty weights and certain fill ranges corrected. Note regarding FM Approval in Section 2.2.4.2 updated. Underfloor paragraph of Section 3.5 revised and expanded. Sentence beginning 'If a cylinder is equipped' added to Section 6.2.1.2. Sentence beginning 'Cylinder equipped with a' added to Section 6.2.1.3.	3/27/2025

Preface

This manual is intended for use with the Janus Fire Systems® Sv Series, Mv Series, and Lv Series Engineered Fire Extinguishing Systems utilizing FK-5-1-12. Those who install, operate, design, or service these systems should read this entire manual.

All design, implementation, and maintenance of the Janus Fire Systems® Engineered Fire Extinguishing Systems must be performed in compliance with the National Fire Protection Association (NFPA) 2001 - Standard on Clean Agent Fire Extinguishing Systems, NFPA 70 - The National Electrical Code, NFPA 72 - The National Fire Alarm Code, and the guidelines outlined in this manual.

All system designs are preformed in conjunction with the Janus Design Suite® hydraulic flow calculation software and in compliance with the Janus Design Suite® Flow Calculation Software Manual Designed For Use With FK-5-1-12, DOC173.

Janus Fire Systems® reserves the right to revise and improve its products as it deems necessary without prior notification. This manual describes the state of Janus Fire Systems® products at the time of its publication and may not reflect those products at all times in the future.

All references to Codes or Standards in this manual refer to the latest edition of that Code or Standard unless otherwise indicated.

Compressed gases shall be handled and used only by persons properly trained in accordance with Compressed Gas Association, Inc. (CGA) pamphlets C-1, C-6, and P-1.

CGA pamphlets are published by the Compressed Gas Association Inc. (www.cganet.com).

The contents of this manual may not be reproduced in any form without the express written consent of Janus Fire Systems®.

Note: Janus Fire System® Fire Extinguishing Systems are designed, manufactured, installed and UL listed and FM approved to deliver a designated quantity of FK-5-1-12 in a "not to exceed" 10 second discharge time. The "Duration of Protection (Hold Time)" as referenced in NFPA 2001, 2018 edition is a function of the hazard enclosure's (room) integrity and not a function (or capability) of the fire suppression system's discharge time referenced in this publication.

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Section 1 General Information

1 GENERAL INFORMATION

The Janus Fire Systems® Sv, Mv, and Lv Series Fire Extinguishing Systems utilize FK-5-1-12 to protect high value assets in areas that may be normally occupied, in locations where clean-up of other agents is problematic, when storage space for a fire suppression agent is restricted, and/or when an electrically non-conductive agent is required.

Systems utilizing FK-5-1-12 may be used for Class A (wood, paper, cloth, rubber, and many plastics), Class B (flammable liquids and flammable gases), and Class C (energized electrical equipment) surface fires.

NFPA 2001 mandates that clean agents such as FK-5-1-12 **shall not** be used on fires involving the following materials unless they have been tested to the satisfaction of the authority having jurisdiction:

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

All systems described in this manual are intended only for total flooding application. NFPA 2001 defines total flooding as the act and manner of discharging an agent for the purpose of achieving a specified minimum agent concentration throughout a hazard volume. FK-5-1-12 must be discharged within 10 seconds and reach a minimum concentration level of 4.5% but not exceeding 10% in normally occupied spaces.

Note: Janus Fire System® Fire Extinguishing Systems are designed, manufactured, installed and UL listed and FM approved to deliver a designated quantity of FK-5-1-12 in a "not to exceed" 10 second discharge time. The "Duration of Protection (Hold Time)" as referenced in NFPA 2001, 2018 edition is a function of the hazard enclosure's (room) integrity and not a function (or capability) of the fire suppression system's discharge time referenced in this publication.

Table 1 - System Performance Specifications	
Lowest Approved System Temperature	32°F (0°C)
Highest Approved System Temperature	130°F (54°C)
Ambient Temperature Limits for Approved Flow Calculations	70°F ±10°F (21.1°C ±5.5°C)
Minimum Height of Protected Space	12 in (304 mm)
Maximum Height of Protected Space (single tier of nozzles)	18 ft 4 in (5588 mm)
Maximum Nozzle Drop Below Finished Ceiling	4 ft 5 in (1346 mm)

Section 1 General Information

1.1 Listings and Approvals

When designed and installed according to the information contained in this manual, the Janus Fire Systems® Sv, Mv, and Lv Series Fire Extinguishing Systems utilizing FK-5-1-12 are Underwriters Laboratories Inc. (UL) listed and Factory Mutual (FM) approved for engineered systems. System has been verified through testing to function at ambient temperatures ranging from 32˚F (0˚C) to 130˚F (54˚C). Flow calculations have been verified at ambient temperatures of 70˚F ±10˚ (21.1˚C ±5.5˚). Storage outside of the range of 70˚F ±10˚ (21.1˚C ±5.5˚) may result in inaccurate flow calculations and may cause one or more nozzles to not discharge the calculated quantity of FK-5-1-12.

1.2 Extinguishing Agent

FK-5-1-12 is formed from the elements carbon, fluorine and oxygen (CF3CF2C(O)CF(CF3)2 - dodecafluoro-2-methylpentan-3-one). The primary extinguishing mechanism of FK-5-1-12 is heat absorption, with a secondary chemical contribution from the thermal decomposition of FK-5-1-12 in the flame. FK-5-1-12 leaves no residue and is safe for use in occupied spaces.

FK-5-1-12 is a highly fluorinated ketone containing no chlorine or bromine. As a result, the Ozone Depletion Potential (ODP) for FK-5-1-12 is zero, meaning it has no effect on stratospheric ozone. FK-5-1-12 has an atmospheric lifetime of 0.014 years. It has a Global Warning Potential of 1.

Janus Fire Systems® Engineered Fire Suppression Systems store FK-5-1-12 as a liquid in steel cylinders. The liquid FK-5-1-12 is superpressurized with nitrogen to 360 psig (24.8 bar) at 70˚F (21.1˚C). When discharged, FK-5-1-12 is atomized at the discharge nozzles and becomes thoroughly mixed with the air throughout the protected area reaching a predetermined design concentration.

1.3 Safety Considerations

The United States Environmental Protection Agency (EPA) Significant New Alternatives Policy (SNAP) Program lists FK-5-1-12 as acceptable for occupied spaces.

FK-5-1-12 must be used in accordance with the NFPA Standard 2001, specifically as follows:

> Unnecessary exposure to FK-5-1-12 — including exposure at and below the no observable adverse effects level (NOAEL)[1] concentrations of 10% or below — and FK-5-1-12 decomposition products shall be avoided. Means shall be provided to limit exposure to no longer than 5 minutes. Unprotected personnel shall not enter a protected space during or after agent discharge. The following additional provisions shall apply:
>
> (1) Systems utilizing FK-5-1-12 fluid for spaces that are normally occupied and designed to concentrations up to the NOAEL shall be permitted. The maximum exposure in any case shall not exceed 5 minutes.
>
> (2) In spaces that are not normally occupied the following provisions shall apply:
>
> (a) Where egress takes longer than 30 seconds but less than 1 minute, the FK-5-1-12 shall not be used in a concentration exceeding its LOAEL[2] (>10%).

1 NOAEL (No Observed Adverse Effect Level) - The highest concentration at which no adverse toxicological or physiological effect has been observed.

2 LOAEL (Lowest Observable Adverse Effect Level) - The lowest concentration at which an adverse physiological or toxicological effect has been observed.

(b) Concentrations exceeding the LOAEL are permitted provided that any personnel in the area can escape within 30 seconds.

(c) A pre-discharge alarm and time delay shall be provided in accordance with the provisions noted in NFPA 2001 for Time Delays.

The discharge of FK-5-1-12 into a hazard may reduce visibility for a brief period. FK-5-1-12 may cause frostbite if liquid discharge or escaping vapor contacts the skin.

⚠ WARNING

When FK-5-1-12 is exposed to temperatures greater than 1300°F (700°C), the potentially hazardous byproduct hydrogen fluoride (HF) will be formed. The system is designed to discharge within 10 seconds or less to minimize the amount of HF formed during extinguishment. The effects of agent decomposition on equipment must be considered when using FK-5-1-12 in hazards with high ambient temperatures (e.g., furnaces and ovens).

The Safety Data Sheet (SDS) on FK-5-1-12 can be found in Appendix A of this manual and should be read and understood before working with the agent. Training of personnel, fire drills, and evacuation plans should be considered.

⚠ CAUTION

A cylinder containing FK-5-1-12 must be handled carefully. **All anti-recoil safety plugs and devices must be in place at all times when the cylinder is not connected to discharge piping.**

2 SYSTEM DESCRIPTION AND COMPONENTS

The Janus Fire Systems® Sv, Mv, and Lv Series Systems can be divided into the following component categories:

1. **Agent Storage Components** - These components consist of the cylinder assembly(s), which contains the FK-5-1-12, and the cylinder bracket(s), which holds the cylinder assembly securely in place.

2. **Agent Distribution Components** - These components consist of the discharge nozzles used to atomize the liquid FK-5-1-12 and introduce it into a protected hazard along with the associated piping system used to connect the nozzles to the cylinder assembly.

3. **Trim Components** - These components complete the installation of the system and may include connection fittings, a pressure gauge, low-pressure supervisory switch, electric valve actuator, and manual valve actuator. The specific components used will vary slightly according to the series valve installed.

4. **Multi-Cylinder Arrangement Components** - These components consist of the pneumatic valve actuator(s), pilot actuation check valve, vent check, actuation hoses, and fittings required for a multiple cylinder (secondary) arrangement.

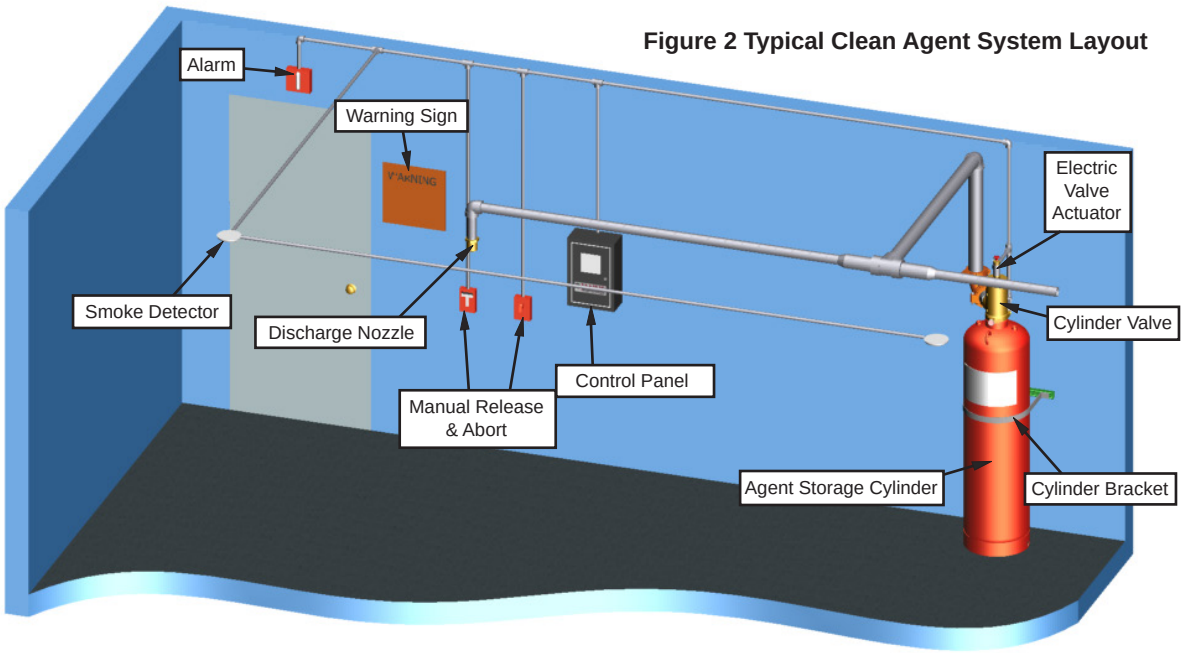
5. **Supplemental Components** - These components include the discharge pressure switch and may be utilized in a variety of locations within an arrangement or for multiple purposes.

6. **Control Panel** - This device monitors the condition of the electric actuator, detectors, warning devices, cylinder pressure, and any manual release and abort stations.

7. **Early Warning and Alarm Devices** - Early warning devices coupled with manual release and abort stations maximize system efficiency while audible and visual alarm devices alert staff of alarm conditions.

The following sections describe the operation and function of all controls and indicators that are used with the Janus Fire Systems® Sv, Mv, and Lv Series Systems utilizing FK-5-1-12.

Figure 2 Typical Clean Agent System Layout



Section 2 System Description and Components

2.1 Cylinder Assembly

The cylinder assembly consists of the cylinder, dip tube, and cylinder valve.

2.1.1 Cylinder

The FK-5-1-12 is stored as a liquid inside a welded steel cylinder. The cylinders are superpressurized with dry nitrogen to a pressure of 360 psig (24.8 bar) at 70°F (21°C). Every cylinder has a minimum fill density of 35 lb/ft^3 (561 kg/m^3) and a maximum fill density of 70 lb/ft^3 (1121 kg/m^3). The capacity of a cylinder varies according to the design requirements and the Series designation (See Table 2.1.1 for a list of available capacities).

Standard domestic cylinders are manufactured according to the requirements of the U.S. Department of Transportation (USDOT) and Transport Canada[1] (TC) for compressed gas and are fitted with an identification label indicating the fill quantity of FK-5-1-12. Each cylinder has internal neck threads to allow for connection to the cylinder valve.

Table 2.1.1 Cylinder Capacities

Valve Series	Nominal Cylinder Size	P/N	P/N (CE)	Fill Capacity				Empty Weight	
				Minimum		Maximum			
				lb	kg	lb	kg	lb	kg
Sv	40 lb	20503	20575	22	10.0	43	19.5	42	19.1
Sv	80 lb	20504	20574	41	18.6	81	36.7	61	27.7
Sv	130 lb	20505	20576	66	29.9	131	59.4	82	37.2
Mv	250 lb	20506	20584	126	57.2	252	114.3	176	79.8
Mv	420 lb	20507	20585	211	95.7	422	191.4	251	113.9
Lv	600 lb	20508	20586	304	137.9	609	275.3	377	171.0
Lv	900 lb	20509	20587	455	206.4	910	412.7	494	224.1
Lv	1000 lb	20510	20588	561	254.5	1122	508.9	639	289.8

Ordering Instructions: Specify the Cylinder Assembly P/N followed by a dash and the fill weight in pounds expressed in three digits. *NOTE: For explosion-proof version of Sv Series cylinders, you must also add an XP after the weight, such as 20503-022XP for 22 lb fill.

2.1.1.1 Rupture Disc

A frangible rupture disc is fitted to the Lv Series cylinder body. It functions as an emergency relief device in the event of excessive internal pressure within the cylinder. Its rupture point is between 850 psi (58.6 bar) and 1000 psi (68.9 bar).

This feature is not found on the Sv Series or Mv Series cylinder. Instead, a rupture disc is located on the side of Sv Series and Mv Series cylinder valve as detailed in sections 2.1.3.1 and 2.1.3.2.

1 1000 lb Cylinders are not Transport Canada approved, but CAN be used in Canada as they meet 49CFR requirements and are marked DOT

2.1.1.2 Liquid Level Indicator

The liquid level indicator consists of a sealed non-magnetic tube containing an external measurement tape fitted with a magnet. A second magnet with an opposing polarity is installed on the outside of the tube and is exposed to the liquid FK-5-1-12. As the tape is extracted from the tube, it will engage with the second magnet creating a noticeable change in tension. The measure on the tape when this change in tension occurs indicates the current liquid level inside the cylinder and can then be compared to a chart located in Appendix B of this manual to determine the current fill weight of the cylinder.

The liquid level indicator assembly is threaded into an outlet on the head (top) of the Mv Series and Lv Series cylinders.

This feature is not found on the Sv Series cylinder.

2.1.2 Dip Tube

A rigid dip tube is threaded into the cylinder valve and extends down the entire length of the cylinder.

2.1.3 Cylinder Valve

A differential pressure operated cylinder valve controls the release of FK-5-1-12 from the cylinder. It is made of forged brass and is threaded onto the cylinder neck. The features and design of each valve vary according to the Series designation.

2.1.3.1 Sv Series Valve Features

(See Figure 2.1.3.1a)

The Sv Series valve has six key features:

1. **Valve Actuation Connection:** A threaded connection located on top of the cylinder valve serves as the attachment point for the electric (primary) or pneumatic (secondary) valve actuator.

2. **Pressure Gauge:** A pressure gauge is permanently mounted to the cylinder valve exterior to provide a visual measure of the cylinder's internal pressure. The gauge shall not be removed.

3. **Rupture Disc:** A frangible rupture disc is fitted to the valve body opposite the pressure gauge. It functions as an emergency relief device in the event of excessive internal pressure within the cylinder. Its rupture point is between 850 psi (58.6 bar) and 1000 psi (68.9 bar). The rupture disc shall not be removed while the cylinder is under pressure.

4. **Low-Pressure Supervisory Switch:** A low-pressure supervisory switch is permanently mounted to the cylinder valve and continuously monitors the internal pressure of the cylinder. It shall not be removed.

5. **Discharge Outlet:** A 1 1/4 in (32 mm) FNPT connection serves as the attachment point for the discharge piping.

6. **Pilot Actuation Port:** A 3/8 in (10 mm) FNPT connection (shipped with a pipe plug) serves as the attachment point for the pilot actuation piping in multiple cylinder systems, providing the actuation pressure used to open the secondary cylinder valve(s). This can also be used for attachment of the discharge pressure switch in single cylinder arrangements. The pipe plug shall remain in place at all times when the port is not connected to pilot actuation piping or a discharge pressure switch.

⚠WARNING

If the pipe plug is not installed in the pilot actuation port of a cylinder when that port IS NOT connected to pilot actuation piping or a discharge pressure switch, agent will discharge from the pilot actuation port during a system discharge, which may result in potential injury and/or property damage, and cause one or more nozzles to not discharge the designed quantity of FK-5-1-12.

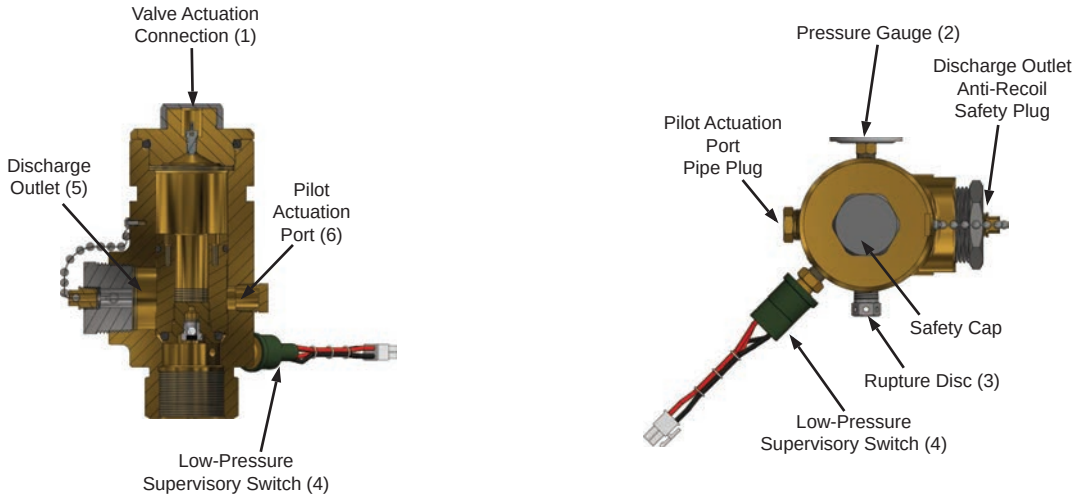


Figure 2.1.3.1a Sv Cylinder Valve Assembly

Section 2 System Description and Components

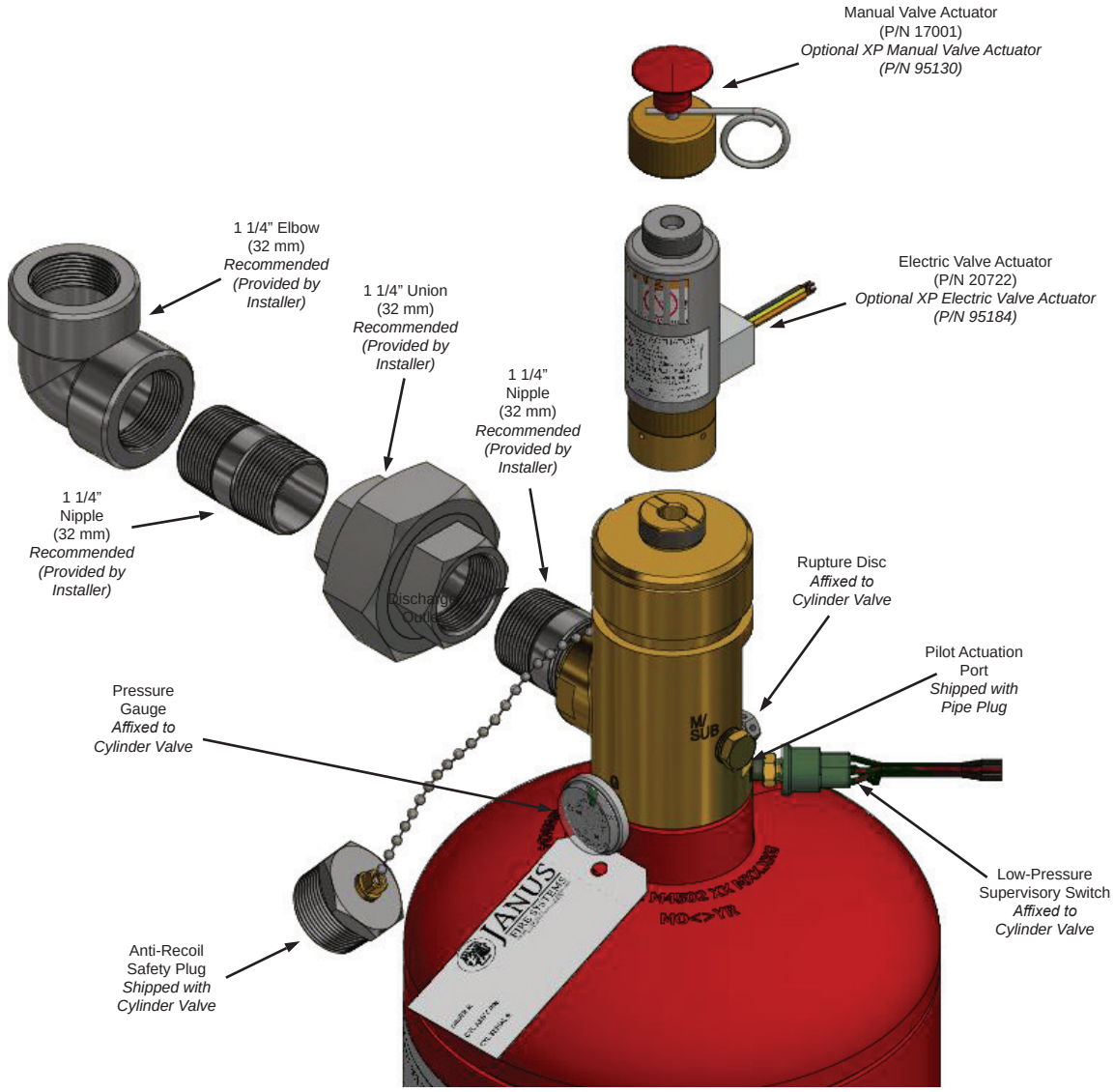


Figure 2.1.3.1b Sv Cylinder Valve w/ Trim Kit

*Note: Standard Low-Pressure Supervisory Switch shown. XP Sv Series Cylinders come fitted with XP Low-Pressure Supervisory Switch. See Section 2.2.2.4.

2.1.3.2 Mv Series Valve Features

(See Figure 2.1.3.2a)

The Mv Series cylinder valve has six key features:

1. **Valve Actuation Connection:** A threaded connection located on top of the cylinder valve serves as the attachment point for the electric (primary) or pneumatic (secondary) valve actuator.

2. **Pressure Gauge Connection:** A female connection serves as the attachment point for the pressure gauge. It is fitted with a Schrader valve to allow the removal of the gauge while the cylinder is pressurized.

3. **Low-Pressure Supervisory Switch Connection:** A female connection serves as the attachment point for the low-pressure supervisory switch. A Schrader valve allows for the removal of the pressure switch while the cylinder is pressurized.

4. **Rupture Disc:** A frangible rupture disc is fitted to the valve body opposite the discharge outlet. It functions as an emergency relief device in the event of excessive internal pressure within the cylinder. Its rupture point is between 850 psi (58.6 bar) and 1000 psi (68.9 bar). The rupture disc shall not be removed while the cylinder is under pressure.

5. **Discharge Outlet:** A 2 in (50 mm) grooved connection serves as the attachment point for discharge piping.

6. **Pilot Actuation Port:** A 1/4 in (8 mm) NPT connection (shipped with a pipe plug) serves as the attachment point for the pilot actuation piping in multiple cylinder systems, providing the actuation pressure used to open the secondary cylinder valve(s). This can also be used for attachment of the discharge pressure switch in single cylinder arrangements. The pipe plug shall remain in place at all times when the port is not connected to pilot actuation piping or a discharge pressure switch.

⚠WARNING

If the pipe plug is not installed in the pilot actuation port of a cylinder when that port IS NOT connected to pilot actuation piping or a discharge pressure switch, agent will discharge from the pilot actuation port during a system discharge, which may result in potential injury and/or property damage, and cause one or more nozzles to not discharge the designed quantity of FK-5-1-12.

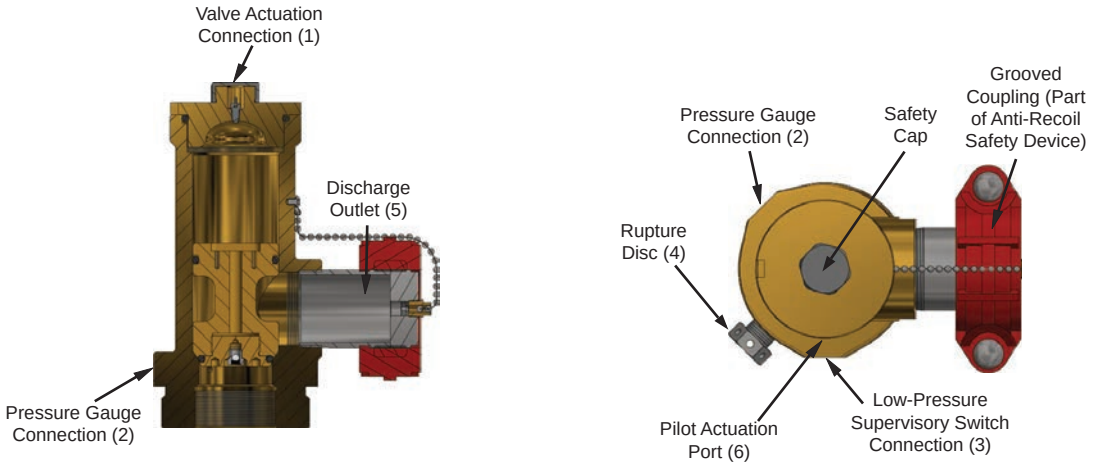


Figure 2.1.3.2a Mv Cylinder Valve Assembly

Section 2 System Description and Components

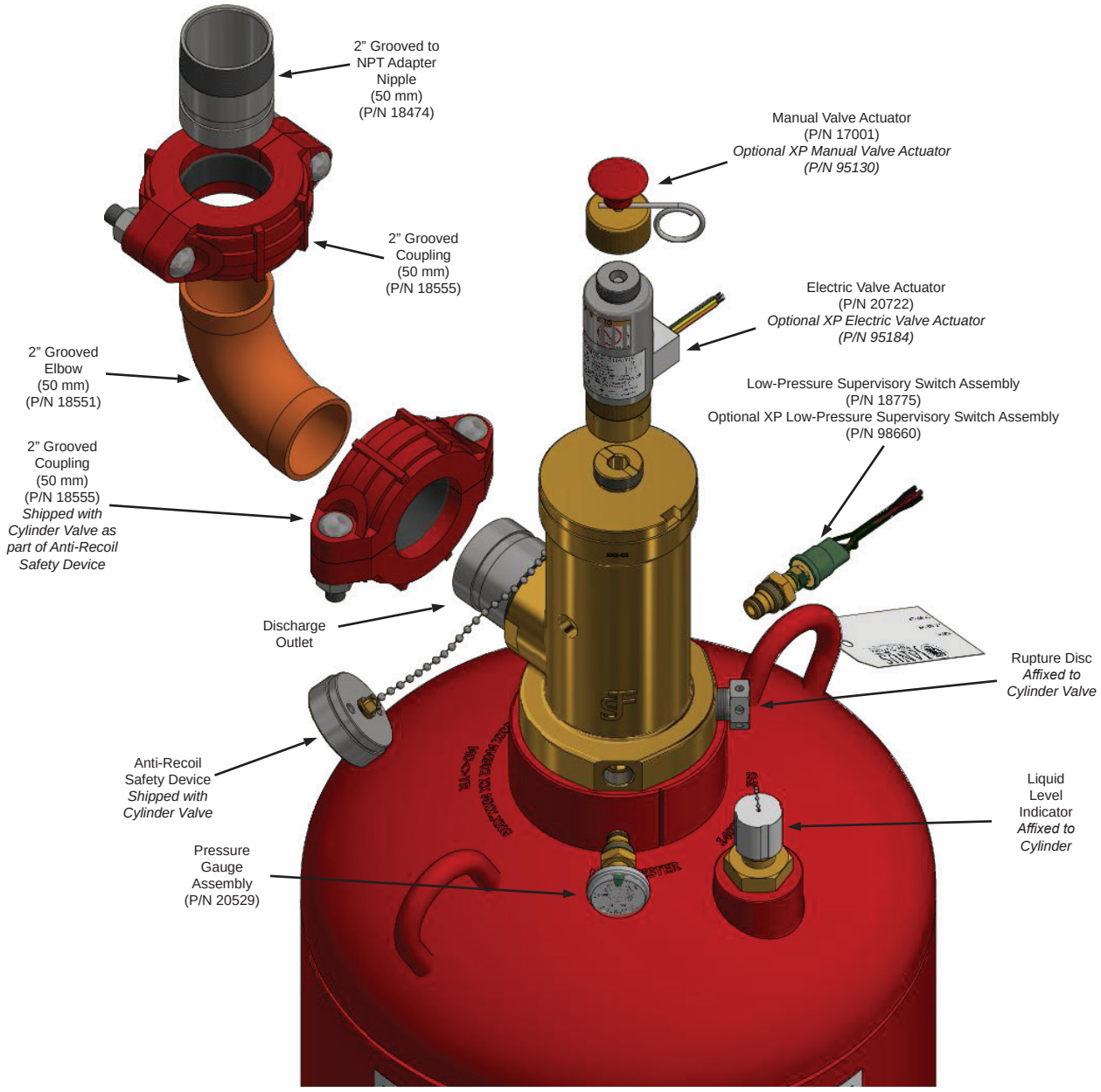


Figure 2.1.3.2b Mv Cylinder Valve w/ Trim Kit

2.1.3.3 Lv Series Valve Features

(See Figure 2.1.3.3a)

The Lv Series cylinder valve has five key features:

1. **Valve Actuation Connection:** A threaded connection located on top of the cylinder valve serves as the attachment point for the electric (primary) or pneumatic (secondary) valve actuator.
2. **Pressure Gauge Connection:** A female connection serves as the attachment point for the pressure gauge. It is fitted with a Schrader valve to allow the removal of the gauge while the cylinder is pressurized.
3. **Low-Pressure Supervisory Switch Connection:** A female connection serves as the attachment point for the low-pressure supervisory switch. A Schrader valve allows for the removal of the pressure switch while the cylinder is pressurized.
4. **Discharge Outlet:** A 3 in (80 mm) grooved connection serves as the attachment point for discharge piping.
5. **Pilot Actuation Port:** A 1/4 in (8 mm) NPT connection (shipped with a pipe plug) serves as the attachment point for the pilot actuation piping in multiple cylinder systems, providing the actuation pressure used to open the secondary cylinder valve(s). This can also be used for attachment of the discharge pressure switch in single cylinder arrangements. The pipe plug shall remain in place at all times when the port is not connected to pilot actuation piping or a discharge pressure switch.

⚠WARNING

If the pipe plug is not installed in the pilot actuation port of a cylinder when that port IS NOT connected to pilot actuation piping or a discharge pressure switch, agent will discharge from the pilot actuation port during a system discharge, which may result in potential injury and/or property damage, and cause one or more nozzles to not discharge the designed quantity of FK-5-1-12.

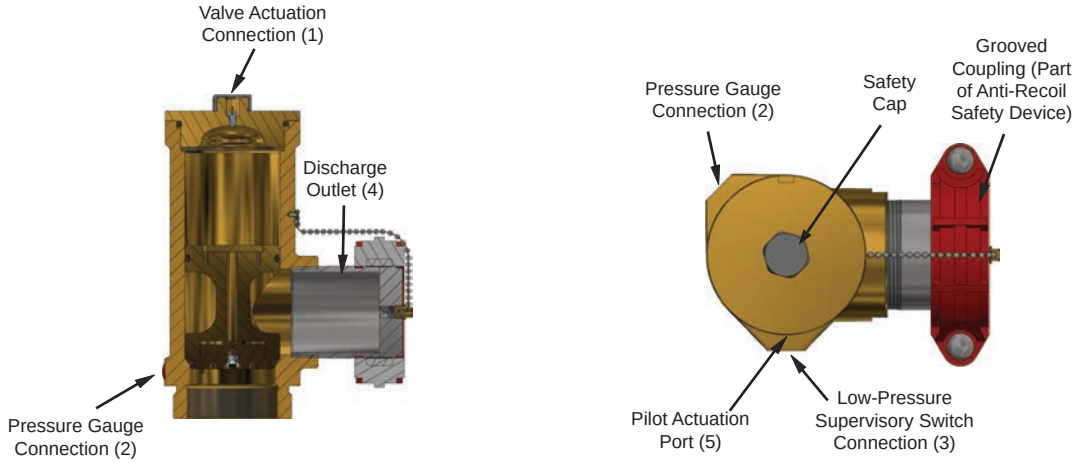


Figure 2.1.3.3a Lv Cylinder Valve Assembly

Section 2 System Description and Components

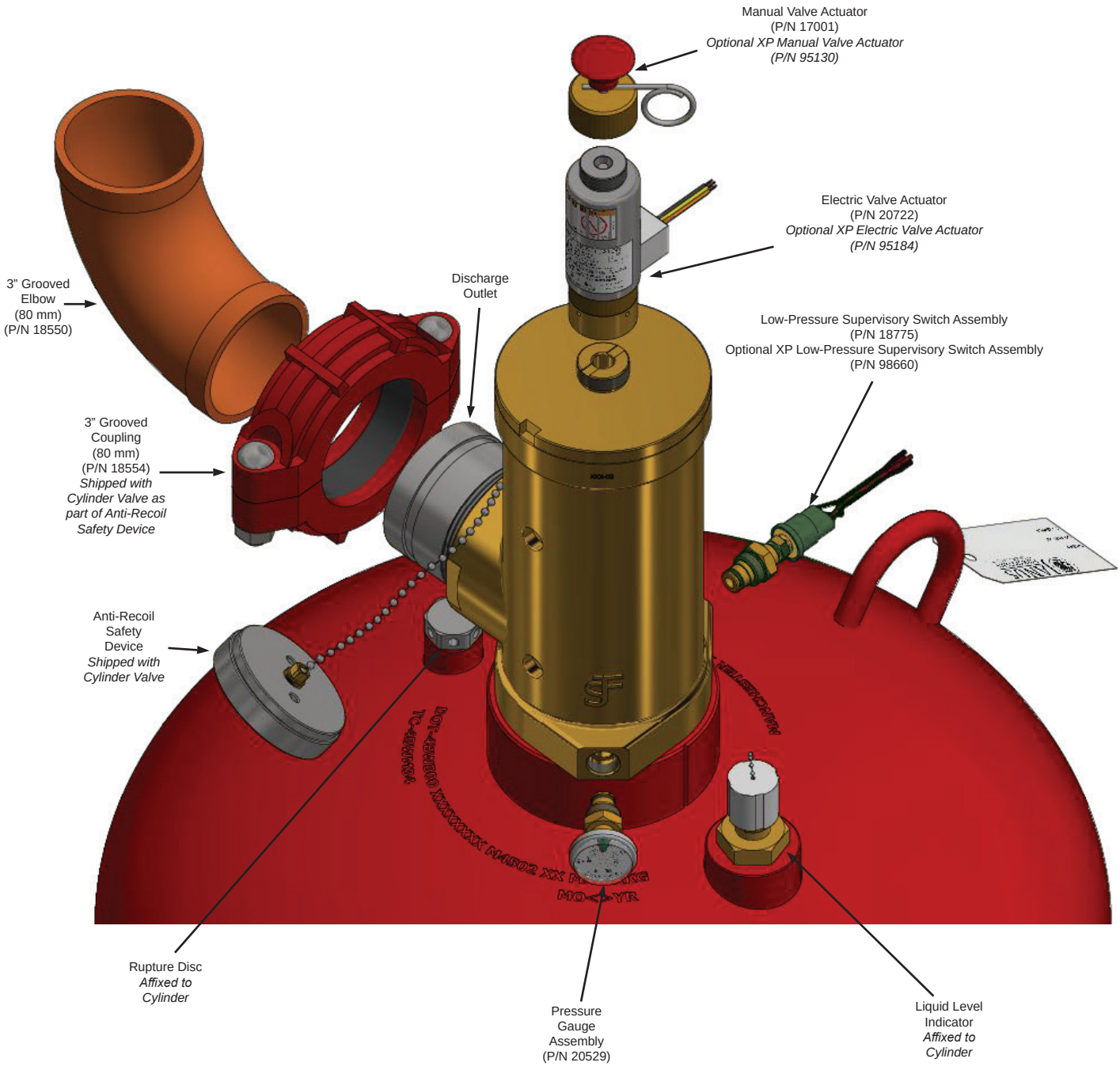


Figure 2.1.3.3b Lv Cylinder Valve w/ Trim Kit

2.2 Trim Components

The following components complete the set up of any Sv, Mv, and Lv Series System regardless of the specific arrangement or number of cylinders utilized.

2.2.1 Pressure Gauge

A pressure gauge for each cylinder provides a reliable means of monitoring the internal pressure condition of the cylinder as mandated by NFPA 2001. The Sv Series pressure gauge differs from the Mv and Lv Series pressure gauge in the method it is affixed to the cylinder valve.

2.2.1.1 Sv Series Pressure Gauge

P/N 19128 (See Figure 2.2.1.1)

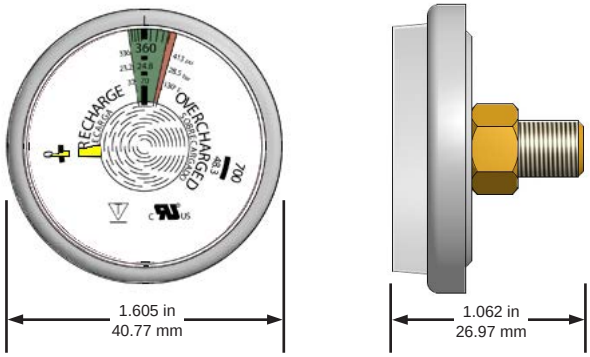


Figure 2.2.1.1 Sv Series Pressure Gauge

The Sv Series pressure gauge is factory mounted to the cylinder valve opposite the rupture disc.

⚠ WARNING

The Sv Series pressure gauge is permanently mounted directly to the cylinder valve and shall not be removed. Removal may damage the pressure gauge or cylinder valve, and removal while the contents are under pressure will cause agent to escape through the pressure gauge connection and discharge the cylinder valve resulting in potential injury and/or property damage, and complete loss of agent.

2.2.1.2 Mv and Lv Series Pressure Gauge Assembly

P/N 20529 (See Figure 2.1.3.3)

The Mv and Lv Series pressure gauge has a swivel nut and O-ring seal allowing it to connect to the Mv and Lv Series cylinder valves at the pressure gauge connection. The pressure gauge ports of the Mv and Lv Series cylinder valves contain a Schrader valve that seals when the gauge is absent. Refer to Section 4.1.4.1 regarding installation and removal of the pressure gauge assembly.

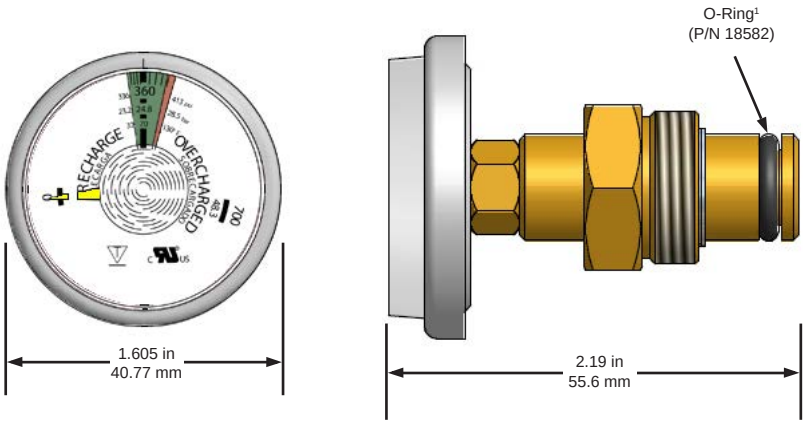


Figure 2.2.1.2 Mv and Lv Series Pressure Gauge Assembly

⚠ CAUTION

The Mv and Lv Series pressure gauge assembly shall not be removed from the cylinder valve while the contents are under pressure. Removal while the contents are under pressure may damage the O-ring seal or gauge, requiring the replacement of the pressure gauge assembly.
However, the Mv and Lv Series cylinder assemblies **shall not** be transported with the pressure gauge assembly installed. Remove the pressure gauge assembly from the cylinder valve **before** transporting the Mv Series or Lv Series cylinder assembly even if the contents are still under pressure. Refer to Section 4.1.4.1 regarding installation and removal of the pressure gauge assembly.

1. O-Rings must be ordered in packs of 25 as P/N 98791

2.2.2 Low-Pressure Supervisory Switch

The low-pressure supervisory switch continuously monitors the pressure within the cylinder. Should the cylinder pressure drop to approximately 280 psi (19.3 bar), the switch contacts will close transmitting an abnormal signal to the system control panel. The contact configuration is single pole, single throw (SPST) with contacts rated 1.5 Amps at 24 VDC. The Sv Series low-pressure supervisory switch differs from the Mv and Lv Series low-pressure supervisory switch in the method it is affixed to the cylinder valve.

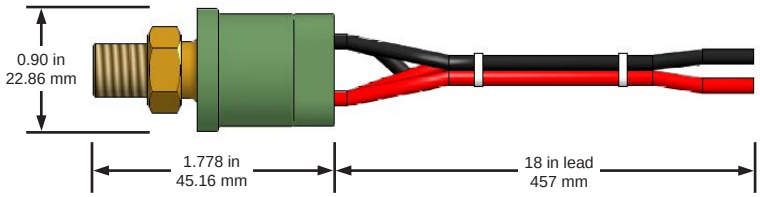


Figure 2.2.2.1 Sv Series Low-Pressure Supervisory Switch

2.2.2.1 Sv Series Low-Pressure Supervisory Switch

P/N 17032 (See Figure 2.2.2.1)

The Sv Series low-pressure supervisory switch is factory mounted to the cylinder valve between the rupture disc and pilot actuation port. The Sv Series switch has 18 inch (457 mm) leads.

⚠ WARNING

The Sv Series low-pressure supervisory switch is mounted directly to the cylinder valve and shall not be removed. Removal may damage the supervisory switch or cylinder valve, and removal while the contents are under pressure will cause agent to escape through the low-pressure switch connection and discharge the cylinder valve resulting in potential injury and/or property damage, and complete loss of agent.

2.2.2.2 Mv and Lv Series Low-Pressure Supervisory Switch Assembly

P/N 18775 (See Figure 2.2.2.2)

The Mv and Lv Series low-pressure supervisory switch is fitted with a swivel nut and O-ring seal to allow it to attach to the Mv and Lv Series cylinder valves at the low-pressure supervisory switch connection. The low-pressure supervisory switch ports of the Mv and Lv Series cylinder valves contain a Schrader valve that seals when the switch is absent. The Mv and Lv Series switch has 36 inch (914 mm) leads. Refer to Section 4.1.4.2 regarding installation and removal of the low-pressure supervisory switch assembly.

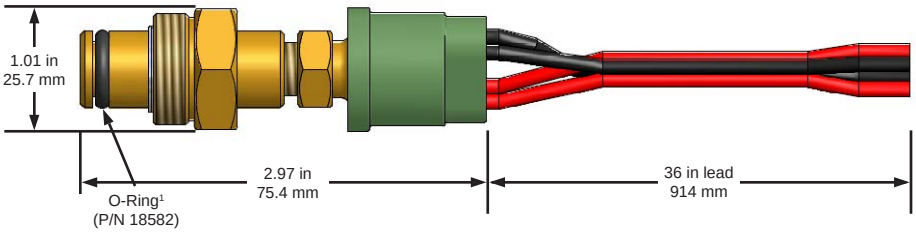


Figure 2.2.2.2 Mv and Lv Series Low-Pressure Supervisory Switch Assembly

⚠ CAUTION

The Mv and Lv Series low-pressure supervisory switch assembly shall not be removed from the cylinder valve while the contents are under pressure. Removal while the contents are under pressure may damage the O-ring seal or switch, requiring the replacement of the low-pressure supervisory switch assembly.
However, the Mv and Lv Series cylinder assemblies **shall not** be transported with the low-pressure supervisory switch assembly installed. Remove the low-pressure supervisory switch assembly from the cylinder valve **before** transporting the Mv Series or Lv Series cylinder assembly even if the contents are still under pressure. Refer to Section 4.1.4.2 regarding installation and removal of the pressure switch assembly.

1. O-Rings must be ordered in packs of 25 as P/N 98791

Section 2 System Description and Components

2.2.2.3 Low-Pressure Supervisory Switch Conduit Adapter

P/N 99408 (See Figure 2.2.2.3a and 2.2.2.3b)

An optional conduit adapter is available for the low-pressure supervisory switch to facilitate the attachment of rigid or flexible conduit over the switch leads. When implemented, the adapter shall be field installed to the body of the low-pressure supervisory switch and the fastening screw secured until the conduit adapter fits snuggly around the low-pressure supervisory switch body as illustrated in Figure 2.2.2.3b.

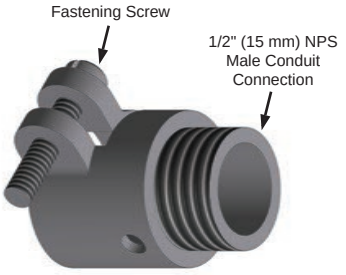


Figure 2.2.2.3a Low-Pressure Supervisory Switch Conduit Adapter

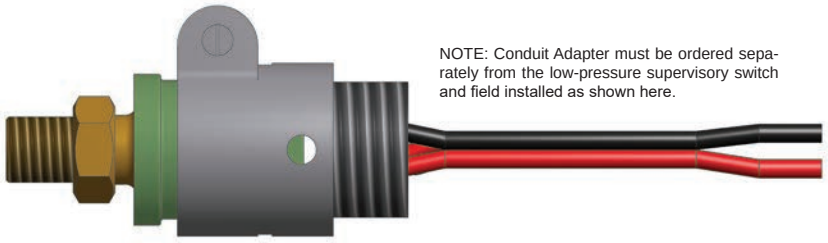


Figure 2.2.2.3b Low-Pressure Supervisory Switch w/ Conduit Adapter (Sv Series Shown)

⚠ CAUTION

The conduit adapter fastening screw shall NOT be overtightened. Overtightening the fastening screw may cause the body of the low-pressure supervisory switch to crack.

2.2.3 Explosion-Proof Low-Pressure Supervisory Switch

An optional explosion-proof low-pressure supervisory switch is also available. The switch has an enclosure rating of NEMA 4x, 7, 9 and IP67 and explosion-proof classifications Class I, Div I, Group A,B,C,D, Class II, Div I, Group E,F,G, and Class III. The contact configuration is single pole, single throw (SPST) with contacts rated 1.5 Amps at 24 VDC. Should the cylinder pressure drop to approximately 315 psi (21.7 bar), the switch contacts will close transmitting an abnormal signal to the system control panel. The XP low-pressure supervisory switch has 72 inch (1829 mm) leads.

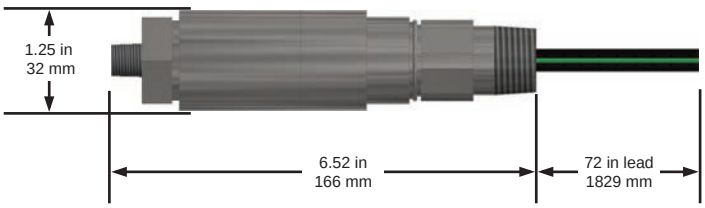


Figure 2.2.3.1 XP Low-Pressure Supervisory Switch

2.2.3.1 Sv Series XP Low-Pressure Supervisory Switch

P/N 98661 (See Figure 2.2.3.1)

The Sv Series XP low-pressure supervisory switch is factory mounted to the Sv Series XP cylinder valve between the rupture disc and pilot actuation port. (See Table 2.1.1 for XP ordering instructions.)

⚠ WARNING

The Sv Series XP low-pressure supervisory switch is mounted directly to the cylinder valve and shall not be removed. Removal may damage the supervisory switch or cylinder valve, and removal while the contents are under pressure will cause agent to escape through the low-pressure switch connection and discharge the cylinder valve resulting in potential injury and/or property damage, and complete loss of agent.

2.2.3.2 Mv and Lv Series XP Low-Pressure Supervisory Switch Assembly

P/N 98660 (See Figure 2.2.3.2)

1. O-Rings must be ordered in packs of 25 as P/N 98791

The Mv and Lv Series XP low-pressure supervisory switch is fitted with a swivel nut and O-ring seal to allow it to attach to the Mv and Lv Series cylinder valves at the low-pressure supervisory switch connection. The low-pressure supervisory switch ports of the Mv and Lv Series cylinder valves contain a Schrader valve that seals when the switch is absent. Refer to Section 4.1.4.2 regarding installation and removal of low-pressure supervisory switch assemblies.

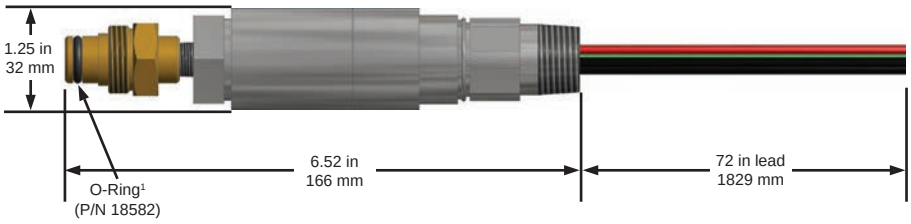


Figure 2.2.3.2 XP Low-Pressure Supervisory Switch Assembly

⚠ CAUTION

The Mv and Lv Series XP low-pressure supervisory switch assembly shall not be removed from the cylinder valve while the contents are under pressure. Removal while the contents are under pressure may damage the O-ring seal or switch, requiring the replacement of the XP low-pressure supervisory switch assembly.
However, the Mv and Lv Series cylinder assemblies **shall not** be transported with the low-pressure supervisory switch assembly installed. Remove the low-pressure supervisory switch assembly from the cylinder valve **before** transporting the Mv Series or Lv Series cylinder assembly even if the contents are still under pressure. Refer to Section 4.1.4.2 regarding installation and removal of the pressure switch assembly.

2.2.4 Electric Valve Actuator

NOTE: Part number 18481 is no longer available for purchase. See section 2.2.4.1 for replacement. For legacy technical information on part number 18481, refer to Appendix F.

2.2.4.1 Electric Valve Actuator w/ Limit Switch

P/N 20722 (See Figure 2.2.4.1a)

The electric valve actuator attaches to the primary cylinder at the valve actuation connection and is utilized to automatically open the cylinder valve upon receipt of a signal from the control panel or other source.

The electric valve actuator has a factory installed limit switch. It operates between 20.4 and 26.4 VDC and consumes 500 mA (.5 Amps) at 24 VDC nominal with a maximum supervisory current of 30 mA (0.03 Amps). The limit switch contacts are normally closed when the actuator is not installed onto the cylinder valve. When the actuator is fully installed onto the valve actuation connection at the top of the cylinder valve, the limit switch contacts open.

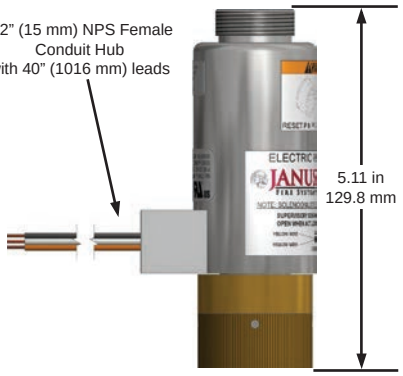


Figure 2.2.4.1a Electrical Valve Actuator w/ Limit Switch

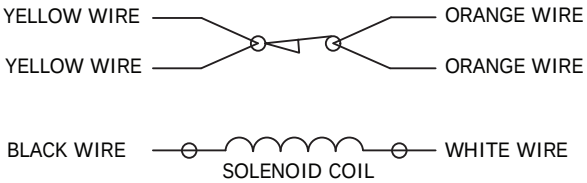


Figure 2.2.4.1b Electrical Valve Actuator w/ Limit Switch Wiring Diagram

The electric valve actuator body is steel construction with a brass knurled swivel nut and a stainless steel actuation pin that depresses the valve core when energized. Following system actuation, the actuation pin of the electrical valve actuator must be manually reset by pushing the pin up until it snaps in the "up" position. (An optional manual reset tool P/N 95113 is available.) The electric valve actuator is shipped with a plastic threaded cap on its top port that should only be removed when installing the manual valve actuator. The electric valve actuator has a life span of 25 years from date of manufacture.

⚠WARNING

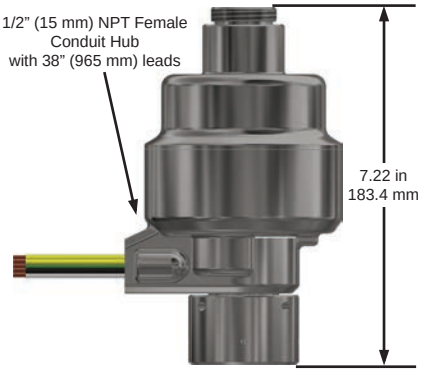
Attaching the electric valve actuator to the cylinder valve when the actuation pin is not fully locked into the "up" position may cause the cylinder valve to actuate, resulting in potential injury and/or property damage, and complete loss of agent.

NOTE: NFPA 2001 requires that the removal of an electric actuator from the agent storage container discharge valve that it controls shall result in an audible and visual indication of system impairment at the system releasing control panel. This is in effect January 1, 2016.

NOTE: Electric Valve Actuators with a 1/2 in (15 mm) Conduit Hub (P/N 20722) must be installed with flexible metal or liquid tight conduit in compliance with all local, state, national and/or international building codes. Refer to DOC323 Electric Actuator Installation Sheet for a list of UL Listed connectors that meet the requirements of Underwriters Laboratories and are suitable for use with these actuators.

2.2.4.2 XP Electric Valve Actuator w/ Limit Switch

P/N 95184 (See Figure 2.2.4.2a)



The XP electric valve actuator attaches to the primary cylinder at the valve actuation connection and is utilized to automatically open the cylinder valve upon receipt of a signal from the control panel or other source. Following system actuation, the actuation pin of the electrical valve actuator must be manually reset by pushing the pin up (using the reset tool P/N 95113) until it snaps in the "up" position. The XP electric valve actuator has a life span of 25 years from date of manufacture.

The XP model electric valve actuator is FM Approved for general indoor applications, but has not been tested by FM for hazardous locations.

Explosion-Proof Ratings:

UL File E492320
+ Class I, Division 1, Groups A, B, C & D, T5
+ Class I, Zone 1, AEx db IIC T5 Gb
+ Ex db IIC T5 Gb
+ Type 4X Enclosure
+ IP66

UL 21 ATEX 2557X
+ 0539 II 2 G Ex db IIC T5 Gb

IECEx UL 21.0050X
+ Ex db IIC T5 Gb

⚠WARNING

Attaching the XP electric valve actuator to the cylinder valve when the actuation pin is not fully locked into the "up" position may cause the cylinder valve to actuate, resulting in potential injury and/or property damage, and complete loss of agent.

2.2.5 Manual Valve Actuator

P/N 17001 (See Figure 2.2.5)

An optional manual valve actuator may be attached to the top of the electric valve actuator to provide a means to manually open the cylinder valve. (Note: The manual valve actuator cannot be attached directly to the cylinder valve, nor is it intended for use with the XP Electric Valve Actuator.)

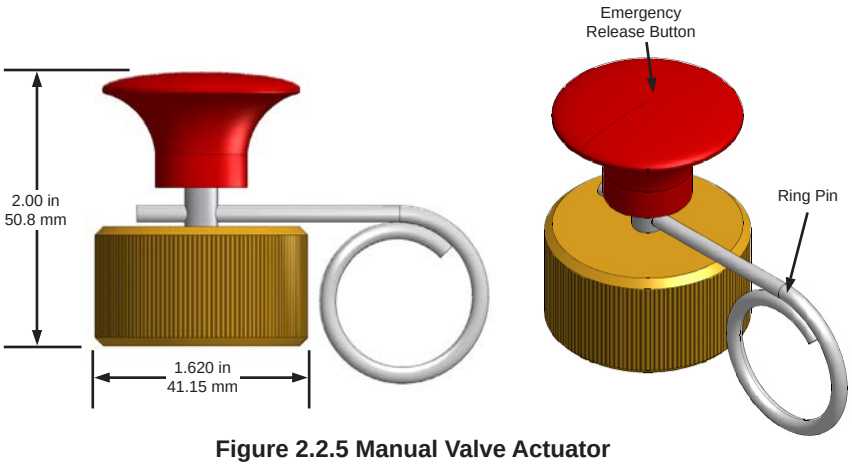


Figure 2.2.5 Manual Valve Actuator

The manual valve actuator consists of a brass body, stainless steel actuation pin, and steel safety ring pin. To discharge the primary cylinder manually, the ring pin is removed and the emergency release button is depressed forcing the actuation pin in the electric valve actuator to depress the valve core of the cylinder valve. All other connected cylinders will then open pneumatically. The manual valve actuator is reset by pulling up on the palm button and inserting the ring pin.

⚠WARNING

Attaching the manual valve actuator to the electric valve actuator when the actuation pin is not fully locked into the "up" position may cause the cylinder valve to actuate, resulting in potential injury and/or property damage, and complete loss of agent.

2.2.5.1 XP Manual Valve Actuator

P/N 95130 (See Figure 2.2.4.2a)

An explosion-proof manual valve actuator is available for use with the explosion-proof electric actuator. The manual valve actuator consists of a stainless steel body, stainless steel actuation pin, and steel safety ring pin. The manual valve actuator is reset by pulling up on the palm button and inserting the ring pin. (NOTE: The XP Manual Valve Actuator is not designed for use with the standard Electric Valve Actuator.)

The XP model manual valve actuator has not been evaluated by Factory Mutual.

Figure 2.2.5.1 XP Manual Valve Actuator

⚠WARNING

Attaching the XP manual valve actuator to the XP electric valve actuator when the actuation pin is not fully locked into the "up" position may cause the cylinder valve to actuate, resulting in potential injury and/or property damage, and complete loss of agent.

2.2.6 Discharge Connection Fittings

Fittings are used to connect the discharge outlet to its associated piping system in order to accommodate differences in size, outlet connection, and/or orientation between the discharge outlet and discharge piping. The fittings used vary according the Series valve.

2.2.6.1 Sv Series Fittings
(supplied by installer)

The fittings for the Sv Series discharge outlet are to be supplied by the installer. The suggested fitting arrangement is shown in Figure 2.2.6.1 and is used to extend the discharge outlet and facilitate the attachment of discharge piping. Elbow outlets may be oriented in any direction.

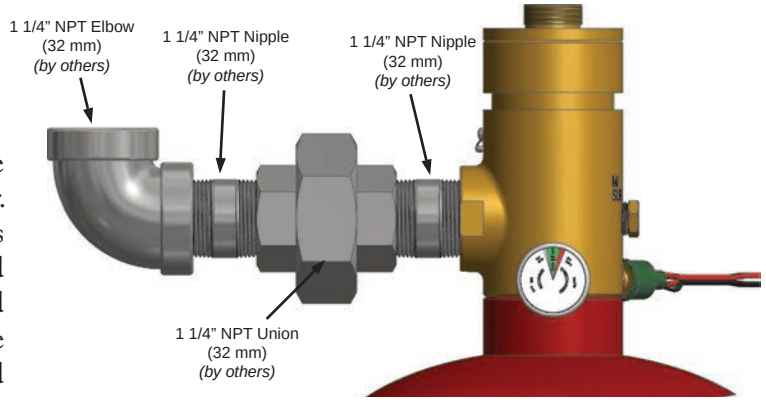


Figure 2.2.5.1 Sv Series Fittings

2.2.6.2 Mv Series Fittings
(See Figure 2.2.6.2 for P/N)

The fittings for the Mv Series discharge outlet consist of two 2 in (50 mm) grooved couplings, one 2 in (50 mm) grooved elbow, and one 2 in (50 mm) grooved to NPT adapter arranged as shown in Figure 2.2.6.2. These fittings extend the discharge outlet and allow for connection of 2 in (50 mm) NPT piping to the 2 in (50 mm) grooved outlet. Elbow outlets may be oriented in any direction.

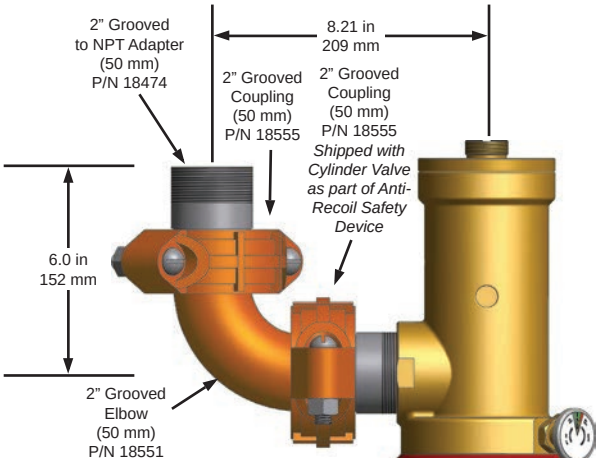


Figure 2.2.5.2 Mv Series Fittings

2.2.6.3 Lv Series Fittings
(See Figure 2.2.6.3 for P/N)

The fittings for the Lv Series discharge outlet consist of one 3 in (80 mm) grooved coupling and one 3 in (80 mm) grooved elbow arranged as shown in Figure 2.2.6.3. These fittings extend the discharge outlet and facilitate the attachment of discharge piping. Elbow outlets may be oriented in any direction.

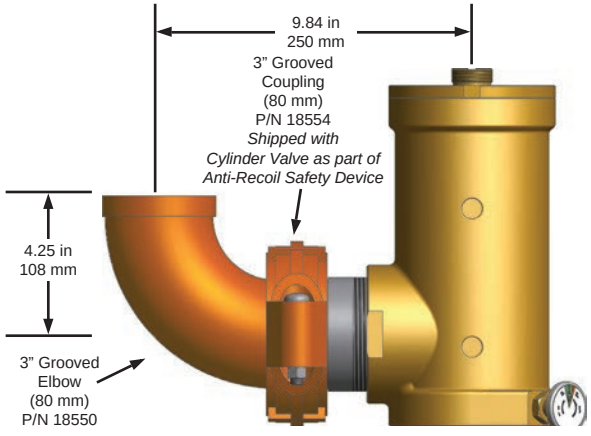


Figure 2.2.5.3 Lv Series Fittings

⚠ CAUTION

The anti-recoil safety device must remain in place in the clean agent cylinder valve outlet at all times when the cylinder assembly is not secured in the cylinder bracket and connected to the discharge piping. Discharge connection fittings should **NOT** be mounted onto the cylinder valve during transportation and storage.

2.3 Multi-Cylinder Arrangement Components

The following components complete the set up of multiple cylinder arrangements.

2.3.1 Pneumatic Valve Actuator

P/N 17019 (See Figure 2.3.1)

In multiple cylinder systems, a pneumatic valve actuator is attached to each secondary cylinder at the valve actuation connection. It receives pressure from the pilot actuation port of the primary cylinder through the pilot actuation line. When the electric valve actuator opens the primary cylinder, pressure from the primary cylinder causes each pneumatic valve actuator to open its attached cylinder pneumatically.

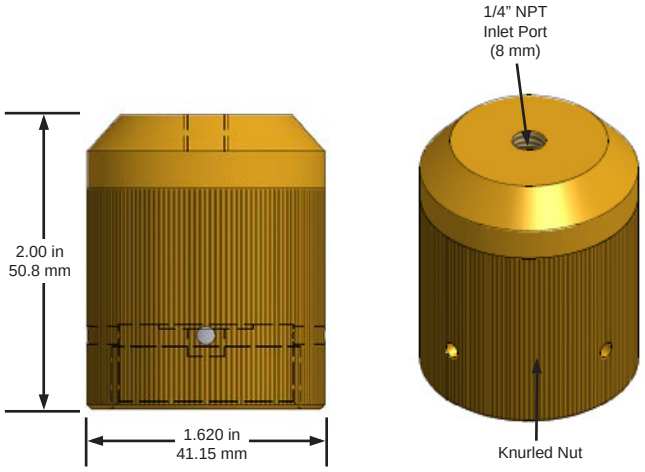


Figure 2.3.1 Pneumatic Valve Actuator

The pneumatic valve actuator is brass with a brass piston and pin. To reset the pneumatic valve actuator, pressure must first be bled down from the pilot actuation line, and then the actuation pin must be pushed up until the pin snaps into the "up" position. (An optional manual reset tool P/N 95113 is available.)

⚠ WARNING

Attaching the pneumatic valve actuator to the cylinder valve when the actuation pin is not fully locked into the "up" position may cause the cylinder valve to actuate, resulting in potential injury and/or property damage, and complete loss of agent.

2.3.2 Vent Check

P/N 10173 (See Figure 2.3.2)

The vent check is a safety device with 1/4 in (8 mm) male NPT threads that is to be installed in the pilot actuation line downstream of the pilot actuation check valve. It is used to bleed off pressure that may accumulate in the secondary cylinder actuation piping, reducing the chance of inadvertent operation of pneumatic valve actuators. A rapid accumulation of actuation pressure will cause the nylon ball located inside the vent check to seat and seal allowing the pneumatic valve actuators to operate as intended. After actuation, pressure must be bled down from the pilot actuation line in order to unseat this nylon ball. This can be done by loosening a fitting along the pilot actuation line.

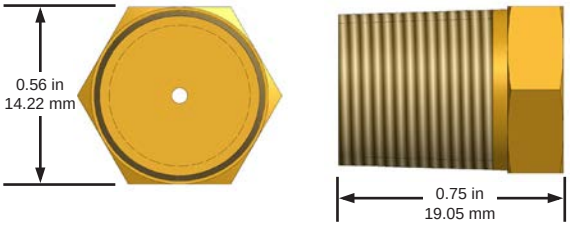


Figure 2.3.2 Vent Check

2.3.3 Pilot Actuation Check Valve

P/N 18560 (See Figure 2.3.3)

A 1/4 in (8 mm) MNPT by 37° male JIC check valve is installed in the pilot actuation port of the primary cylinder valve with direction of flow OUT of the valve. When the valve opens, pressure will be directed through the pilot actuation check valve to the pneumatic valve actuators on the secondary cylinders. The purpose of the pilot actuation check valve is to ensure the pneumatic actuator(s) remain pressurized for the entire discharge period.

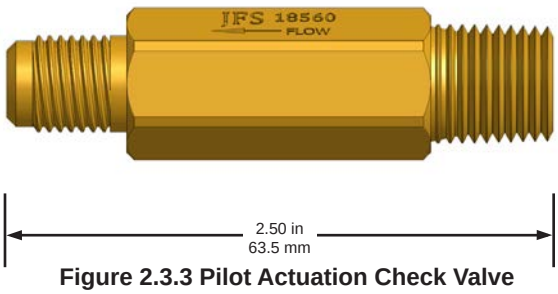


Figure 2.3.3 Pilot Actuation Check Valve

2.3.4 NPT Style Pilot Actuation Check Valve

P/N 10262 (See Figure 2.3.4)

The NPT Style Pilot Actuation Check Valve is recommended for pilot actuation line configurations utilizing copper or SST tubing or two-side pilot actuation lines (refer to Sections 4.1.6.2 and 4.1.6.4) in place of the standard Pilot Actuation Check Valve. It is a 1/4 in (8 mm) FNPT by MNPT check valve. An adapter hex nipple (Sv Series P/N 18713; Mv and Lv Series P/N 19192) is required to facilitate the installation of the NPT Style Pilot Actuation Check Valve into the pilot actuation port of the primary cylinder valve with direction of flow OUT of the valve.

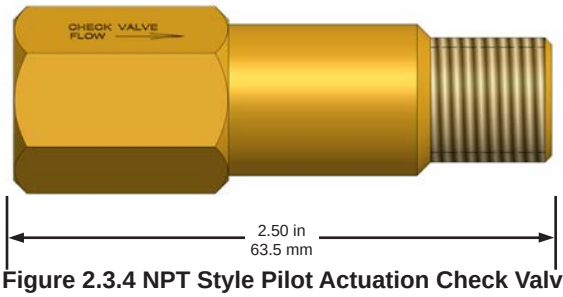


Figure 2.3.4 NPT Style Pilot Actuation Check Valve

2.3.5 Pilot Actuation Adapter

P/N 18624 (See Figure 2.3.5)

A 3/8 in (10 mm) MNPT by 1/4 in (8 mm) FNPT brass pipe bushing is fitted into the pilot actuation port of the Sv Series primary cylinder to facilitate the attachment of the pilot actuation check valve. This component is not required on the Mv or Lv Series system.

Figure 2.3.5 Pilot Actuation Adapter

2.3.6 Pilot Actuation Mid Line Tee

P/N 18622 (See Figure 2.3.6)

A 1/4 in (8 mm) 37° male JIC by MNPT brass branch tee is utilized to attach the pilot actuation line to the pneumatic valve actuator on all but the final secondary cylinder.

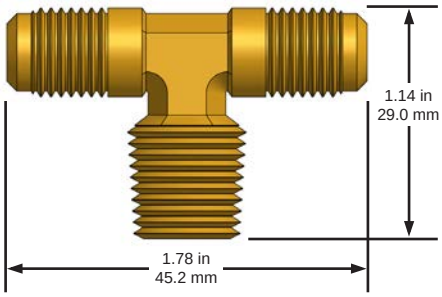


Figure 2.3.6 Pilot Actuation Mid Line Tee

2.3.7 Male NPT Adapter

P/N 18625 (See Figure 2.3.7)

A 1/4 in (8 mm) 37° male JIC by MNPT adapter fits into the pilot actuation end line tee of the final secondary cylinder to facilitate the attachment of the pilot actuation line. It also may be utilized to facilitate the attachment of flex hose to the discharge pressure switch and flex hose to the pilot actuation port.

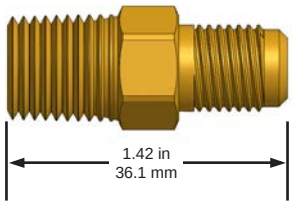


Figure 2.3.7 Male NPT Adapter

2.3.8 Pilot Actuation End Line Tee

P/N 18611 (See Figure 2.3.8)

A 1/4 in (8 mm) FNPT by MNPT brass branch tee mounts to the final pneumatic valve actuator to facilitate attachment of the vent check to the pilot actuation line.

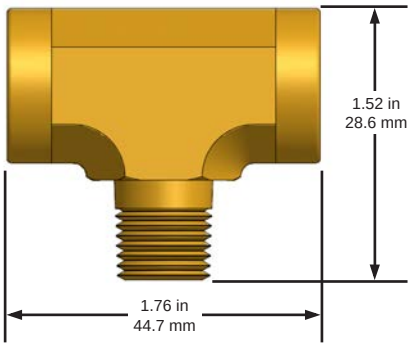


Figure 2.3.8 Pilot Actuation End Line Tee

2.3.9 Flex Hose

Refer to Table 2.3.9 for P/N (See Figure 2.3.9)

Flex hoses are 3/16 in (7 mm) Teflon® lined stainless steel wire braided hoses of varying lengths with 1/4 in (8 mm) 37° female JIC flare fittings. They are utilized to interconnect cylinders when a multi-cylinder arrangement is required. Flex hose can also be used to attach the discharge pressure switch to a manifold or pilot actuation port.

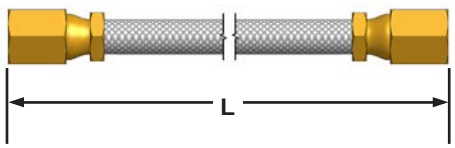


Figure 2.3.9 Flex Hose

Note: Flex hoses must be hydrostatically tested or replaced every 5 years in accordance with NFPA 2001.

Table 2.3.9 Flex Hose Lengths

P/N	Hose Length (L)	Series
18648	16 in (406 mm)	Sv – 40 lb, 80 lb, 130 lb
18649	24 in (610 mm)	Mv – 250 lb, 420 lb
18650	34 in (864 mm)	Lv – 600 lb, 900 lb
18651	40 in (1016 mm)	Lv - 1000 lb

2.4 Supplemental Components

The following components are either only required for specific types of Sv, Mv, and Lv Series System arrangements or else may be utilized in different capacities or locations depending on the specific arrangement.

2.4.1 Manifold Check Valve

P/N 18547 (Sv), 18546 (Mv), 18538 (Lv) (See Figure 2.4.1a, 2.4.1b, and 2.4.1c)

In a multiple cylinder arrangement where the secondary and primary cylinders share a common manifold or in a connected main/reserve arrangement, a manifold check valve must be placed between the discharge outlet and the discharge manifold. The manifold check valve prevents back flow from the manifold should the system be inadvertently discharged when one or more cylinders are disconnected for weighing or servicing. The check valve required depends on the Series type of the system. The Sv Series check valve has 1 1/4 in (32 mm) NPT connections, the Mv Series has 2 in (50 mm) NPT connections, and the Lv Series has 3 in (80 mm) grooved connections.

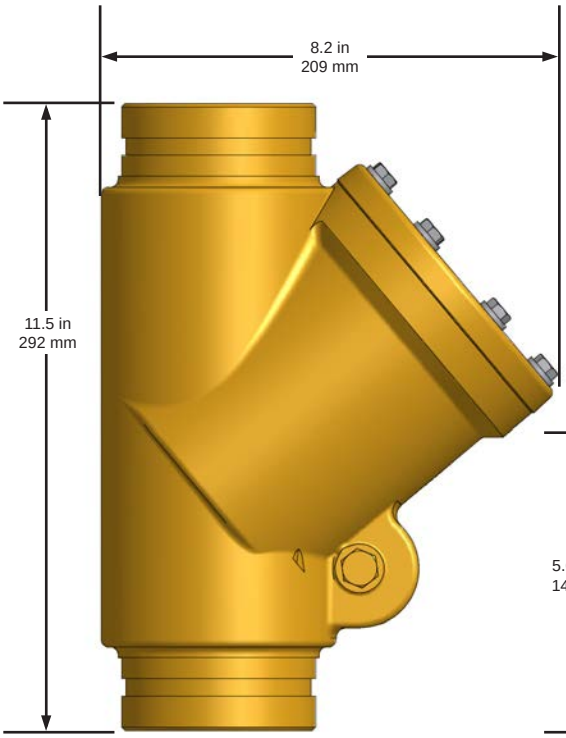


Figure 2.4.1a
Lv Manifold Check Valve

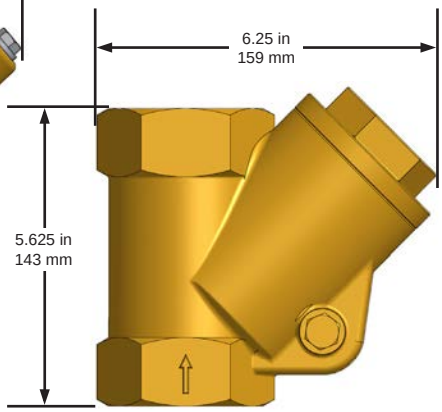


Figure 2.4.1b
Mv Manifold Check Valve

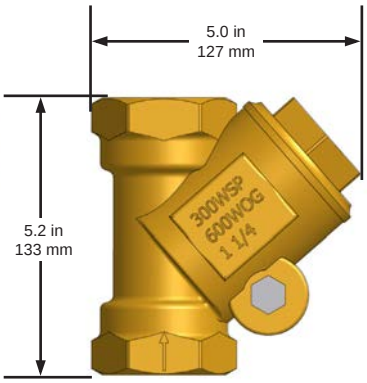


Figure 2.4.1c
Sv Manifold Check Valve

2.4.2 Discharge Pressure Switch

P/N 97428 (See Figure 2.4.2)

A discharge pressure switch is used in the system to send a signal confirming agent discharge to the control panel or to initiate the shut down of equipment that may deplete agent concentration. It is a single pole, double throw (SPDT) switch with contacts rated 15 Amps at 125/250/480 VAC and 0.5 Amps at 125 VDC. It has a NEMA 4X and IP66 enclosure. The discharge pressure switch shall be required where mechanical system actuation is possible, though its placement varies according to the individual system arrangement.

Figure 2.4.2 Weather-Proof Discharge Pressure Switch, Manual Reset

2.4.2.1 Explosion-Proof Discharge Pressure Switch, Self-Restoring

P/N 97430 (See Figure 2.4.2.1)

A self-restoring NEMA 4X, 7, 9 and IP67 Explosion-Proof Discharge Pressure Switch can be used in potentially explosive atmospheres to send indication of agent discharge to a releasing panel and/or initiate the shut down of equipment that may deplete agent concentration. It is a self-restoring double pole, double throw (DPDT) switch with contacts rated 5 Amps at 125/250 VAC and 28 VDC resistive. It is factory set at 50 psig (3.44 bar) rise.

Explosion-Proof Ratings:

Class I Div 1 Groups A, B, C, & D
Class II Div 1 Groups E, F, & G
T5 or T6
II 2GD
Ex d IIC T6/T5 Gb
Ex tb IIIC T85°C/100°C Db

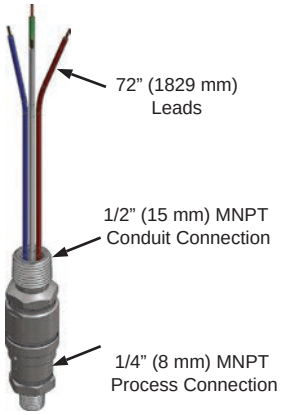


Figure 2.4.2.1 Explosion-Proof Discharge Pressure Switch, Self Restoring

2.4.3 Discharge Manifold

(supplied by installer)

A discharge manifold may be used in a multiple cylinder system to direct the flow of agent from two or more cylinders into a common pipe. Manifolds are to be supplied by the installer and may be constructed out of threaded or welded pipe and fittings. When two or more cylinders are grouped together with a common manifold, they must be of the same size and fill. A manifolded cylinder arrangement must be fitted with a manifold check valve. Suggested manifold dimensions and arrangements are shown in Figure 2.4.3a, 2.4.3b, 2.4.3c, 2.4.3d, and 2.4.3e. Actual manifold size and dimensions must comply with hydraulic flow calculations derived from the Janus Design Suite® software.

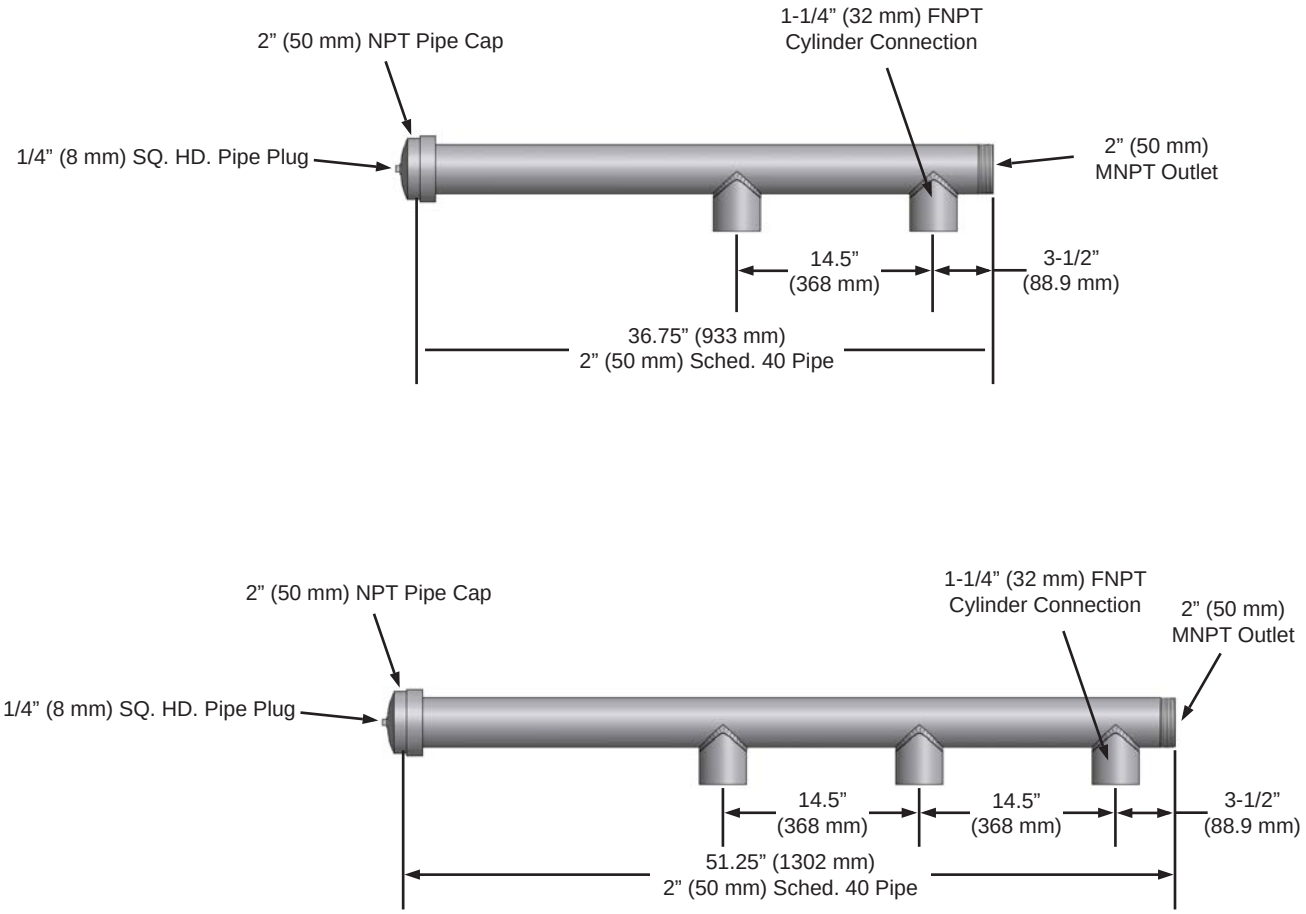


Figure 2.4.3a Suggested Manifold Configurations for 40, 80, and 130 lb Cylinders

Section 2 System Description and Components

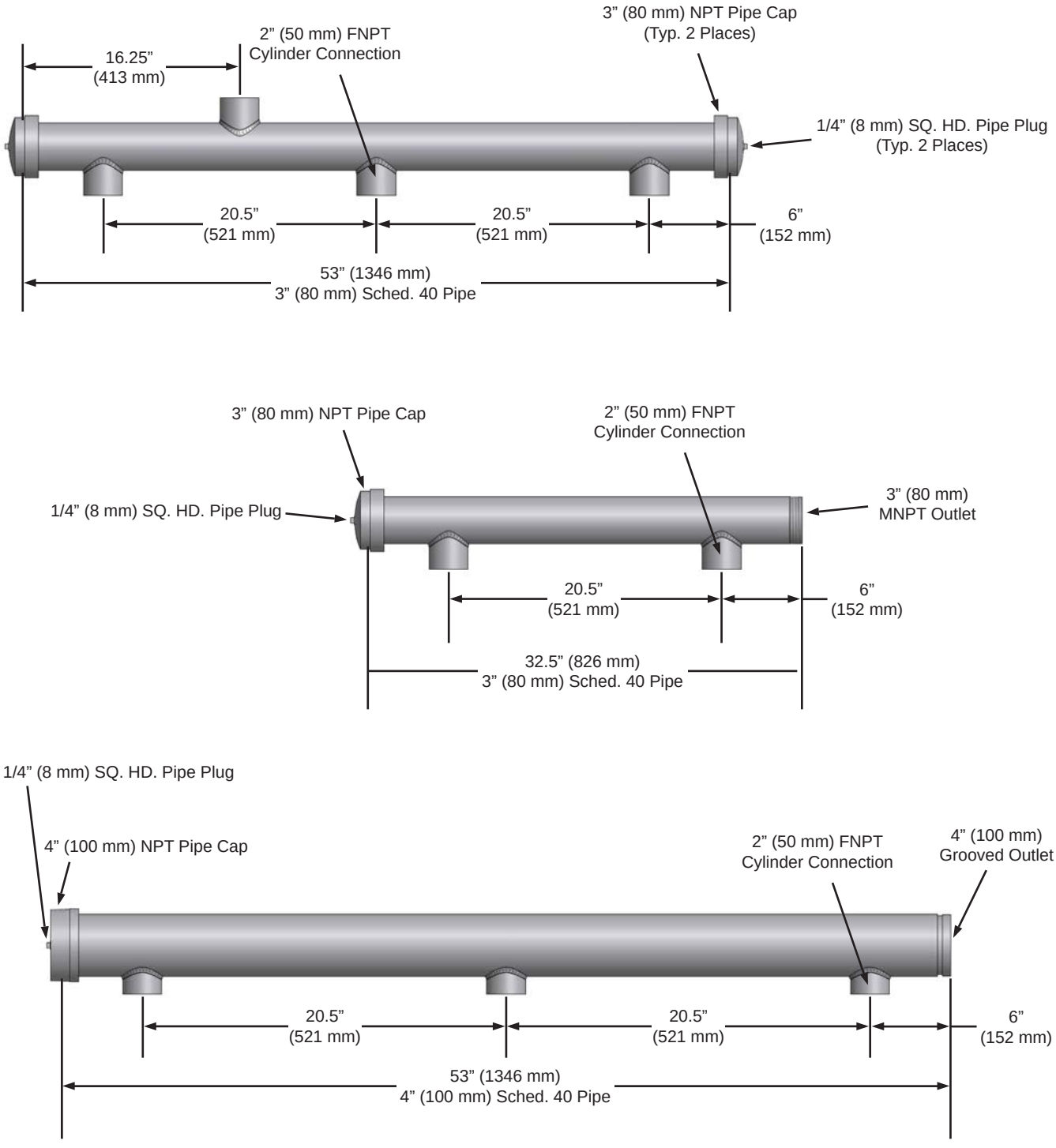


Figure 2.4.3b Suggested Manifold Configurations for 250 and 420 lb Cylinders

Section 2 System Description and Components

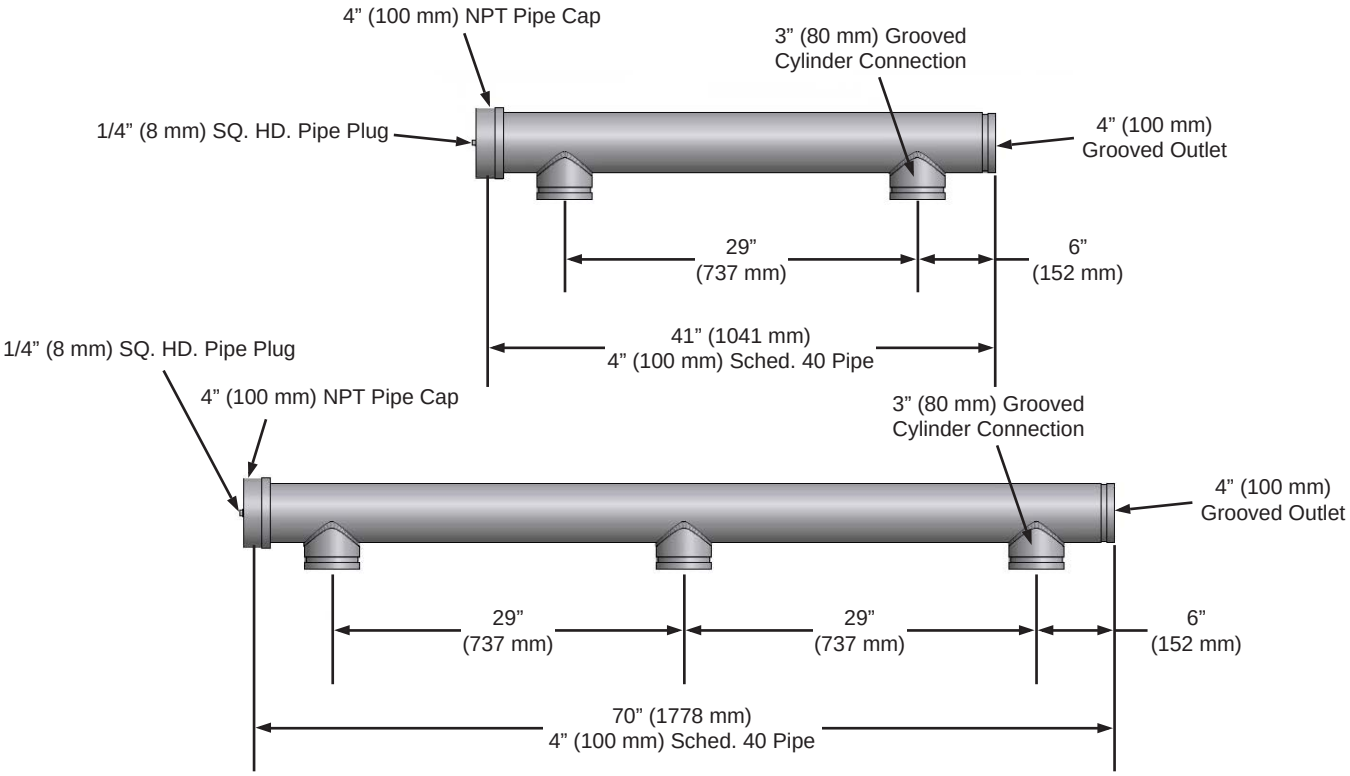


Figure 2.4.3c Suggested Manifold Configurations for 600 and 900 lb Cylinders

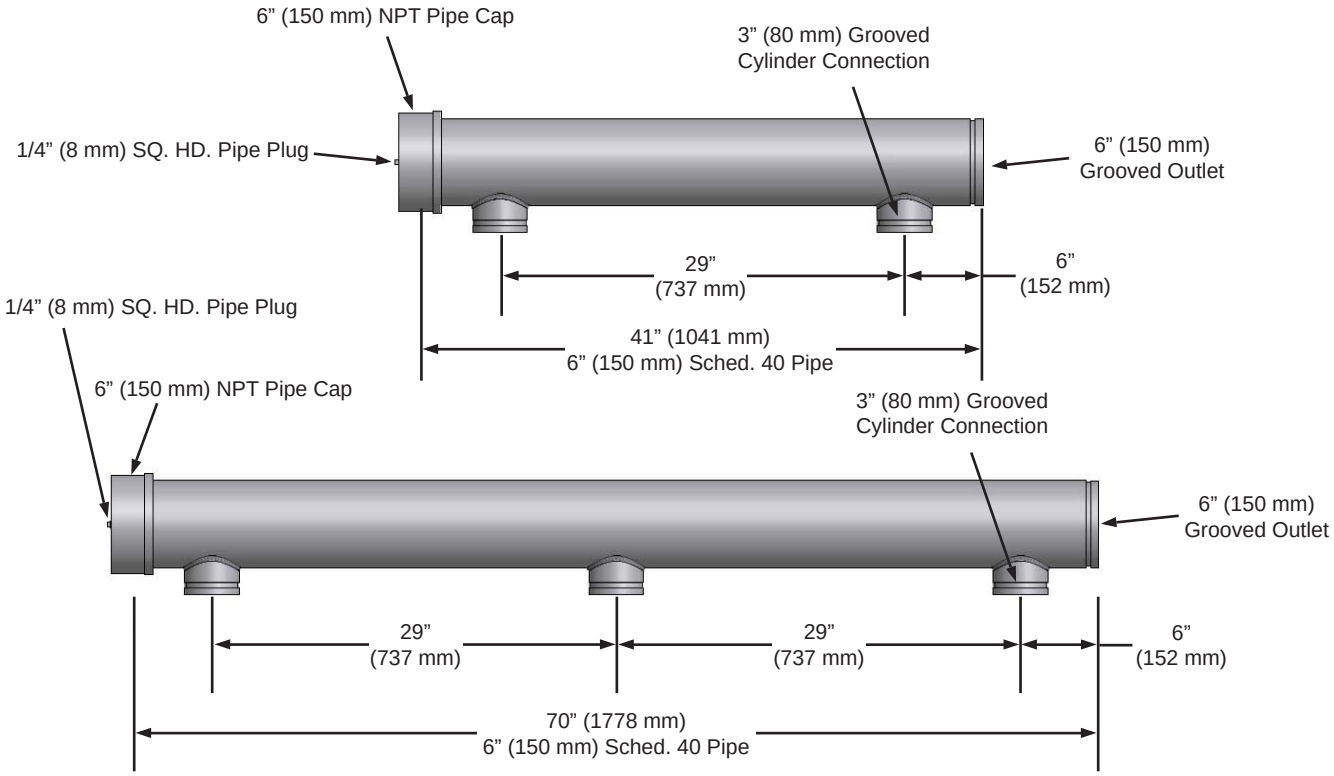


Figure 2.4.3d Suggested Manifold Configurations for 900 lb Cylinders

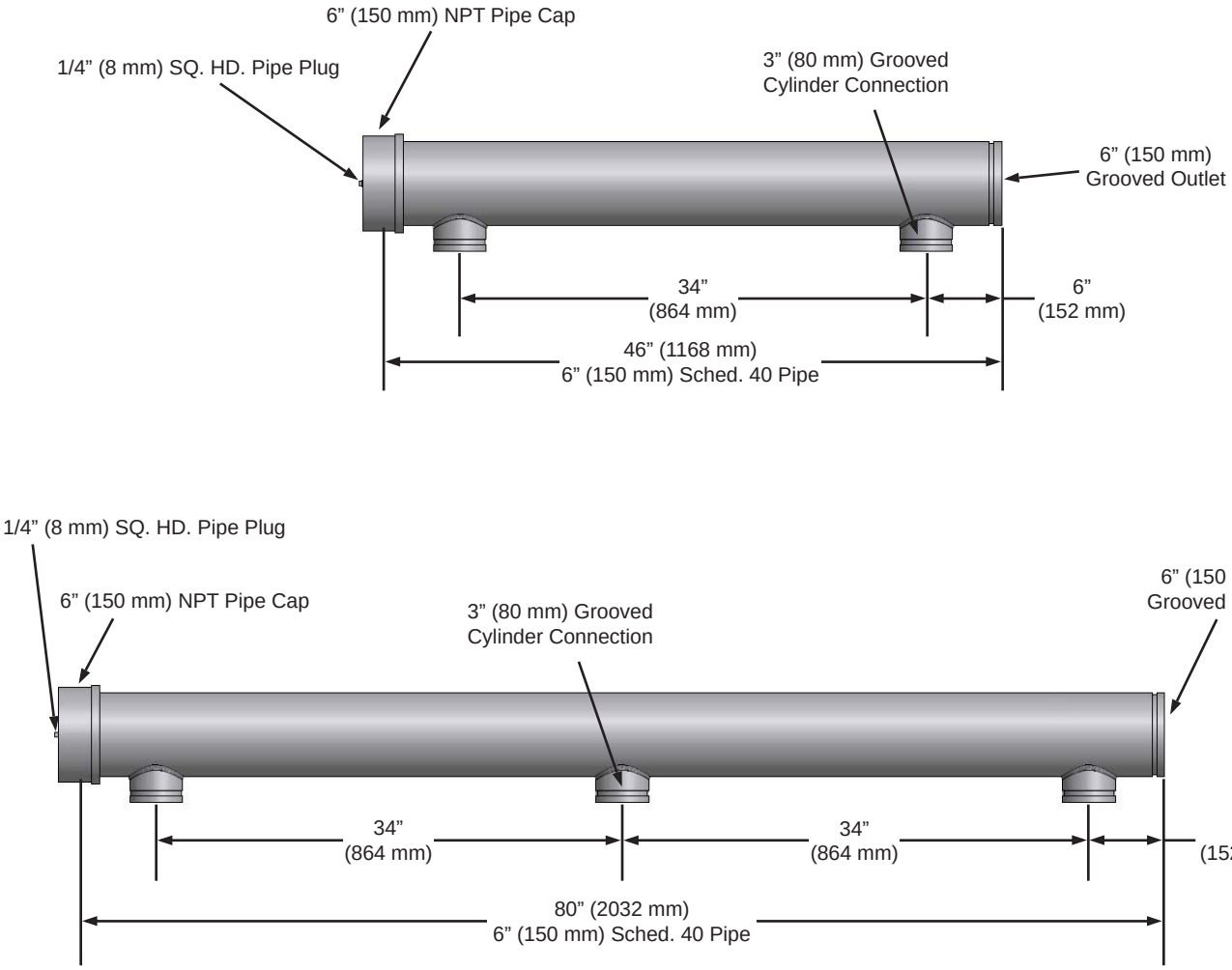


Figure 2.4.3e Suggested Manifold Configurations for 1000 lb Cylinders

2.4.4 Pressure Release Trip

P/N 20239 (See Figure 2.4.4)

The pressure release trip can be used to release dampers, close fire doors, windows, louvres, fuel supply valves, to open dump valves, etc., automatically when the system discharges. The equipment to be operated must be weight or spring loaded, or be pivoted off center. The release trip is connected to the agent discharge piping for operation when the system discharges. A cable from the equipment to be controlled is looped over the pressure release operating stem. When the trip is operated, the stem retracts and the cable is released. The maximum load that can be hung on the piston stem is 35 lbs (15.88 kg).

Figure 2.4.4 Pressure Release Trip

2.4.5 Discharge Indicator

P/N 20238 (See Figure 2.4.5)

The Janus Fire Systems® Discharge Indicator acts as a nonelectrical visual indicator of system actuation. It is actuated through discharge pressure and remains in the upright (discharged) position until manually reset.

Upon system actuation, pressure within the discharge piping enters the discharge indicator, actuating the internal plunger. This forces the external indication stem into the upright (discharged) position. The stem and plunger remain in the upright position until the discharge indicator is manually reset by depressing the indication stem into the down (standby) position.

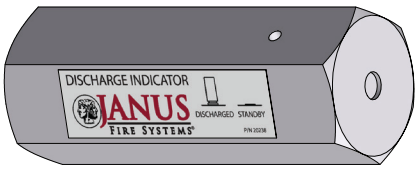


Figure 2.4.5 Discharge Indicator

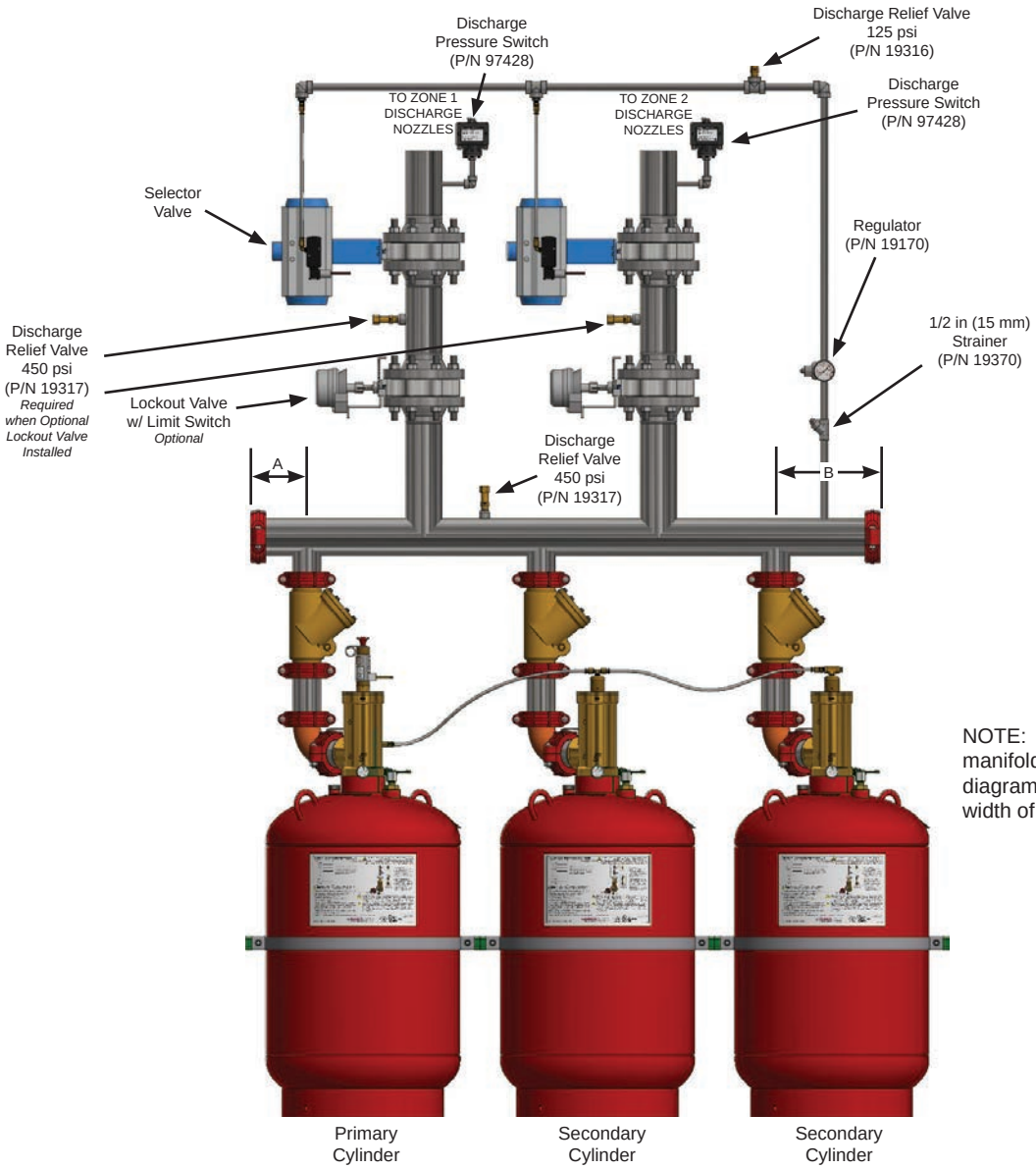
2.5 Selector Valve Components

(See Figure 2.5)

Multiple hazards can often be protected with a common set of cylinders by using selector valves. Selector valves components are required in these specific cylinder arrangements that utilize selector valves to allow the protection of multiple hazards or hazard zones by one set of clean agent cylinders.

There are typically two types of selector valve arrangements utilized for multiple hazard protection with a common set of agent cylinders.

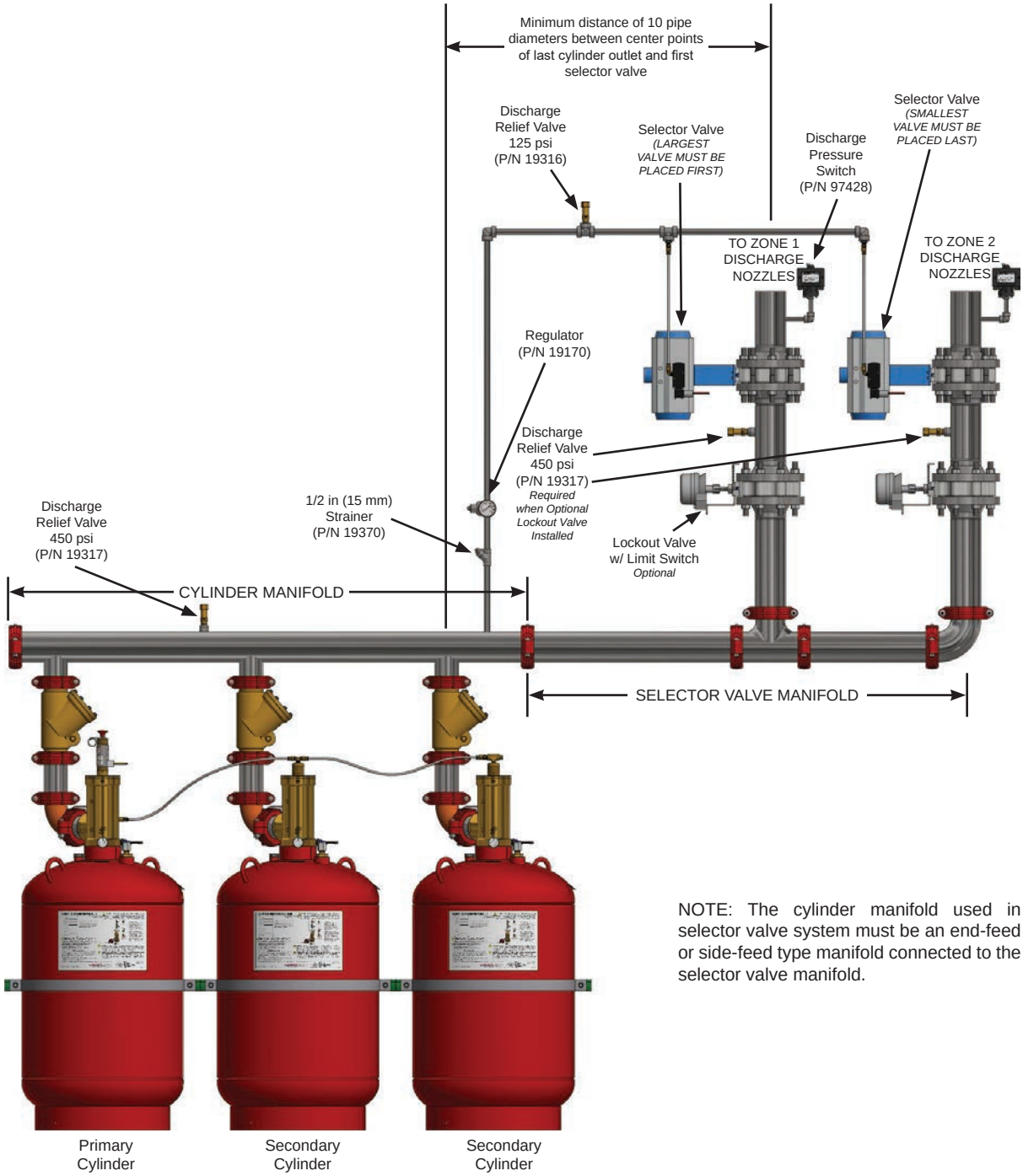
- **TYPE A** - The Type A arrangement consists of the selector valves mounted directly on the cylinder manifold. This arrangement does not require pipe modeling or performing a selector valve manifold calculation. However, the free ends of the manifold cannot exceed half width of the agent cylinder when installed using this arrangement. Refer to Figure 2.5a.



NOTE: The free ends of the manifold (marked A and B on the diagram) cannot exceed half the width of the agent cylinder.

Figure 2.5a Selector Valve Arrangement - TYPE A

- **TYPE B** - The Type B arrangement consists of a selector valve manifold located downstream of an end-feed cylinder manifold. This arrangement requires pipe modeling and for a selector valve manifold calculation to be performed. Manifold must be designed and installed in accordance with the calculations determined using the Janus Design Suite® flow calculation software and the limitations detailed in the Janus Design Suite® Flow Calculation Manual For Use with FK-5-1-12 (DOC173). Refer to Figure 2.5b.



NOTE: The cylinder manifold used in selector valve system must be an end-feed or side-feed type manifold connected to the selector valve manifold.

Figure 2.5b Selector Valve Arrangement - TYPE B

2.5.1 Selector Valves

Selector valves are operated by pressure from the discharge manifold during agent discharge. The pressure is regulated down to 100 psi (6.89 bar) and enters the selector valve pneumatic actuation port upon passing through the valve solenoid. Janus Fire Systems® clean agent selector valves are available as 1/2 in (15 mm) through 2 in (50 mm) pneumatically actuated ball valves or 3 in (80 mm) through 8 in (200 mm) pneumatically actuated wafer valves. Optional explosion-proof position indicator switch and lockout with proximity switch are available. Refer to Appendix C for part numbers and ordering information.

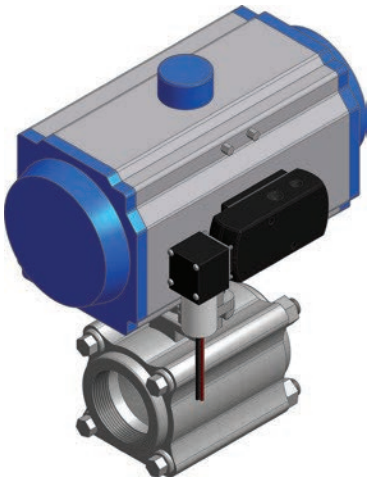


Figure 2.5.1a Selector Valve

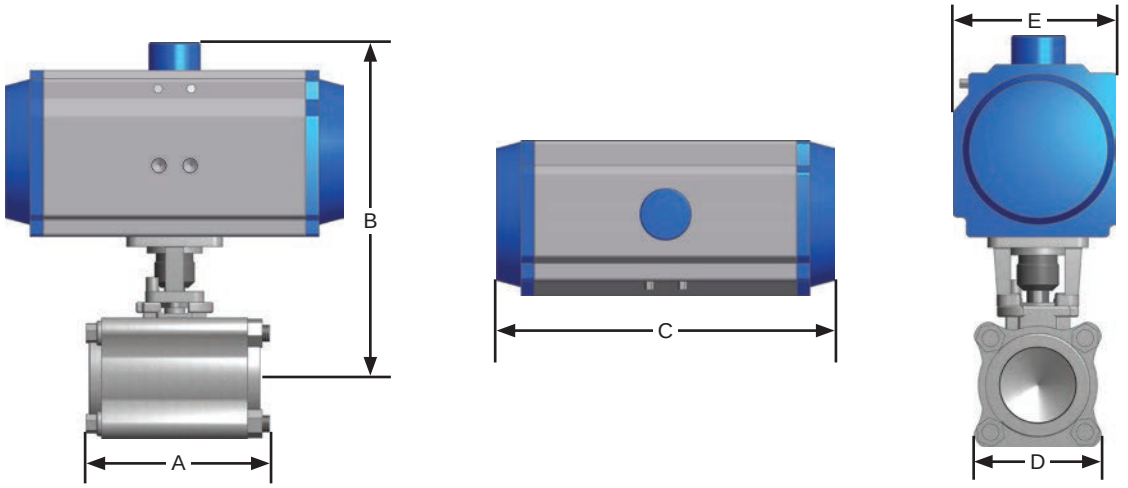


Figure 2.5.1b Pneumatically Actuated Ball Valve Dimensions

Table 2.5.1a - Pneumatically Actuated Ball Valve Dimensions

Valve Size		Port Size		Dimensions									
				A		B		C		D		E	
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
1/2	15	1/8	6	2.60	65	6.00	152	5.50	140	2.06	52	2.81	71
3/4	20	1/8	6	3.05	77	6.68	170	6.04	153	2.23	57	3.33	84
1	25	1/8	6	3.76	95	7.55	192	6.04	153	2.57	65	3.33	84
1-1/2	40	1/8	6	5.05	128	9.17	233	9.49	241	3.32	84	4.06	103
2	50	1/4	8	5.53	140	10.13	257	10.20	259	3.64	92	4.67	119

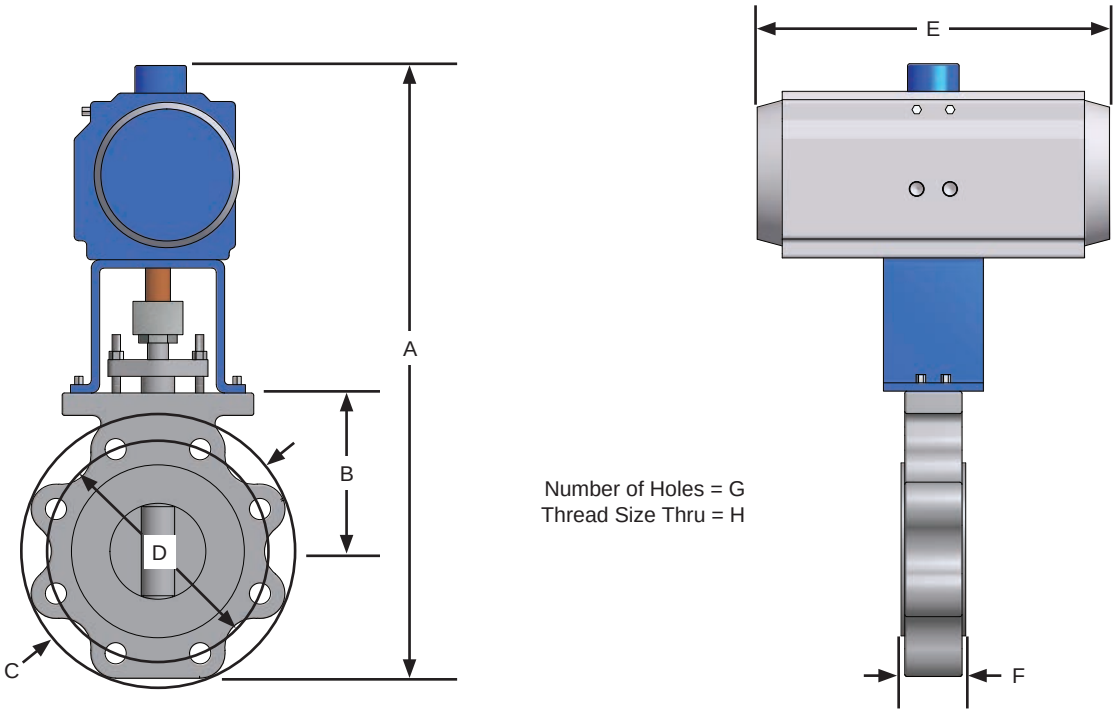


Figure 2.5.1c Series 830 Pneumatically Actuated Wafer Valve

Table 2.5.1b - Pneumatically Actuated Wafer Valve Dimensions

Valve Size		Port Size		Dimensions													
				A		B		C		D		E		F		G	H
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm		
3	80	1/4	8	18.39	467	4.75	121	8.13	207	6.63	168	10.20	259	1.94	49	8	3/4-10
4	100	1/4	8	23.13	587	5.25	133	9.38	238	7.88	200	13.11	333	2.13	54	8	3/4-10
6	150	1/4	8	27.77	705	6.88	175	12.13	308	10.63	270	16.63	422	2.31	59	12	3/4-10
8	200	1/4	8	34.10	866	8.38	213	15.00	381	13.00	330	20.80	528	2.88	73	12	7/8-9

2.5.1.1 Valve Solenoid

Refer to Table 2.5.1.1 for P/N (See Figure 2.5.1.1)

A solenoid is fitted to the selector valves at the pneumatic actuation port to prevent pilot pressure from actuating the valve until receiving a signal from the fire control panel. The solenoid has a NEMA 4 enclosure with a 1/4 in (8 mm) inlet and 1/8 in (6 mm) exhaust. The solenoid has a standard voltage of 24 VDC or an optional voltage of 120 VAC 60 Hz (110/50). Additional voltages such as 240 VAC 60 Hz and 12 VDC are available. It consumes 6.9 watts DC and 6.3 watts AC.

Table 2.5.1.1 - Valve Solenoids

P/N	Solenoid Type
99807	24 VDC, Weatherproof
99806	120 VAC, Weatherproof
99769	24 VDC, Weatherproof, Explosion-Proof
99768	120 VAC, Weatherproof, Explosion-Proof

Figure 2.5.1.1 Valve Solenoid

2.5.1.2 Manual Lockout

Refer to Table 2.5.1.2 for P/N (See Figure 2.5.1.2)

An optional lockout may be placed on the pneumatically actuated valves to prevent accidental actuation. These lockouts use proximity switches to provide electronic verification that each lockout is in the correct position. The proximity switches have NEMA 4, 4x, and 6 enclosures with 1/2 in (15 mm) FNPT conduit connections. The switch has normally open contacts rated 0.3 Amp at 8 to 125 VDC or 24 to 125 VAC.

Table 2.5.1.2 - Manual Lockout w/ Proximity Switch	
P/N	Part Type
99455	Proximity Switch
99454	Manual Lockout, 1/2" - 2" Valves
99453	Manual Lockout, 3" - 4" Valves
99452	Manual Lockout, 6" - 8" Valves

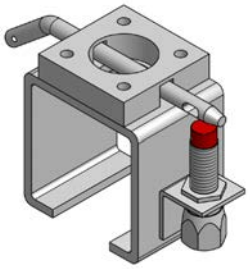


Figure 2.5.1.2 Manual Lockout

2.5.1.3 Position Indicator Switch

P/N 99456 (See Figure 2.5.1.3)

An optional explosion-proof/weatherproof position indicator switch may be mounted on the top of the pneumatic valve actuator to provide visual and/or electronic confirmation of whether the valve is in open or closed position. It has a green "open" indicator and a red "closed" indicator. The switch has a NEMA 4, 4x, and 6 enclosure with one (1) 3/4 in (20 mm) NPT and one (1) 1/2 in (15 mm) conduit connection. The switch is double pull double throw with contacts rated 10 Amps at 125/250 VAC and 0.5 Amp at 125 VDC.

Figure 2.5.1.3.Position Indicator Switch

2.5.2 Lockout Valves

Lockout valves are used any place in the clean agent system where manual isolation of pipe is required. Janus Fire Systems® clean agent lockout valves are available as 1/2 in (15 mm) through 2 in (50 mm) manually actuated ball valves or 3 in (80 mm) through 8 in (200 mm) manually actuated wafer valve. Optional stem extension and explosion-proof limit switch are available. Refer to Appendix D for part numbers and ordering information.

Figure 2.5.2a Lockout Valve

Section 2 System Description and Components

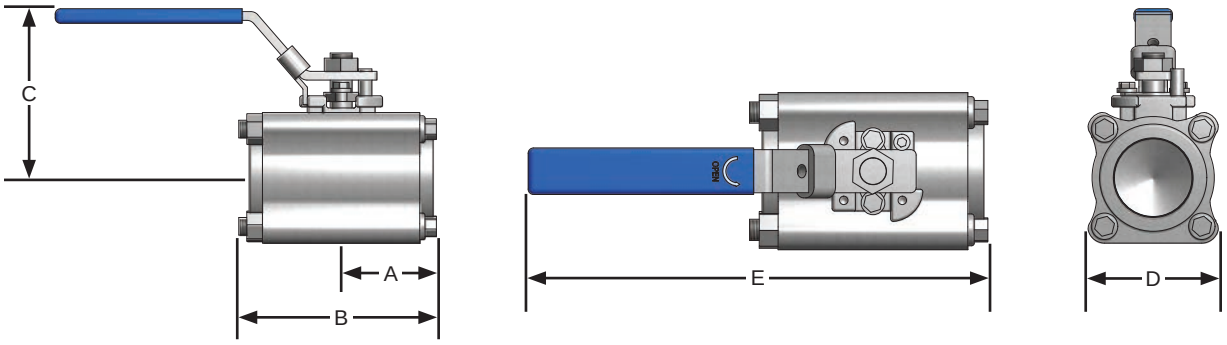


Figure 2.5.2b Manually Actuated Ball Valve Dimensions

Table 2.5.2a - Manually Actuated Ball Valve Dimensions											
Valve Size		Dimensions									
		A		B		C		D		E	
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
1/2	15	1.28	33	2.60	65	2.36	60	2.06	52	6.29	160
3/4	20	1.50	38	3.05	77	2.53	64	2.23	57	6.50	165
1	25	1.86	47	3.76	95	3.28	83	2.57	65	8.54	217
1-1/2	40	2.43	62	5.05	128	4.27	108	3.32	84	10.42	265
2	50	2.66	68	5.53	140	4.73	120	3.64	92	10.66	271

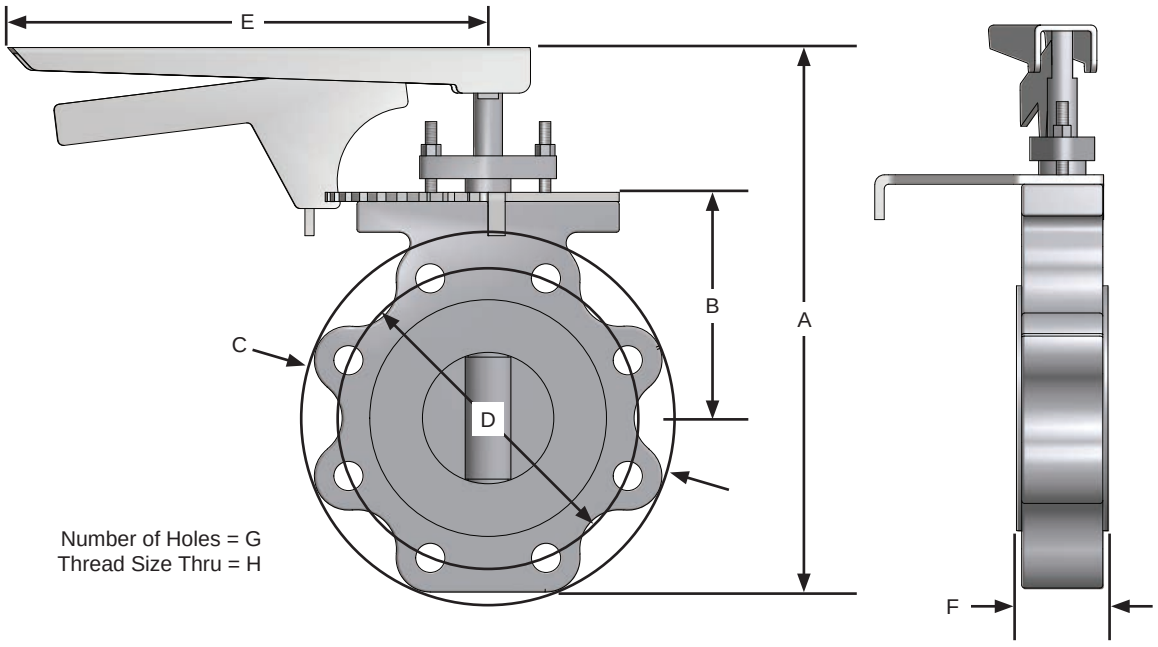


Figure 2.5.2c Series 830 Manually Actuated Wafer Valve

Table 2.5.2b - Manually Actuated Wafer Valve Dimensions															
Valve Size		Dimensions													
		A		B		C		D		E		F		G	H
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm		
3	80	11.89	302	4.75	121	8.13	207	6.63	168	10.53	267	1.94	49	8	3/4-10
4	100	12.96	329	5.25	133	9.38	238	7.88	200	10.53	267	2.13	54	8	3/4-10
6	150	16.06	408	6.88	175	12.13	308	10.63	270	22.13	562	2.31	59	12	3/4-10
8	200	19.43	494	8.38	213	15.00	381	13.00	330	22.13	562	2.88	73	12	7/8-9

2.5.2.1 Limit Switch

P/N 99456 (See Figure 2.5.2.1)

An optional explosion-proof limit switch may be placed on the manually actuated valves to provide electronic confirmation that the valves are in proper position. The limit switch has a NEMA 4, 4x, and 6 enclosure with one (1) 3/4 in (20 mm) NPT and one (1) 1/2 in (15 mm) conduit connection. The switch is double pull double throw with contacts rated 10 Amps at 125/250 VAC and 0.5 Amp at 125 VDC.

Figure 2.5.2.1 Limit Switch

2.5.3 Pilot Line Regulator

P/N 19170 (See Figure 2.5.3)

A polyamide and aluminum gas regulator is placed between the discharge manifold and selector valves to reduce the pressure into selector valve actuation ports. It has a 1/2 in (15 mm) FNPT inlet and outlet with a maximum inlet pressure of 580 psig (40 bar) and an outlet range of 50 to 135 psig (3.4 to 9.3 bar). It is normally set to 100 psi (6.89 bar). The regulator has a standalone ambient temperature range of -20˚ to 130˚F (-29˚ to 54˚C) and a Cv of 3.6. A pressure gauge (0-160 psig P/N 19171) is attached to the regulator to allow visual monitoring of outlet pressure. A 1 in (25 mm) regulator is available (P/N 19513). A 1/2 in (15 mm) stainless steel strainer (P/N 19370) is required to be installed upstream of the pressure regulator to prevent debris from entering the regulator or pneumatic actuation port of the solenoid. (Strainer has an internal filter size of 40 mesh and is rated ASME class 300.)

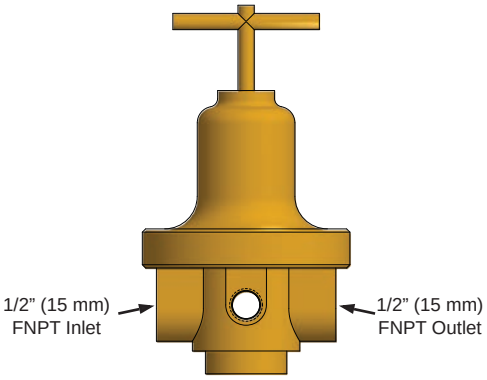


Figure 2.5.3 Pilot Line Regulator

2.5.4 Discharge Relief Valve

P/N 19317 / 19316 (See Figure 2.5.4)

A discharge relief valve must be installed in the discharge piping at any point where pipe may be closed off between a lock-out valve and a selector valve. P/N 19317 shall be installed upstream of the pilot line regulator and is set to open should line pressure exceed 450 psi (31.0 bar). P/N 19316 shall be installed downstream of the pilot line regulator and is set to open should line pressure exceed 125 psi (8.6 bar). Each relief valve has a 0.062 in^2 (40 mm^2) orifice area, a brass body with a stainless steel spring, and a standalone ambient temperature range of -320˚F to 165˚F (-196˚C to 74˚C). A pipe-away adapter (P/N 19318) is available to convert the outlet to a 1/2" (15 mm) FNPT connection.

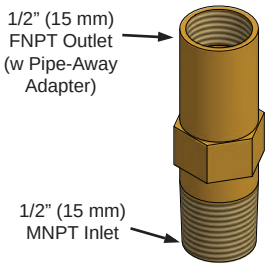
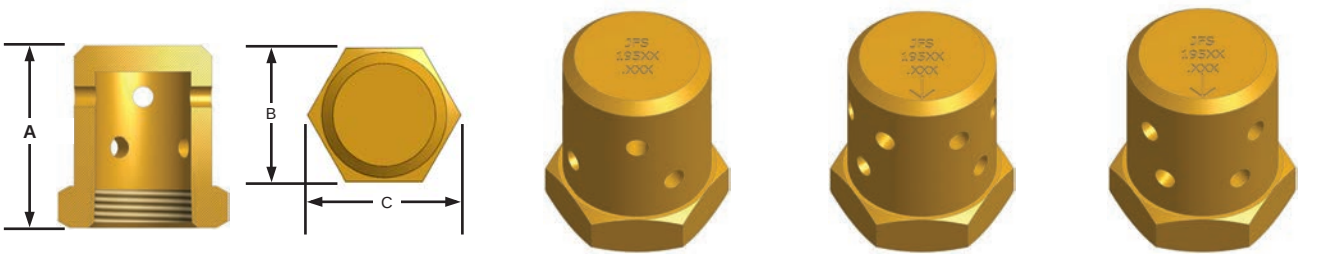


Figure 2.5.4 Discharge Relief Valve

2.6 Discharge Nozzles

(See Figure 2.6)

Discharge nozzles are used to disperse the FK-5-1-12. Available in brass or stainless steel, the nozzles are performance tested to ensure that the agent is properly distributed throughout the protected area. Discharge nozzles are available with three separate port arrangements to accommodate placement in varying locations around a room or enclosure: 90˚ (4 port) corner nozzles, 180˚ (6 port) sidewall nozzles, and 360˚ (8 port) radial nozzles. Each nozzle is stamped with the nozzle part number and orifice diameter.



Side Cut View | Top View | 360° Radial Nozzle (8 Port) | 180° Sidewall Nozzle (6 Port) | 90° Corner Nozzle (4 Port)

Figure 2.6 Discharge Nozzle Configurations

Table 2.6 - Discharge Nozzle Sizes

Nozzle Orientation Part Number						Nominal Pipe Size	Nozzle Dimensions					
Brass			Stainless Steel				A		B		C	
360°	180°	90°	360°	180°	90°		in	mm	in	mm	in	mm
19529	19522	19515	20445	20438	20431	3/8 in (10mm)	1.436	36.5	1.125	28.57	1.30	33.02
19530	19523	19516	20446	20439	20432	1/2 in (15 mm)	1.722	43.7	1.250	37.75	1.44	36.58
19531	19524	19517	20447	20440	20433	3/4 in (20 mm)	1.926	48.9	1.500	38.10	1.73	43.94
19532	19525	19518	20448	20441	20434	1 in (25 mm)	2.176	55.3	1.750	44.45	2.02	51.31
19533	19526	19519	20449	20442	20435	1 1/4 in (32 mm)	2.500	63.5	2.250	57.15	2.60	66.04
19534	19527	19520	20450	20443	20436	1 1/2 in (40 mm)	2.689	68.3	2.250	57.15	2.60	66.04
19535	19528	19521	20451	20444	20437	2 in (50 mm)	3.100	78.7	3.000	76.20	3.46	87.88

Ordering Instructions: Specify the Nozzle P/N followed by a dash and the three digits representative of the drill code as provided by the Janus Design Suite software.

Example: 19529-XXX = Nozzle: 360°, 3/8” (10 mm), Brass (with drill code as specified)

3 SYSTEM DESIGN

This section lists the methods and guidelines necessary to properly design an engineered Janus Fire Systems® Fire Extinguishing System utilizing FK-5-1-12.

Note: Janus Fire System® Fire Extinguishing Systems are designed, manufactured, installed and UL listed and FM approved to deliver a designated quantity of FK-5-1-12 in a "not to exceed" 10 second discharge time. The "Duration of Protection (Hold Time)" as referenced in NFPA 2001, 2018 edition is a function of the hazard enclosure's (room) integrity and not a function (or capability) of the fire suppression system's discharge time referenced in this publication.

3.1 Hazard Analysis

The first step in designing an engineered total flooding system utilizing FK-5-1-12 is to identify the unique requirements of the area to be protected.

3.1.1 Fuel Source

The design specifications for the system are dependent on the hazard type, so it is first necessary to identify the type of hazard to be protected.

Hazard type is classified according to the combustible materials found in an area and may be considered Class A (wood, paper, cloth, rubber, and many plastics), Class B (flammable liquids and flammable gases), Class C (energized electrical equipment), or any combination of the three.

Class A Hazards:

NFPA 2001 (latest edition) requires the minimum design concentration for a Class A surface fire to be equal to 4.5%, the minimum extinguishing concentration of heptane.

Class B Hazards:

The minimum design concentration for a Class B fire depends on the extinguishing concentration for the specific fuel type found in the hazard plus a 30% safety factor. The minimum design concentrations for particular fuels based upon their cup burner extinguishing concentration are listed in Tables 3.1.1a and 3.1.1b in Appendix B.

Class C Hazards:

For energized electrical hazards supplied ***less than or equal to 480 volts,*** the minimum design concentration for a Class C fire shall be 4.5%, which is equal to the extinguishing concentration of Class A fuels times a safety factor of 1.35, in accordance with NFPA 2001 (2018 edition). Per NFPA 2001, the minimum design concentration for spaces containing energized electrical hazards supplied at ***greater than 480 volts*** that remain powered during and after discharge shall be determined by testing, as necessary, and a hazard analysis.

NOTE: FK-5-1-12 design concentrations should be calculated according to the lowest expected ambient temperature within the protected area. When calculating the concentration levels for normally occupied spaces, the design concentration for FK-5-1-12 must not exceed the NOAEL (No Observed Adverse Effect Level) of 10% at the highest expected ambient temperature as stated in NFPA 2001[1].

1. Refer to Appendix G, Section G.1.2 for information on protecting occupiable enclosures requiring concentrations that exceed the NOAEL.

3.1.2 Hazard Dimensions

Once the minimum design concentration is determined, the volume for the protected area must be calculated. Volume is determined by multiplying the area's length by its width by its height (Volume = l x w x h).

The space below a raised floor (underfloor) must be included in the system design unless it is sealed from the room above. Separate nozzles are required for the underfloor and discharge should occur from both the room and underfloor nozzles simultaneously. All rooms located above a common unsealed underfloor must be protected by simultaneously operated systems to ensure minimum design concentration is reached.

If not shut down or closed automatically, the volume of any self-contained recirculating dampered ventilation systems ducts and components mounted below the ceiling height of the protected space must be considered as part of the total hazard volume when determining the quantity of agent.

3.1.3 Hazard Integrity

If a protected hazard is not sufficiently sealed, agent leakage may occur. Leakage of FK-5-1-12 may prevent the required concentration levels from being reached or maintained for the entire holding period, making it difficult for the FK-5-1-12 to extinguish the source of ignition. When a room opening does exist, adding more agent within a room to counter leakage may actually increase the rate of loss due to an increase in pressure created by the additional agent.

Doors should be checked for tightness. Weather stripping, seals, and door sweeps should be installed to minimize leakage. Any door required to remain open must be closed automatically prior to the discharge of the FK-5-1-12.

Walls should be inspected for openings that could result in agent leakage. Openings or penetrations for cables or ducts should be permanently sealed. Joints where walls contact floors, other walls, and ceilings should be caulked or otherwise sealed. Caulking materials should be chosen based upon their elasticity and fire rating.

Ductwork leading into or out of the hazard area must contain dampers with airtight seals.

Shut down is recommended for any recirculating air handling units prior to discharge. Mechanical air handlers can contribute to agent loss.

Floor drains in the protected space or underfloor must have traps with automatic primers or environmentally acceptable seals to preclude the loss of agent through an open trap.

A room integrity test must be performed to confirm any potential sources of leakage. NFPA 2001 contains an outline for such testing.

Note: Janus Fire System® Fire Extinguishing Systems are designed, manufactured, installed and UL listed and FM approved to deliver a designated quantity of FK-5-1-12 in a "not to exceed" 10 second discharge time. The "Duration of Protection (Hold Time)" as referenced in NFPA 2001, 2018 edition is a function of the hazard enclosure's (room) integrity and not a function (or capability) of the fire suppression system's discharge time referenced in this publication.

3.1.4 Hazard Altitude

FK-5-1-12 expands to a greater specific vapor at elevations above sea level. Higher altitudes require less agent to achieve design concentration. Altitude differences can be corrected for using the correction factors listed in Table 3.1.4.

Table 3.1.4 - Altitude Correction Chart

Altitude		Enclosure Pressure		Correction Factor
ft	m	psia	mm Hg	
-3,000	-914	16.25	840	1.11
-2,000	-610	15.71	812	1.07
-1,000	-305	15.23	787	1.04
0	0	14.71	760	1.00
1,000	305	14.18	733	0.96
2,000	610	13.64	705	0.93
3,000	914	13.12	678	0.89
4,000	1219	12.58	650	0.86
5,000	1524	12.04	622	0.82
6,000	1829	11.53	596	0.78
7,000	2134	11.03	570	0.75
8,000	2438	10.64	550	0.72
9,000	2743	10.22	528	0.69
10,000	3048	9.77	505	0.66

Note: Multiply the design quantity at sea level by the correction factor to obtain the adjusted quantity for a given altitude.

3.2 Agent Requirement

Once the requirements and dimensions of the hazard are determined, they can be used to calculate the required amount of FK-5-1-12. FK-5-1-12 quantities are classified according to storage weight. There are two methods to calculate the required weight. Either the volume of the protected area can be multiplied by an agent factor listed in Tables 3.2a or 3.2b (See Appendix B for factors and design worksheet) or the following formula can be used:

US Standard

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

W = Agent weight in pounds

V = Hazard volume in cubic feet

C = FK-5-1-12 design concentration, percent by volume

s = FK-5-1-12 specific vapor in cubic feet/pounds
s = 0.9856 + (0.002441 x t)
t = minimum room temperature in °F

Example A: Our room has a volume of 16,000 ft^3, our ambient temperature is 70°F, and our design concentration is 4.5%. Using the first method, we consult Table 3.2a and find our agent factor is 0.0407. Now we multiply our volume by this factor to determine the agent weight.

$$16{,}000\ ft^3 \times 0.0407\ lbs/ft^3 = 651.2\ lbs$$

Example B: Using the second method for the same situation, we would use the formula as follows:

$$s = 0.9856 + (0.002441 \times 70) = 1.15647$$

$$W = \frac{16000}{1.15647}\left(\frac{4.5}{100 - 4.5}\right) = 651.92\ lbs$$

Agent weights are always rounded up to the nearest whole pound for filling. For both Example A and Example B this would be 652 lbs.

Metric

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

W = Agent weight in kilograms

V = Hazard volume in cubic meters

C = FK-5-1-12 design concentration, percent by volume

s = FK-5-1-12 specific vapor in cubic meters/kilograms
s = 0.0664 + (0.0002741 x t)
t = minimum room temperature in °C

Example A: Our room has a volume of 500 m^3, our ambient temperature is 20°C, and our design concentration is 4.5%. Using the first method, we consult Table 3.2b and find our agent factor is 0.6555. Now we multiply our volume by this factor to determine the agent weight.

$$500\ m^3 \times 0.6555\ kg/m^3 = 327.75\ kg$$

Example B: Using the second method for the same situation, we would use the formula as follows:

$$s = 0.0664 + (0.0002741 \times 20) = 0.071882$$

$$W = \frac{500}{0.071882}\left(\frac{4.5}{100 - 4.5}\right) = 327.76\ kg$$

An agent weight calculated using metric measurements must be converted to pounds and rounded up to the nearest pound for ordering purposes using the conversion factors found in Table B.2a of Appendix B.

A check should be made using either method to ensure that the maximum NOAEL level of 10% of FK-5-1-12 is not exceeded based upon the highest expected ambient temperature of the protected area.

3.3 Number of Cylinders

Once the necessary quantity of agent has been calculated, the size and number of cylinders required can be determined. Refer to table 2.1 for a list of available cylinder sizes and capacities. If the required weight exceeds the fill capacity of one cylinder, multiple cylinders must be used. When two or more cylinders are grouped together with a common manifold, they must be of the same size and fill. A manifolded cylinder arrangement must be fitted with a manifold check valve.

3.4 Cylinder Location

The cylinder(s) should be located in a climate controlled area that is relatively clean, dry, accessible, and vibration-free. Avoid high traffic areas or other areas where physical damage or tampering is more likely. The cylinder(s) should not be located where they could be exposed to splashing or submersion in any liquid.

⚠ CAUTION

System has been verified through testing to function at ambient temperatures ranging from 32°F (0°C) to 130°F (54°C). Flow calculations have been verified at an ambient temperature of 70°F (21.1°C). Storage outside of the range of 70°F ±10° (21.1°C ±5.5°) may result in inaccurate flow calculations and cause one or more nozzles to not discharge the designed quantity of FK-5-1-12.

The cylinder(s) should optimally be placed outside the protected area in a location that permits convenient access for inspection, maintenance, and removal. Placement inside the protected area is acceptable if the cylinder(s) are not exposed to fire or excessive heat that could impair system operation.

If the primary cylinder is fitted with a manual valve actuator for emergency manual release of the FK-5-1-12, then the cylinder must be placed so that the emergency release button is readily accessible to ensure operation in emergency situations.

⚠ CAUTION

The cylinder assembly must be mounted in a vertical position so its valve assembly is located at the top of the cylinder. All cylinders for a single hazard must be stored at the same temperature.

The cylinder(s) should be mounted to wall frames or columns capable of rigidly supporting the cylinder bracket by bolting or welding and oriented so that the pressure gauge faces out. The cylinder must rest on a surface capable of supporting the combined weight of the cylinder and agent.

3.5 Nozzle Determination

The placement, arrangement, and selection of discharge nozzles should be considered according to the hazard configuration and the coverage of each nozzle. Nozzles are designed for 90˚ (corner), 180˚ (sidewall), and 360˚ (radial) orientation.

The 90˚ corner nozzle can cover a maximum area of 24 ft x 24 ft (7.32 m x 7.32 m). A single corner nozzle may be used to protect a room with a total area of 576 ft^2 (53.5 m^2) or less provided the nozzle is not more than 33.94 ft (10.34 m) from the farthest point it is intended to protect. Refer to Figure 3.5a in Appendix E for alternate spacing options. The centerline of a 90˚ corner nozzle must be located within 12 in (305 mm) of each adjacent wall. The nozzle must be oriented so that it is directed at the opposite corner.

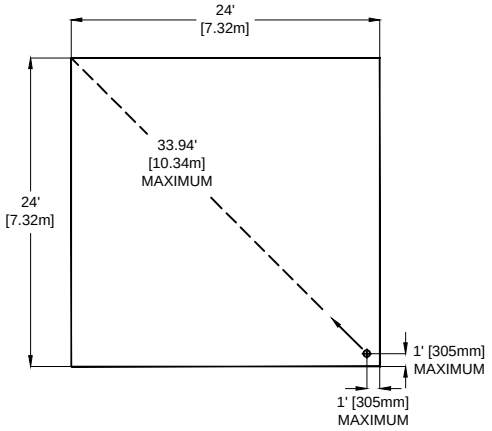


Figure 3.5a 90° Corner Nozzle Maximum Coverage Area

A single 180˚ sidewall nozzle can cover a maximum area of 39 ft x 39 ft (11.89 m x 11.89 m). A single sidewall nozzle may be used to protect a room with an area of 1521 ft^2 (141.3 m^2) or less provided the nozzle is not more than 43.6 ft (13.28 m) from the farthest point it is intended to protect. Refer to Table 3.5b in Appendix E for alternate spacing options. The centerline of a 180˚ nozzle must be located within 12 in (305 mm) of the adjacent wall (or within 18 in [457 mm] of the reverse-facing nozzle in a back-to-back nozzle orientation). When spacing multiple sidewall nozzles, due to the area exceeding the coverage of a single nozzle the maximum distance between nozzles cannot exceed 39 ft (11.89 m) and the maximum distance from the side walls cannot exceed half the distance between nozzles [19 ft 6 in (5.94 m)]. The nozzle must be oriented so that it is directed at the opposite wall. For back-to-back nozzle orientation limits refer to Table 3.5c and Figure 3.5d in Appendix E.

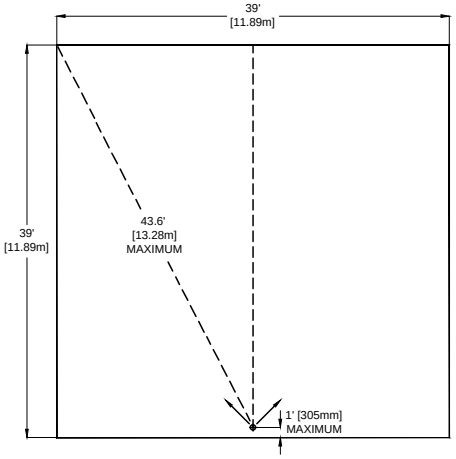


Figure 3.5b 180° Sidewall Nozzle Maximum Coverage Area (Single Nozzle)

The 360˚ radial nozzle can cover a maximum area of 39 ft x 39 ft (11.89 m x 11.89 m). The centerline of a 360˚ nozzle cannot be more than 27.6 ft (8.41 m) from the farthest point it is intended to protect. When using multiple radial nozzles, due to the area exceeding the coverage of a single nozzle the maximum distance between nozzles cannot exceed 39 ft (11.89 m) and the maximum distance from the side walls cannot exceed half the distance between nozzles [19 ft 6 in (5.94 m)]. NOTE: Two 180˚ sidewall nozzles may be used back-to-back as an alternative to a 360˚ radial nozzle to increase the area of coverage at a single point, provide additional flexibility in piping design, and provide improved flow performance.

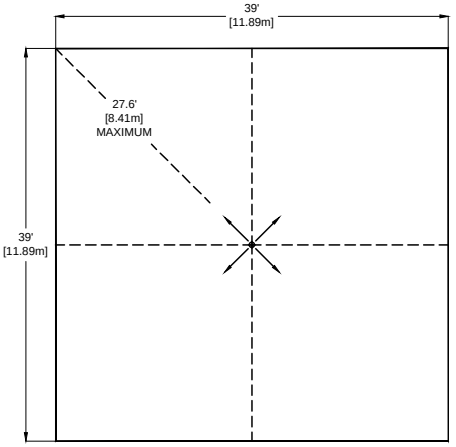


Figure 3.5c 360° Radial Nozzle Maximum Coverage Area

All nozzles: Discharge nozzles must be located at or near the ceiling with the halfway point between the two vertical orifice layers no more than 4 ft 5 in (1.346 m) below the ceiling. The maximum height for a single tier of nozzles is 18 ft 4 in (5.588 m) from floor to ceiling. For ceiling heights greater than 18 ft 4 in (5.588 m), additional tiers may be installed so that the maximum distance between the floor and lowest row does not exceed 18 ft 4 in (5.588 m) and the maximum distance between rows does not exceed 18 ft 4 in (5.588 m). Each nozzle must be positioned vertically, installed either on the bottom or top of a vertical pipe section and should be placed as close to the cylinders as possible to minimize system piping. The ceiling tiles around each nozzle must be clipped to hold them in place during a discharge and to prevent damage.

⚠ CAUTION

NFPA 2001 mandates that agent shall not directly impinge on areas where personnel could be found in the normal work area and that agent shall not directly impinge on loose objects or shelves, cabinet tops, or similar surfaces where loose objects could be present and become airborne during discharge.

Below Raised Floors (Underfloors): NFPA 2001 states: "***Where a clean agent total-flooding system is being provided for the protection of a room with a raised or sunken floor, the room and raised or sunken floor shall be simultaneously protected.***" In addition, the following is written: "***Each volume, room, and raised or sunken floor to be protected shall be provided with detectors, piping network, and nozzles.***"

The spacing and coverage limitations for nozzles protecting below raised floors are the same as those stated above. However, the extent of obstructions and blockage to agent discharge is greatly increased below raised floors. When the horizontal line of sight in the underfloor is more than 70% obstructed, reduce the maximum spacing for each nozzle by 50%. In addition, locate nozzles on both sides of obstructions to ensure uniform distribution of FK-5-1-12.

The minimum height of enclosures tested by UL and FM is 12 inches (305 mm). For enclosures with heights less than 12 inches (305 mm) no testing has been validated. For enclosures with heights less than 12 inches (305 mm) (i.e. underfloors, subfloors) it is recommended that the nozzle spacing be reduced by at least 50% and nozzles be located on both sides of obstructions to ensure uniform distribution of FK-5-1-12.

3.6 Pipe Determination

Pipe sizes must be determined using the Janus Design Suite® flow calculation software. Table 3.6 may be referenced for the purposes of estimation. The actual diameters may vary due to distance or software optimization.

A minimum distance equal to or greater than ten pipe diameters is required between each tee and any other tee or elbow, either upstream or downstream of it.

Table 3.6 - Pipe Size vs. Flow Rate

Schedule 40 Pipe Size Nominal Inches (mm)	Minimum Flow Rate For All Sections Leading to a Tee		80% of Flow Rate For All Sections Ending with a Nozzle	
	Lbs/Sec	Kg/Sec	Lbs/Sec	Kg/Sec
3/8 (10)	.775	.352	.620	.282
1/2 (15)	1.29	.585	1.03	.468
3/4 (20)	2.27	1.03	1.82	.824
1 (25)	3.65	1.65	2.92	1.32
1 1/4 (32)	6.34	2.88	5.07	2.30
1 1/2 (40)	8.73	3.96	6.98	3.17
2 (50)	14.91	6.76	11.93	5.41
2 1/2 (65)	22.03	9.99	17.62	7.99
3 (80)	35.67	16.18	28.54	12.94
4 (100)	64.64	29.32	51.71	23.46
6 (150)	143.27	64.99	114.62	51.99

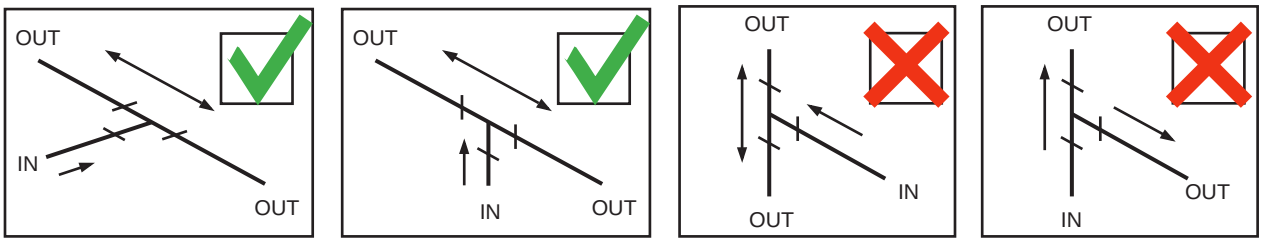
⚠ CAUTION

System has been verified through testing to function at ambient temperatures ranging from 32°F (0°C) to 130°F (54°C). Flow calculations have been verified at an ambient temperature of 70°F (21.1°C). Storage outside of the range of 70°F ±10° (21.1°C ±5.5°) may result in inaccurate flow calculations and cause one or more nozzles to not discharge the designed quantity of FK-5-1-12.

Flow calculations have been verified for specific types of fittings, pipe and pipe ID. Failure to maintain the verified limitations as stated in the Janus Design Suite® Flow Calculation Software Manual Designed For Use With FK-5-1-12, DOC173, may result in inaccurate flow calculations and cause one or more nozzles to not discharge the designed quantity of FK-5-1-12.

⚠ CAUTION

The outlets of a tee branch must be on the same horizontal plane or an imbalance will result from the gravitational effects of the liquid and vapor separation and may cause one or more nozzles to not discharge the designed concentration of FK-5-1-12.



3.6.1 Elevation Changes

Any elevation differences between outlet tees exceeding 30 ft (9.1 m) are beyond the limitations set forth by the Underwriters Laboratories. Although sound engineering theory is used to predict pressure changes due to elevation, actual testing has not been performed outside of this range. Should this distance be exceeded, consideration should be given to rerouting piping to reduce elevation differences.

Note: If a clean agent system flows the total amount of agent through a piping network to nozzles that are discharging the agent into a single protected space, the 30 ft (9.1 m) limitation does not apply. The successful performance of the JDS calculation becomes the only governing limitation to system elevation changes.

If a clean agent system flows the total amount of agent through a piping network with unbalanced flow splits to nozzles that protect multiple protected spaces, then the following applies, or consideration should be given to rerouting piping to reduce elevation:

1. If nozzles are located above the discharge outlet, then the maximum elevation difference between the discharge outlet and the highest horizontal pipe run or discharge nozzle (whichever is highest) shall not exceed 30 feet (9.1 m).

2. If nozzles are only located below the discharge outlet, then the maximum elevation difference between the discharge outlet and the lowest horizontal pipe run or discharge nozzle (whichever is lowest) shall not exceed 30 feet (9.1 m).

3. If nozzles are located both above and below the discharge outlet, then the maximum elevation difference between the highest horizontal pipe run or discharge nozzle (whichever is highest) and the lowest horizontal pipe run or discharge nozzle (whichever is lowest) shall not exceed 30 feet (9.1 m).

3.7 Peripheral Equipment and Accessories

The final step is the selection and placement of any and all control panels, detection devices, and accessories. This section provides a brief overview of these components. A more detailed description is available in other publications.

3.7.1 Control Panel

For systems requiring UL listing, the control panel must be UL listed and compatible with the electrical valve actuator as indicated in the control panel manual. For systems requiring FM approval, the control panel must be FM approved and compatible with the electric valve actuator as indicated in the control panel manual. The control panel should be located in an accessible area and installed in compliance with NFPA 72 (National Fire Alarm Code).

3.7.2 Early Warning Detection

Detector selection is dependent upon hazard occupancy and environmental conditions. Systems are designed to extinguish a fire rapidly in its incipient stage. The use of smoke detectors of appropriate type must be considered to provide the earliest possible indication of a fire detection with a low susceptibility to false alarms. For systems requiring UL listing, detectors must be UL listed and compatible with the control panel as indicated in the control panel manual.

Air sampling detection systems can also be utilized.

In most applications, the detection devices are installed in a cross-zone (double knock) or voting configuration. Cross-zoning of early warning detectors affords stability yet provides early detection.

3.7.3 Accessories

Audible and visual devices may be utilized to indicate alarm conditions, system status, or trouble conditions within the system. Audible alarm devices must be of a sufficient decibel level to be heard over the maximum noise level in the protected hazard.

3.8 Sample Equipment Order List

Sample Sv Series Single Cylinder Equipment Order List		
Quantity	**P/N**	**Description**
1	20504-065	Cylinder Assembly, FK-5-1-12, 80 lb
65 lbs	FK-5-1-12	FK-5-1-12 Agent
1	18595	Bracket Assembly, Cylinder, 10”
1	20722	Electric Valve Actuator
1	17001	Manual Valve Actuator
As Required	Various	Discharge Nozzles
1	97428	Switch, Discharge Pressure
1	18489	Sign, Warning, Exit, Clean Agent
1	18770	Sign, Warning, Entrance, Clean Agent

Sample Sv Series Three Cylinder Equipment Order List		
Quantity	**P/N**	**Description**
3	20504-050	Cylinder Assembly, FK-5-1-12, 80 lb
150 lbs	FK-5-1-12	FK-5-1-12 Agent (50 lbs per Cylinder)
3	18595	Bracket Assembly, Cylinder, 10”
1	20722	Electric Valve Actuator
1	17001	Manual Valve Actuator
2	17019	Pneumatic Valve Actuator
1	18624	Bushing, 3/8” MNPT x 1/4” FNPT (10 mm x 8 mm), Brass *Pilot Actuation Adapter*
1	18560	Valve, Check, 1/4” MNPT x 1/4” JIC Male (8 mm x 8 mm), Brass *Pilot Actuation Check Valve*
2	18648	Hose, Flex, 3/16”, 1/4” (8 mm) JIC Female - 16” (406 mm)
1	18622	Tee, 1/4” JIC Male x 1/4” MNPT (8 mm x 8 mm), Brass *Pilot Actuation Mid Line Tee*
1	18625	Adapter, 1/4” MNPT x 1/4” JIC Male (8 mm x 8 mm), Brass *Male NPT Adapter*
1	18611	Tee, 1/4” FNPT x 1/4” MNPT (8 mm x 8 mm), Brass *Pilot Actuation End Line Tee*
1	10173	Vent Check
As Required	Various	Discharge Nozzles
1	97428	Switch, Discharge Pressure
3	18547	Valve, Check, 1-1/4” FNPT (32 mm)
1	18489	Sign, Warning, Exit, Clean Agent
1	18770	Sign, Warning, Entrance, Clean Agent

Section 3 System Design

Sample Mv Series Single Cylinder Equipment Order List		
Quantity	**P/N**	**Description**
1	20507-350	Cylinder Assembly, FK-5-1-12, 420 lb
350 lbs	FK-5-1-12	FK-5-1-12 Agent
1	18535	Bracket Assembly, Cylinder, 16”
1	20722	Electric Valve Actuator
1	17001	Manual Valve Actuator
1	20529	Gauge Assembly, Pressure, FK-5-1-12
1	18775	Switch Assembly, Low-Pressure Supervisory
1	18555	Coupling, Grooved, 2” (50 mm)
1	18551	Elbow, Grooved, 2” (50 mm)
1	18474	Nipple, Grooved x MNPT, 2” (50 mm)
As Required	Various	Discharge Nozzles
1	97428	Switch, Discharge Pressure
1	18489	Sign, Warning, Exit, Clean Agent
1	18770	Sign, Warning, Entrance, Clean Agent

Sample Mv Series Two Cylinder Equipment Order List (Manifolded)		
Quantity	**P/N**	**Description**
2	20506-200	Cylinder Assembly, FK-5-1-12, 250 lb
400 lbs	FK-5-1-12	FK-5-1-12 Agent (200 lbs per Cylinder)
2	18535	Bracket Assembly, Cylinder, 16”
1	20722	Electric Valve Actuator
1	17001	Manual Valve Actuator
2	20529	Gauge Assembly, Pressure, FK-5-1-12
2	18775	Switch Assembly, Low-Pressure Supervisory
2	18555	Coupling, Grooved, 2” (50 mm)
2	18551	Elbow, Grooved, 2” (50 mm)
2	18474	Nipple, Grooved x MNPT, 2” (50 mm)
1	17019	Pneumatic Valve Actuator
1	18560	Valve, Check, 1/4” MNPT x 1/4” JIC Male (8 mm x 8 mm), Brass *Pilot Actuation Check Valve*
1	18649	Hose, Flex, 3/16”, 1/4” (8 mm) JIC Female - 24” (610 mm)
1	18625	Adapter, 1/4” MNPT x 1/4” JIC Male (8 mm x 8 mm), Brass *Male NPT Adapter*
1	18611	Tee, 1/4” FNPT x 1/4” MNPT (8 mm x 8 mm), Brass *Pilot Actuation End Line Tee*
1	10173	Vent Check
As Required	Various	Discharge Nozzles
1	97428	Switch, Discharge Pressure
2	18546	Valve, Check, 2” FNPT (50 mm)
1	18489	Sign, Warning, Exit, Clean Agent
1	18770	Sign, Warning, Entrance, Clean Agent

Sample Lv Series Single Cylinder Equipment Order List		
Quantity	**P/N**	**Description**
1	20510-945	Cylinder Assembly, FK-5-1-12, 1000 lb
945 lbs	FK-5-1-12	FK-5-1-12 Agent
1	18537	Bracket Assembly, Cylinder, 30”
1	20722	Electric Valve Actuator
1	17001	Manual Valve Actuator
1	20529	Gauge Assembly, Pressure, FK-5-1-12
1	18775	Switch Assembly, Low-Pressure Supervisory
1	18554	Coupling, Grooved, 3” (80 mm)
1	18550	Elbow, Grooved, 3” (80 mm)
As Required	Various	Discharge Nozzles
1	97428	Switch, Discharge Pressure
1	18489	Sign, Warning, Exit, Clean Agent
1	18770	Sign, Warning, Entrance, Clean Agent

Sample Lv Series Three Cylinder Equipment Order List (Manifolded)		
Quantity	**P/N**	**Description**
3	20508-450	Cylinder Assembly, FK-5-1-12, 600 lb
1350 lbs	FK-5-1-12	FK-5-1-12 Agent (450 lbs per Cylinder)
3	18536	Bracket Assembly, Cylinder, 24”
1	20722	Electric Valve Actuator
1	17001	Manual Valve Actuator
3	20529	Gauge Assembly, Pressure, FK-5-1-12
3	18775	Switch Assembly, Low-Pressure Supervisory
3	18554	Coupling, Grooved, 3” (80 mm)
3	18550	Elbow, Grooved, 3” (80 mm)
2	17019	Pneumatic Valve Actuator
1	18560	Valve, Check, 1/4” MNPT x 1/4” JIC Male (8 mm x 8 mm), Brass *Pilot Actuation Check Valve*
2	18650	Hose, Flex, 3/16”, 1/4” (8 mm) JIC Female - 34” (864 mm)
1	18622	Tee, 1/4” JIC Male x 1/4” MNPT (8 mm x 8 mm), Brass *Pilot Actuation Mid Line Tee*
1	18625	Adapter, 1/4” MNPT x 1/4” JIC Male (8 mm x 8 mm), Brass *Male NPT Adapter*
1	18611	Tee, 1/4” FNPT x 1/4” MNPT (8 mm x 8 mm), Brass *Pilot Actuation End Line Tee*
1	10173	Vent Check
As Required	Various	Discharge Nozzles
1	97428	Switch, Discharge Pressure
3	18538	Valve, Check, 3” Grooved (80 mm)
1	18489	Sign, Warning, Exit, Clean Agent
1	18770	Sign, Warning, Entrance, Clean Agent

4 SYSTEM INSTALLATION

The installation of the Janus Fire Systems® Fire Extinguishing System utilizing FK-5-1-12 should be undertaken by competent mechanical and electrical technicians familiar with NFPA 2001 and with the installation of clean agent systems who have reviewed this manual and all hazard drawings and calculations. No special tools are required to assemble the equipment.

A complete hazard analysis and system design, including a drawing of the system layout, must be completed before the installation of any system and submitted to the authority having jurisdiction (AHJ). The design, drawings, and material list should be compared with conditions found on site. Cylinder size and agent fill must match design calculations. Temperature and humidity of the area must be within system limitations and room integrity must be consistent with the initial design. All components should be inspected for shipping damage.

Materials such as piping, pipe hangers, fittings, tubing, conduit, and mounting hardware are not typically supplied by Janus Fire Systems. These items are to be supplied by the installer and must meet the minimum required material specifications found in this manual, NFPA 2001 - Standard on Clean Agent Fire Extinguishing Systems, NFPA 72 - The National Electrical Code, as well as local building and fire codes or local norms.

System has been verified through testing to function in ambient temperatures ranging from 32˚F (0˚C) to 130˚F (54˚C). Flow calculations have been verified at ambient temperatures of 70˚F ±10˚ (21.1˚C ±5.5˚). Storage outside of the range of 70˚F ±10˚ (21.1˚C ±5.5˚) may result in inaccurate flow calculations and cause one or more nozzles to not discharge the designed quantity of FK-5-1-12.

⚠ WARNING

Discharge of an unsecured cylinder may result in injury, death, or damage to property from violent cylinder movement or over-exposure to high concentrations of agent. The cylinder is fitted with an anti-recoil safety plug or device to protect against violent cylinder movement during accidental discharge. Do not remove the anti-recoil safety device from the discharge outlet until the cylinder is securely mounted in the bracket and the cylinder is ready to be connected to the discharge piping system. Do not transport the cylinder unless the anti-recoil safety device is in place. Handle the cylinder assembly with care even when the safety device is in place.

Do not install the electric, manual, or pneumatic valve actuators until all cylinder straps, pipe, and nozzles are securely installed. Failure to comply could result in accidental discharge of the cylinder. Remove the electric, manual, and pneumatic valve actuators before transporting cylinder.

Do not apply excessive force to the low-pressure supervisory switch or pressure gauge or attempt to carry the cylinder assembly or cylinder valve by the low-pressure switch or pressure gauge. If the low-pressure supervisory switch or pressure gauge breaks at the fitting, agent will discharge through the port potentially causing personal injury or property damage, and complete loss of agent.

Section 4 System Installation

4.1 Mechanical Installation

Mechanical installation may be performed in conjunction with electrical installation or performed separately, but both installations must be completed before the system is commissioned (Section 5).

⚠ WARNING

Do not install the electric, pneumatic, or manual valve actuators until the system has been fully commissioned as detailed in Section 5. Failure to comply could result in personal injury or death from violent cylinder movement or over-exposure to high concentrations of agent.

4.1.1 Installing Cylinder Bracket Channels

⚠ CAUTION

All clean agent cylinders for a single hazard must be stored at the same temperature.

All care shall be taken to avoid accidental damage or wear to the cylinder assembly(s) during the installation of discharge piping and nozzles. The cylinder assembly may be temporarily placed into position to properly locate the placement of cylinder bracket channel and discharge piping, but should not be secured into the cylinder bracket until discharge piping and nozzle installation is completed.

Fasten the back channel(s) securely to a rigid load-bearing vertical surface at the appropriate height. The clean agent cylinder(s) must rest on a surface capable of supporting the combined weight of the cylinder and agent. The cylinder must be oriented so that the pressure gauge faces out.

⚠ CAUTION

The clean agent cylinder assembly must be mounted in a vertical position so its valve assembly is located at the top of the cylinder.

Figure 4.1.1a Sv Cylinder Bracket & Dimensions

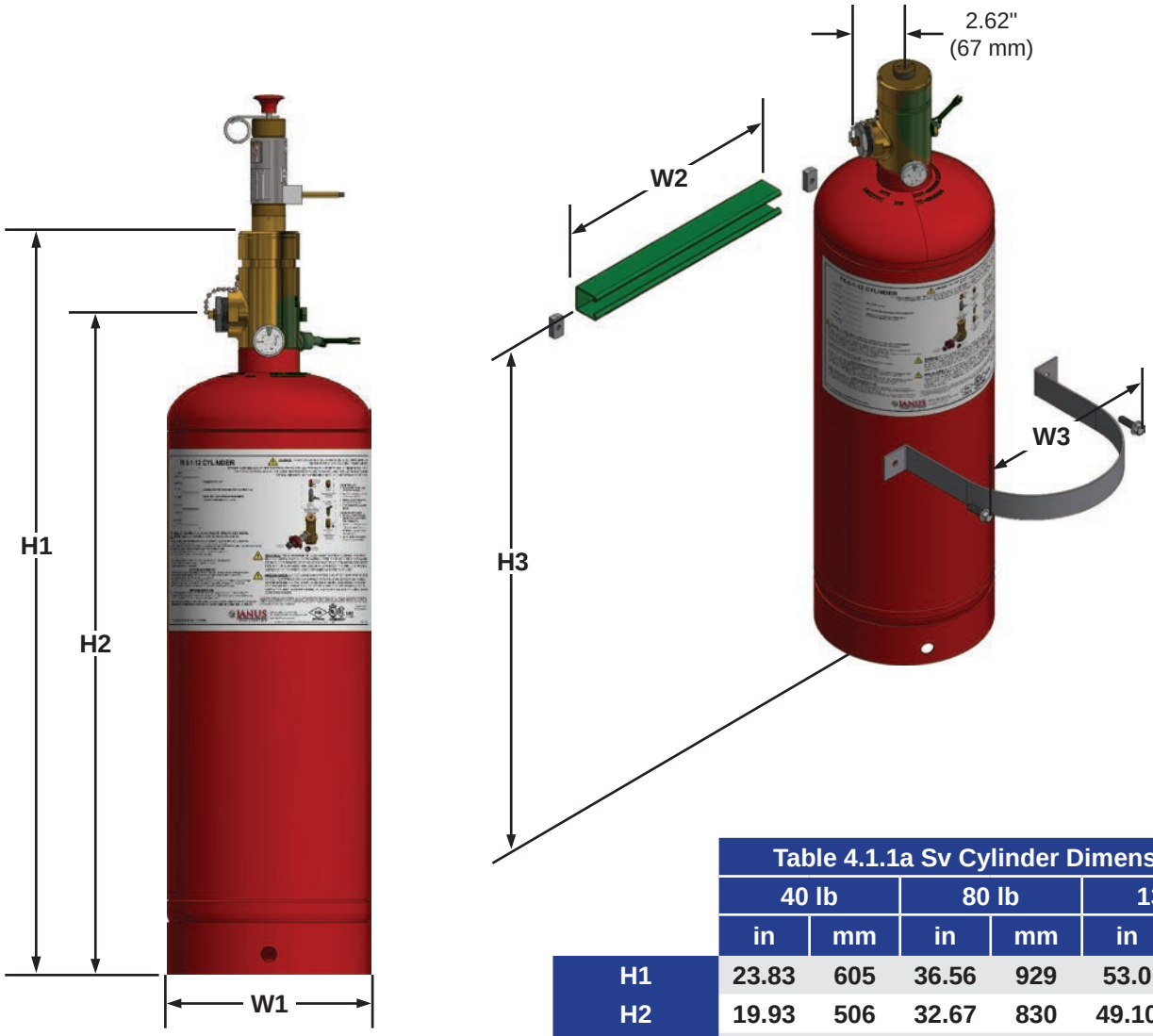


Table 4.1.1a Sv Cylinder Dimensions						
	40 lb		80 lb		130 lb	
	in	mm	in	mm	in	mm
H1	23.83	605	36.56	929	53.0	1346
H2	19.93	506	32.67	830	49.10	1247
H3	13.63	346	15.75	400	30.75	781
W1	10.0	254	10.0	254	10.0	254
W2	14.0	356	14.0	356	14.0	356
W3	11.9	302	11.9	302	11.9	302
Bracket P/N	18595		18595		18595	

Bracket Assembly includes:
(2) 3/8" twirl nuts (P/N 18811)
(2) 3/8"-16 1-1/14" cap screws (P/N 18606)
(1) strap (P/N 18596)
back channel (P/N 98254)

Section 4 System Installation

Figure 4.1.1b Mv Cylinder Bracket & Dimensions

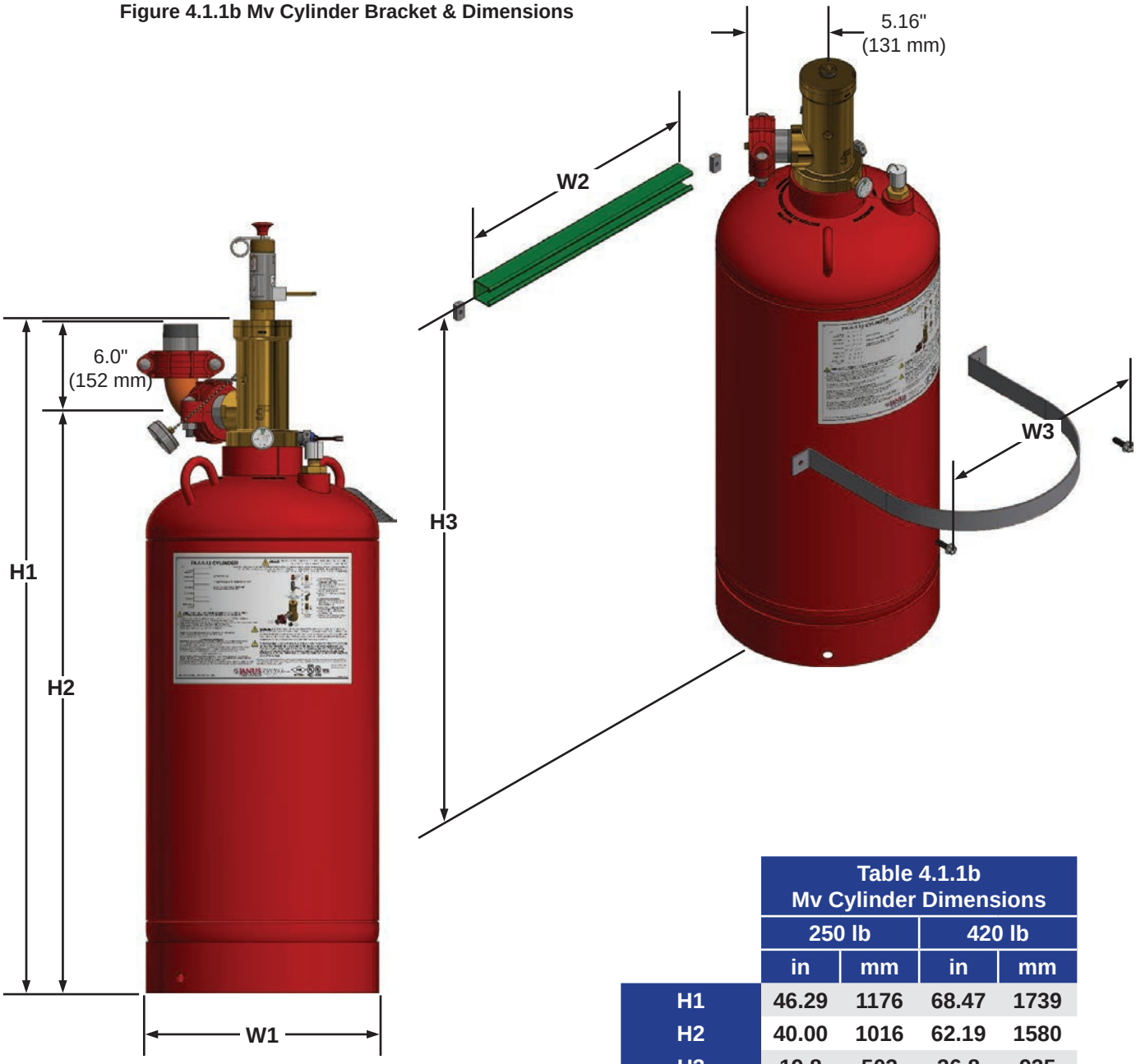
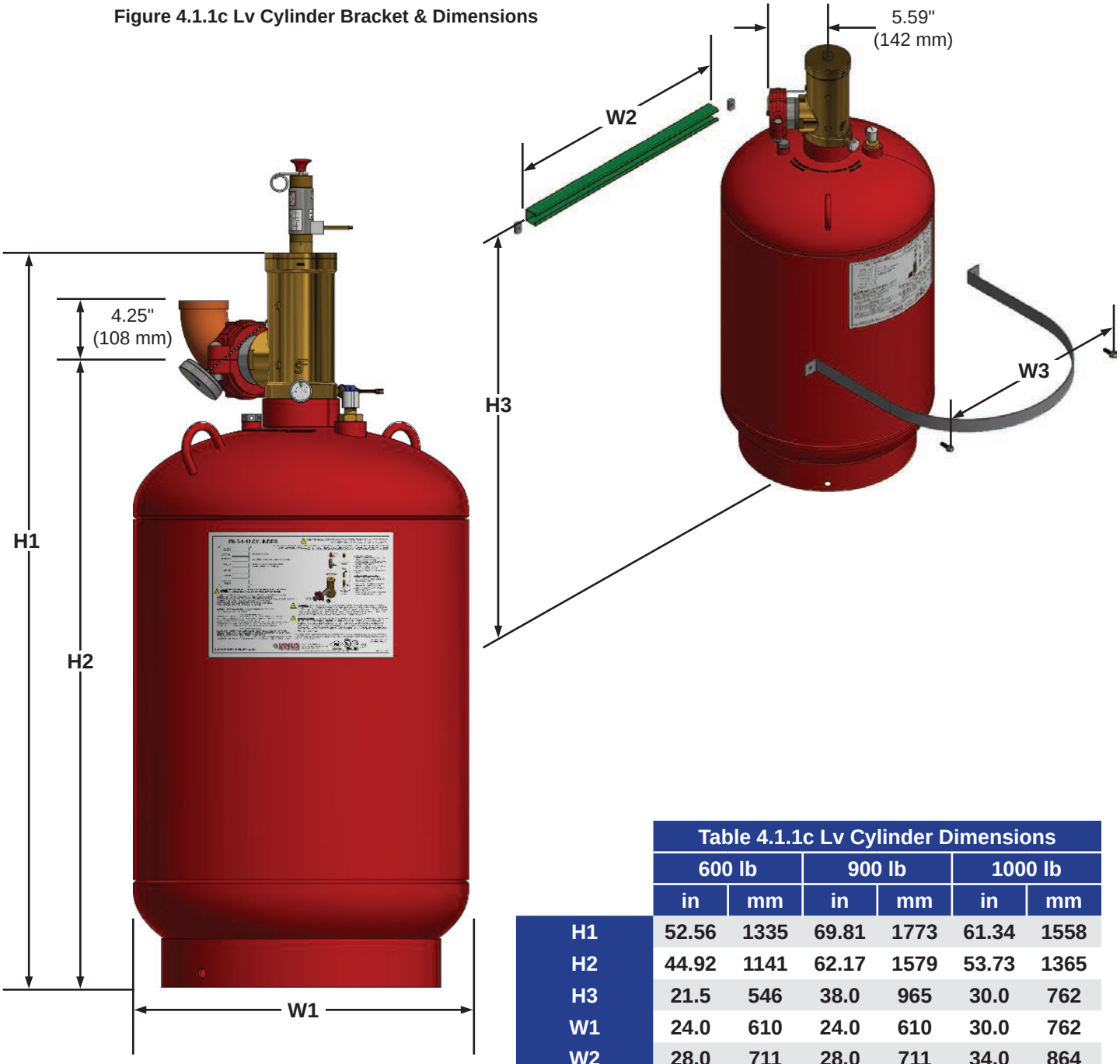


Table 4.1.1b Mv Cylinder Dimensions				
	250 lb		420 lb	
	in	mm	in	mm
H1	46.29	1176	68.47	1739
H2	40.00	1016	62.19	1580
H3	19.8	503	36.8	935
W1	16.0	406	16.0	406
W2	20.0	508	20.0	508
W3	17.9	455	17.9	455
Bracket P/N	18535		18535	

Bracket Assembly includes:
(2) 3/8" twirl nuts (P/N 18811)
(2) 3/8"-16 1-1/14" cap screws (P/N 18606)
(1) strap (P/N 18597)
back channel (P/N 98253)

Figure 4.1.1c Lv Cylinder Bracket & Dimensions



Bracket Assembly includes:

(2) 3/8" twirl nuts (P/N 18811)
(2) 3/8"-16 1-1/14" cap screws (P/N 18606)
(1) strap (600/900 lb - P/N 18598; 1000 lb - P/N 18599)
(1) back channel (600/900 lb - P/N 98252; 1000 lb - P/N 98251)

Table 4.1.1c Lv Cylinder Dimensions

	600 lb		900 lb		1000 lb	
	in	mm	in	mm	in	mm
H1	52.56	1335	69.81	1773	61.34	1558
H2	44.92	1141	62.17	1579	53.73	1365
H3	21.5	546	38.0	965	30.0	762
W1	24.0	610	24.0	610	30.0	762
W2	28.0	711	28.0	711	34.0	864
W3	25.9	658	25.9	658	31.9	810
Bracket P/N	18536		18536		18537	

4.1.2 Installing Discharge Piping

Discharge pipe, fittings, brackets, and hangers are not normally supplied by Janus Fire Systems and must be provided by installer. Materials should be new and free from rust and corrosion. Pipe size, schedule, routing, reductions, changes in elevations, etc must be in accordance with the drawings and in accordance with calculations performed using the Janus Design Suite® software. Any deviations in routing or fitting quantities must be coordinated and verified by the system designer prior to implementing changes.

Pipe must comply with NFPA 2001 and be either Schedule 40 or 80. Pipe can be of any of the following fabrication classifications.

Seamless - Round pipe without a longitudinal seam.

Electric Resistance Welded (ERW) - Pipe with a longitudinal joint where fusion of the joint is produced by the heat obtained from the resistance to the flow of electric current.

Furnace Butt Welded Pipe (Welded Pipe) - Pipe fabricated by mechanical pressure developed by drawing the furnace heated metal through a conical die that serves to form and weld the tubular shape.

Refer to Table 4.1.2 for acceptable pipe grades.

Table 4.1.2 Acceptable Pipe Grades

Seamless	**Grade A-53 A or B, Grade A-106 A or B or C**
Electric Resistance Welded (ERW)	**Grade A-53 A or B**
Furnace Welded	**Grade A-53 F - 3/8" (10 mm) to 4" (100 mm) Pipe Sizes**

⚠ WARNING

Cast iron pipe, steel pipe conforming to ASTM A-120, aluminum pipe, or non-metallic pipe shall not be used.

4.1.2.1 Threaded Pipe

At a minimum threaded pipe joints must be reamed free of burrs and obstructions. Any lubricants used in the threading process must be cleaned from the ends of the pipe to reduce the chance of cutting lubricant or shavings entering the nozzle orifices or being deposited in ceilings or equipment. Threaded joints must conform to ANSI B1-20.1. Pipe sections should be swabbed with appropriate nonflammable degreasing solvent to remove any traces of preservatives or lubricant.

Prior to fit up dry compressed air or nitrogen can be used to “blow out” any debris left in the pipe bore during the cleaning process.

The exposed threaded joints must be wrapped with polytetrafluoroethylene (PTFE or Teflon tape) or anaerobic PTFE-based paste. Both are used as a lubricant that allows threads to mate more readily and fills any variances in the thread surfaces.

4.1.2.2 Threaded Fittings

Threaded fittings must comply with NFPA 2001 and be at a minimum class 300 malleable iron, class 300 ductile iron, or have a **minimum rated working pressure** of 416 psi (28.7 bar) at 70°F (21.1°C).

⚠ WARNING

Class 150 lb fittings shall not be used.

4.1.2.3 Grooved Fittings and Couplings

Grooved fittings and couplings must comply with NFPA 2001 and have a **minimum rated working pressure** of 416 psi (28.7 bar) at 70°F (21.1°C) based upon carbon steel pipe roll or cut grooved in accordance with the fitting or coupling manufacturer's guidelines.

Gaskets must be compatible with FK-5-1-12 (typically EPDM having a temperature range of -30°F to 230°F [-34°C to 110°C]). Gasket lubricant must be in accordance with manufacturer's specifications.

4.1.2.4 Pipe Reductions

Reductions in pipe sizes may be accomplished using threaded or grooved concentric reducing fittings, steel or stainless steel concentric swage fittings, or steel or stainless steel reducing bushings. All such fittings must comply with NFPA 2001 and have a **minimum rated working pressure** of 416 psi (28.7 bar) at 70°F (21.1°C).

⚠ WARNING

Pipe reductions can be made using machined or forged steel hex bushings. Malleable and/or cast iron bushings are NOT to be used.

4.1.2.5 Pipe Supports and Hangers

System piping must be adequately supported with appropriate pipe supports and hangers to withstand the thrust exerted during system discharge. The number of supports and hangers required depends on the specific system piping configuration.

All supports and hangers shall comply with NFPA 2001 and be used in accordance to their manufacturer's limits and specifications and state and local building codes.

Hangers and supports must be steel. They must adequately allow for movement or contraction occurring from changing thermal conditions.

Hangers and supports must be designed and installed to minimize vertical and lateral sway or thrust.

Hangers and supports must be placed at every change in direction of the piping network and at every nozzle. Additional supports shall be placed at intermediate location in between.

When intermediate hangers are of the rod type, they must be steel clad or steel clevis, of proper size, and with a solid bar-type hanger rod to support the weight of the pipe and agent.

When grooved pipe, fittings, and couplings are used, brackets and supports must be anchored per the fitting manufacturer's specifications. No grooved pipe length shall be left unsupported.

⚠ WARNING

Cast iron supports, conduit clamps, or "C" clamps are not to be used to support pipe.

4.1.3 Installing Nozzles

Nozzle type, style, and orifice diameter are determined based upon flow calculations made by the Janus Design Suite software during the system design. Discharge nozzles are female NPT thread and must be installed as designed according to the guidelines covered under section 3.5.

Due to the thrust generated from a 90˚ corner or 180˚ sidewall nozzle, a rigid hanger or support must be located within 12 in (305 mm) of the nozzle to prevent pipe movement and/or nozzle rotation during discharge.

4.1.4 Installing Cylinder Assembly

Position the cylinder assembly against the back channel so that the pressure gauge faces out.

Secure the mounting strap into the back channel with the bracket held horizontally. Fasten the strap with the supplied 3/8"-16 1-1/4" cap screw and 3/8" twirl nut.

4.1.4.1 Installing Pressure Gauge Assembly (Mv and Lv Series only)

Prior to installing the pressure gauge assembly, both the o-ring on the assembly connection and the inside of the pressure gauge connection on the cylinder valve must be lightly lubricated with Molykote 55 by Dow Corning (P/N 19056) or equivalent. Teflon tape shall not be used.

Install the pressure gauge assembly into the pressure gauge connection and tighten the swivel nut until it mates with the valve face. When the swivel nut is almost tight, the pressure gauge assembly will upset the Schrader valve. The O-ring on the pressure gauge assembly immediately seals to prevent loss of FK-5-1-12.

Once the pressure gauge assembly is connected, it should be used to check the pressure inside the cylinder. A pressure drop of more than 10% indicates the cylinder assembly must be recharged or replaced. Pressure should be 360 psig (24.8 bar) at 70˚F (21˚C). Refer to Table 6.2.1.1 in Appendix B for normal pressures at other temperatures.

Any time the pressure gauge assembly is removed from the cylinder valve, the assembly o-ring must be replaced with a new o-ring (P/N 98791 - Pack of 25). Prior to re-installing the pressure gauge assembly, both the new o-ring and the inside of the pressure gauge connection on the cylinder valve must be lightly lubricated with Molykote 55 by Dow Corning (P/N 19056) or equivalent.

4.1.4.2 Installing Low-Pressure Supervisory Switch Assembly (Mv and Lv Series only)

Prior to installing the low-pressure supervisory switch assembly, both the o-ring on the assembly connection and the inside of the pressure gauge connection on the cylinder valve must be lightly lubricated with Molykote 55 by Dow Corning (P/N 19056) or equivalent. Teflon tape shall not be used.

Install the low-pressure supervisory switch assembly into the low-pressure supervisory connection and tighten the swivel nut until it mates with the valve face. When the swivel nut is almost tight, the low-pressure supervisory switch assembly will upset the Schrader valve. The O-ring on the low-pressure supervisory switch assembly immediately seals to prevent loss of FK-5-1-12.

Any time the low-pressure supervisory switch assembly is removed from the cylinder valve, the assembly o-ring must be replaced with a new o-ring (P/N 98791 - Pack of 25). Prior to re-installing the slow-pressure supervisory witch assembly, both the new o-ring and the inside of the pressure gauge connection on the cylinder valve must be lightly lubricated with Molykote 55 by Dow Corning (P/N 19056) or equivalent.

4.1.5 Installing Discharge Pressure Switch

Pressure to operate the discharge pressure switch is supplied by the primary cylinder. In a single cylinder system, it can be connected to the pilot actuation port or a tee in the discharge piping. In a multiple cylinder systems, it can be connected to the discharge manifold or the pilot actuation port of the final secondary cylinder.

The discharge pressure switch has a SPDT contact for connection to the control panel. The switch will send a signal to the control panel confirming system actuation. If a control panel is not included, the discharge pressure switch can provide necessary control functions for closing any doors or dampers in the room or enclosure or to initiate the shut down of equipment that may deplete agent concentration.

1. Mount the switch box securely onto a wall or structural member using the mounting holes provided. The switch should be located so that it can be manually reset following actuation. Preferred mounting is upright with pipe connections to the bottom.

2. Connect 3/4 inch conduit and appropriate wiring to the electrical connection on the switch box.

3. To switch loads heavier than the switch rating, or requiring more than two contacts, the switch should be used to operate a relay or contactor to control the load.

4. Connect the 1/4 inch NPT connection at the bottom of the front plate to the agent piping using 1/4 inch steel pipe, 1/4 inch or 3/16 inch O.D. copper or SST tube, or 3/16 inch flex hose. Install a union fitting at base of cover to allow removal of front plate for testing.

4.1.6 Installing Pilot Actuation Line

On a multiple cylinder system, the primary and secondary cylinders must be interconnected with the pilot actuation line. Flex hose and fittings necessary to assemble the pilot actuation line can be ordered from Janus Fire Systems, but the pilot actuation line may also be assembled using copper or SST tubing or schedule 40 pipe provided by the installer. Refer to Sections 4.1.6.1 through 4.1.6.4 for requirements to each specific type of pilot actuation line arrangement.

Up to 16 cylinders can be actuated simultaneously on a single system. The primary cylinder valve is discharged electrically or manually and up to 15 secondary cylinders can be actuated pneumatically using pressure from the primary cylinder through the pilot actuation line.

A pilot actuation check valve **must** be installed into the pilot actuation port with the direction of flow ***out*** of the valve. This pilot actuation check valve is used to maintain pressure in the pilot actuation line and pneumatic valve actuators to ensure the valve remains open during discharge and a complete dispersal of secondary cylinder contents is achieved.

The pilot actuation line connects to each secondary cylinder at a 1/4 in (8 mm) female NPT inlet port in the pneumatic valve actuator. One pneumatic valve actuator is required for each secondary cylinder.

A vent check must be installed in the pilot actuation line downstream of the pilot actuation check valve typically at the last cylinder. It is used to bleed off pressure that may accumulate in the pilot actuation line, reducing the chance of inadvertent operation of the pneumatic valve actuators. The vent check contains a ball seat that seals the vent check during the rapid pressure accumulation of an actual discharge.

Before assembling the pilot actuation line, all hose, tubing, pipe and/or fittings should be carefully cleaned internally to remove all oil, dirt, or foreign material.

Teflon tape or joint compound must be used on all threaded connections. Use care when applying pipe tape or joint compound so they don't enter the pipe. Do not use pipe tape or compound on flared fittings.

On multiple cylinder systems, the discharge pressure switch must not be connected to the pilot actuation line. It may be connected to the discharge manifold or the pilot actuation port of the final secondary cylinder.

4.1.6.1 Installation Using Flex Hose

Janus Fire Systems flex hose assemblies may be used to assemble the pilot actuation line as shown in Figures 4.1.6.1a, 4.1.6.1b, and 4.1.6.1c. The appropriate length of flex hose for each cylinder assembly size is shown in Table 2.3.9. All fittings necessary to complete the pilot actuation line are available from Janus Fire Systems and are describe in Section 2 of this manual. Any other fittings utilized must be appropriate 1/4" brass 37° JIC fittings with a minimum pressure rating of 1200 psig (82.7 bar).

The pilot actuation line begins at the pilot actuation port of the primary cylinder and ends at the pneumatic valve actuator of the last secondary cylinder. When utilizing flex hose, the total length of the pilot actuation line from the primary cylinder to the last secondary cylinder (including any rises or drops) cannot be greater than 100 ft (30.48 m).

4.1.6.2 Installation Using Copper or Stainless Steel Tubing

Copper tubing or stainless steel (such as 304 or 316) seamless tubing and appropriate fittings provided by the installer may be used to assemble the pilot actuation line as shown in Figures 4.1.6.2. Copper tubing must be 1/4" O.D. with a 0.030" wall thickness (meeting ASTM B280). All fittings utilized must be appropriate brass or steel compression style fittings (with brass or steel sleeves or ferrules) or SAE 45° flared tube fittings with a minimum pressure rating of 1200 psig (82.7 bar). Stainless steel tubing must be 1/4" O.D. with a 0.035" wall thickness (conforming to ASTM A-213 and A-269). All fittings utilized must be appropriate stainless steel compression style fittings (with stainless steel sleeves or ferrules) or SAE 45° flared tube fittings with a minimum pressure rating of 1200 psig (82.7 bar).

To accommodate the use of compression style or SAE 45° flared tube fittings, the standard Janus Fire Systems® Pilot Actuation Check Valve (P/N 18560) is not recommended. Instead, the Janus Fire Systems® NPT Style Pilot Actuation Check Valve (P/N 10262) along with an adapter hex nipple (P/N 18713 or P/N 19192) is used as shown in the highlighted section of Figure 4.1.6.2.

The pilot actuation line begins at the pilot actuation port of the primary cylinder and ends at the pneumatic valve actuator of the last secondary cylinder. When utilizing copper or stainless steel tubing, the total length of the pilot actuation line from the primary cylinder to the last secondary cylinder (including any rises or drops) cannot be greater than 100 ft (30.48 m).

4.1.6.3 Installation Using Schedule 40 Pipe

Schedule 40 pipe provided by the installer may be used to assemble the pilot actuation line as shown in Figures 4.1.6.3. The Schedule 40 pipe must be 1/4" (8 mm) and comply with the guidelines set forth in NFPA 2001 and Sections 4.1.2 through 4.1.2.5 of this manual.

Janus Fire Systems 24" (610 mm) flex hose assemblies (P/N 18649) should be used to connect pilot actuation piping to the pilot actuation check valve and pneumatic actuators, utilizing appropriate 1/4" brass 37° JIC or 45° SAE flare fittings with a minimum pressure rating of 1200 psig (82.7 bar).

The pilot actuation line begins at the pilot actuation port of the primary cylinder and ends at the pneumatic valve actuator of the last secondary cylinder. When utilizing Schedule 40 pipe, the total length of Schedule 40 pipe from the primary cylinder to the last secondary cylinder (including any rises or drops) cannot exceed 25 ft (7.62 m) in length.

4.1.6.4 Two-Sided Pilot Actuation Lines

To maximize distances between cylinders, a tee may be installed extending from the pilot actuation port of the primary cylinder (after the pilot actuation check valve) to allow the pilot actuation line to extend in two directions. All guidelines and limits previously stated in Sections 4.1.6 through 4.1.6.3 apply to such arrangements in addition to the following:

- When utilizing flex hose, the total length of the pilot actuation line from the primary cylinder to the last secondary cylinder in either direction (including any rises or drops) cannot be greater than 100 ft (30.48 m) in each direction.
- When utilizing copper or stainless steel tubing, the total length of the pilot actuation line from the primary cylinder to the last secondary cylinder in either direction (including any rises or drops) cannot be greater than 100 ft (30.48 m) in each direction.
- When utilizing Schedule 40 pipe, the total length of the pilot actuation line from the primary cylinder to the last secondary cylinder in either direction (including any rises or drops) cannot be greater than 25 ft (7.62 m) in each direction.
- To accommodate the use of the standard Janus Fire Systems® Pilot Actuation Mid Line Tee to allow the pilot actuation line to extend in two directions, the Janus Fire Systems® NPT Style Pilot Actuation Check Valve (P/N 10262) along with an adapter hex nipple (P/N 18713 or P/N 19192) is used. A 1/4" (8 mm) FNPT x FNPT coupling (P/N 99686) is needed to connect the NPT Style Pilot Actuation Check Valve to the Pilot Actuation Mid Line Tee.

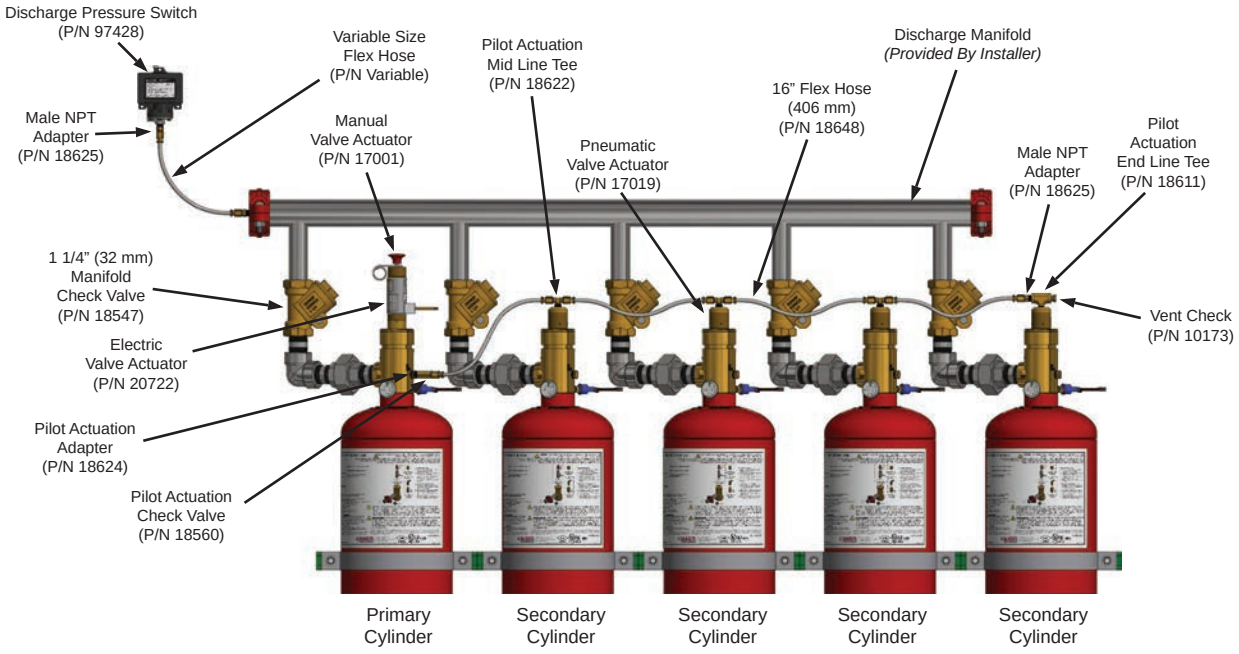


Figure 4.1.6.1a Pilot Actuation Line Configuration for Sv Series Cylinders

Section 4 System Installation

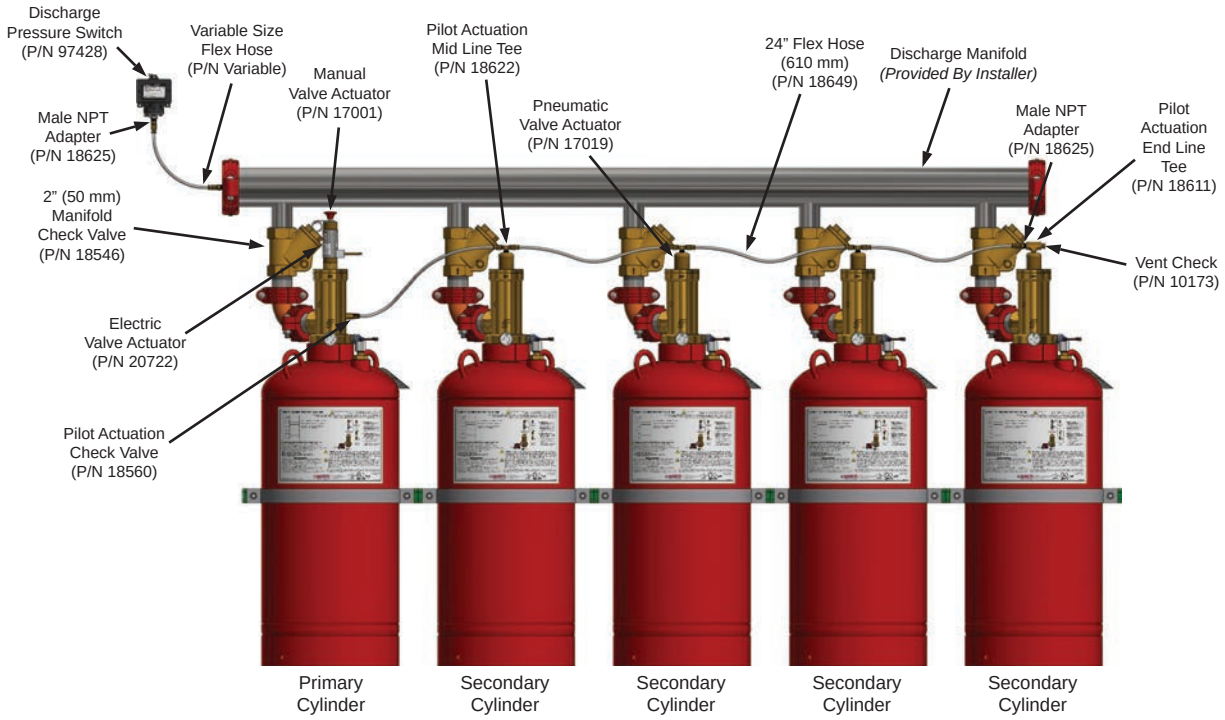


Figure 4.1.6.1b Pilot Actuation Line Configuration for Mv Series Cylinders

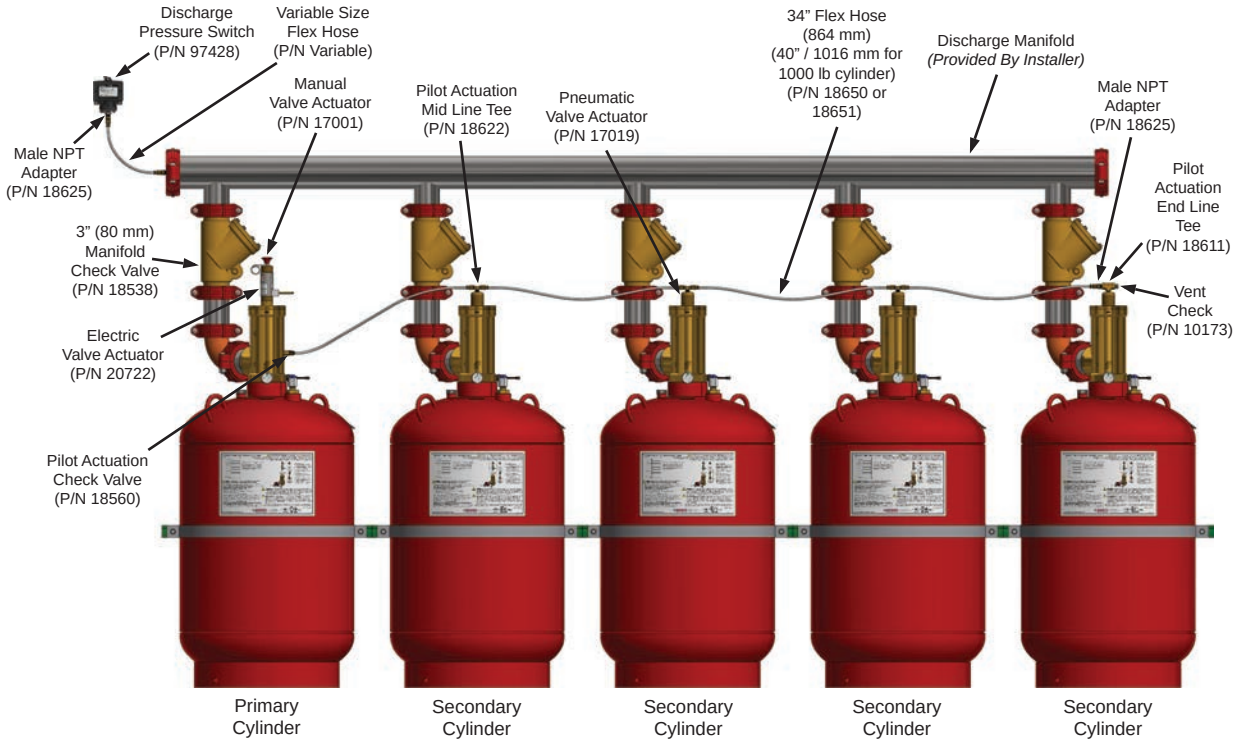


Figure 4.1.6.1c Pilot Actuation Line Configuration for Lv Series Cylinders

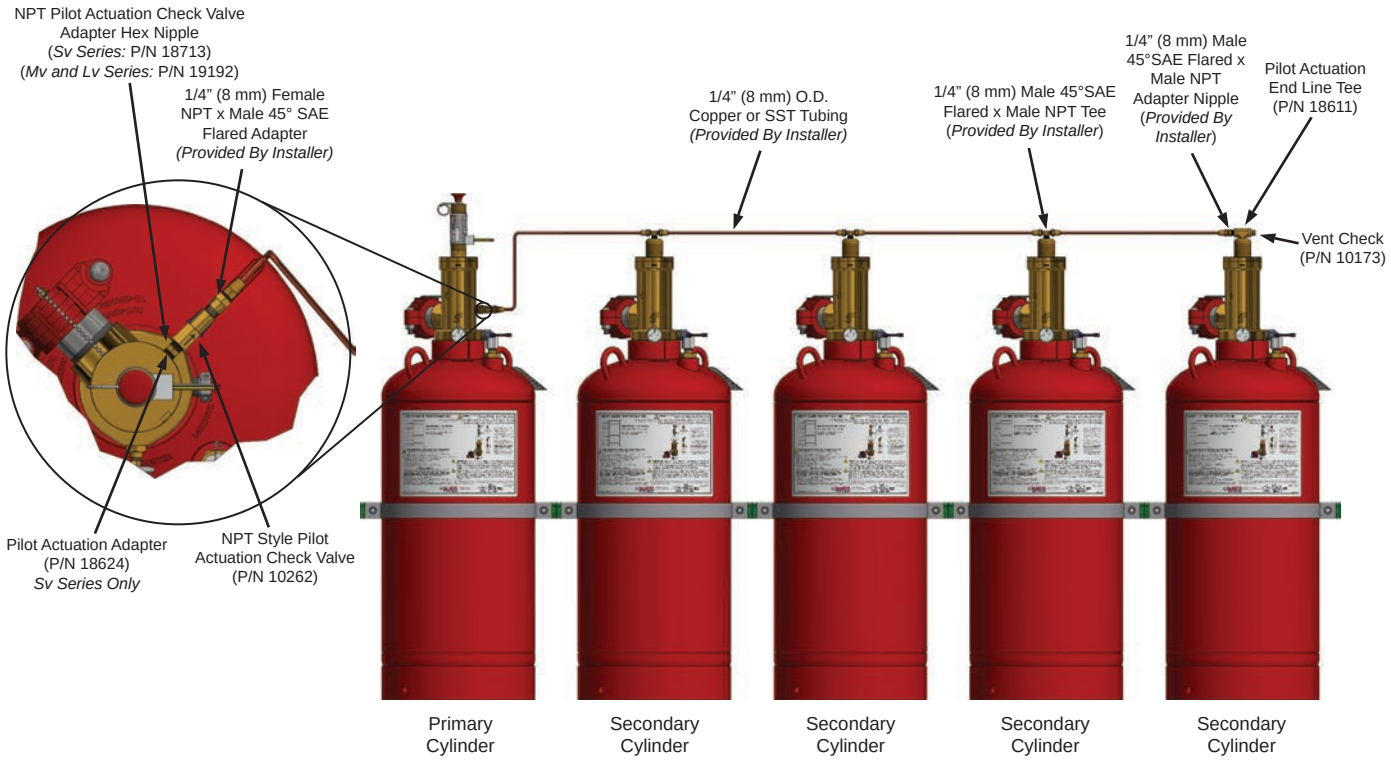


Figure 4.1.6.2 Alternate Pilot Actuation Line Configuration – Utilizing Copper or SST Tubing
(Mv Series Shown. Same for all Series)

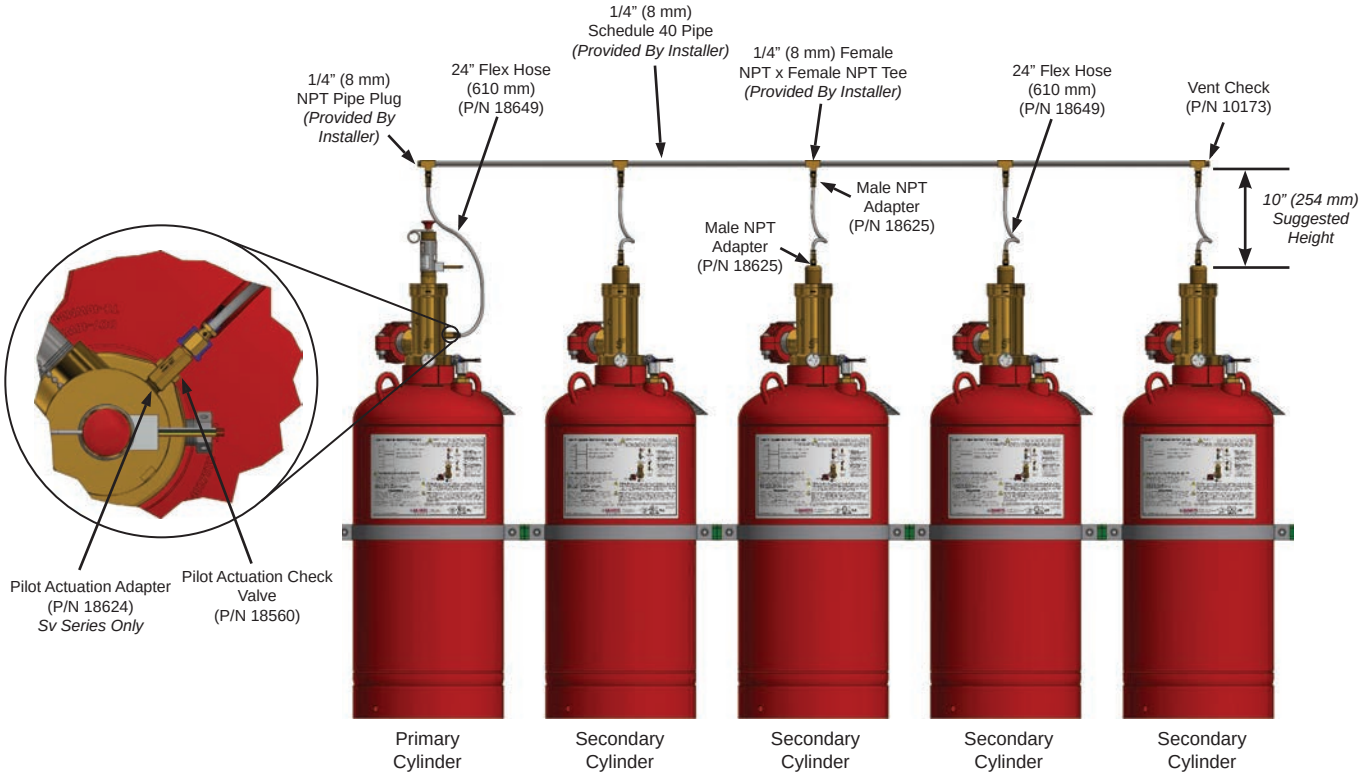


Figure 4.1.6.3 Alternate Pilot Actuation Line Configuration – Utilizing Schedule 40 Pipe
(Mv Series Shown. Same for all Series)

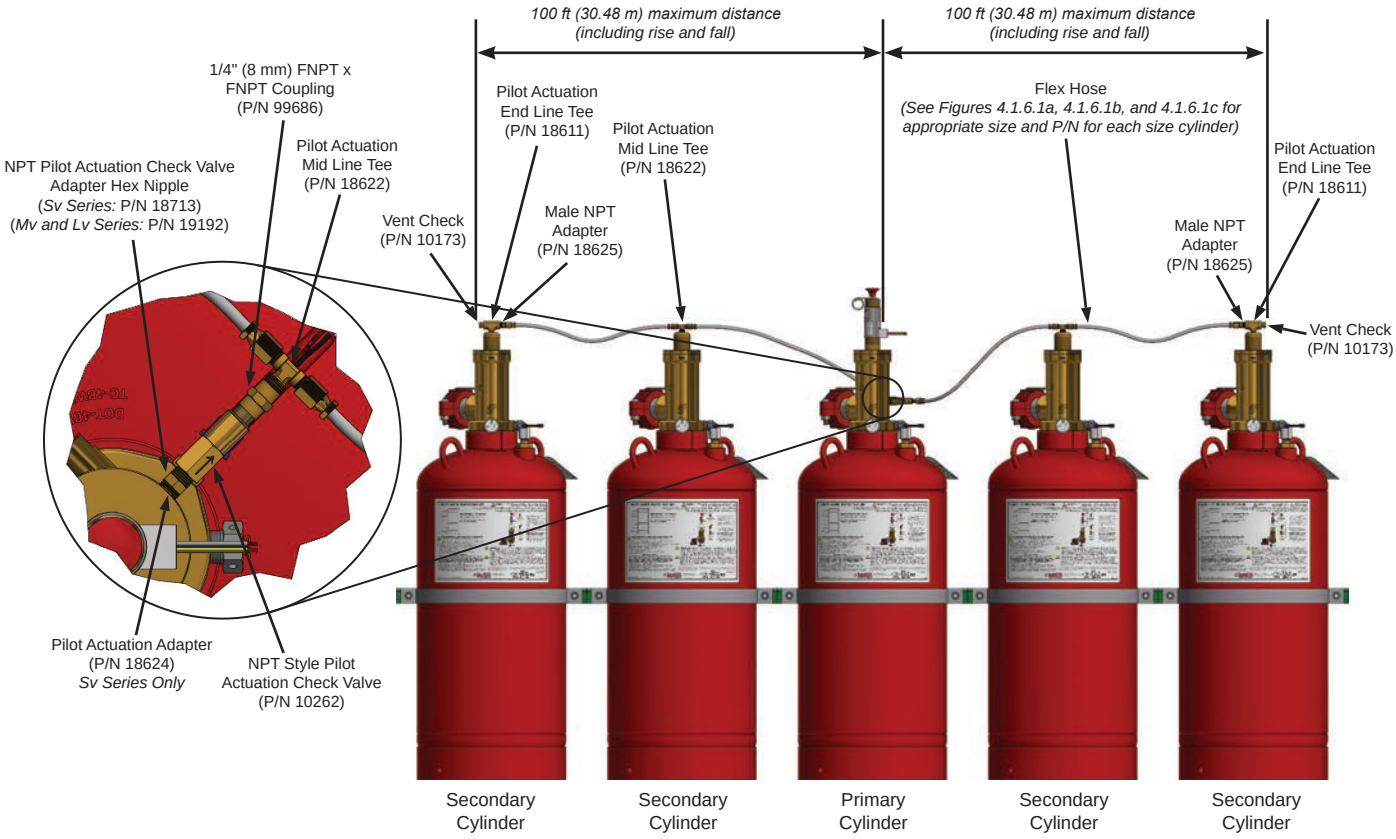


Figure 4.1.6.4 Alternate Pilot Actuation Line Configuration – Two-Sided Pilot Actuation Line
(Mv Series Shown. Same for all Series)

- A vent check shall be installed at both ends of the pilot actuation line downstream of the pilot actuation check valve.

Refer to Figure 4.1.6.4 for an example of a two-sided pilot actuation line arrangement utilizing flex hose.

4.2 Electrical Installation

Electrical installation may be done in conjunction with mechanical installation or separately, but both installations must be completed before the system is commissioned (Section 5). Wiring must be installed in accordance with the guidelines of NFPA 70 - National Electrical Code, NEMA, and local electrical codes. Early warning detection, audible and visible alarm device, and control panels must be installed and tested in accordance with NFPA 70 - National Electrical Code and NFPA 72 - National Fire Alarm Code as well as local electrical codes.

5 COMMISSIONING SYSTEM

⚠ WARNING

Do not install the electric, pneumatic, or manual valve actuators until the system has been fully commissioned. Failure to comply could result in personal injury or death from violent cylinder movement or over-exposure to high concentrations of agent.

The system checkout procedures outlined in this chapter are intended to represent the minimum requirements for the extinguishing system portion of the system. NFPA 2001 shall also be consulted. Additional procedures may be required by the local authority having jurisdiction (AHJ).

The control system portion of the system providing automatic detection and release should be thoroughly checked out according to the appropriate technical manual and the requirements of the local authority having jurisdiction (AHJ) before completing this section.

5.1 System Review

Conduct a room integrity (door fan) test in accordance with NFPA 2001. The results of this test will provide equivalent leakage area and, when conducted in accordance with the manufacturer's instructions, will predict the timeline for a descending interface to fall to a given height and estimate how long the extinguishing concentration will be maintained in the protected room. Room dimensions identified in the course of this test shall be verified to correspond with room volume utilized in determining Janus Design Suite® flow calculations for the enclosure.

Check security and tightness of cylinder mounting brackets to a solid structure and cylinder bracket straps.

Check and record cylinder pressure gauges and room temperature. Pressure should be 360 psig at 70˚F (24.8 bar at 21˚C). For temperatures other than 70˚F (21˚C) refer to the pressure temperature chart in the appendix.

Check the stamped fill weight on the cylinder nameplate to verify it is the correct amount for the room as determined and documented in the design.

Piping should be checked for correct size, length, and grade and compared to the installation drawings, Janus Design Suite® flow calculation results, and manual limitations.

Check pipe supports for proper type, mounting, and spacing.

Check that nozzle location, size, style, and drill diameters of orifices match both installation/design drawings and calculations.

5.2 Discharge Piping Pressure Test

⚠WARNING

Do not apply pressure to the discharge piping while the pipe is connected to the discharge outlet. Applying pressure to the discharge outlet may cause the valve to open and pressurize the distribution pipe with the FK-5-1-12, causing personal injury or property damage, and complete loss of agent.

NFPA 2001 mandates that all fittings be checked for tightness and pressure tested. Remove the nozzles and install pipe caps. Remove the discharge piping from the cylinder valve and install the anti-recoil safety device onto the cylinder discharge outlet. Connect a source of dry compressed air or nitrogen to the distribution piping. Slowly increase the pressure in the piping to 40 psi (2.76 bar) and then close the valve supplying pressure. Check the pressure after 10 minutes. If the pressure is equal to or above 32 psig (2.20 bar) (80% of test pressure) the system is considered sealed. If it drops below 32 psig (2.20 bar) check and tighten all fittings then re-run the test. After completing the test, remove pipe caps, reinstall nozzles, and reconnect discharge piping to cylinder.

⚠WARNING

Pressure testing may potentially cause a rupture of the piping system and introduce dangerous projectiles into the protected area. Personnel should be evacuated prior to pressure testing.

NFPA 2001 allows this pressure test to be omitted if the total piping contains no more than one change in direction between the cylinder outlet and the nozzle and all piping is physically checked for tightness.

Dry compressed air or nitrogen must be discharged through the piping network and nozzles to verify the flow is continuous and that the piping and nozzles are unobstructed. Make certain air/nitrogen is discharging from all nozzles.

Check all nozzles to be sure the correct nozzles are installed as shown on the installation drawing, installed securely to the pipe, properly anchored, and properly oriented.

Check all nozzles for any obstructions or objects placed in the direct pattern of discharge.

Perform a full functional test of the control system in accordance with the appropriate technical manual and system design drawings including verification that all control functions such as damper and door closure, HVAC shut down, and power shut down occur as intended.

If the HVAC is NOT being shutdown prior to system discharge it must be of the re-circulating close loop type and enough agent must be provided to compensate for the volume of the duct and plenum.

5.3 Installing Pneumatic Valve Actuator

⚠ WARNING

Attaching the pneumatic valve actuator to the cylinder valve when the actuation pin is not fully locked into the "up" position may cause the cylinder valve to actuate, resulting in potential injury and/or property damage, and complete loss of agent.

Reset the pneumatic valve actuator by pushing up on the actuation pin until it bottoms out on the inside of the actuator body. If the pin is not reset, it will depress the valve core stem when the pneumatic valve actuator is threaded onto valve actuation connection causing the valve to open.

The pneumatic valve actuator should be installed hand tight until contact is made between the actuator and the top of the cylinder valve. A small gap will be present between the bottom of the pneumatic valve actuator and the valve body.

5.4 Installing Electric Valve Actuator

⚠ WARNING

Do not install the electric valve actuators until all pipe and nozzles are securely installed and system has been fully commissioned. Failure to comply could result in personal injury or death from violent cylinder movement or over-exposure to high concentrations of agent.

Attaching the electric valve actuator to the cylinder valve when the actuation pin is not fully locked into the "up" position may cause the cylinder valve to actuate, resulting in potential injury and/or property damage, and complete loss of agent.

Reset the electric valve actuator by pushing the pin up until it latches. If the pin is not reset, the valve core stem could be depressed when the electric valve actuator is threaded onto the valve top causing the cylinder valve to actuate.

Do not install the electric valve actuator if the control panel is in alarm or trouble. Clear all alarm conditions and trouble conditions on the panel before installing the electric valve actuator.

The electric valve actuator assembly has a swivel base that is threaded onto the valve top.

The actuator is to be installed **hand tight until** contact is made between the actuator and valve top. A small gap will be present between the bottom of the actuator and the valve body.

Section 5 Commissioning System

5.5 Installing Manual Valve Actuator

⚠ WARNING

Attaching the manual valve actuator to the electric valve actuator when the actuation pin is not fully locked into the “up” position may cause the cylinder valve to actuate, resulting in potential injury and/or property damage, and complete loss of agent.

Reset the manual valve actuator by pulling up on the palm button and inserting the ring pin. The actuation pin should be in the full up position before installing on the electric valve actuator. If the pin is not reset the valve could open when the manual valve actuator is threaded onto the electric valve actuator.

The manual valve actuator assembly has a swivel base that is threaded onto the top of the electric valve actuator.

The actuator is to be installed **hand tight until** contact is made between the manual valve actuator and the top of the electric valve actuator. A small gap may be present between the bottom of the manual valve actuator and the top of the electric valve actuator.

⚠ CAUTION

The system is now fully armed and commissioned. Actuation of the manual or electric valve actuators will result in the discharge of the system.

5.6 Warning Signs

Warning signs must be placed at entrances to and inside protected areas.

5.7 Additional Considerations

Janus Fire Systems® equipment as shipped does not require painting.

5.8 Enclosure Venting Considerations

The effectiveness of a total flooding fire extinguishing system depends, in part, on retention of the agent mixture within the protected volume for a period of time. Retention of the agent within the enclosure requires that leakage be minimized, however, addition of a gaseous fire extinguishing agent to an enclosure having limited vent area will naturally result in a change of pressure therein. If the enclosure is sealed too tightly during the agent discharge, i.e., too little vent area or equivalent leakage area (EQL), the pressure change could exceed the structural strength of the enclosure. Conversely, if the enclosure has too much vent area then FK-5-1-12 leakage will occur rapidly, leading to short retention time of the agent within the protected volume. Thus, the use of gaseous fire extinguishing systems must address both pressure relief within the protected volume during the period of agent discharge, and retention of the agent-air mixture within the enclosure for a specified period of time after the completion of the discharge.

Figure 5.6a Clean Agent Warning Sign - Exit (P/N 18489)

Figure 5.6b Clean Agent Warning Sign - Entrance (P/N 18770)

A door fan integrity test should be performed to determine both the estimated leakage rate of FK-5-1-12 and provide the existing vent area in the protected volume. The Janus Design Suite can provide an estimate of the vent area required for the amount of FK-5-1-12 being discharged. With the combined information, adjustments can be made to determine additional venting needs for the enclosure.

For more complete information regarding enclosure integrity and venting consideration please consult *Fire Suppression Systems Association Guide to Estimating Enclosure Pressure and Pressure Relief Vent Area for Applications Using Clean Agent Fire Extinguishing Systems*, **PRG-01, First Edition, August 2008**, NFPA 2001 and Janus Design Suite® Flow Calculation Software Manual Designed For Use With FK-5-1-12.

5.9 Manual

An "as built" instruction and maintenance manual that includes a full sequence of operations and a full set of drawings and calculations shall be maintained on site.

5.10 Label

Each cylinder is fitted with an identification label indicating the fill quantity of FK-5-1-12.

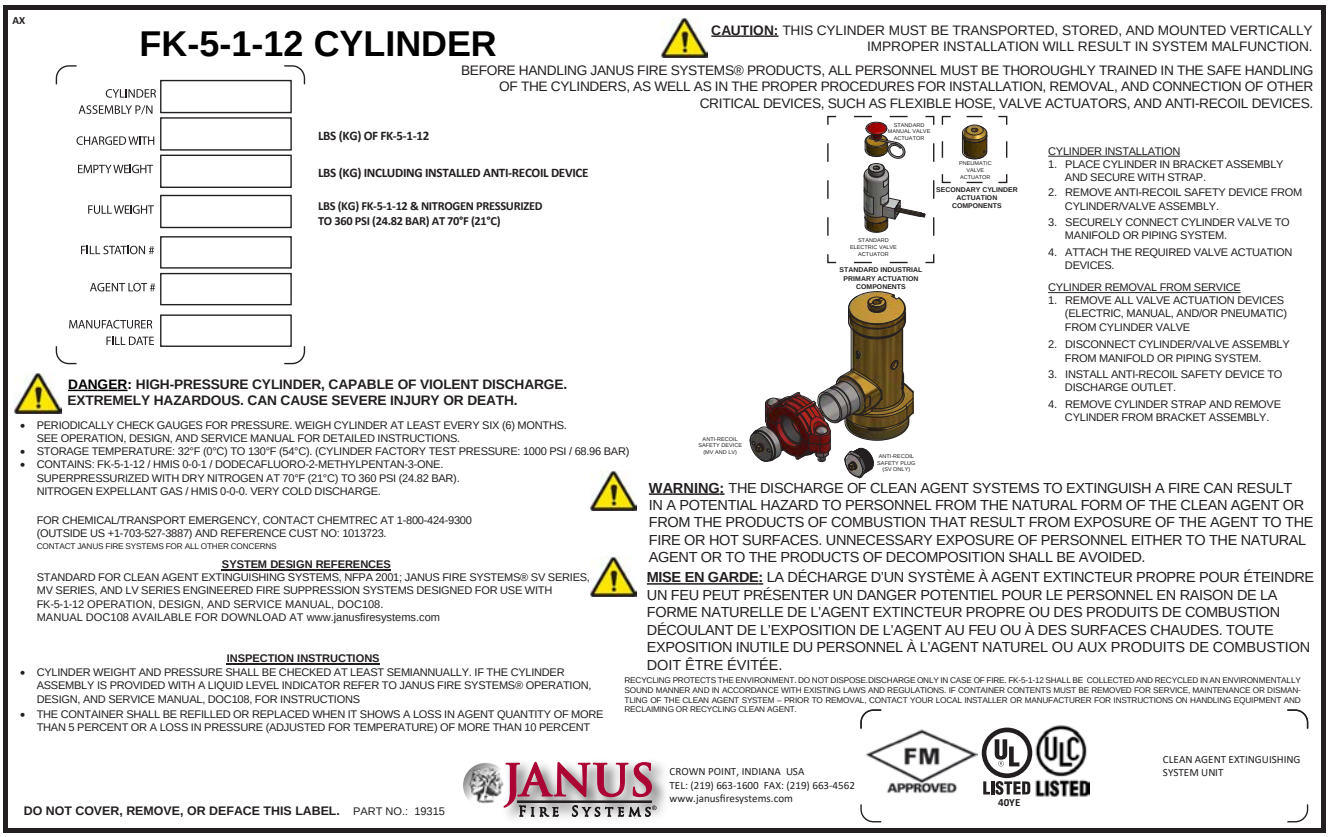


Figure 5.10 Cylinder Label

5.11 Transportation Information

Cylinders filled with FK-5-1-12 and pressurized with nitrogen are considered the following classifications for shipping purposes:

- Proper Shipping Name : LIQUEFIED GASES
- Hazard Class : 2.2
- I.D. No. (UN/NA) : UN1058[1]
- DOT Hazardous Materials Description : non-flammable charged with nitrogen

[1] Sv Series 40 lb nominal fill cylinders are considered UN1044 - FIRE EXTINGUISHER for shipping purposes.

6 SYSTEM INSPECTION AND MAINTENANCE

Each Janus Fire Systems® Fire Extinguishing System utilizing FK-5-1-12 must be properly inspected and maintained at regular intervals by competent individuals qualified in the installation and testing of clean agent extinguishing systems and thoroughly trained in the functions they are expected to perform.

It is the owner's responsibility to coordinate and schedule inspection and maintenance and verify that individuals performing the functions are properly trained as required by NFPA 2001.

6.1 Monthly Inspection

Inspection is a quick check of the system and is intended to give reasonable assurance that the system is fully charged and operational. This is done by reviewing the system to check that it has not been tampered with, all components are in place, no physical damage exists or no condition exists that could prevent operation.

This section does not cover inspection requirements of the detection, control, and releasing system. Consult NFPA 72 and the appropriate technical manual for instructions on performing inspection.

The individual conducting the inspection should be familiar and knowledgeable with the system components and the intended operation of the system.

The system should be inspected on monthly intervals or more frequently if conditions dictate, with records maintained identifying as a minimum the person performing the inspection, date of inspection, observations, and results of the inspection noting any action to be taken.

A minimum of the following items should be checked during inspection:

- Visually verify that the control panel is free of trouble or alarm conditions.
- Check each cylinder bracket to make certain the cylinder is securely mounted.
- Check the pressure gauge on each cylinder to determine that cylinder pressure is in the correct range for the temperature.
- Check to make certain the discharge piping is properly connected to the discharge outlet.
- Check that all actuators are properly installed on the cylinder valves: electric valve actuator on primary cylinder and pneumatic valve actuators on any secondary cylinders.
- Check the manual valve actuator to be certain the ring pin is properly installed and sealed in place.
- Check that all pilot actuation piping is properly connected.
- Visually inspect all components for any signs of damage, denting, corrosion, etc.
- Check the nozzles to make sure they are properly aimed, securely connected to the pipe, free of debris, not painted, and that no objects are blocking their discharge pattern.
- Visually check detectors to make certain they are in place, not damaged, not coated with dust, dirt or debris, not painted, and not obstructed.

- Check all electric manual release stations and abort switches to make certain they have not been tampered with, are in their normal and operational condition, are accessible, and are visible.
- Check all alarm devices to make certain they have not been tampered with, are not damaged or dirty, corroded, etc.
- Check all warning signs to make certain they are in place, not covered or obstructed, not painted over, and easily visible.
- Check all doors to confirm they are not blocked or held open and that automatic door closures will allow doors to close.
- Visually inspect the hazard for any changes that may have occurred such as additional partitions, moved partitions, new equipment, different fuels, openings or penetrations for cable or ductwork, HVAC modifications, etc.

Any discrepancy or problem found during inspection must be brought to the attention of the proper personnel and corrected.

6.2 Maintenance

Maintenance is a thorough check of the system and is intended to give maximum assurance that the system will operate effectively and safely. It includes a thorough examination and any necessary repair, recharge, part replacement, or hydrostatic testing that may be required.

This section does not cover maintenance and service requirements of the detection, control, and releasing system. Consult NFPA 72 and the appropriate technical manual for instructions on performing service and maintenance.

Notify all appropriate personnel that the fire extinguishing system will be disconnected and not functional during the duration of the service. When service is completed notify all appropriate personnel to make them aware that the system is back in service. Appropriate personnel may include the facility Owner or Manager, Safety Director or Manager, Security Director or Manager, Emergency Response Team, Maintenance, Department Manager, or local Fire Department.

Those individuals responsible for maintenance of a Janus Fire Systems® fire extinguishing system utilizing FK-5-1-12 must be trained.

Minimally, the date of service, name of technician performing the service, results of the service, gross weight, agent weight, cylinder pressure, cylinder temperature, and any other observations should be recorded noting any action taken to address or rectify a discrepancy.

6.2.1 Semi-Annual Maintenance

In addition to the monthly inspection steps and in accordance with NFPA 2001, at least semiannually the agent quantity and pressure shall be checked.

6.2.1.1 Pressure Check

Check the pressure indicated by the gauge and the temperature of the cylinder and compare with the Table 6.2.1.1 in Appendix B. If the gauge pressure is below the pressure shown in the “90% Pressure” column for the temperature of the cylinder, the cylinder must be removed from service, agent recovered, all leaks identified and repaired, and the cylinder refilled.

6.2.1.2 Liquid Level Indicator

The liquid level indicator may be used to determine the quantity of agent in the Mv and Lv Series cylinders without weighing or having to disconnect the cylinder.

The liquid level indicator used in the Mv and Lv Series cylinders for determining the quantity of agent are UL Listed and FM Approved for this application. If a cylinder is equipped with a liquid level indicator, the cylinder is not required to be weighed as part of inspections as detailed in Section 6.2.1.3. The instructions provided below must be followed.

The ambient temperature of the cylinder must first be measured before obtaining a measure with the liquid level indicator. Make certain the cylinder is stored at this temperature for at least 24 hours to ensure an accurate reading.

Remove the protective cap on the liquid level indicator and slowly pull the tape until the magnet engages. Record the measurement on the tape to the nearest eighth of an inch. Consult the graphs located in Appendix B of this manual and use this measurement along with the ambient temperature to determine the weight of the cylinder contents. If the weight determined from these graphs show a 5% or greater loss from the fill weight stamped on the cylinder label, then additional service or maintenance may be required including refilling and reweighing to confirm the required quantity for enclosure protection. See Section 6.2.1.3 for instructions on weighing.

[Note: The weight values indicated on the graphs located in Appendix B may show fill weights less than or greater than the Listed/Approved fills weights (capacities) shown in Table 2.1.1 "Cylinder Capacities" on page 6 of this manual. Do not exceed or underfill the cylinder capacities noted in Table 2.1.1.]

Once measurement is recorded, replace the tape in the liquid level indicator. First pull the tape until the magnet disengages and then slide it back into the cylinder. Make certain the cap is replaced.

6.2.1.3 Cylinder Weighing

The cylinder shall be weighed on a calibrated scale and the weight compared to the weight stamped on the cylinder label. When weighing the cylinder the anti-recoil safety plug or device must be installed in the discharge outlet and the electric or pneumatic valve actuator must be removed from the cylinder valve and the shipping cap installed on the top of the valve.

Cylinders equipped with a liquid level indicator are not required to be disconnected and weighed as described in the previous paragraph. The liquid level indicator instructions provided in Section 6.2.1.2 must be followed.

The maximum weight loss allowed is 5% of the fill weight (agent weight).

Example: A 130 lb (59.0 kg) cylinder filled with 76 lb (34.5 kg) of agent with a total weight stamped on the cylinder label of 163 lb (73.94 kg) can have a maximum loss of 3.8 lb (1.73 kg) or 5% of 76 (5% of 34.5). If the agent weight is below 72.2 lb (32.77 kg) or the total cylinder weight is below 159.2 lb (72.21 kg) (163 – 3.8) (73.94 – 1.73) the cylinder must be removed from service, agent recovered, all leaks identified & repaired, and the cylinder refilled.

6.2.2 Annual Maintenance

In addition to the monthly inspection steps and semiannual maintenance the system shall be thoroughly examined at least once each year.

A minimum of the following steps should be performed during the annual maintenance:

- Survey the hazard to determine if it has changed from what the system was designed to protect. While surveying the hazard look for different fuels, loss of hazard integrity, new hazards, etc. If discrepancies are found the changes must be noted and the system re-calculated to determine if the system is appropriate for the existing hazard.
- Thoroughly inspect the perimeter of the enclosure for penetrations or openings that could adversely affect agent leakage. Any openings found should be noted on the service report and sealed.
- Remove all actuators from cylinder valves and test for proper operation. Leave all actuators off until service is completed.

⚠ WARNING

Do not install the electric, pneumatic, or manual valve actuators until the system has been fully inspected. Failure to comply could result in personal injury or death from violent cylinder movement or over-exposure to high concentrations of agent.

- Examine the cylinder and valve assembly for any signs of damage, denting, corrosion, etc. as described in NFPA 2001. If any deficiency is identified the cylinder shall be hydrostatically tested.
- Check the cylinder bracket for corrosion or damage and make certain it is securely fastened to a rigid vertical structure.
- Check to be certain the cylinder is securely installed in the bracket with the appropriate fasteners and that the bracket is at the correct height
- Check all nozzles to make certain they are securely installed on the pipe, aimed properly, not corroded, not plugged, correct orifice size, correct style, and the discharge pattern is not obstructed.
- Check the condition of the piping to make certain it is properly secured in the hangers and all fittings are tight.

- Visually inspect the pilot actuation hose for signs of damage, corrosion, abrasions, weather checking, or aging. If any deficiency is identified the hose shall be replaced or hydrostatically tested.
- Check all warning signs to make certain they are in place, mounted securely, readable, not damaged, and not obstructed.
- Perform a full functional test of the detection, control, and release system to be certain the sequence of operation is correct, all detectors function as intended, electric manual release stations operate, abort switches operate, all electric valve actuators function properly, all alarm devices operate, all doors and dampers close, HVAC shuts down, and power shuts off to the hazard area. For detailed instructions follow procedures in the appropriate control system technical manual and consult NFPA 72.
- Reset all electric manual release stations, abort switches, the control panel, and all actuators. After the control panel has returned to normal with no trouble signals, no supervisory signals, and no alarm signals and all valve actuators have been reset, reconnect the discharge pipe/hose and reinstall all pneumatic, electric, and manual valve actuators following the procedures outlined in sections 5.3 through 5.5.

6.2.3 Five Year Maintenance

In addition to the monthly inspection, semiannual maintenance, and annual maintenance, the agent cylinders shall be thoroughly examined and the system actuation hoses shall be hydrostatically tested every five years.

All cylinders shall be visually examined in accordance with NFPA 2001 and the Compressed Gas Association Pamphlet C-6. Section 3; except that the cylinders need not be emptied or stamped while under pressure.

6.2.4 Additional Notes on Maintenance

⚠ WARNING

The Sv Series pressure gauge is mounted directly to the cylinder valve and shall not be removed while the contents are under pressure. Removal while the contents are under pressure will cause agent to escape through the pressure valve connection and discharge the cylinder valve.

⚠ CAUTION

The Mv and Lv Series pressure gauge assembly shall not be removed from the cylinder valve while the contents are under pressure. Removal while the contents are under pressure may damage the O-ring seal or gauge, requiring the replacement of the pressure gauge assembly.

Any time the pressure gauge assembly is removed from the cylinder valve, the assembly o-ring must be replaced with a new o-ring (P/N 98791 - Pack of 25). Prior to re-installing the pressure gauge assembly, both the new o-ring and the inside of the pressure gauge connection on the cylinder valve must be lightly lubricated with Molykote 55 by Dow Corning (P/N 19056) or equivalent.

7 SYSTEM RECHARGE AND RESET

Those individuals responsible for maintenance of a Janus Fire Systems® fire extinguishing system utilizing FK-5-1-12 must be trained.

To maintain FM Approval cylinder recharge must be done at a Janus Fire Systems® recognized facility.

This chapter does not include instructions on resetting the automatic control system. Refer to the appropriate technical manual for this information.

7.1 Piping and Nozzles

High heat from a fire could damage piping and nozzles, and possibly pipe support members. Check all pipe supports and fittings for any signs of damage or corrosion. Remove nozzles from pipe and inspect for damage, corrosion, or obstructions. Clean nozzles and reinstall making certain to tighten and aim properly.

7.2 Recharging

Recharge consists of removing the cylinder, reconditioning and cleaning the valve assembly, and refilling and pressurizing the cylinder.

⚠WARNING

Do not transport the cylinder unless the anti-recoil safety device is in place. Handle the cylinder assembly with care even when the safety device is in place. All removable trim components shall be removed before transportation.
Do not apply excessive force to the low-pressure supervisory switch or pressure gauge or attempt to carry the cylinder assembly or valve assembly by the low-pressure switch or pressure gauge. The low-pressure supervisory switch and pressure gauge are not designed or intended to be used to carry the cylinder or valve. If the low-pressure supervisory switch or pressure gauge breaks at the fitting, agent will discharge through the port causing possible personal injury or property damage, and complete loss of agent.

7.2.1 Removing The Cylinder

- Remove the electric and pneumatic valve actuators and install the shipping cap onto the valve actuation connection.
- Remove the empty cylinders by removing the discharge pipe and installing the anti-recoil safety plug or device.
- Disconnect the low-pressure supervisory switch electrical connector.
- For Mv and Lv Series cylinders, remove the low-pressure supervisory switch and pressure gauge assemblies from the cylinder valve.

⚠WARNING

Do not remove the pressure gauge or low-pressure supervisory switch from the Sv cylinder valve during the recharge process.

- Remove the cylinder from the bracket only after ensuring all appropriate safety measures have been complied with and all relevant warnings noted.

7.2.2 Cleaning and Servicing The Valve Assembly

Janus Fire Systems recommends that the following steps be followed prior to refilling the cylinder(s):

⚠WARNING

Check the pressure gauge and cylinder weight to verify the cylinder is empty and at atmospheric pressure before attempting to remove the valve. Failure to comply could result in personal injury or death from violent cylinder movement or over-exposure to high concentrations of agent.

- Remove the top cap.
- Pull the piston assembly up and out of the top of the valve body using the piston removal tool (P/N 97642) and inspect both the piston and valve body bore for damage.
- Clean all internal valve surfaces using caution not to scratch or nick the seating surfaces.
- Hold the piston in place by carefully gripping the smaller diameter cylindrical surface with a strap wrench or similar device (i.e., appropriate Piston Key as shown in Table. 7.2.2). Use a pin-style spanner wrench to remove the piston cap by turning it counter-clockwise.
- Replace the lower piston O-ring around the piston cap.
- Reinstall the piston cap using the strap wrench and spanner wrench. Tighten until the cap bottoms out on the piston body.
- Remove the upper piston O-ring on the piston body and discard.
- Lubricate the new upper piston O-ring with Molykote 55 by Dow Corning (P/N 19056) or equivalent and install the new upper piston O-ring onto the piston body.
- Lightly lubricate the internal valve bore with Molykote 55 by Dow Corning (P/N 19056) or equivalent and insert the valve piston into the valve body.
- Remove the valve cap O-ring and discard.
- To prevent damage to the new valve cap O-ring during installation cover the threads of the valve cap with masking tape.
- Lightly lubricate the new valve cap O-ring with Molykote 55 by Dow Corning (P/N 19056) or equivalent and install on the valve cap.
- Remove masking tape from valve cap threads and clean the threads on the valve cap. Carefully thread the top cap onto the valve assembly. Tighten securely, do not apply excessive force.
- Reinstall the low-pressure supervisory switch and pressure gauge assemblies on Mv and Lv Series valve assemblies.

Table 7.2.2 Clean Agent Valve Replacement Components			
Part Description	**Sv P/N**	**Mv P/N**	**Lv P/N**
Collar O-ring	**17551**	**18400**	**18400**
Upper Piston O-ring	**17552**	**18475**	**18398**
Lower Piston O-ring	**17553**	**18476**	**18399**
Valve Cap O-ring	**17551**	**18399**	**18397**
Valve Core	**16999**	**16999**	**16999**
Piston Removal Tool	**97642**	**97642**	**97642**
Piston Key	**97609**	**97608**	**97607**
Piston Assembly	**17335**	**18471**	**18393**
Valve Rebuild Kit[1]	**17030**	**19019**	**19020**

[1] Valve Rebuild Kit includes the appropriate collar O-ring, valve cap O-ring, piston assembly (with upper and lower piston o-ring), and valve core for the cylinder valve indicated by the kit part number.

7.2.3 Recharge Procedure

- Follow the procedures outlined in the technical manual supplied with the recharge station to fill the cylinder to the correct amount by weight. See nameplate for fill weight and fill to a minimum of the stamped fill weight and no more than ¼ pound (4 oz) (113 g) above the stamped fill weight. The pressure gauge on the cylinder shall not be used to determine when the proper charge pressure has been reached. A pressure regulator must be used when the pressure source is a tank of high pressure gas.

- Pressurize cylinder with dry nitrogen to required pressure based on the ambient temperature. Forcefully agitate the cylinder while pressurizing so the agent can absorb nitrogen. Add nitrogen as necessary until the required pressure is reached.

- Once required pressure is reached, use the valve closing adapter (P/N 17292) to close the valve. The procedure to close the valve is:

  1) Close the ball valve controlling flow of agent and nitrogen through the valve outlet.

  2) Set the regulator on the nitrogen supply used to close the valve to 550 psi (38 bar).

  3) Momentarily open the ball valve controlling nitrogen flow to the recharge adapter. The ball valve should not remain open for more than 2 seconds to avoid over-pressurizing the cylinder. Close ball valve after step 4 is completed.

  4) Vent the pressure from the recharge fitting attached to the valve outlet by opening and closing the vent ball valve. Immediately close the ball valve opened in step 3.

  5) Once the pressure is removed from the outlet adapter the system cylinder valve should be closed.

  6) Open the vent ball valve at the outlet adapter. Absence of pressure verifies that the valve is closed. If pressure is present, close the vent valve immediately and repeat the valve closing procedure starting at step 2.

- Let cylinder assembly stand for 3 hours and check for leaks using a soap solution.

- Check cylinder gauge pressure based on pressure temperature chart.

- Weigh cylinder assembly to be certain the filled weight is correct and equal to the total weight shown on the cylinder label.
- Replace the charged cylinder in the bracket and follow procedures outlined in Section 4 and Section 5 to reinstall the system.
- Inform appropriate personnel that the system is back in service.

Appendix A

Safety Data Sheet
(refer to www.janusfiresystems.com for latest version)

Appendix A

SAFETY DATA SHEET

Section 1. PRODUCT AND COMPANY IDENTIFICATION

Product Name:	FK-5-1-12 Fire Protection Fluid with Expellant
Other Identifiers:	FK-5-1-12 with Expellant
Product Use:	Fire Extinguishing Agent
Model Groups:	Lv (Lv 500) Series*: 1000lb, 900lb, 600lb Mv (Mv 500) Series*: 420lb, 250lb Sv (Sv 500) Series*: 130lb, 80lb, 40lb (*: Weights referenced in model groups are nominal reference descriptions of containers and not actual physical weights.)
Manufacturer:	Janus Fire Systems
Internet Address:	www.janusfiresystems.com
Address:	1102 Rupcich Dr. Crown Point, IN 46307
Company Telephone:	(219) 663-1600
E-mail Address:	info@janusfiresystems.com
Emergency Contacts:	Chemtrec 1(800) 424-9300 (Outside US +1-703-527-3887) and Reference Cust No: 1013723
Issued:	July 3, 2023

Section 2. HAZARDS IDENTIFICATION

GHS – Classification

Health	Environmental	Physical
Acute Toxicity- Category 5	None	None
Skin Corrosion/Irritation	None	None
Skin Sensitization: NO	None	None
Eye: 2B	None	Mild
Carcinogen: Category None	None	None

GHS – Label Symbol(s):

GHS – Signal Word(s): **Warning: Gas Under Pressure**

Other Hazards Not Resulting in Classification: Simple asphyxiant. May displace oxygen and cause rapid suffocation.

May cause frostbite if contact with skin or eyes.

GHS – Hazard Phrases

GHS Hazard	GHS Codes(s)	Code Phrase(s)
Physical	H229	Pressurized container; may burst if heated.
Health	None	None
Environmental	H412	Harmful to aquatic life with long lasting effects.
Precautionary:		
General	P101 102	If medical advice is needed, have product container or label at hand. Keep out of reach of children.
Prevention	P251 273	Do not pierce or burn, even after use. Avoid release to the environment.
Response	P312 321 302+352 305+351+338 332+313 337+313	Call a doctor if you feel unwell. Specific treatment (see Section 4. First Aid Measures) IF ON SKIN: Wash with plenty of water. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing. If skin irritation occurs: Get medical advice/attention. If eye irritation persists get medical advice/attention.
Storage	P410+403	Protect from sunlight. Store in well-ventilated place.
Disposal	P501	Dispose of contents through a licensed disposal company. Contaminated container should be disposed of as unused product.

Section 3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	EC No.	REACH Reg. No.	CAS-No.	Weight %
1,1,1,2,2,4,5,5,5- Nonafluoro-4-(trifluromethyl)-3-pentanone (FK-5-1-12)	436-710-6	NA	756-13-8	>99.9

Note: Pressurized cylinder uses nitrogen as an expellant.

Emergency overview: Clear liquid, low odor.

Section 4. FIRST AID MEASURES

Eye Exposure: Liquid or cold gas can cause freezing injury to eyes. Flush eyes with cool water for 15 minutes. Seek medical attention immediately.

Skin Exposure: May cause cold burns or frostbite. Remove contaminated clothing and flush affected areas with lukewarm (NOT HOT) water. Seek medical attention immediately if blistering of the dermal surface or if deep tissue freezing occurs

Inhalation: May cause coughing. If respiratory irritation or distress occurs, remove victim to fresh air. Seek medical attention if problems persists.

Ingestion: None under normal conditions

Medical conditions possibly aggravated by exposure: None

Appendix A

Section 5. FIRE-FIGHTING MEASURES

Flammable Properties:	Not flammable
Flash Point:	None
Suitable Extinguishing Media:	Non-combustible. Use extinguishing media suitable for surrounding conditions.
Hazardous Combustion Products:	Main decomposition product is hydrogen fluoride in fire situations. Byproducts are irritating and potentially toxic. Pressurized container can explode in heat of fire
Explosion Data:	
Sensitivity to Mechanical Impact:	Not sensitive
Sensitivity to Static Discharge:	Not sensitive
Unusual fire/explosion hazards:	Pressurized container can explode in heat of fire
Protective Equipment and Precautions for Firefighters:	As in any fire, wear self-contained breathing apparatus in pressure-demand, NIOSH approved or equivalent and full protective gear.

Section 6. ACCIDENTAL RELEASE MEASURES

Personal Precautions:	Evacuate personnel to safe areas. Ensure adequate ventilation, especially in confined areas. Monitor oxygen level.
Personal Protective Equipment:	None unless there is a chance of direct contact with the chemical. Wear self-contained breathing apparatus when entering area unless atmosphere is proved safe. Wear appropriate PPE for the situation.
Emergency Procedures:	Handle in accordance with good health and safety practices.
Methods for Containment:	Stop the flow of gas or remove cylinder to outdoor location if this can be done without risk. If leak is in container or container valve, contact the appropriate emergency telephone number in Section 1 or call your closest supplier location.
Methods for Clean Up:	Return cylinder to authorized distributor.
Environmental Precautions:	Prevent spreading of vapors through sewers, ventilation systems and confined areas.
Other:	If product is contaminated, use PPE and containment appropriate to the nature of the most toxic chemical/material in the mixture.

Section 7. HANDLING AND STORAGE

Personal Precautions:	Put on appropriate personal protective equipment. Contains gas under pressure. Do not get in eyes, on skin or clothing. Avoid breathing gas. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container.
Conditions for Safe Storage/Handling:	Protect from sunlight and store in a well-ventilated place. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use suitable equipment for cylinder movement. Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating area.

Section 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Chemical Name	CAS NO.	OSHA PEL
1,1,1,2,2,4,5,5,5- Nonafluoro-4-(triflurомethyl)-3-pentanone	756-13-8	TWA: 150 ppm (1,940 mg/m³)

Value is an 8 hour time weighted average concentration.

Engineering Controls

Provide appropriate local exhaust when product is heated. Use general dilution ventilation and/or local exhaust ventilation to control airborne exposures to below relevant exposure Limits and/or control fumes/gas/mist/vapors/spray. If ventilation is not adequate, use respiratory protection equipment.

Personal Protective Equipment (PPE)

Eye/face protection
Eye protection recommended when handling pressurized cylinders.

Skin/hand protection
Select and use gloves and/or protective clothing approved to relevant local standards to prevent skin contact based on the results of an exposure assessment. Selection should be based on use factors such as exposure levels, concentration of the substance or mixture, frequency and duration, physical challenges such as temperature extremes, and other use conditions. Consult with your glove and/or protective clothing manufacturer for selection of appropriate compatible gloves/protective clothing.

Gloves made from the following material(s) are recommended: Neoprene

Foot protection
Appropriate safety shoes are recommended when handling compress gas cylinders.

Respiratory protection
During heating:
Use a positive pressure supplied-air respirator if there is a potential for over exposure from an uncontrolled release, exposure levels are not known, or under any other circumstances where air-purifying respirators may not provide adequate protection.

Section 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Colorless liquid
Molecular Weight:	316.05
Odor:	Low odor
Odor Threshold:	No information available
Decomposition Temperature °C:	No information available
Freezing/Melting Point °C:	-108°C
Initial Boiling Point °C:	49°C at 1 atm
Physical State:	Liquid
pH:	Not applicable
Flash Point °C:	None
Auto-ignition Temperature °C:	Not applicable
Flammability:	Not Flammable
Flammability Limits in Air °C:	Upper – Not Flammable; Lower-Not Flammable
Explosivity	Upper – Not Explosive; Lower-Not Explosive
Volatile Organic Compounds	1600 g/L
Percent Volatile	100%
Evaporation Rate:	>1
Vapor Density:	11.6 (AIR=1)
Vapor Pressure:	0.404 bar @ 25°C
Specific gravity at 25°C:	1.6
Solubility:	40.95 mg/L @ 25°C
Partition Coefficient: octanol/air	8.3E-012
Viscosity:	0.6 centipoise @ 25°C

Section 10. STABILITY AND REACTIVITY

Stability:	Stable under recommended storage and handling conditions.

Reactivity:	This material may be reactive with certain agents under certain conditions - see the remaining headings in this section.
Incompatibles:	Strong bases, amines, alcohols, water
Conditions to Avoid:	Storage or handling near incompatibles, heat, sunlight. Pressurized containers may rupture or explode if exposed to heat.
Hazardous Decomposition Products:	Heat of fire or elevated temperatures may release hydrogen fluoride and perfluoroisobutylene.
Possibility of Hazardous Reactions:	Slight
Hazardous Polymerization	Will not occur

Section 11. TOXICOLOGICAL INFORMATION

Likely Routes of Exposure:	Inhalation, skin, and eye contact.
Symptoms:	
Immediate:	
Inhalation:	No known health effects
Eyes:	Normally does not cause significant irritation
Skin:	Normally does not cause significant irritation
Delayed:	Normally does not have a delayed reaction
Acute Toxicity:	Relatively non-toxic.
Chronic Toxicity:	
Short-term Exposure:	None known.
Long-term Exposure:	None known

Acute Toxicity Values - Health

Chemical Name	LD50		LC50 (Inhalation)
	Oral	Dermal	
1,1,1,2,2,4,5,5,5- Nonafluoro-4-(trifluromethyl)-3-pentanone	>2000 mg/kg (rat)	>2000 mg/kg (rat)	1,227 mg/m³ (rat)

Reproductive Toxicity:	This product's ingredients are not known to have reproductive or teratogenic effects.
Target Organs and Effects (TOST):	This product is not known to have any single exposure target organ toxicities. Some data exists concerning impacts on liver, kidney, bladder, but the data are not sufficient for classification; all other potential organ impacts are not apparent.

Appendix A

Other Toxicity Categories

Chemical Name	Germ Cell Mutagenicity	Carcinogenicity	Reproductive	Aspiration
1,1,1,2,2,4,5,5,5- Nonafluoro-4-(triflurомethyl)-3-pentanone	Not a hazard	Not considered carcinogenic	Not considered a hazard	Not a hazard

Note: Nitrogen, the expellant when in a pressurized container, is a simple asphyxiant.

Section 12. ECOLOGICAL INFORMATION

Ecotoxicity:	Harmful to aquatic life with long lasting impacts
Persistence/Degradability:	Insoluble in water; Photolytic half-life 3-5 days
Probability of rapid biodegradation:	Est: -1.325 (Slow)
Anaerobic biodegradation probability:	Est: 0.2243 (Slow)
Bioaccummulation potential:	63.04 L/kg (Low)
Bioconcentration factor:	63.02 L/kg (wet-wt) (Low BFC)
Mobility in soil:	Highly insoluble in water
Log Koc (Kow Method):	Est: 2.66
Log Koa:	Est: 1.529
Log Kow:	Est 2.79

Ecotoxicological Information - 1,1,1,2,2,4,5,5,5- Nonafluoro-4-(triflurомethyl-3-pentanone

Test Organism	Acute (LC50)	EC50
Green algae, *Selenastrum capricornutum*	N/A	7.7 mg/L (72 hours)
Zebra Fish, *Brachydanio rerio*	>1200 mg/L (96 hours)	NA
Water flea, *Daphnia magna*	NA	>1200 mg/L (48 hours)
Green algae, *Selenastrum capricornutum*	NA	1.2 mg/L (72 hours, No obs EC)

Section 13. DISPOSAL CONSIDERATIONS

Safe Handling	Use appropriate PPE when handling, and wash thoroughly after handling (see Section 8).
Waste Disposal Considerations	Dispose in accordance with federal, state, and local regulations.
Contaminated Packaging	Dispose in accordance with federal, state, and local regulations. Use a leak-proof container

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

NOTES:
This product is not a RCRA characteristically hazardous or listed hazardous waste.

Section 14a. TRANSPORT INFORMATION

Applies to Model groups: Lv (Lv 500) Series: 1000lb, 900lb, 600lb
Mv (Mv 500) Series: 420lb, 250lb
Sv (Sv 500) Series: 130lb, 80lb

*(Note: The following applies to all models except Sv Series 40lb. For information for Sv Series: 40lb see **Section 14b. TRANSPORT INFORMATION**)*

International Regulations

IATA-DGR

UN/ID No.:	UN 1058
Proper shipping name:	Liquefied gases
Class :	2.2
Packing group:	
Labels:	Non-flamm. gas
Packing instruction (cargo aircraft):	200
Packing instruction (passenger aircraft):	200

IMDG-Code

UN number:	UN 1058
Proper shipping name:	LIQUEFIED GASES
Class:	2.2
Packing group:	
Labels:	2.2
EmS Code:	F-C, S-V
Marine pollutant:	No

Domestic regulation

49 CFR

UN/ID/NA number:	UN 1058
Proper shipping name:	Liquefied gases
Class:	2.2
Packing group:	
ERG Code:	ERG No. 120
Marine pollutant:	No

Section 14b. TRANSPORT INFORMATION

Applies to Model groups: Sv (Sv 500) Series: 40lb

*(Note: For information for all other model groups see Section **14a. TRANSPORT INFORMATION)***

International Regulations

IATA-DGR

UN/ID No.:	UN 1044
Proper shipping name:	Fire Extinguishers
Class :	2.2
Packing group:	
Labels:	Non-flamm. gas
Packing instruction (cargo aircraft):	213
Packing instruction (passenger aircraft):	213

IMDG-Code

UN number:	UN 1044
Proper shipping name:	Fire Extinguishers
Class:	2.2
Packing group:	
Labels:	2.2
EmS Code:	F-C, S-V
Marine pollutant:	No

Domestic regulation

49 CFR

UN/ID/NA number:	UN 1044
Proper shipping name:	Fire Extinguishers
Class:	2.2
Packing group:	
ERG Code:	ERG No. 126
Marine pollutant:	No

Section 15. REGULATORY INFORMATION

International Inventory Status: All ingredients are on the following inventories

Country(ies)	Agency	Status
United States of America	TSCA	Yes
Canada	DSL	Yes
Europe	EINECS/ELINCS	Yes
Australia	AICS	Yes
Japan	MITI	Yes
South Korea	KECL	Does not comply

U.S. Federal Regulatory Information:

SARA Title III Sect 311/312 Categorization: Pressurized
Pressure Hazard

SARA Title III Sect 311/312 Categorization: Non-pressurized
None

SARA Title III Sect 313
This product does not contain any chemicals that are listed in Section 313 at or above de minimis concentrations.

Clean Water/Clean Air Acts:
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42) or Clean Air Act, Section 112 Hazardous Air Pollutants (HAPs) (see 40 CFR 61) and Section 112 of the Clean Air Act Amendments of 1990.

CERCLA
This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfunds Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, state, or provincial level.

U.S. State Regulatory Information:

Chemicals in this product are covered under specific State regulations, as denoted below:

Alaska - Designated Toxic and Hazardous Substances: None
California – Permissible Exposure Limits for Chemical Contaminants: None
Florida – Substance List: None
Illinois – Toxic Substance List: None
Kansas – Section 302/303 List: None
Massachusetts – Substance List: None
Minnesota – List of Hazardous Substances: None

Missouri – Employer Information/Toxic Substance List: None
New Jersey – Right to Know Hazardous Substance List: None
North Dakota – List of Hazardous Chemicals, Reportable Quantities: None
Pennsylvania – Hazardous Substance List: None
Rhode Island – Hazardous Substance List: None
Texas – Hazardous Substance List: None
West Virginia – Hazardous Substance List: None
Wisconsin – Toxic and Hazardous Substances: None
California Proposition 65: No component is listed on the California Proposition 65 list.

U.S. State Right-to-Know Regulations

This product does not contain any substances regulated by state right-to-know regulations.

Section 16. OTHER INFORMATION

This SDS conforms to requirements under U.S., U.K., Canadian, Australian, and EU regulations or standards, and conforms to the 2003 ANSI Z400.1 format. No modifications of this SDS are authorized by Janus Fire Systems. Questions or comments should be directed to Janus Fire Systems (See Section 1).

Issuing Date	03-July-2023
Revision Date	03-July-2023; Revision -
Revision Notes	None

Appendix A

Appendix B

Assorted Charts & Worksheets

Appendix B

B.1 Design Worksheet	U.S. Standard

Surface Fire Requirements

Class A

Project:		**Date:**	
Hazard:		**Engineer:**	

Required FK-5-1-12 – Class A (4.5% Concentration)

Volume		Design Concentration Factor @ 70°F		FK-5-1-12 Agent Weight Sea Level		Altitude Correction Factor[1]		Required Weight FK-5-1-12	
	ft^3 x	.0407	=		lbs x		=		lbs

Note: For other design concentrations or ambient temperatures use the formula located in section 3.2.

Storage Requirements

Required Weight FK-5-1-12		Number of Cylinders		Weight per Cylinder	
	lbs /		=		lbs / cylinder[2]

	Cylinders Main		Cylinders Reserve

Qty	Series Valve	Nominal Cylinder Size	Fill Capacity		Qty	Series Valve	Nominal Cylinder Size	Fill Capacity	
			Minimum	Maximum				Minimum	Maximum
	Sv	40 lb	22 lbs	43 lbs		Mv	420 lb	211 lbs	422 lbs
	Sv	80 lb	41 lbs	81 lbs		Lv	600 lb	304 lbs	607 lbs
	Sv	130 lb	66 lbs	131 lbs		Lv	900 lb	455 lbs	910 lbs
	Mv	250 lb	138 lbs	274 lbs		Lv	1000 lb	619 lbs	1000 lbs

1 See Table 3.1.4 for altitude correction factor.
2 Agent weights must be rounded UP to the nearest whole pound when ordering for filling purposes.

Appendix B

B.2 Design Worksheet		Metric

Surface Fire Requirements

Class A

Project:		**Date:**	
Hazard:		**Engineer:**	

Required FK-5-1-12 – Class A (4.5% Concentration)

Volume		Design Concentration Factor @ 20°C		FK-5-1-12 Agent Weight Sea Level		Altitude Correction Factor[1]		Required Weight FK-5-1-12	
	m^3 x	.6555	=		kg x		=		kg

Note: For other design concentrations or ambient temperatures use the formula located in section 3.2.

Storage Requirements

Required Weight FK-5-1-12		Number of Cylinders		Weight per Cylinder	
	kg /		=		kg / cylinder[2]

	Cylinders Main		Cylinders Reserve

Qty	Series Valve	Nominal Cylinder Size	Fill Capacity		Qty	Series Valve	Nominal Cylinder Size	Fill Capacity	
			Minimum	Maximum				Minimum	Maximum
	Sv	40 lb	22 lbs (10.0 kg)	43 lbs (19.5 kg)		Mv	420 lb	211 lbs (95.7 kg)	422 lbs (191.4 kg)
	Sv	80 lb	41 lbs (18.6 kg)	81 lbs (36.7 kg)		Lv	600 lb	304 lbs (137.9 kg)	607 lbs (275.3 kg)
	Sv	130 lb	66 lbs (29.9 kg)	131 lbs (59.4 kg)		Lv	900 lb	455 lbs (206.4 kg)	910 lbs (412.8 kg)
	Mv	250 lb	138 lbs (62.6 kg)	274 lbs (124.3 kg)		Lv	1000 lb	619 lbs (280.8 kg)	1000 lbs (453.6 kg)

1 See Table 3.1.4 for altitude correction factor.
2 Agent weights calculated using metric measurements must be converted to pounds and rounded UP to the nearest whole pound when ordering for filling purposes. See Table B.2a for conversion factors.

Appendix B

Table 3.2a FK-5-1-12 Total Flooding Quantity (U.S. Standard)										
Temp (*t*) [°F][b]	FK-5-1-12 Specific Vapor Volume (s) [ft³/lb][c]	FK-5-1-12 Weight Requirements of Hazard Volume, W/V (lb/ft³)[a]								
		FK-5-1-12 Design Concentration (*C*) [% by Volume][d]								
		4.2%	4.5%	4.7%	5%	5.85%	6%	7%	8%	9%
-20	0.93678	0.0468	0.0503	0.0526	0.0562	0.0663	0.0681	0.0803	0.0928	0.1056
-10	0.96119	0.0456	0.0490	0.0513	0.0548	0.0646	0.0664	0.0783	0.0905	0.1029
0	0.9856	0.0445	0.0478	0.0500	0.0534	0.0630	0.0648	0.0764	0.0882	0.1003
10	1.01001	0.0434	0.0467	0.0488	0.0521	0.0615	0.0632	0.0745	0.0861	0.0979
20	1.03442	0.0424	0.0456	0.0477	0.0509	0.0601	0.0617	0.0728	0.0841	0.0956
30	1.05883	0.0414	0.0445	0.0466	0.0497	0.0587	0.0603	0.0711	0.0821	0.0934
40	1.08324	0.0405	0.0435	0.0455	0.0486	0.0574	0.0589	0.0695	0.0803	0.0913
50	1.10765	0.0396	0.0425	0.0445	0.0475	0.0561	0.0576	0.0680	0.0785	0.0893
60	1.13206	0.0387	0.0416	0.0436	0.0465	0.0549	0.0564	0.0665	0.0768	0.0874
70	1.15647	0.0379	0.0407	0.0426	0.0455	0.0537	0.0552	0.0651	0.0752	0.0855
80	1.18088	0.0371	0.0399	0.0418	0.0446	0.0526	0.0541	0.0637	0.0736	0.0838
90	1.20529	0.0364	0.0391	0.0409	0.0437	0.0516	0.0530	0.0624	0.0721	0.0821
100	1.2297	0.0357	0.0383	0.0401	0.0428	0.0505	0.0519	0.0612	0.0707	0.0804
110	1.25411	0.0350	0.0376	0.0393	0.0420	0.0495	0.0509	0.0600	0.0693	0.0789
120	1.27852	0.0343	0.0369	0.0386	0.0412	0.0486	0.0499	0.0589	0.0680	0.0774
130	1.30293	0.0336	0.0362	0.0379	0.0404	0.0477	0.0490	0.0578	0.0667	0.0759
140	1.32734	0.0330	0.0355	0.0372	0.0397	0.0468	0.0481	0.0567	0.0655	0.0745
150	1.35175	0.0324	0.0349	0.0365	0.0389	0.0460	0.0472	0.0557	0.0643	0.0732
160	1.37616	0.0319	0.0342	0.0358	0.0382	0.0452	0.0464	0.0547	0.0632	0.0719
170	1.40057	0.0313	0.0336	0.0352	0.0376	0.0444	0.0456	0.0537	0.0621	0.0706
180	1.42498	0.0308	0.0331	0.0346	0.0369	0.0436	0.0448	0.0528	0.0610	0.0694
190	1.44939	0.0302	0.0325	0.0340	0.0363	0.0429	0.0440	0.0519	0.0600	0.0682
200	1.4738	0.0297	0.0320	0.0335	0.0357	0.0422	0.0433	0.0511	0.0590	0.0671
210	1.49821	0.0293	0.0315	0.0329	0.0351	0.0415	0.0426	0.0502	0.0580	0.0660
220	1.52262	0.0288	0.0309	0.0324	0.0346	0.0408	0.0419	0.0494	0.0571	0.0650

[a] *W / V* [agent weight requirements (lb/ft³)] - pounds of agent required per cubic foot of protected volume to produce indicated concentration at temperature specified.

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

[b] *t* [temperature (°F)] - the design temperature in the hazard area.

[c] *s* [specific volume (ft³/lb)] - specific volume of FK-5-1-12 vapor may be approximated by the formula:
$s = 0.9856 + 0.002441t$
where t = temperature (°F)

[d] *C* [concentration (%)] - volumetric concentration of FK-5-1-12 in air at the temperature indicated.

Appendix B

Table 3.2b FK-5-1-12 Total Flooding Quantity (Metric)										
Temp (*t*) [°C][b]	FK-5-1-12 Specific Vapor Volume (s) [m^3/kg][c]	FK-5-1-12 Weight Requirements of Hazard Volume, *W/V* (kg/m^3)[a]								
		FK-5-1-12 Design Concentration (*C*) [% by Volume][d]								
		4.2%	4.5%	4.7%	5%	5.85%	6%	7%	8%	9%
-20	0.0609140	0.7197	0.7736	0.8096	0.8640	1.0200	1.0479	1.2357	1.4275	1.6236
-15	0.0622855	0.7039	0.7565	0.7918	0.8450	0.9976	1.0248	1.2084	1.3961	1.5879
-10	0.0636570	0.6887	0.7402	0.7747	0.8268	0.9761	1.0027	1.1824	1.3660	1.5537
-5	0.0650285	0.6742	0.7246	0.7584	0.8094	0.9555	0.9816	1.1575	1.3372	1.5209
0	0.0664000	0.6603	0.7096	0.7427	0.7926	0.9358	0.9613	1.1336	1.3096	1.4895
5	0.0677715	0.6469	0.6953	0.7277	0.7766	0.9168	0.9418	1.1106	1.2831	1.4593
10	0.0691430	0.6341	0.6815	0.7133	0.7612	0.8986	0.9232	1.0886	1.2576	1.4304
15	0.0705145	0.6217	0.6682	0.6994	0.7464	0.8812	0.9052	1.0674	1.2332	1.4026
20	0.0718860	0.6099	0.6555	0.6861	0.7322	0.8644	0.8879	1.0471	1.2096	1.3758
25	0.0732575	0.5985	0.6432	0.6732	0.7184	0.8482	0.8713	1.0275	1.1870	1.3500
30	0.0746290	0.5875	0.6314	0.6608	0.7052	0.8326	0.8553	1.0086	1.1652	1.3252
35	0.0760005	0.5769	0.6200	0.6489	0.6925	0.8176	0.8399	0.9904	1.1442	1.3013
40	0.0773720	0.5666	0.6090	0.6374	0.6802	0.8031	0.8250	0.9728	1.1239	1.2783
45	0.0787435	0.5568	0.5984	0.6263	0.6684	0.7891	0.8106	0.9559	1.1043	1.2560
50	0.0801150	0.5472	0.5882	0.6156	0.6570	0.7756	0.7967	0.9395	1.0854	1.2345
55	0.0814865	0.5380	0.5783	0.6052	0.6459	0.7625	0.7833	0.9237	1.0671	1.2137
60	0.0828580	0.5291	0.5687	0.5952	0.6352	0.7499	0.7704	0.9084	1.0495	1.1936
65	0.0842295	0.5205	0.5594	0.5855	0.6249	0.7377	0.7578	0.8936	1.0324	1.1742
70	0.0856010	0.5122	0.5505	0.5761	0.6148	0.7259	0.7457	0.8793	1.0158	1.1554
75	0.0869725	0.5041	0.5418	0.5671	0.6052	0.7144	0.7339	0.8654	0.9998	1.1372
80	0.0883440	0.4963	0.5334	0.5582	0.5958	0.7033	0.7225	0.8520	0.9843	1.1195
85	0.0897155	0.4887	0.5252	0.5497	0.5866	0.6926	0.7115	0.8390	0.9692	1.1024
90	0.0910870	0.4813	0.5173	0.5414	0.5778	0.6821	0.7008	0.8263	0.9547	1.0858
95	0.0924585	0.4742	0.5096	0.5334	0.5692	0.6720	0.6904	0.8141	0.9405	1.0697
100	0.0938300	0.4672	0.5022	0.5256	0.5609	0.6622	0.6803	0.8022	0.9267	1.0540

[a] *W / V* [agent weight requirements (kg/m^3)] - pounds of agent required per cubic foot of protected volume to produce indicated concentration at temperature specified.

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

[b] *t* [temperature (°C)] - the design temperature in the hazard area.

[c] *s* [specific volume (m^3/kg)] - specific volume of FK-5-1-12 vapor may be approximated by the formula:
$s = 0.0664 + 0.0002741t$
where t = temperature (°C)

[d] *C* [concentration (%)] - volumetric concentration of FK-5-1-12 in air at the temperature indicated.

Appendix B

Table 3.1.1a FK-5-1-12 Cup Burner Extinguishing Concentrations			
Fuel Source	Design Concentration % v/v	Fuel Source	Design Concentration % v/v
1-butanol	6.4	diesel fuel	5.9
1-propanol	7.0	diethyl ether	6.4
2,2,4-trimethylpentane	6.1	diethylethanolamine	6.2
2-butoxyethanol	6.8	dimethoxymethane	7.4
2-(2-methoxyethoxy)-ethanol	7.3	dimethyl carbonate	6.3
acetic acid	5.9	DMSO	6.4
acetone	5.9	E15 race fuel	5.9
acetonitrile	5.9	E85 biofuels	7.0
AvGas	5.9	E90 (electrolyte)	6.3
AvTur	5.9	ethane	7.3
benzene	5.9	ethanol	7.2
benzyl alcohol	5.9	ethyl acetate	6.1
butoxyethylacetate	6.0	ethyl methyl carbonate	6.5
butyl acetate	5.9	gasoline-87 oct. unleaded	5.9
commercial heptane	5.9	glacial acrylic acid	5.9
commercial hexanes	5.9	glycerine	8.3
cyclohexane	5.9	glycol ether DB	7.2
cyclohexylamine	5.9	hexanes	5.85
cyclopentane	5.9	hexene	6.0
cyclopentanone	6.0	hydrogen	13.3
denatured alcohol (92.2% EtOH 4.6% IPA and 3.1% MeOH)	6.9	hydrogen sulfide	5.9
Figures based on testing by 3M Company (September 1 2008)			

Table 3.1.1a FK-5-1-12 Cup Burner Extinguishing Concentrations (Cont'd)			
Fuel Source	Design Concentration % v/v	Fuel Source	Design Concentration % v/v
iso-butane	6.3	n-butane	5.9
isobutyl alcohol	6.6	n-heptane	5.9
isobutyl isobutyrate	5.9	n-hexane	5.9
isooctane	6.1	nitromethane	8.9
isopropyl alcohol	6.4	n-pentane	6.1
Jet A	5.9	octane	5.9
JP-4	5.9	P-0036 (with formulations)	5.9
JP-5	5.9	P-0036 (without formulations)	6.3
kerosene	5.9	propane	6.5
methane	6.2	propylene carbonate	6.6
methanol	8.5	propylene glycol	7.3
methyl amyl ketone	6.0	propylene glycol mono ether acetate	7.3
methyl ethyl ketone	5.9	propylene glycol mono ethyl ether	7.3
methyl formate	7.0	pyrrolidine	6.1
methyl isobutyl ketone	5.9	standard solvent (white spirit)	5.9
methyl siloxane	7.9	technical heptane	5.9
methyl tert butyl ether	5.9	tetrahydrofuran	6.5
methylpyrrolidone	5.9	toluene	5.9
mineral oil, heavy	7.0	transformer oil	5.9
mineral oil, light	6.9	transformer oil (varsol)	5.9
morpholine	6.8	xylene	5.9
m-xylene	5.9		

Appendix B

Table 3.1.1b FK-5-1-12 Inerting Concentrations	
Fuel Source	**Design Concentration % v/v**
Methane	8.8
Propane	8.1

Table 6.2.1.1 - Approximate Container Pressure vs. Temperature					
Temperature		**Pressure**		**90% Pressure**	
°F	**°C**	**psig**	**bar**	**psig**	**bar**
32	0.0	324.0	22.34	291.6	20.11
40	4.4	331.0	22.82	297.9	20.54
50	10	341.0	23.51	306.9	21.16
60	15.6	351.0	24.20	315.9	21.78
70	21.1	360.0	24.82	324.0	22.34
80	26.7	370.0	25.51	333.0	22.96
90	32.2	380.0	26.20	342.0	23.58
100	37.8	389.0	26.82	350.1	24.14
110	43.3	399.0	27.51	359.1	24.76
120	48.9	409.0	28.20	368.1	25.38
130	54.4	418.0	28.82	376.2	25.94

Appendix B

Table B.1a U.S. Standard to Metric Conversion Factors (Approximate)			
Measure	**U.S. Standard**	**Multiply By**	**Metric**
Length	inches (in)	25.4	millimeters (mm)
	feet (ft)	304.8	millimeters (mm)
	feet (ft)	0.3048	meters (m)
Area	square inches (in^2)	645.16	square millimeters (mm^2)
	square feet (ft^2)	0.0929	square meters (m^2)
Weight (mass)	ounces (oz)	28.349	grams (g)
	pounds (lb)	0.4536	kilograms (kg)
Volume	cubic inches (in^3)	16387.06	cubic millimeters (mm^3)
	fluid ounces (fl oz)	29.57	milliliters (mL)
	cubic feet (ft^3)	0.0283	cubic meters (m^3)
Pressure	inches of mercury (inHG)	3.453	kilopascals (kPa)
	pounds per square inch (psi)	6.895	kilopascals (kPa)
	pounds per square inch (psi)	0.0689	bar (bar)
Temperature	degrees Fahrenheit (°F)	5/9 (after subtracting 32)	degrees Celsius (°C)

Table B.2a Metric to U.S. Standard Conversion Factors (Approximate)			
Measure	**Metric**	**Multiply By**	**U.S. Standard**
Length	millimeters (mm)	0.0394	inches (in)
	millimeters (mm)	0.00328	feet (ft)
	meters (m)	3.2808	feet (ft)
Area	square millimeters (mm^2)	0.00155	square inches (in^2)
	square meters (m^2)	10.764	square feet (ft^2)
Weight (mass)	grams (g)	0.03527	ounces (oz)
	kilograms (kg)	2.205	pounds (lb)
Volume	cubic millimeters (mm^3)	0.00006102	cubic inches (in^3)
	milliliters (mL)	0.0338	fluid ounces (fl oz)
	cubic meters (m^3)	35.336	cubic feet (ft^3)
Pressure	kilopascals (kPa)	0.2896	inches of mercury (inHG)
	kilopascals (kPa)	0.1450	pounds per square inch (psi)
	bar (bar)	14.5138	pounds per square inch (psi)
Temperature	degrees Celsius (°C)	9/5 (after adding 32)	degrees Fahrenheit (°F)

Appendix B

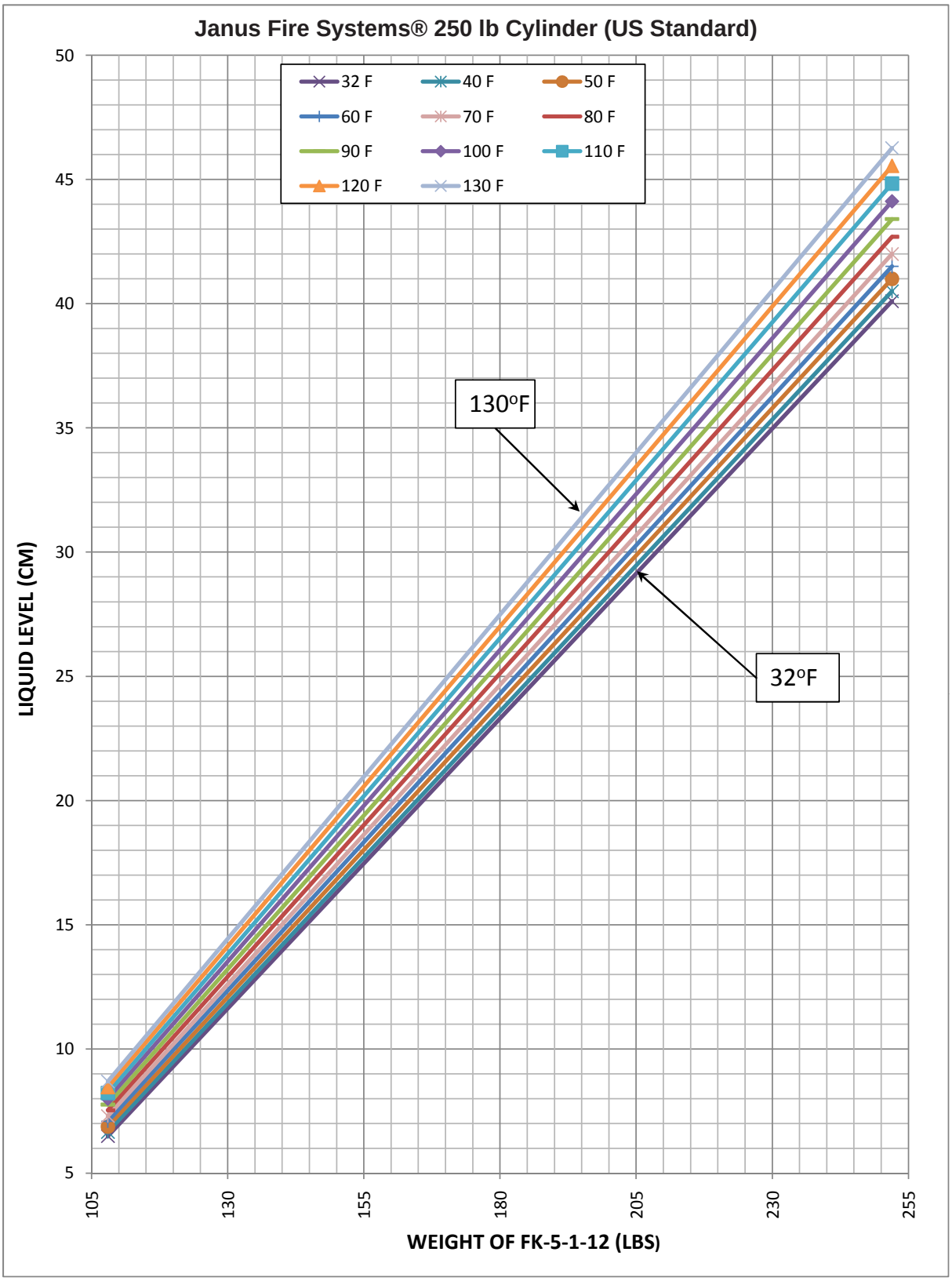


Table 6.2.1.2a Liquid Level Chart – 250 lb Cylinder (U.S. Standard)

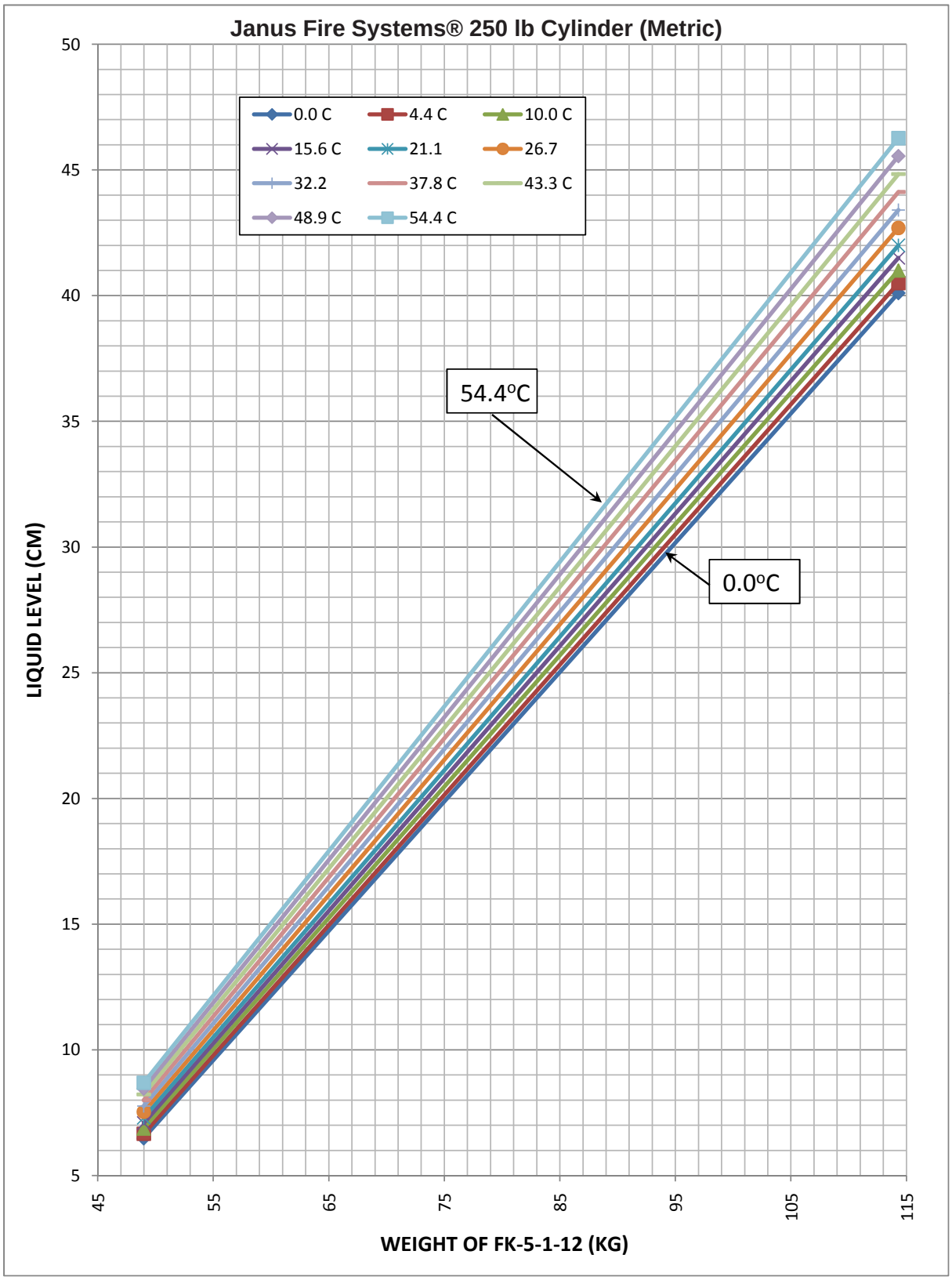


Table 6.2.1.2b Liquid Level Chart – 250 lb Cylinder (Metric)

Appendix B

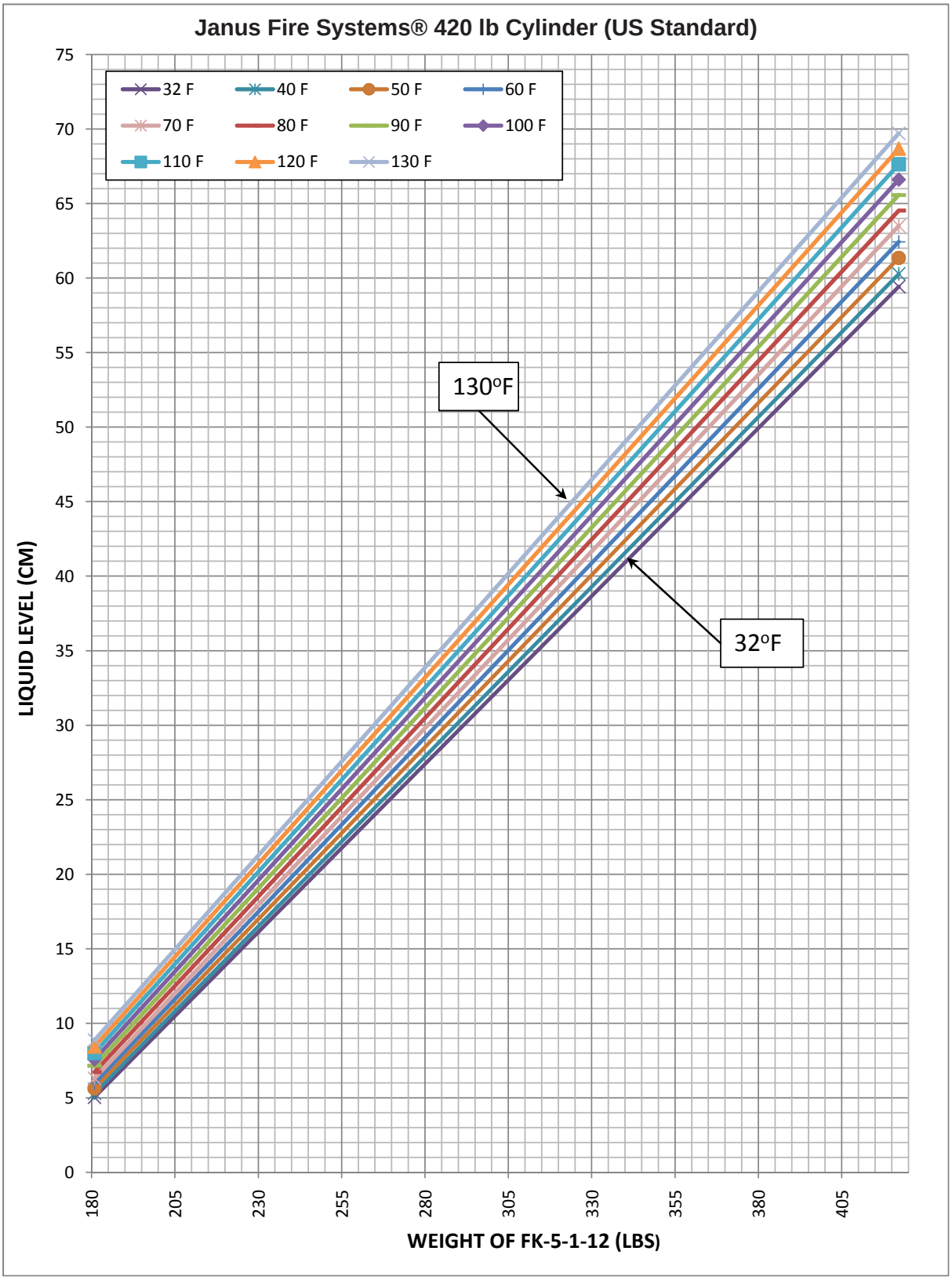


Table 6.2.1.2c Liquid Level Chart – 420 lb Cylinder (U.S. Standard)

Appendix B

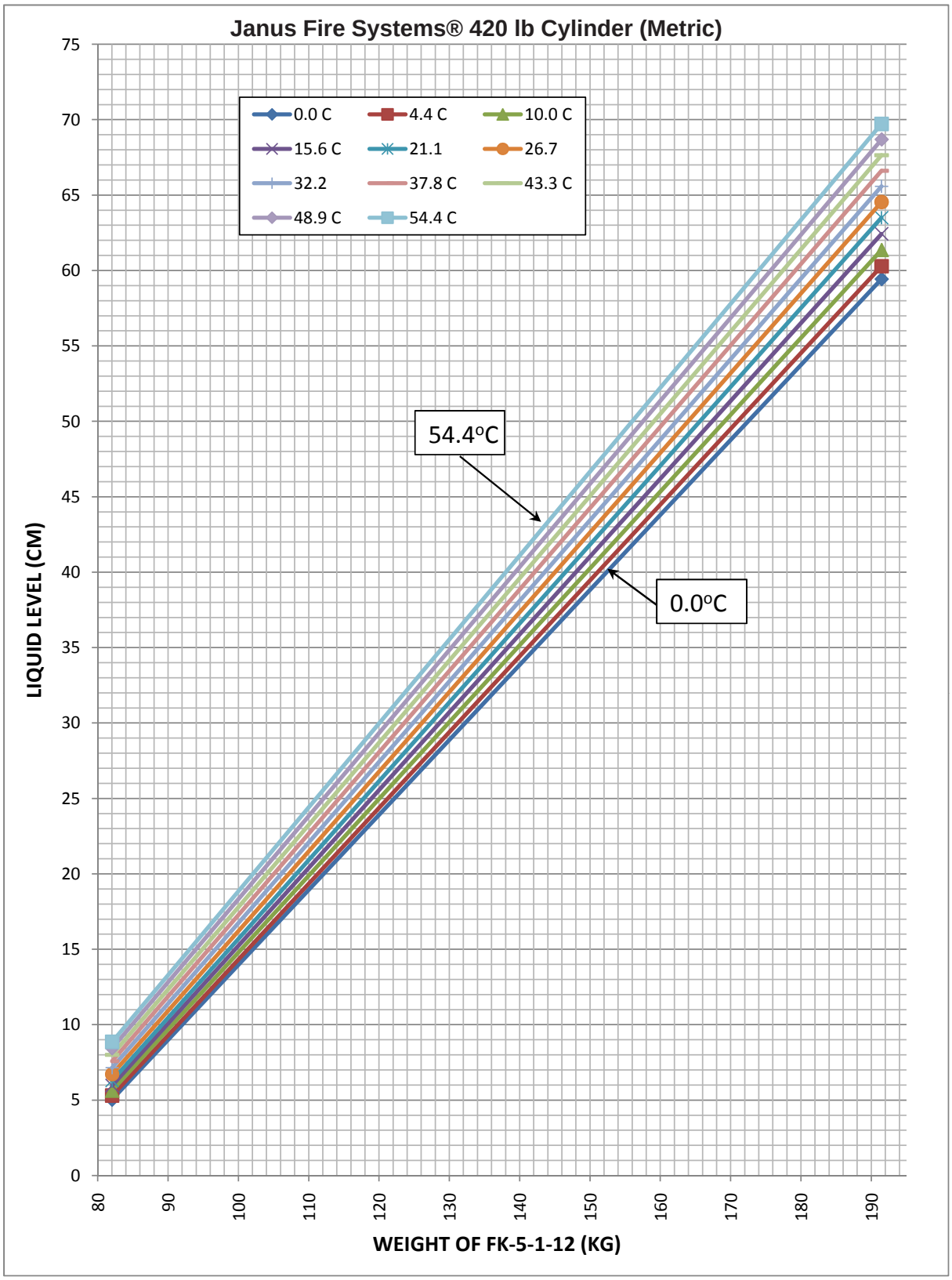


Table 6.2.1.2d Liquid Level Chart – 420 lb Cylinder (Metric)

Appendix B

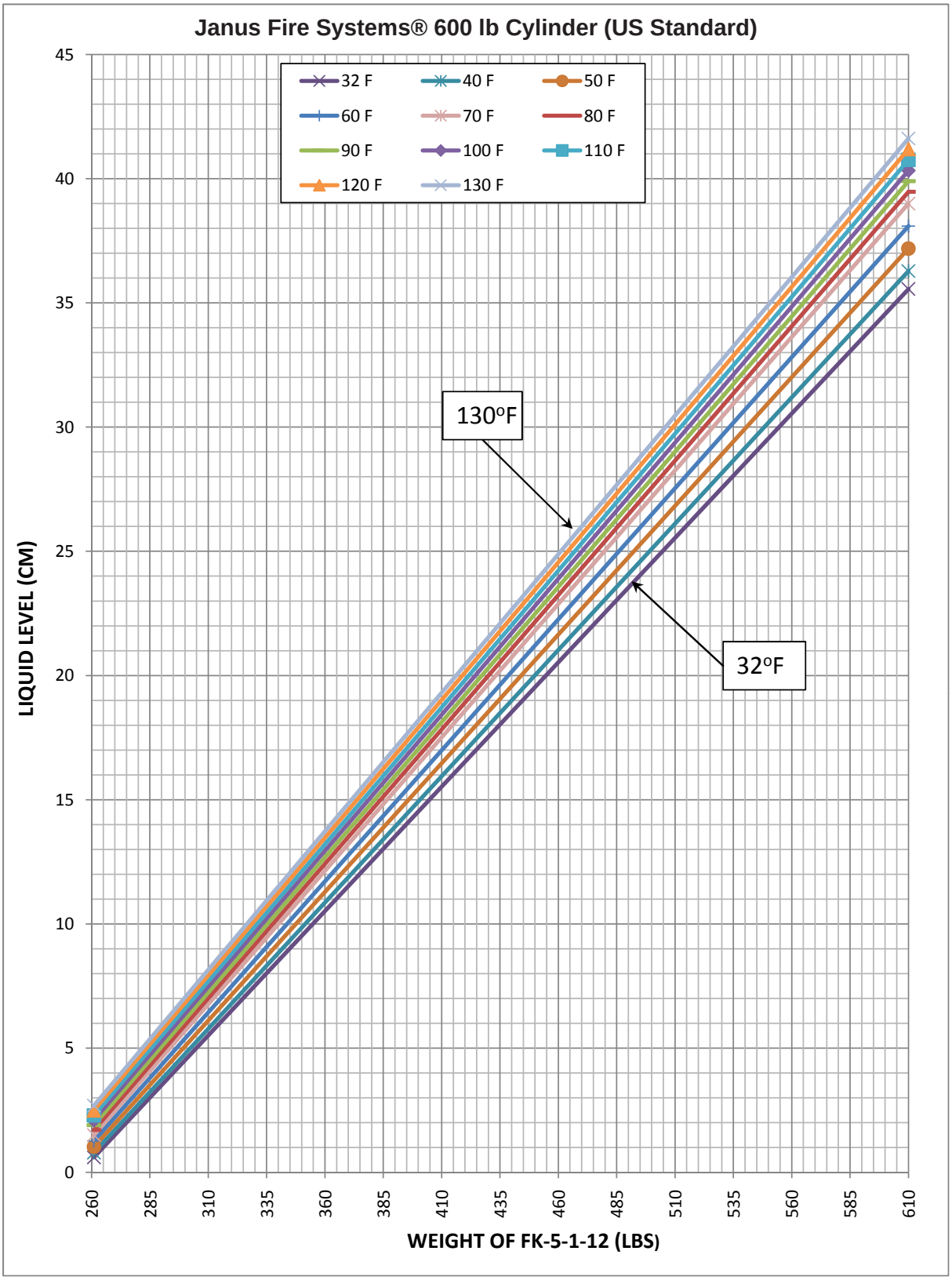


Table 6.2.1.2e Liquid Level Chart – 600 lb Cylinder (U.S. Standard)

Appendix B

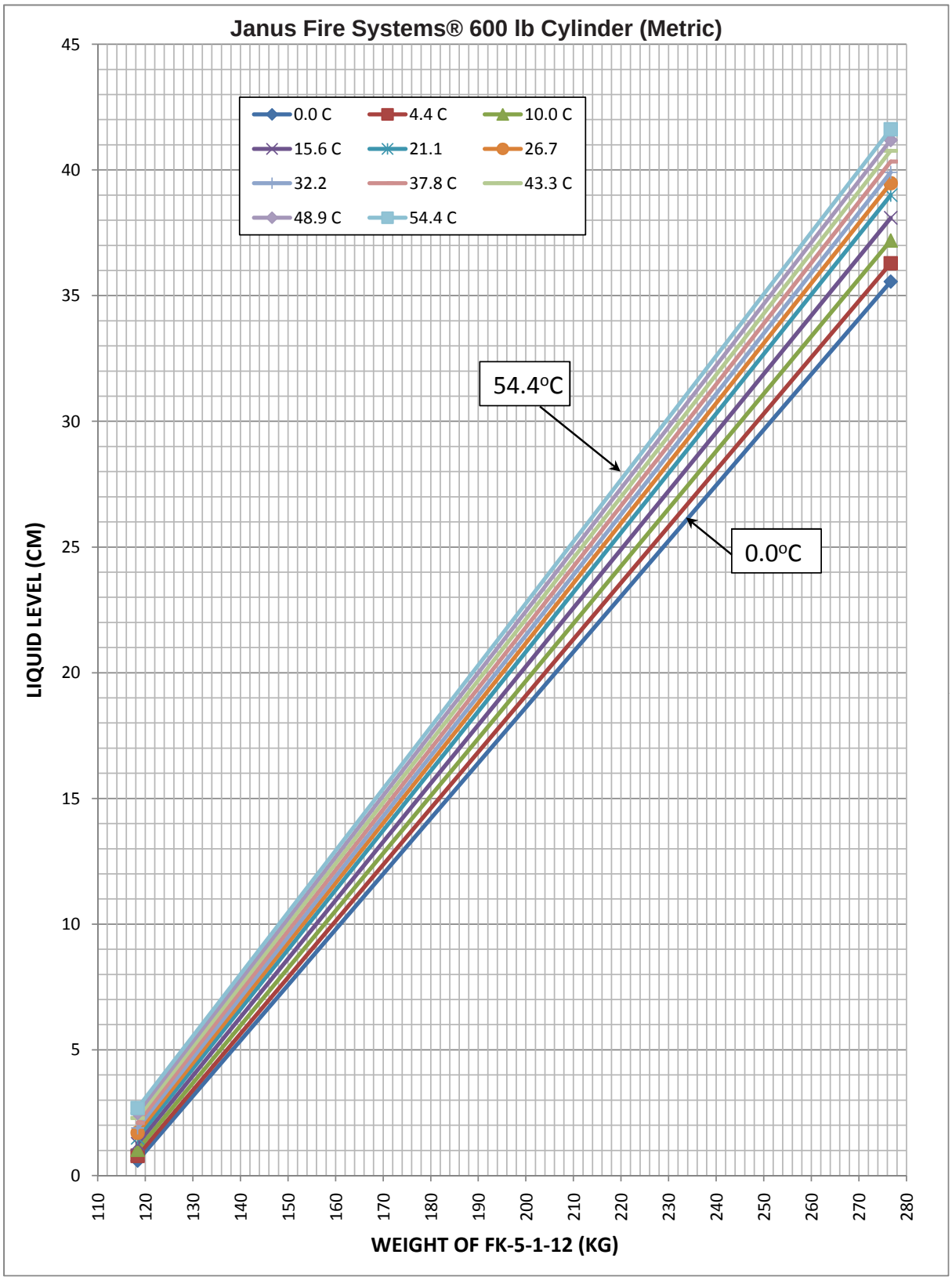


Table 6.2.1.2f Liquid Level Chart – 600 lb Cylinder (Metric)

Appendix B

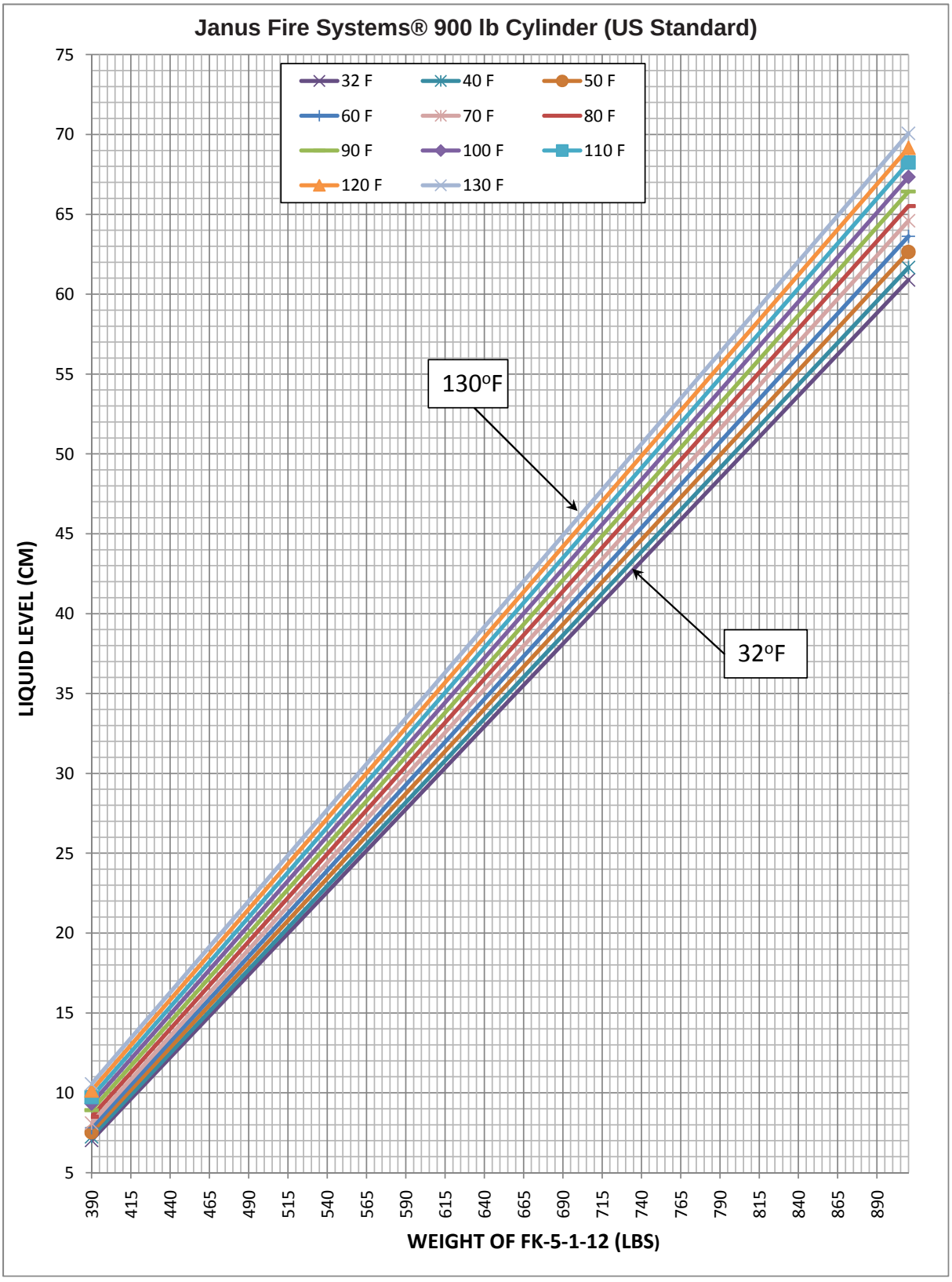


Table 6.2.1.2g Liquid Level Chart – 900 lb Cylinder (U.S. Standard)

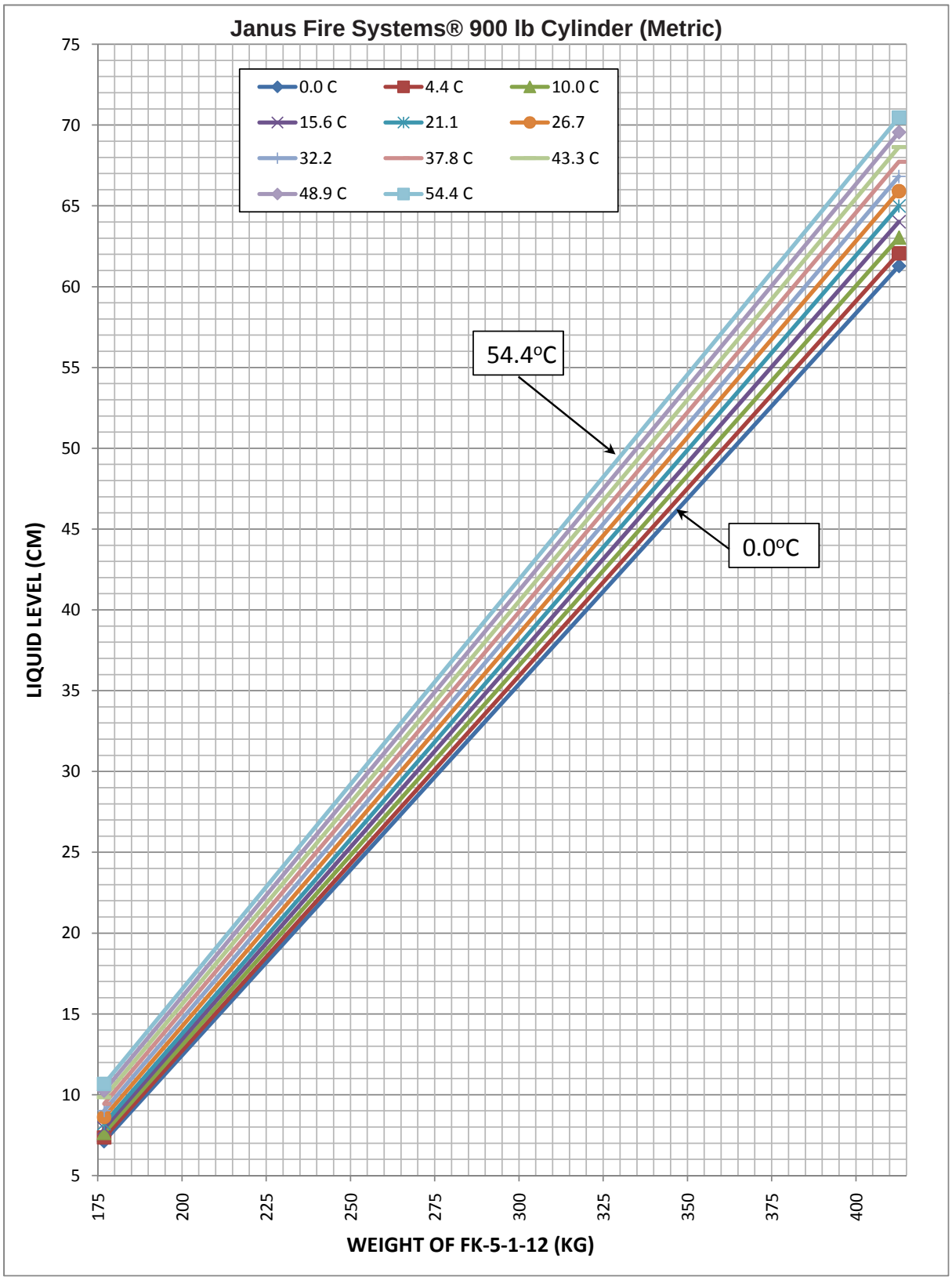


Table 6.2.1.2h Liquid Level Chart – 900 lb Cylinder (Metric)

Appendix B

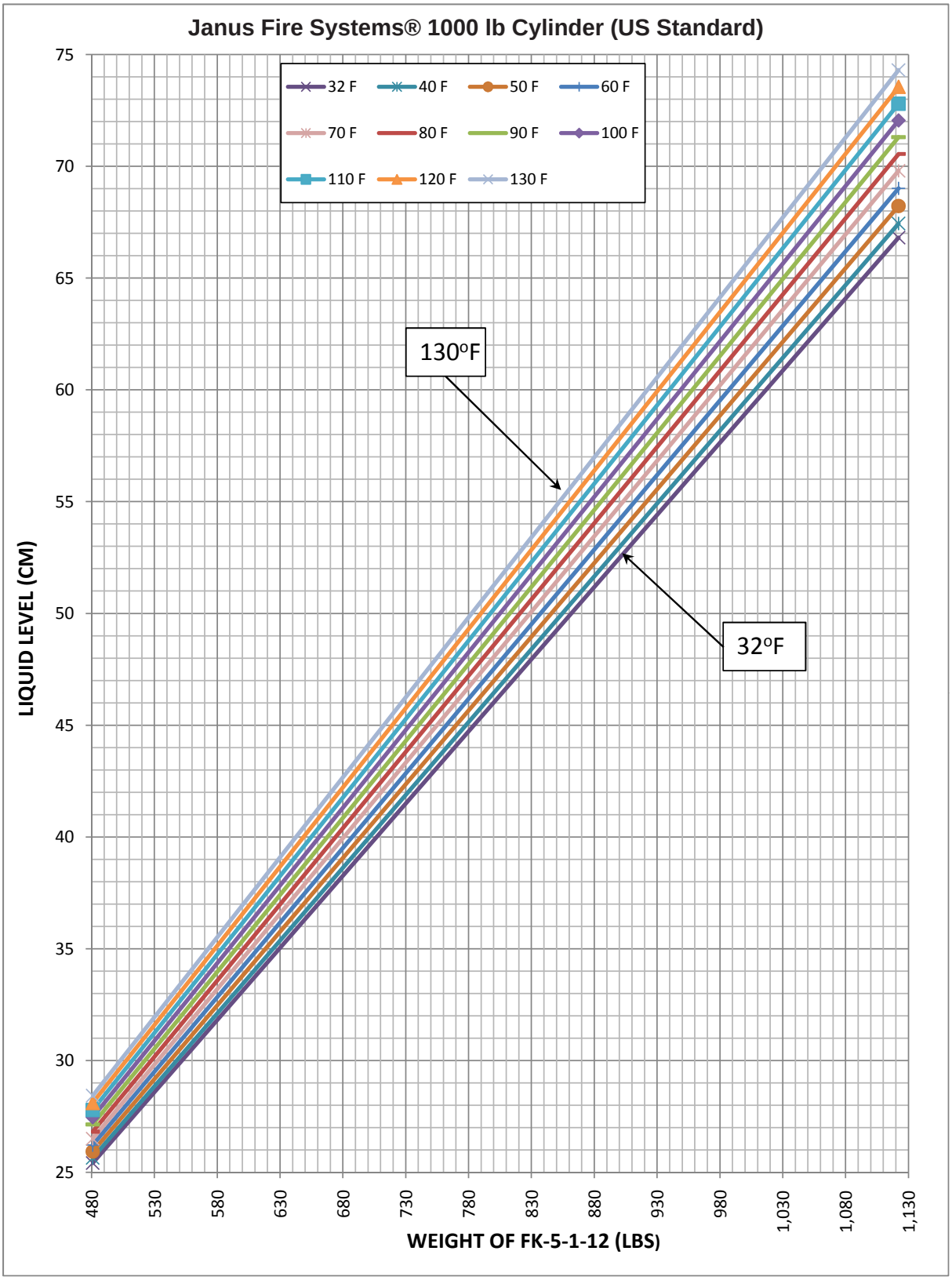


Table 6.2.1.2i Liquid Level Chart – 1000 lb Cylinder (U.S. Standard)

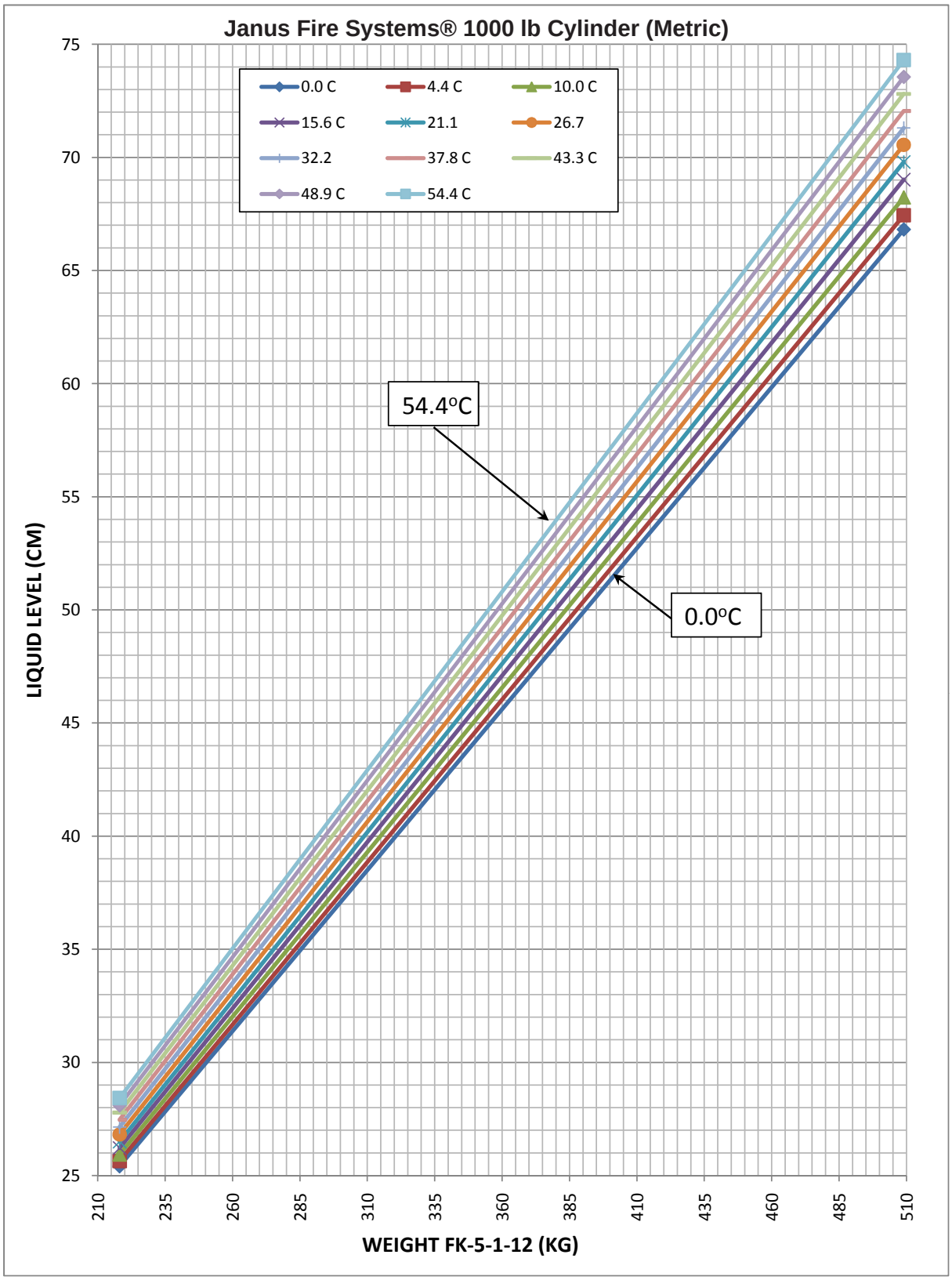


Table 6.2.1.2j Liquid Level Chart – 1000 lb Cylinder (Metric)

Appendix B

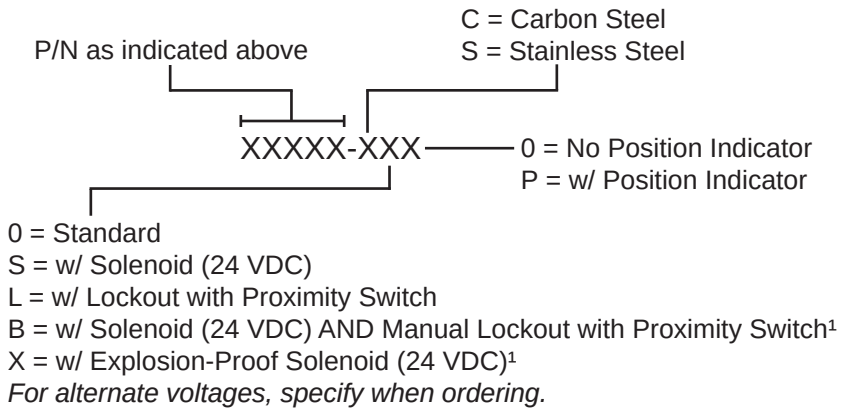
Appendix C

Master and Selector Valve Ordering Information

Appendix C

Table C.1 - Master and Selector Valve Ordering Information			
P/N	**Valve Size**	**Description (see below for options)**	**Nominal Weight lb (kg)**
19483	1/2”	Ball Valve, Pneumatically Actuated	4.2 (1.9)
19484	3/4”	Ball Valve, Pneumatically Actuated	6.5 (2.9)
19485	1”	Ball Valve, Pneumatically Actuated	8.6 (3.9)
19486	1-1/2”	Ball Valve, Pneumatically Actuated	19.5 (8.8)
19487	2”	Ball Valve, Pneumatically Actuated	27.0 (12.3)
19488	3”	Wafer Valve, 830 Series, Pneumatically Actuated	34.3 (15.5)
19489	4”	Wafer Valve, 830 Series, Pneumatically Actuated	56.8 (26.0)
19490	6”	Wafer Valve, 830 Series, Pneumatically Actuated	105.0 (48.0)
19491	8”	Wafer Valve, 830 Series, Pneumatically Actuated	191.0 (87.0)

Ordering Instructions: Specify the Valve P/N followed by a dash and the appropriate three digit option code as illustrated below.



Examples:
19483-C00 – 1/2” Ball Valve, Carbon Steel
19485-SS0 – 1” Ball Valve, with Solenoid (24 VDC), Stainless Steel

[1]*Explosion-Proof Solenoid is not compatible with Lockout with Proximity Switch option.*

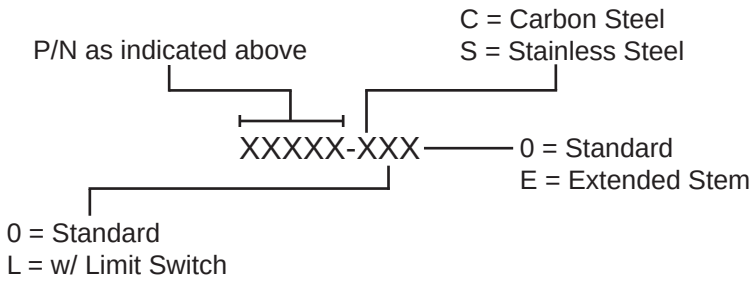
Appendix D

Lockout Valve
Ordering Information

Appendix D

Table D.1 - Lockout Valve Ordering Information			
P/N	**Valve Size**	**Description (see below for options)**	**Nominal Weight lb (kg)**
19465	1/2”	Ball Valve, Manually Actuated	1.9 (0.9)
19466	3/4”	Ball Valve, Manually Actuated	2.7 (1.2)
19467	1”	Ball Valve, Manually Actuated	4.8 (2.2)
19468	1-1/2”	Ball Valve, Manually Actuated	9.8 (4.4)
19469	2”	Ball Valve, Manually Actuated	12.7 (5.8)
19470	3”	Wafer Valve, 830 Series, Manually Actuated	23.0 (10.3)
19471	4”	Wafer Valve, 830 Series, Manually Actuated	32.0 (14.3)
19472	6”	Wafer Valve, 830 Series, Manually Actuated	69.0 (30.8)
19473	8”	Wafer Valve, 830 Series, Manually Actuated	107.0 (48.8)

Ordering Instructions: Specify the Valve P/N followed by a dash and the appropriate three digit option code as illustrated below.



Examples:
19465-C00 – 1/2” Ball Valve, Carbon Steel
19467-SL0 – 1” Ball Valve, with Limit Switch, Stainless Steel

Appendix E

Alternate Nozzle Spacing Options

Appendix E

A single corner nozzle may be used to protect a room with a total area of 576 ft^2 (53.5 m^2) or less provided the nozzle is not more than 33.94 ft (10.34 m) from the farthest point it is intended to protect.

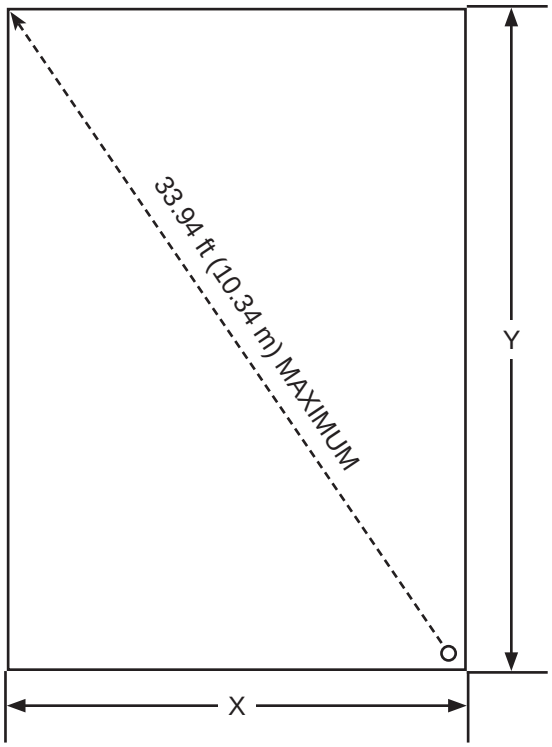


Table 3.5a - Alternate Nozzle Spacing for 90° Corner Nozzles

X distance		Y distance	
ft	m	ft	m
24	7.3	24	7.3
22	6.7	25	7.9
21	6.4	26	8.1
20	6.1	27	8.4
19	5.8	28	8.6
17	5.2	29	9.0
15	4.6	30	9.3
13	4.0	31	9.6
11	3.4	32	9.8
7	2.1	33	10.1

Appendix E

A single sidewall nozzle may be used to protect a room with an area of 1521 ft^2 (141.3 m^2) or less provided the nozzle is not more than 43.6 ft (13.28 m) from the farthest point it is intended to protect.

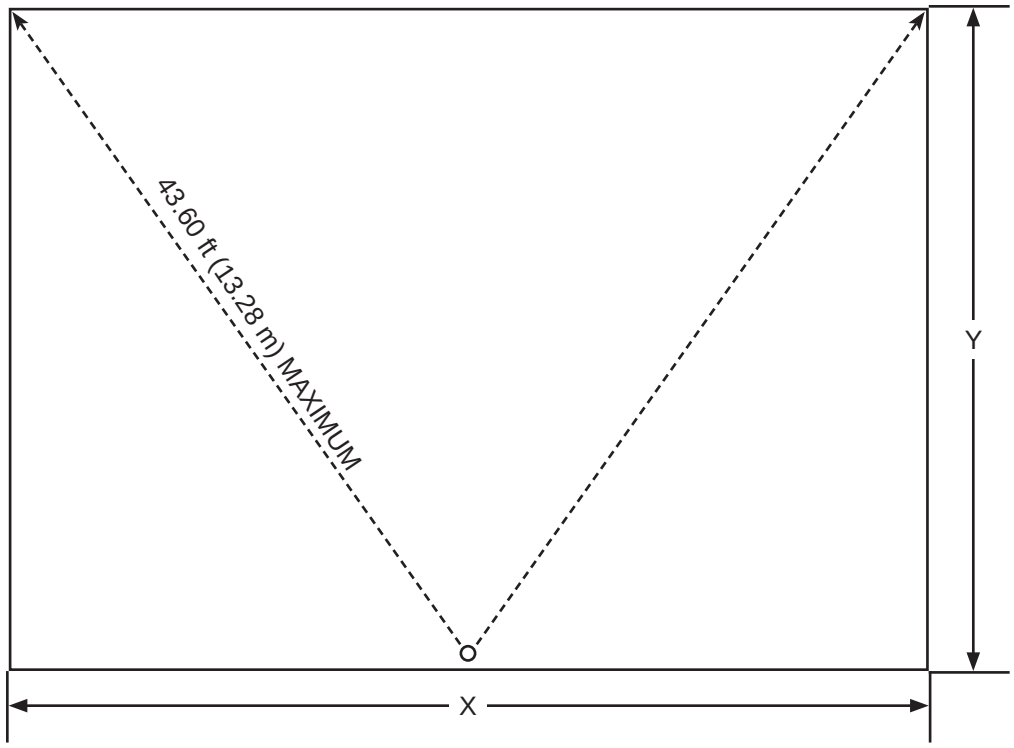


Table 3.5b - Alternate Nozzle Spacing for 180° Sidewall Nozzles - Selected Values							
X distance (width)		Y distance (throw)*		X distance (width)		Y distance (throw)*	
ft	m	ft	m	ft	m	ft	m
14	4.3	43	13.1	64	19.5	29	8.8
22	6.7	42	12.9	66	20.1	28	8.5
28	8.5	41	12.6	68	20.7	27	8.2
34	10.4	40	12.2	70	21.3	26	7.9
39	11.9	39	11.9	72	21.9	24	7.3
44	13.4	37	11.3	74	22.6	23	7
48	14.6	36	11	76	23.2	21	6.4
52	15.8	35	10.7	78	23.8	19	5.8
54	16.5	34	10.4	80	24.4	17	5.2
56	17.1	33	10.1	82	25	14	4.3
58	17.7	32	9.8	84	25.6	11	3.4
60	18.3	31	9.4	86	26.2	7	2.1

* Y distance rounded to lowest whole value where applicable

Appendix E

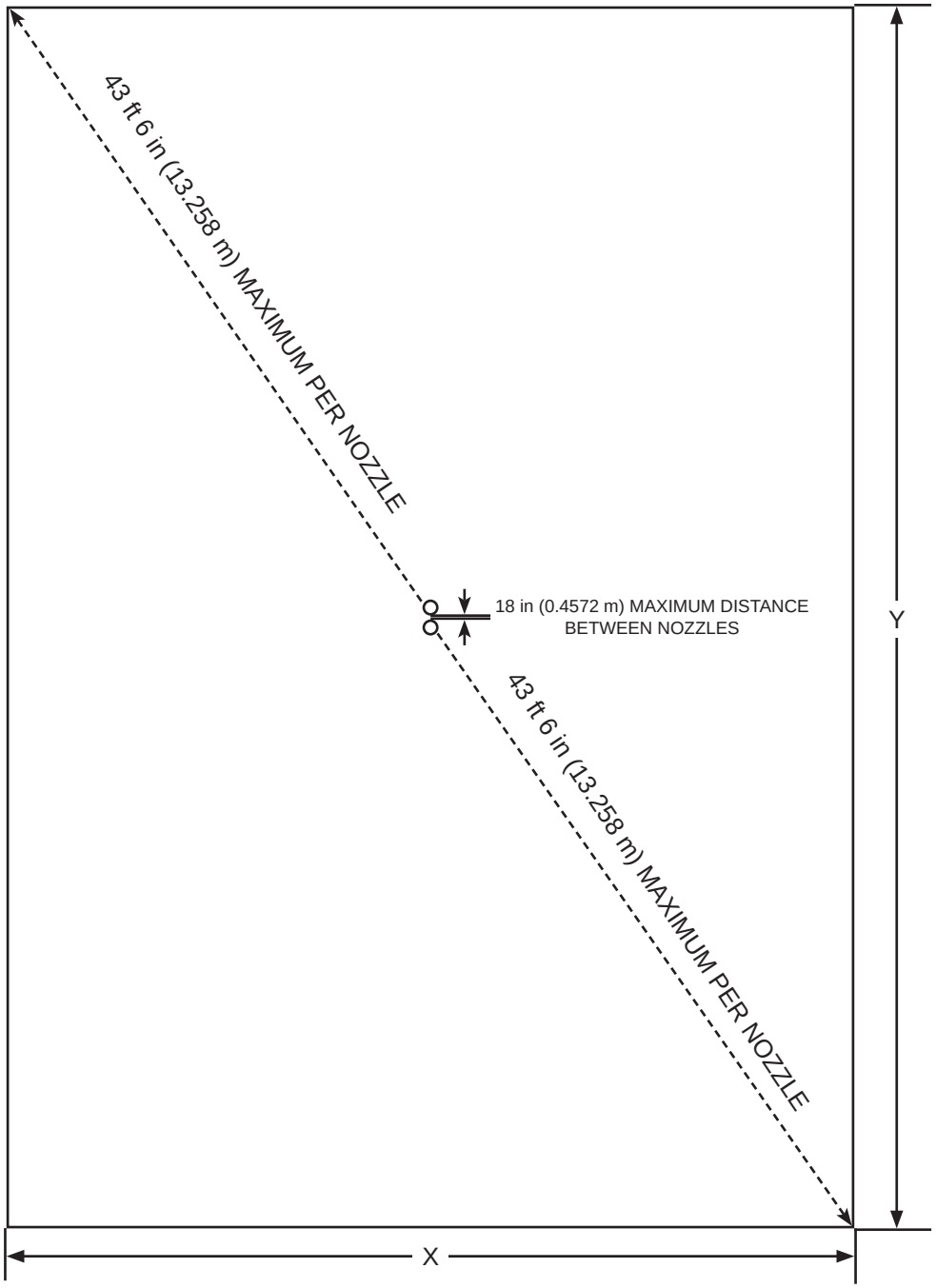


Table 3.5c - Nozzle Spacing for Back-to-Back 180° Sidewall Nozzles - Selected Values

X distance		Y distance*		X distance		Y distance*		X distance		Y distance*		X distance		Y distance*	
ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
14	4.3	86	26.2	46	14	74	22.6	60	18.3	63	19.2	74	22.6	46	14
22	6.7	84	25.6	48	14.6	72	21.9	62	18.9	61	18.6	76	23.2	42	12.8
28	8.5	82	25	50	15.2	71	21.6	64	19.5	59	18	78	23.8	39	11.9
34	10.4	80	24.4	52	15.8	70	21.3	66	20.1	57	17.4	80	24.4	34	10.4
39	11.9	78	23.8	54	16.5	68	20.7	68	20.7	54	16.5	82	25	29	8.8
42	12.8	76	23.2	56	17.1	66	20.1	70	21.3	52	15.8	84	25.6	23	7
44	13.4	75	22.9	58	17.7	65	19.8	72	21.9	49	14.9	86	26.2	14	4.3

* Y distance rounded to lowest whole value where applicable

In a back-to-back sidewall arrangement, the nozzles shall be installed as shown in Figure 3.5d below and must be orientated with direction of flow in opposite directions so that the centerlines of both nozzles are parallel to the run of the tee immediately feeding into the nozzles. Back-to-back sidewall nozzles may be orientated in a pendant or upright position.

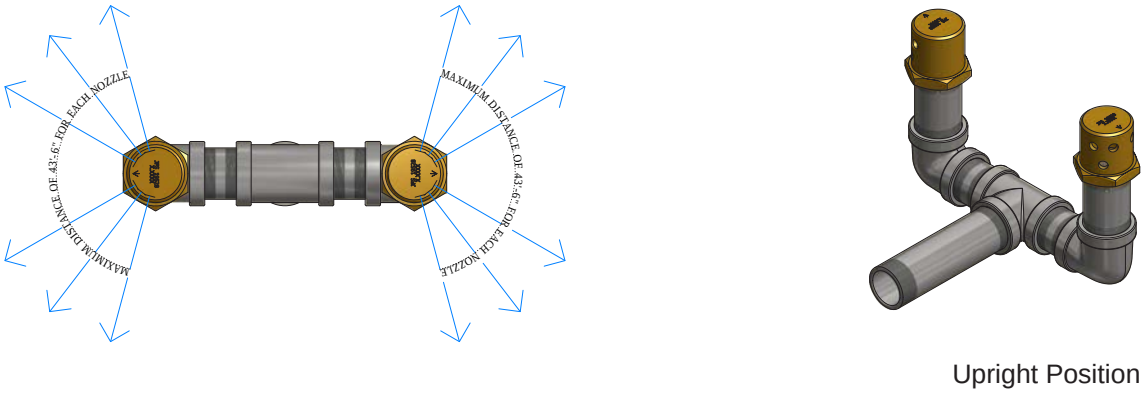


Figure 3.5d Back-to-Back Sidewall Nozzle Orientation - Typical Arrangements

Appendix F

Legacy and Auxiliary Components

Appendix F

F.1 Legacy Components

This section contains the technical information on parts that are no longer available for purchase. Please reference these sections for existing systems that utilize these components or to identify the recommended replacement component.

F.1.1 Electric Valve Actuator w/o Supervision

P/N 18481 (See Figure F.1.1)

The electric valve actuator attaches to the primary cylinder at the valve actuation connection and is utilized to automatically open the cylinder valve upon receipt of a signal from the control panel or other source. It operates between 20.4 and 26.4 VDC and consumes 500 mA (.5 Amps) at 24 VDC nominal with a maximum supervisory current of 30 mA (0.03 Amps).

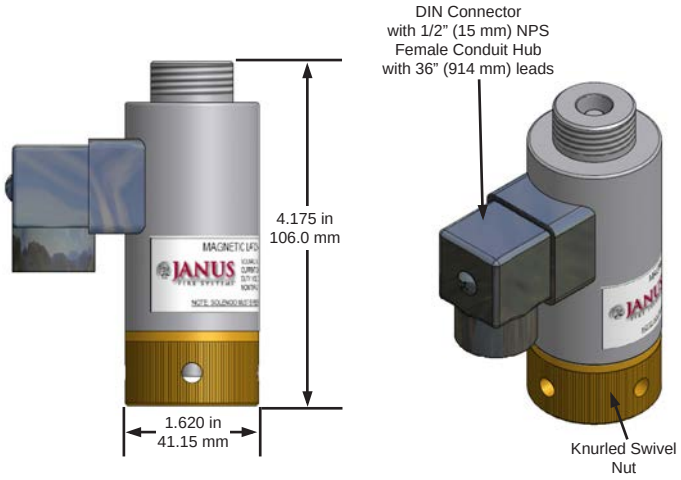


Figure F.1.1 Electric Valve Actuator

The electric valve actuator body is steel construction with a brass knurled swivel nut and a stainless steel actuation pin that depresses the valve core when energized. It must be manually reset by pushing the pin up until it snaps in the "up" position. (An optional manual reset tool P/N 95113 is available.) The electric valve actuator is shipped with a plastic threaded cap on its top port that should only be removed when installing the manual valve actuator.

⚠WARNING

Attaching the electric valve actuator to the cylinder valve when the actuation pin is not fully locked into the "up" position may cause the cylinder valve to actuate, resulting in potential injury and/or property damage, and complete loss of agent.

NOTE: NFPA 2001 requires that the removal of an electric actuator from the agent storage container discharge valve that it controls shall result in an audible and visual indication of system impairment at the system releasing control panel. This is in effect January 1, 2016.

NOTE: Electric Valve Actuators with a 1/2 in (15 mm) Conduit Hub must be installed with flexible metal or liquid tight conduit in compliance with all local, state, national and/or international building codes. Refer to DOC323 Electric Actuator Installation Sheet for a list of UL Listed connectors that meet the requirements of Underwriters Laboratories and are suitable for use with these actuators.

REPLACEMENT COMPONENT: The electric valve actuator has a life span of 25 years from date of manufacture. Refer to Section 2.2.3.1 of this manual for the equivalent replacement component.

F.1.2 Discharge Pressure Switch

P/N 18773 (See Figure F.1.2)

A discharge pressure switch is used in the system to send a signal confirming agent discharge to the control panel or to initiate the shut down of equipment that may deplete agent concentration. It is a single pole, double throw (SPDT) switch with contacts rated 10 Amps resistive at 30 VDC. The discharge pressure switch shall be required where mechanical system actuation is possible, though its placement varies according to the individual system arrangement.

REPLACEMENT COMPONENT: Refer to Section 2.4.2 of this manual for the equivalent replacement component.

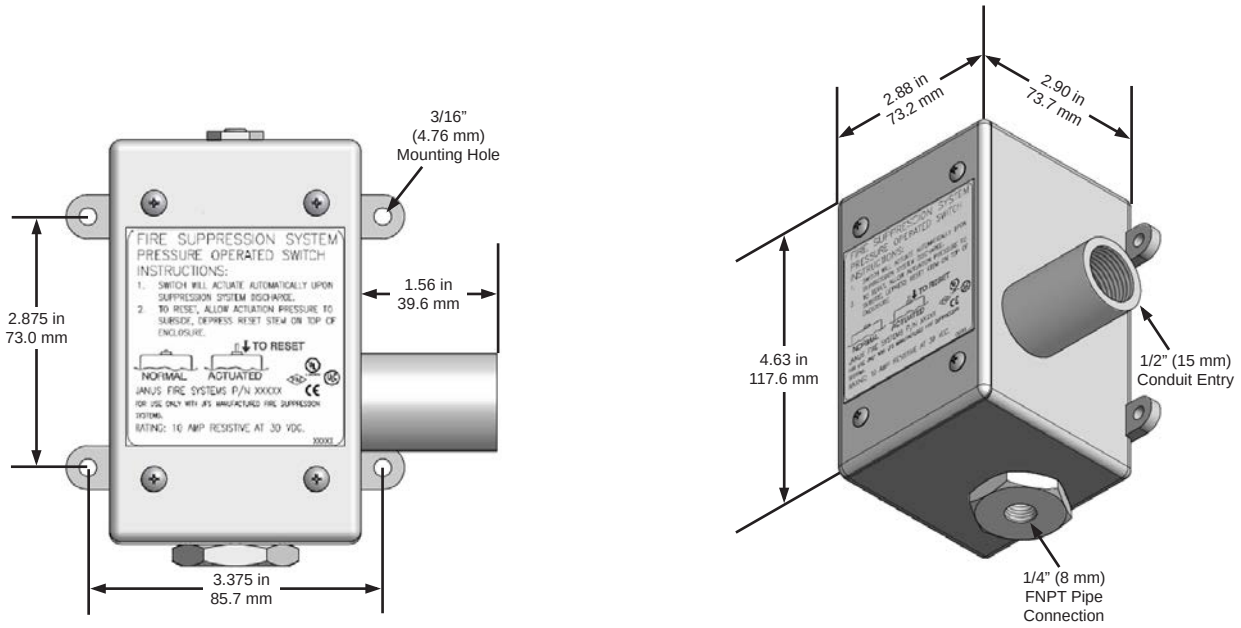


Figure F.1.2 Discharge Pressure Switch

Appendix F

F.2 Auxiliary Components

This section contains the technical information on non-standard parts.

F.2.1 Explosion-Proof Pressure Switch, Manual Reset

P/N 97429 (See Figure F.2.1)

A manually reset NEMA 7 and 9 Explosion-Proof Discharge Pressure Switch (P/N 97429) can be used in potentially explosive atmospheres to send indication of agent discharge to a releasing panel and/or initiate the shut down of equipment that may deplete agent concentration. It has two tandem double pole, double throw (DPDT) switches operating in parallel with contacts rated 15 Amps at 125/250/480 VAC and 0.5 Amps at 125 VDC. It is factory set at 50 psig (3.44 bar) rise.

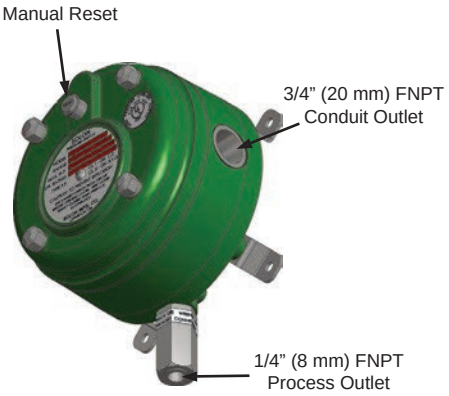


Figure F.2.1 Explosion-Proof Pressure Switch, Manual Reset

This model pressure switch has not been evaluated by Factory Mutual. The switch is Underwriters Laboratories Listed by the manufacturer Solon Manufacturing Company under the following file numbers:

Industrial Controls Equipment Type 4 & 12, File E130423,
Pressure Operated Switch for Hazardous Locations,
Class I, Groups C & D; Class II, Groups E, F, & G File E65371

F.2.2 Weather-Proof Pressure Switch, Self-Restoring

P/N 98580 (See Figure F.2.2)

A weather-proof self-restoring discharge pressure switch can be used to send indication of agent discharge to a releasing panel and/or initiate the shut down of equipment that may deplete agent concentration. The switch sends an indication of agent discharge at 21 psig (1.45 bar), on the rise, to a PLC. It is a single pole, double throw (SPDT) switch with 5 amps resistive and 5 amps inductive at 125 VAC & 250 VAC and 0.5 amps resistive and 0.25 amps inductive at 125 VDC.

Figure F.2.2 Weather-Proof Discharge Pressure Switch

The switch has a temperature rating of -20˚F to 180˚F (-28˚C to 82˚C) and a proof pressure of 3000 psig (206.9 bar). The body material is aluminum and has a brass connection.

F.2.3 Pressure Regulator

P/N 19599 (See Figure F.2.3)

A 316L stainless steel self-relieving pressure regulator with Teflon seat is available to be placed between the discharge manifold and selector valves to reduce the pressure into selector valve actuation ports. It has a 1/4 in (8 mm) FNPT inlet and outlet with a maximum operating inlet pressure of 3600 psig (248 bar) and an outlet range of 0 to 250 psig (0 to 17.2 bar). The regulator has a standalone ambient temperature range of -40˚ to 500˚F (-40˚ to 260˚C) and a Cv of 0.5. A pressure gauge (0-160 psig P/N 19171) may be fastened to the regulator to allow visual monitoring of outlet pressure. A 1/2 in (15 mm) stainless steel strainer (P/N 19370) is required to be installed upstream of the pressure regulator to prevent debris from entering the regulator or pneumatic actuation port of the solenoid. (Strainer has an internal filter size of 40 mesh and is rated ASME class 300.)

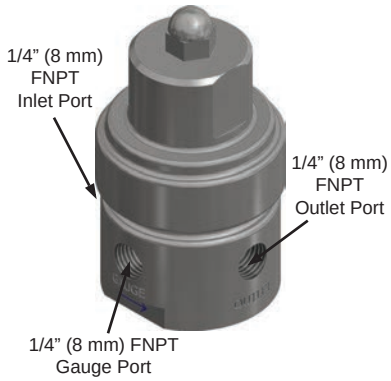


Figure F.2.3 Pressure Regulator

F.2.4 High Pressure Regulator

P/N 99772 (See Figure F.2.4)

A 316L stainless steel self-relieving pressure regulator with Teflon seat is available. It has a 1/2 in (15 mm) FNPT inlet and outlet with a maximum operating inlet pressure of 3600 psig (248 bar) and an outlet range of 0 to 250 psig (0 to 17.2 bar). The regulator has a standalone ambient temperature range of -4˚ to 176˚F (-20˚ to 80˚C) and a Cv of 1.0. A pressure gauge (0-160 psig P/N 19171) may be fastened to the regulator to allow visual monitoring of outlet pressure. A 1/2 in (15 mm) stainless steel strainer (P/N 19370) is required to be installed upstream of the pressure regulator to prevent debris from entering the regulator or pneumatic actuation port of the solenoid. (Strainer has an internal filter size of 40 mesh and is rated ASME class 300.)

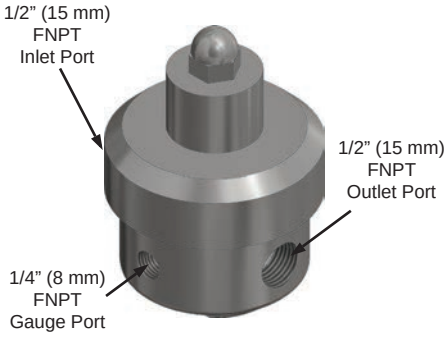


Figure F.2.4 High Pressure Regulator

F.2.5 XP Low-Pressure Supervisory Switch Assembly

P/N 98660 (See Figure F.2.5)

An optional explosion-proof low-pressure supervisory switch is also available. The switch has an enclosure rating of NEMA 4x, 7, 9 and IP67 and explosion-proof classifications Class I, Div I, Group A,B,C,D, Class II, Div I, Group E,F,G, and Class III.

1. O-Rings must be ordered in packs of 25 as P/N 98791

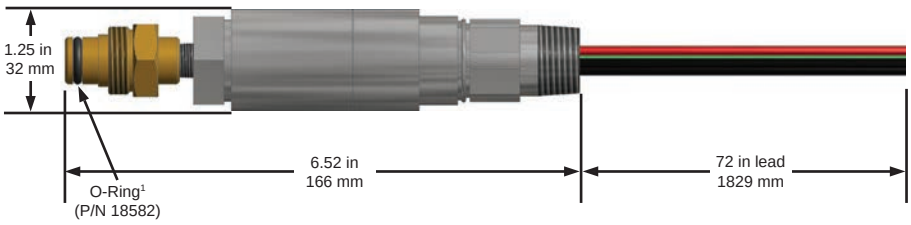


Figure F.2.5 XP Low-Pressure Supervisory Switch Assembly

The contact configuration is single pole, single throw (SPST) with contacts rated 1.5 Amps at 24 VDC. Should the cylinder pressure drop to approximately 315 psi (21.7 bar), the switch contacts will close transmitting an abnormal signal to the system control panel. The low-pressure supervisory switch has 72 inch (1829 mm) leads.

F.2.6 Inline Check Valves

A range of inline check valves are available. These may be used in main/reserve or selector valve cylinder arrangements as required by the unique design.

Table F.2.6a - Inline Check Valves							
P/N		Valve Size (FNPT)		Length (L)		Weight	
Brass	Stainless Steel	in	mm	in	mm	lbs	kg
19501	19507	1/2	15	2.71	69	0.6	0.3
19502	19508	3/4	20	2.94	75	0.7	0.3
19503	19509	1	25	3.64	92	1.4	0.6
19504	19510	1-1/2	40	4.37	111	3.9	1.8
19505	19511	2	50	5.85	149	5.8	2.6
19506	19512	3	80	6.25	159	16.4	7.4

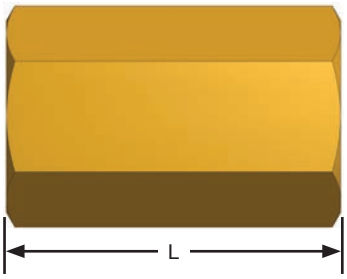


Figure F.2.6a Inline Check Valve

Additional male connection check valves are available. These check valves have a maximum pressure of 3000 psig @ 70˚F (206 bar @ 21˚C) and are available in two different sizes and made of brass or stainless steel.

Table F.2.6b - Male Inline Check Valves							
P/N		Valve Size (MNPT)		Length		Weight	
Brass	Stainless Steel	in	mm	in	mm	lbs	kg
19475	19476	1/4	8	1.62	41	0.4	0.2
19477	19375	1/2	15	2.28	58	0.6	0.3

Figure F.2.6b Male Check Valve

Appendix G

Remote Pneumatic Components

Appendix G

G.1 Remote Pneumatic Actuation

This section details the components and arrangements necessary to achieve remote pneumatic operation of the Janus Fire Systems® Sv, Mv, and Lv Series Fire Extinguishing Systems utilizing FK-5-1-12.

G.1.1 Standard Remote Pneumatic Arrangement

The basic remote pneumatic arrangement of the Janus Fire Systems® Sv, Mv, and Lv Series Fire Extinguishing System locates the standard Electric Valve Actuator (P/N 20722) on a Remote Nitrogen Actuation Cylinder (P/N 26311 or 26310) via the Remote Pneumatic Actuation/Bracket Kit (P/N 97643). Upon actuation of the Electric Valve Actuator, the Remote Nitrogen Actuation Cylinder opens sending nitrogen pressure to the actuation port of the Manual-Pneumatic Actuator (P/N 98533) installed on the primary cylinder as shown in Figure G.1.1a. Any additional secondary cylinders shall be actuated as in the standard multiple-cylinder pilot arrangement shown in Section 4.1.6 of this manual.

In addition, a Lever-Pull Manual Actuator (P/N 19589) can be fitted on a remote nitrogen actuation cylinder "for manual only" system operation, and the XP Electric Valve Actuator (P/N 95184) and XP Manual Valve Actuator (P/N 95130) may be installed on the remote nitrogen actuation cylinder within Class I, Division 1 hazardous locations.

Multiple remote nitrogen actuation cylinders with electric valve actuators, lever-pull manual actuators or a combination of both components may be installed on a single FK-5-1-12 system. Tees and/or check valves shall be installed as indicated in Figure G.1.1b when utilizing multiple remote nitrogen actuation cylinders on a single system. There is no limit to the number of remote nitrogen actuation cylinders that may be installed as long as:

Each cylinder is isolated via check valves to ensure that each remote nitrogen cylinder is isolated from one another through the use of check valves so that the flow of actuation pressure from a single nitrogen cylinder never branches into more than one direction on its path to the agent cylinders AND individual runs of the remote nitrogen cylinder to the agent cylinders (including any rises or drops and any runs to a discharge pressure switch) do not exceed the length limitations listed in Table G.2a.

(For systems protecting occupiable enclosures where the required agent concentration is equal to or exceeding the NOAEL, refer to section G.1.2).

NOTE: The XP Electric Valve Actuator (P/N 95184) and XP Manual Valve Actuator (P/N 95130) may be used in place of the standard actuator to allow installation in Class I, Division 1 hazardous locations. For installation in Class II and Class III hazardous locations, the lever pull manual actuator and manual/pneumatic actuator combination may be fitted as detailed in Figure G1.1.1c "MANUAL ONLY" option. If Low-Pressure Supervisory Switches are provided as part of the system design for remote nitrogen actuation cylinders installed in hazardous locations using either of the above methods, the Explosion-Proof model (P/N 98302) must be provided (refer to Appendix F, Section F.2.5).

⚠ WARNING

The standard Electric Valve Actuator, P/N 20722, must never be located within hazardous locations (Class I, II, and III, Divisions 1 and 2) or be installed on a remote nitrogen actuator, Janus clean agent cylinder, or any Janus component that is located within hazardous locations (Class I, II, and III, Divisions 1 and 2). Explosion-Proof components must only be installed in a hazardous location that matches the class(es) they are rated for.

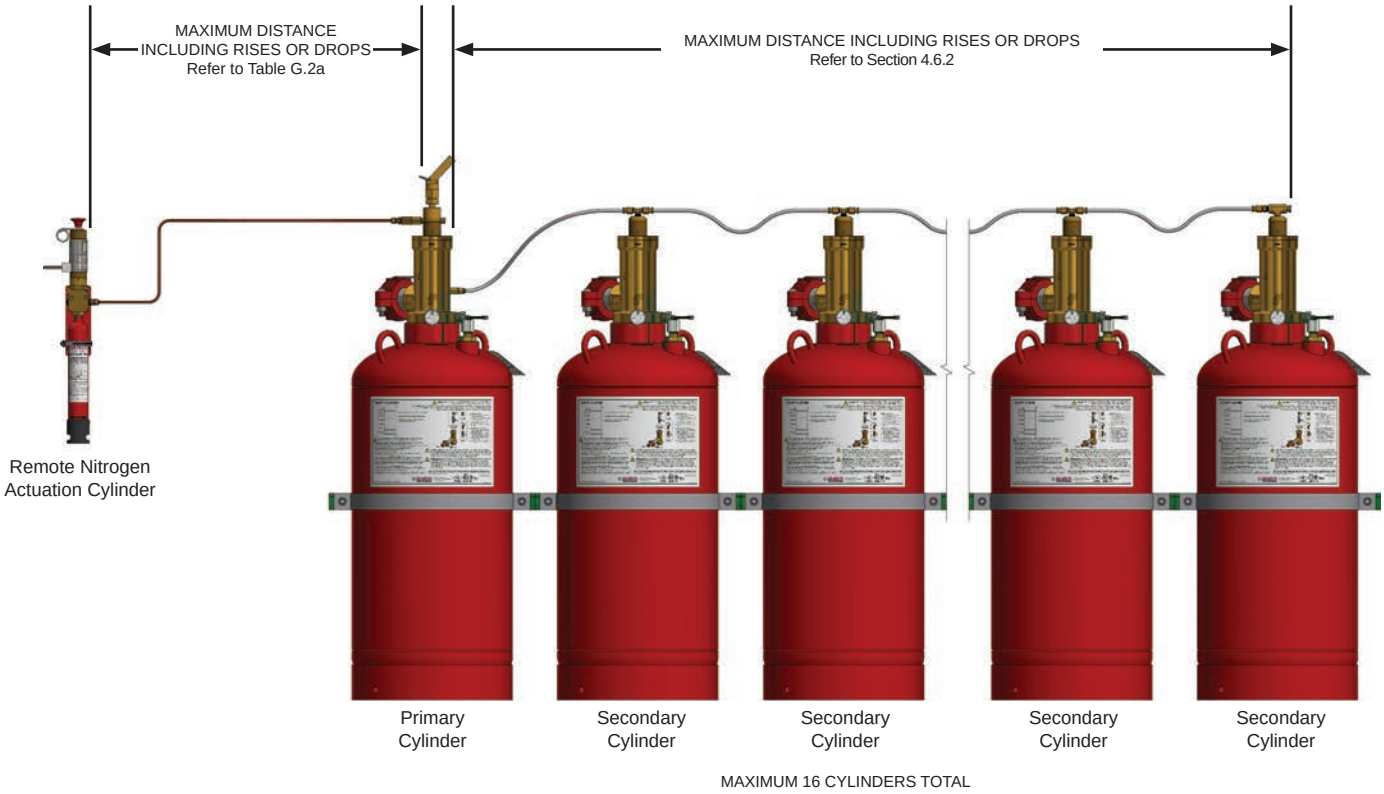


Figure G.1.1a Standard Remote Pneumatic Arrangement

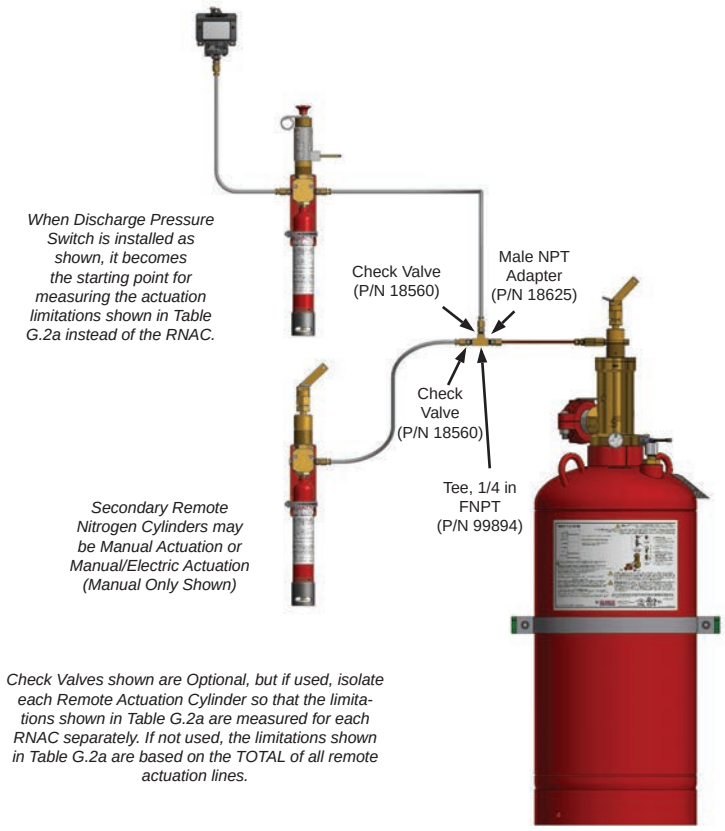
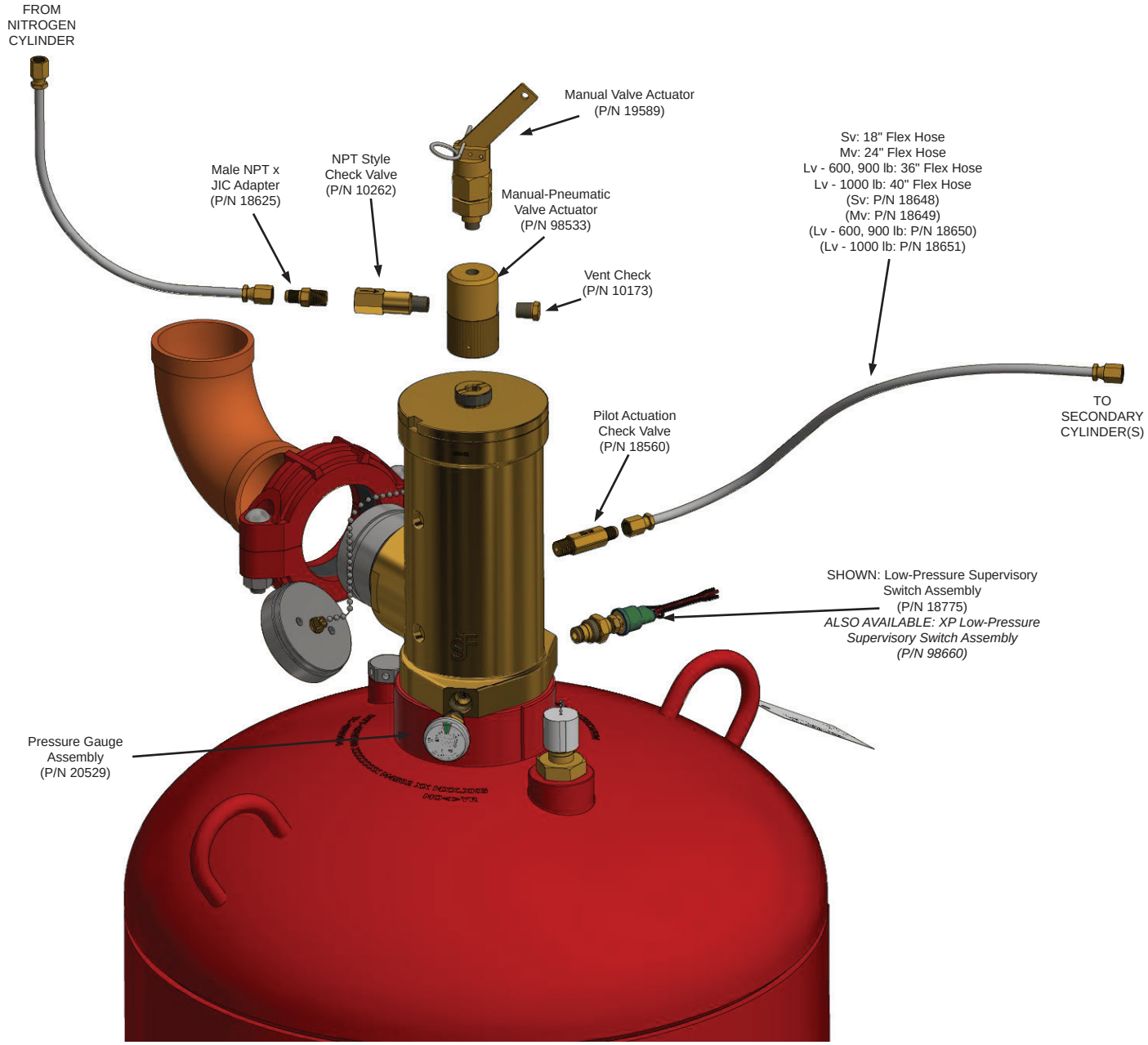


Figure G.1.1b Standard Remote Pneumatic Arrangement

Appendix G



NOTE: Lv Series Cylinder Shown

Figure G.1.1b Sample Remote Pneumatically Actuated Cylinder w/ Trim Components

G.1.1.1 Remote Nitrogen Actuation Cylinder

P/N 26311 (See Figure G.1.1.1a)

The remote nitrogen actuation cylinder (RNAC) is pressurized with nitrogen to 500 psi (34.48 bar). A pressure gauge is permanently affixed to the base of the cylinder. The actuation port of the cylinder is fitted with an internal Schrader valve that is upset when the remote pneumatic actuation/bracket kit is actuated, causing the cylinder to open. The electric and manual valve actuators are attached to the remote nitrogen actuation cylinder via the remote pneumatic actuation/bracket kit so that, upon actuation of the manual or electric valve actuator, nitrogen pilot pressure is sent from the remote nitrogen cylinder to the manual-pneumatic actuator installed on the primary clean agent cylinder.

An optional version (P/N 26310) is available with an additional port below the discharge outlet to allow installation of a low-pressure supervisory switch (P/N 22946 or 98302)

Figure G.1.1.1a Remote Nitrogen Actuation Cylinder

G.1.1.2 Remote Pneumatic Actuation/Bracket Kit

P/N 97643 (See Figure G.1.1.2)

A remote pneumatic actuation/bracket kit is installed with the remote nitrogen actuation cylinder to both support the cylinder and to allow the actuation of the cylinder through the electric or manual pneumatic actuators. A pressure inlet port at the base of the remote pneumatic/actuation bracket kit fits onto the actuation port of the remote nitrogen cylinder, while the electric valve actuator is installed onto the actuation port on the top of the remote pneumatic actuation/bracket kit. Upon actuation of the electric valve actuator via the control panel or manual valve actuator, the pin inside the electric valve actuator causes the actuation pin of the remote pneumatic actuation/bracket kit to actuate, upsetting the Schrader valve inside the actuation port of the remote nitrogen actuation cylinder. The actuation pin must be manually reset by pushing the pin up until it snaps into the "up" position.

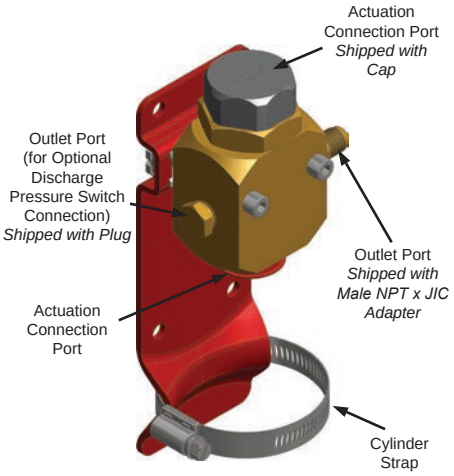


Figure G.1.1.2 Remote Pneumatic Actuation/Bracket Kit

⚠ WARNING

Attaching the remote pneumatic actuation/bracket kit to the remote nitrogen actuation cylinder when the actuation pin is not fully locked into the "up" position may cause the cylinder to actuate, resulting in potential injury and/or property damage, and total loss of agent.

The remote pneumatic actuation/bracket kit has two 1/4 in (8 mm) FNPT pressure outlet ports on either side of its body. One is used to connect to agent cylinders via the pilot actuation line, while the other may be used to install an optional discharge pressure switch. The kit comes with one male NPT x JIC adapter fitting to facilitate the attachment of flex hose and a plug in the optional discharge pressure switch connection port.

Appendix G

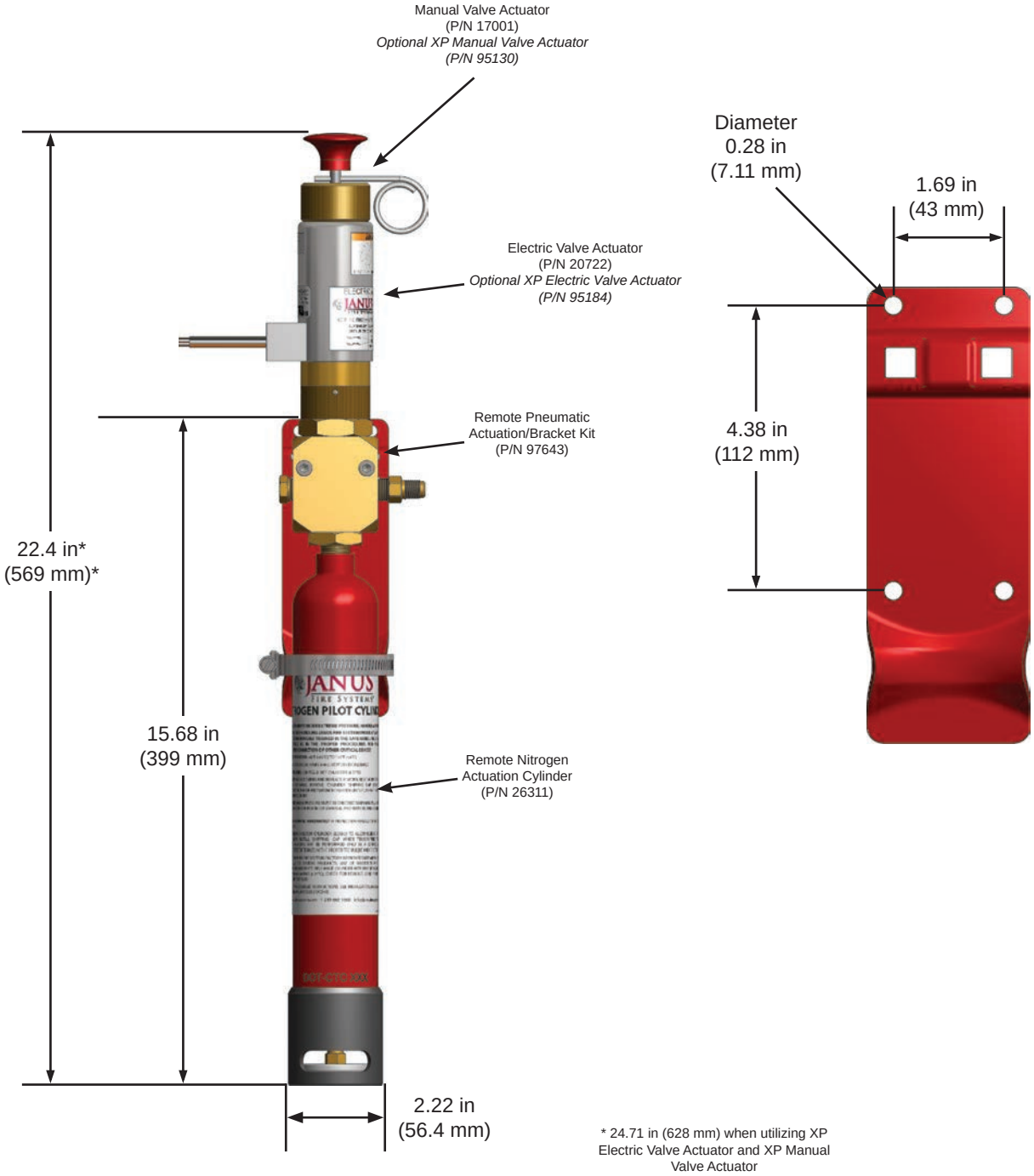


Figure G.1.1.1b Remote Actuation Kit/Bracket Dimensions

Appendix G

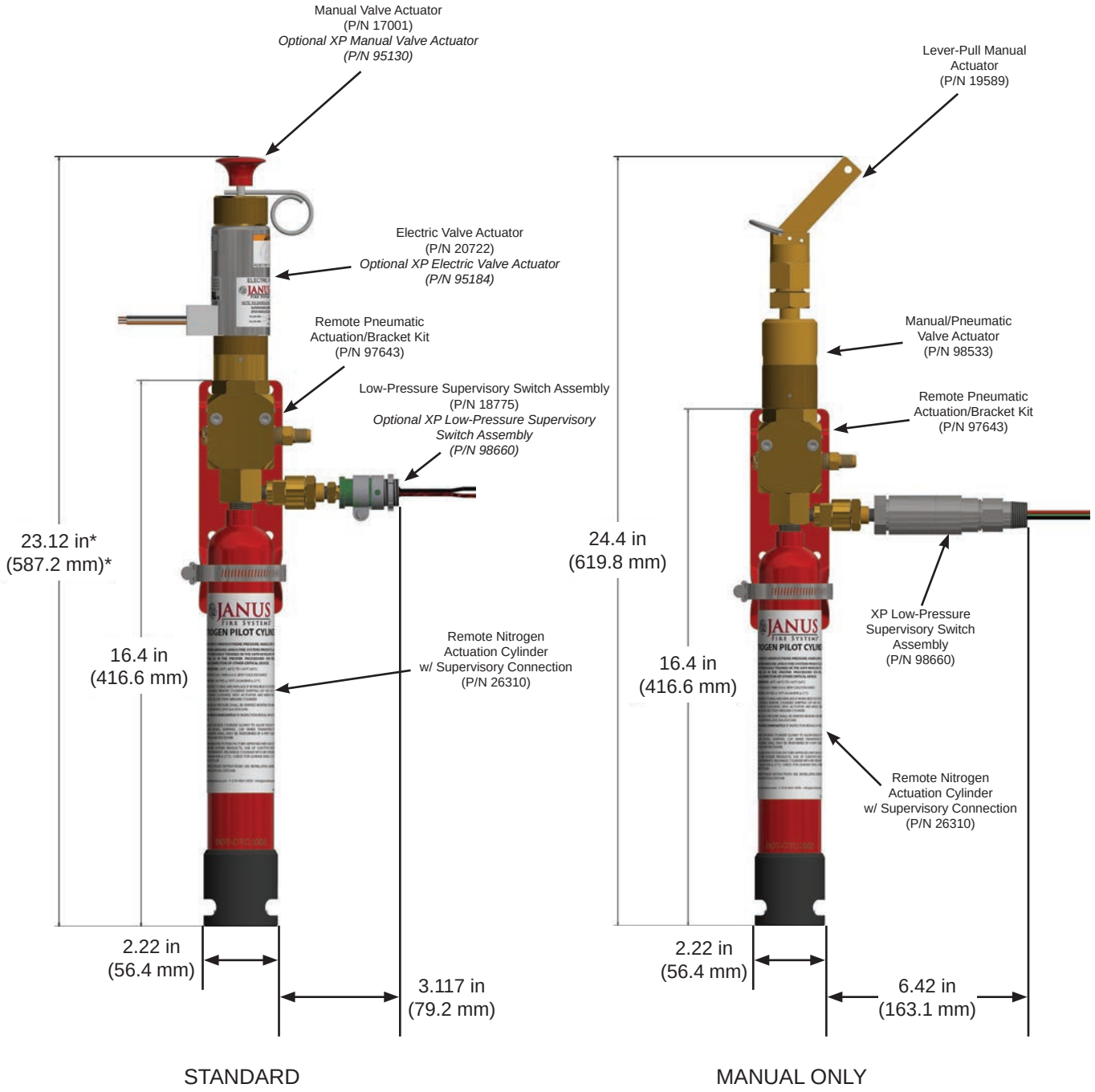


Figure G.1.1.1c Remote Actuation Cylinder w Supervisory Connection Dimensions

* 25.43 in (646 mm) when utilizing XP Electric Valve Actuator and XP Manual Valve Actuator

Appendix G

G.1.1.3 Manual-Pneumatic Valve Actuator

P/N 98533 (See Figure G.1.1.3)

The manual-pneumatic valve actuator attaches to the valve actuation connection of the primary clean agent cylinder. The manual valve actuator is installed into the top of the manual-pneumatic valve actuator. The manual-pneumatic valve actuator has two pressure ports located on either side, either of which may be used interchangeably as the actuation inlet port. However, the port not being used must be fitted with a vent check (P/N 10173).

The actuation inlet port of the manual-pneumatic actuator is connected to the remote nitrogen actuation cylinder. Nitrogen pressure from the remote nitrogen actuation cylinder or actuation of the manual valve actuator will cause the pin inside the manual-pneumatic actuator to open the clean agent cylinder valve. To reset the actuator, the actuation pin must be pushed up until the pin snaps into the "up" position. (An optional manual reset tool P/N 95113 is available.)

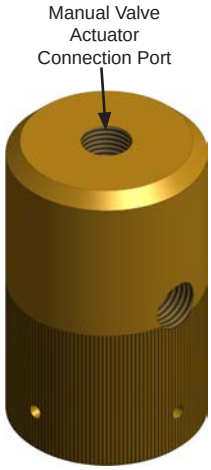


Figure G.1.1.3 Manual-Pneumatic Valve Actuator

⚠WARNING

Attaching the manual-pneumatic valve actuator to the clean agent cylinder valve when the actuation pin is not fully locked into the "up" position may cause the cylinder valve to actuate, resulting in potential injury and/or property damage, and total loss of agent. Do not attach the manual-pneumatic valve actuator to the cylinder valve until it is verified that all cylinders are properly secured and that all necessary piping and nozzles are connected to the cylinder valve discharge outlet.

G.1.1.4 Lever-Pull Manual Valve Actuator

P/N 19589 (See Figure G.1.1.4)

The lever-pull manual valve actuator is installed in the manual valve actuator connection port of the manual-pneumatic valve actuator (P/N 98533). The manual valve actuator consists of a brass body, ring pin, and emergency release lever.

In the event of an emergency situation the manual valve actuator on the nitrogen driver cylinder may be manually actuated by removing the ring pin of the valve actuator and pulling the emergency release lever.

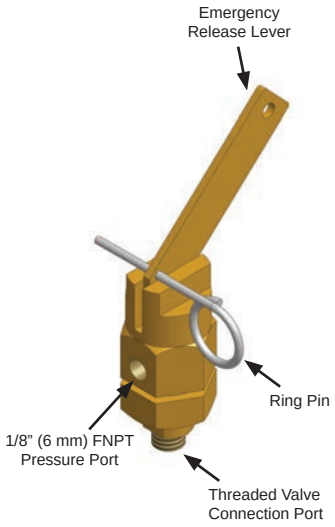


Figure G.1.1.4 Lever-Pull Manual Valve Actuator

⚠WARNING

Attaching the lever-pull manual valve actuator to either the nitrogen driver cylinder valve or clean agent cylinder valve when the emergency release lever is not fully locked into the "up" position with the ring pin fixed in place may cause the cylinder valve to actuate, resulting in potential injury and/or property damage, and total loss of agent. Do not attach the manual valve actuator to the cylinder valve until it is verified that all cylinders are properly secured and that all necessary piping and nozzles are connected to the cylinder valve discharge outlet.

G.1.2 Pneumatic Time Delay Arrangement

NFPA 2001, 2018 edition, section 1.5.1.5.3 requires that for systems protecting occupiable enclosures or spaces where the clean agent design concentration exceeds that approved for use in normally occupied spaces the systems shall include the following:

(1) Supervised system lockout valves
(2) Pneumatic pre-discharge alarms
(3) Pneumatic time delays
(4) Warning signs

NFPA 2001, in the subsequent section 1.5.1.5.4, requires that the pneumatic pre-discharge alarms be operated by an inert gas.

This section details the arrangement designed to meet the requirements of NFPA 2001 for systems protecting occupiable enclosures where the clean agent design concentration exceeds that approved for use in normally occupied spaces (refer to Figure G.1.2 for full arrangement).

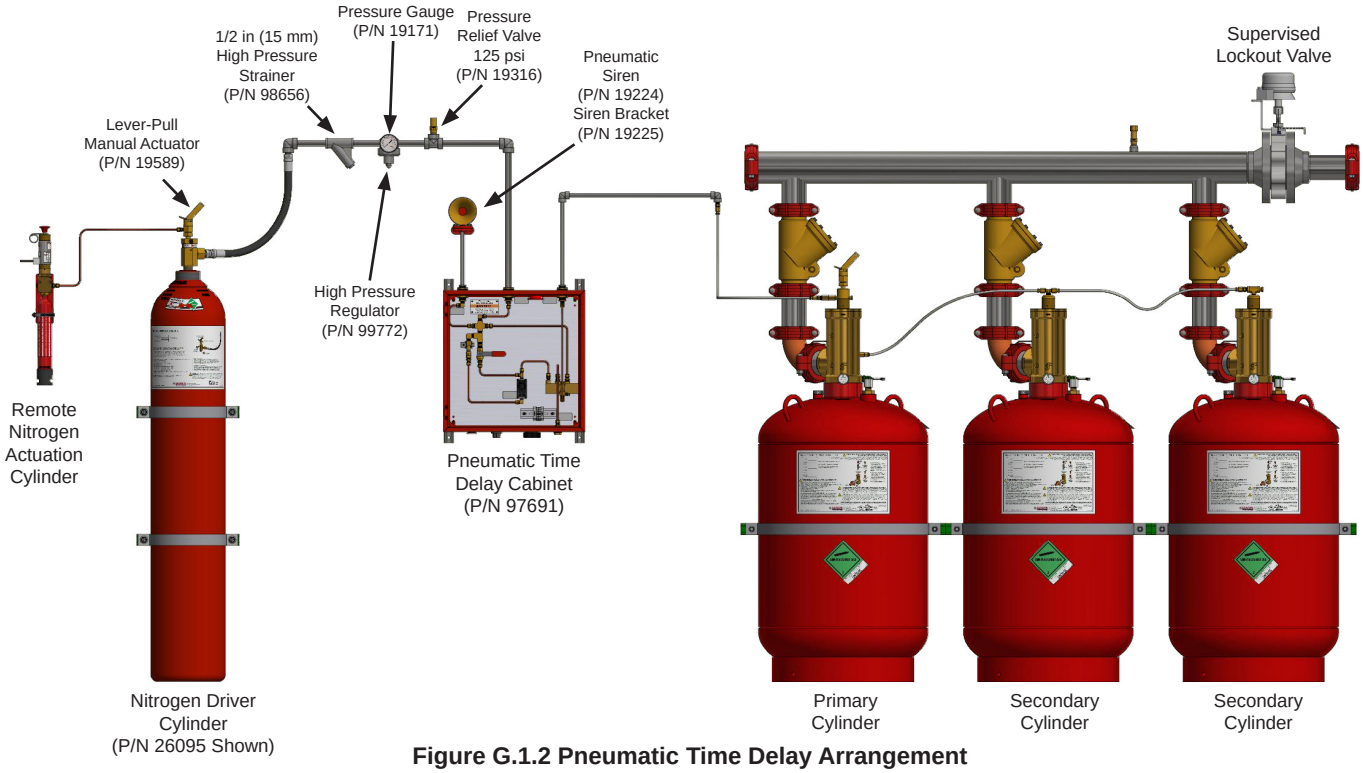


Figure G.1.2 Pneumatic Time Delay Arrangement

G.1.2.1 Pneumatic Time Delay Sequence of Operation

An electric valve actuator and optional manual valve actuator are installed on the remote nitrogen cylinder (RNAC). Upon receipt of an actuation signal, the actuation pin of the electric valve actuator depresses, causing the RNAC to open. (Manual actuation by removing the ring pin and depressing the red emergency actuation button of the manual valve actuation installed on the electric valve actuator will also cause the actuation pin to depress and open the RNAC). Nitrogen actuation pressure then flows from the outlet RNAC to the pressure port of the manual valve actuator installed on the top of the nitrogen driver cylinder, causing the nitrogen driver cylinder valve to open.

NOTE: The nitrogen driver cylinder can also be actuated manually by removing the ring pin and pulling the emergency lever of the manual valve actuator installed on the top of the nitrogen driver cylinder.

Upon opening, the nitrogen driver cylinder valve sends nitrogen driver pressure to the pneumatic time delay cabinet after being regulated down to 100 psi (6.89 bar). When nitrogen pressure enters the pneumatic time delay cabinet, it is directed to the constant pressure port of the pneumatic pilot valve inside the cabinet where it is stopped. It is also directed to the pneumatic timer, which begins the pneumatic pre-discharge time delay, while simultaneously being directed to actuate the pneumatic pre-discharge siren.

NOTE: The pre-discharge time delay can be bypassed by opening the timer bypass valve.

⚠ CAUTION

Opening the timer bypass valve will cause the system to discharge clean agent immediately upon the actuation of the nitrogen driver cylinder. The timer bypass valve should only be opened if the hazard area has been cleared of all personnel and there is no possibility that personnel will be occupying the protected hazard during discharge.

Upon completion of the pre-discharge time delay, nitrogen pressure passes through the pneumatic timer into the actuation port of the pneumatic pilot valve. This causes the pneumatic pilot valve constant pressure port to open, allowing nitrogen pressure to exit the cabinet and enter the actuation inlet port of the manual-pneumatic valve actuator installed on the primary cylinder valve.

Upon receiving nitrogen driver pressure, the actuation pin located inside the manual-pneumatic actuator will depress causing the primary cylinder valve to open. Actuation pressure from the pilot actuation port of the primary cylinder will cause any secondary cylinders to be actuated pneumatically.

EMERGENCY MANUAL OPERATION

An emergency manual valve actuator is installed on the clean agent primary cylinder.

⚠ CAUTION

Actuating the clean agent cylinder using the manual valve actuator installed on the clean agent cylinder valve will cause the system to immediately discharge, bypassing the pre-discharge time delay. Therefore, the system shall only be actuated in this manner as a last resort.

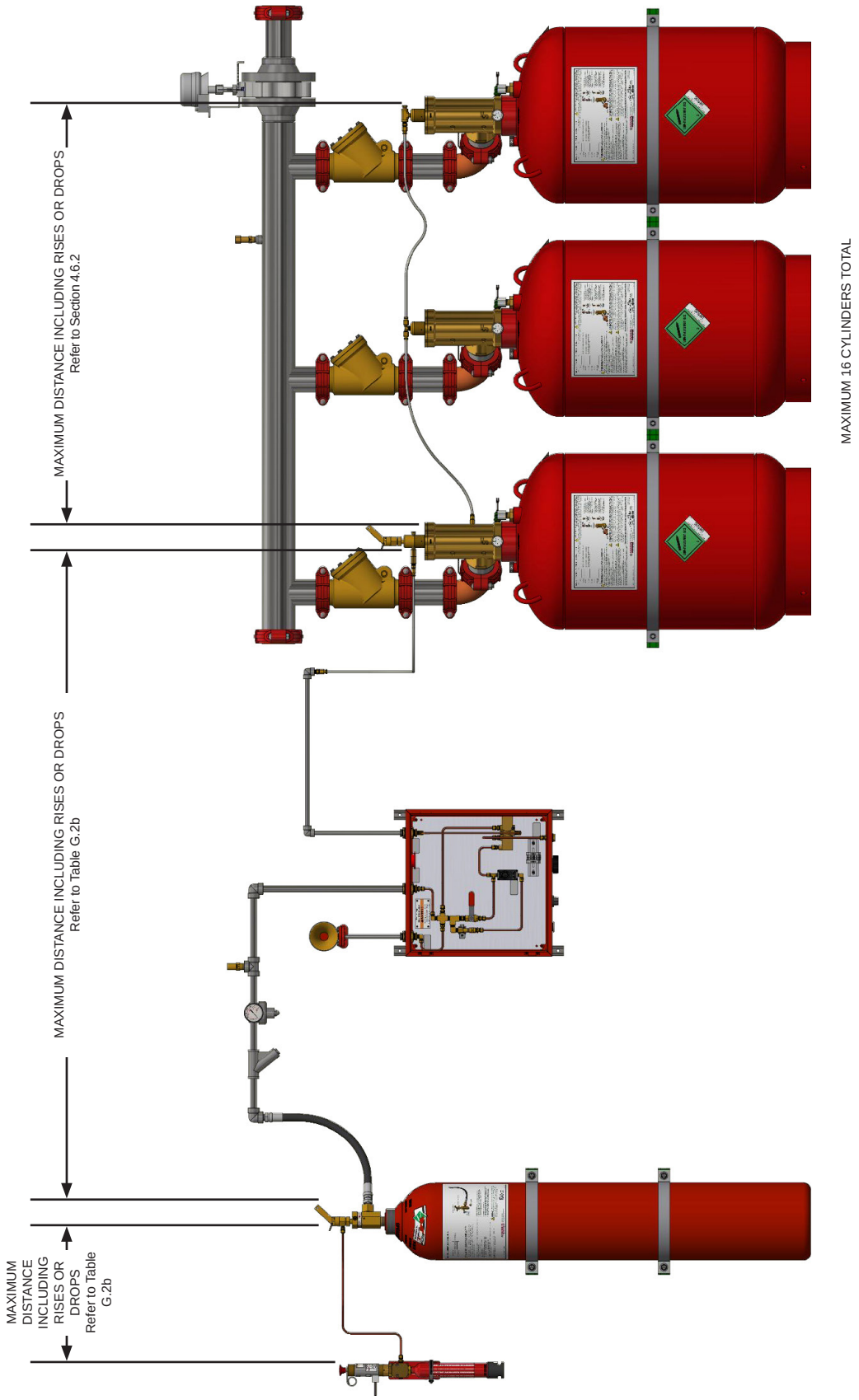


Figure G.1.2.1 Pneumatic Time Delay Piping Limitations

Appendix G

G.1.2.2 Nitrogen Driver Cylinder Assemblies

P/N 26311 (See Figure G.1.2.2a)

The nitrogen driver cylinder assembly consists of a cylinder and cylinder valve.

The cylinder is seamless spun steel. It is designed to hold pressurized nitrogen in gaseous form at atmospheric temperatures, corresponding to a nominal pressure of 1800 psi (124.1 bar) at 70˚F (21˚C).

The cylinders are manufactured and tested in accordance with the requirements of Transport Canada and/or Department of Transport (USA), Specification 3AA-1800 or higher. Nitrogen driver cylinders have standard capacities of 39.1 L (2,386 in^3), 50.0 L (3,051 in^3), and 66.7 L (4,070 in^3).

The pressure inside the cylinder will vary as the temperature changes. In general, the ambient storage temperature for the nitrogen driver cylinders should be between -20˚F (-28˚C) and 130˚F (54˚C). The pressure gauges used with the nitrogen driver cylinder are rated for an ambient temperature range of -4˚F (-20˚C) to 120˚F (49˚C).

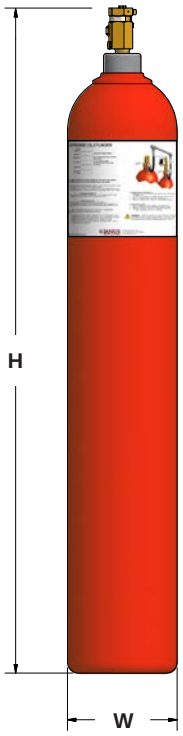


Figure G.1.2.2a Nitrogen Driver Cylinder Assembly

Table G.1.2.2 Cylinder Sizes and Dimensions

Nominal Cylinder Size		P/N	Height (H)		Width (W)	
L	in^3		in	mm	in	mm
39.1	2,386	26093	55.6	1412	8.5	216
50.0	3,051	26094	61.1	1552	9.2	234
66.7	4,070	26095	62.6	1590	10.4	264

The nitrogen driver cylinder valve is brass. It is a differential type valve using a piston seal. The pressure above the piston is maintained at cylinder pressure, but the area at the top of the piston is greater than the seal area. This results in a higher force above the piston, which acts to keep the valve closed.

To operate (or discharge) the valve, the pressure above the piston (the Primary Valve Cavity as indicated in Figure G.1.2.2b) is vented and the cylinder pressure below the piston forces the piston upward allowing nitrogen from the cylinder to flow through the valve and discharge through the valve outlet.

The nitrogen driver cylinder valve is opened pneumatically or mechanically via the Manual Valve Actuator (P/N 19589) attached to the Manual Actuation Port at the top of the valve (refer to Figure G.1.2.2b).

The purpose of Secondary Actuation Vent (refer to Figure G.1.2.2b) is to ensure that the operating nitrogen valve is maintained in the open (discharge) position by the continuous venting of the Primary Valve Cavity; the valve cannot be closed or reset as long as pressure is provided by discharging nitrogen at the discharge outlet of the valve. This continuous venting of the primary valve cavity of each cylinder assembly is through the Secondary Actuation Vent, (refer to Figure G.1.2.2b) and is discharged to the atmosphere and will continue until the nitrogen driver cylinder is completely discharged.

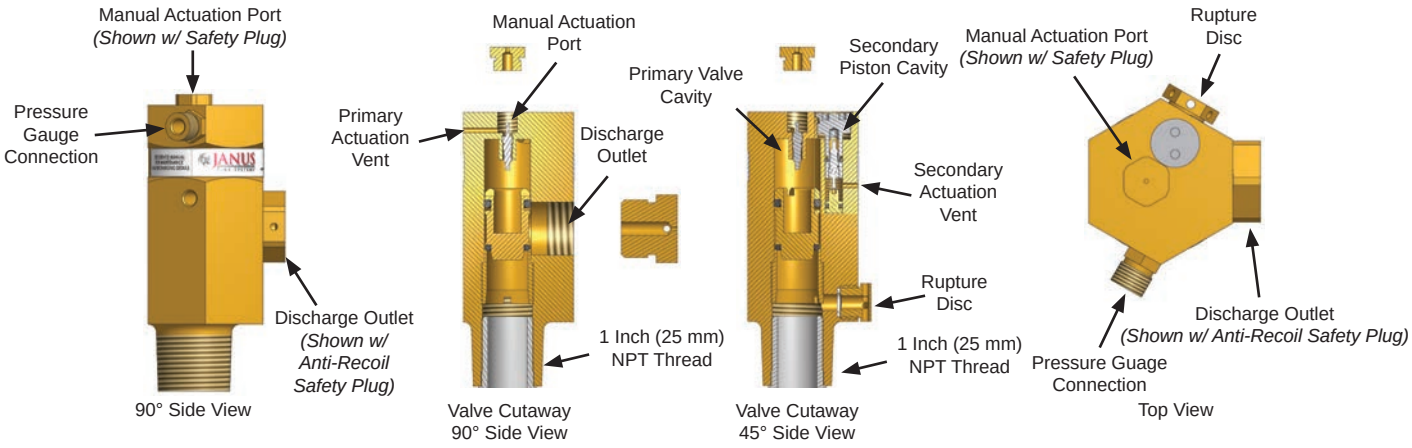


Figure G.1.2.2b Nitrogen Driver Cylinder Valve

An anti-recoil safety plug is attached to the valve by a chain and must be attached to the discharge port when the cylinder is disconnected from the discharge piping.

⚠ WARNING

Do not remove the anti-recoil plug until it is verified that the cylinder is properly secured, and only when ready to attach the cylinder to the nitrogen piping system.

A pressure relief rupture disc, incorporated into the cylinder valve, is designed to release pressure should the cylinder be subjected to exceptionally high temperatures or other abnormal conditions. The disc rupture point is in the range of 2,650 to 3,000 psi (182.7 to 206.8 bar). The rupture disc nut is of a type that will relieve pressure without cylinder recoil.

G.1.2.2.1 Nitrogen Driver Discharge Flex Hose

P/N 99707 (See Figure G.1.2.2.1)

A 22 in (559 mm) discharge flex hose is used to connect the nitrogen driver cylinder valve outlet to the pneumatic time delay cabinet. This flexible hose allows for the temporary misalignment of the cylinders on installation and for ease of cylinder removal during maintenance. The 3/4 in (20 mm) MNPT cylinder end of the hose has a swivel connection for ease of installation. The flex hose has a minimum bend radius of 9.5 inches (241 mm). A discharge outlet adapters is affixed to the flex hose to facilitate the attachment of discharge flex hose to the nitrogen driver cylinder valve.

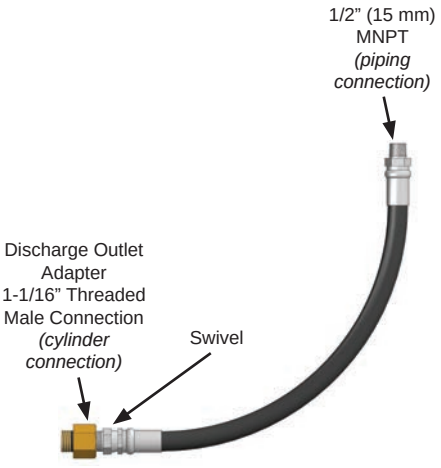


Figure G.1.2.2.1 Discharge Flex Hose

⚠ CAUTION

The anti-recoil safety device must remain in place in the nitrogen driver cylinder valve outlet at all times when the cylinder assembly is not secured in the cylinder bracket and connected to the discharge piping. Discharge flex hose should **NOT** be mounted onto the cylinder valve during transportation and storage.

Appendix G

G.1.2.3 Pneumatic Time Delay Cabinet

P/N 97691 (See Figure G.1.2.3)

The pneumatic time delay cabinet is installed downstream of the nitrogen driver cylinder and upstream of the clean agent cylinders. It utilizes a pneumatic timer to allow for a pre-discharge time delay upon actuation of the nitrogen driver cylinder while also sounding a pneumatic pre-discharge siren.

Enclosure
NEMA 4 & 12 (IP66)
Includes Heater
Dimensions: 20“ x 20" x 6" (508 mm x 508 mm x 152 mm)
Standalone Ambient Temp: -20° to 130°F (-29° to 54°C)
(NOTE: 40°F to 130°F without Heater)

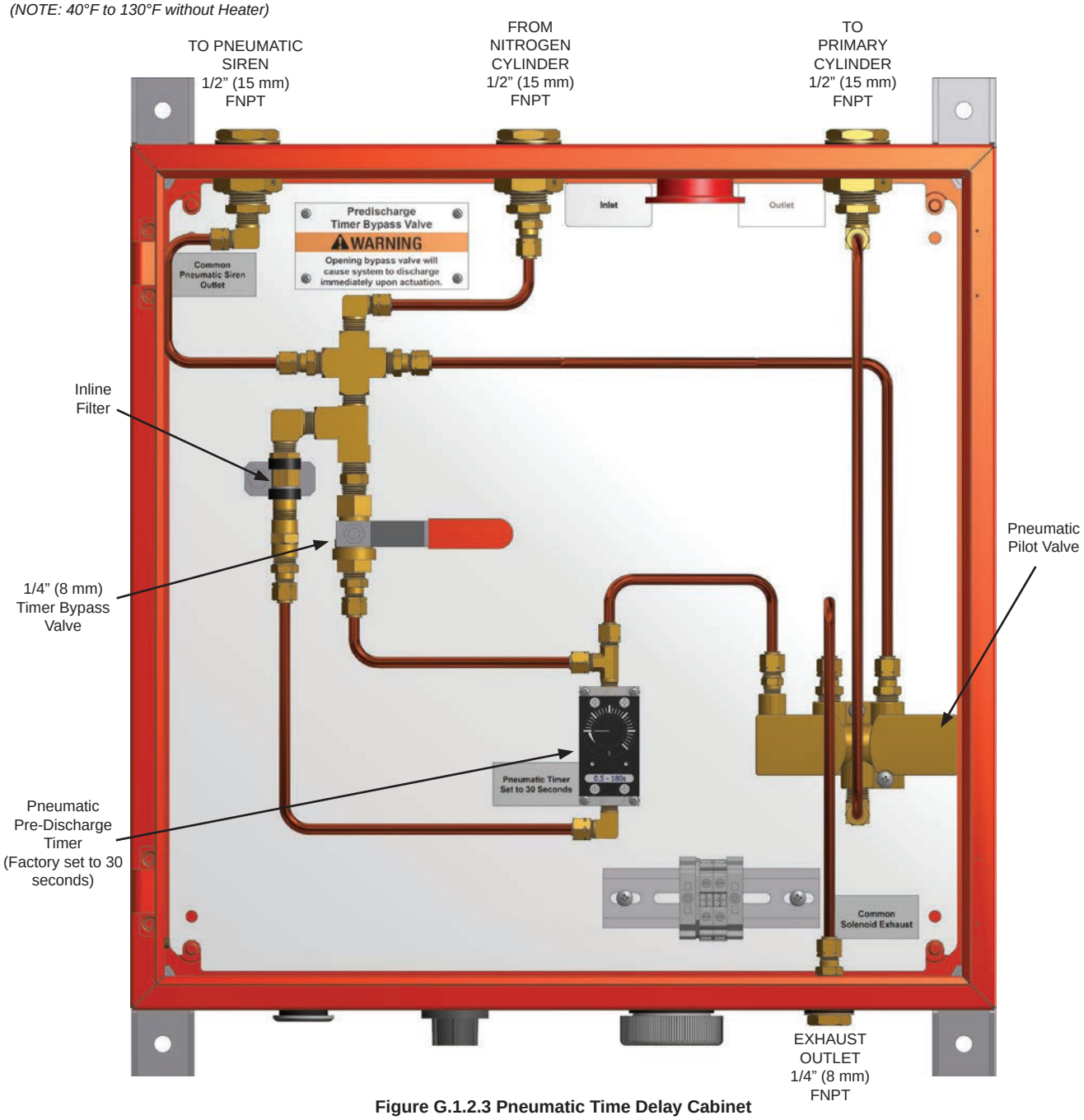


Figure G.1.2.3 Pneumatic Time Delay Cabinet

G.1.2.3.1 Pneumatic Timer
P/N 19172 (See Figure G.1.2.3.1)

The pneumatic timer is installed inside the time delay cabinet downstream of the inlet port. It acts to create a pre-discharge delay between system actuation and system discharge to allow for notification of personnel via the pneumatic siren. The approved timer set point range is 25 to 80 seconds (1 to 180 second dial). It has a 1/8 in (6 mm) NPT inlet and outlet port and a 3-way internal exhaust. The standalone ambient temperature range for the timer is 20˚ to 130˚F (-7˚ to 54˚C). The timer base is aluminum with a polyamide housing.

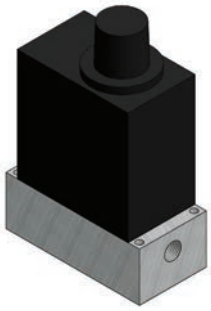


Figure G.1.2.3.1 Pneumatic Timer

G.1.2.3.2 Timer Bypass Valve
P/N 19173 (See Figure G.1.2.3.2)

The timer bypass valve is installed in the time delay cabinet downstream of the inlet port in parallel to the pneumatic timer. When open, it bypasses the pneumatic timer and immediately sends actuation pressure to the manual-pneumatic valve actuator installed on the primary clean agent cylinder upon actuation of the nitrogen driver cylinder. The timer bypass valve is a manually actuated full port ball valve made of forged brass with reinforced PTFE seats and seals and has 1/4 in (8 mm) FNPT connections. The standalone ambient temperature range for the valve is -20˚ to 130˚F (-29˚ to 54˚C).

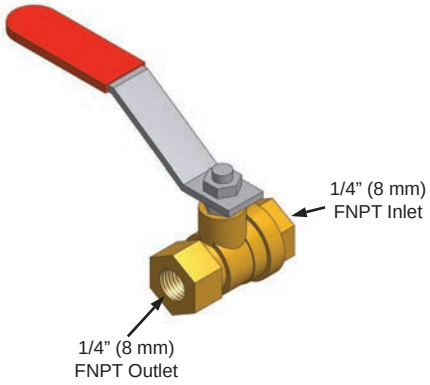


Figure G.1.2.3.2 Timer Bypass Valve

G.1.2.3.3 Pneumatic Pilot Valve
P/N 19174 (See Figure G.1.2.3.3)

A pneumatic pilot valve is installed in the time delay cabinet immediately upstream of the outlet port. It has a brass body with buna seal and has four ports: a supply inlet, an actuation inlet, an outlet, and an exhaust. Upon receiving pressure to its actuation inlet, the valve opens sending nitrogen pressure from its supply inlet to the manual-pneumatic valve installed on the primary clean agent cylinder. It has a standalone ambient temperature range of 5˚ to 150˚F (-15˚ to 66˚C).

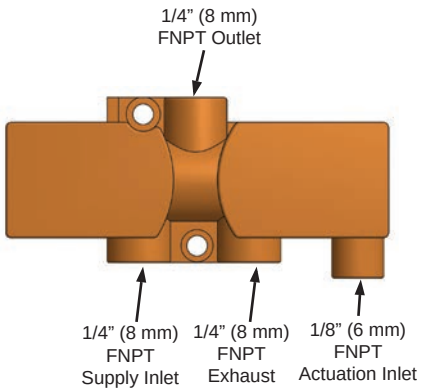


Figure G.1.2.3.3 Pneumatic Pilot Valve

G.1.2.3.4 Inline Filter
P/N 99109 (See Figure G.1.2.3.4)

A 40 micron inline filter is installed immediately upstream of the pneumatic timer to protect the timer from debris. It has a brass body with a sintered bronze filter element. The filter has a 1/4 in (8 mm) FNPT inlet and a 1/4 in (8 mm) MNPT outlet.

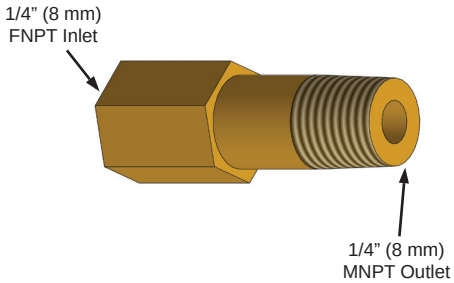


Figure G.1.2.3.4 Inline Filter

Appendix G

G.1.2.4 Pneumatic Siren

P/N 19224 (See Figure G.1.2.4)

A pneumatic siren is installed outside the time delay cabinet so that it receives nitrogen pressure from the time delay cabinet immediately upon actuation of the nitrogen driver cylinder. The cabinet siren outlet is upstream of the pneumatic timer so that the pneumatic siren is sounded during the pre-discharge period. The siren has a solid cast bronze bell with a stainless steel diaphragm and reaches a sound level of 119 ± 1DBA @ 100 psi at 10 ft (3.05 m). The siren has a Cv of .25. It has an operating pressure of 50 to 150 psi (3.45 to 10.35 bar) and a standalone ambient temperature range of -4° to 400°F (-20° to 204°C).

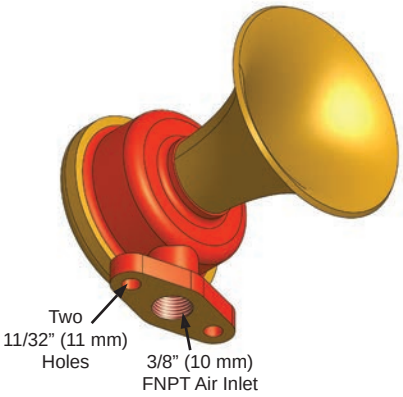


Figure G.1.2.4 Pneumatic Siren

NOTE: A maximum of four sirens will sound for a minimum of 180 seconds for all nitrogen driver sizes. Pneumatic sirens cannot be silenced.

G.1.2.4.1 Pneumatic Siren Bracket

P/N 19225 (See Figure G.1.2.4.1)

The pneumatic siren bracket affixes to the base of the pneumatic siren to allow the siren to be fastened to an outside surface.

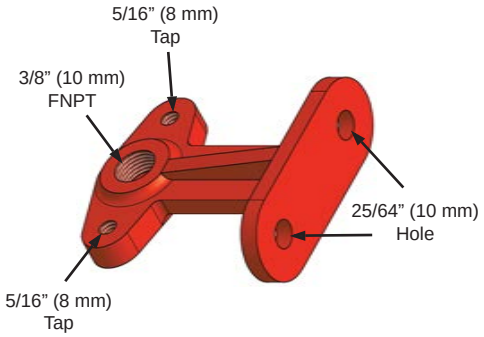


Figure G.1.2.4.1 Pneumatic Siren Bracket

G.1.2.5 High Pressure Regulator

P/N 99772 (See Figure G.1.2.5)

A 316L stainless steel self-relieving pressure regulator with Teflon seat is utilized to regulate nitrogen pressure into the pneumatic time delay cabinet. It has a 1/2 in (15 mm) FNPT inlet and outlet with a maximum operating inlet pressure of 3600 psig (248 bar) and an outlet range of 0 to 250 psig (0 to 17.2 bar). The regulator has a standalone ambient temperature range of -4° to 176°F (-20° to 80°C) and a Cv of 1.0. A pressure gauge (0-160 psig P/N 19171) may be fastened to the regulator to allow visual monitoring of outlet pressure.

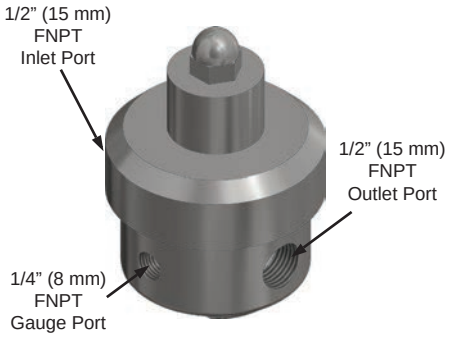


Figure G.1.2.5 High Pressure Regulator

G.1.2.6 High Pressure Strainer

P/N 98656 (See Figure G.1.2.6)

A 1/2" (15 mm) strainer is used to eliminate damaging contaminants from entering the high pressure regulator or time delay cabinet. The "Y" pattern design and generous screen area function to minimize initial pressure drop while maximizing time between cleaning. The strainer is stainless steel and is provided with a 40 mesh lining. The connections are FNPT. Strainer rating is ASME class 1500. Drain/blow off connection is furnished with plug.

Figure G.1.2.6 High Pressure Strainer

G.1.3 Additional Pneumatic Arrangements

This section details additional alternative pneumatic arrangements that may be implemented.

G.1.3.1 Manual-Only Pneumatic Arrangements

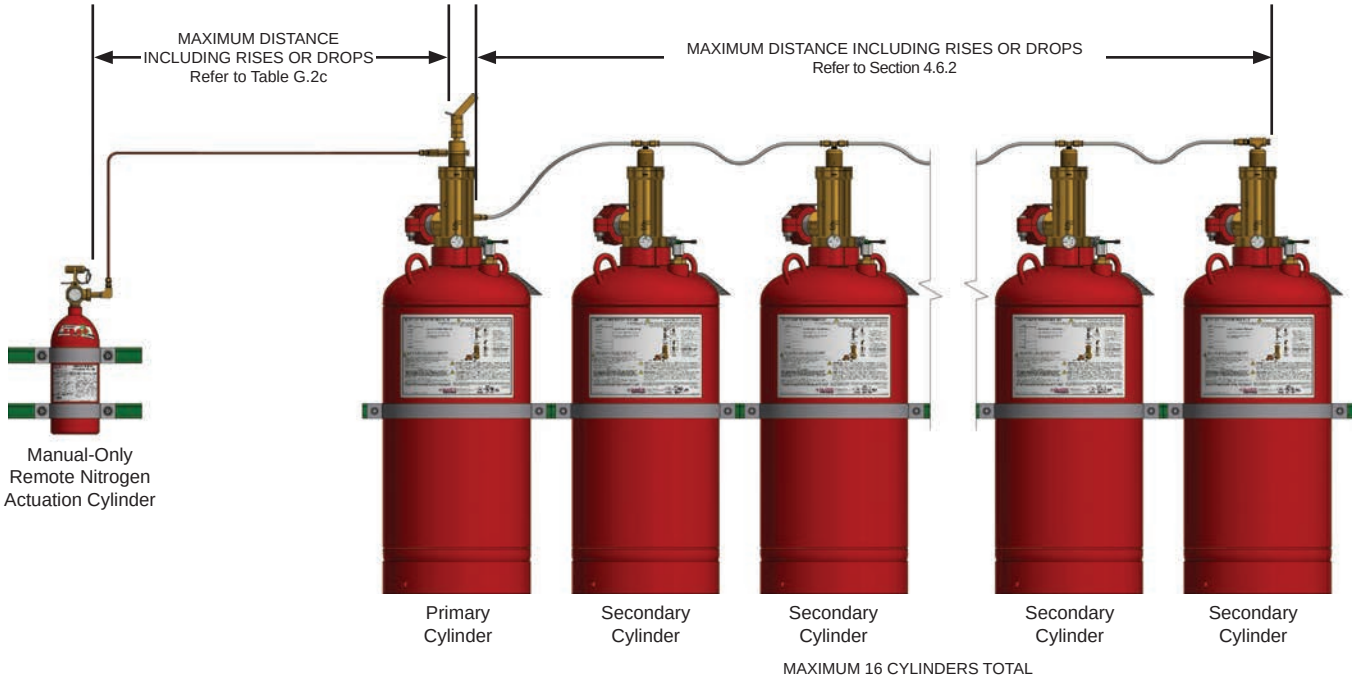


Figure G.1.3.1a Manual-Only Remote Pneumatic Arrangement

G.1.3.1.1 Manual-Only Remote Nitrogen Actuation Cylinder

P/N 26101 (See Figure G.1.3.1.1)

A manual-only remote nitrogen actuation cylinder (RNAC) can be used as illustrated in Figure G.1.3.1a and G.1.3.1b to allow greater distances from the RNAC to the primary clean agent cylinder. NOTE: The manual-only RNAC cannot be used in conjunction with the pneumatic siren or time-delay cabinet.

Nitrogen is stored in the actuation cylinder at a pressure of 1,800 psi (124 bar) at 70˚F (21˚C). The ambient storage temperature for the remote nitrogen actuation cylinders should be between -20˚F (-28˚C) and 130˚F (54˚C). A 3,360 psi (231.7 bar) pressure relief is located opposite of the pressure gauge dial.

A ring pin with tamper seal is installed in the manual release lever to protect against accidental manual actuation of the cylinder. To actuate the nitrogen cylinder, the ring pin is removed and the manual release lever is pulled.

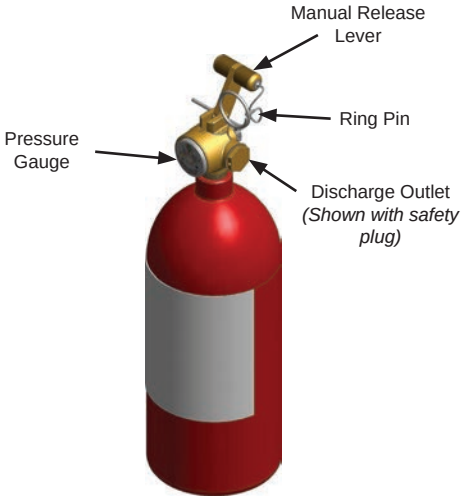


Figure G.1.3.1.1 Manual-Only Remote Nitrogen Actuation Cylinder

The manual-only RNAC is installed using a dual-strap cylinder bracket kit (P/N 97769). A CGA 580 cylinder connection (P/N 97987) is ordered separately and installed into the discharge outlet of the manual-only RNAC to facilitate the connection of tubing.

Appendix G

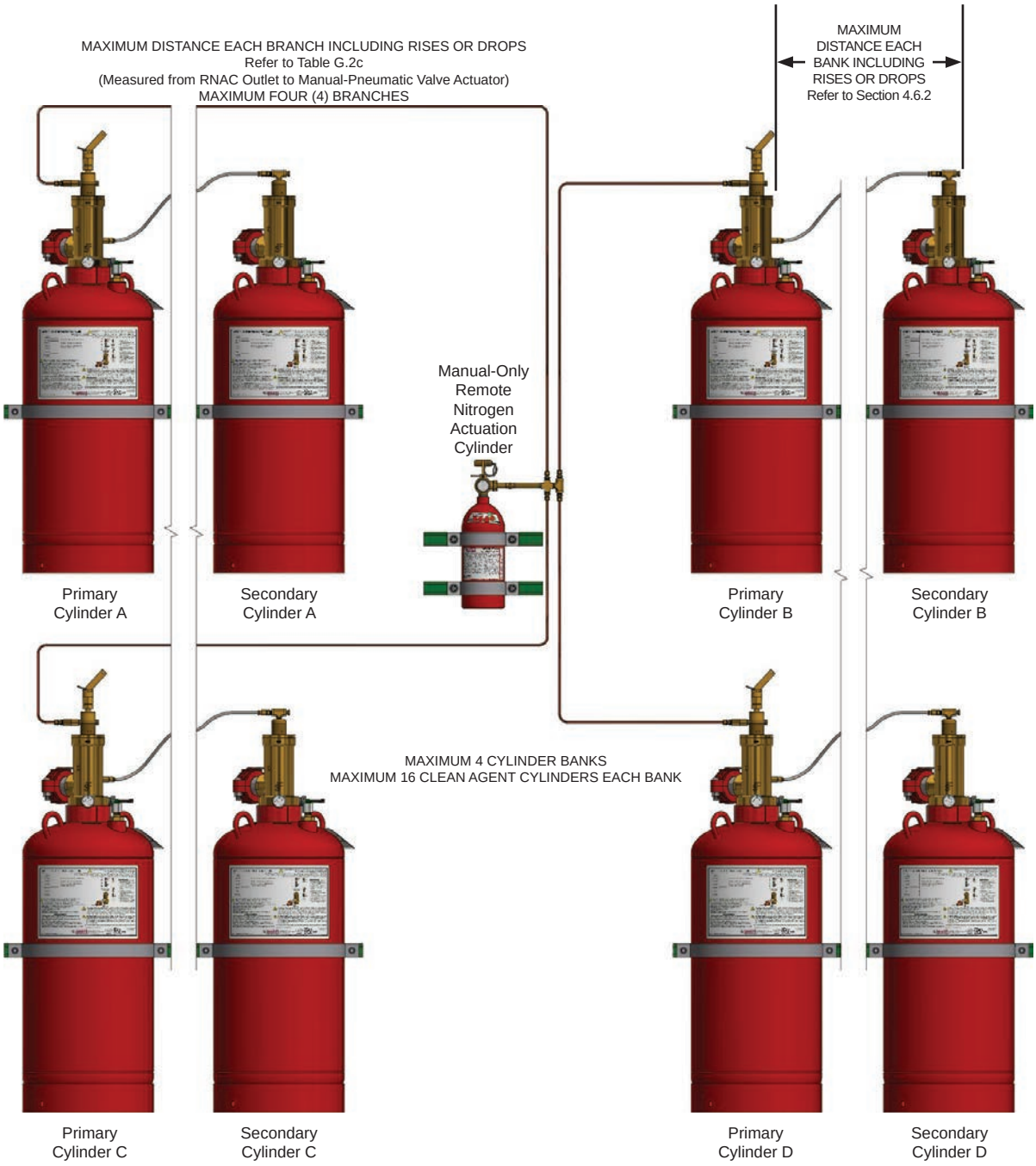


Figure G.1.3.1b Manual-Only Multi-Bank Remote Pneumatic Arrangement

The remote nitrogen actuation cylinder valve is supplied with an anti-recoil safety plug screwed into the discharge port. The plug has two holes drilled perpendicular to the axis of the discharge port, so that if accidental discharge does occur, it will be diffused in a safe manner.

⚠WARNING

Do not remove the anti-recoil plug until it is verified that the cylinder is properly secured, and only when ready to attach the cylinder to the nitrogen piping system.

G.2 Nitrogen Actuation Piping Limitations

All piping or tubing required for connection, from the furthermost remote nitrogen actuator up until the manual-pneumatic actuator at the primary cylinder (regardless which of the preceding arrangements is used) is herein classified as the nitrogen actuation piping.

Nitrogen actuation piping (including pipe, tubing, fittings, brackets, and hangers) is not normally supplied by Janus Fire Systems and must be provided by installer. Materials should be new and free from rust and corrosion. Pipe size, schedule, routing, reductions, changes in elevations, etc must be in accordance with the drawings. Any deviations in routing or fitting quantities must be coordinated and verified by the system designer prior to implementing changes. 1/4 in Schedule 40 pipe or tubing should be used as indicated in Table G.2a, Table G.2b, and Table G.2c. All pipe must comply with NFPA 2001 and can be any of the types indicated in Table G.2d.

Table G.2a Standard Remote Arrangement - Nitrogen Actuation Pipe Limitations (including all rises and drops)

Cylinder Size	1/4" OD Tube, 0.030" Wall Thickness, Copper	1/4" OD Tube, 0.035" Wall Thickness, SST 316 Seamless	1/4" Schedule 40 Pipe
RNAC (P/N 26311 or 26310) to Manual-Pneumatic Actuator	150 ft (45.72 m)	150 ft (45.72 m)	45 ft (13.72 m)

Table G.2b Pneumatic Time Delay Arrangement - Nitrogen Actuation Pipe Limitations (including all rises and drops)

Cylinder Size	1/4" OD Tube, 0.035" Wall Thickness, SST 316 Seamless	3/8" OD Tube, 0.035" Wall Thickness, SST 316 Seamless	1/4" Schedule 40 Pipe
RNAC (P/N 26311 or 26310) to Nitrogen Driver	10 ft (3 m)	NOT PERMITTED	NOT PERMITTED
Nitrogen Driver (all sizes) to Manual-Pneumatic Actuator	1100 ft (335.3 m)	1100 ft (335.3 m)	800 ft (243.8 m)

NOTE: In the Pneumatic Time Delay Arrangement, the nitrogen driver hose connection is 1/2 in MNPT, the pressure reducing regulator connections are 1/2 in FNPT, and the pilot cabinet inlet connection is 1/2 in FNPT. An appropriate reducer should be used to accommodate these connections (refer to Section G.2.3) or else 1/2 in schedule 40 pipe may be used between the nitrogen driver cylinder and pilot cabinet. If 1/2 in pipe is used, then the distance between the nitrogen driver and pilot cabinet connection should not exceed 50 feet.

Table G.2c Manual-Only Remote Arrangement - Nitrogen Actuation Pipe Limitations (including all rises and drops)

Cylinder Size	1/4" OD Tube, 0.035" Wall Thickness, SST 316 Seamless	1/4" Schedule 40 Pipe
Manual-Only RNAC (P/N 26101) to Manual-Pneumatic Actuator (Single Clean Agent Bank)	500 ft (152.4 m)	139 ft (42.36 m)
Manual-Only RNAC (P/N 26101) to Manual-Pneumatic Actuator EACH BRANCH (2 to 4 Clean Agent Banks System)	200 ft (45.72 m)[1]	NOT PERMITTED

[1] Maximum distance all branches combined - 800 ft (243.8 m)

Appendix G

Table G.2d Acceptable Nitrogen Actuation Pipe Grades	
Seamless - 1/4" Sched 40	Grade A-53 A or B, Grade A-106 A or B or C
Electric Resistance Welded (ERW) - 1/4" Sched 40	Grade A-53 B
Seamless - 1/2" Sched 40	Grade A-53 B, Grade A-106 B or C

⚠WARNING

Cast iron pipe, steel pipe conforming to ASTM A-120, Furnace Welded Grade A-53 F, aluminum pipe, or non-metallic pipe shall not be used.

G.2.1 Threaded Pipe

At a minimum threaded pipe joints must be reamed free of burrs and obstructions. Any lubricants used in the threading process must be cleaned from the ends of the pipe to reduce the chance of cutting lubricant or shavings entering the nozzle orifices or being deposited in ceilings or equipment. Threaded joints must conform to ANSI B1-20.1. Pipe sections should be swabbed with appropriate nonflammable degreasing solvent to remove any traces of preservatives or lubricant.

Prior to fit up dry compressed air or nitrogen can be used to "blow out" any debris left in the pipe bore during the cleaning process.

The exposed threaded joints must be wrapped with polytetrafluoroethylene (PTFE or Teflon tape) or anaerobic PTFE-based paste. Both are used as a lubricant that allows threads to mate more readily and fills any variances in the thread surfaces.

G.2.2 Threaded Fittings

Threaded fittings used for nitrogen actuation piping must be forged steel class 3000 malleable iron or have a **minimum rated working pressure** of 2004 psi (138.1 bar).

⚠WARNING

Class 2000, 300, and 150 lb fittings shall not be used.

G.2.3 Pipe Reductions

Reductions in nitrogen actuation pipe sizes may be accomplished using threaded or grooved concentric reducing fittings, steel or stainless steel concentric swage fittings, or steel or stainless steel reducing bushings. All such fittings must have a **minimum rated working pressure** of 2004 psi (138.1 bar).

⚠WARNING

Pipe reductions can be made using machined or forged steel hex bushings. Malleable and/or cast iron bushings are NOT to be used.

G.2.4 Tubing

Stainless steel (such as 304 or 316) seamless tubing with a minimum wall thickness of 0.035 inch and conforming to ASTM A-213 and A-269 should be used for nitrogen actuation piping. The **minimum rated working pressure** of the tubing should be of 2004 psi (138.1 bar). Tubing should be free of scratches and suitable for bending.

Compression fittings should be used to join ends of tube together. Only stainless steel fittings should be used on stainless steel tubing. A softer fitting such as copper may not seal properly around the tube. The compression should seal around the tube and prevent any leaks from occurring. All such fittings must have a **minimum rated working pressure** of 2004 psi (138.1 bar).

⚠ CAUTION

Any leaks in the tubing or piping may prevent the system from operating properly. Leak check all connections prior to entering into service.

G.2.5 Pipe Supports and Hangers

All pipe used for nitrogen actuation must be supported following all requirements indicated in section 4.1.2.5.

⚠ WARNING

Cast iron supports, conduit clamps, or "C" clamps are not to be used to support pipe.