This file contains the following:

Title	Part Number	Rev
Manuals		
Kidde Fire Systems ECS Fire Suppression System with HFC-227ea Agent: Design, Installation, Operation and Maintenance Manual	06-236115-001	BA
Addenda		
Supplement to Kidde Fire Systems ECS Fire Suppression System with HFC-227ea Agent: Design, Installation, Operation, and Maintenance Manual Rev BA, P/N 06-236115-001 Placement Supervision	06-236115-003	AB
Kidde Fire Systems 2” Valve and Safety Burst Disc Rebuild Kit and Instructions Addendum	06-237553-001	AA
Supplement to Kidde Fire Systems® ECS Fire Suppression System with HFC-227ea Agent: Design, Installation, Operation, and Maintenance Manual Rev BA, P/N 06-236115-001 Stainless Steel Nozzles	06-236115-004	AA

November 2017

P/N 06-236115-001
October 2014

Kidde Fire Systems® ECS Fire Suppression System with HFC-227ea Agent:

Design, Installation, Operation and Maintenance Manual

UL LISTED
UL Listing File
No. EX 4674

FM APPROVED
FM Approvals
Project ID 3014861

Kidde Fire Systems

FOREWORD

This manual is written for those who are installing a Kidde Fire Systems® ECS Fire Suppression System with HFC-227ea Agent.

IMPORTANT

Kidde-Fenwal assumes no responsibility for the application of any systems other than those addressed in this manual. The technical data contained herein is limited strictly for information purposes only. Kidde-Fenwal believes this data to be accurate, but it is published and presented without any guarantee or warranty whatsoever. Kidde-Fenwal disclaims any liability for any use that may be made of the data and information contained herein by any and all other parties.

Kidde ECS Fire Suppression Systems with HFC-227ea Agent (Kidde ECS Systems) are to be designed, installed, inspected, maintained, tested and recharged by qualified, trained personnel in accordance with the following:

- Standard of the National Fire Protection Association No. 2001, titled Clean Agent Fire Extinguishing Systems.
- All instructions, limitations, etc. contained in this manual, 06-236115-001.
- All information contained on the system container nameplate(s).

Storage, handling, transportation, service, maintenance, recharge, and test of agent storage containers shall be performed only by qualified and trained personnel in accordance with the information in this manual and Compressed Gas Association* pamphlets C-1, C-6 and P-1:

- C-1, Methods for Hydrostatic Testing of Compressed Gas Cylinders.
- C-6, Standards for Visual Inspection of Compressed Gas Cylinders.
- P-1, Safe Handling of Compressed Gases In Containers.

*CGA pamphlets are published by: http://www.cganet.com.

- Standard of the National Fire Protection Association No. 2001, titled Clean Agent Fire Extinguishing Systems.
- All instructions, limitations, etc. contained in this manual, 06-236115-001.
- All information contained on the system container nameplate(s).

The new design concentration for Class A and C fires applies to systems designed to meet and comply with UL 2166 and NFPA 2001, 2012 Edition guidelines. As such, our customers are reminded and advised:

- The applicable best practice that these systems use automatic actuation;
- Designers should also take note of clause 4.3.5.6 in NFPA 2001[1], 2012 Edition, with regard to time delays;
- The designer should also take note of A.3-4.2.4 in NFPA 2001, 2000 Edition and confirm that the hazard protected does not include any identifiable fire accelerants, which would classify the area as a Class B hazard;
- In addition, the designer should refer to section A.3-6 in NFPA 2001, 2000 Edition and confirm that the area does not include a material number of power or energized cables in close proximity that would predicate the usage of a different design concentration. Please contact applications engineering for design guidance in this instance.

1. Clause 2-3.5.6.1 in NFPA 2001, 2000 Edition states: “For clean agent extinguishing systems, a pre-discharge alarm and time delay, sufficient to allow personnel evacuation prior to discharge, shall be provided. For hazard areas subject to fast growth fires, where the provision of a time delay would seriously increase the threat to life and property, a time delay shall be permitted to be eliminated.”
2. A.3-4.2.4 in NFPA 2001, 2000 Edition states: “…Hazards containing both Class A and Class B fuels should be evaluated on the basis of the fuel requiring the highest design concentration.”
3. A.3.6 in NFPA 2001, 2000 Edition states in part: “...Energized electrical equipment that could provide a prolonged ignition source shall be de-energized prior to or during agent discharge. If electrical equipment cannot be de-energized, consideration should be given to the use of extended agent discharge, higher initial concentration, and the possibility of formation of combustion and decomposition products. Additional testing can be needed on suppression of energized electrical equipment fires to determine these quantities...”

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

Kidde-Fenwal Inc.
400 Main Street
Ashland, MA 01721
Phone: (508) 881-2000
Fax: (508) 881-8920

National Fire Protection Associate Standard No. 2001, Edition 2012, available from:

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02269

Note: Some of the hardware components have been discontinued, but these were left in the manual for informational purposes. For more information, see Chapter 7 Parts List. When reviewing part numbers, use Chapter 7 to look up the full part numbers.

MATERIAL SAFETY DATA SHEETS

The Material Safety Data Sheets (MSDS) can be found in the Appendix A. The latest version of the MSDS can also be found online at the Kidde Fire Systems website (www.kiddefiresystems.com). Use the built-in navigation links to view the desired sheet.

SAFETY SUMMARY

Kidde ECS Systems use pressurized equipment; therefore, personnel responsible for fire suppression systems must be aware of the dangers associated with the improper handling, installation or maintenance of this equipment.

Fire suppression system service personnel must be thoroughly trained in the proper handling, installation and service of HFC-227ea equipment and follow the instructions used in this manual and in the Safety Bulletin and cylinder nameplate listed below.

Kidde has provided warnings and cautions at appropriate locations throughout the text of this manual. These warnings and cautions are to be adhered to at all times. Failure to do so may result in serious injury to personnel.

DEFINITIONS

WARNING — **Indicates an imminently hazardous situation which, if not avoided, could result in death, serious bodily injury and/or property damage.**

CAUTION — **Indicates a potentially hazardous situation which, if not avoided, could result in property or equipment damage.**

SAFETY BULLETIN 1; MARCH 2, 1987
SUBJECT: SAFE CYLINDER HANDLING PROCEDURES

WARNING

Pressurized (charged) cylinders are extremely hazardous and if not handled properly are capable of violent discharge. This may result in serious bodily injury, death and property damage.

BEFORE handling Kidde system products, all personnel must be thoroughly trained in the safe handling of the containers as well as in the proper procedures for installation, removal, filling, and connection of other critical devices, such as flex hoses, control heads, discharge heads, and anti-recoil devices.

READ, UNDERSTAND and ALWAYS FOLLOW the operation and maintenance manuals, owner's manuals, service manuals, etc., that are provided with the individual systems.

The following safety procedures must be observed at all times:

Moving Container: Containers must be shipped compactly in the upright position, and properly secured in place. Containers must not be rolled, dragged or slid, nor allowed to be slid from tailgates of vehicles. A suitable hand truck, fork truck, roll platform or similar device must be used.

Rough Handling: Containers must not be dropped or permitted to strike violently against each other or other surfaces.

Storage: Containers must be stored standing upright where they are not likely to be knocked over, or the containers must be secured.

For additional information on safe handling of compressed gas cylinders, see CGA Pamphlet PI titled "Safe Handling of Compressed Gases in Containers". CGA pamphlets may be purchased from their website address at: http://www.cganet.com.

SAFETY BULLETIN 2; MAY 1, 1993
SUBJECT: SAFE CYLINDER HANDLING PROCEDURES FOR PRESSURIZED CYLINDERS

WARNING

Pressurized (charged) cylinders are extremely hazardous and if not handled properly are capable of violent discharge. This will result in serious bodily injury, death and property damage.

BEFORE handling Kidde system products, all personnel must be thoroughly trained in the safe handling of the containers as well as in the proper procedures for installation, removal, filling, and connection of other critical devices, such as flexible hoses, control heads, and safety caps.

READ, UNDERSTAND and ALWAYS FOLLOW the operation and maintenance manuals, owner's manuals, service manuals, and other information that is provided with the individual systems.

THESE INSTRUCTIONS MUST BE FOLLOWED IN THE EXACT SEQUENCE AS WRITTEN TO PREVENT SERIOUS INJURY, DEATH OR PROPERTY DAMAGE.

SAFETY CAP

- Each HFC-227ea cylinder is factory equipped with a safety cap installed on the valve outlet, and securely chained to the valve to prevent loss. This device is a safety feature, and will provide controlled safe discharge when installed if the cylinder is actuated accidentally.
- The safety cap must be installed in the valve outlet AT ALL TIMES except when the cylinders are connected into the system piping or being filled.
- The safety cap is intentionally chained to the cylinder valve to prevent loss while in service and must not be removed from its chain.

PROTECTION CAP

A protection cap is factory installed on the actuation port and securely chained to the valve to prevent loss. The cap is attached to the actuation port to prevent tampering or depression of the actuating pin. No attachments (control head, pressure control head) are to be connected to the actuation port during shipment, storage, or handling.

INSTALLATION

THIS SEQUENCE FOR CYLINDER INSTALLATION MUST BE FOLLOWED AT ALL TIMES:

1. Install cylinder into bracketing.

WARNING

Discharge hoses or valve outlet adapter must be connected into system piping before attaching to cylinder valve outlet to prevent injury in the event of discharge.

2. Remove safety cap and connect all cylinder valves into system piping using flex hose or valve outlet adapter.
3. Remove protection cap and attach control heads, pressure control heads, pilot loops, etc., as required.

WARNING

Control heads must be in the set position before attaching to the cylinder valve actuation port, in order to prevent accidental discharge.

REMOVAL FROM SERVICE

1. Remove all control heads, pressure operated heads, and pilot loops from cylinder valve, and attach protection cap to actuation port.
2. Disconnect cylinders from system piping at the valve outlet. Disconnect valve outlet adapter, if used.
3. Immediately install safety cap on valve outlet.

WARNING

Do not disconnect the cylinder from system piping if the safety cap is missing. Obtain a new safety cap from Kidde.

4. Remove cylinder from bracketing.

WARNING

Failure to follow these instructions, and improper use or handling, may cause serious bodily injury, death, and property damage.

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CHAPTER 1
GENERAL INFORMATION

1-1 INTRODUCTION

Kidde Fire Systems® ECS Fire Suppression Systems with HFC-227ea Agent are listed by Underwriters Laboratories, Inc. (UL) and Approved by Factory Mutual (FM). These systems are designed for total flooding in accordance with NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*. These systems have been tested to the limits established jointly by UL and FM. In any situation not specifically covered by this manual, the application and installation of the system must meet the requirements of the standards as stated. In any case, all installations must meet the requirements of the local Authority Having Jurisdiction (AHJ).

The complexity of two-phase flow does not allow for any simple method of manual HFC-227ea calculation. For this reason, the flow calculations and design criteria described in this manual have been incorporated into the latest version of the flow calculation software program. The calculations are based on conserving mass, energy and momentum in the pipe network. The routine calculates the flow in quasi-steady state steps from the initiation of the discharge to the final gas blowdown. This is a significantly more rigorous treatment than the traditional Halon NFPA 12A method.

The system designer must become thoroughly familiar with the latest version of the Flow Calculation Software User's Guide 06-236272-001 in order to learn the proper procedures for applying the input parameters to the flow program. There are a number of limitations to these input parameters which must be observed if accurate results are to be obtained.

Kidde ECS Fire Suppression Systems (Kidde ECS System) with HFC-227ea combine an environmentally safe fire suppression agent, highly effective detection devices and specially developed components for fast agent discharge. The resulting rapid suppression of a fire reduces property damage and products of combustion to the lowest possible level. These systems are electrically, pressure and/or cable operated, with a normal design discharge time of less than ten seconds. Agent storage containers can be strategically located throughout a protected zone, eliminating expensive piping.

1-2 SYSTEM DESCRIPTION

1-2.1 General

Kidde ECS Systems are used to suppress fires in specific hazards or equipment located where an electrically non-conductive agent is required, where agent cleanup creates a problem, where extinguishing capability with low weight is a factor and where the hazard is normally occupied by personnel. Kidde ECS Systems are intended to protect the following:

- Data processing facilities
- Telecommunications facilities
- Process control rooms
- High value medical facilities
- High value industrial equipment areas
- Libraries, museums, art galleries
- Anechoic chambers
- Flammable liquid storage areas

HFC-227ea systems are designed for the following classes of fire:

- Class A Surface Type Fires; Wood or other cellulose-type material
- Class B; Flammable liquids
- Class C; Energized electrical equipment

For hazards beyond the scope described above, the designer must consult with Kidde and NFPA 2001, on the suitability of HFC-227ea for the protection, necessary design concentration and personnel exposure effects from that concentration.

HFC-227ea shall not be used on fires involving the following materials, unless they have been tested to the satisfaction of the Authority Having Jurisdiction:

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

1-2.1.1 Operating Temperature Range Limitations

The operating temperature range for all components used in the Kidde ECS Systems is 32°F to 130°F (0°C to 54°C). The components are tested within this range and may not perform as specified outside this range.

1-2.1.2 Agent Storage Container Temperature Range Limitations

The temperature of the location for the agent storage containers depends on the design of the system.

1-2.1.2.1 Balanced System Agent Storage Container Temperature Range

In balanced systems, where agent flow through each nozzle is equal, the agent cylinder storage temperature range is 32°F to 130°F (0°C to 54°C).

1-2.1.2.2 Unbalanced System Agent Storage Container Temperature Range

In unbalanced systems, where agent flows through the nozzles at varying rates, the agent cylinder storage temperature range is 60°F and 80°F (16°C and 27°C).

The latest version of the flow calculation software is written and tested for a 70°F (21°C) agent cylinder storage temperature (for more information see latest version of the Flow Calculation Software User's Guide 06-236272-001). If the agent cylinder storage temperature is outside of this range, an insufficient quantity of agent may be discharged from one or more nozzles in an unbalanced system, resulting in one or more hazards receiving an insufficient concentration of agent.

1-2.2 Extinguishing Agent

HFC-227ea (1,1,1,2,3,3,3-heptafluoropropane) is a compound of carbon, fluorine and hydrogen (CF_3CHFCF_3). It is colorless, odorless and electrically non-conductive. It suppresses fire by a combination of chemical and physical mechanisms with minimal effect on the available oxygen. This allows people to see and breathe, permitting them to leave the fire area safely.

HFC-227ea is acceptable for use in occupied spaces when used in accordance with the United States Environmental Protection Agency (EPA) Significant New Alternatives Policy (SNAP) program rules.

Although HFC-227ea is considered non-toxic to humans in concentrations necessary to extinguish most fires, certain safety considerations should be observed when applying and handling the agent. The discharge of HFC-227ea may create a hazard to people from the undecomposed agent itself and from the decomposition products which result when the agent is exposed to fire or other hot surfaces. Exposure to the agent is generally of less concern than is exposure to the decomposition products. Unnecessary exposure to the agent or the decomposition products should be avoided.

1-2.2.1 Toxicity

Unnecessary exposure to clean agents is to be avoided in accordance with the requirements of NFPA-2001, 2000 Edition. As such, upon operation of a system pre-discharge alarm, all personnel should immediately exit the protected space. In no case shall personnel remain in a room in which there is a fire. In the very unlikely instance where a clean agent system should discharge unexpectedly into an occupied room, all personnel should proceed in a calm and orderly manner to an exit and leave the room.

HFC-227ea halocarbon clean agent has been evaluated for cardiac sensitization in accordance with test protocols approved by the United States Environmental Protection Agency (U.S. EPA). The EPA's SNAP Program classifies HFC-227ea as acceptable for use as a total flooding agent in occupied spaces with specific limitations. Refer to the SNAP program rules or NFPA 2001 for more information. HFC-227ea halocarbon clean agent has been judged acceptable by the U.S. EPA for use in occupied spaces when used in accordance with the guidance of NFPA 2001. In accordance with NFPA 2001. HFC-227ea halocarbon clean agent systems designed for use with agent vapor concentrations up to nine volume per cent in air are permitted. See NFPA 2001, 2012 Edition Sect. 1-5, Safety. Although HFC-227ea has negligible toxicity in concentrations needed to suppress most fires, certain safety considerations must be observed when applying and handling the agent. The discharge of HFC-227ea halocarbon clean agent has negligible toxicity in concentrations needed to suppress most fires, certain safety considerations must be observed when applying and handling the agent. For example, HFC-227ea is a liquefied compressed gas. Upon release to atmospheric pressure (e.g., from nozzles) the liquid flash evaporates at a low temperature (2°F/-16°C). Thus, nozzles must be located to avoid direct impingement on personnel.

1-2.2.2 Decomposition

When HFC-227ea is exposed to temperatures over approximately 1300°F (700°C), products of decomposition (halogen acids) are formed. If the HFC-227ea is discharged in 10 seconds or less, flames are rapidly extinguished and the amount of by-products produced is minimal.

1-2.2.3 Cleanliness

HFC-227ea is clean and leaves no residue, thereby eliminating costly after-fire clean-up and keeping expensive downtime to a minimum. Most materials such as steel, stainless steel, aluminum, brass and other metals as well as plastics, rubber and electronic components are unaffected by exposure to HFC-227ea.

1-2.2.4 Other Safety Considerations

The high pressure discharge of HFC-227ea from a system nozzle can create noise loud enough to be startling. The high velocity discharge can be significant enough to dislodge objects located directly in the discharge path. Enough turbulence may be created in the enclosure to move unsecured paper and other light objects. Direct contact with the vaporizing agent discharged from a nozzle will have a chilling effect on objects, and can cause frostbite burns to the skin. The liquid phase vaporizes rapidly when mixed with air and limits the chilling hazard to the immediate vicinity of a nozzle.

HFC-227ea itself is colorless. Discharge of HFC-227ea into a humid atmosphere may cause fog and reduce visibility for a short time.

1-2.2.5 Storage

HFC-227ea is stored in steel containers at 360 PSIG at 70°F (25 bar at 21°C) as a liquid with nitrogen added to improve the discharge characteristics. The pressure of the stored HFC-227ea varies substantially with temperature changes, as illustrated in Figure 1-1. When discharged, the HFC-227ea liquid vaporizes at the discharge nozzles and is uniformly distributed as it enters the fire area.

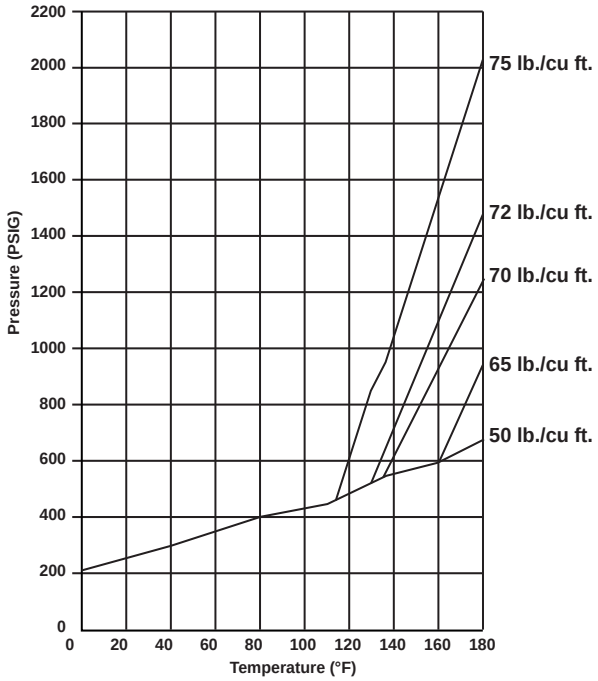

Figure 1-1. HFC-227ea Pressure/Temperature Curve Isometric Diagram

Table 1-1. HFC-227ea Select Physical Properties, U.S. Units

Description	Units	Measurement
Molecular Weight	N/A	170.03
Boiling Point at 1 atm	°F	2.59
Heat of Vaporization at Boiling Point	Btu/lb.	56.7
Vapor Pressure at 75 °F	psi	65.9
Liquid Density at 77 °F	$lb./ft^3$	37.1
For more properties, see NFPA 2001		

Table 1-2. HFC-227ea Select Physical Properties, Metric Units

Description	Units	Measurement
Molecular Weight	N/A	170.03
Boiling Point at 1 atm	°C	-16.3
Heat of Vaporization at Boiling Point	kJ/kg °C	132.6
Vapor Pressure at 25 °C	kPa	454.7
Liquid Density at 25 °F	kg/m^3	594.2
For more properties, see NFPA 2001		

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CHAPTER 2
OPERATION

2-1 INTRODUCTION

This chapter describes the controls and indicators for the Kidde ECS System.

2-2 SYSTEM CONTROLS AND INDICATORS

2-2.1 General

Compressed HFC-227ea liquid is held in the cylinder by a discharge valve. When the discharge valve is actuated by a control head, the valve piston is displaced and the compressed liquid escapes through the discharge port of the valve and is directed through the distribution piping to the nozzles. The nozzles provide the proper flow rate and distribution of HFC-227ea.

2-2.2 Operating Procedures

2-2.2.1 Automatic Operation

When a system is operated automatically by means of a detection and control system, everyone must evacuate the hazard area promptly upon hearing the predischarge alarm. Make sure no one enters the hazard area. Call the fire department immediately.

2-2.2.2 Remote Manual Operation

Operate as follows:

1. Proceed to the appropriate remote manual pull station for the hazard.
2. Operate the manual pull station.
3. Leave the hazard area immediately.
4. Allow no one to enter the hazard area. Call the fire department immediately.

Note: The above instructions must be displayed in the protected area.

2-2.2.3 Local Manual Operation

CAUTION **Manual control is not part of normal system actuation and should only be used in an emergency as a last resort.**

1. Proceed to appropriate HFC-227ea cylinder for the hazard.
2. Remove the safety pull pin from the cylinder control head.
3. Operate the lever, following the instructions on the lever or control head nameplate.
4. Leave the hazard area immediately.
5. Allow no one to enter the hazard area. Call the fire department immediately.

2-2.3 Post-Fire Operation

After an HFC-227ea discharge, qualified fire suppression system maintenance personnel must perform post-fire maintenance as directed in Chapter 6 of this manual. Observe all warnings, especially those pertaining to the length of elapsed time before entering the hazard area.

WARNING

Do not enter a hazard area with an open flame or lighted smoking materials. Flammable vapors may cause re-ignition or explosion.

Ensure the fire is completely extinguished before ventilating the area. Before permitting anyone to enter the hazard area, ventilate the area thoroughly or use self-contained breathing apparatus.

2-2.4 Cylinder Recharge

Recharge all HFC-227ea and nitrogen pilot cylinders immediately after use. Return all cylinders to a Kidde Distributor or other qualified refill agency. Refill in accordance with the procedures outlined in Chapter 6 of this manual.

2-2.5 Special System Precautions

2-2.5.1 Systems Actuated with a Master HFC-227ea Cylinder

In systems where a master HFC-227ea cylinder actuates a pressure operated control head on a slave cylinder, the pressure in the flexible actuation hose line is vented into the discharge manifold following the system discharge. The pressure drop in the pilot line allows the pressure operated control head to automatically reset. However, as a precaution before reinstating the system, ensure that the control head actuating pin is in the retracted (SET) position.

2-2.5.2 Systems Actuated with a Pilot Nitrogen Cylinder

In systems where a pilot nitrogen cylinder actuates a pressure operated control head on a slave HFC-227ea cylinder, nitrogen pressure is trapped in the pilot manifold when the system actuates and is not self-venting. Therefore, before reattaching a pressure operated control head to a recharged HFC-227ea cylinder, the following procedure must be performed to ensure that the pilot manifold is vented and the pressure operated control heads have returned to the SET position.

1. Vent any remaining pressure from the pilot line and remove the master control head from the nitrogen pilot cylinder(s). Reset the master control head and remove the pressure operated control head(s) from the slave cylinder(s).
2. Recharge and reinstall the nitrogen pilot cylinders to the correct charged pressure and reinstall the master control head.
3. Before installing a pressure operated control head on an HFC-227ea cylinder, ensure that the actuator pin is in the retracted (SET) position.
4. Follow all other procedures and cautions as detailed in Chapter 6 of this manual.

CHAPTER 3
COMPONENT DESCRIPTION

3-1 INTRODUCTION

This chapter provides a functional description of the modules and assemblies in the Kidde ECS System.

3-1.1 3 in Cylinder Valve

In 2001, Kidde Fire Systems added a 3 inch discharge valve to its product line. This valve replaces the 2½ inch valves previously used on the 600 lb cylinder and is a standard fitting for the 900 lb cylinder assemblies (also new for the year 2001). A number of distinct differences between the 1½ inch, 2 inch and 2½ inch valves and the new 3 inch valve are detailed in this manual (see Paragraph 3-3.1, Paragraph 3-3.7.2, Paragraph 3-3.7.10, Paragraph 4-3.21, Paragraph 6-2.3 and Paragraph 6-2.8). Data relating to the 600 lb cylinder assembly with a 2½ inch valve is included in this manual and is indicated by the reference "old style". For information on the availability of obsolete products, including spare parts, please contact the factory or your Kidde Representative.

3-2 FUNCTIONAL DESCRIPTION

Compressed HFC-227ea liquid is held in the agent storage container by a discharge valve. When the discharge valve is actuated, the compressed liquid agent discharges through the valve outlet and is directed through the distribution piping to the nozzles. The nozzles provide the proper flow rate and distribution of HFC-227ea.

The Kidde ECS System is composed of the following components and assemblies:

- Cylinder/valve assembly
- Liquid level indicator (optional)
- Control head (electric, cable operated, lever operated, pressure operated and electric and cable operated)
- Pressure gauge
- Straps and brackets for mounting the cylinder
- Cable manual pull station
- Nitrogen actuator and mounting bracket
- Actuation hose
- Flexible discharge hose
- Master cylinder adapter kit
- Tees, elbows and adapters
- Check valve
- Valve outlet adapter
- Discharge nozzle
- Discharge indicator
- Corner pulley
- Supervisory pressure switch (optional)
- Hydrostatic test adapter
- HFC-227ea cylinder recharge adapter
- HFC-227ea cylinder seating adapter
- Main to reserve transfer switch
- Manifold El-check
- Detector
- Pressure operated switch and trip
- Control panel

Figure 3-1 and Figure 3-2 show the above components in two typical configurations.

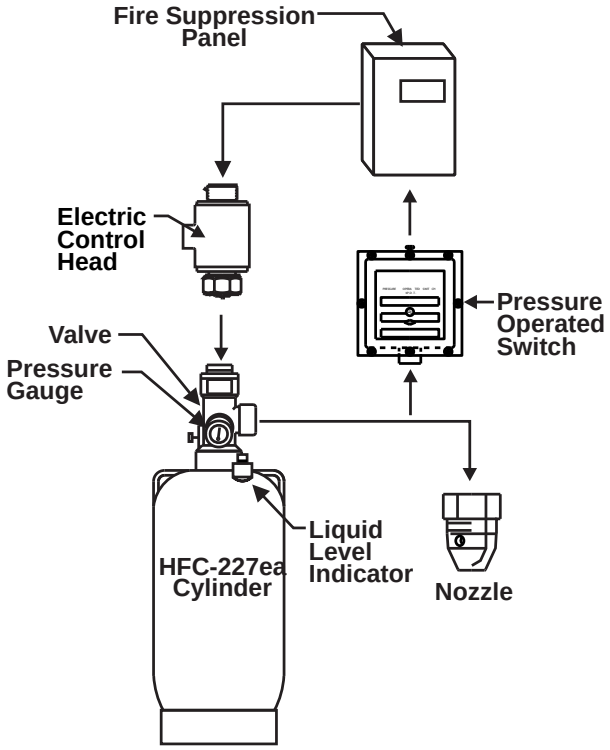


Figure 3-1. Typical HFC-227ea System with Electric Control Head

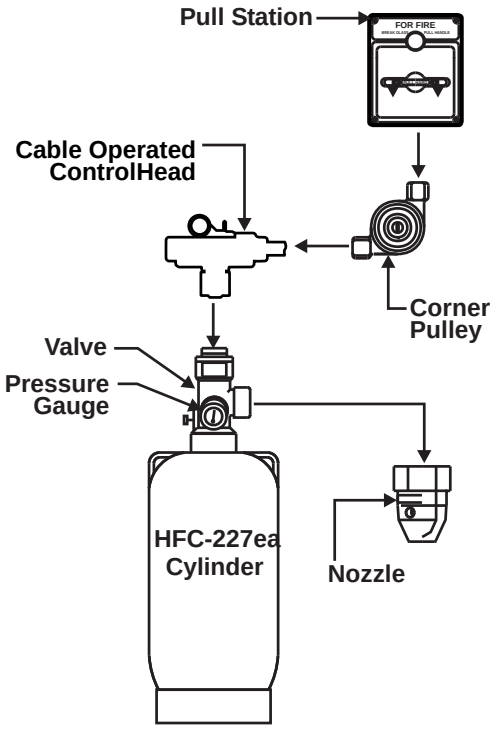


Figure 3-2. Typical HFC-227ea System with Cable Operated Control Head

3-3 COMPONENT DESCRIPTIONS

3-3.1 HFC-227ea Cylinder/Valve Assemblies

HFC-227ea is stored in steel cylinders as a liquid, superpressurized with nitrogen to 360 PSIG at 70°F (25 bar gauge at 21°C). The cylinder valve assembly is equipped with a supervisory pressure switch connection for monitoring cylinder pressure, a pressure gauge and a safety burst disc in compliance with DOT requirements.

In addition, each cylinder/valve assembly is provided with a safety cap and a protection cap which is a safety feature to prevent uncontrolled, accidental discharge.

WARNING

The safety cap must be installed on the discharge outlet whenever a charged cylinder/valve assembly is not connected to the system piping. Failure to install the safety cap could result in violent movement of the container in the event of inadvertent actuation. Failure to follow these instructions could cause death, personal injury and/or property damage.

Figure 3-3 through Figure 3-6 represent typical cylinder assemblies. See Table 3-4 for cylinder dimensions.

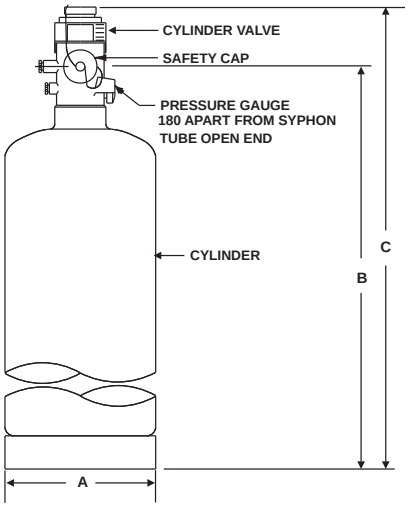


Figure 3-3. Typical Cylinder Assembly, 10 to 70 lb.

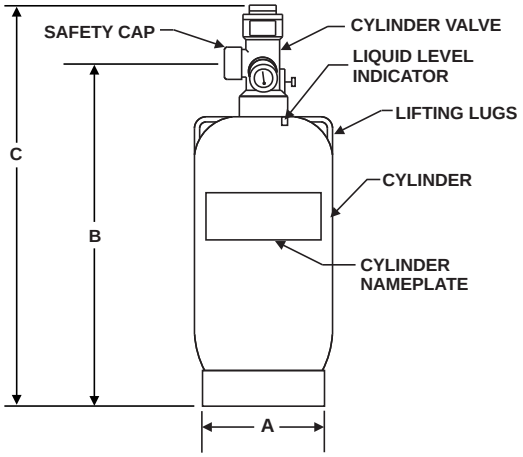


Figure 3-4. Typical Cylinder Assembly, 125 lb and 200 lb and 300 lb Manufactured through April 2014.

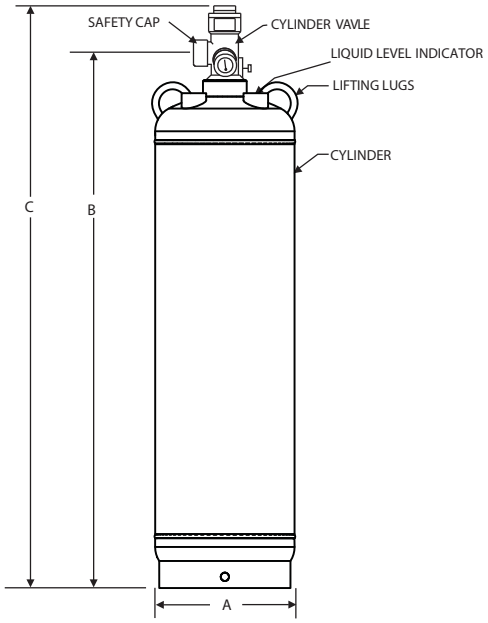


Figure 3-5. Typical Cylinder Assembly, 200 and 350 lb Manufactured After April 2014.

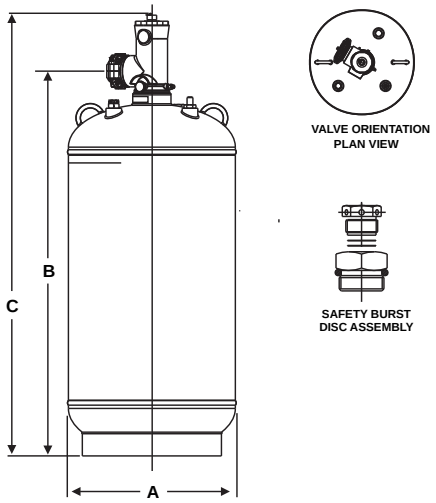


Figure 3-6. 600 and 900 lb. Cylinder with 3" Valve

The Kidde ECS System equipment listed herein is designed for an operating temperature range of 32°F to 130°F (0°C to 54°C). Table 3-1 shows the container temperature-pressure relationship based on a maximum fill density of 70 lb./ft.^{3} (1121 kg/m^3). The latest version of the Flow Calculation Software User's Guide 06-236271-001 is designed for a 70°F (21°C) container operating/storage temperature. Therefore, the container operating and storage temperature must be in the range of 60°F to 80°F (16°C to 27°C) for a single unbalanced system protecting two or more separate hazards. If the container operating and storage temperature is outside this range, an insufficient quantity of agent may be discharged from one or more discharge nozzles.

Table 3-1. Container Temperature-Pressure Correlation
(Based on a cylinder fill density of 70 lb./ft.^{3} or 1121 kg/m^3)

Temperature		Nominal Charge, Pressure	
°F	°C	PSIG	Bar
32	0	288	19.9
40	4.4	303	20.9
50	10	321	22.2
60	15.6	340	23.5
70	21.1	360	24.8
80	26.7	381	26.3
90	32.2	402	27.7
100	37.8	425	29.3
110	43.3	449	31
120	48.9	475	32.7
130	54.4	502	34

If desired, the 125, 200, 350, 600 and 900 lb. cylinders can be provided with an integral Liquid Level Indicator (see Paragraph 3-3.2).

Table 3-2. Cylinder, Equivalent Lengths

Part Number	Nomenclature	Discharge Outlet	Equivalent Length w/o Flex Hose		Equivalent Length w/ Flex Hose	
			ft.	m	ft.	m
90-100010-001	10 lb. Cylinder	1½"	61.8	18.84	65	19.81
90-100020-001	20 lb. Cylinder	1½"	61.8	18.84	65	19.81
90-100040-001	40 lb. Cylinder	1½"	61.8	18.84	65	19.81
90-100070-001	70 lb. Cylinder	1½"	61.8	18.84	65	19.81
90-10012X-001	125 lb. Cylinder	1½"	61.8	18.84	65	19.81
90-10020X-001	200 lb. Cylinder	2"	59	17.98	65	19.81
90-10035X-001	350 lb. Cylinder	2"	59	17.98	65	19.81
90-10060X-001	600 lb. Cylinder (old style)	2½"	59	17.98	65	19.81
90-10060X-100	600 lb. Cylinder (new style)	3"	50	15	80	24
90-10090X-001	900 lb. Cylinder	3"	50	15	80	24

As a reference guide, Table 3-2 provides the equivalent lengths for all the Kidde ECS System cylinder and valve assemblies. The numbers shown in the table represent the equivalent length through the cylinder valve with the flex hose or without the flex hose, depending on the application. This table can also be found in the latest version of the Flow Calculation Software User's Guide 06-236271-001. Table 3-3 and Table 3-4 show the dimensions and fill range for cylinder/valve assemblies in vertical installations.

Figure 3-7 and Figure 3-9 represent the 1½" through 3" valve arrangements.

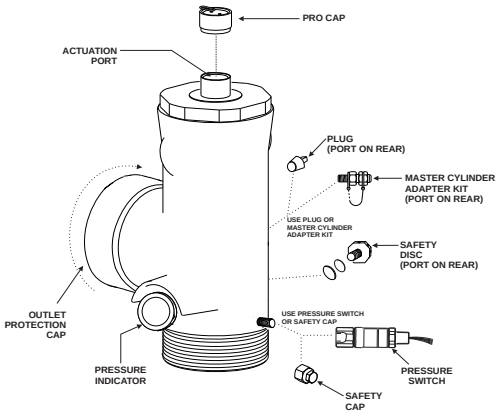


Figure 3-7. 1½", Older Style 2" and 2½" Valve General Arrangement

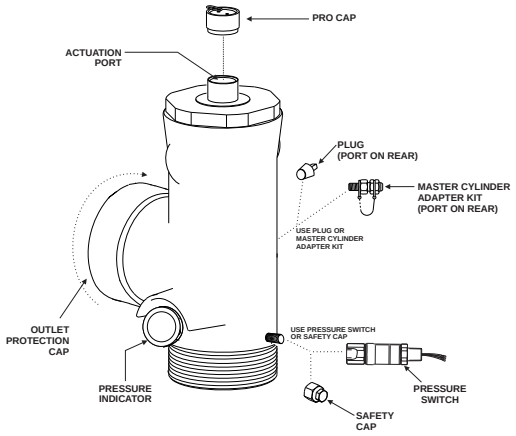


Figure 3-8. Newer 2" Valve General Arrangement

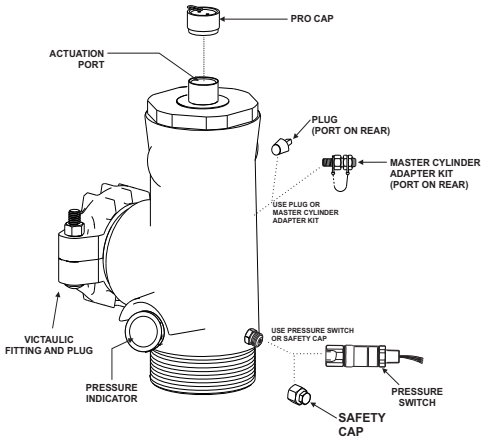


Figure 3-9. 3" Valve General Arrangement

Table 3-3. Dimensions, HFC-227ea Cylinder/Valve Assemblies for Vertical Installation Only

Part Number	Valve	w/LLI	Height		Diameter		Volume		Valve Outlet Height	
			C		A				B	
			in.	m	in.	m	$ft.^3$	m^3	in.	m
90-10001X-001	1½"	No	17.3	0.44	7.07	0.18	0.167	0.0047	13.3	0.33
90-10002X-001	1½"	No	24.97	0.64	7.07	0.18	0.286	0.0081	21	0.53
90-10004X-001	1½"	No	26.76	0.68	9	0.23	0.572	0.0162	22.8	0.58
90-10007X-001	1½"	No	38.83	0.99	9	0.23	1	0.0283	34.9	0.89
90-100121-001	1½"	Yes	35.93	0.92	12.75	0.33	1.788	0.0506	32	0.81
90-100125-001	1½"	No	35.93	0.92	12.75	0.33	1.788	0.0506	32	0.81
90-100200-101	2"	No	52.75	1.34	12.75	0.33	2.859	0.081	47.5	1.21
90-100201-101	2"	Yes	52.75	1.34	12.75	0.33	2.859	0.081	47.5	1.21
90-100350-001	2"	No	58.36	1.49	16	0.41	5	0.1416	53.1	1.35
90-100351-001	2"	Yes	58.36	1.49	16	0.41	5	0.1416	53.1	1.35
90-100600-001	2½"	No	56.72	1.45	22	0.56	8.572	0.2427	50.5	1.28
90-100601-001	2½"	Yes	56.72	1.45	22	0.56	8.572	0.2427	50.5	1.28
90-100600-100	3"	No	58	1.47	22	0.56	8.68	0.246	50.5	1.28
90-100601-100	3"	Yes	58	1.47	22	0.56	8.68	0.246	50.5	1.28
90-100900-001	3"	No	70	1.78	24	0.61	13	0.368	62	1.57
90-100901-001	3"	Yes	70	1.78	24	0.61	13	0.368	62	1.57

Table 3-4. Fill Range HFC-227ea Cylinder/Valve Assemblies for Vertical Installation Only

Part Number	Fill Range		Empty Weight		Gross Weight			
					Min. Fill		Max. Fill	
	lb.	kg	lb.	kg	lb.	kg	lb.	kg
90-10001X-001	6-10	3-4.5	25	11	30	14	35	16
90-10002X-001	9-20	4-9	31	14	40	18	51	23
90-10004X-001	18-40	8-18	38	17	55	25	78	35
90-10007X-001	30-70	14-31.5	52	24	82	38	123	56
90-100121-001	54-125	24.5-56.5	98	45	152	69	223	101
90-100125-001	54-125	24.5-56.5	98	45	152	69	223	101
90-100200-101	86-200	39-90.5	133	60	219	100	333	151
90-100201-101	86-200	39-90.5	133	60	219	100	333	151
90-100350-001	150-350	68-158.5	201	91	351	159	555	250
90-100351-001	150-350	68-158.5	203	92	353	160	557	251
90-100600-001	258-600	117-272	335	152	593	270	935	425
90-100601-001	258-600	117-272	337	153	595	270	937	426
90-100600-100	258-600	117-272	362	165	620	281	962	437
90-100601-100	258-600	117-272	362	165	620	281	962	637
90-100900-001	390-900	177-408	505	230	895	407	1405	637
90-100901-001	390-900	177-408	505	230	895	407	1405	637

3-3.2 Liquid Level Indicator

The optional Liquid Level Indicator (LLI) consists of a hollow metal tube inserted into a special fitting in the top of the 125, 200, 350, 600 or 900 lb HFC-227ea cylinder. See Table 3-5 for part number information. The indicator is provided with a graduated tape which senses the position of a toroidal magnet encased within an internal float riding on the liquid surface. The graduations on the tape indicate the liquid level within the cylinder (see Figure 3-10).

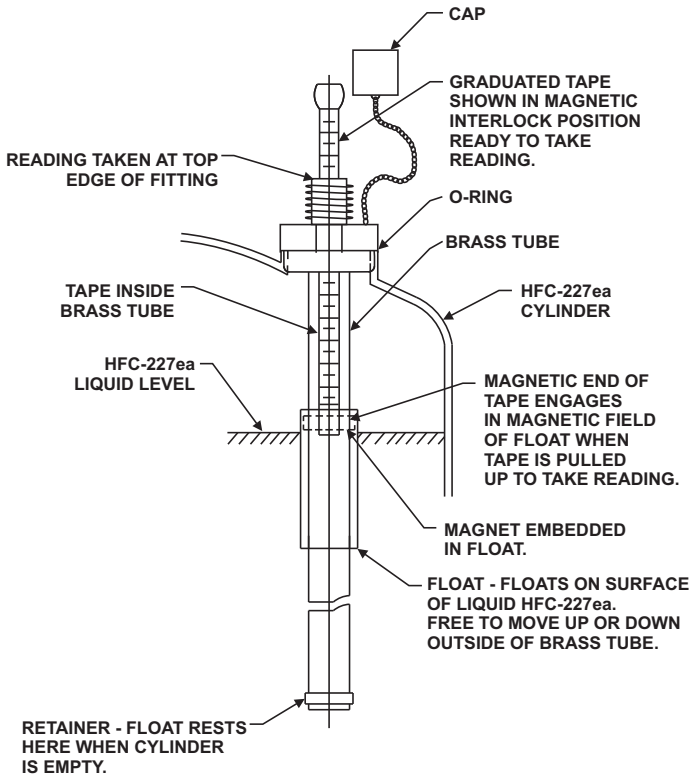


Figure 3-10. Liquid Level Indicator

Table 3-5. Liquid Level Indicator Part Numbers

Cylinder	Liquid Level Tape Part Number
125	06-400125-001
200	WK-400200-000
350	WK-400350-000
600	WK-400600-000
900	WK-400900-000

3-3.3 Cylinder Mounting Equipment

Steel straps and brackets are used to mount the cylinders in a vertical position.

Cylinder straps (P/N WK-283945-000, WK-283934-000, 06-235317-001, WK-292971-000, WK-281866-000, WK-294651-000, and 06-236125-001) are available for all size cylinders (see Figure 3-11 and Table 3-6 and Table 3-7).

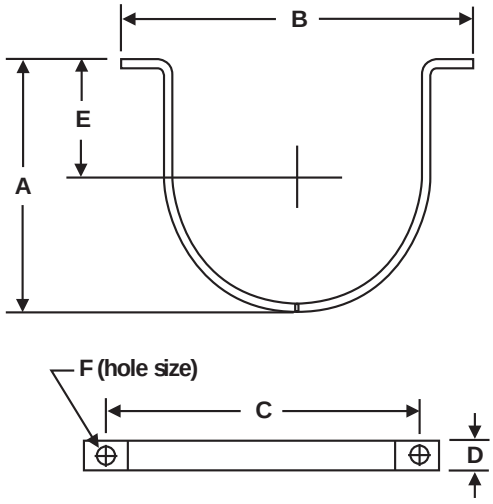


Figure 3-11. Cylinder Mounting Straps

Table 3-6. Dimensions–Cylinder Mounting Straps

Part Number	Cylinder Size	Cylinder O.D.	Dimensions*					
	lb		A	B	C	D	E	F
WK-283945-000	10 20	7.07	6.48	9.62	8.62	1.00	2.78	0.437
WK-283934-000	40 70	9.00	8.16	11.69	10.69	1.00	3.50	0.437
06-235317-001	125, 200 new style	12.75	12.175	16.18	14.56	1.75	5.59	0.625
WK-292971-000	200 old style	13.6	13.09	17.06	15.44	1.75	6.06	0.625
WK-281866-000	350	16.00	15.50	19.50	17.88	1.75	7.25	0.625
WK-294651-000	600	22.00	21.56	25.75	24.12	1.75	10.25	0.625
06-236125-001	900	24.00	23.75	27.75	26.00	1.75	12.13	0.625
*Note: Dimensions are in millimeters.								

Table 3-7. Dimensions–Cylinder Mounting Straps, Metric

Part Number	Cylinder Size	Cylinder O.D.	Dimensions*					
	lb		A	B	C	D	E	F
WK-283945-000	10 20	180	165	244	219	25	71	11
WK-283934-000	40 70	229	207	297	272	25	89	11
06-235317-001	125, 200 new style	324	309	411	370	44	142	16
WK-292971-000	200 old style	345	332	433	392	44	154	16
WK-281866-000	350	406	394	495	454	44	184	16
WK-294651-000	600	559	548	654	613	44	260	16
06-236125-001	900	610	603	705	660	44	308	16
*Note: Dimensions are in inches.								

Wall brackets (P/N 82-486485-000, 82-486486-000, 82-486487-000, and 82-486488-000) are available for the 10, 20, 40 and 70 lb size cylinders (see Figure 3-12 and Table 3-8 and Table 3-9).

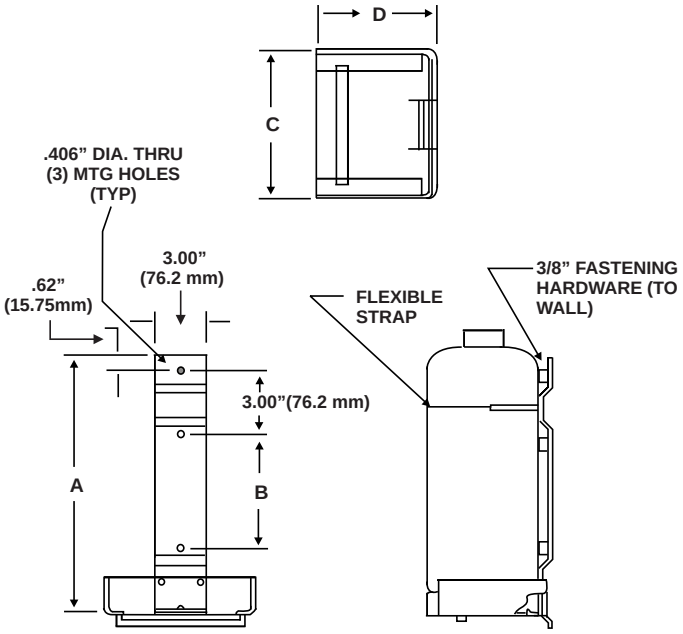


Figure 3-12. Cylinder Wall Brackets

Table 3-8. Dimensions–Cylinder Wall Brackets

Part Number	Cylinder Capacity	Dimensions*			
	lb	A	B	C	D
82-486485-000	10	8.62	1.56	7.68	5.75
82-486486-000	20	14.37	7.31	7.68	5.75
82-486487-000	40	13.12	5.94	9.75	6.75
82-486488-000	70	19.62	12.44	9.75	6.75
*Note: Dimensions are in inches.					

Table 3-9. Dimensions–Cylinder Wall Brackets, Metric

Part Number	Cylinder Capacity	Dimensions*			
	lb	A	B	C	D
82-486485-000	10	218.95	39.62	194.31	146.05
82-486486-000	20	264.99	185.67	195.07	146.05
82-486487-000	40	333.25	150.88	247.65	171.45
82-486488-000	70	498.35	315.98	247.65	171.45
*Note: Dimensions are in millimeters.					

3-3.4 Control Heads

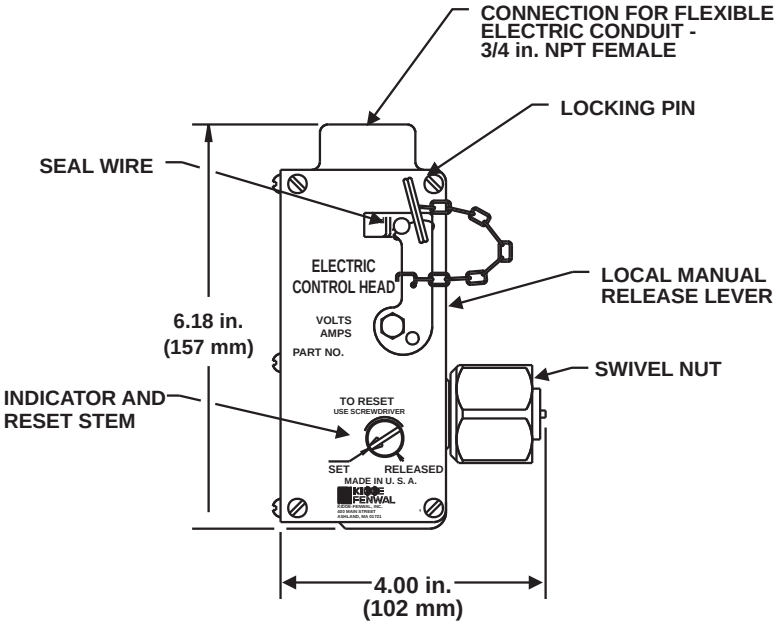
A suitable control unit, specifically Listed and Approved for use with the following electric control heads, shall be provided for supervision of the releasing circuits per NFPA requirements. In addition, a 24-hour back-up power source shall be provided per NFPA requirements.

3-3.4.1 Electric Control Heads, P/N WK-890181-000, P/N 81-890149-000, and P/N WK-890165-000

CAUTION

The stackable control head (P/N 82-486500-010) cannot be used with 3 in valve cylinders (P/Ns 90-100600-100, 90-100601-100, 90-100900-001 and 90-100901-001). The stackable control head does not have sufficient force to activate the 3 in valve (P/N 90-17000-000) and may result in a system failure. The electric/manual control heads (P/Ns WK-890181-000, 81-890149-000, and WK-890165-000) may be used with the 3 in valve.

The Electric Control Head provides for electric actuation of the HFC-227ea cylinder valve. It is operated electrically from a detection and control system, a remote manual station, or locally with a manual lever on the electric control head (P/N WK-890181-000 only). See Figure 3-13.



Part Number	Control Head	
	Voltage	Current
WK-890181-000 81-890149-000[a] WK-890165-000[a],[b]	24 Vdc 125 Vdc 115 Vac	2.0A 0.3A 1.0A

(a) Not FM Approved for use with HFC-227ea Systems
(b) Not UL Listed for use with HFC-227ea Systems

Figure 3-13. Electric Control Head

The Stackable Control Head (P/N 82-486500-010) is rated for use in hazardous (classified) locations Class 1, Div 1, Groups C, D, and Class II, Div II, Groups E, F and G between -40°F to 130°F (-40°C to 54°C). Use conduit seal within 18 in (457 mm) of this device.

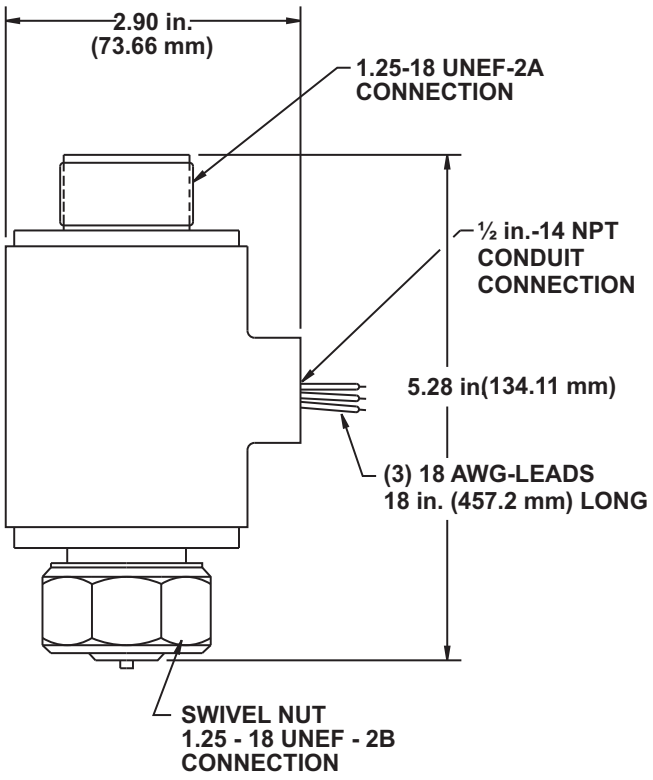


Figure 3-14. Electric Control Head, Stackable

Table 3-10. Electric Control Head, Stackable (Explosion Proof)

Part Number	Voltage	Amps
82-486500-010	24 Vdc	0.2 continuous

CAUTION

Electric Control Head, P/N 82-486500-010, is designed for installation directly on Kidde ECS System cylinder valves only. This control head must not be installed on any other type of HFC-227ea cylinder valve, nitrogen valve or carbon dioxide cylinder valve. Installation of this control head on any other device (for example, a pressure operated control head) will result in failure of the device when the control head is actuated.

3-3.4.2 Electric/Cable Operated Control Heads, P/N 81-895630-000 and P/N WK-897494-000

The electric/cable operated control head mounts directly on top of the HFC-227ea cylinder valve and provides for both electric actuation or remote cable operation. The control head is operated remotely by an electrical signal from a detection system or electric manual pull station. The control head can also be operated mechanically from a remote cable operated manual pull station or locally using the manual lever on the control head (see Figure 3-15 and Table 3-11).

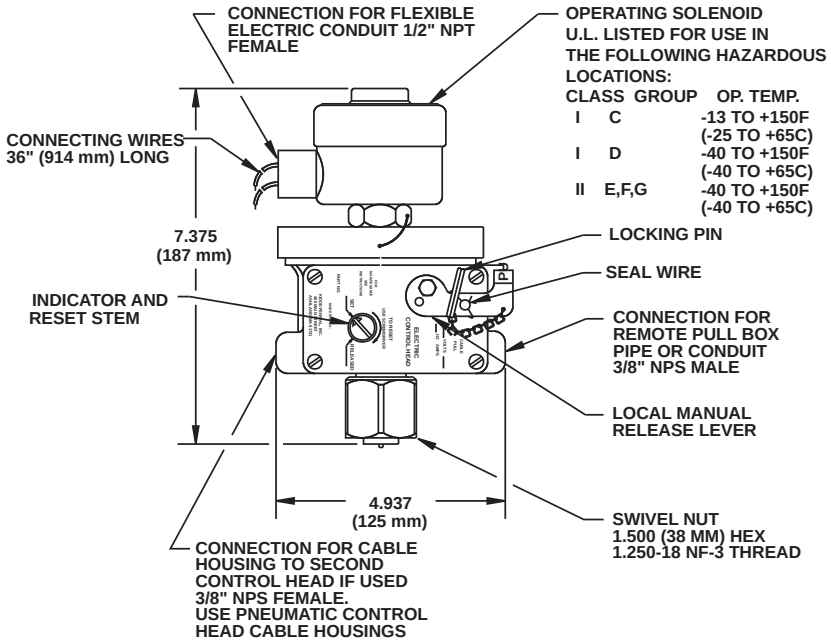


Figure 3-15. Electric/Cable Operated Control Head

Table 3-11. Electric/Cable Operated Control Heads

Part Number	Type	Voltage	Amps	Rating
81-895630-000	Standard	24 Vdc	2.0 momentary	33.0 Watts
WK-897494-000	Explosion Proof	24 Vdc	1.65 continuous	33.0 Watts

3-3.4.3 Cable Operated Control Head, P/N 81-979469-000

The Cable Operated Control Head is used for systems designed for manual operation only. It mounts directly on top of the HFC-227ea cylinder valve and is operated either remotely from a cable manual pull station or locally using the manual lever on the control head (see Figure 3-16).

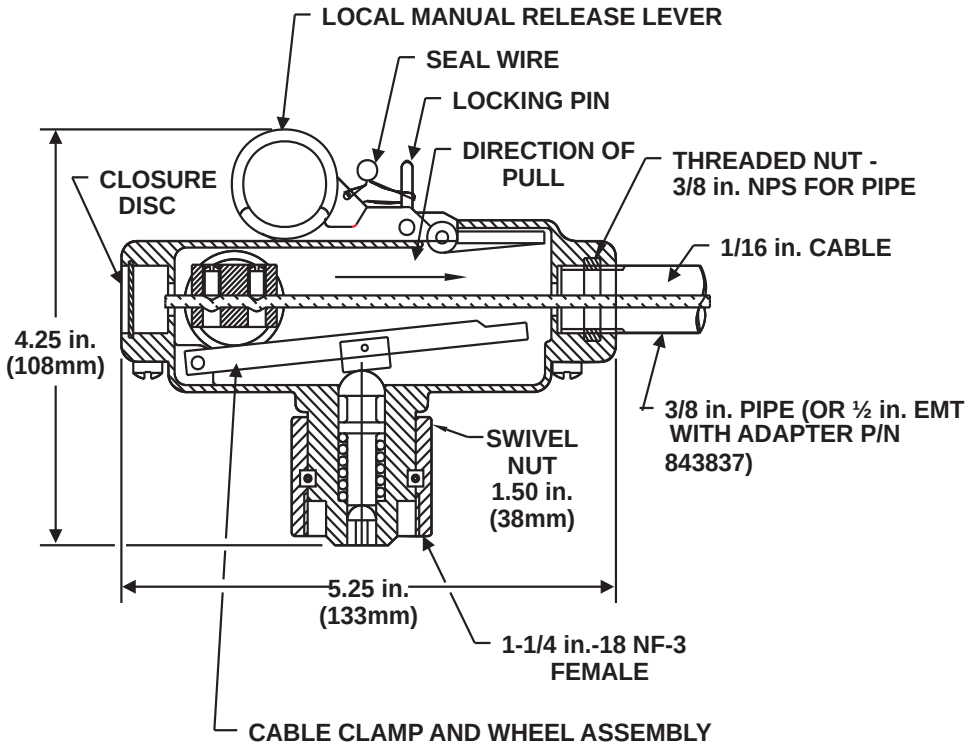


Figure 3-16. Cable Operated Control Head

3-3.4.4 Lever Operated Control Head, P/N WK-870652-000

The Lever Operated Control Head is equipped with an operating lever, secured in the closed position by a safety pull pin. By removing the safety pin, the lever can be manually rotated to the open position, thereby activating the cylinder or valve on which it is installed (see Figure 3-17).

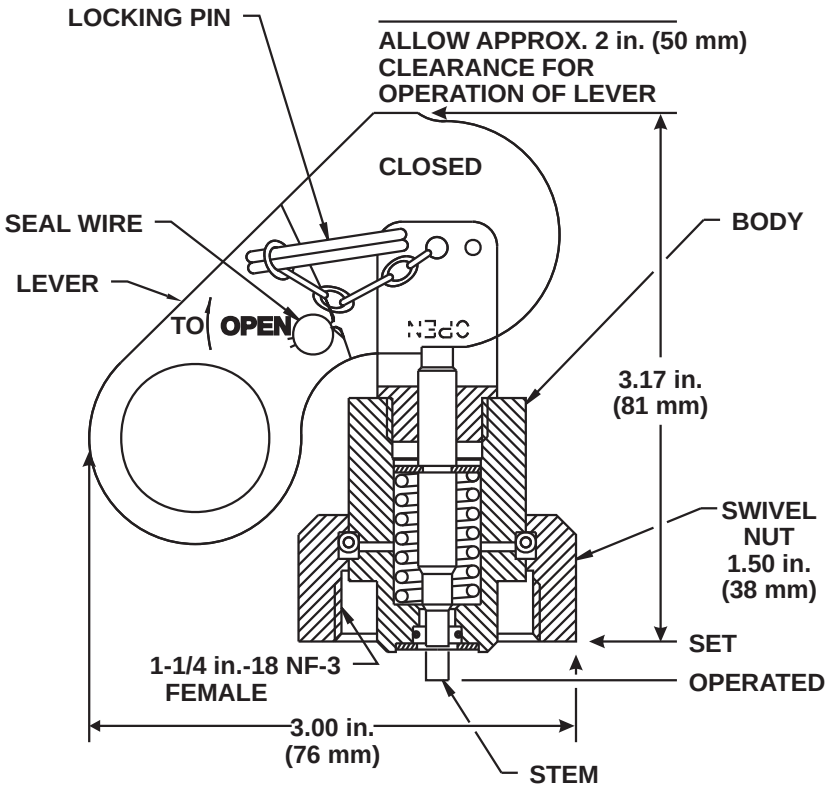


Figure 3-17. Lever Operated Control Head

3-3.4.5 Lever/Pressure Operated Control Head, P/N 82-878751-000

The Lever/Pressure Operated Control Head allows manual or pressure actuation of several system components, including HFC-227ea cylinder valves and nitrogen actuators (see Figure 3-18).

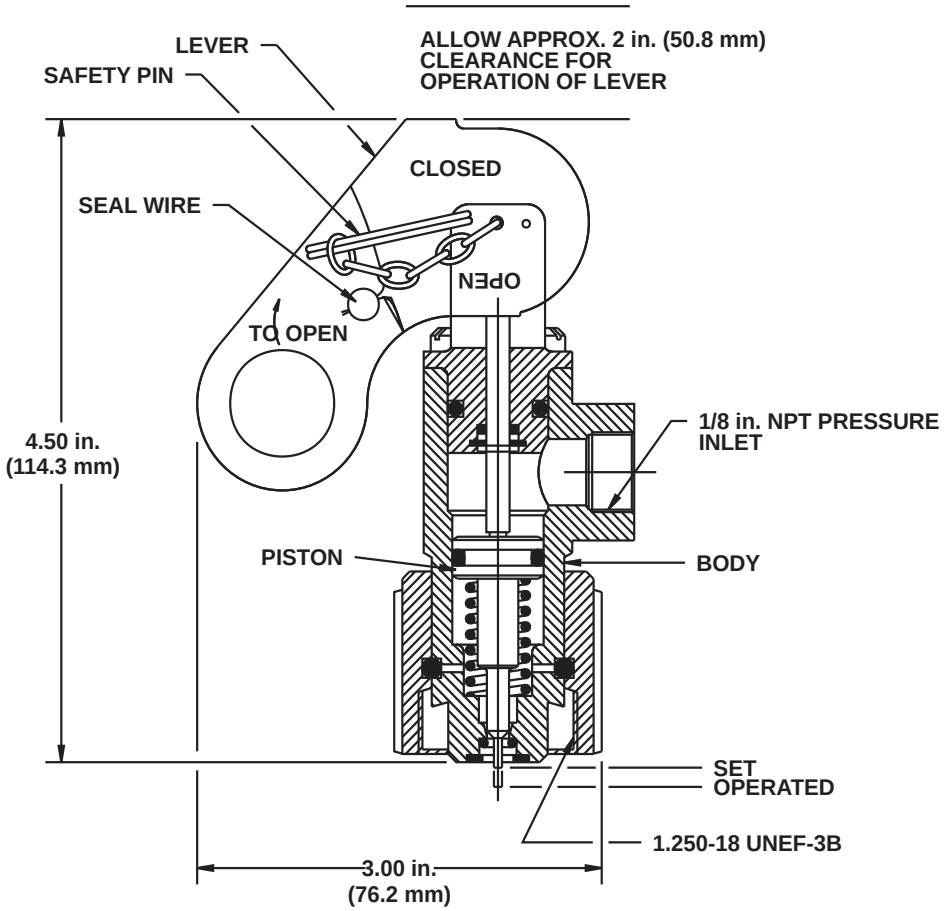


Figure 3-18. Lever/Pressure Operated Control Head

WARNING

Before resetting the lever/pressure operated control head, all pressure must be relieved from the cylinder and actuation lines.

Pressure can be relieved from unvented actuation tubing by loosening the fitting on the control head slightly and allowing the line to bleed out completely. Failure to perform this action can result in damage to the control head.

When attaching the Lever/Pressure operated control head to the valve, the swivel nut must be tightened to a toque of 55ft·lb. Failure to tighten the swivel nut may result in leakage during actuation.

3-3.4.6 Pressure Operated Control Head, P/N 82-878737-000 and P/N 82-878750-000

The Pressure Operated Control Head, P/N 82-878737-000, allows for pressure actuation of HFC-227ea cylinders and is mounted directly on top of the HFC-227ea cylinder valve (see Figure 3-19). The pressure operated control head, P/N 82-878750-000, offers a stackable design and is used where an electric/mechanical control head actuation is also required on the same cylinder (see Figure 3-20).

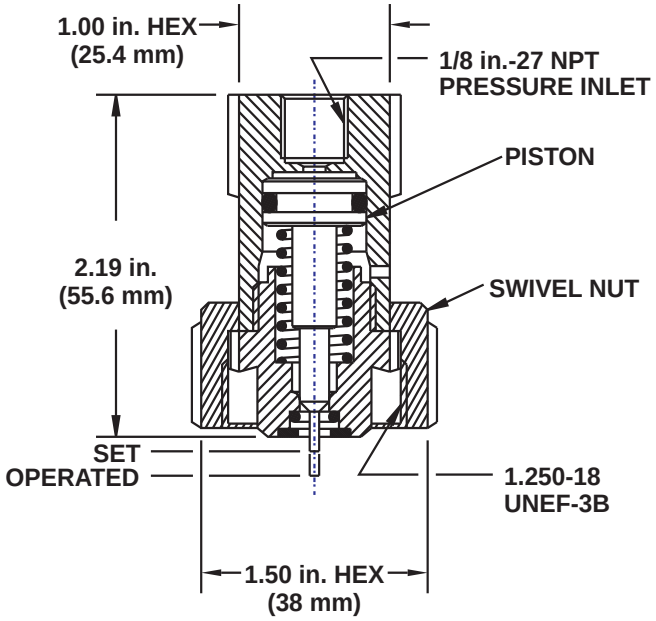


Figure 3-19. Pressure Operated Control Head

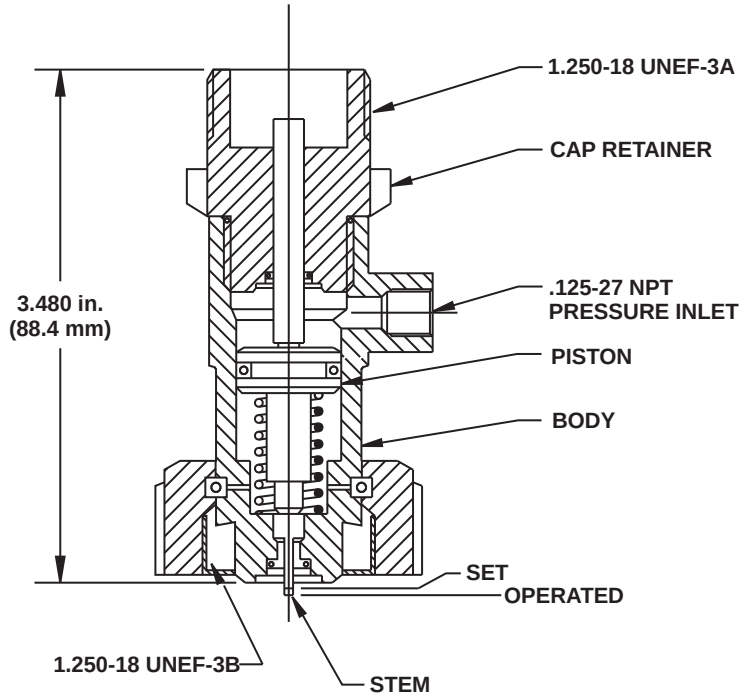


Figure 3-20. Stackable Pressure Operated Control Head

3-3.5 Remote Pull Stations

3-3.5.1 Electric Remote Pull Box, P/N 84-330001-001

The Electric Remote Pull Box is an electrically operated device. To actuate the HFC-227ea system, pull the handle on the front of the box.

3-3.5.2 Cable Manual Pull Station, Surface, P/N 81-871403-000

The surface type remote Cable Manual Pull Station is a cable operated device. To actuate the HFC-227ea system, break the glass plate on the box using the attached hammer and pull the handle (see Figure 3-21).

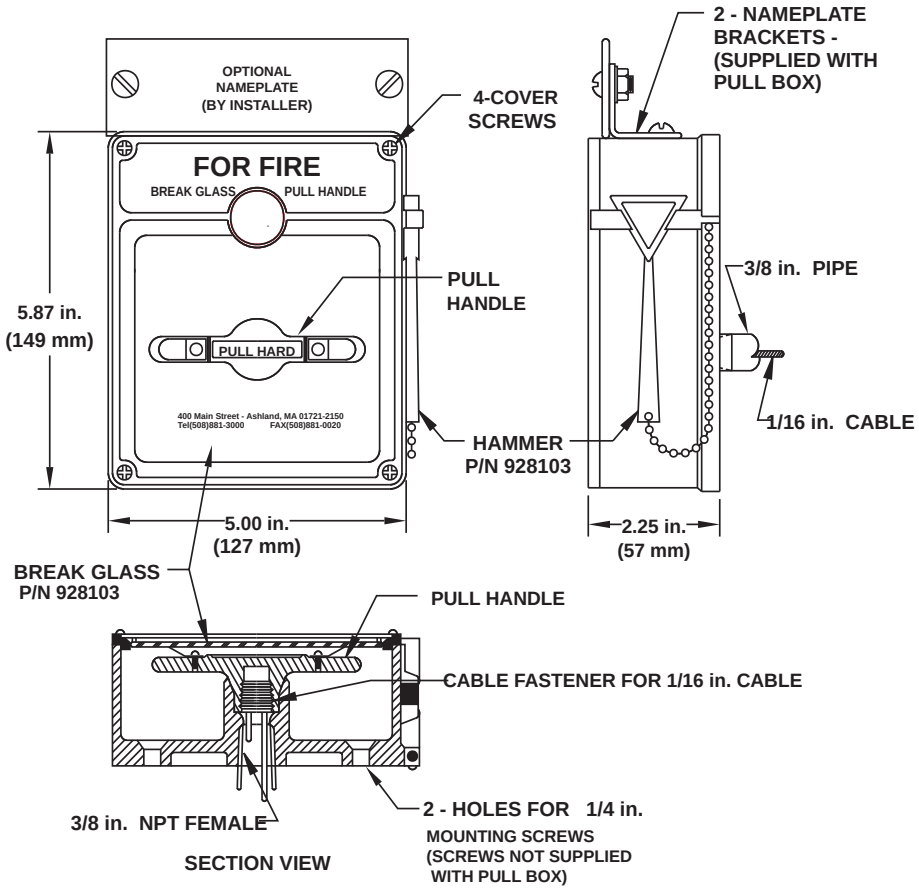


Figure 3-21. Cable Manual Pull Station

3-3.6 Actuation Accessories

3-3.6.1 Nitrogen Actuator, Mounting Bracket and Adapter, P/N WK-877940-000, P/N WK-877845-000 and P/N WK-699205-010 respectively

Gas pressure from a nitrogen cylinder is routed to the pressure operated control head mounted on each HFC-227ea cylinder. When the control head on the remote nitrogen cylinder is actuated, the HFC-227ea cylinder will be activated, causing HFC-227ea to be discharged from the cylinder.

The nitrogen cylinder is used in multiple cylinder and main/reserve systems. When activated by a control head, gas pressure is routed from the nitrogen cylinder to pressure operated control heads mounted on each HFC-227ea cylinder, resulting in a complete system discharge (see Figure 3-22).

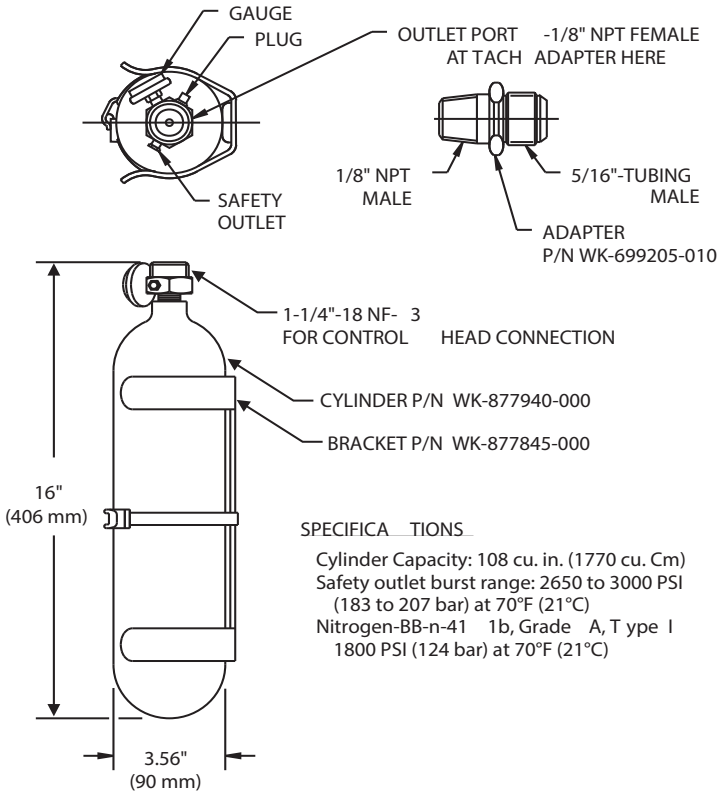


Figure 3-22. Nitrogen Actuator, Mounting Bracket and Adapter

3-3.6.2 Flexible Actuation Hose, P/N WK-264986-000 and P/N WK-264987-000

The Flexible Actuation Hose is used in multiple cylinder systems. Pilot pressure is directed to a pressure operated control head on each HFC-227ea cylinder valve using a 1/4-inch actuation hose (see Figure 3-23 and Table 3-12).

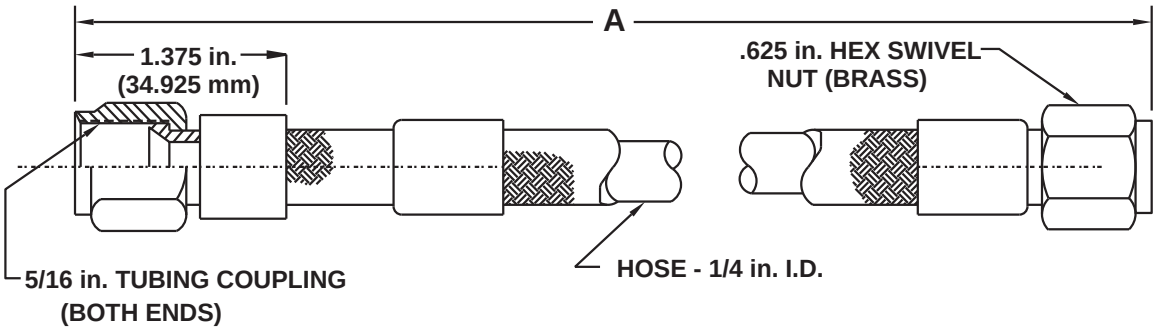


Figure 3-23. Flexible Actuation Hose

Table 3-12. Dimensions, Flexible Actuation Hose

Part Number	Dimension A	
	in.	mm
WK-264986-000	30	762
WK-264987-000	22	558

3-3.6.3 Master Cylinder Adapter Kit, P/N 82-844895-000

The Master Cylinder Adapter Kit provides a means of connecting a flexible actuation hose to the master and slave cylinder/valve assemblies. The adapter kit is provided with a cap intentionally chained to the adapter to prevent loss while in service; do not remove the cap from the chain. The kit also contains a pressure sensitive label which is placed on the cylinder valve after adapter installation (see Figure 3-24).

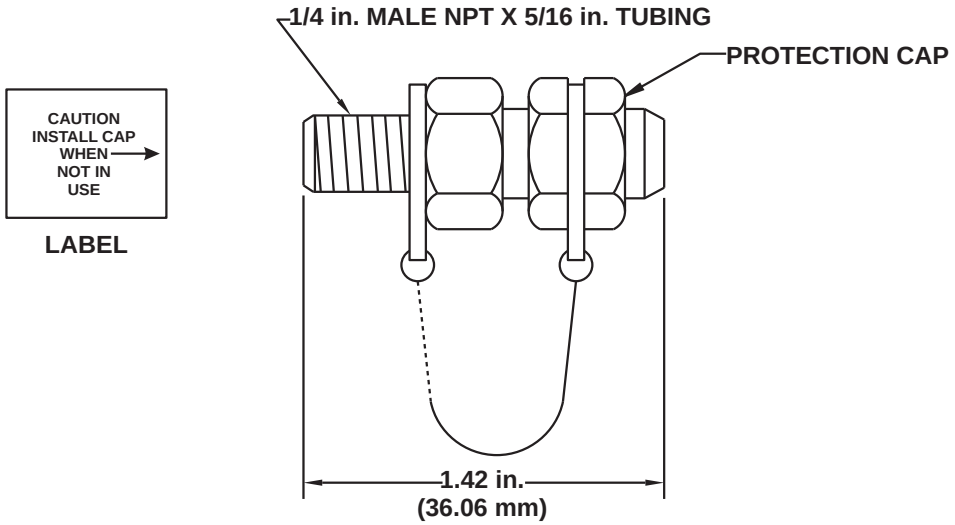


Figure 3-24. Master Cylinder Adapter Kit

3-3.6.4 Tees, Elbows and Adapters

Tees, elbows and adapters connect actuation hoses to pressure operated control heads in multiple cylinder system installations (see Figure 3-25).

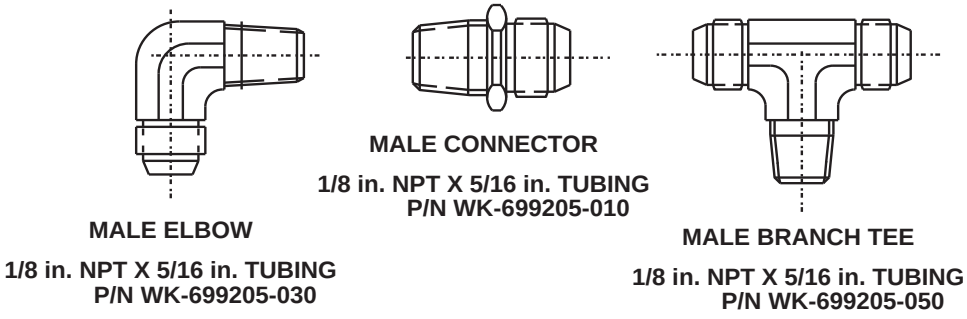


Figure 3-25. Tees, Elbows and Adapters

3-3.7 Discharge Accessories

3-3.7.1 Flexible Discharge Hose, P/N WK-283898-000, P/N WK-283899-000 and P/N WK-283900-000

HFC-227ea agent is routed from the storage cylinders to the discharge piping by a flexible rubber covered hose with wire braided reinforcements. These hoses come in 1½ inch, 2 inch or 2½ inch sizes. The hose is connected to the discharge outlet of the HFC-227ea cylinder valve and terminates at the system piping or discharge manifold (see Figure 3-26 and Table 3-13).

The 3" discharge hose is a stainless steel braid over convoluted hose, incorporating roll-groove fittings.

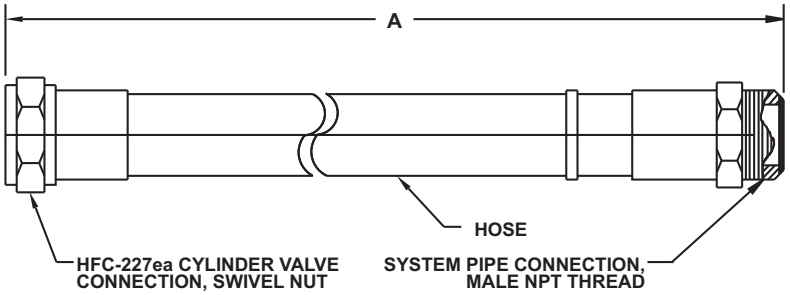


Figure 3-26. Flexible Discharge Hoses

Table 3-13. Dimensions, Flexible Discharge Hoses

Part Number	Hose Size	Dimension A		Min. Bend Radius	
		in	mm	in	mm
WK-283898-000	1½ in.	24	609.6	10.5	266.7
WK-283899-000	2 in.	31	787.4	13.5	342.9
WK-283900-000	2½ in.	48	1219.2	22.5	571.5
06-118225-001	3 in.	54	1372.0	24	610.0

3-3.7.2 Valve Outlet Adapters, P/N WK-283904-000, P/N WK-283905-000 and P/N WK-283906-000

A valve outlet adapter connects the cylinder valve outlet to the discharge piping when a flexible discharge hose is not used (see Figure 3-27 and Table 3-14).

Note: 3" valve cylinders are equipped with a roll-groove outlet. Use a standard groove-groove connection in lieu of a valve outlet adapter.

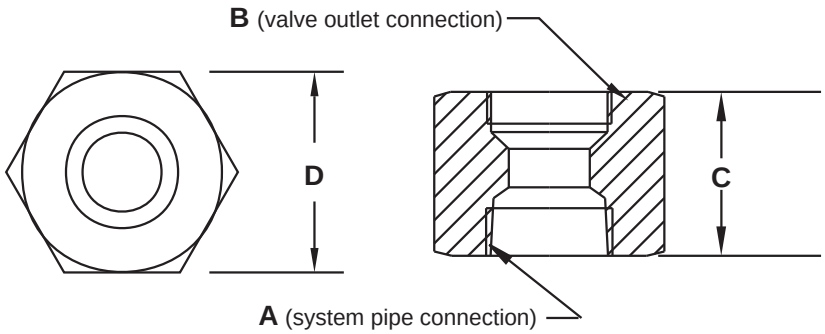


Figure 3-27. Valve Outlet Adapter

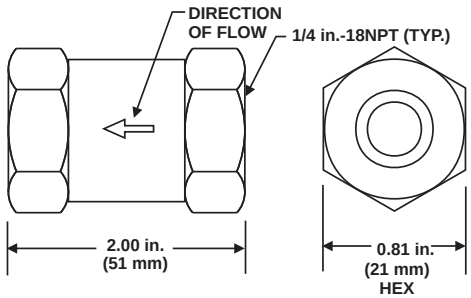
Table 3-14. Dimensions, Valve Outlet Adapter

Part Number	Size	A	B	C		D	
				in	mm	in	mm
WK-283904-000	1½"	1½" to 11½ NPT	1.874"	2.69	68.33	2.50 HEX	63.5
WK-283905-000	2"	2" to 11½ NPT	2.500" 12 UNJ	3.12	79.25	3.00 HEX	76.2
WK-283906-000	2½"	2½"to 8 NPT	3.00" 12 UNJ	3	76.2	3.75 HEX	95.2

3-3.7.3 Check Valve, 1/4-inch, P/N WK-264985-000

Check Valves are installed in sections of piping in main/reserve systems to prevent the actuation of the reserve system when the main system is discharged.

1/4-inch check valves are installed in the pilot manifold to ensure the proper number of cylinders are discharged (see Figure 3-28).



Note: Install the valve with the arrow pointing in the direction of flow.

Figure 3-28. Check Valve

3-3.7.4 Manifold EL-Checks, P/N WK-877690-000 and P/N 82-878743-000

Manifold El-Checks are installed at the discharge manifold in a multiple cylinder arrangement to allow removal of any HFC-227ea cylinder from the manifold while still retaining a closed system. The 2-inch El-check is used on the 10 through 350 lb size cylinders; the 2½-inch El-check is used with the 600 lb size cylinder (see Figure 3-29 and Table 3-15 and Table 3-16).

CAUTION

Manifold El-checks are not intended to be used as check valves in main/reserve systems. Improper use of equipment can cause system malfunction.

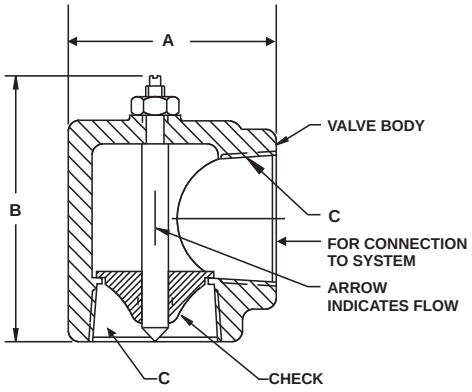


Figure 3-29. Manifold El-Checks

Table 3-15. Dimensions, Manifold El-Checks

Part Number	Size	A	B	C
WK-877690-000	2 in	3.93 in (99.8 mm)	4.88 in (123.95 mm)	2 in-11½ NPT
82-878743-000	2½ in	4.96 in (125 mm)	5.76 in (146.3 mm)	2½ in-8 NPT

Table 3-16. Check Valves, Equivalent Lengths

Part Number	Nomenclature	Pipe Type	Equivalent Length	
			ft	m
81-800327-000	Check Valve, ½ in NPT	40 T & 40 W	7.0	2.13
81-800266-000	Check Valve, ¾ in NPT	40 T & 40 W	17.0	5.18
WK-800443-000	Check Valve, 1 in NPT	40 T & 40 W	12.0	3.66
81-800444-000	Check Valve, 1¼ in NPT	40 T & 40 W	51.0	15.54
81-870152-000	Check Valve, 1½ in NPT	40 T & 40 W	57.0	17.37
81-870151-000	Check Valve, 2 in NPT	40 T & 40 W	165.0	50.29
81-870100-000	Check Valve, 3 in NPT	40 T & 40 W	795.0	242.31
06-118213-001	Swing Check, 2 in	40 T & 40 W	13.4	4.06
06-118058-001	Swing Check, 3 in	40 T & 40 W	13.0	3.96
WK-877690-000	2 in. El Check	40 T & 40 W	12.2	3.71
82-878743-000	2-1/2 in. El Check	40 T & 40 W	13.5	4.11
WK-877690-000 and WK-283899-000	2 in El check and Flex Hose	40 T & 40 W	16.0	4.88
82-878743-000 and WK-283900-000	2½ in El check and Flex Hose	40 T & 40 W	17.5	5.33

3-3.7.5 Pressure Operated Switches, P/N 81-486536-000 and P/N 81-981332-000

Pressure Switches operate from system pressure upon discharge to energize or de-energize electrically operated equipment. Pressure switches may be used to shut down machinery and ventilation or to annunciate system discharge (see Figure 3-30 and Figure 3-31).

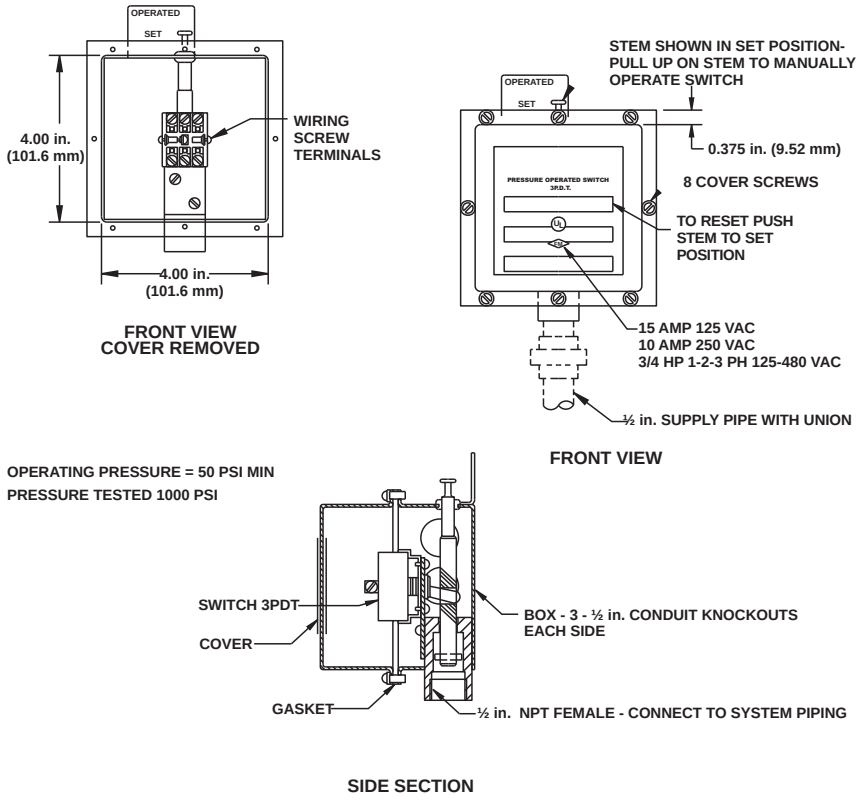


Figure 3-30. Pressure Operated Switch

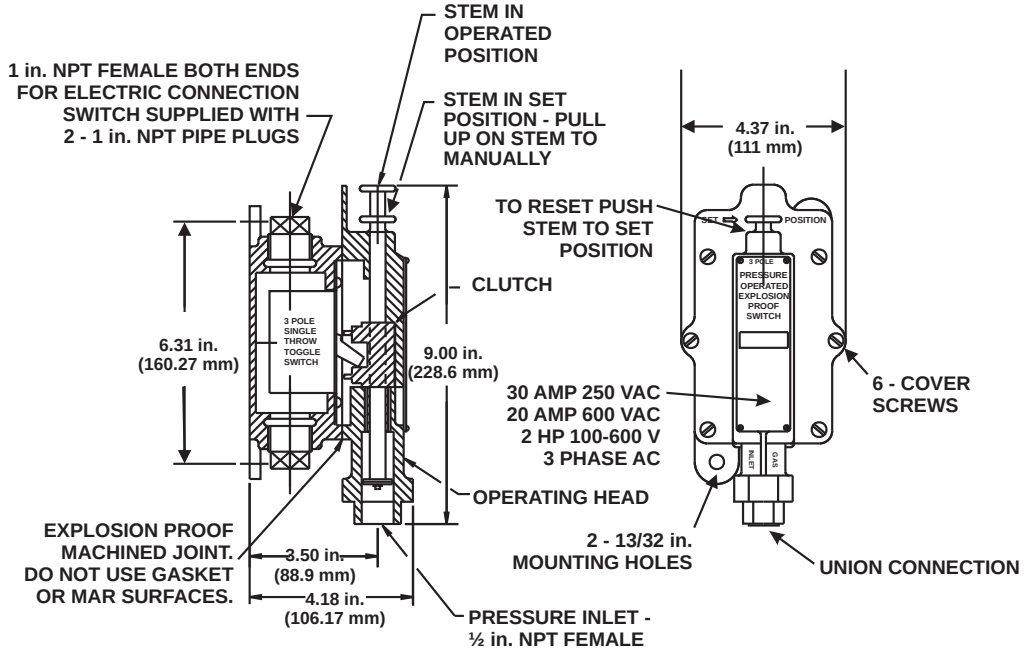


Figure 3-31. Pressure Operated Switch, Explosion Proof

3-3.7.6 Pressure Operated Trip, P/N 81-874290-000

Pressure Operated Trips are used to close off the hazard space upon system discharge. The trips, operated by system pressure, are designed to release self-closing units for doors, windows and dampers. The maximum load to be attached to a pressure trip is 100 lb (45.36 kg). This is based on a minimum pressure of 75 PSIG (5.17 bar gauge) at the pressure trip.

3-3.7.7 Discharge Indicator, P/N 81-875553-000

The Discharge Indicator may be installed in the discharge piping to visually indicate a system discharge. When in the SET position, the discharge indicator acts as a vent (see Figure 3-32).

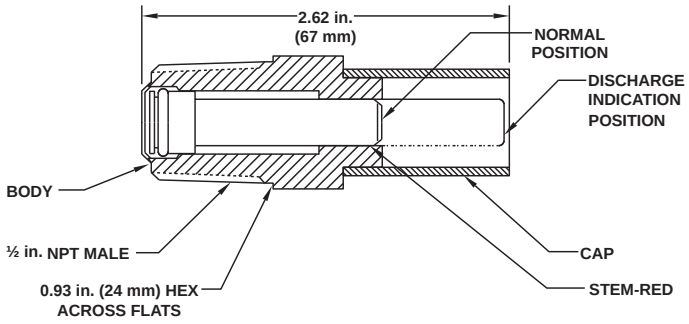


Figure 3-32. Discharge Indicator

3-3.7.8 Corner Pulleys, P/N 81-803808-000 and P/N WK-844648-000

Corner Pulleys change the direction of cable lines without binding to ensure smooth operation. P/N 81-803808-000 is used for all watertight applications; P/N WK-844648-000 is used for all industrial applications (see Figure 3-33 and Figure 3-34).

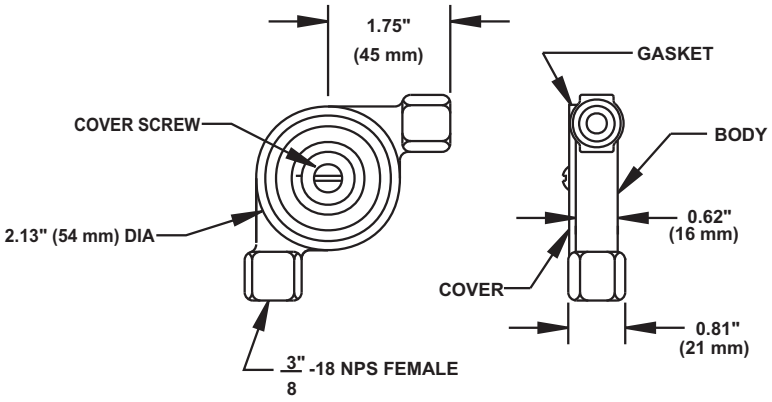


Figure 3-33. Corner Pulleys, Watertight Applications

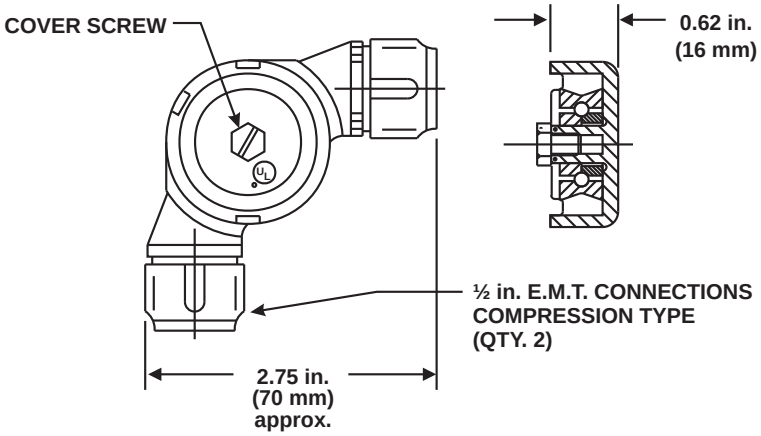


Figure 3-34. 1/2-Inch E.M.T. Corner Pulley, General Applications

3-3.7.9 Cylinder Supervisory Pressure Switch, P/N 06-118262-001

The Cylinder Supervisory Pressure Switch, P/N 06-118262-001, is intended to detect a fall in pressure in the HFC-227ea cylinder (see Figure 3-35). The cylinder supervisory pressure switch can be wired for either normally-open or normally-closed operation, depending on installation requirements. If the pressure inside the cylinder falls below 305 PSIG (21 bar gauge), the switch contacts will transfer and invoke a "trouble" signal at the control panel.

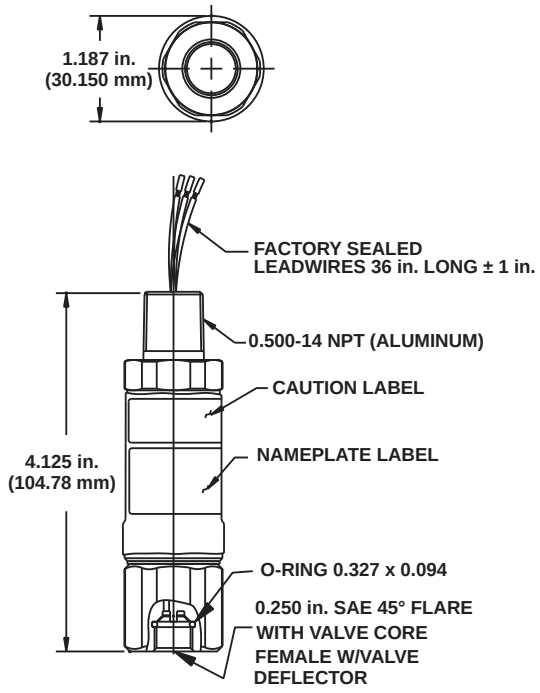


Figure 3-35. Cylinder Supervisory Pressure Switch

3-3.7.10 Supervisory Pressure Switch, P/N 06-118263-001

Note: The cylinder supervisory pressure switch can be installed on 600 lb through 900 lb capacity HFC-227ea cylinders with a 3" discharge valve manufactured prior to May 2013. Any valve produced after May 2013 must use P/N 06-118262-001 Cylinder Supervisory Pressure Switch.

The Supervisory Pressure Switch (P/N 06-118263-001) is intended to detect a fall in pressure in the HFC-227ea cylinder (see Figure 3-36). The cylinder supervisory pressure switch can be wired for either normally-open or normally-closed operation, depending on installation requirements. The cylinder supervisory pressure switch can be installed on 600 lb through 900 lb capacity HFC-227ea cylinders with a 3 in discharge valve. If the pressure inside the cylinder falls below 305 PSIG (21 bar gauge), the switch contacts will transfer and invoke a "trouble" signal at the control panel.

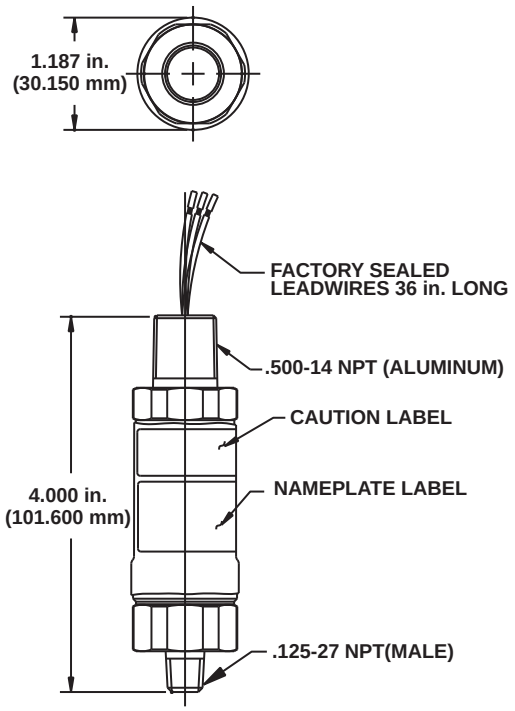


Figure 3-36. Supervisory Pressure Switch

3-3.7.11 Main-to-Reserve Transfer Switch, P/N 84-802398-000

The Main-to-Reserve Switch is installed on systems having main and reserve cylinders. Placing the switch in either the MAIN or RESERVE position provides uninterrupted fire protection during system maintenance or in the event of a system discharge (see Figure 3-37).

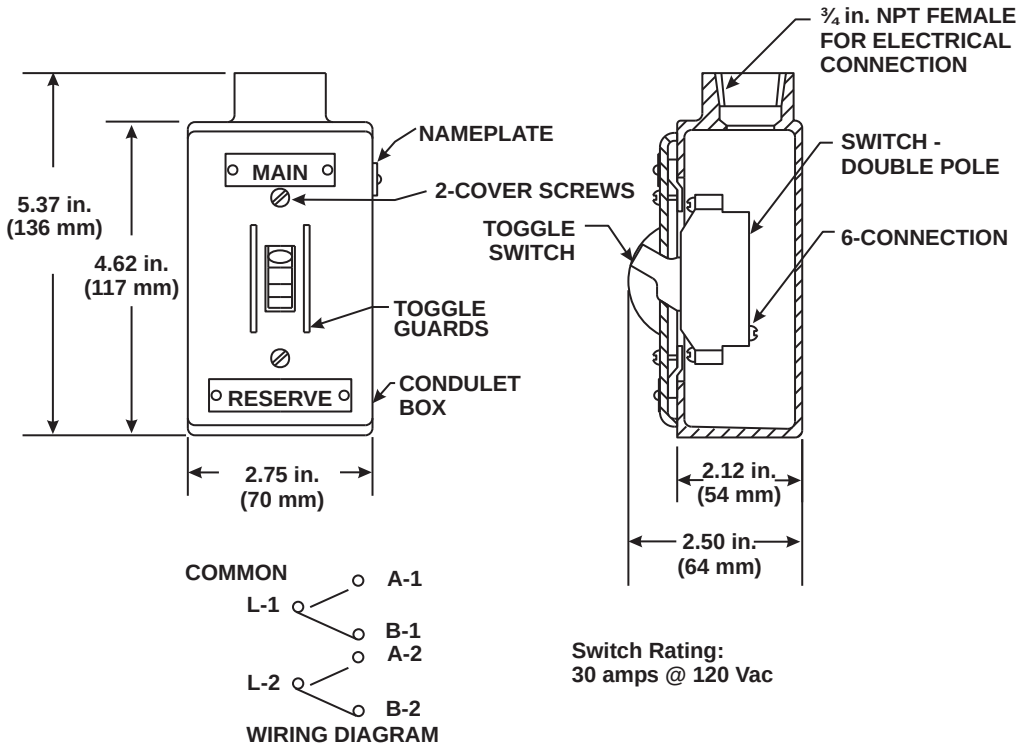


Figure 3-37. Main to Reserve Transfer Switch

3-3.7.12 Discharge Nozzles

The 180° and 360° discharge nozzles are designed to provide the proper flow rate and distribution of HFC-227ea to flood a hazard area. The 180° nozzle is engineered to provide a 180° discharge pattern for sidewall applications. The 360° nozzle offers a full 360° discharge pattern for installations where nozzles are located in the center of the hazard. See Figure 3-38 and Figure 3-39 and Table 3-17 and Table 3-18 for further information.

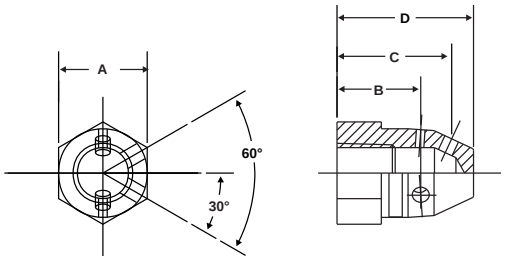


Figure 3-38. 180° Discharge Nozzle

Table 3-17. Dimensions–180° Discharge Nozzle

Pipe Size	A	B	C	D
½ in (12.70 mm)	1.25 in (31.75 mm)	1.25 in (31.75 mm)	1.687 in (42.85 mm)	2.0 in (50.80 mm)
¾ in (19.05 mm)	1.5 in (38.10 mm)	1.375 in (34.92 mm)	1.95 in (49.53 mm)	2.296 in (58.32 mm)
1 in (25.40 mm)	1.75 in (44.45 mm)	1.562 in (39.67 mm)	2.218 in (56.34 mm)	2.671 in(67.84 mm)
1¼ in (31.75 mm)	2.25 in (57.15 mm)	1.75 in (44.45 mm)	2.656 in (67.46 mm)	3.25 in (82.55 mm)
1½ in (38.10 mm)	2.5 in (63.5 mm)	1.95 in (49.53 mm)	2.95 in (74.93 mm)	3.625 in(92.07 mm)
2 in (50.80 mm)	3.0 in (76.2 mm)	1.968 in (49.98 mm)	2.875 in (73.02 mm)	3.656 in (92.86 mm)

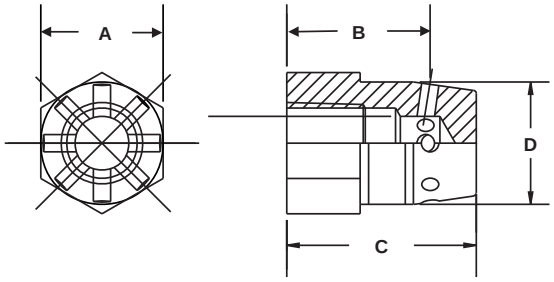


Figure 3-39. 360° Discharge Nozzle

Table 3-18. Dimensions–360° Discharge Nozzle

Pipe Size	A	B	C	D
½ in (12.70 mm)	1.250 in (31.75 mm)	1.468 in (37.30 mm)	1.937 in (49.20 mm)	1.250 in (31.75mm)
¾ in (19.05 mm)	1.500 in (38.10 mm)	1.578 in (40.08 mm)	2.125 in (53.97 mm)	1.500 in (38.10 mm)
1 in (25.40 mm)	1.750 in (44.45 mm)	1.718 in (43.64 mm)	2.375 in (60.32 mm)	1.750 in (44.45 mm)
1¼ in (31.75 mm)	2.250 in (57.15 mm)	1.950 in (49.53 mm)	2.751 in (69.88 mm)	2.250 in (57.15 mm)
1½ in (38.10 mm)	2.250 in (63.50 mm)	2.000 in (50.80 mm)	2.937 in (74.60 mm)	2.500 in (63.50 mm)
2 in (50.80 mm)	3.000 in (76.20 mm)	2.062 in (52.37 mm)	3.125 in (79.37 mm)	3.000 in (76.20 mm)

3-3.8 Other Accessories

3-3.8.1 Hydrostatic Test Adapters

The hydrostatic pressure test adapter is installed on the HFC-227ea cylinder in place of the cylinder valve when the cylinder is to be hydrostatically pressure tested. For cylinder test requirements, see Paragraph 5-5.3 of this manual.

3-3.8.2 HFC-227ea Cylinder Recharge Adapters

The HFC-227ea recharge adapter is installed in the cylinder discharge outlet during the cylinder charging procedure. This adapter is used for refilling the cylinder with HFC-227ea agent and super pressurizing the cylinder with nitrogen (see Figure 3-40 and Table 3-19).

Note: The 3 in valve and associated cylinders (new style 600 lb and 900 lb) do not require a recharge adaptor. Recharge of these cylinders is achieved via the 1/2 in NPT connection on the grooved fitting plate on the outlet port.

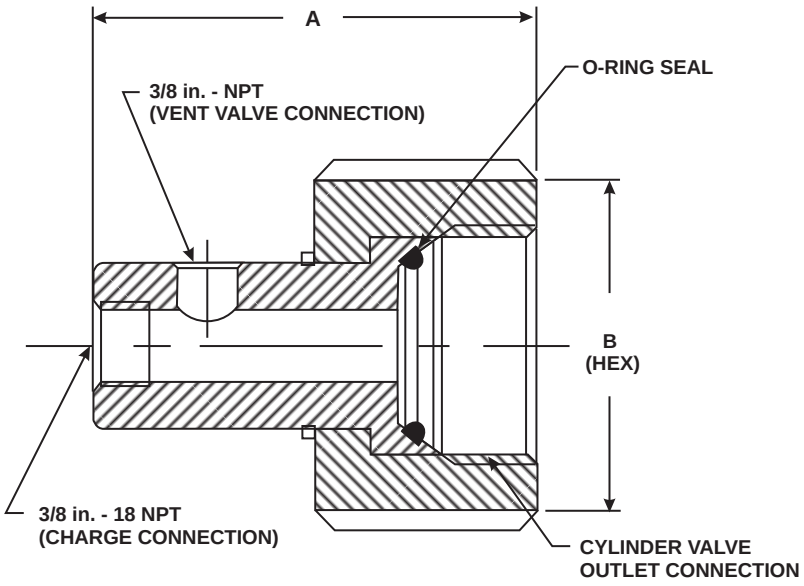


Figure 3-40. Cylinder Recharge Adapters

Table 3-19. Dimensions–Cylinder Recharge Adapters

Part Number	Cylinder Size	A		B	
	lb	in.	mm	in.	mm
82-878757-000	10-125	3.22	81.79	2.50	63.50
82-878758-000	200, 350	4.06	103.12	3.25	82.55
82-878759-000	600	4.00	101.60	3.62	91.95

3-3.8.3 Cylinder Seating Adapter (P/N WK-933537-000)

The HFC-227ea Seating Adapter is installed on the cylinder actuation port during the cylinder charging procedure. This adapter is used for seating the valve assembly after charging and super pressurization is complete. This seating adapter can be used for the Agent or Nitrogen Pilot cylinders.

3-3.9 Detectors and Control Panels

3-3.9.1 Detectors

Detectors (ionization, photoelectric, thermal, ultraviolet, ultraviolet/infrared, etc.) interfacing with Kidde Systems must be UL Listed and/or FM Approved for the intended application.

3-3.9.2 Control Panel

The control panel must be UL Listed and/or FM Approved for releasing device service and compatible with Kidde equipment.

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CHAPTER 4
DESIGN AND INSTALLATION

4-1 INTRODUCTION

This chapter is intended for system designers and installers. It outlines the steps needed to design the system including the limitations imposed on the design by the system hardware. The second part of this chapter explains equipment installation.

4-2 DESIGN PROCEDURE

4-2.1 General

The system design is based on the requirements of National Fire Protection Association (NFPA) Standard 2001, 2012 Edition, and the Authority Having Jurisdiction (AHJ).

4-2.2 Application

The following steps must be taken to design an HFC-227ea system:

- Determine the amount of HFC-227ea required based on the design concentration required for the hazard and other factors related to the hazard. Refer to Table 4-1 for Class A and Class C hazards. Refer to Table 4-3 for Class B hazards.
- Determine the required components for the system.
- Determine the nozzle and cylinder locations.
- Determine piping layout and pipe type.

4-2.2.1 Determine Minimum Use Concentration Required

A Class A surface fire hazard is one that involves ordinary combustible materials.

A Class B fire hazard is one that involves flammable and combustible liquids and flammable gasses.

A Class C fire hazard is one that involves energized electrical equipment.

Table 4-1 shows the minimum design concentrations of HFC-227ea for Class A surface fires and Class C fires. Refer to Table 4-3 for minimum design concentrations for hazards the involve Class B fuels.

The minimum design concentration of HFC-227ea for Class A surface fires is 6.7 vol% in accordance with the requirements of NFPA 2001, 2012 Edition Section 5.4.2.4. The minimum design concentration for Class C fires is 7.0 vol% in accordance with the requirements of NFPA 2001, 2012 Edition Section 5.4.2.5. The classification of a hazard where electric power to energized equipment has been turned off prior to discharge of the extinguishing system is Class A.

Table 4-1. HFC-227ea Fire Suppression Use Concentrations

Occupancy Fire Risk	HFC-227ea Minimum Design Concentration, vol.%
Class A surface fires	6.7
Class C fires (fires involving electrically energized equipment)	7.0

Note: Where NFPA 2001, 2008 or earlier editions are enforced, it is acceptable to use the minimum design concentrations based on the requirements of the accepted edition. The governing authority or authority having jurisdiction (AHJ) must specifically approve the design approach selected.

4-2.2.2 Calculate the Volume of Protected Area

Calculate the volume of the protected area based on the length, width, and height, or geometry of the hazard. This volume is used when calculating the quantity of agent required.

4-2.2.2.1 Adjusting for Altitude or Pressure

The procedure for determination of the agent quantity assumes that the protected enclosure is at sea level or has an internal pressure of 14.7 psia (101.4 kPa). The design agent quantity must be adjusted where the protected enclosure is at an altitude or pressure that differs by more than 11% from sea level values. Table 4-2 lists "Atmospheric Corrections Factors" as a function of altitude or pressure. Calculate the adjusted (altitude-corrected) agent quantity as follows:

Adjusted quantity = (Sea-level quantity) x (Atmospheric Correction Factor)

Note: Use the value of Atmospheric Correction Factor corresponding to the highest possible enclosure pressure where the pressure can be varied, by design, from the prevailing barometric pressure at the altitude of the installation. This procedure assures that the agent concentration will not be less than the design concentration at the highest achievable enclosure pressure.

Table 4-2. Atmospheric Correction Factors

Altitude Above Sea Level		Enclosure Pressure		Atmospheric Correction Factor
ft.	m	psia	kPa	
-3000	-920	16.25	112.1	1.11
-2000	-610	15.71	108.3	1.07
-1000	-300	15.23	105	1.04
0	0	14.70	101.4	1.00
1000	300	14.18	97.8	0.96
2000	610	13.64	94.1	0.93
3000	920	13.12	90.5	0.89
4000	1,210	12.58	86.8	0.86
5000	1,520	12.04	83	0.82
6000	1,830	11.53	79.5	0.78
7000	2,130	11.03	76.1	0.75
8000	2,440	10.64	73.4	0.72
9000	2,740	10.22	70.5	0.69
10000	3,050	9.77	67.4	0.66

Table 4-3. Class B Suppression Design Concentrations

Fuel	Cup Burner (% v/v)	Design Concentration, 30% Safety Factor (%v/v)	Fuel	Cup Burner (% v/v)	Design Concentration, 30% Safety Factor (%v/v)
Acetone	6.9	9	1-Hexene	5.8	7.6
Acetonitrile	4.3	7	Hydraulic Fluid*	6.5	8.5
t-Amyl Alcohol	7.3	9.5	Hydraulic Oil*	5.9	7.7
AV Gas	6.5	8.5	Hydrogen	13.2	17.2
Benzene	5.5	7.2	Isobutyl Alcohol	7.6	9.9
n-Butane	6.6	8.6	Isopropanol	7.5	9.8
n-Butanol	7.6	9.9	JP4	6.9	9
2-Butoxyethanol*	7.4	9.6	JP5	6.9	9
2-Butoxyethyl Acetate*	6.9	9	Kerosene	7.4	9.6
n-Butyl Acetate	7	9.1	Methane	5.5	7.2
Carbon Disulfide	11.8	15.4	Methanol	10.4	13.5
Chloroethane	6.3	8.2	2-Methoxyethanol	9.4	12.2
Commercial Grade Heptane	6.7	8.7	Methyl Ethyl Ketone	7.4	9.6
Crude Oil*	6.5	8.5	Methyl Isobutyl Ketone	7	9.1
Cyclohexane	7.2	9.4	Mineral Spirits	6.6	8.6
Cyclohexylamine	8.3	8.7	Morpholine	7.9	10.3
Cyclopentanone	7.4	9.6	Nitromethane	9.9	12.9
1,2-Dichloroethane	5.8	7.6	n-Pentane	6.8	8.8
Diesel	6.7	8.7	Propane	6.7	8.7
N,N-Diethylethanolamine*	7.8	10.1	1-Propanol	7.7	10
Diethyl Ether	7.5	9.8	Propylene	6.2	8.1
Ethane	6.7	8.7	Propylene Glycol	8.6	11.2
Ethanol	8.3	10.8	Pyrrolidine	7.3	9.5
Ethyl Acetate	6.8	8.9	Tetrahydrofuran	7.4	9.6
Ethyl Benzene*	6.3	8.2	Tetrahydrothiophene	6.6	8.6
Ethylene	8.4	10.9	Toluene	5.6	7.3
Ethylene Glycol	7.6	9.9	Tolylene-2, 4-Diisocyanate	4	7
Gasoline-no lead	6.9	9	Transformer Oil	7.3	9.5
n-Heptane	6.7	8.7	Turbine Oil**	7.2	9.4
n-Hexane	6.9	9	Xylene	6	7.8

* General guideline only–MSDS required to determine proper concentration

** Texaco R+O 32

Note: Cup Burner source data, Great Lakes Chemical Corporation.

Table 4-4. HFC-227ea Total Flooding Concentration Factors (*W/V*), English

Temp[a] t (°F)[c]	Specific Vapor Volumes (ft^3/lb)[d]	Weight Requirements of Hazard Volume, W/V (lb/ft^3)[b] Design Concentrations (% by Volume)[e]											
		6	6.25	6.70	7	8	9	10	11	12	13	14	15
30	2.0210	0.0316	0.0330	0.0355	0.0372	0.0430	0.0489	0.0550	0.0612	0.0675	0.0739	0.0805	0.0873
40	2.0678	0.0309	0.0322	0.0347	0.0364	0.0421	0.0478	0.0537	0.0598	0.0659	0.0723	0.0787	0.0853
50	2.1146	0.0302	0.0315	0.0339	0.0356	0.0411	0.0468	0.0525	0.0584	0.0645	0.0707	0.0770	0.0835
60	2.1612	0.0295	0.0308	0.0332	0.0348	0.0402	0.0458	0.0514	0.0572	0.0631	0.0691	0.0753	0.0817
70	2.2075	0.0289	0.0302	0.0325	0.0341	0.0394	0.0448	0.0503	0.0560	0.0618	0.0677	0.0737	0.0799
80	2.2538	0.0283	0.0296	0.0319	0.0334	0.0386	0.0439	0.0493	0.0548	0.0605	0.0663	0.0722	0.0783
90	2.2994	0.0278	0.0290	0.0312	0.0327	0.0378	0.0430	0.0483	0.0538	0.0593	0.0650	0.0708	0.0767
100	2.3452	0.0272	0.0284	0.0306	0.0321	0.0371	0.0422	0.0474	0.0527	0.0581	0.0637	0.0694	0.0752
110	2.3912	0.0267	0.0279	0.0300	0.0315	0.0364	0.0414	0.0465	0.0517	0.0570	0.0625	0.0681	0.0738
120	2.4366	0.0262	0.0274	0.0295	0.0309	0.0357	0.0406	0.0456	0.0507	0.0560	0.0613	0.0668	0.0724
130	2.4820	0.0257	0.0269	0.0289	0.0303	0.0350	0.0398	0.0448	0.0498	0.0549	0.0602	0.0656	0.0711
140	2.5272	0.0253	0.0264	0.0284	0.0298	0.0344	0.0391	0.0440	0.0489	0.0540	0.0591	0.0644	0.0698
150	2.5727	0.0248	0.0259	0.0279	0.0293	0.0338	0.0384	0.0432	0.0480	0.0530	0.0581	0.0633	0.0686
160	2.6171	0.0244	0.0255	0.0274	0.0288	0.0332	0.0378	0.0425	0.0472	0.0521	0.0571	0.0622	0.0674
170	2.6624	0.0240	0.0250	0.0269	0.0283	0.0327	0.0371	0.0417	0.0464	0.0512	0.0561	0.0611	0.0663
180	2.7071	0.0236	0.0246	0.0265	0.0278	0.0321	0.0365	0.0410	0.0457	0.0504	0.0552	0.0601	0.0652
190	2.7518	0.0232	0.0242	0.0260	0.0274	0.0316	0.0359	0.0404	0.0449	0.0496	0.0543	0.0592	0.0641
200	2.7954	0.0228	0.0238	0.0256	0.0269	0.0311	0.0354	0.0397	0.0442	0.0488	0.0535	0.0582	0.0631

a The minimum design temperature in the flooded space.

b W/V [agent weight requirements (lb/ft^3)] = Pounds of agent required per cubic foot of protected volume to produce indicated concentration at the temperature specified.

$$W = (V/s) \times [c/(100 - c)]$$

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

d s [specific volume (ft^3/lb)] = Specific volume of superheated HFC-227ea vapor can be approximated by the formula:

$$s = 1.885 + 0.0046t$$ where t = temperature (°F)

e C [concentration (%)] = Volumetric concentration of HFC-227ea in air at the temperature indicated.

Table 4-5. HFC-227ea Total Flooding Concentration Factors (*W/V*), Metric

Temp[a] t (°C)[c]	Specific Vapor Volume s (m^3/kg)[d]	Weight Requirements of Hazard Volume, W/V (kg/m^3)[b] Design Concentrations (% by Volume)[e]										
		6.25	6.70	7	8	9	10	11	12	13	14	15
0	0.1268	0.5258	0.5659	0.5936	0.6858	0.7800	0.8763	0.9748	1.0755	1.1785	1.2839	1.3918
5	0.1294	0.5152	0.5550	0.5816	0.6719	0.7642	0.8586	0.9550	1.0537	1.1546	1.2579	1.3636
10	0.1320	0.5051	0.5444	0.5700	0.6585	0.7490	0.8414	0.9360	1.0327	1.1316	1.2328	1.3364
15	0.1347	0.4949	0.5343	0.5589	0.6457	0.7344	0.8251	0.9178	1.0126	1.1096	1.2089	1.3105
20	0.1373	0.4856	0.5246	0.5483	0.6335	0.7205	0.8094	0.9004	0.9934	1.0886	1.1859	1.2856
25	0.1399	0.4765	0.5151	0.5382	0.6217	0.7071	0.7944	0.8837	0.9750	1.0684	1.1640	1.2618
30	0.1425	0.4678	0.5061	0.5284	0.6104	0.6943	0.7800	0.8676	0.9573	1.0490	1.1428	1.2388
35	0.1450	0.4598	0.4973	0.5190	0.5996	0.6819	0.7661	0.8522	0.9402	1.0303	1.1224	1.2168
40	0.1476	0.4517	0.4888	0.5099	0.5891	0.6701	0.7528	0.8374	0.9230	1.0124	1.1029	1.1956
45	0.1502	0.4439	0.4807	0.5012	0.5790	0.6586	0.7399	0.8230	0.9000	0.9950	1.0840	1.1751
50	0.1527	0.4366	0.4728	0.4929	0.5694	0.6476	0.7276	0.8093	0.8929	0.9784	1.0660	1.1555
55	0.1553	0.4293	0.4651	0.4847	0.5600	0.6369	0.7156	0.7960	0.8782	0.9623	1.0484	1.1365
60	0.1578	0.4225	0.4577	0.4770	0.5510	0.6267	0.7041	0.7821	0.8410	0.9469	1.0316	1.1183
65	0.1604	0.4156	0.4505	0.4694	0.5412	0.6167	0.6929	0.7707	0.8504	0.9318	1.0152	1.1005
70	0.1629	0.4092	0.4436	0.4621	0.5338	0.6072	0.6821	0.7588	0.8371	0.9173	0.9994	1.0834
75	0.1654	0.4031	0.4368	0.4550	0.5257	0.5979	0.6717	0.7471	0.8243	0.9033	0.9841	1.0668
80	0.1679	0.3971	0.4303	0.4482	0.5178	0.5890	0.6617	0.7360	0.8120	0.8898	0.9694	1.0509
85	0.1704	0.3912	0.4239	0.4416	0.5102	0.5803	0.6519	0.7251	0.800	0.8767	0.9551	1.0354
90	0.1730	0.3854	0.4178	0.4351	0.5027	0.5717	0.6423	0.7145	0.7883	0.8638	0.9411	1.0202

a The minimum design temperature in the flooded space.

b W/V [agent weight requirements (kg/m^3)] = Kilograms of agent required per cubic meter of protected volume to produce indicated concentration at the temperature specified.

$$W = (V/s) \times [c/(100 - c)]$$

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

d s [specific volume (m^3/kg)] = Specific volume of superheated HFC-227ea vapor can be approximated by the formula:

$$s = 0.1269 + 0.0005t \quad \text{where } t = \text{temperature (°C)}$$

e C [concentration (%)] = Volumetric concentration of HFC-227ea in air at the temperature indicated.

4-2.2.3 Determine What Components are Required

- Cylinder size, quantity and fill requirements. Refer to Table 4-4 and Table 4-5.
- Cylinder framing, mounting brackets, etc.
- Detection and control equipment required.
- Other system requirements, such as reserve supply, pressure switches, etc.

4-2.2.4 Locate Nozzles

Locate nozzles based on the following:

- Ceiling height (16 ft [4.87 m] maximum, 1 ft [0.30 m] minimum).
- Nozzle area coverage.
- Special hazard area layout considerations.

4-2.2.5 Locate Cylinders

Locate cylinders based on the following:

- Number of cylinders required.
- Storage temperature/environmental considerations, such as weather, area classification and corrosive environment.
- Accessibility.
- Floor loading.

4-2.2.6 Locate Piping

Locate piping based on the following:

- Nozzle location.
- Structural members for bracing the pipe.

4-2.2.7 Pipe Size and Layout

Determine pipe size and layout for the following factors:

- Draw piping isometric.
- Dimensions of all pipe sections.
- Locate all fittings.
- Note all elevation changes.

The preceding information will be entered into the computer program.

4-2.2.8 Using the HFC-227ea Concentration Flooding Factors

To find the total quantity of HFC-227ea required at a specific temperature and concentration, multiply the hazard area volume by the multiplier from Table 4-4 and Table 4-5 that correspond to the design temperature and concentration desired.

Note: NFPA 2001, 2012 Edition and the U.S. Environmental Protection Agency Significant New Alternatives Policy (SNAP) provide specific guidelines for using HFC-227ea. The minimum use concentration for total flooding applications is 6.7% w/v, unless a higher concentration is required for the specific hazard being protected.
The agent required must be based on the lowest expected ambient temperature in the protected space. Care must be taken that the calculated concentration for normally occupied spaces at the highest expected ambient temperature in the space does not exceed the value of 10.5% per NFPA 2001.

Per NFPA 2001, HFC-227ea systems with use concentrations below the NOAEL (9% w/v) are permitted for use in occupied areas. HFC-227ea can be designed between 9% and 10.5% for a five minute exposure using the PBPK model.

4-2.2.9 Manifolds

When multiple cylinders are needed, they may be connected to the same set of distribution piping through a manifold. This is necessary in three circumstances.

- A connected reserve supply of HFC-227ea is required.
- The quantity of agent required is greater than the maximum fill of a single cylinder.
- A single cylinder does not contain enough nitrogen to discharge the required agent through the pipe network.

In accordance with standards set by NFPA 2001:

- All cylinders are of the same size and quantity.
- Each cylinder must have an El-check or swing-check to prevent back flow of agent through the discharge hose, in case the system is discharged while a cylinder is removed for maintenance.

Standard check valves MUST be installed and modeled in the latest version of the flow calculation software program whenever any of the following conditions exist.

- Multiple cylinders are required
- A connected reserve supply is required
- Multiple cylinder actuation from a master HFC-227ea cylinder

4-2.3 Design Criteria

The complexity of two-phase flow formulas does not allow for any simple method of manual HFC-227ea calculation. For this reason, the flow calculations and design criteria described in this manual have been programmed into a flow calculation software program.

CAUTION

The latest version of the flow calculation software program is the only calculation method to be used with Kidde ECS System equipment. No other calculation method is accepted by Kidde.

The system designer must become thoroughly familiar with the latest version of the Flow Calculation Software User's Guide 06-236272-001 to determine the proper procedures for applying the input parameters to the Kidde computer program. There are a number of limitations to these input parameters which must be observed if accurate results are to be obtained. Most of these limitations are in the program. However, there are certain restrictions that must be addressed by the system designer before applying the input data. The following paragraphs describe the essential design parameters and design limitations which must be considered.

4-2.3.1 First Branch Flow Split

To assure accuracy of the flow calculations, there are various agent flow limits. The maximum% agent in pipe for all systems is 80%. There is a limit on the allowable percent of agent prior to the first tee. When these conditions are not met, the computer displays a warning. It is then up to the system designer to correct the piping volume to the first branch split. For example, when reading Figure 4-1, in order to achieve 60% agent in pipe, a minimum of 8.3% agent is required prior to the first tee. When this condition is not met, the computer displays a warning. It is then up to the system designer to correct the piping volume to the first branch split to meet this design requirement (see Figure 4-2).

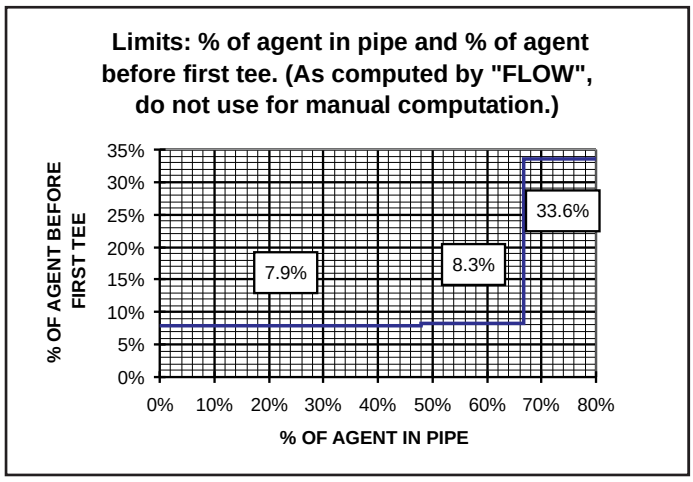
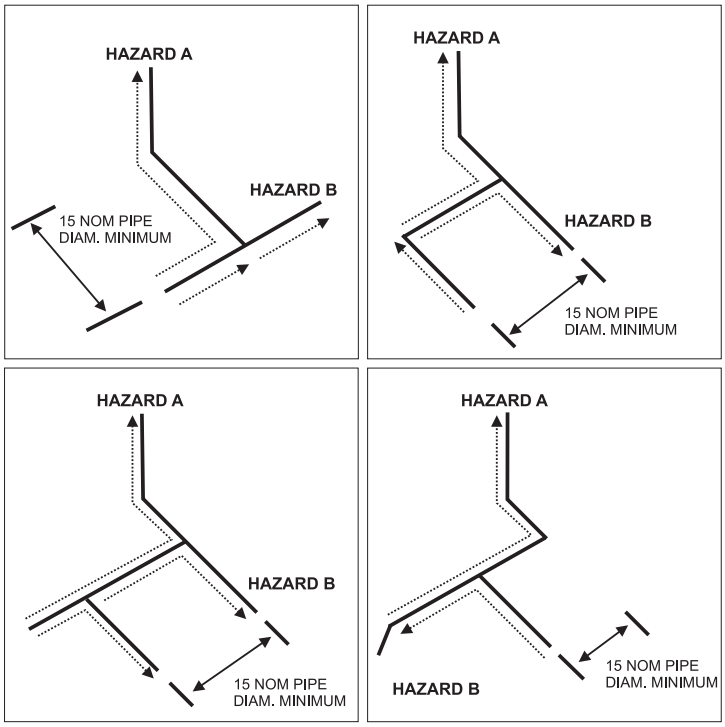


Figure 4-1. Percent Agent Before First Tee as a Function of Percent Agent in Pipe



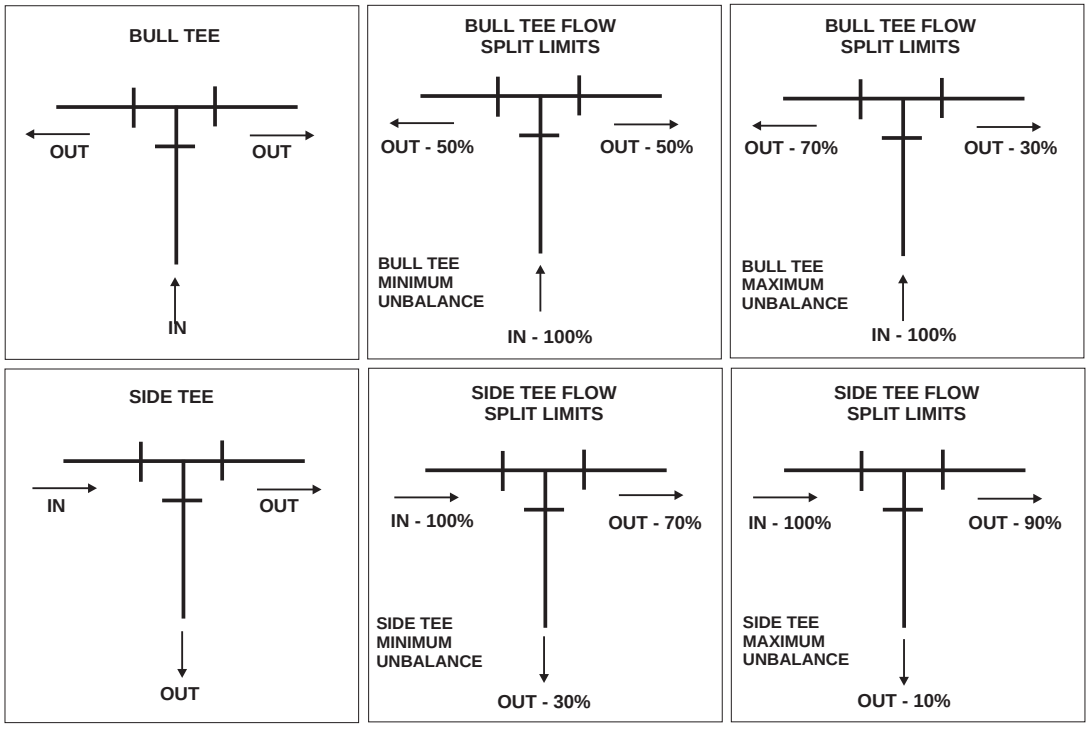


Figure 4-2. Acceptable Tee Flow Splits for HFC-227ea

4-2.3.2 Tee Flow Splits

Flow splits at tee junctions are sensitive to gravity. Even though turbulent flow exists, there is a tendency for the vapor phase to migrate to the upper portion of the pipe leaving a more dense medium at the bottom of the pipe. For this reason, the limitations in Figure 4-2 must be observed.

4-2.3.2.1 Requirements for Tee Flow Splits

1. Bull head tees must have both outlets in the horizontal plane. The inlet to a bull head tee may approach in a horizontal, vertically up or vertically down direction.
2. Side tees must have the inlet and both outlets all in the horizontal plane.
3. Elbows either before a tee, or after, which split to a separate hazard must be located a minimum distance of 15 pipe diameters (nominal) before the tee.
4. Tee splits going to separate hazards from a common supply line must be spaced a minimum of 15 pipe diameters (nominal) apart.
5. Pipe reducers must be the concentric reducer type.
6. Minimum flow out of a side tee branch is 10% of total flow at the tee.
7. For flow splits less than 30%, the split shall be done through a side tee with the smaller flow going through the side tee member. The minimum flow through the side tee member is 10%. The maximum flow through the tee is 90%.
8. For flow splits equal to or greater than 30%, the split shall be done through a bull head tee. The maximum flow split through a bull head tee is 70%.

Table 4-6. 15 Pipe Diameters

Pipe Size	15 Pipe Diameters		
	feet	feet and inches	meters
1/2 in	0.63	7½ in	0.192
3/4 in	0.94	11¼ in	0.287
1 in	1.25	1 ft 3 in	0.381
1¼ in	1.56	1 ft 6 ¾ in	0.475
1½ in	1.88	1 ft10½ in	0.573
2 in	2.50	2 ft 6 in	0.762
2½ in	3.13	3 ft 1½ in	0.954
3 in	3.75	3 ft 9 in	1.143
4 in	5.00	5 ft	1.524

4-2.3.3 Duration of Discharge

Per NFPA 2001, 2012 Edition, the liquid agent discharge shall be completed in a nominal 10 seconds or less. Discharge times shorter than 10 seconds are desirable to minimize production of breakdown products. Discharge times as short as six seconds should be considered when circumstances permit.

4-2.3.4 Nozzle Selection and Placement

There are two basic Kidde ECS System nozzle configurations:

1. The 360° nozzle, which provides a full 360° discharge pattern designed for placement in the center of the hazard.
2. The 180° nozzle, which provides a 180° discharge pattern designed for placement adjacent to a side wall of the hazard.

Use the latest version of the flow calculation software program as a tool to determine the selection of the required orifice area and nozzle.

Maximum orifice area to pipe area ratio:

- The ratio between the nozzle orifice area for a 360 degree nozzle at the given node and the pipe cross sectional area for the pipe segment preceding that nozzle is 0.72, or 72%,
- The ratio between the nozzle orifice area for a 180 degree nozzle at the given node and the pipe cross sectional area for the pipe segment preceding that nozzle is 0.66, or 66%.

Minimum orifice area to pipe area ratio:

- The ratio between the nozzle orifice area for a 360 degree nozzle at the given node and the pipe cross sectional area for the pipe segment preceding that nozzle is 0.27, or 27%.
- The ratio between the nozzle orifice area for a 180 degree nozzle at the given node and the pipe cross sectional area for the pipe segment preceding that nozzle is 0.27, or 27%.

Nozzles are available in nominal pipe sizes of 1/2 in, 3/4 in, 1 in, 1¼ in, 1½ in and 2 in.

4-2.3.5 Nozzle Placement

There are certain coverage and height limitations which must be observed with each nozzle configuration to ensure proper agent distribution.

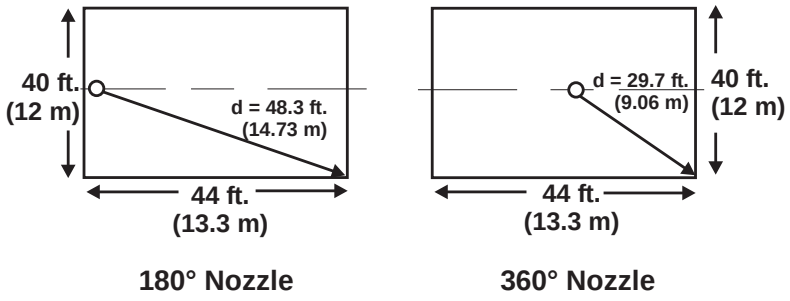


Figure 4-3. Nozzle Placement and Coverage

- **Orientation**-Nozzles must be mounted perpendicular to the ceiling or subfloor surface and oriented with the orifices radiating symmetrically outward from the pipe network.
- **Ceiling Clearance**-Nozzles must be installed so that the orifices are located 6 +/- 2 inches (0.15 +/- 0.05 m) below the ceiling.
- **Maximum Height**-The maximum protected height for a single row of nozzles is 16 feet (4.87 m). The 16 ft (4.87 m) coverage height includes the 6 +/- 2 inches (0.15 +/- 0.05 m) below the ceiling.
  Nozzles may be tiered to accommodate enclosures with ceiling heights greater than 16 ft (4.87 m).
- **Minimum Ceiling Height**-The minimum ceiling height for UL Listed/FM Approved systems is 1 ft (0.3 m).
  Systems designed for enclosures 6 to 12 inches (0.15 m to 0.3 m) are acceptable, but not UL Listed or FM Approved.

- **180° Nozzles**-180° nozzles must be located 12 +/- 2 inches (0.3 +/- 0.05 m) from a wall, with the orifices directed away from the wall. The nozzle shall be located as close to the center of the wall as possible, but at least 1/3 of the way along the wall.

  180° nozzles have a maximum coverage area defined as any rectangle that can be inscribed in a semicircle of distance 48.3 ft (14.73 m, diagonal of a rectangle 20' x 44'). Refer to Figure 4-3 for further information.

  180° nozzles may be used in a back-to-back configuration. The nozzles should be place 1 to 2 ft (0.3 m to 0.6 m) apart.
- **360° Nozzles**-360° nozzles must be located as close to the center of the enclosure as possible. 360° nozzles have a maximum coverage area defined as any rectangle that can be inscribed in a circle of radius 29.7 ft (9.06 m, diagonal of a rectangle 20' x 22'). Refer to Figure 4-3 for further information.
- **Multiple Nozzles**-Nozzles whose discharge patterns will intersect must be placed at least 10 ft (3.05 m) apart to assure adequate agent distribution.
- **Walls and Obstructions**-HFC-227ea discharged from the nozzle requires a certain length from the nozzle to atomize into a gas. If the HFC-227ea comes into contact with a surface before the agent is fully atomized, frosting can occur. As a result, the concentration throughout the enclosure will be less than required to appropriately protect the space. Therefore, nozzles must be located with at least four to six feet of clearance from walls and/or significant obstructions (ex. high rise racking and columns). If this requirement cannot be met, additional agent may be discharged to compensate for this agent "loss".
- **Reduced Coverage Area**-Consideration should be given to reducing nozzle spacing when obstructions that would impede the uniform distribution of HFC-227ea throughout the area are present. Nozzle coverage area must be reduced to 25 ft x 25 ft for enclosure heights six to twelve inches (7.5 m x 7.5 m for heights 0.15 to 0.3 meters).

4-2.3.5.1 Limits on Nozzle Conditions

- **Minimum average nozzle pressure**-The nozzle pressure must be a minimum of 74 PSIG for the nozzle to effectively disperse the agent and mix the agent into the air of the enclosure being protected.
- **Maximum arrival time imbalance**-The difference between liquid arrival times at two of the nozzles must not exceed the 0.8 seconds allowed maximum.
- **Maximum run-out time imbalance**-The difference between nozzle liquid runout times at two of the nozzles must not exceed the 2.0 second allowed maximum.

4-2.3.5.2 Maximum Elevation Differences in Pipe Runs:

- If nozzles are only located above the container outlet, then the maximum elevation difference between the container outlet and the furthest horizontal pipe run or discharge nozzle (whichever is furthest) shall not exceed 30 ft (9 m).
- If nozzles are only located below the container outlet, then the maximum elevation difference between the container outlet and the furthest horizontal pipe run or discharge nozzle (whichever is furthest) shall not exceed 30 ft (9 m).
- If nozzles are located both above and below the container outlet, then the maximum elevation difference between the furthest horizontal pipe runs or discharge nozzles (whichever is furthest) shall not exceed 30 ft (9 m).

Note: If you have a system design that violates these limits, the factory must be consulted to determine what course of action should be taken. See Figure 4-4 for further clarification.

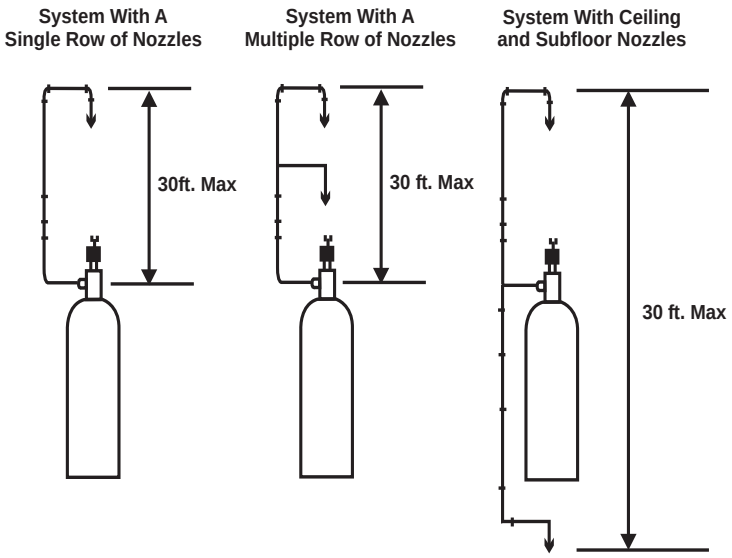


Figure 4-4. Nozzle Limitations

Note: Any system designed for a space less than 12 in (0.3 m) in height is not a UL Listed or FM Approved design.

4-2.3.6 Pipe Sizing

The following table may be used as an estimating guide for sizing distribution piping.

Table 4-7. Kidde Pipe Size Estimating Table

Nominal Pipe Size (inches)	Flow Rate (lb/sec)		Flow Rate (kg/s)	
	Minimum Design	Max. Nom. Design	Minimum Design	Max. Nom. Design
1/2	1	3.0	0.5	1.4
3/4	2	5.5	0.9	2.5
1	3.5	8.5	1.6	3.9
1¼	6	12.5	2.7	5.7
1½	9	20.0	4.1	9.0
2	14	30.0	6.4	13.6
2½	20	55.0	9.0	25.0
3	30	90.0	13.6	40.9
4	55	125.0	25	56.8
5	90	200.0	40.9	90.9
6	120	300.0	54.5	136.4

Note: This table is intended for use as a guide only. The latest version of the flow calculation software program must be used for the final design.

4-2.4 Other Conditions

4-2.4.1 Operating/Storage Temperature Range

Kidde ECS System equipment listed herein is designed to operate within a temperature range of 32°F to 130°F (0°C to 54°C). The latest version of the flow calculation software program assumes a temperature of 70°F (21°C). Therefore, the container operating and storage temperature must be in the range of 60°F to 80°F (16°C to 27°C) for a single unbalanced system protecting two or more separate hazards. If the container operating/storage temperature is outside this range, an insufficient quantity of agent may be discharged from one or more discharge nozzles.

4-2.4.2 Storage Temperature

Kidde ECS System equipment is suitable for storage from 32°F to 130°F (0°C to 54°C).

4-2.4.3 System Operating Pressure

The normal system operating pressure for Kidde ECS System equipment is 360 PSIG at 70°F (25 bar gauge at 21°C).

4-2.5 Pressure Actuation Limitations

Four modes of pressure actuation of the Kidde ECS System cylinders are available.

Note: When cylinders are all connected to a common manifold, they shall be at the same size and fill density.

4-2.5.1 Cylinders Close Coupled Using Pressure From A Master Cylinder

For cylinders close coupled (reach of one flex hose, max. 30 in) using pressure from one master HFC-227ea cylinder, a maximum of fourteen slave cylinders close coupled can be actuated from that one master cylinder, using pressure operated control heads on the slave cylinders. The slave cylinder operation will be through pilot flexible hoses.

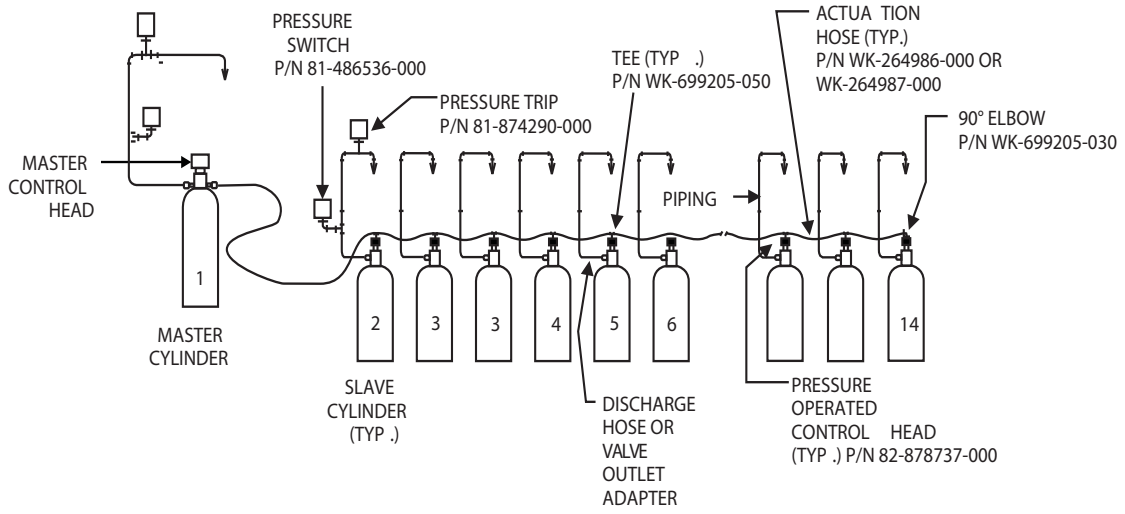


Figure 4-5. Pressure Actuation Using Pressure from 1 Master Cylinder to Actuate a maximum of Fourteen Slaves (Fifteen Sets Total), Close Coupled.

4-2.5.2 Cylinders Not Close Coupled Using Pressure From A Master Cylinder

For cylinders not close coupled using pressure from one master HFC-227ea cylinder, a maximum of four slave cylinders (maximum five cylinders in a group) can be actuated by that one master cylinder using pressure operated control heads on the slave cylinders. The slave cylinder operation will be through a 5/16 in O.D. x 0.032 in wall copper tubing actuator line having a maximum total length of 100 ft (30.5 m). See Figure 4-6.

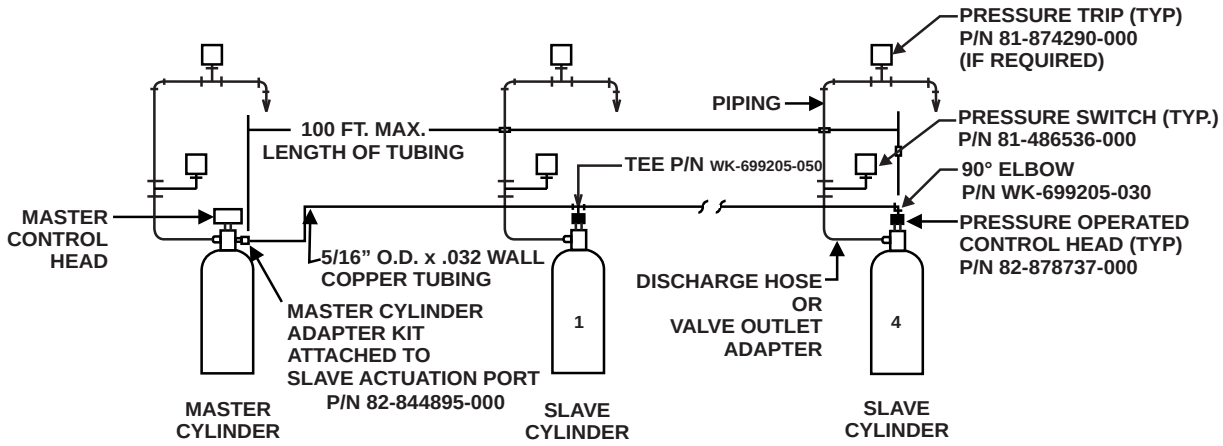


Figure 4-6. Pressure Actuation Using Pressure from 1 Master Cylinder to Actuate a Maximum of Four Slaves (Five Sets Total), Not Close Coupled.

4-2.5.3 Cylinders Not Close Coupled Using Pilot Nitrogen Cylinder Pressure

For cylinders not close coupled using nitrogen pressure from one pilot nitrogen cylinder, from one to fifteen slave HFC-227ea cylinders can be actuated from the one pilot nitrogen cylinder using pressure operated control heads on the slave cylinders. See Figure 4-7.

Slave operation will be through a 5/16 O.D. x 0.032 in wall stainless steel tubing actuator line having the following limitations:

- Maximum total length of tubing is 320 ft (97.5 m).
- Maximum length of tubing between cylinder #1 and the last cylinder is 220 ft (67 m).
- The nominal min/max. length of tubing between the nitrogen pilot cylinder and HFC-227ea cylinder #1 is up to 100 ft (30.5 m).
- If required, the nitrogen pilot cylinder can be located at a distance greater than 100 ft (30.5 m) from HFC-227ea cylinder #1. In this instance, tubing length can be taken from the line between the slave cylinders and added to the line between the nitrogen cylinder and slave cylinder #1, provided that the maximum total length of tubing does not exceed 320 ft (97.5 m).
- The tubing actuation line must be designed for a minimum working pressure of 1800 PSIG (124 bar gauge).

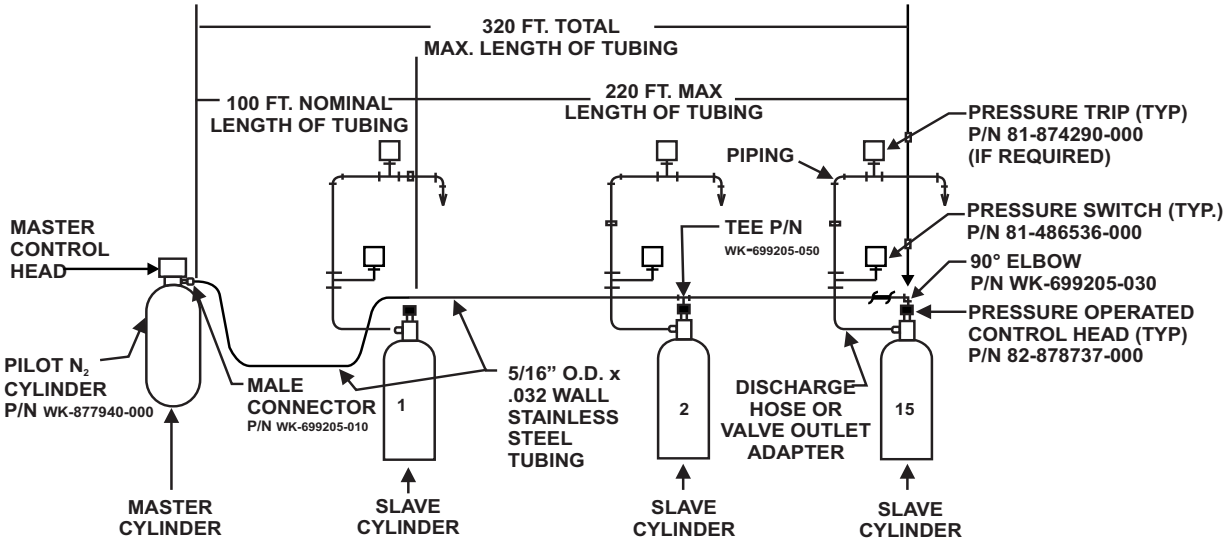


Figure 4-7. Pressure Actuation Using Pressure from 1 Nitrogen Pilot Cylinder to Actuate a Maximum of 15 HFC-227ea Cylinders NOT Closed Coupled

4-2.5.4 Cylinders Close Coupled Using Pilot Nitrogen Pressure

For cylinders close coupled using nitrogen pressure from one pilot nitrogen cylinder from one to fifteen slave cylinder sets can be actuated from one pilot nitrogen cylinder using pressure operated control heads on the nitrogen driver cylinders. See Figure 4-8.

Slave operation will be through a 1/4-inch Schedule 40 steel pipe actuator line having the following limitations:

- Maximum length between the nitrogen cylinder and the first HFC-227ea cylinder is 320 ft (97.5 m).
- Maximum quantity of flexible actuation hoses is fifteen (one at the nitrogen cylinder and one at each HFC-227ea cylinder).
- All HFC-227ea cylinders must be located adjacent to one another.

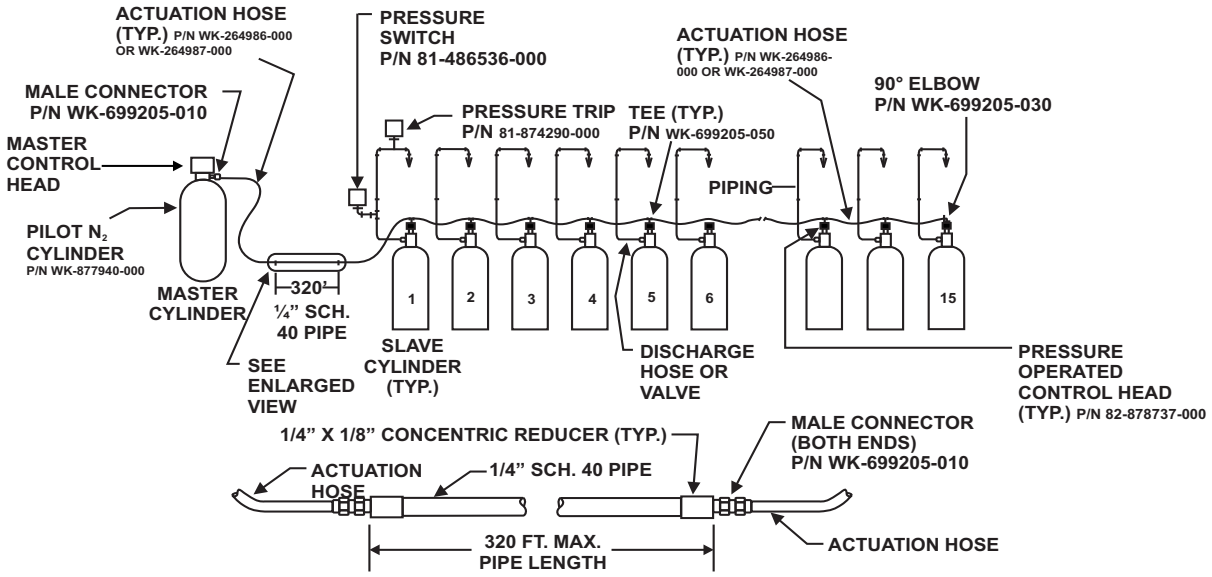


Figure 4-8. Pressure Actuation Using Pressure from 1 Cylinder to Actuate a Maximum of Fifteen Sets of ECS Cylinders, Close Coupled.

4-2.5.5 Corner Pulley and Cable Limitations

Refer to Table 4-8 for corner pulley and cable length limitations.

Table 4-8. Corner Pulley and Cable Limitations

Control Head Type	Part Number	Pulley		Max. Cable Length
		P/N 81-803808-000	P/N WK-844648-000	ft
Cable Operated	81-979469-000	15	30	100
Electric/Cable	81-895630-000	6	30	100
Electric/Cable	81-895627-000	6	30	100
Electric/Cable, Explosion-Proof	WK-897494-000	6	30	100
Electric/Cable, Explosion-Proof	WK-897560-000	6	30	100

4-2.5.6 Pressure Trip Limitations

The maximum load to be attached to pressure trip (P/N 81-874290-000) is 100 lb (45.3 kg), based on a minimum pressure of 75 PSIG (5.17 bar gauge) at the pressure trip.

4-3 EQUIPMENT INSTALLATION

4-3.1 General

All Kidde ECS System equipment must be installed to facilitate proper inspection, testing, manual operation, recharging and any other required maintenance as may be necessary. Equipment must not be subject to severe weather conditions or mechanical, chemical or other damage that could render the equipment inoperative. Equipment must be installed in accordance with NFPA Standard 2001.

WARNING

The HFC-227ea cylinder/valve assemblies must be handled, installed and serviced in accordance with the instructions contained in this paragraph and Compressed Gas Association (CGA) pamphlets C-1, C-6 and P-1. CGA pamphlets may be obtained from: http://www.cganet.com. Failure to follow these instructions can cause HFC-227ea cylinders to violently discharge, resulting in severe injury, death and/or property destruction.

4-3.2 Distribution Piping and Fittings

4-3.2.1 Threads

Threads on all pipe and fittings must be tapered threads conforming to ANSI Specification 8-20.1. Joint compound, tape or thread lubricant must be applied only to the male threads of the joint.

4-3.2.2 Pipe

Piping must be of noncombustible material having physical and chemical characteristics, such that its integrity under stress can be predicted with reliability. The latest version of the flow calculation software program has only been verified for the specific types and schedule of pipe and fittings covered in this manual. There is a risk that the system may not supply the required quantity of agent in unbalanced systems when other pipe types and fittings are used.

4-3.2.2.1 Ferrous Piping

Black steel or galvanized pipe must be either ASTM A-53 seamless or electric resistance welded, Grade A or B, or ASTM A-53 furnace weld Class F (up to 1½" diameter) or ASTM A-106, Grade A, B or C. ASTM B-120 and ordinary cast iron pipe must not be used. The thickness of the pipe wall must be calculated in accordance with ANSI B-31.1, Power Piping Code. The internal pressure for this calculation shall not be less than the minimum piping design pressure of 402 PSIG (28 bar gauge) at 70°F (21°C). The minimum piping design pressure of 402 PSIG at 70°F corresponds to eighty percent of the maximum pressure of 502 PSIG (35 bar gauge) in the agent container at the maximum storage temperature at 130°F (54°C), using the maximum allowable fill density at 70 lb/cu.ft (1121 kg/cu.m).

CAUTION

Pipe supplied as dual stenciled A-120/A-53 Class F meets the requirements of Class F furnace welded pipe ASTM A-53 as listed above. Ordinary cast-iron pipe, steel pipe conforming to ASTM A-120, or nonmetallic pipe must not be used.

4-3.2.2.2 Piping Joints

The type of piping joint shall be suitable for the design conditions and shall be selected with consideration of joint tightness and mechanical strength.

4-3.2.2.3 Fittings

Fittings shall conform to the requirements of NFPA 2001, Sections 2-2.3 and A-2-2.3.1. Class 150 and cast iron fittings must not be used. Class 300 lb malleable or ductile iron fittings in sizes 3-inch and smaller, or 1000 lb ductile iron or forged steel fittings in sizes greater than 3-inch are to be used. Class 300 flanged joints are acceptable for use in all sizes. All grooved couplings and fittings shall be UL Listed and/or FM Approved (as appropriate) and have a minimum rated working pressure equal to or greater than the minimum piping design pressure of 402 PSIG (28 bar gauge) at 70°F (21°C).

Concentric bell reducers are the only means for reducing pipe size. Reductions can be made after a tee or after a union. Where reducers are used at tees, the reducers must be downstream of each tee. Reductions made after a union are possible only if the next change in direction (tee split) is located a minimum of 15 nominal pipe diameters downstream of the concentric bell reducer. Gaskets for flanged fittings shall be neoprene impregnated or compliant with NFPA 2001.

CAUTION

The latest version of the flow calculation software program has only been verified for use with the piping, inside pipe diameter and fittings specified in this manual. When unspecified piping and fittings are used, there is a risk that the system will not supply the required quantity of HFC-227ea.

4-3.3 Installation of Pipe and Fittings

Pipe and fittings must be installed in strict accordance with the system drawings and good commercial practices. The piping between the cylinder and the nozzles must be the shortest route possible, with a minimum of fittings. Any deviations in the routing or number of fittings must be approved by the design engineer before installation.

Note: Strict piping rules regarding flow splits to multiple hazards must be adhered to. Please refer to Paragraph 4-2.3.2 of this manual for proper tee installations.

Piping must be reamed free of burrs and ridges after cutting, welding or threading. All threaded joints must conform to ANSI B1-20-1. Joint compound or thread tape must be applied only to the male threads of the joint, excluding the first two threads. Welding must be in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Each pipe section must be swabbed clean, using a non-flammable organic solvent.

All piping must be blown clear with dry nitrogen or compressed air before installing the discharge nozzles.

The piping must be securely braced to account for discharge reaction forces and thermal expansion/contraction. Care must be taken to insure the piping is not subjected to vibration, mechanical or chemical damage. All hangers must be FM Approved or UL Listed and must conform to general industry standards for pipe hangers and conform to ANSI B-31.1. Refer to ANSI B-31.1 for additional bracing requirements.

4-3.4 Installation of Check Valves

Install the check valves as shown on the system drawings. Apply Teflon tape or pipe compound to all the male threads, except the first two threads. Valves greater than two inches in size are provided with flanged outlets. All valves must be installed with the arrow on the valve body pointing in the proper direction of the flow.

4-3.5 Installation of Discharge Nozzles

After the system piping has been blown free of debris, install the discharge nozzles in strict accordance with the system drawings. Orient the nozzles as shown on drawings. Make certain that the correct nozzle type, part number and orifice size are installed in the proper location. See Paragraph 4-2.3.5 for correct nozzle placement and orientation.

4-3.6 Installation of Pressure Actuation Pipe

The pressure actuation pipe must be 1/4-inch Schedule 40 or 80 pipe. The pipe or tubing must be routed in the most direct manner with a minimum of fittings. Pipe and fittings must be in accordance with the requirements listed in Paragraph 4-2.5. Fittings can be flared or compression type. The pressure-temperature ratings of the fitting manufacturer must not be exceeded.

Piping must be reamed free of burrs and ridges after cutting, threading or flaring. Upon assembly, pipes must be blown out with dry nitrogen or compressed air. Piping should be securely braced and isolated from vibration, mechanical or chemical damage.

4-3.7 Installation of Valve Outlet Adapter

WARNING **Always connect a valve outlet adapter into system piping (union connection) before connecting to an HFC-227ea cylinder.**

Install valve outlet adapter (P/Ns WK-283904-000, WK-283905-000, and WK-283906-000) in system piping. Tighten securely and continue with threaded rigid pipe. A union needs to be installed for ease of disconnecting the cylinder. Use check valves for connecting multiple cylinders on to manifold.

Note: A groove-groove fitting is used in place of a valve outlet adapter for the 3-inch valve and associated cylinders.

4-3.8 Installation of Flexible Discharge Hose

Attach the flexible discharge hose from system piping or El-check in the discharge manifold to the cylinder valve. Tighten securely. See Figure 4-9 and Table 4-9 and Table 4-10.

WARNING **Always connect the flexible discharge hose into system piping before connecting to an HFC-227ea cylinder.**

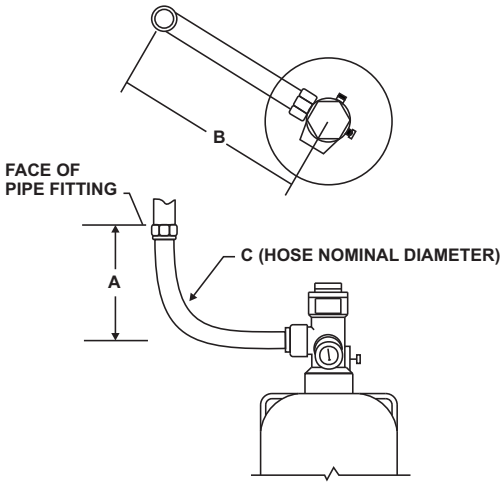


Figure 4-9. Installation of the Flexible Hose Directly into System Piping

Table 4-9. Installation of the Flexible Hose Directly into System Piping, English (inches)

Cylinder Capacity	Dimensions in inches		
	A	B	C
10 lb	14 5/8	16 3/4	1 1/2
20 lb	14 5/8	16 3/4	1 1/2
40 lb	14 5/8	16 3/4	1 1/2
70 lb	14 5/8	16 3/4	1 1/2
125 lb	14 5/8	16 3/4	1 1/2
200 lb	19	21 3/4	2
350 lb	19	21 3/4	2
600 lb (old style)	29 5/8	32 3/4	2 1/2
600 lb (new style)	33	36	3
900 lb	33	36	3
Dimensions A and B must be maintained in order to obtain a smooth radius in flexible loop.			

Table 4-10. Installation of the Flexible Hose Directly into System Piping, Metric (millimeters)

Cylinder Capacity	Dimensions in millimeters		
	A	B	C
10 lb	371	425	38
20 lb	371	425	38
40 lb	371	425	38
70 lb	371	425	38
125 lb	371	425	38
200 lb	483	552	51
350 lb	483	552	51
600 lb (old style)	752	832	64
600 lb (new style)	838	914	76
900 lb	838	914	76
Dimensions A and B must be maintained in order to obtain a smooth radius in flexible loop.			

4-3.9 Installation of Master Cylinder Adapter Kit P/N 82-894895-000

Note: Master cylinder adapter installation can be accomplished safely with a pressurized cylinder.

1. Remove the 1/4-inch pipe plug from the slave actuation port on the master cylinder valve.
2. Before assembling the adapter to the cylinder valve, apply Permacel No. 412D Teflon® tape to the male threads on the adapter.
3. Ensure the cap is screwed onto the adapter outlet port before assembling to the cylinder valve.
4. Install the adapter into the slave actuation port on the master cylinder valve.
5. Attach the label to the valve body.

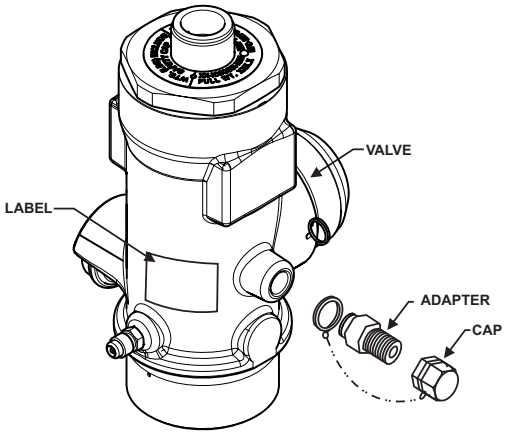


Figure 4-10. Installation of Master Cylinder Adapter Kit

4-3.10 Installation of HFC-227ea Cylinder/Valve Assemblies

The HFC-227ea cylinders should be located as close as possible to the protected hazard area. The assemblies should be located in a place which is readily accessible for manual actuation and inspection, service and maintenance. The cylinders shall be located in an environment protected from the weather, and where the ambient temperature does not exceed 80°F (27°C) or fall below 60°F (16°C). External heating or cooling may be required to maintain this temperature range. The following installation instructions must be followed in the exact sequence outlined below to prevent accidental discharge, bodily injury and property damage.

4-3.10.1 Single Cylinder System

WARNING

Cylinders must be located and mounted where they will not be accidently damaged or moved. If necessary, install suitable protection to prevent the cylinder from damage or movement.

1. Position HFC-227ea cylinder in designated location and secure in place with cylinder strap and attaching hardware (see Figure 4-11 and Table 4-11, through Table 4-12). Orient cylinder with valve outlet angled toward system piping.
2. Remove the safety cap from the cylinder valve outlet port.
3. Connect a 1½-, 2-, 2½-, or 3-inch flexible discharge hose or valve outlet adapter to the cylinder outlet port.

Note: If a valve outlet adapter is used, a union must be installed in the discharge piping.

WARNING

Connect the discharge hose to system piping before attaching it to the cylinder valve.

The valve outlet adapter must be connected into system piping (union connection) before attaching it to the cylinder valve.

1. Remove the protection cap from the cylinder valve actuation port.

WARNING

The control head must be in the SET position (that is, the actuating pin must be in the fully retracted or SET position) before attaching it to an HFC-227ea cylinder in order to prevent accidental discharge.

2. Install the control head to the cylinder valve actuation port.

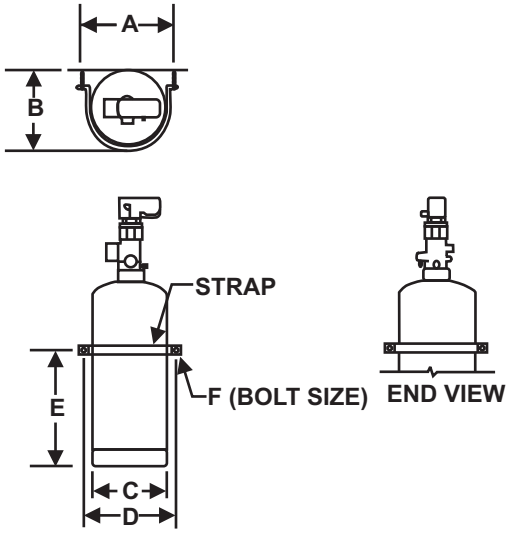


Figure 4-11. Single Cylinder Installation, Vertical Mounting (See Table 4-11)

Table 4-11. Single Cylinder Installation Dimensions, English (inches)

Cylinder P/N	A	B	C	D	E	F
90-10001X-001	9.62	7.19	7.07	8.52	7.38	3/8
90-10002X-001	9.62	7.19	7.07	8.52	12.50	3/8
90-10004X-001	11.69	9.13	9.00	10.69	10.63	3/8
90-10007X-001	11.69	9.13	9.00	10.69	27.50	3/8
90-100121-001	16.18	12.94	12.75	14.56	23.75	9/16
90-100125-001	16.18	12.94	12.75	14.56	23.75	9/16
90-10020X-001	17.06	13.78	13.60	15.44	39.00	9/16
90-10020X-101	16.18	12.94	12.75	14.56	39.00	9/16
90-10035X-001	19.50	16.19	16.00	17.88	44.00	9/16
90-10060X-001	25.75	22.25	22.00	24.12	38.50	9/16
90-10060X-100	25.75	22.25	22.00	24.12	38.50	9/16
90-10090X-001	27.75	25.00	24.00	26.00	48.50	9/16

Note: The "X" within the part numbers denotes whether a Liquid Level Indicator (LLI) is ordered with the cylinder. A one (1) is used if a LLI is needed, a five (5) is used if one is not.

Table 4-12. Single Cylinder Installation Dimensions, Metric (millimeters)

Cylinder P/N	A	B	C	D	E	F
90-10001X-001	244	183	180	216	187	M10
90-10002X-001	244	183	180	216	318	M10
90-10004X-001	297	232	229	272	270	M10
90-10007X-001	297	232	229	272	699	M10
90-100121-001	411	329	324	370	603	M14
90-100125-001	411	329	324	370	603	M14
90-10020X-001	433	350	345	392	991	M14
90-10020X-101	411	329	324	370	991	M14
90-10035X-001	495	411	406	454	1118	M14
90-10060X-001	654	565	559	613	978	M14
90-10060X-100	654	565	559	613	978	M14
90-10090X-001	704	635	610	660	1232	M14

Note: The "X" within the part numbers denotes whether a Liquid Level Indicator (LLI) is ordered with the cylinder. A one (1) is used if a LLI is needed, a five (5) is used if one is not.

Table 4-13. Strap Part Numbers for Cylinder Installation

Strap Part Number	Cylinder Size
WK-283945-000	10 and 20 lb
WK-283934-000	40 and 70 lb
WK-292971-000	125 and 200 lb (old style)
06-235317-001	125 and 200 lb (new style)
WK-281866-000	350 lb
WK-294651-000	600 lb
06-236125-001	900 lb

4-3.10.2 Multiple Cylinder System

WARNING

Cylinders must be located and mounted where they will not be accidently damaged or moved. If necessary, install suitable protection to prevent the cylinder from damage or movement.

1. Position the cylinders in the designated location and secure them in place with cylinder straps and attaching hardware (see Figure 4-12 and Table 4-14 and Table 4-15). Orient the cylinders so that the valve outlets are angled towards the El-check valves in the manifold.

WARNING

The discharge hose must be connected into the system piping before attaching it to the cylinder valve.

2. Remove the safety cap from one cylinder outlet port and connect the flexible discharge hose to the cylinder outlet port. Repeat for each cylinder in the system.
3. Remove the protection caps from the cylinder actuation ports.
4. Install the control heads on the cylinder valve actuation ports.

WARNING

Control heads must be in the SET position (that is, the actuating pin must be in the fully retracted or SET position) before attaching to HFC-227ea cylinders in order to prevent accidental discharge. Personal injury and/or property damage could occur.

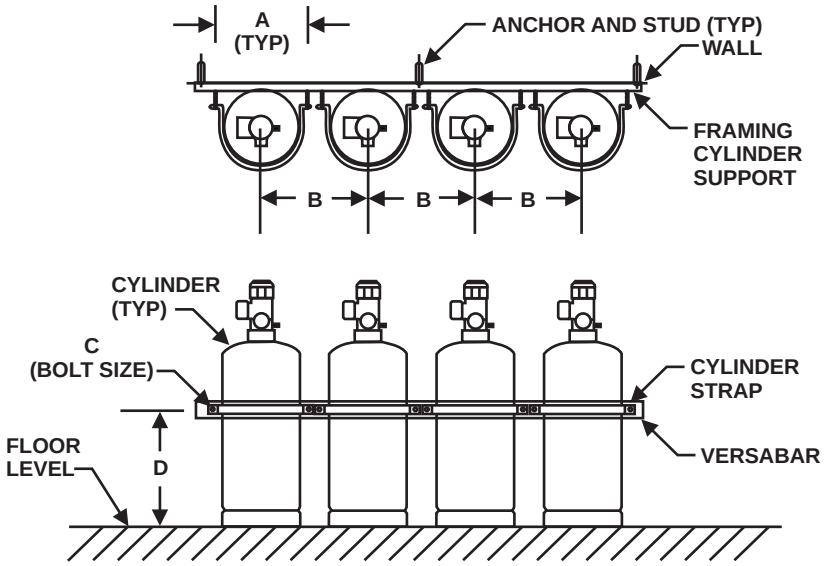


Figure 4-12. Multiple Cylinder Installation, Vertical Mounting (see Table 4-14 and Table 4-15 for dimensions)

Table 4-14. Multiple Cylinder Installation Dimensions, Inches

Cylinder Part Number	Dimensions			
	A	B	C	D
90-10001X-001	8.52	11.00	3/8	7.38
90-10002X-001	8.52	11.00	3/8	12.50
90-10004X-001	10.69	13.00	3/8	10.63
90-10007X-001	10.69	13.00	3/8	20.00
90-100125-001	14.56	18.00	9/16	20.88
90-10020X-001	15.44	18.00	9/16	29.63
90-10020X-101	14.56	18.00	9/16	29.63
90-10035X-001	17.88	21.00	9/16	37.13
90-10060X-001	24.12	27.00	9/16	34.00
90-10060X-100	25.75	27.00	9/16	38.50
90-10090X-001	25.75	30.00	9/16	48.50

Table 4-15. Multiple Cylinder Installation Dimensions, Millimeters

Cylinder Part Number	Dimensions			
	A	B	C	D
90-10001X-001	216	279	10	187
90-10002X-001	216	279	10	318
90-10004X-001	272	330	10	270
90-10007X-001	272	330	10	508
90-100125-001	370	457	14	530
90-10020X-001	392	457	14	753
90-10020X-101	370	457	14	753
90-10035X-001	454	533	14	943
90-10060X-001	613	686	14	864
90-10060X-100	654	686	14	864
90-10090X-001	704	762	14	1232

4-3.10.3 Main and Reserve System

Install main and reserve systems as instructed in the previous paragraphs.

4-3.11 Installation of Electric Control Heads

WARNING

Before installing a control head on an HFC-227ea cylinder valve, ensure the control head is in the SET position (that is, the actuating pin is in the fully retracted or SET position). Failure to position the control head in the SET position will result in accidental HFC-227ea cylinder discharge when the control head is installed on cylinder valve. Personal injury and/or property damage could occur.

Electric Control Head, P/N 82-486500-010 is designed for Kidde 1½ in, 2 in and 2½ in HFC-227ea cylinder valves only. Installing this control head on any other device (for example, pressure operated control head) will cause the device to malfunction when the control head is actuated.

1. Remove the protection cap from the HFC-227ea cylinder actuation port. Ensure the control head is in SET position (that is, the actuating pin is in the fully retracted or SET position).
2. Install the electric control head on the cylinder actuation port. Tighten the swivel nut.
3. Make all electrical connections.

Note: P/N 82-486500-010 is a polarized control head. Improper wiring will cause the device to malfunction.

CAUTION

The stackable control head (P/N 82-486500-010) cannot be used with the 3-inch valve cylinder (P/Ns 90-100600-100, 90-100601-100, 90-100900-001 and 90-100901-001). The stackable control head does not have sufficient force to activate the 3-inch valve (P/N 90-17000-000) and may result in system failure. Use the electric/manual control heads (P/Ns 8901XX) with the 3-inch valve.

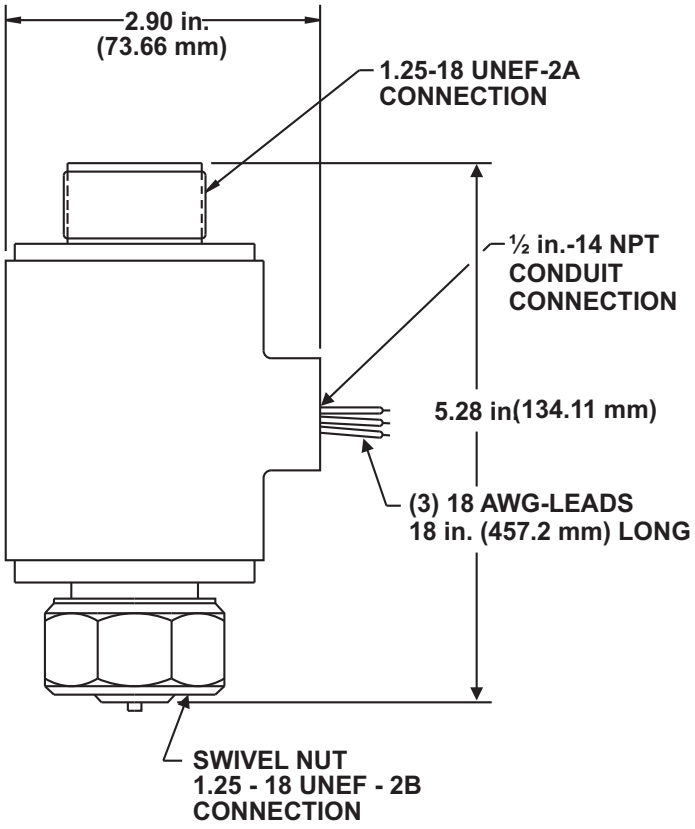


Figure 4-13. Installation of Electric Control Head (Stackable Type), P/N 486500-01

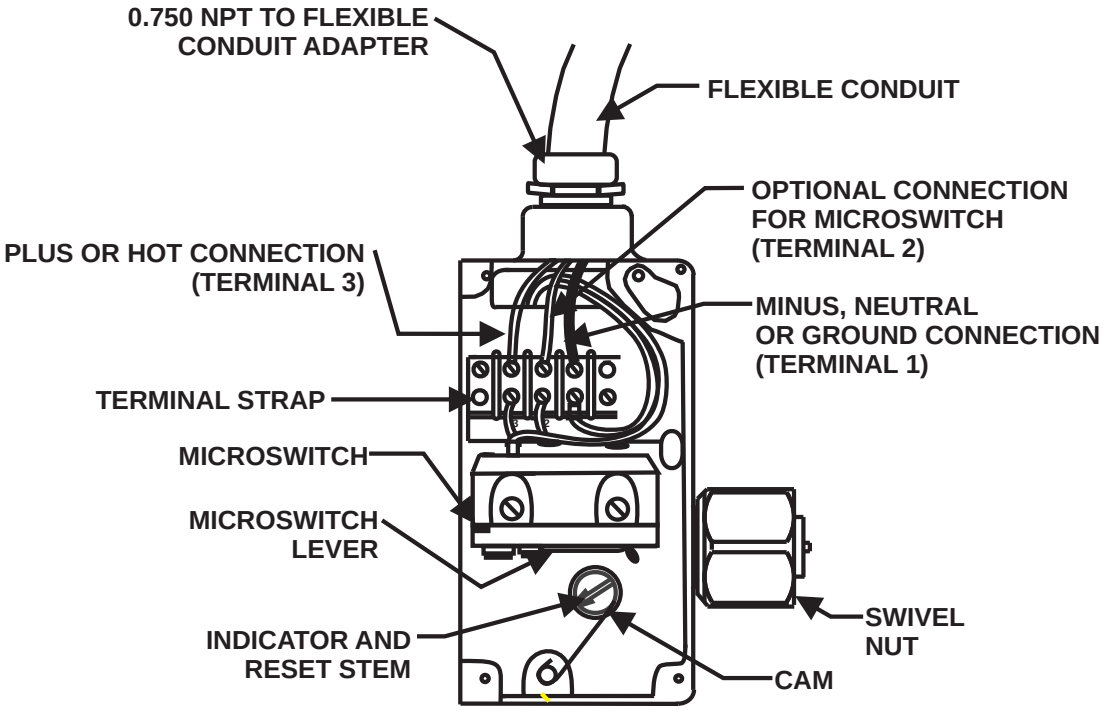


Figure 4-14. Electrical Connections for Control Head, P/Ns WK-890181-000, 81-895630-000, and 81-890149-000

4-3.12 Installation of Pressure Operated Control Head, P/N 82-878751-000

1. Remove the protection cap from the cylinder actuation port (see Figure 4-15).

WARNING

When attaching the Lever/Pressure operated control head to the valve, the swivel nut must be tightened to a toque of 55ft·lb. Failure to tighten the swivel nut may result in leakage during actuation.

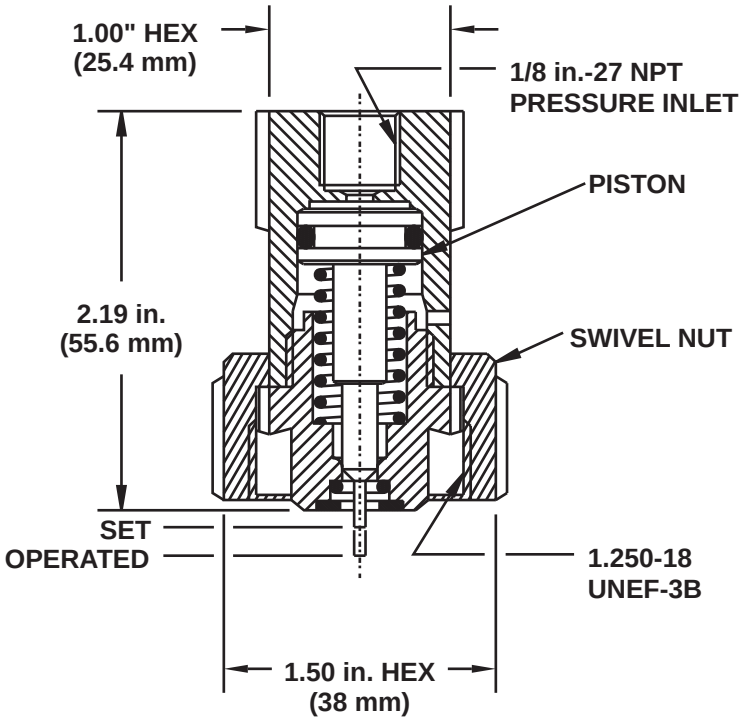


Figure 4-15. Pressure Operated Control Head

2. Install a pressure operated control head with flexible actuation hose attached to the cylinder actuation port.

WARNING

Ensure that the pilot line is non-pressurized and the actuating pins are in the retracted (SET) position. Failure to follow this procedure will cause the HFC-227ea cylinder to discharge accidentally when the control head is installed on the cylinder valve.

4-3.13 Installation of Electric/Cable Operated Control Head, P/N 81-895630-000 and P/N WK-897494-000

The following procedures must be performed before attaching a control head to a cylinder valve. See Figure 4-16.

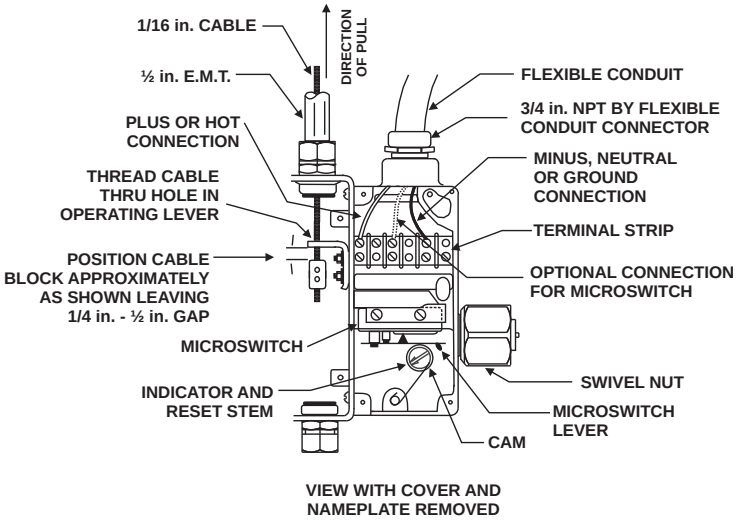


Figure 4-16. Electric/Cable Operated Control Head

WARNING

Before installing a control head on a nitrogen driver cylinder valve, ensure the control head is in the SET position (that is, the actuating pin is in the fully retracted or SET position). Failure to position the control head in the SET position will result in accidental discharge and possible personal injury when the control head is installed on the driver valve.

1. Remove the four screws holding the cable housing cover on the control head. Remove the cover.
2. Position the control head in the approximately installed position at the HFC-227ea cylinder valve control port but do not assemble onto the actuation port of the HFC-227ea cylinder valve.
3. Check that the control head is in the SET position.
4. Assemble the pull cable conduit to the conduit connection on the control head.
5. Feed the cable into the control head through the hole in the operating lever.
6. Feed the cable through the cable clamp. Pull the cable taut, allowing approximately 1/4 in to 1/2 in clearance between the cable clamp and the operating lever. Tighten the set screws in the cable clamp to secure the cable to the clamp.
7. Cut off any excess cable.
8. Verify the manual remote cable operation to ensure control head actuates and all cable clamps are tight.
9. Pull the cable back to its normal set (non-operated) position.
10. Reset the control head.
11. Replace the control head cover.
12. Examine the seal wire at the safety pull pin. Make sure it is intact.
13. Make all electrical connections.
14. Assemble the control head to the cylinder valve actuation port. Tighten the swivel nut securely.

4-3.14 Installation of Cable Operated Control Head, P/N 81-979469-000

WARNING

The cable operated control head (P/N 81-979469-000) must not be used with the stackable pressure operated control head (P/N 82-878750-000). Installing the cable operated control head on the actuation port of the stackable pressure operated control head will cause the device to malfunction.

The following procedures must be performed before attaching the control head to the cylinder valve.

1. Remove the protection cap from the cylinder actuation port.
2. Remove the cover from the control head and take out the wheel assembly, cable pipe locknut and closure disc.
3. Make sure the plunger is below the surface of the control head body. Position the control head at the valve control port with the arrow pointing in the direction of pull.
4. Assemble the cable pipe locknut to the cable pipe and place the cable pipe in the control head body.
5. Slide the wheel assembly on the control cable to the SET position. Tighten the set screws securely. Make sure the wheel assembly is at the start of the stroke.
6. Cut off any excess control cable close to the wheel assembly.
7. Insert the closure disc and replace the cover on the control head. The control head is now armed.

CAUTION

To ensure the manual lever does not snag or trap the cable, make sure the local manual release lever is in the SET position with the locking pin and seal wire installed before assembling the control head cover to the body.

8. Assemble control head to cylinder valve actuation port. Tighten swivel nut securely.

4-3.15 Installation of Lever Operated Control Head, P/N WK-870652-000

1. Ensure the control head is in the SET position with the safety pull pin and seal wire intact.
2. Remove the protection cap from the cylinder valve actuation port.
3. Using a suitable wrench, assemble the control head to the cylinder valve actuation port. Tighten the swivel nut securely.

4-3.16 Installation of Nitrogen Cylinder, P/N WK-877940-000 and Mounting Bracket, P/N WK-877845-000

1. Locate the nitrogen cylinder mounting bracket in an area where the cylinder valve assembly and control head will be protected from inclement weather by a suitable total or partial enclosure, preferably adjacent to the HFC-227ea storage cylinders.
2. Install the mounting bracket clamps and hardware. Install the nitrogen cylinder in position in a mounting bracket; tighten sufficiently to hold the cylinder in place while allowing the cylinder enough free play to be rotated.
3. Turn the cylinder until the cylinder valve discharge outlet is in the desired position. The nitrogen cylinder must be positioned so that control head is readily accessible during manual operation.
4. Securely tighten the mounting bracket clamps and hardware.
5. Attach the adapter (P/N WK-699205-010) and connect the nitrogen pilot lines.
6. Remove the protective cap from the cylinder valve actuation port.

WARNING

Ensure the control head is in the SET position (that is, the actuating pin is in the fully retracted or SET position) before attaching it to the cylinder valve. If the control head is not in the SET position, HFC-227ea will discharge accidentally.

7. Install the control head to the cylinder valve actuation port and tighten securely.

4-3.17 Installation of Pressure Switch, P/N 81-486536-000 and P/N 81-981332-000

WARNING

To prevent personal injury, de-energize all electrical components before installing the pressure switch.

Pressure switches must be connected to the discharge manifold or piping in an upright position as shown on the system drawings. Both the standard and explosion-proof switches have 1/2-inch NPT pressure inlets to connect to the system piping. The electrical connections are either 1/2-inch conduit knockouts for the standard pressure switch and 1-inch NPT fittings for the explosion-proof pressure switch.

4-3.18 Installation of Pressure Trip, P/N 81-874290-000

Install the pressure trip on the discharge manifold or piping in the horizontal position as shown on the system drawings. Connect the trip to the piping with 1/2-inch Schedule 40 pipe. The minimum operating pressure required is 75 PSIG (5 bar gauge). The maximum allowable load to be attached to the retaining ring is 100 lb (45 kg).

4-3.19 Installation of Manual Pull Station, P/N 81-871403-000

1. Locate the remote pull boxes as shown on the system installation drawings.
2. Connect the pull boxes to the control heads using 3/8-inch, Schedule 40 pipe. Do not run more than one cable in each pipe run.
3. Install a corner pulley at each change in pipe direction. Do not bend the pipe. A dual-pull equalizer (P/N 81-840051-000) should be installed where one pull box operates two controls. A dual pull mechanism (P/N 81-840058-000) should be installed where two pull boxes operate one control.
4. Beginning at the pull boxes, remove the covers of the first corner pulley. Feed the cable through the pulley into the 3/8-inch pipe. Connect one end of the cable to the cable fastener in the pull box, allowing the short end to project at least 1/2-inch. Seat the cable in the groove by pulling on the long end. Screw the fastener and cable into the handle. Route the other end to the control heads, taking up as much slack as possible. Attach the end of the cable to the fastener in the control head.
5. Reattach the corner pulley covers.
6. Check that control head is in SET position. Install the control head to the HFC-227ea cylinder valve.

4-3.20 Installation of Discharge Indicator (P/N 81-875553-000)

The discharge indicator must be installed on the discharge manifold, either in a vertical or horizontal position. The indicator has a 3/4-inch NPT male connection. Make certain the indicator stem is in the normal position.

4-3.21 Installation of Supervisory Pressure Switch (P/Ns 06-118262-001 and 06-118263-001)

Installation of the supervisory pressure switch can be accomplished safely on a pressurized cylinder.

WARNING **Before installing the pressure switch, de-energize all electrical components to prevent injury.**

CAUTION **When attaching or removing the supervisory pressure switch from the cylinder valve, attach a wrench to the fitting and hold securely while tightening or loosening the pressure switch.**

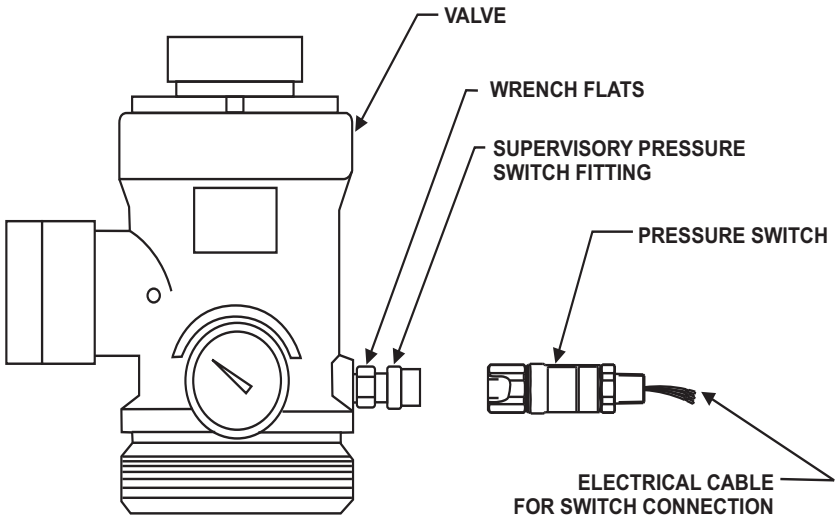


Figure 4-17. Installation of Supervisory Pressure Switch (Up to 2½ in Valve)

Note: The control panel must be UL Listed and/or FM Approved for releasing device service and compatible with Kidde ECS System equipment.

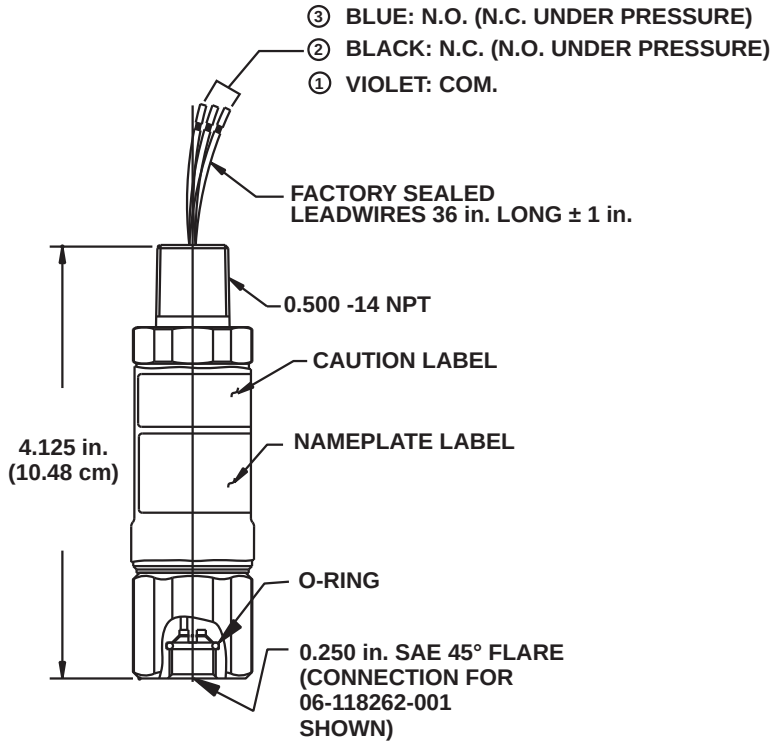
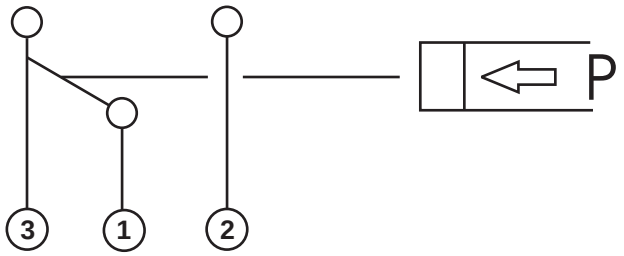


Figure 4-18. Supervisory Pressure Switch Electrical Connections



- 5A 24 Vdc (Resistive)
- 5A 240 Vac (Resistive)

Figure 4-19. Supervisory Pressure Switch Connection Diagram and Electrical Rating

Note: When cylinder supervisory pressure switch (P/N 06-11826X-001) is connected to a supervised control panel circuit, and the switch is wired NC under pressure, it is not possible to distinguish between a wiring fault and a loss of container pressure. This configuration should only be used if accepted by the Authority Having Jurisdiction.

4-3.21.1 Installation of Pressure Switch 06-118262-001

Install the pressure switch as follows:

Note: Do not use with 3" valves manufactured prior to May 1, 2013.

1. Check that the sealing surface of the flare connection of the supervisory switch is not scratched, dented, scored, etc.
2. Remove the end cap from the pressure switch port of the valve. This is a flare fitting and does not require tape dope or any type of sealant.
3. Install the pressure switch onto the pressure port of the valve. Be sure to secure the pressure port with a wrench so that you are not turning the port fitting further into the valve. Tighten the switch hand-tight and then tighten 1/4-turn further using a wrench.

   Important: Leak test the pressure switch connection with an HFC-227ea leak detector or a bubbling solution. If the connection leaks, the switch may be tightened further until the leak is eliminated, again, be sure to have a counter wrench on the switch port.

4-3.21.2 Installation of Pressure Switch 06-118263-001

Install the pressure switch as follows:

Note: For 3" valves manufactured prior to May 1, 2013 only.

1. Hold the pressure switch fitting on the valve with a wrench and remove the 1/8-inch plug with a second wrench. Ensure that the fitting does not rotate in the valve body. The fitting contains a check valve that will prevent the escape of the cylinder contents.
2. Before fitting the switch, apply Permacel® No. 412D Teflon® tape to the male threads of the pressure switch.
3. Install the pressure switch into the port of the valve. Be sure to secure the pressure port fitting with a wrench. Tighten the switch hand-tight and then tighten 1¼-turns further using a wrench.

   Important: Leak test the pressure switch connection with an HFC-227ea leak detector or a bubbling solution. If the connection leaks, the switch may be tightened further a 1/4-inch turn at a time until the leak is eliminated, again, be sure to have a counter wrench on the switch port. Do not exceed two turns from hand-tight. Refer to ANSI B1.20.3 for NPT thread engagement details.

4-3.22 Post-Installation Checkout

After an HFC-227ea system installation has been completed, perform the following inspections and tests.

1. Verify that the cylinders of correct weight and pressure are installed in accordance with installation drawings.
2. Verify that the cylinder brackets and straps are properly installed and all fittings are tight.
3. The piping distribution system must be inspected for compliance with the system drawings, NFPA 2001, design limitations within this manual and the computerized hydraulic calculations associated with each independent piping and nozzle configuration.
4. Check that the discharge manifold, discharge piping and actuation piping are securely hung. Ensure all fittings are tight and securely fastened to prevent agent leakage and hazardous movement during discharge. The means of pipe size reduction and installation position of the tees must be checked for conformance to the design requirements.
5. The piping distribution system must be cleaned, blown free of foreign material and inspected internally to ensure that oil or particulate matter will not soil the hazard area or reduce the nozzle orifice area and affect agent distribution.
6. System piping should be pressure tested in accordance with the requirements of NFPA 2001.
7. Ensure that the check valves are installed in the proper location as indicated on the installation drawings and that the equipment is installed with the arrow pointing in the direction of flow.
8. Verify the nozzles are installed in the correct locations and have the correct part numbers and orifice sizes as indicated on installation drawings. Discharge nozzles must be oriented such that optimum agent dispersal can be achieved. Check the nozzle orifices for any obstructions.
9. The discharge nozzles, piping and mounting brackets must be installed such that they will not cause injury to personnel. The agent must not be discharged at head height or below where people in a normal work area could be injured by the discharge. The agent must not directly impinge on any loose objects or shelves, cabinet tops or similar surfaces where loose objects could be propelled by the discharge.
10. For systems with a main/reserve capability, the MAIN/RESERVE switch must be clearly identified and properly installed where it is readily accessible.
11. Manual pull stations must also be clearly identified and properly installed where they are readily accessible. All manual stations that activate HFC-227ea systems should be properly identified as to their purpose. Particular care should be taken where manual pull stations for more than one system are in close proximity and could be confused and the wrong system actuated. In this case, manual stations should be clearly identified as to which hazard area they affect.
12. Perform the electric control head test outlined in Paragraph 5-4.3.1 on all cylinders equipped with electric control heads.
13. Perform the pressure switch test outlined in Paragraph 4-2.3.1 for all pressure switches installed.
14. All acceptance testing shall be in accordance with NFPA 2001.

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CHAPTER 5
MAINTENANCE

5-1 INTRODUCTION

This chapter contains maintenance instructions for the Kidde ECS System. These procedures must be performed regularly in accordance with regulations. If problems arise, corrective action must be taken.

5-2 MAINTENANCE PROCEDURES

WARNING

HFC-227ea and nitrogen cylinder valve assemblies must be handled, installed, inspected and serviced only by qualified and trained personnel in accordance with the instructions contained in this manual and Compressed Gas Association (CGA) pamphlets C-1, C-6 and P-1. CGA pamphlets my be obtained from http://www.cganet.com.

Before performing these maintenance procedures, refer to the Material Safety Data Sheets and Safety Bulletins in the appendices of this manual.

5-2.1 General

A regular program of systematic maintenance is essential for continuous, proper operation of all HFC-227ea systems. A periodic maintenance schedule must be followed and an inspection log maintained for ready reference. As a minimum, the log must record:

- Inspection interval
- Inspection procedure performed
- Maintenance performed, if any, as a result of inspection
- Name of inspector performing task

If the inspection indicates areas of rust or corrosion, immediately clean and repaint the area. Perform cylinder hydrostatic pressure testing in accordance with Paragraph 5-5 of this manual.

5-3 PREVENTATIVE MAINTENANCE

Perform preventive maintenance per Table 5-1.

Table 5-1. Preventive Maintenance Schedule

Schedule	Requirement	Paragraph
Daily	Check HFC-227ea cylinder pressures Check Nitrogen cylinder pressures	5-4.1
Monthly	Inspect hazard area system components	5-4.2
Semi-Annually	Test pressure switches Test electric control heads Check HFC-227ea cylinder weights and pressures	5-4.3
Every 2 Years	Blow out distribution piping	5-4.4
Every 5 Years	HFC-227ea and nitrogen cylinder and flexible hose hydrostatic pressure test and/or inspection	5-5 and 6-4.1

5-4 INSPECTION PROCEDURES

5-4.1 Daily

5-4.1.1 Check HFC-227ea Cylinder Pressure

Check the HFC-227ea cylinder pressure gauges for proper operating pressure. If the pressure gauge indicates a pressure loss (adjusted for temperature) of more than 10%, or loss in agent quantity shown on cylinder valve of more than 5%, it shall be refilled. Remove and recharge the cylinder as instructed in Paragraph 5-7 and Paragraph 6-3.

5-4.1.2 Check Nitrogen Cylinder Pressure

Check the nitrogen cylinder for proper operating pressure. If the pressure loss (adjusted for temperature) exceeds 10%, recharge with nitrogen to 1800 PSIG at 70°F (124 bar gauge at 21°C).

5-4.2 Monthly

5-4.2.1 General inspection

Make a general inspection survey of all cylinders and equipment for damaged or missing parts. If the equipment requires replacement, refer to Paragraph 5-6.3.

5-4.2.2 Hazard access

Ensure access to hazard areas, manual pull stations, discharge nozzles, and cylinders are unobstructed and that nothing obstructs the operation of the equipment or distribution of HFC-227ea agent.

5-4.2.3 Inspect hoses

Inspect 1/4-inch flexible actuation hoses for loose fittings, damaged threads, cracks, distortion, cuts, dirt and frayed wire braid. Tighten loose fittings and replace hoses with stripped threads or other damage. If necessary, clean parts as directed in Paragraph 5-6.1. Inspect the adapters, couplings and tees at the HFC-227ea cylinder pilot outlets and tighten couplings if necessary. Replace any damaged parts.

5-4.2.4 Inspect Pressure Control Heads

Inspect HFC-227ea cylinder pressure operated control heads for physical damage, deterioration, corrosion, distortion, cracks, dirt and loose couplings. Tighten loose couplings. Replace damaged caps. Replace the control head if damaged. If necessary, clean as directed in Paragraph 5-6.1.

WARNING

Before resetting the lever / pressure operated control head, all pressure must be relieved from the cylinder and actuation lines.

Pressure can be relieved from unvented actuation tubing by loosening the fitting on the control head slightly and allowing the line to bleed out completely. Failure to perform this action can result in damage to the control head.

5-4.2.5 Inspect Electric Control Heads

Inspect the HFC-227ea cylinder electric control heads for damage, corrosion, and dirt. Check the control heads' flexible electrical line for wear and damage. Check the control head for loose coupling and tighten if necessary. Check that the indicator is in the SET position, the pull pin is installed in the manual lever, and the seal wire is intact. Replace the control head if damaged. If necessary, clean as directed in Paragraph 5-6.1

5-4.2.6 Inspect Cylinder and Valve Assembly

Inspect the HFC-227ea cylinder and valve assembly for leakage and physical damage such as cracks, dents, distortion and worn parts. Check the burst disc and pressure gauges for damage. Replace damaged gauges or burst disc per Paragraph 6-2.7 or Paragraph 6-2.8. If the gauge pressure is not normal (360 PSIG at 70°F [25 bar gauge at 21°C]), remove and recharge the cylinder as instructed in Paragraph 5-7 and Paragraph 6-3. If damaged parts are found on the HFC-227ea cylinder or cylinder valve, replace the HFC-227ea cylinder. If necessary, clean the cylinder and associated parts as directed in Paragraph 5-6.1.

5-4.2.7 Inspect Brackets, Straps, Cradles and Mounting Hardware

Inspect the HFC-227ea cylinder brackets, straps, cradles and mounting hardware for loose, damaged or broken parts. Check the cylinder brackets, straps and associated parts for corrosion, oil, grease and grime. Tighten any loose hardware. Replace damaged parts. If necessary, clean as directed in Paragraph 5-6.1.

5-4.2.8 Inspect Discharge Hoses

Inspect The flexible discharge hoses for loose fittings, damaged threads, cracks, rust, kinks, distortion, dirt and frayed wire braid. Tighten loose fittings and replace hoses with stripped threads. If necessary, clean as directed in Paragraph 5-6.1.

5-4.2.9 Inspect Actuation Line

Inspect the nitrogen actuation line (if used) and support brackets for continuity, physical damage, loose fittings, distortion, cracks or cuts. Tighten loose fittings. Replace damaged parts. If necessary, clean as directed in Paragraph 5-6.1.

5-4.2.10 Inspect Discharge Nozzles

Inspect discharge nozzles for dirt and physical damage. Replace damaged nozzles. If nozzles are dirty or clogged, refer to Paragraph 5-6.1.

CAUTION

Nozzles must never be painted.

Nozzles must be replaced by nozzles of the same part number. (A part number is located on each nozzle.) Nozzles must never be interchanged since random interchanging of nozzles could adversely affect proper HFC-227ea distribution and concentration within a hazard area.

5-4.2.11 Inspect Pull Stations

Inspect all manual pull stations for cracks, broken or cracked glass plate, dirt or distortion. Inspect the station for signs of physical damage. Replace damaged glass. Replace the station if damaged. If necessary, clean as directed in Paragraph 5-6.1.

5-4.2.12 Inspect Pressure Switches

Inspect pressure switches for deformations, cracks, dirt or other damage. Replace the switch if damaged. If necessary, clean the switch as directed in Paragraph 5-6.1.

5-4.3 Inspection Procedures, Semi-Annual

5-4.3.1 Pressure Switch Test

Perform the pressure switch test as follows:

1. Contact the appropriate personnel and obtain authorization for shutdown.
2. Ensure the hazard area operations controlled by pressure switch are operative.
3. Manually operate the switch by pulling up on the plunger and verify that hazard area operations controlled by pressure switch shut down.
4. Return the pressure switch to the SET position.
5. Reactivate all systems that were shut down by the pressure switch (such as power, ventilation systems and compressors).

5-4.3.2 Electric Control Head Test

Electric control heads must be tested semiannually for proper operation. This test can be performed without discharging the HFC-227ea cylinders. Test one hazard area at a time before proceeding to the next, as follows:

CAUTION

All control heads must be removed from HFC-227ea cylinders and nitrogen pilot cylinders prior to testing to prevent accidental cylinder discharge.

1. Remove all electric control heads from all HFC-227ea cylinders and nitrogen pilot cylinders serving the hazard area being tested. Let the electric control heads hang freely from the flexible electric conduit connections. Leave all pressure operated control heads and pilot actuation hoses attached to the cylinders.
2. Operate HFC-227ea system electrically. This can be accomplished by actuation of the HFC-227ea system at the system control panel or by manual operation of an electric pull station.
3. Ensure all electric control heads have operated, that is, the indicator on the electric control head has moved to the RELEASED position, or in the case of a control head (P/N 82-486500-010) observe that the actuating pin has moved to the fully actuated position. If any control heads have not operated, check the circuit for electric continuity to these particular heads and repeat the test. Replace all damaged heads. Repeat the test if any control heads have been replaced.

CAUTION

Electric control heads must be reset manually before reconnecting to the cylinder valves.

4. Observe the instructions on the caution label attached to each electric control head (P/N 82-486500-010). Replace any damaged heads which fail to reset properly before reconnecting to cylinders. Reattach all electric control heads to the threaded port on the cylinder valve or pressure operated control head. Tighten the swivel nut securely. Make certain each electric control head is in SET position before reconnecting to cylinders. Failure to follow this procedure will result in accidental HFC-227ea discharge.

5-4.3.3 Check HFC-227ea cylinder weights and pressures

Use the following procedures to check the weights and pressures of all HFC-227ea cylinders.

5-4.3.3.1 Cylinders Not Equipped with Flexible Tape Liquid Level Indicator

Weigh 10 through 900 lb HFC-227ea cylinders as follows:

WARNING

Install a protection cap on the HFC-227ea cylinder valve actuation port and safety cap on the cylinder valve outlet port.

Disconnect all cylinder control heads, discharge hoses, and flexible pilot hoses to prevent accidental system discharge.

1. Remove the cylinder as instructed in Paragraph 5-7.
2. Place the cylinder on a scale.
3. Record the weight and date on a record card and attach it to the cylinder. The gross weight and tare (empty) weight are metal stamped on the HFC-227ea cylinder valve label. Therefore, subtract tare weight from the gross weight to determine net weight of the original charge. Then, subtract tare weight from the scale reading to determine net weight of the HFC-227ea agent remaining in the cylinder. If the recorded agent net weight is less than 95% of original charge net weight, replace the cylinder with a fully charged HFC-227ea cylinder (recharging the cylinders is explained in Paragraph 6-3).
4. Reinstall the cylinder (see Paragraph 5-8 for reinstallation instructions).

5-4.3.3.2 Cylinders Equipped with Flexible Tape Liquid Level Indicator

The following procedure explains how to determine the HFC-227ea weight of 125, 200, 350, 600 and 900 lb cylinders equipped with a flexible tape liquid level indicator. This procedure can be performed without removing the HFC-227ea cylinders from the system.

1. Remove the protective cap to expose the tape.
2. Raise the flexible tape slowly until it latches.
3. Note the reading at the point where the tape emerges from the fitting.

CAUTION

Take care to not pull the flexible tape upwards after it latches to ensure an accurate reading.

4. To determine the final, more precise reading, repeat the above procedure. About two inches before the tape should latch, raise the tape very slowly until it latches.
5. While supporting the weight of the tape, record the liquid level measurement.

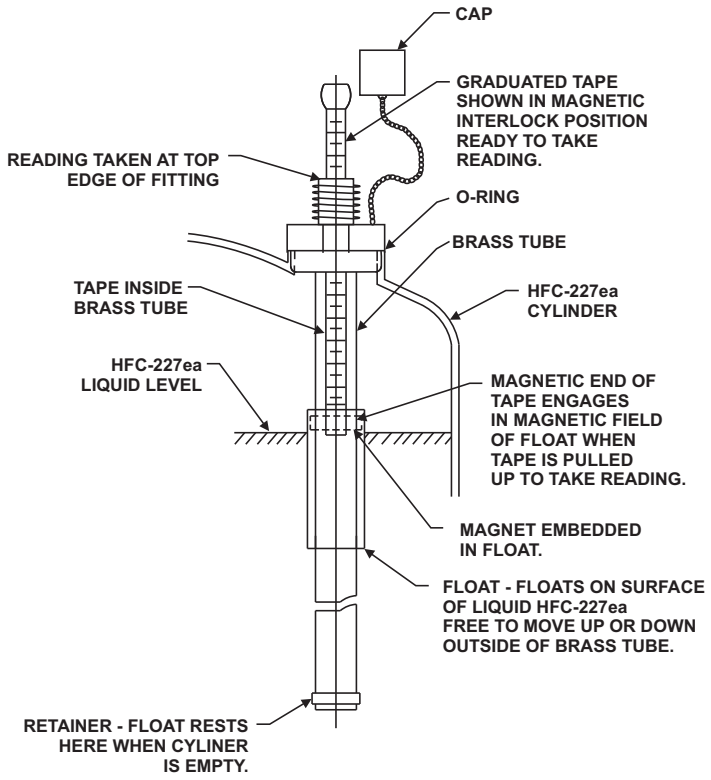

Figure 5-1. Liquid Level Indicator

6. Check the ambient temperature where the HFC-227ea cylinders are stored and record the temperature.
7. Refer to the appropriate calibration charts (see Figure 5-2 through Figure 5-7) and locate the level reading on the vertical axis (labeled Flexible Tape Reading). Trace horizontally to the right to the appropriate temperature line. Read the weight of HFC-227ea from the scale at the bottom of the chart. Record the weight and date on the record tag attached to the cylinder.
8. After taking the reading, carefully push the tape down into the liquid level housing. Replace the protective cap.

Note: If the weight measured by the liquid level indicator indicates the cylinder should be re-charged, we recommend the cylinder first be removed from service and the weight loss verified using a weigh scale before recharging.

All HFC-227ea cylinders must be filled or recharged by weight using a platform scale or equivalent. If weight loss is more than 5% of the HFC-227ea charge, the unit must be recharged.

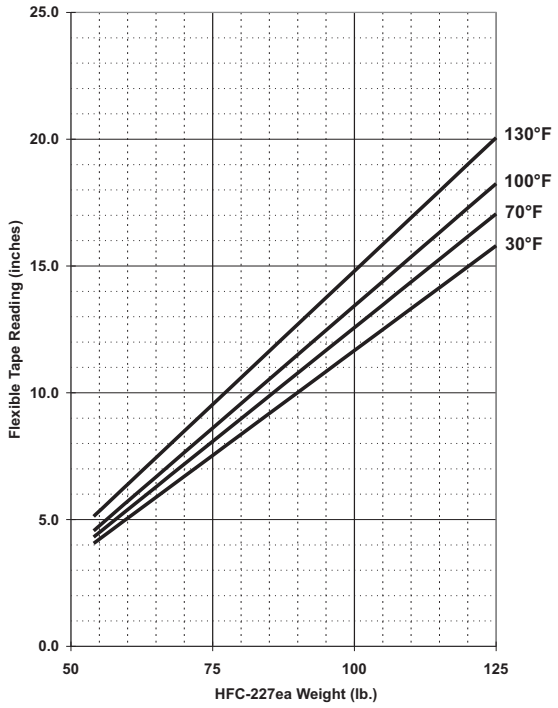

Figure 5-2. Calibration Chart 125lb Cylinder

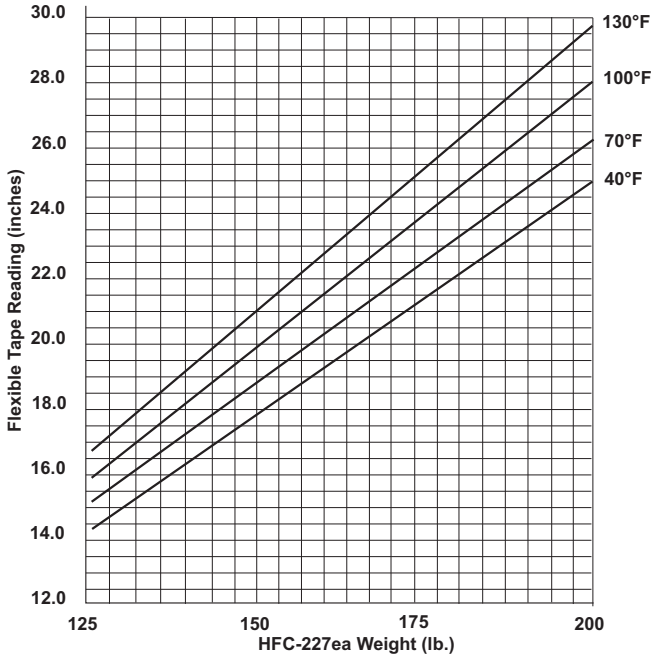

Figure 5-3. Calibration Chart for Old 200lb Cylinder

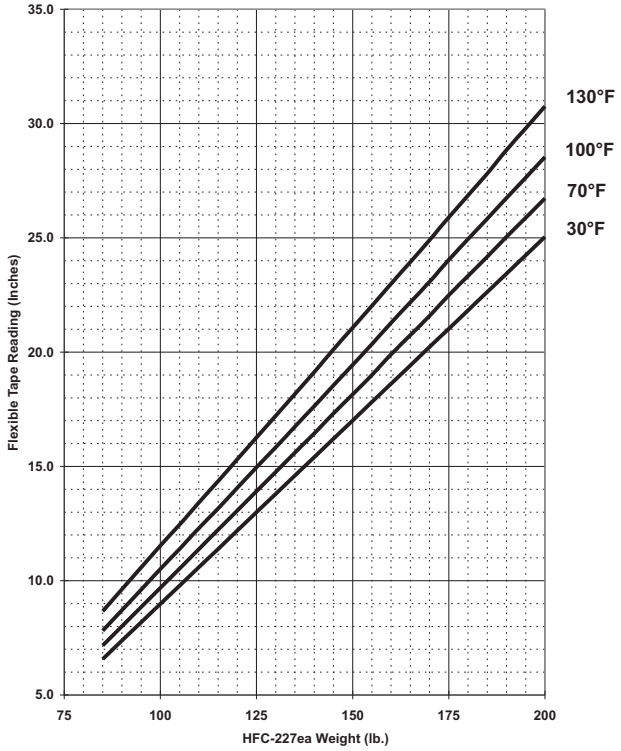

Figure 5-4. Calibration Chart for a New 200lb Cylinder (New Design Ellipsoidal Head Manufactured After 3/98)

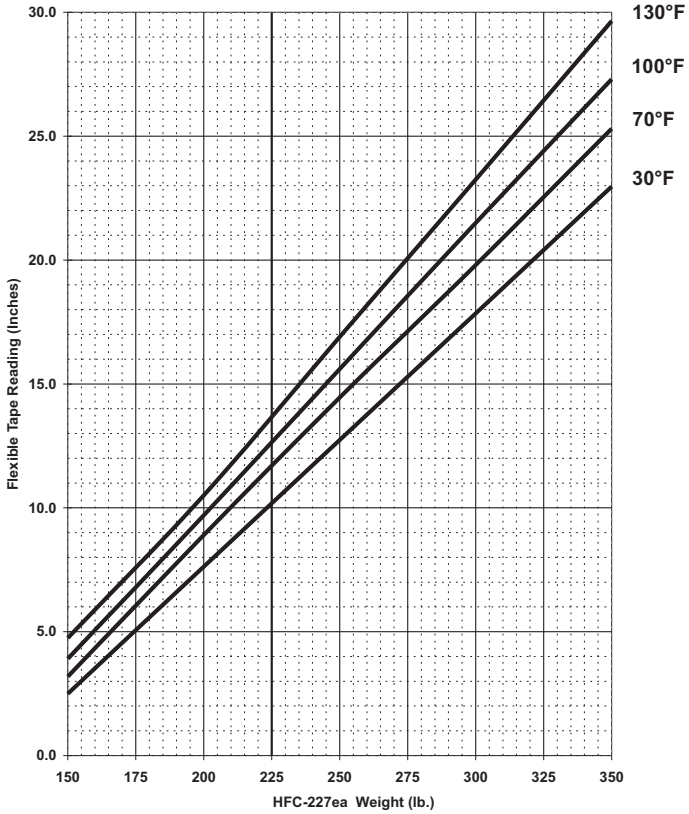

Figure 5-5. Calibration Chart for 350lb Cylinder

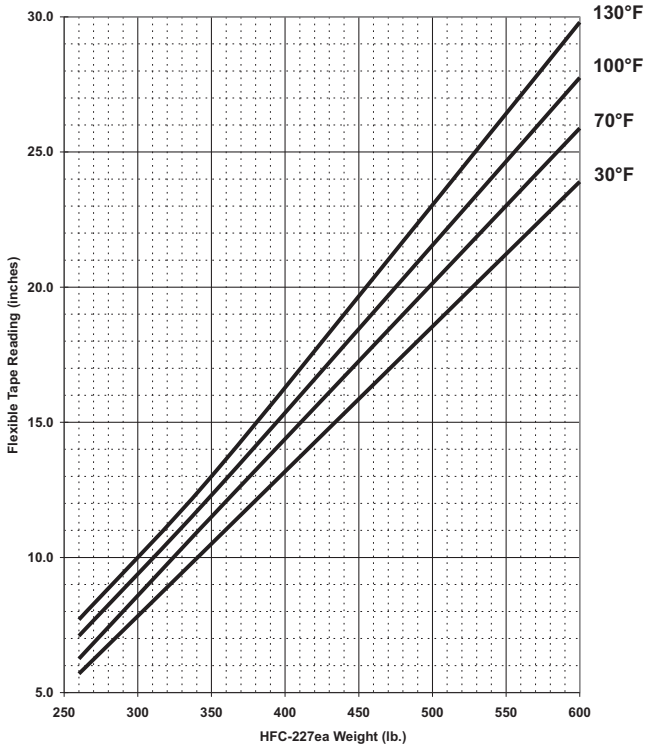

Figure 5-6. Calibration Chart for 600lb Cylinder

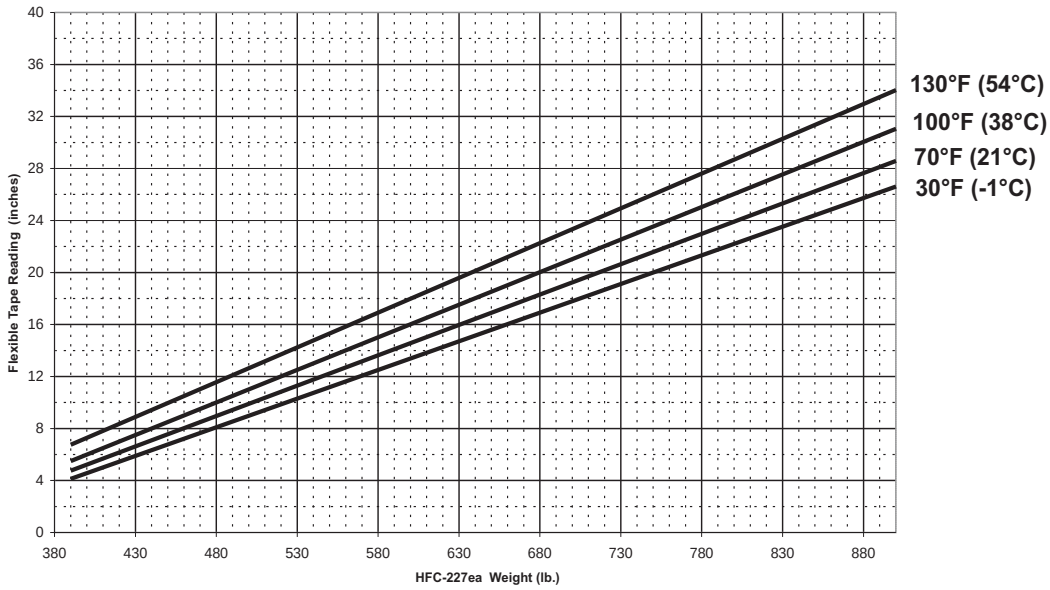

Figure 5-7. Calibration Chart for 900lb Cylinder

5-4.4 Inspection Procedures–2 Year

WARNING **Do not use water or oxygen to blow out pipe lines. Using oxygen is especially dangerous since even a minute quantity of oil may cause an explosion.**

1. Remove any nozzles from piping to allow any foreign matter to blow clear.
2. Remove all pressure operated control heads from the HFC-227ea cylinders.

WARNING **Do not disconnect the flexible hose from the pressure operated control head. If HFC-227ea accidentally discharges, the unattached flexible hose will whip around and may damage equipment and cause severe bodily injury.**

3. Open the distributing valves and keep them open long enough to ensure the pipes are clean.
4. Blow out all distribution piping with air or nitrogen to ensure it is not obstructed.
5. Reconnect all control heads.

5-5 INSPECTION AND RETEST PROCEDURES FOR HFC-227ea CYLINDERS

A cylinder that is damaged or corroded should be emptied, retested and restamped in accordance with DOT Regulatory Compliance Guide, 49 CFR 180.209 (see Paragraph 5-5.3).

CAUTION **These guidelines do not apply to cylinders containing a commodity other than HFC-227ea.**

All Kidde ECS cylinders are designed, fabricated, and factory tested at 1000 PSIG (68.9 bar gauge) in compliance with DOT CFR 49 4BA-500 or 4BW-500 as stamped on each cylinder.

Two sets of regulations will apply to periodic inspection and test procedures depending on the following:

5-5.1 Cylinders Continuously in Service Without Discharge

These cylinders are governed by NFPA 2001 regulations. Cylinders in continuous service without discharge require a complete external visual inspection every five years in accordance with Compressed Gas Association Pamphlet C-6, Section 3, except that the cylinders need not be emptied or stamped while under pressure. Record date of inspection on record tag attached to each cylinder. Where the visual inspection shows damage or corrosion, the cylinder shall be emptied, retested and restamped in accordance with the DOT Regulatory Compliance Guide, 49 CFR 180.209.

5-5.2 Discharged Cylinders or Charged Cylinders That are Transported

These cylinders may come under NFPA 2001 requirements, or, in the case of shipment of charged cylinders, DOT, federal or state regulations may apply. In either case, the cylinders shall not be charged and shipped if more than five years have elapsed from the date of the last test date stamped on the cylinder. The cylinders shall be retested and restamped in accordance with the DOT Regulatory Compliance Guide, 49 CFR 180.209.

5-5.3 Retest

DOT 4BA and 4BW cylinders used exclusively in HFC-227ea services that are commercially free from corroding components are required to be hydrostatically retested and restamped every five years, in accordance with the DOT Regulatory Compliance Guide, 49 CFR 180.209, prior to recharge and shipment. An alternate option is an external visual inspection performed in lieu of the hydrostatic test at the time the periodic retest becomes due (this option is in accordance with CFR 49, Paragraph 180.209). Table 5-2 highlights the two options for retesting HFC-227ea cylinders.

Table 5-2. Retest Schedule

Retest Method	First Retest Due	Subsequent Retest Due	Special Marketing
Full hydrostatic test including determination of cylinder expansion	5 Years	5 Years	Retest Date Month/Year
External visual inspection per DOT Regulatory Compliance Guide, 49 CFR 180.209 and CGA Pamphlet C-6, Section 3	5 Years	5 Years	Retest Date Followed by "E"

5-5.4 Flexible Hoses

In accordance with NFPA 2001 Edition 2012 (Clause 7.3), all system hoses shall be examined annually for damage. If visual examination shows any deficiency, the hose shall be replaced or tested.

5-6 SERVICE

5-6.1 Cleaning

Remove dirt from metallic parts using a lint-free cloth moistened with dry cleaning solvent. Dry parts with a clean, dry, lint-free cloth, or air blow dry. Wipe non-metallic parts with a clean, dry lint-free cloth. Remove corrosion with a crocus cloth.

5-6.2 Nozzle Service

Service nozzles after use as follows:

1. Clean the outside of the nozzles with a rag or soft brush.
2. Examine the discharge orifices for damage or blockage. If the nozzles appear to be obstructed, unscrew the nozzles and clean by immersing them in cleaning solvent. Dry thoroughly with lint-free cloth. Replace damaged nozzles. Nozzles must be replaced with the same part number in the same location. See Paragraph 4-2.3.5 for the correct nozzle placement and orientation.

5-6.3 Repairs

Replace all damaged parts found during inspection. Replacement procedures for HFC-227ea cylinders are provided below. Since replacement for other system components are similar, refer to the installation drawings and HFC-227ea system assembly drawings for guidance.

HFC-227ea cylinders must be recharged when the cylinder pressure gauge indicates the pressure is below normal (360 PSIG at 70°F [25 bar gauge at 21°C]), immediately after discharge, when a loss in weight is in excess of 5% of the original charged net weight or when there is a loss of pressure (adjusted for temperature) of more than 10%.

5-7 REMOVING AN HFC-227ea CYLINDER

Remove an HFC-227ea cylinder as follows:

WARNING

Do not disconnect the flexible discharge hose or valve outlet adapter prior to removing pressure and electric control heads from the HFC-227ea cylinders. Before replacing an HFC-227ea cylinder in a hazard area group, ensure that the pilot line is completely vented of all pressure.

5-7.1 Single Cylinder System

1. Remove the supervisory pressure switch (where installed) by disconnecting the electrical connection at the switch, then remove the wire lead protection or conduit. Unscrew the switch from the cylinder valve and install the protection cap on the switch connection port. Install a protection cap on the nitrogen driver cylinder valve actuation port.
2. Disconnect the swivel nut on the control head from the cylinder valve actuation port, Remove the control head from the HFC-227ea cylinder.
3. Install a protection cap on the HFC-227ea cylinder valve actuation port.
4. Remove the valve outlet adapter or loosen the swivel nut and remove the flexible discharge hose from the discharge outlet port adapter.
5. Immediately install a safety cap on the cylinder valve outlet port.
6. Remove the cylinder strap. Remove the HFC-227ea cylinder from the bracket. Weigh the cylinder using a platform scale.

5-7.2 Multiple Cylinder System

WARNING

Remove all control heads from the HFC-227ea cylinders.

1. Remove the supervisory pressure switches (where installed) by disconnecting the electrical connection at the switch, then remove the wire lead protection or conduit. Unscrew the switch from the cylinder valve and install the protection cap on the switch connection port.
2. Disconnect the swivel nut on the pressure operated control heads from the cylinder valve actuation port. Remove the control heads from all HFC-227ea cylinder valves, leaving the flexible actuation hose or tubing attached to the pressure operated control heads.
3. Immediately install a protection cap on all HFC-227ea cylinder valve actuation ports.
4. Remove the tubing from the master cylinder adapter on the master cylinder (if used).

WARNING

To prevent injury in the event of discharge, the master cylinder adapter cap must be installed on the adapter whenever tubing is not connected to the master cylinder valve. Under no circumstances is the protection cap to be removed from its chain.

5. Immediately install the protection cap on the master cylinder adapter port.
6. Loosen swivel nut and remove flexible discharge hose from discharge outlet port.

WARNING

To prevent injury, all cylinders must have safety caps installed immediately on the outlet ports when discharge hoses or the valve outlet adapter is disconnected.

7. Immediately install the safety cap on the cylinder valve outlet port.
8. Remove the attaching hardware or cylinder straps. Remove the HFC-227ea cylinder from the bracket. Weigh the cylinders using a platform scale.

5-8 REINSTALLING AN HFC-227ea CYLINDER

Installing an HFC-227ea Cylinder. Install HFC-227ea cylinders as follows:

5-8.1 Single Cylinder System

1. Position the HFC-227ea cylinder in the designated location. Secure it in place with a cylinder strap or wall bracket and mounting hardware. Orient the cylinder with the valve outlet angled toward the cylinder discharge piping (refer to the installation drawings).

WARNING

Discharge hoses or valve outlet adapters must be connected into system piping (union connection) before attaching to cylinder valves.

2. Remove the safety cap from the cylinder valve outlet port.
3. Immediately reconnect the valve outlet adapter or flexible discharge hose to the cylinder outlet port.
4. Remove the protection cap from the HFC-227ea cylinder actuation port.

WARNING

The control head must be in the SET position (that is, the actuating pin must be in the fully retracted or SET position) before being attached to the cylinder valve. Control heads not in the SET position will cause discharge of HFC-227ea when installed on the cylinder valve.

5. Install the control head.
6. If required, install the supervisory pressure switch, as instructed in Paragraph 4-3.21.

5-8.2 Multiple Cylinder System

1. Position the HFC-227ea cylinders in the designated locations. Secure it in place with a cylinder strap or wall bracket and mounting hardware. Orient the cylinder with the valve outlet angled toward the cylinder discharge piping (refer to the installation drawings).

WARNING

Discharge hoses or valve outlet adapters must be connected into system piping (union connection) before attaching to cylinder valves.

2. Remove the safety caps from the cylinder valve outlet ports.
3. Immediately reconnect the flexible discharge hoses or valve outlet adapters to the cylinder valve outlet ports.
4. Remove the protection cap from the master cylinder adapter port (if used) and reconnect the tubing to the slave port on the master cylinder. Tighten the swivel nut.
5. Remove the protection caps from the HFC-227ea cylinder valve actuation ports.

WARNING

The control head must be in the SET position (that is, the actuating pin must be in the fully retracted or SET position) before being attached to the cylinder valve. Control heads not in the SET position will cause discharge of HFC-227ea when installed on the cylinder valve.

6. Reinstall electric and pressure operated control heads with flexible actuation hoses or tubing on the cylinder valve actuation ports. Tighten the swivel nuts.
7. If required, install the supervisory pressure switches as explained in Paragraph 4-3.21.

5-8.3 Nitrogen Pilot Cylinders

1. Install nitrogen cylinder in mounting bracket. Rotate cylinder until valve outlet is in desired position.
2. Tighten mounting bracket strap.
3. Remove pipe plug and connect adapter (Part No. WK-699205-010) to cylinder valve outlet port. Attach flexible actuation hose to outlet port adapter.
4. Remove protection cap from cylinder valve control head port.

WARNING

Control head must be in the "set" or "closed" position before attaching to the cylinder valve, which will prevent:

an accidental discharge of the nitrogen cylinder and any corresponding suppression agent or nitrogen leak during actuation

Failure to properly set the control head may cause damage to the unit and could result in one of the aforementioned concerns.

5. Install control head to cylinder valve.
6. Tighten the control head to the valve. Tightening the control head to the valve requires that a wrench be used to hold the valve while the control head hex nut is tightened. The outlet fitting (1/8 NPT to 5/16 tube connector) must be removed to expose the two flats on the valve body (new cylinders are supplied with plastic shipping plug in this outlet).
7. Both the valve body and the control head hex nut are 1-1/2" across the flats. Hold the valve body using a 1-1/2" wrench (preferred) or a suitable smooth jawed adjustable wrench.
8. Position the control head in the desired orientation and hand tighten the hex-nut. Using a torque wrench[1] fitted with a 1-1/2" crowfoot wrench, tighten to a minimum torque of 60 ft· lb[2].
9. Reinstall outlet fitting and connect to system hose, tubing or pipe (as appropriate).

[1] Recommended 10-100 ft·lb 1/2" drive torque wrench. Other ranges are acceptable provided 40-60 ft·lb is within optimum tolerance for the tool.

[2] Set wrench to a minimum setting of 55 ft·lb (most styles of crowfoot will increase the actual torque value by approximately 10% since a typical 1-1/2" crowfoot wrench has a center-to-center dimension of 2". Actual minimum torque value is 60 ft· lb Calculate effect of crowfoot using tool manufacturer's data.

CHAPTER 6
POST- DISCHARGE MAINTENANCE

6-1 INTRODUCTION

Follow these procedures after the Kidde ECS System has been activated and HFC-227ea has been discharged.

6-2 POST-FIRE MAINTENANCE

6-2.1 HFC-227ea Valve Inspection and Service

Inspect and service the HFC-227ea valve as follows:

Important–Because the HFC-227ea tends to dissolve and wash out lubricant, certain components in the HFC-227ea valve assembly will have to be inspected and serviced before recharging the cylinder/valve assembly. Part numbers for items which may require replacement are listed in Table 6-1.

Note: Whenever the valve is rebuilt, the Safety Disc Assembly must be replaced along with the O-rings.

6-2.2 Valve Disassembly (1½ in, 2 in and 2½ in Valve)

Refer to Figure 6-1, Figure 6-2, Table 6-1, and Table 6-2.

WARNING **Before removing the valve, make sure that all pressure has been relieved from the cylinder. To relieve any remaining pressure, restrain the cylinder and depress the pressure switch Schraeder valve until all pressure is relieved.**

1. Remove the valve with the siphon tube from the cylinder.
2. Remove the O-ring and replace it, applying a lubricant to the new O-ring.
3. Remove the valve cap, spring and piston assembly.

Note: Remove all internal components of HFC-227ea valve from the top of the assembly. However, if there is excessive piston O-ring friction, the siphon tube may have to be removed and the piston assembly pressed out from the bottom.

4. Remove the O-rings and replace, applying lubricant to the new O-rings.
5. Ensure that the O-ring protrudes a minimum or 0.020 in (0.5 mm) above the conical seating surface of the piston assembly. Replace this O-ring by removing the seat retainer. Before reassembly, apply a lubricant to the O-ring.
6. Examine the valve core pin for any evidence of bending or other damage. Depress the pin and make certain it snaps back freely. Replace the valve core if necessary using a standard Schraeder core wrench. When reinstalling a new Schraeder core element, torque to 1½ to 3 in· lb (0.17 to .34 N-m).

CAUTION **After reinstalling a Schraeder core, the distance from the top of the core pin to the control head seating surface must fall between the dimensions of 0.515 in to 0.565 in (13 mm to 14 mm) when in the "shut" or non-actuated position (see Figure 6-1).**

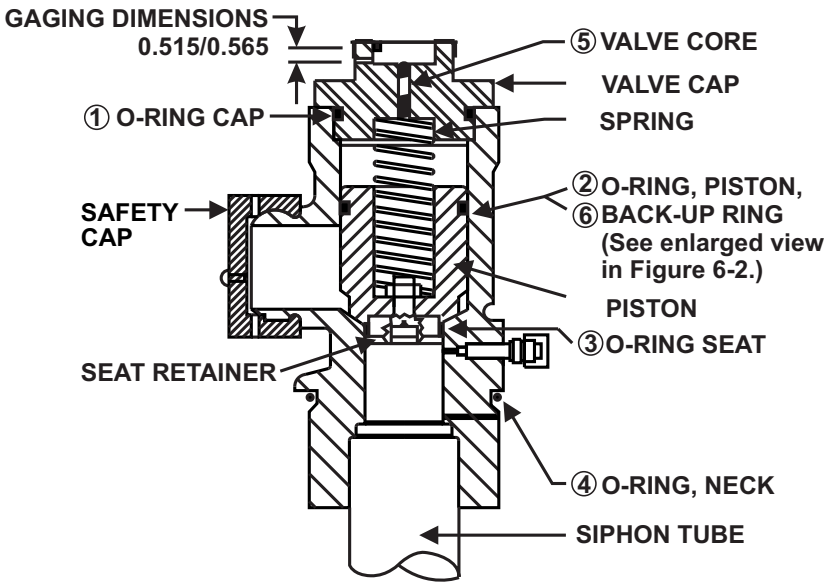

Figure 6-1. Valve Assembly (1 1/2", 2", and 2 1/2")

Figure 6-2. Piston O-Ring

Table 6-1. Valve Components

Figure Item No.	Description	1 1/2" Valve	2" Valve	2 1/2" Valve
1	O-ring, cap	WK-566102-250	WK-566102-300	WK-566102-340
2	O-ring, piston	WK-566103-250	WK-566103-300	WK-566103-340
3	O-ring, seat	WK-566102-150	WK-566103-260	WK-566103-310
4	O-ring, neck	WK-566109-320	WK-566103-350	WK-566103-390
5	Schraeder core	WK-220278-000	WK-220278-000	WK-220278-000
6	Back-up ring	WK-554003-250	WK-554003-300	WK-554003-340

Table 6-2. Other Valve Component Materials

Other Materials	Manufacturer and Nomenclature
Lubricant	Parker Seal Co. Super-O-Lube or equivalent
Loctite Sealant	Loctite Corp. Sealant, Grade CV or equivalent
Locquic Primer	Loctite Corp. Primer, Grade N or equivalent

6-2.3 Valve Disassembly (3-inch Valve)

Note: Refer to Figure 6-3 and Table 6-3 for items.

WARNING

Before removing the valve, make sure that all pressure has been relieved from the cylinder. To relieve any remaining pressure, ensure the cylinder is secured then depress the pressure check in the Supervisory Pressure Switch.

1. Remove the valve with the siphon tube from the cylinder.
2. Remove the cylinder neck O-ring and replace it. Before reinstalling the O-ring, apply lubricant.
3. Remove the valve cap, spring and piston assembly.

Note: Remove all internal components of the HFC-227ea valve from the top of the assembly. However, if there is excessive piston O-ring friction, the siphon tube may have to be removed and the piston assembly pressed out from the bottom.

4. Remove the O-rings and replace them. Before reinstalling the O-rings, apply lubricant.
5. Ensure that the O-ring protrudes a minimum of 0.020 in. (0.5 mm) above the conical seating surface of the piston assembly. Replace this O-ring by removing the seat retainer. Before reassembling, apply lubricant to the O-ring.
6. Examine the pilot check for any evidence of bending or other damage. Depress the check and make certain it snaps back freely. Replace pilot check if necessary.

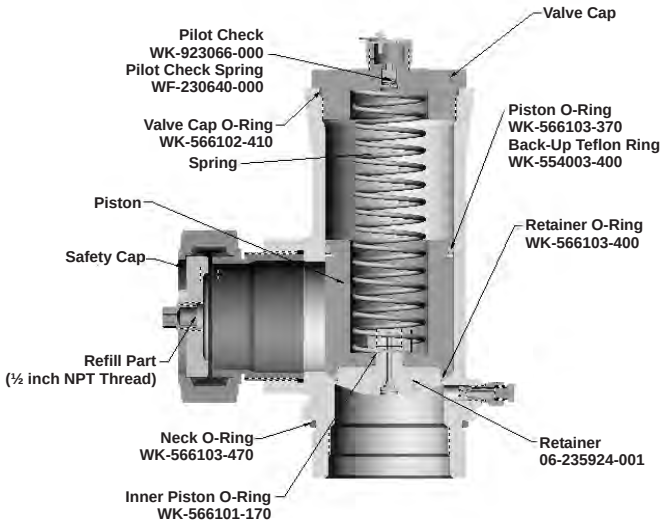

Figure 6-3. 3-inch Valve Assembly

Table 6-3. 3-inch Valve Components

Description	Part Number
O-ring, Cap	WK-566102-410
O-ring, Piston	WK-566103-370
O-ring, Seat	WK-566103-400
O-ring, Neck	WK-566103-470
O-ring, Inner Piston	WK-566101-170
Back-up Ring	WK-554003-400

6-2.4 Replacing 3-Inch Valve Pilot Check

Note: Refer to Figure 6-4 for items.

1. Remove the valve cap.
2. Using retaining ring pliers, remove the retaining ring holding the pilot check, spring, and disk in place. Save the retaining ring.
3. Remove the disk, spring, and pilot check. Save the disk.
4. Install the new pilot check and new spring.
5. Place the disk in and hold the assembly in place with the retaining ring.
6. Make sure the pilot check moves freely.

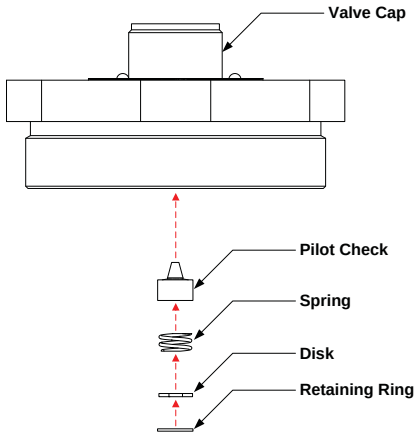

Figure 6-4. 3-Inch Valve Pilot Check Assembly

6-2.5 Valve Assembly (1½ in, 2 in and 2½ in Valve)

Note: The items refer to Figure 6-1.

CAUTION

If the siphon tube is being replaced due to damage or wear, contact Kidde Fenwal Inc. to ensure the proper replacement part is ordered based on the manufacturing date of the valve.

1. Install the O-ring in the piston groove.

CAUTION

Make certain that the Teflon® back-up ring is below the O-ring as shown in Figure 6-2.

2. Press the piston back into the valve body.
3. Install the spring.
4. Install the O-ring (Item 1) onto the groove in the valve cap, screw the cap into the valve body and torque to 250 in lb (28.2 N-m).
5. If the siphon tube had to be removed to disassemble the valve, wire brush the siphon tube threads to remove the old Loctite® residue.
6. Apply a film of Loctite® primer to the siphon tube threads and allow three to five minutes to dry.
7. Apply a film of Loctite® sealant to the threads and reinstall the siphon tube.
8. Install the O-ring onto the valve neck groove, screw the valve and siphon tube into the cylinder, and torque to 50 to 55 ft lb (68 to 75 N-m).

6-2.6 Valve Assembly (3-inch)

Note: Refer to Figure 6-3 and Table 6-3.

CAUTION

If the siphon tube is being replaced due to damage or wear, contact Kidde Fenwal Inc. to ensure the proper replacement part is ordered based on the manufacturing date of the valve.

1. Install the O-ring (Item 2 in Figure 6-3) in the piston groove.

CAUTION

Make certain that the Teflon® back-up ring is below the O-ring as shown in Figure 6-3.

2. Press the piston back into the valve body.
3. Install the spring.
4. Install the O-ring onto the groove in the valve cap. Screw the cap onto the valve body and torque to 360 in lb (41 N-m).
5. If the siphon tube had to be removed for valve disassembly, wire brush the siphon tube threads to remove the old Loctite residue.
6. Apply a film of Loctite® primer to the siphon tube threads and allow three to five minutes to dry.
7. Apply a film of Loctite® sealant to the threads and reinstall the siphon tube.
8. Install the O-ring onto the valve neck groove, screw the valve and siphon tube onto the cylinder, and torque to 600 to 660 in lb (68 to 75 N-m).

6-2.7 Safety Disc Replacement (1½-inch and 2½-inch valves and 2-inch valves manufactured prior to May 2014)

Note: For 2 inch valves, this process only applies to those 2 inch valves manufactured prior to or during April 2014. For 2 inch valves manufactured after April 2014, see Section 6-2.8.

CAUTION

Whenever the valve is rebuilt, the Safety Disc Assembly must be replaced. Refer to Figure 6-5.

WARNING

Before removing the valve, make sure that all pressure has been relieved from the cylinder. To relieve any remaining pressure, restrain the cylinder and depress the pressure check in the Supervisory Pressure Switch.

The safety disc is located on the valve.

1. Remove the safety disc retainer including safety disc and safety disc washer from the cylinder body. See Figure 6-5. Discard the safety disc and washer.
2. Assemble the new safety disc retainer with a new safety disc and safety disc washer to the valve body. Torque to the appropriate value listed in Table 6-4.

WARNING

Never install any type disc other than specified in Table 6-4 for the appropriate cylinder. Installing the incorrect disc could result in violent rupture of the cylinder and serious injury.

Make sure that multiple safety discs are not stuck together. Installing more than one safety disc could result in violent rupture of the cylinder and serious injury.

Never reinstall a used safety disc and/or washer. Once the retainer has been removed or the valve has been rebuilt, the disc and washer must be replaced with new components.

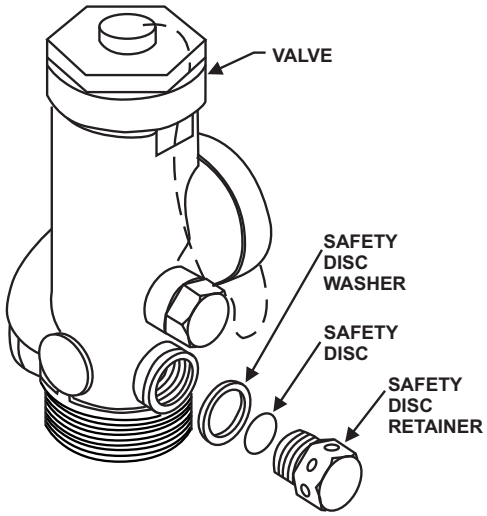

Figure 6-5. Safety Disc Replacement

Table 6-4. Safety Disc Replacement (11/2 in, 2 in and 21/2 in Valve)

Valve Size	Safety Disc P/N	Safety Disc Washer P/N	Torque Valve	PSIG @ 70°F
1 1/2 in	WK-242461-000	WK-294500-000	33 ft lb	750-900
2 in	WK-264925-000	WK-220360-000	38 ft lb	800-975
2 1/2 in	WK-264929-000	WK-220362-000	48 ft lb	800-975

6-2.8 Safety Disc Replacement (3-inch and 2-inch Manufactured after April 2014)

Note: This process only applies to 3-inch valves and 2-inch valves manufactured after April 2014. For 2-inch valves manufactured during or before April 2014, see Section 6-2.7.

CAUTION

Whenever the valve is rebuilt, the Safety Disc Assembly must be replaced.

WARNING

Before removing the Safety Burst Disc Assembly, make sure that all pressure has been relieved from the cylinder. To relieve any remaining pressure, restrain the cylinder and depress the pressure check in the Supervisory Pressure Switch.

The safety disc for the new 2-inch valve and the 3-inch valve is located on the cylinder head, not on the cylinder valve.

1. Remove and discard the safety burst disc assembly (see Figure 6-6 and Figure 6-7).
2. Apply lubricant to the packing o-ring of the new safety burst disc assembly.
3. Install the new safety disc assembly to the cylinder. Torque to the appropriate value listed in Table 6-5.

WARNING

Never install any other type of safety burst disc assembly than specified in Table 6-5 for the corresponding cylinder. Installing the incorrect assembly could result in a violent rupture of the cylinder and cause death, serious injury and/or property damage. The Safety Disc Retainer on the 2-inch valve is smaller than the Safety Disc Retainer on the 3-inch valve.

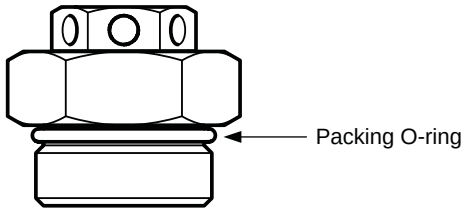

Figure 6-6. 2” Valve/Cylinder Safety Burst Disc Assembly

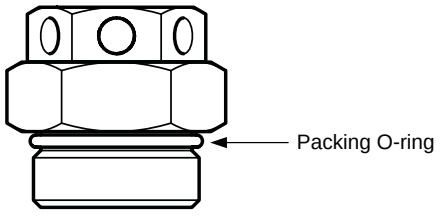

Figure 6-7. 3” Valve/Cylinder Safety Burst Disc Assembly

Table 6-5. Safety Disc Replacement Table (3-inch Valve and New 2-inch Valve)

Safety Disc Assembly P/N	Torque	PSIG @ 70°F	Cylinder Size
90-150100-000	90 ft lb	800-975	200 and 350 lb.
90-170100-000	90 ft lb	800-975	600 and 900 lb.

6-3 RECHARGING HFC-227ea CYLINDERS

CAUTION

HFC-227ea cylinders may require retest before recharging. See Paragraph 5-5 for details on cylinder retest. FM Approval is based upon the usage of factory filled HFC-227ea cylinders.

WARNING

Under no circumstances while performing either cylinder recharge or leak test should a charged cylinder be allowed to free stand without either the charging apparatus attached or the safety cap installed. Whenever these devices are not installed, a charged cylinder must be securely clamped to a rigid structure capable of sustaining the full thrust that would result should the valve inadvertently open. The clamping device and supports must be capable of withstanding a thrust force of 1800 lb (816 kg) for the 2-inch valve or 2800 (1270 kg) for the 3-inch valve. This approximates the thrust force generated out of the HFC-227ea cylinder valve outlet on a full, wide open discharge.

HFC-227ea charging equipment consists of an HFC-227ea storage container, piping adapter, control valves, strainer, pressure gauge, flexible hoses, seating adapter, recharge adapter, pump, scale and interconnecting plumbing. Recharge equipment must be suitable for the purpose intended and must be compatible with HFC-227ea. A typical HFC-227ea charging system schematic is shown in Figure 6-8.

Note: During recharge, cylinder pressure gauge is not to be used to determine charging pressure.

Locate the charging equipment in a clean, well-ventilated area near the HFC-227ea supply and cylinder storage. There should be sufficient room for moving the cylinders to and from the charging equipment.

6-3.1 Charging Equipment Installation

Before assembling the charging equipment, apply Permacel® No. 412D Teflon® tape to all pipe threads.

6-3.2 Charging System Diagram

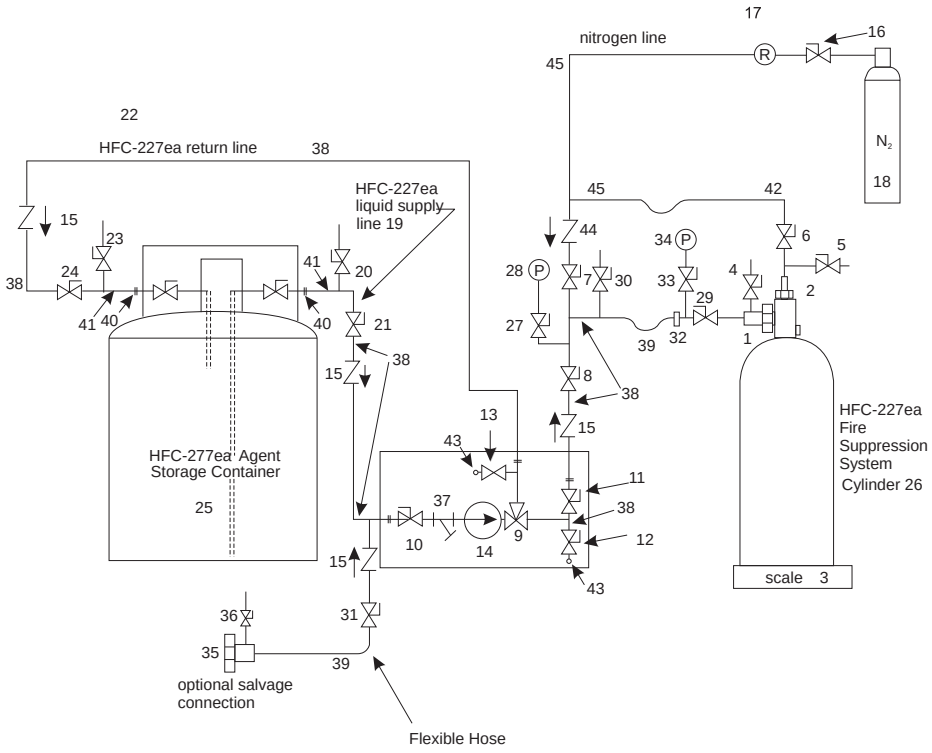

Figure 6-8. Typical HFC-227ea Charging System for Kidde ECS Cylinders

Table 6-6. Item List for Figure 6-8

Item No.	Description	Item No.	Description	Item No.	Description	Item No.	Description
1	Recharge adapter	**13**	Safety relief - vapor	**25**	HFC-227ea storage container	**37**	Strainer
2	Seating adapter	**14**	Pump	**26**	HFC-227ea Fire Suppression System cylinder	**38**	Stainless Steel pipe
3	Weigh scale	**15**	Check valve	**27**	Ball valve	**39**	Flex hose
4	Vent valve - recharge	**16**	Ball valve	**28**	Master pressure gauge	**40**	Valve adapter
5	Vent valve - seating	**17**	Regulator	**29**	Ball valve	**41**	Hose, flex metal
6	Ball valve	**18**	Nitrogen cylinder	**30**	Vent valve	**42**	Flex metal hose
7	Ball valve	**19**	HFC-227ea Supply Line	**31**	Ball valve	**43**	Relief Valve
8	Ball valve	**20**	Vent valve	**32**	Quick disconnect fitting	**44**	1/4” NPT check valve
9	3-Way valve	**21**	Ball valve	**33**	Ball valve	**45**	1/4” sch stainless steel pipe
10	Ball valve	**22**	HFC-227ea return line valve	**34**	Pressure Gauge		
11	Ball valve	**23**	Vent valve	**35**	Salvage adapter		
12	Safety relief - liquid	**24**	Ball valve	**36**	Vent valve - salvage		

6-3.3 Charging Procedure

Recharge HFC-227ea cylinder and valve assembly as follows:

Note: HFC-227ea cylinder received from Kidde Fire Systems may be pressurized per the partial fill tag.

1. Check the cylinder for the last hydrostatic test date. Perform any required Department of Transportation (DOT) requalification tests or examinations.
2. Check the cylinder and valve assembly for physical defects. If you find any of the following, do not charge the cylinder: cracks of any kind, elongated pits of any length, inclusions of any size, pitting, bulging, dents, corrosion, fire damage, mechanical defects, scratches, nicks or gouges if more than superficial in nature. These defects shall be cause for rejection.
3. Weigh the cylinder/valve assembly to verify the quantity of agent in cylinder. Ensure that no more than 10 PSIG (0.7 bar) of nitrogen is in cylinder before beginning fill procedures.

CAUTION

HFC-227ea **is a colorless, odorless gas, low in toxicity, and is an extremely effective fire suppression agent.** HFC-227ea **can be liquefied by compression, and is normally shipped and stored in this condition. Being a liquefied compressed gas,** HFC-227ea **is stored and handled under saturated conditions (that is, the liquid and vapor coexist in equilibrium). A reduction in pressure, without a corresponding reduction in temperature, will cause the liquid to flash into vapor with accompanying refrigeration effects. By understanding the physical properties of** HFC-227ea **and its safe handling techniques, the agent may be transferred from shipping cylinders to the desired end use container safely.**

4. Connect the HFC-227ea supply and return lines to the HFC-227ea storage container valves.
5. Close all valves in the charging system.
6. Set the 3-way valve (Item 9 in Figure 6-8) to allow flow from the HFC-227ea supply to the cylinder.
7. Open the HFC-227ea supply valves (Items 19, 21, 10, 11, 8 and 27). DO NOT open the return line valve (Item 22) at this time.
   The pressure gauge (Item 28) should indicate supply pressure.
8. Crack the vent valve (Item 30) until HFC-227ea liquid is present, then close the valve (Item 30).
9. Turn the 3-way valve (Item 9) to the return line position.
10. Open the valve (Item 24).
11. Crack the vent valve (Item 23) until HFC-227ea liquid is present. Then, close the valve (Item 23).
12. Open the return line valve (Item 22).
    The charging system is now ready for use.
13. Position the HFC-227ea cylinder/valve assembly (Item 26) with safety cap and pilot actuation port protection cap in place and properly connected on the weigh scale (Item 3).

Note: The empty weight of the cylinder assembly and the HFC-227ea weight must be stamped on the cylinder valve nameplate.

14. Remove the safety cap and immediately connect the cylinder assembly to the charging system by assembling the recharge adapter with o-ring packing (Item 1) to the cylinder valve outlet port.

Note: When approximately 10 PSIG (0.7 bar) differential exists at the outlet port, the main piston in the cylinder valve assembly will unseat, permitting flow into the assembly. Valve seating occurs with the removal of pressure from the valve outlet port and subsequent momentary application of 450 to 600 PSIG (31 to 41 bar) of nitrogen as discussed below.

15. Monitor the scale and record the empty cylinder assembly weight. Determine the charge weight using the formula $C=A+B+N_2$ where A is the empty cylinder weight, B is the weight of the HFC-227ea agent indicated on the valve nameplate and N_2 is the weight of the nitrogen charge.
16. Set the 3-way valve (Item 9) to allow flow from the HFC-227ea supply to the cylinder.
17. Open the valves (Items 29 and 33) and start the pump (Item 14).
18. Monitor the pressure of the cylinder with the pressure gauge (Item 34). Monitor the weigh scale (Item 3).

Note: The 44 PSIG (3.0 bar gauge) pressure applies to the filling procedure without nitrogen and HFC-227ea at 70°F ± 10°F (21°C ± 5°C). When the temperature is other than 70°F (21°C), refer to Table 6-7 for required total pressure. Do not fill HFC-227ea cylinders at temperatures below 60°F (16°C) or above 90°F (32°C).

The final pressure required, after the charged container has had sufficient time to stabilize, is 44.1 PSIG @ 70°F (3 bar gauge @ 21°C).

Table 6-7. Pressure vs. Temperature

Pressure versus Temperature	
Temperature °F (°C)	**Pressure PSIG (bar)**
60 (15.6)	34.4 (2.37)
70 (21.1)	44.1 (3.04)
80 (26.7)	55.1 (3.79)
90 (32.2)	67.6 (4.66)

19. When the scale indicates a fill weight of the agent determined in Step 15, shut off the pump (Item 14) and close the HFC-227ea supply valves (Items 29 and 8). Do not remove the recharge adapter (Item 1). Fill tolerances are listed in Table 6-8.

Table 6-8. Fill Tolerances

	Less than 100 lb. (45.3 kg)	**100 too 300 lb. (45.3 to 136 kg)**	**300 lb. and greater (136 kg and greater)**
Max Cylinder Capacity lb. (kgs)	+ 0.5, -0 (+0.22, -0)	+1, -0 (+0.45, -0)	+2, -0 (+0.9, -0)

20. Obtain the temperature of the HFC-227ea in the supply line. This is required for the N_2 filling procedure.
21. Remove the pilot actuation port protection cap and assemble the seating adapter (Item 2) with the flexible hose on the cylinder valve actuation port.
22. Open the valves (Item 6 and 16) and adjust the regulator (Item 17) to momentarily apply 450 to 600 PSIG (31 to 41 bar) nitrogen pressure to the actuation port to firmly seat the cylinder valve piston.
23. While momentarily maintaining pressure on the actuation port, open the vent valve (Item 4) on the recharge adapter (Item 1) to rapidly vent HFC-227ea from the valve assembly outlet port. The sudden decrease in pressure at the valve outlet will ensure the valve seat stays in the closed position.
24. Leave the vent valve (Item 4) open. Close valve (Item 6) and open valve (Item 5) to vent nitrogen from the seating adapter.

CAUTION

Hissing or discharge coming from vent valve (Item 4) indicates the piston is not seated properly or has opened. If this occurs, repeat Step 23. Verify that the cylinder valve piston remains closed.

25. Keep the vent valve (Item 4) open. Close valve (Item 5) and once again open valve (Item 6) to reapply nitrogen pressure to the actuation port.
26. While momentarily maintaining pressure on the actuation port, remove the recharge adapter (Item 1) from the cylinder valve outlet port and immediately install the safety cap.
27. Close the vent valve (Item 4) and open vent valve (Item 30) to relieve pressure on the quick disconnect fitting (Item 32).
28. Ensure Vent valve (Item 4) and valve (Item 29) are closed.
29. Separate the quick disconnect fitting (Item 32).
30. Close the nitrogen supply valve (Item 16) and open vent valve (Item 5) to vent nitrogen from the supply line.
31. Remove the seating adapter (Item 2) from the cylinder valve and reinstall the actuation port protection cap.
32. Close vent valves and the nitrogen supply valve (Items 5, 6, and 30).

Note: When charging more than one HFC-227ea cylinder, it may be advantageous to leave the pump (Item 14) running. In this case, when a cylinder is full, rotate the 3-way valve (Item 9) to direct the flow back to the supply tank through the HFC-227ea return line. To resume charging operations, return the 3-way valve (Item 9) back to the filling position.

To change the HFC-227ea storage container (Item 25), close the cylinder valves (Items 19 and 22) and close valves (Items 21 and 24). Carefully open vent valves (Item 20 and 23) to bleed pressure. Disconnect the charging lines from the HFC-227ea supply cylinder. Position a new HFC-227ea supply cylinder in its place. Connect the charging lines to the new HFC-227ea supply cylinder, ensuring vapor and liquid lines are connected to their proper valves. Close vent valves (Items 20 and 23). Open valves (Items 21 and 24).

6-3.4 HFC-227ea Cylinder Leak Test

WARNING

Clamp HFC-227ea cylinder securely in place. The clamping device and supports must be capable of withstanding a thrust force of 1800 lb (817 kg). This approximates the thrust force generated out of the HFC-227ea cylinder valve outlet on a full, wide open discharge.

CAUTION

HFC-227ea cylinder leak tests must be conducted in a well-ventilated area, away from the charging station so as not to be influenced by extraneous HFC-227ea vapors released during the filling operations. Kidde recommends the Bacharach Model H-25C leak detector for HFC-227ea and the Bacharach H-25IR leak standard for HFC-227ea for calibrating the leak detector.

1. Warm up the leak detector for 30 minutes before proceeding with Step 2.
2. Calibrate the detector against the H-25IR leak standard by holding the probe about 1/8-inch (3 mm) away, and noting the meter deflection for the leakage allowance of the standard. Maximum allowable leak rates are shown in Table 6-9.
3. Remove the safety cap from the discharge outlet. Blow nitrogen on the surface where the plug was removed.
4. Move the probe back and forth slowly about 1/8 in (3 mm) away from all potential leak points (such as the discharge outlet area, pilot check, valve bonnet, supervisory pressure switch connection, safety outlet, liquid level indicator, valve-to-cylinder connections, gauge and container welds).
5. Meter deflections greater than indicated during calibration are considered excessive and will be cause for rejection.
6. Replace the safety cap immediately after the test.
7. If excess leakage is detected, salvage the HFC-227ea agent, perform the required maintenance on the container and recharge.
8. After the leak test is complete, reassemble the protection cap to the actuation port of the valve assembly. Unclamp the cylinder.

Table 6-9. Maximum Permitted Leakage Rates

Part Number	Cylinder Size	Cylinder Fill Weight	Maximum Allowable Leakage
	lb	lb	ounces/year
90-100010-001	10	6-11	0.11
90-100020-001	20	9-23	0.20
90-100040-001	40	17-40	0.37
90-100070-001	70	30-70	0.67
90-100125-001	125	54-125	1.20
90-100200-001	200	86-200	1.81
90-100201-001*	200	86-200	1.81
90-100200-101	200	86-200	1.81
90-100201-101*	200	86-200	1.81
90-100350-001	350	150-350	3.34
90-100351-001*	350	150-350	3.34
90-100600-001	600	258-600	5.74
90-100601-001*	600	258-600	5.74
90-100900-001	900	390-900	8.68
90-100901-001*	900	390-900	8.68
***Note:** Includes liquid level indicator.			

6-3.5 Salvaging HFC-227ea from a Leaking Cylinder Assembly

WARNING **Target container must be significantly larger than the source container to prevent dangerous pressure buildup.**

1. Close the HFC-227ea supply valve (Item 19) and close valve (Item 21). Open valve (Item 20) to vent pressure. Disconnect the charging flexible hose from the HFC-227ea supply valve (Item 19).
2. Connect the salvage discharge assembly to the flexible hose coupling. Then assemble the discharge assembly to the outlet port of the leaking cylinder assembly (not shown).
3. Position an empty cylinder assembly of suitable size for HFC-227ea storage on the scale. Record the empty weight.
4. Connect the recharge adapter (Item 1) to the empty cylinder outlet port.
5. Assemble a manually operated control head onto the cylinder valve actuation port of the leaking cylinder assembly.
6. Check that all charging system valves are closed. Open valves (Items 8, 9, 10, 11, 21 and 27). Set the manually operated control head to the OPEN position. The pressure gauge (Item 28) should indicate the supply pressure. Crack vent valve (Item 30) until HFC-227ea liquid is present. Shut valve (Item 30).
7. If the cylinder assembly on the scale is of sufficient size and is being used to store HFC-227ea, monitor the scale, open the valve (Item 29) and start the pump. Continue pumping until a maximum of HFC-227ea is transferred from the leaking cylinder assembly as indicated by a pressure drop on the pressure gauge.
8. If the cylinder assembly on the scale is being charged, fill with the required weight of HFC-227ea by adding the required pounds to the empty cylinder weight. Follow the charging procedure outlined in Section 6-3.3. Conduct a cylinder leak test as described in Paragraph 6-3.4.
9. Continue to transfer the HFC-227ea agent until the leaking cylinder assembly is empty as indicated by pressure drop as measured by the pressure gauge. Shut off the pump and close the hose control valve (Item 29) and valve (Item 21).
10. Open valve (Item 20) to vent pressure, then disassemble the adapter from the outlet port of the leaking cylinder assembly and from the flexible hose hookup. Reassemble the flexible hose to the HFC-227ea supply valve (Item 19).
11. If the cylinder assembly being recharged, is not charged sufficiently, continue the charging procedure as indicated in Paragraph 6-3.3 using the HFC-227ea supply.

6-4 NITROGEN PILOT CYLINDER SERVICE AND MAINTENANCE

WARNING

Any area in which nitrogen is used or stored must be properly ventilated. A person working in an area where air has become enriched with nitrogen can become unconscious without sensing the lack of oxygen. Remove the victim to fresh air. Administer artificial respiration if necessary and summon a physician. Never dispose of liquefied nitrogen in an indoor work or storage area.

6-4.1 Nitrogen Driver Cylinder Hydrostatic Pressure Test

A hydrostatic test must be performed in accordance with the DOT Regulatory Compliance Guide, 49 CFR 180.209. Nitrogen cylinders shall not be recharged and shipped without hydrostatic test if more than five years has elapsed from the date of the last test.

Nitrogen cylinders continuously in service without discharging can be retained in service for a maximum of five years from the date of the last hydrostatic test. At the end of five years the cylinder shall be visually inspected per CGA pamphlet C-6.

Cylinders must also be hydrostatic pressure tested immediately if the cylinder shows evidence of distortion, cracking, corrosion or mechanical or fire damage.

6-4.2 Nitrogen Cylinder Replacement

WARNING

When removing a pressurized cylinder due to pressure loss, the control head must be in the SET position with the safety pull pin installed. A control head in the released position will cause the remaining contents of cylinder to discharge resulting in a system activation which may damage property and cause bodily injury.

Replace the nitrogen cylinder when expended or when loss of pressure occurs, as follows:

1. Remove the control head from the nitrogen driver cylinder valve.
2. Immediately install the protection cap on the nitrogen cylinder actuation port.
3. Remove the flexible actuation hose or tubing and adapter (P/N WK-699205-010) from the cylinder valve outlet.
4. Remove the clamps and hardware that secure the nitrogen cylinder to the mounting bracket.

6-4.3 Nitrogen Cylinder Recharge

Nitrogen cylinders must be recharged when the cylinder pressure gauge indicates pressure is below normal (1800 PSIG at 70°F [124 bar gauge at 21°C] or as adjusted for temperature) or immediately after discharge. Nitrogen used for charging must comply with Federal Specification BB-N-411C, Grade A, Type 1. Copies of this specification may be obtained from: http://www.global.ths.com/.

WARNING

Before recharging, the cylinder must be firmly secured by chains, clamps or other devices to an immovable object such as a wall, structural I-beam or permanently mounted holding rack.

Recharge the nitrogen cylinders as follows:

1. Remove the protection cap from the cylinder valve actuation port.
2. Install the cylinder seating adapter (P/N WK-933537-000) to the cylinder valve actuation port.
3. Connect the nitrogen recharging supply hose to the adapter. Tighten securely.
4. Open the nitrogen recharging control valve slowly until full nitrogen flow is obtained.
5. Monitor the recharging supply pressure gauge. Close the charging control valve when the gauge indicates the proper cylinder pressure (1800 PSIG at 70°F [124 bar gauge at 21°C]).
6. Allow the cylinder to cool to ambient temperature and recheck the nitrogen cylinder pressure.
7. Open the valve and add additional nitrogen as necessary to obtain a full cylinder charge at ambient temperature (1800 PSIG at 70°F [124 bar gauge at 21°C]).
8. Close the valve and remove the supply hose and charging adapter from the nitrogen cylinder.
9. Using a soap solution, thoroughly check the nitrogen cylinder valve for leakage. Bubbles in the soap solution indicate leakage and shall be cause for rejection of the cylinder.
10. At the completion of the leak test, thoroughly clean and dry the cylinder valve.
11. Ensure the cylinder valve control head port is clean and dry.
12. Immediately install the protective cap to the actuation port of the cylinder valve.
13. Install the charged cylinder as described below.

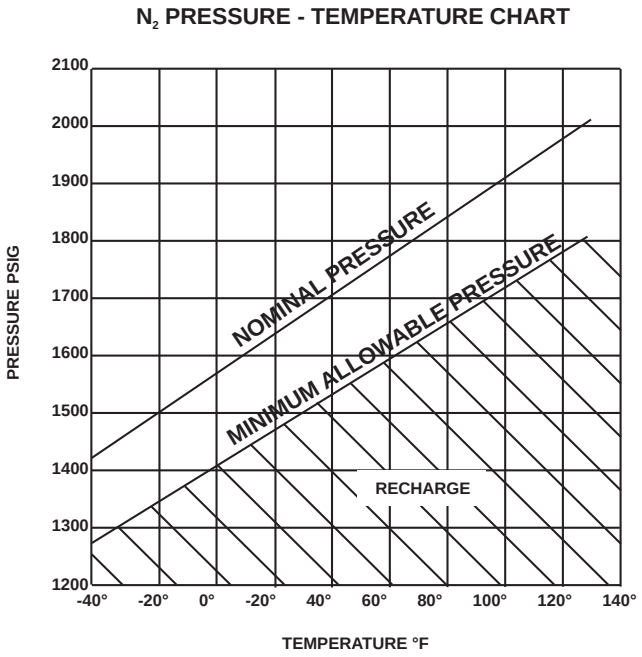

Figure 6-9. Nitrogen Temperature vs. Pressure Data

6-4.4 Nitrogen Cylinder Installation

1. Install the nitrogen cylinder in position in the mounting bracket.
2. Tighten sufficiently to hold cylinder in place while allowing cylinder enough free play to be manually rotated.
3. Turn the cylinder until the cylinder valve discharge outlet is in the desired position.

CAUTION

The nitrogen cylinder must be positioned so that the control head, when installed, is readily accessible and cannot be obstructed during manual operation.

4. Securely tighten the mounting bracket clamps and hardware.
5. Remove the pipe plug, reconnect the adapter (P/N WK-699205-010) and flexible actuation hose or tubing to the cylinder valve outlet port.
6. Remove the protective cap from the cylinder valve actuation port.

WARNING

Ensure the control head is in the SET position (that is, the actuating pin is in the fully retracted or SET position). Failure to do so will cause the nitrogen cylinder to discharge when the control head is installed.

7. Install the control head to the cylinder valve and tighten securely.

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CHAPTER 7
PARTS LIST

7-1 INTRODUCTION AND PARTS LIST

The table below, and on the following pages, provides a complete list of the Kidde Fire Systems ECS Fire Suppression System with HFC-227ea Agent parts and associated system equipment. Equipment can be ordered as complete assemblies or as individual items. In most situations, when ordering a system, it will be easier and more cost effective to order by assembly part numbers.

Note: Unless otherwise noted, the parts documented in this section are UL Listed and FM Approved. For non-agency approved parts, see datasheet K-90-2075.

Table 7-1. Parts List

Nomenclature	Part Number	Original P/N
Cylinder/Valve Assemblies		
10 lb STD		90-100010-001
20 lb STD		90-100020-001
40 lb STD		90-100040-001
70 lb STD		90-100070-001
125 lb STD		90-100125-001
125 lb W/LLI		90-100121-001
200 lb STD Old Style Hemispherical Head before 3/98		90-100200-001
200 lb W/LLI Old Style Hemispherical Head before 3/98		90-100201-001
200 lb STD New Style Ellipsoidal Head after 3/98		90-100200-101
200 lb W/LLI New Style Ellipsoidal Head after 3/98		90-100201-101
350 lb STD		90-100350-001
350 lb W/LLI		90-100351-001
600 lb STD old style supplied before 9/01 (discontinued)		90-100600-001
600 lb W/LLI old style supplied before 9/01 (discontinued)		90-100601-001
600 lb STD new style supplied after 9/01		90-100600-100
600 lb W/LLI new style supplied after 9/01		90-100601-100
900 lb STD		90-100900-001
900 lb W/LLI		90-100901-001
(STD=Standard Cylinder Assembly, W/LLI=Cylinder with liquid level indicator)		
Flexible Discharge Hoses		
10-125 lb Cylinders	WK-283898-000	283898
200-350 lb Cylinders	WK-283899-000	283899
600 lb Cylinders (old style supplied before 9/01)	WK-283900-000	283900
600 lb Cylinders (new style after 9/01)		06-118225-001
900 lb Cylinders		06-118225-001

Table 7-1. Parts List

Nomenclature	Part Number	Original P/N
Valve Outlet Adapters		
10-125 lb. Cylinders	WK-283904-000	283904
200-350 lb. Cylinders	WK-283905-000	283905
600 lb. Cylinders (old style; before 9/01)	WK-283906-000	283906
Cylinder Straps		
10-20 lb	WK-283945-000	283945
40-70 lb	WK-283934-000	283934
125-200 lb (new style cylinder, after 3/98)	06-235317-001	235317
350 lb	WK-281866-000	281866
600 lb (old and new style)	WK-294651-000	294651
900 lb	06-236125-001	236125
Brackets, Wall Mounting		
10 lb	82-486485-000	486485
20 lb	82-486486-000	486486
40 lb	82-486487-000	486487
70 lb	82-486488-000	486488
Cradles		
125 lb and 200 lb	06-235431-001	235431
350 lb	WK-281867-000	281867
600 lb	WK-294652-000	294652
Front Clamps		
125 lb and 200 lb	06-235432-001	235432
350 lb	WK-281868-000	281868
600 lb	WK-294653-000	294653
Control Heads		
Electric, Stackable (Explosion Proof) 24 Vdc	82-486500-010	486500-01
Electric, Standard 24 Vdc*	WK-890181-000	890181
Electric, Standard 115 Vac*	WK-890165-000	890165
Electric, Standard 125 Vdc*	81-890149-000	890149
Electric/Cable, Standard 24 Vdc	81-895630-000	895630
Electric/Cable (Explosion Proof) 24 Vdc	WK-897494-000	897494
Lever Operated	WK-870652-000	870652
Pressure Operated	82-878737-000	878737
Pressure Operated, Stackable	82-878750-000	878750
Lever/Pressure Operated	82-878751-000	878751
Cable Operated	81-979469-000	979469

Table 7-1. Parts List

Nomenclature	Part Number	Original P/N
Pressure Control Equipment		
Master Cylinder Adapter Kit	82-844895-000	844895
Male Branch Tee, 5/16 in Flare x 1/8 in NPT	WK-699205-050	6992-0505
Male Elbow, 5/16 in Flare x 1/8 in NPT	WK-699205-030	6992-0503
Male Connector, 5/16 in Flare x 1/8 in NPT	WK-699205-010	6992-0501
Actuation Hose, 22 in (10-200 lb cylinder)	WK-264987-000	264987
Actuation Hose, 30 in (350-600 lb cylinder)	WK-264986-000	264986
Nitrogen Pilot Cylinder	WK-877940-000	877940
Mounting Bracket, N_2 Pilot Cylinder	WK-877845-000	877845
1/4 in Check Valve	WK-264985-000	264985
Safety Outlet, 3/4 in NPT	82-844346-000	844346
Safety Outlet, 3/4 in NPT 2400-2800 psi (165-193 bars)	81-803242-000	803242
Remote Control Equipment, Electronic Operated		
Pull Box, Electric Remote 24 Vdc	84-330001-001	893607
Remote Control Equipment, Cable Operated		
Pull Box, Break Glass	81-871403-000	871403
Corner Pulley, Watertight	81-803808-000	803808
Corner Pulley, 1/2 in EMT		WK-844648-000
1/16 in Cable 100 ft Roll	06-118316-100	1593-0002
1/16 in Cable 500 ft Roll	WK-219649-000	1593-0002
Pull Box Bracket (Z-Bracket)	81-605320-000	60532
Adapter, 1/2 in EMT	WK-843837-000	843837
Dual Pull Equalizer	81-840051-000	840051
Dual Pull Mechanism	81-840058-000	840058
Auxiliary Equipment		
Supervisory Pressure Switch		06-118262-001
Supervisory Pressure Switch (600-900 lb cylinders manufactured prior to XXX 2013)		06-118263-001
Pressure Operated Switch, Standard	81-486536-000	486536
Pressure Operated Switch, Ex-Proof	81-981332-000	981332
Pressure Trip	81-874290-000	874290
Transfer Switch, Main to Reserve	84-802398-000	802398
Discharge Indicator 1/2 in (Al)	81-875553-000	875553
Discharge Indicator 3/4 in (Brass)	81-967082-000	967082
Adapter, CO2/N2 Recharge or Agent Valve Seating	WK-933537-000	933537

Table 7-1. Parts List

Nomenclature	Part Number	Original P/N
Check Valves		
Check Valve, 1/2 in NPT	81-800327-000	800327
Check Valve, 3/4 in NPT	81-800266-000	800266
Check Valve, 1 in NPT	WK-800443-000	800443
Check Valve, 1-1/4 in NPT	81-800444-000	800444
Check Valves, 1-1/2 in NPT	81-870152-000	870152
Check Valve, 2 in NPT	81-870151-000	870151
Check Valves, 2-1/2 in NPT	WK-263716-000	263716
Check Valves, 3 in NPT	81-870100-000	870100
Swing Check Valve, 2 in NPT		06-118213-001
Swing Check Valve, 3 in NPT		06-118058-001
Manifold El-Check Valve, 2 in NPT	WK-877690-000	877690
Manifold El-Check Valve, 2-1/2 in NPT	82-878743-000	878743
Cylinder Recharge Adapters		
Cylinder Size, 10-125	82-878757-000	878757
Cylinder Size, 200, 350	82-878758-000	878758
Cylinder Size, 600 (old style)	82-878759-000	878759
Name Plate		
“Main”	WK-310330-000	31033
“Reserve”	WK-310340-000	31034
Agent Warning Nameplate		85-909300-001

Table 7-1. Parts List

Nomenclature	Part Number	Original P/N
Safety Burst Disc Assemblies and Rebuild kits		
Assembly, 3" Valve Safety Burst Disc		90-170100-000
Assembly, 2" Valve Safety Burst Disc		90-150100-000
Kit, 2" Valve re-build. For valves manufactured prior to May 2014. Includes 1 of each of the following: WK-264925-000 - Safety Disc, 2" Valve WK-220360-000 - Washer, Safety Disc (2" valve) WK-258426-000 - Nut, Safety Disc (1-1/2 - 2-1/2 Vlv) Retainer WK-566102-300 - O-Ring, Cap (2" valve) WK-566103-300 - O-Ring, Piston (2" valve) WK-554003-300 - Teflon Back-Up Ring, Piston (2" valve) WK-566103-260 - O-Ring, Seat (2" valve) WK-566103-350 - O-Ring, Cylinder Neck (2" valve)		90-150100-000
Kit, 1-1/2"Valve re-build. Includes 1 of each of the following: WK-242461-000 - Safety Disc (1-1/2" Valve) WK-294500-000 - Washer, Safety Disc - 1-1/2" Valve WK-258426-000 - Nut, Safety Disc (1-1/2 - 2-1/2 Vlv) Retainer WK-566102-250 - O-Ring, Cap (1-1/2" valve) WK-566103-250 - O-Ring, Piston (1-1/2" valve) WK-554003-250 - Teflon Back-Up Ring, Piston (1-1/2" valve) WK-566102-150 - O-Ring, Seat (1-1/2" valve) WK-566109-320 - O-Ring, Cylinder Neck (1-1/2" valve)		90-140100-000
2-1/2" Valve Maintenance Kit - Includes 1 each of the following: WK-264929-000 - Safety Disc WK-220362-000 - Washer WK-554003-340 - Teflon Back-up Ring WK-566102-340 - O-Ring, Cap WK-566103-340 - O-Ring, Piston WK-566103-310 - O-Ring, Seat WK-566103-390 - O-Ring, Cylinder Neck		90-160100-000

7-2 OBSOLETE PARTS

The following parts are no longer in service. For replacement options, contact your distributor or Kidde-Fenwal, Inc.

Nomenclature	Part Number	Original P/N
10-125 lb Cylinders (old style supplied before 9/01)	WK-283906-000	283906
125-200 lb (old style cylinder, before 3/98)	WK-292971-000	292971
200 lb Cradle	WK-292938-000	292938
200 lb Front Clamp	WK-293457-000	293457
Check Valve 3/8 in NPT	81-261193-100	261193
Cylinder Strap	WK-292971-000	292971
Cable Housing, 125, 200		260702
Cable Housing, 350		260951
Cable Housing, 600		263602

7-3 DISCHARGE NOZZLES

WARNING **Only listed Kidde ECS System HFC-227ea nozzles are to be used on Kidde ECS Systems. Failure to comply with this WARNING can result in unpredictable agent distribution.**

7-3.1 UL Listed 360 Degree Nozzles

Note: An additional nozzle finish has been added for a special application. This is a nickel plated nozzle designed to the specifications of the brass version which is FM Approved. The part numbers are exact to that below except for the sixth digit which is a “3” instead of a “0”.

Area (in^2)	UL Listed 360 Degree Nozzles					
	1/2 in NPT	3/4 in NPT	1 in NPT	1-1/4 in NPT	1-1/2 in NPT	2 in NPT
0.0774	90-194023-111					
0.0802	90-194023-113					
0.0845	90-194023-116					
0.0905	90-194023-120					
0.0982	90-194023-125					
0.1037	90-194023-129					
0.1162	90-194023-136					
0.1240	90-194023-141					
0.1303	90-194023-144					
0.1358	90-194023-147	90-194024-147				
0.1404	90-194023-150	90-194024-150				
0.1534	90-194023-156	90-194024-156				
0.1629	90-194023-161	90-194024-161				
0.1731	90-194023-166	90-194024-166				
0.1856	90-194023-172	90-194024-172				
0.1968	90-194023-177	90-194024-177				
0.2035	90-194023-180	90-194024-180				
0.2080	90-194023-182	90-194024-182				
0.2150	90-194023-185	90-194024-185				
0.2244		90-194024-189	90-194025-189			
0.2353		90-194024-194	90-194025-194			
0.2488		90-194024-199	90-194025-199			
0.2653		90-194024-206	90-194025-206			
0.2851		90-194024-213	90-194025-213			
0.3007		90-194024-219	90-194025-219			
0.3069		90-194024-221	90-194025-221			
0.3266		90-194024-228	90-194025-228			
0.3440		90-194024-234	90-194025-234			
0.3559		90-194024-238	90-194025-238			
0.3802			90-194025-246	90-194026-246		

Area (in^2)	UL Listed 360 Degree Nozzles					
	1/2 in NPT	3/4 in NPT	1 in NPT	1-1/4 in NPT	1-1/2 in NPT	2 in NPT
0.3927			90-194025-250	90-194026-250		
0.4150			90-194025-257	90-194026-257		
0.4280			90-194025-261	90-194026-261		
0.4433			90-194025-266	90-194026-266		
0.4649			90-194025-272	90-194026-272		
0.4821			90-194025-277	90-194026-277		
0.5284			90-194025-290	90-194026-290	90-194027-290	
0.5468			90-194025-295	90-194026-295	90-194027-295	
0.5731			90-194025-302	90-194026-302	90-194027-302	
0.6136			90-194025-313	90-194026-313	90-194027-313	
0.6274				90-194026-316	90-194027-316	
0.6555				90-194026-323	90-194027-323	
0.6765				90-194026-328	90-194027-328	
0.6926				90-194026-332	90-194027-332	
0.7221				90-194026-339	90-194027-339	
0.7424				90-194026-344	90-194027-344	
0.8053				90-194026-358	90-194027-358	
0.8115				90-194026-359	90-194027-359	
0.8509				90-194026-368	90-194027-368	90-194028-368
0.8836				90-194026-375	90-194027-375	90-194028-375
0.8930				90-194026-377	90-194027-377	90-194028-377
0.9362				90-194026-386	90-194027-386	90-194028-386
0.9587				90-194026-391	90-194027-391	90-194028-391
0.9903				90-194026-397	90-194027-397	90-194028-397
1.0255				90-194026-404	90-194027-404	90-194028-404
1.0717				90-194026-272	90-194027-413	90-194028-413
1.1183				90-194026-277	90-194027-422	90-194028-422
1.2026				90-194026-290	90-194027-438	90-194028-438
1.2901				90-194026-295	90-194027-453	90-194028-453
1.3806				90-194026-302	90-194027-469	90-194028-469
1.4742				90-194026-313	90-194027-290	90-194028-484
1.5708				90-194026-316	90-194027-295	90-194028-500
1.6705				90-194026-323	90-194027-302	90-194028-516
1.7733				90-194026-328	90-194027-313	90-194028-531
1.8791				90-194026-332	90-194027-316	90-194028-547
1.9880				90-194026-339	90-194027-323	90-194028-563
2.1000				90-194026-344	90-194027-328	90-194028-578
2.2151				90-194026-358	90-194027-332	90-194028-594
2.3332				90-194026-359	90-194027-339	90-194028-609

7-3.2 UL Listed 180 Degree Nozzles:

Note: An additional nozzle finish has been added for a special application. This is a nickel plated nozzle designed to the specifications of the brass version which is FM Approved. The part numbers are exact to that below except for the sixth digit which is a “3” instead of a “0”.

Area (in^2)	UL Listed 180 Degree Nozzles					
	1/2 in NPT	3/4 in NPT	1 in NPT	1-1/4 in NPT	1-1/2 in NPT	2 in NPT
0.0770	90-194013-109					
0.0810	90-194013-111					
0.0820	90-194013-113					
0.0875	90-194013-116					
0.0931	90-194013-120					
0.1030	90-194013-125					
0.1072	90-194013-129					
0.1190	90-194013-136					
0.1289	90-194013-141					
0.1342	90-194013-144	90-194014-144				
0.1384	90-194013-147	90-194014-147				
0.1428	90-194013-150	90-194014-150				
0.1605	90-194013-156	90-194014-156				
0.1694	90-194013-161	90-194014-161				
0.1779	90-194013-166	90-194014-166				
0.1909	90-194013-172	90-194014-172				
0.2049		90-194014-177				
0.2113		90-194014-180				
0.2177		90-194014-182	90-194015-182			
0.2215		90-194014-185	90-194015-185			
0.2313		90-194014-189	90-194015-189			
0.2405		90-194014-194	90-194015-194			
0.2597		90-194014-199	90-194015-199			
0.2744		90-194014-206	90-194015-206			
0.3005		90-194014-213	90-194015-213			
0.3080		90-194014-219	90-194015-219			
0.3128		90-194014-221	90-194015-221			
0.3364		90-194014-228	90-194015-228			
0.3504			90-194015-234			
0.3623			90-194015-238			
0.4039			90-194015-246	90-194016-246		

Area (in^2)	UL Listed 360 Degree Nozzles					
	1/2 in NPT	3/4 in NPT	1 in NPT	1-1/4 in NPT	1-1/2 in NPT	2 in NPT
0.4056			90-194015-250	90-194016-250		
0.4233			90-194015-257	90-194016-257		
0.4400			90-194015-261	90-194016-261		
0.4485			90-194015-266	90-194016-266		
0.4734			90-194015-272	90-194016-272		
0.4954			90-194015-277	90-194016-277		
0.5379			90-194015-290	90-194016-290	90-194017-290	
0.5636				90-194016-295	90-194017-295	
0.5967				90-194016-302	90-194017-302	
0.6382				90-194016-313	90-194017-313	
0.6439				90-194016-316	90-194017-316	
0.6787				90-194016-323	90-194017-323	
0.6875				90-194016-328	90-194017-328	
0.7254				90-194016-332	90-194017-332	
0.7401				90-194016-339	90-194017-339	
0.7884				90-194016-344	90-194017-344	
0.8439				90-194016-358	90-194017-358	90-194018-358
0.8439				90-194016-359	90-194017-359	90-194018-359
0.8767				90-194016-368	90-194017-368	90-194018-368
0.9047				90-194016-375	90-194017-375	90-194018-375
0.9311				90-194016-377	90-194017-377	90-194018-377
0.9588				90-194016-386	90-194017-386	90-194018-386
0.9896					90-194017-391	90-194018-391
1.0140					90-194017-397	90-194018-397
1.0498					90-194017-404	90-194018-404
1.1081					90-194017-413	90-194018-413
1.1699					90-194017-422	90-194018-422
1.2368					90-194017-438	90-194018-438
1.3374						90-194018-453
1.4146						90-194018-469
1.5114						90-194018-484
1.6264						90-194018-500
1.7045						90-194018-516
1.8205						90-194018-531
1.9075						90-194018-547
2.0304						90-194018-563
2.1566						90-194018-578

APPENDIX A
MATERIAL SAFETY DATASHEETS

Kidde Fire Systems
A UTC Fire & Security Company

MATERIAL SAFETY DATA SHEET

FM-200 (Fire Extinguishing Agent)

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATIONS AND OF THE COMPANY UNDERTAKING

Product Name	FM-200 (Fire Extinguishing Agent)
Other Trade Names	Heptafluoropropane, HFC-227ea
Product Description	Fire Extinguishing Agent
Manufacturer/Supplier	Kidde Fire Systems
Address	400 Main Street Ashland, MA 01721 USA
Phone Number	(508) 881-2000
Chemtrec Number (for emergencies only)	(800) 424-9300 (703) 527-3887 (International)
Revision Date:	February 12, 2012
MSDS Date:	February 9, 2009

Safety Data Sheet according to EC directive 2001/59/EC and OSHA's Hazcom Standard (29 CFR 1910.1200)

2. HAZARDS IDENTIFICATION

EU Main Hazards
Non Flammable Gas

Routes of Entry
Eye contact - Inhalation - Skin contact

Carcinogenic Status
Not considered carcinogenic by NTP, IARC, and OSHA.

Target Organs
Respiratory System - Skin - Eye - Cardiovascular System - Central Nervous System

Health Effects - Eyes
Direct contact with the cold gas or liquid can cause freezing of exposed tissues, with pain, redness, burns and corneal damage.

Health Effects - Skin
Direct contact with the cold gas or liquid can cause freezing of exposed tissues.

Health Effects - Ingestion
Ingestion is not a possible route of exposure.

Health Effects - Inhalation
Exposure to vapor at high concentrations have the following effects: - light headedness - dizziness - difficulty with breathing - drowsiness - nausea - mental confusion - increased blood pressure – increased respiratory rate - heart irregularities - loss of consciousness - suffocation if air is displaced by vapors. Individuals with preexisting diseases of the cardiovascular system or nervous system may have increased susceptibility from excessive exposures.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Component Name	CAS#/Codes	Concentration	R Phrases	EU Classification
1,1,1,2,3,3,3-Heptafluoropropane	431-89-0 EC#207-079-2	>99.9%	None	Non Flammable Gas

4. FIRST AID MEASURES

Eyes
Immediately flood the eye with plenty of warm water for at least 15 minutes, holding the eye open. Obtain medical attention if soreness or redness persists.

Skin
Flush with water. Obtain medical attention if frostbite or blistering occurs or redness persists.

Ingestion
Ingestion is not considered a potential route of exposure.

Inhalation
Remove from exposure. If there is difficulty in breathing, give oxygen. Obtain medical attention immediately.

Advice to Physicians
In case of frostbite, place the frostbitten part in warm water. If warm water is not available or impractical to use, wrap the affected parts gently in blankets. DO NOT USE HOT WATER.
The use of epinephrine or similar compounds can increase susceptibility to heart irregularities caused by excessive exposure to these types of compounds.

5. FIRE - FIGHTING MEASURES

Extinguishing Media
FM-200 is used as an extinguishing agent and therefore is not a problem when trying to control a blaze. Use extinguishing agent appropriate to other materials involved. Keep containers and surroundings cool with water spray as containers may rupture or burst in the heat of a fire.

Unusual Fire and Explosion Hazards
Containers may explode in heat of fire.

Protective Equipment for Fire-Fighting
Wear full protective clothing and self-contained breathing apparatus as appropriate for specific fire conditions.

6. ACCIDENTAL RELEASE MEASURES

Wear full protective clothing and self-contained breathing apparatus. Remove leaking cylinder to a safe place. Ventilate the area. Leaks inside confined spaces may cause suffocation as vapors may displace air, and should not be entered without a self-contained breathing apparatus.

7. HANDLING AND STORAGE

Containers should be properly stored and secured to prevent falling or being knocked over. Do not drag, slide or roll containers. Do not drop containers or permit them to strike against each other. Never apply flame or localized heat directly to any part of the containers. Store away from sources of heat or ignition. Storage area should be: - cool - dry - well ventilated - under cover - out of direct sunlight

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Standards
Occupational exposure limits are listed below, if they exist.
1,1,1,2,3,3,3-Heptafluoropropane
None established.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Control Measures
Use with adequate ventilation. There should be local procedures for the selection, training, inspection and maintenance of this equipment. When used in large volumes or odor becomes apparent, use local exhaust ventilation.

Respiratory Protection
Not normally required under conditions of use as a portable fire extinguisher. For other applications creating oxygen deficient atmospheres, use a self contained breathing apparatus, as an air purifying respirator will not provide protection.

Hand Protection
Wear rubber gloves. Avoid contact with skin.

Eye Protection
Chemical goggles or safety glasses with side shields. Avoid contact with eyes.

Body Protection
Normal work wear.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State	Liquefied gas under pressure
Color	Colorless
Odor	Odorless
Specific Gravity	1.46
Boiling Range/Point (°C/F)	-16.4^{o}C/3 ^{o}F
Flash Point (PMCC) (°C/F)	Not Flammable
Solubility in Water	260 mg/L
Vapor Density (Air = 1)	6.04
Vapor Pressure	58.8 psia @ 70^{o}F
Gas Density	2.01 lb/ft^{3} @ 70^{o}F
Evaporation Rate	Not applicable

10. STABILITY AND REACTIVITY

Stability
Stable under normal conditions.

Conditions to Avoid
- Heat - High temperatures - Exposure to direct sunlight

Materials to Avoid
- powdered metals (ex. aluminum, zinc, etc.) - strong oxidizing agents – strong reducing agents – strong alkalis

Hazardous Polymerization
Will not occur.

Hazardous Decomposition Products
- oxides of carbon - hydrogen fluoride

11. TOXICOLOGICAL INFORMATION

Acute Toxicity
4 hour LC50(rat) >788,698 ppm

Chronic Toxicity/Carcinogenicity
This product is not expected to cause long term adverse health effects.

Genotoxicity
This product is not expected to cause any mutagenic effects. Tests have shown that this material does not cause genetic damage in bacterial or mammalian cell cultures.

Reproductive/Developmental Toxicity
This product is not expected to cause adverse reproductive effects.

12. ECOLOGICAL INFORMATION

Mobility
No data available.

Persistence/Degradability
No data available.

Bio-accumulation
No data available.

Ecotoxicity
No data available.

13. DISPOSAL CONSIDERATIONS

Dispose of container in accordance with all applicable local and national regulations. Do not cut, puncture or weld on or near to the container. If spilled, contents will vaporize to the atmosphere.

14. TRANSPORT INFORMATION

DOT CFR 172.101 Data	**Heptafluoropropane, 2.2, UN3296**
UN Proper Shipping Name	Heptafluoropropane
UN Class	(2.2) Non-Flammable Gas
UN Number	UN3296
UN Packaging Group	Not applicable

15. REGULATORY INFORMATION

EU Label Information

Classification and labelling have been performed according to EU directives 67/548/EEC and 99/45/EC including amendments(2001/60/EC and 2006/8/EC)

EU Hazard Symbol and Indication of Danger.
Non Flammable Gas

R phrases
None

S phrases
None

15. REGULATORY INFORMATION

US REGULATIONS (Federal, State) and INTERNATIONAL CHEMICAL REGISTRATION LAWS

TSCA Listing
This product contains ingredients that are listed on or exempt from listing on the EPA Toxic Substance Control Act Chemical Substance Inventory.

EINECS Listing
All ingredients in this product are listed on the European Inventory of Existing Commercial Chemical Substances (EINECS) or the European List of New Chemical Substances (ELINCS) or are exempt from listing.

DSL/NDSL (Canadian) Listing
All ingredients in this product are listed on the Domestic Substance List (DSL) or the Non-Domestic Substance List (NDSL) or are exempt from listing.

WHMIS Classification
A

This product was classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations and the MSDS contains all the information required by these regulations.

MA Right To Know Law
All components have been checked for inclusion on the Massachusetts Substance List (MSL). Those components present at or above the de minimis concentration include: - none

PA Right To Know Law
This product contains the following chemicals found on the Pennsylvania Hazardous Substance List: - none

NJ Right To Know Law
This product contains the following chemicals found on the NJ Right To Know Hazardous Substance List: - none

California Proposition 65
This product does not contain materials which the State of California has found to cause cancer, birth defects or other reproductive harm.

SARA Title III Sect. 302 (EHS)
This product does not contain any chemicals subject to SARA Title III Section 302.

SARA Title III Sect. 304
This product does not contain any chemicals subject to SARA Title III Section 304.

SARA Title III Sect. 311/312 Categorization
- Immediate (Acute) Health Hazard - Pressure Hazard

SARA Title III Sect. 313
This product does not contain a chemical which is listed in Section 313 at or above de minimis concentrations.

16. OTHER INFORMATION

NFPA Ratings
NFPA Code for Health - 1
NFPA Code for Flammability - 0
NFPA Code for Reactivity - 0
NFPA Code for Special Hazards – None

16. OTHER INFORMATION

HMIS Ratings
HMIS Code for Health - 1
HMIS Code for Flammability - 0
HMIS Code for Reactivity - 0
HMIS Code for Personal Protection - See Section 8

Abbreviations
N/A: Denotes no applicable information found or available
CAS#: Chemical Abstracts Service Number
ACGIH: American Conference of Governmental Industrial Hygienists
OSHA: Occupational Safety and Health Administration
TLV: Threshold Limit Value
PEL: Permissible Exposure Limit
STEL: Short Term Exposure Limit
NTP: National Toxicology Program
IARC: International Agency for Research on Cancer
R: Risk
S: Safety

Prepared By: EnviroNet LLC.

The information contained herein is based on data believed to be accurate. However, no representation, warranty, or guarantee is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability and completeness of such information for its own particular use. Kidde Fire Systems assumes no responsibility for personal injury or property damage resulting from use, handling or from contact with this product.

MATERIAL SAFETY DATA SHEET

Nitrogen (Expellant)

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATIONS AND OF THE COMPANY UNDERTAKING

Product Name	Nitrogen (Expellant)
Other Trade Names	N_2
Product Description	Expellant
Manufacturer/Supplier	Kidde Fire Systems
Address	400 Main Street Ashland, MA 01721 USA
Phone Number	(508) 881-2000
Chemtrec Number (for emergencies only)	(800) 424-9300 (703) 527-3887 (International)
Revision Date:	February 9, 2012
MSDS Date:	February 9, 2009

Safety Data Sheet according to EC directive 2001/59/EC and OSHA's Hazcom Standard (29 CFR 1910.1200)

2. HAZARDS IDENTIFICATION

EU Main Hazards
Non Flammable Gas

Routes of Entry
Eye contact - Inhalation - Skin contact

Carcinogenic Status
Not considered carcinogenic by NTP, IARC, and OSHA.

Target Organs
Respiratory System

Health Effects - Eyes
Non-irritating gas

Health Effects - Skin
Non-irritating gas

Health Effects - Ingestion
Ingestion is not a possible route of exposure.

Health Effects - Inhalation
Avoid direct inhalation of undiluted gas. Can cause suffocation by reducing oxygen available for breathing. Breathing very high concentrations can cause dizziness, shortness of breath, unconsciousness or asphyxiation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Component Name	CAS#/Codes	Concentration	R Phrases	EU Classification
Nitrogen	7727-37-9 EC#231-783-9	100%	None	Non Flammable Gas

4. FIRST AID MEASURES

Eyes
No specific measures.

Skin
No specific measures.

Ingestion
Ingestion is not considered a potential route of exposure.

Inhalation
Remove from exposure. If there is difficulty in breathing, give oxygen. Obtain medical attention immediately.

Advice to Physicians
Treat symptomatically.

5. FIRE - FIGHTING MEASURES

Extinguishing Media
All known extinguishing media can be used. Use extinguishing media appropriate for containers in the area.

Unusual Fire and Explosion Hazards
Containers may explode in heat of fire.

Protective Equipment for Fire-Fighting
Wear full protective clothing and self-contained breathing apparatus as appropriate for specific fire conditions.

6. ACCIDENTAL RELEASE MEASURES

Material is a normal atmospheric gas. Remove leaking cylinder to a safe place. Ventilate the area. Wear self contained breathing apparatus when entering confined spaces unless atmosphere is proven to be safe.

7. HANDLING AND STORAGE

Cylinders should be properly stored and secured to prevent falling or being knocked over. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike against each other. Never apply flame or localized heat directly to any part of the cylinder. Store away from sources of heat or ignition. Storage area should be: - cool - dry - well ventilated - under cover - out of direct sunlight

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Standards
Nitrogen
None
Engineering Control Measures
Use with adequate ventilation (natural or mechanical), especially in a confined space.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Respiratory Protection
Not normally required. In oxygen deficient atmospheres, use a self contained breathing apparatus, as an air purifying respirator will not provide protection.

Hand Protection
Use leather or sturdy work gloves when handling cylinders.

Eye Protection
Chemical goggles or safety glasses with side shields.

Body Protection
Normal work wear.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State	Compressed gas
Color	Colorless
Odor	None
Specific Gravity	Not applicable
Boiling Range/Point (°C/F)	-321°F
Flash Point (PMCC) (°C/F)	Not Flammable
Solubility in Water	0.2 g/l
Vapor Density (Air = 1)	0.97.
Vapor Pressure	Not determined
Gas Density	0.075 lb/ft^3 @70°F as vapor
Evaporation Rate	Not applicable

10. STABILITY AND REACTIVITY

Stability
Stable under normal conditions.

Conditions to Avoid
Extremely high temperatures - flames

Materials to Avoid
None known

Hazardous Polymerization
Will not occur.

Hazardous Decomposition Products
None

11. TOXICOLOGICAL INFORMATION

Acute Toxicity
Simple asphyxiant.

Chronic Toxicity/Carcinogenicity
This product is not expected to cause long term adverse health effects.

11. TOXICOLOGICAL INFORMATION

Genotoxicity
This product is not expected to cause any mutagenic effects.

Reproductive/Developmental Toxicity
This product is not expected to cause adverse reproductive effects.

12. ECOLOGICAL INFORMATION

Mobility
Nitrogen occurs naturally in the atmosphere.

Persistence/Degradability
Nitrogen occurs naturally in the atmosphere.

Bio-accumulation
Nitrogen occurs naturally in the atmosphere.

Ecotoxicity
No data available

13. DISPOSAL CONSIDERATIONS

Dispose of container in accordance with all applicable local and national regulations. Do not cut, puncture or weld on or near to the container. If spilled, contents will vaporize to the atmosphere.

14. TRANSPORT INFORMATION

DOT CFR 172.101 Data	Nitrogen, compressed, 2.2, UN1066
UN Proper Shipping Name	Nitrogen, compressed
UN Class	(2.2) Non-Flammable Gas
UN Number	UN1066
UN Packaging Group	Not applicable

15. REGULATORY INFORMATION

EU Label Information

Classification and labelling have been performed according to EU directives 67/548/EEC and 99/45/EC including amendments(2001/60/EC and 2006/8/EC)

EU Hazard Symbol and Indication of Danger.
Non Flammable Gas

R phrases
None

S phrases
S9 Keep container in a well ventilated place.

15. REGULATORY INFORMATION

US REGULATIONS (Federal, State) and INTERNATIONAL CHEMICAL REGISTRATION LAWS

TSCA Listing
This product contains ingredients that are listed on or exempt from listing on the EPA Toxic Substance Control Act Chemical Substance Inventory.

EINECS Listing
All ingredients in this product are listed on the European Inventory of Existing Commercial Chemical Substances (EINECS) or the European List of New Chemical Substances (ELINCS) or are exempt from listing.

DSL/NDSL (Canadian) Listing
All ingredients in this product are listed on the Domestic Substance List (DSL) or the Non-Domestic Substance List (NDSL) or are exempt from listing.

WHMIS Classification
A

This product was classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations and the MSDS contains all the information required by these regulations.

MA Right To Know Law
All components have been checked for inclusion on the Massachusetts Substance List (MSL). Those components present at or above the de minimis concentration include: Nitrogen

PA Right To Know Law
This product contains the following chemicals found on the Pennsylvania Hazardous Substance List: - Nitrogen

NJ Right To Know Law
This product contains the following chemicals found on the NJ Right To Know Hazardous Substance List: - Nitrogen

California Proposition 65
This product does not contain materials which the State of California has found to cause cancer, birth defects or other reproductive harm.

SARA Title III Sect. 302 (EHS)
This product does not contain any chemicals subject to SARA Title III Section 302.

SARA Title III Sect. 304
This product does not contain any chemicals subject to SARA Title III Section 304.

SARA Title III Sect. 311/312 Categorization
- Immediate (Acute) Health Hazard - Pressure Hazard

SARA Title III Sect. 313
This product does not contain a chemical which is listed in Section 313 at or above de minimis concentrations.

16. OTHER INFORMATION

NFPA Ratings
NFPA Code for Health - 0
NFPA Code for Flammability - 0
NFPA Code for Reactivity - 0
NFPA Code for Special Hazards – None

16. OTHER INFORMATION

HMIS Ratings
HMIS Code for Health - 0
HMIS Code for Flammability - 0
HMIS Code for Reactivity - 0
HMIS Code for Personal Protection - See Section 8

Abbreviations
N/A: Denotes no applicable information found or available
CAS#: Chemical Abstracts Service Number
ACGIH: American Conference of Governmental Industrial Hygienists
OSHA: Occupational Safety and Health Administration
TLV: Threshold Limit Value
PEL: Permissible Exposure Limit
STEL: Short Term Exposure Limit
NTP: National Toxicology Program
IARC: International Agency for Research on Cancer
R: Risk
S: Safety

Prepared By: EnviroNet LLC.

The information contained herein is based on data believed to be accurate. However, no representation, warranty, or guarantee is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability and completeness of such information for its own particular use. Kidde Fire Systems assumes no responsibility for personal injury or property damage resulting from use, handling or from contact with this product.

MATERIAL SAFETY DATA SHEET

Carbon Dioxide
(Fire Extinguishing Agent and Expellant)

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATIONS AND OF THE COMPANY UNDERTAKING

Product Name	Carbon Dioxide (Fire Extinguishing Agent and Expellant)
Other Trade Names	CO2
Product Description	Fire Extinguishing Agent and Expellant
Manufacturer/Supplier	Kidde Fire Systems
Address	400 Main Street Ashland, MA 01721 USA
Phone Number	(508) 881-2000
Chemtrec Number (for emergencies only)	(800) 424-9300 (703) 527-3887 (International)
Revision Date:	February 9, 2012
MSDS Date:	February 9, 2009

Safety Data Sheet according to EC directive 2001/59/EC and OSHA's Hazcom Standard (29 CFR 1910.1200)

2. HAZARDS IDENTIFICATION

EU Main Hazards
Non Flammable Gas

Routes of Entry
Eye contact - Inhalation - Skin contact

Carcinogenic Status
Not considered carcinogenic by NTP, IARC, and OSHA.

Target Organs
Respiratory System - Skin - Eye – Cardiovascular System

Health Effects - Eyes
Direct contact with the cold gas or liquid can cause freezing of exposed tissues, with pain, redness, burns and corneal damage. Moisture in the air can react to form carbonic acid which causes eye irritation.

Health Effects - Skin
Direct contact with the cold gas or liquid can cause freezing of exposed tissues.

Health Effects - Ingestion
Ingestion is not a possible route of exposure.

Health Effects - Inhalation
Exposure to vapor at high concentrations have the following effects: - light headedness - dizziness - difficulty with breathing - drowsiness - nausea - mental confusion - increased blood pressure – increased respiratory rate - loss of consciousness which may prove fatal due to suffocation as it displaces oxygen. Individuals with pre-existing disease will be at increased risk.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Component Name	CAS#/Codes	Concentration	R Phrases	EU Classification
Carbon Dioxide	124-38-9 EC#204-696-9	>99.8	None	Non Flammable Gas

4. FIRST AID MEASURES

Eyes
Immediately flood the eye with plenty of warm water for at least 15 minutes, holding the eye open. Obtain medical attention if soreness or redness persists.
Skin
Gently warm affected areas. Obtain medical attention if blistering occurs or redness persists.
Ingestion
Ingestion is not considered a potential route of exposure.
Inhalation
Remove from exposure. If there is difficulty in breathing, give oxygen. Obtain medical attention immediately.
Advice to Physicians
In case of frostbite, place the frostbitten part in warm water. If warm water is not available or impractical to use, wrap the affected parts gently in blankets. DO NOT USE HOT WATER.

5. FIRE - FIGHTING MEASURES

Extinguishing Media
Carbon Dioxide is used as an extinguishing agent and therefore is not a problem when trying to control a blaze. Use extinguishing agent appropriate to other materials involved. Keep containers and surroundings cool with water spray as containers may rupture or burst in the heat of a fire.
Unusual Fire and Explosion Hazards
Containers may explode in heat of fire.
Protective Equipment for Fire-Fighting
Wear full protective clothing and self-contained breathing apparatus as appropriate for specific fire conditions.

6. ACCIDENTAL RELEASE MEASURES

Wear full protective clothing and self-contained breathing apparatus. Remove leaking cylinder to a safe place. Ventilate the area. Vapors can accumulate in low areas. Leaks inside confined spaces may cause suffocation as oxygen is displaced and should not be entered without a self-contained breathing apparatus.

7. HANDLING AND STORAGE

Cylinders should be properly stored and secured to prevent falling or being knocked over. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike against each other. Never apply flame or localized heat directly to any part of the cylinder. Store away from sources of heat or ignition. Storage area should be: - cool - dry - well ventilated - under cover - out of direct sunlight

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Standards
Occupational exposure limits are listed below, if they exist.
Carbon Dioxide
ACGIH TLV: 5000 ppm (9000 mg/m3) STEL: 30,000 ppm (54,000 mg/m3)
OSHA PEL: 5000 ppm (9000 mg/m3)
Engineering Control Measures
Use with adequate ventilation. There should be local procedures for the selection, training, inspection and maintenance of this equipment. When used in large volumes or odor becomes apparent, use local exhaust ventilation.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Respiratory Protection
Not normally required under conditions of use as a portable fire extinguisher. For other applications creating oxygen deficient atmospheres, use a self contained breathing apparatus, as an air purifying respirator will not provide protection.

Hand Protection
Wear rubber gloves. Avoid contact with skin.

Eye Protection
Chemical goggles or safety glasses with side shields. Avoid contact with eyes.

Body Protection
Normal work wear.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State	Liquefied gas under pressure
Color	Colorless
Odor	Odorless to Slightly Acidic
Specific Gravity	1.522
Boiling Range/Point (°C/F)	-109.3°F
Flash Point (PMCC) (°C/F)	Not Flammable
Solubility in Water	Soluble
Vapor Density (Air = 1)	Heavier than air.
Vapor Pressure	838 psig @70°F and 1 atmosphere
Gas Density	0.1144 lb/ft^3
Evaporation Rate	Not applicable

10. STABILITY AND REACTIVITY

Stability
Stable under normal conditions.

Conditions to Avoid
- Heat - High temperatures - Exposure to direct sunlight

Materials to Avoid
- alkali or alkaline earth metal (ex. aluminum, zinc, etc.) - Strong oxidizing agents

Hazardous Polymerization
Will not occur.

Hazardous Decomposition Products
- in contact with moisture will generate carbonic acid

11. TOXICOLOGICAL INFORMATION

Acute Toxicity
Simple asphyxiant. LCLo (inhalation in humans): 90,000ppm/ 5 minutes.

11. TOXICOLOGICAL INFORMATION

Chronic Toxicity/Carcinogenicity
This product is not expected to cause long term adverse health effects.

Genotoxicity
This product is not expected to cause any mutagenic effects.

Reproductive/Developmental Toxicity
This product is not expected to cause adverse reproductive effects.

12. ECOLOGICAL INFORMATION

Mobility
Carbon dioxide occurs naturally in the atmosphere.

Persistence/Degradability
Carbon dioxide occurs naturally in the atmosphere.

Bio-accumulation
Carbon dioxide occurs naturally in the atmosphere.

Ecotoxicity
Aquatic Toxicity: 100-200 mg/l/no time specified/various organisms/fresh water
Waterfowl toxicity: 5-8%, no effect

13. DISPOSAL CONSIDERATIONS

Dispose of container in accordance with all applicable local and national regulations. Do not cut, puncture or weld on or near to the container. If spilled, contents will vaporize to the atmosphere.

14. TRANSPORT INFORMATION

DOT CFR 172.101 Data	Carbon Dioxide, 2.2, UN1013
UN Proper Shipping Name	Carbon Dioxide
UN Class	(2.2) Non-Flammable Gas
UN Number	UN1013
UN Packaging Group	Not applicable

15. REGULATORY INFORMATION

EU Label Information

Classification and labelling have been performed according to EU directives 67/548/EEC and 99/45/EC including amendments(2001/60/EC and 2006/8/EC)

EU Hazard Symbol and Indication of Danger.
Non Flammable Gas

R phrases
None

S phrases
S9 Keep container in a well ventilated place.

15. REGULATORY INFORMATION

US REGULATIONS (Federal, State) and INTERNATIONAL CHEMICAL REGISTRATION LAWS

TSCA Listing
This product contains ingredients that are listed on or exempt from listing on the EPA Toxic Substance Control Act Chemical Substance Inventory.

EINECS Listing
All ingredients in this product are listed on the European Inventory of Existing Commercial Chemical Substances (EINECS) or the European List of New Chemical Substances (ELINCS) or are exempt from listing.

DSL/NDSL (Canadian) Listing
All ingredients in this product are listed on the Domestic Substance List (DSL) or the Non-Domestic Substance List (NDSL) or are exempt from listing.

WHMIS Classification
A

This product was classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations and the MSDS contains all the information required by these regulations.

MA Right To Know Law
All components have been checked for inclusion on the Massachusetts Substance List (MSL). Those components present at or above the de minimis concentration include: - carbon dioxide

PA Right To Know Law
This product contains the following chemicals found on the Pennsylvania Hazardous Substance List: - carbon dioxide

NJ Right To Know Law
This product contains the following chemicals found on the NJ Right To Know Hazardous Substance List: - carbon dioxide

California Proposition 65
This product does not contain materials which the State of California has found to cause cancer, birth defects or other reproductive harm.

SARA Title III Sect. 302 (EHS)
This product does not contain any chemicals subject to SARA Title III Section 302.

SARA Title III Sect. 304
This product does not contain any chemicals subject to SARA Title III Section 304.

SARA Title III Sect. 311/312 Categorization
- Immediate (Acute) Health Hazard - Pressure Hazard

SARA Title III Sect. 313
This product does not contain a chemical which is listed in Section 313 at or above de minimis concentrations.

16. OTHER INFORMATION

NFPA Ratings
NFPA Code for Health - 1
NFPA Code for Flammability - 0
NFPA Code for Reactivity - 0
NFPA Code for Special Hazards - None

16. OTHER INFORMATION

HMIS Ratings
HMIS Code for Health - 1
HMIS Code for Flammability - 0
HMIS Code for Reactivity - 0
HMIS Code for Personal Protection - See Section 8

Abbreviations
N/A: Denotes no applicable information found or available
CAS#: Chemical Abstracts Service Number
ACGIH: American Conference of Governmental Industrial Hygienists
OSHA: Occupational Safety and Health Administration
TLV: Threshold Limit Value
PEL: Permissible Exposure Limit
STEL: Short Term Exposure Limit
NTP: National Toxicology Program
IARC: International Agency for Research on Cancer
R: Risk
S: Safety
LCLo: Lethal concentration low

Prepared By: EnviroNet LLC.

The information contained herein is based on data believed to be accurate. However, no representation, warranty, or guarantee is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability and completeness of such information for its own particular use. Kidde Fire Systems assumes no responsibility for personal injury or property damage resulting from use, handling or from contact with this product.

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06-236115-001 Rev. BA

06-236115-003
July 2016

Supplement to

Kidde Fire Systems® ECS Fire Suppression System with HFC-227ea Agent: Design, Installation, Operation, and Maintenance Manual Rev BA, P/N 06-236115-001

Placement Supervision

UL LISTED
UL Listing File No. EX 4674

ULC LISTED
UL Listing File No. EX 4674

FM APPROVED
FM Approvals Project ID 3054754

Kidde Fire Systems

Jurisdiction: EAR
US ECCN: EAR99
This document contains technical data subject to the EAR

TABLE OF CONTENTS

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1 GENERAL

To comply with NFPA 2001 (2012 ed.), all control head must be under placement supervision such that, if an electric actuator is removed, an audible and visual signal will be initiated at the control panel indicating system impairment. To accomplish this, Kidde is offering a Control Head Monitor suitable for mounting between the electric control head and the corresponding discharge valves.

This document provides instructions to install the Control Head Monitor.

For other details, see the Kidde Fire Systems® ECS Fire Suppression System with HFC-227ea Agent: DIOM Rev BA, P/N 06-236115-001.

2 COMPONENT DESCRIPTIONS

2.1 Control Head Monitor with Explosion Proof Assembly, P/N 85-100000-100

The Control Head Monitor with explosion proof assembly provides supervision for control head placement in normal and explosive environments in one easy to install component.

The following specifications apply to the Control Head Monitor:

- Rated Voltage: 42 VDC maximum
- Resistive Load: 0.5A maximum

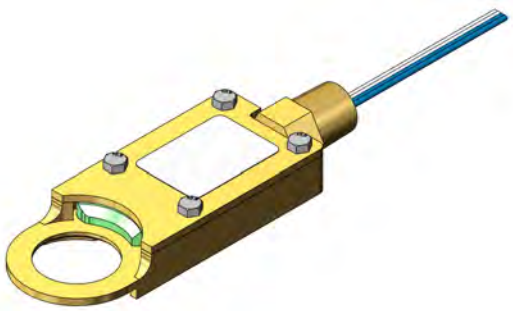

Figure 1. Control Head Monitor with Explosion Proof Assembly

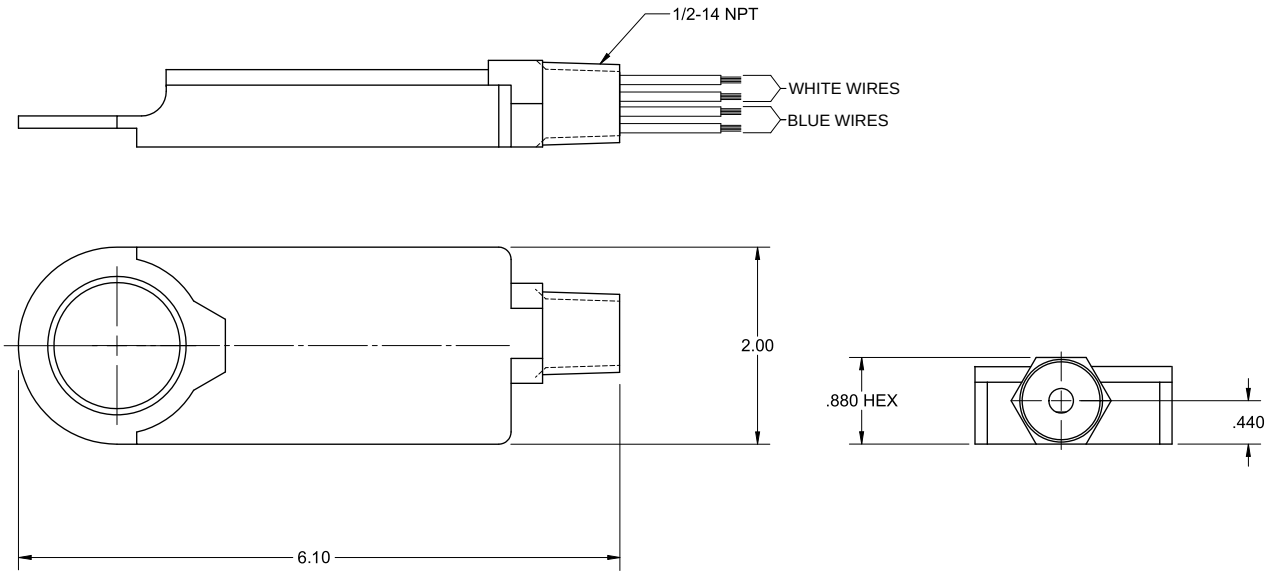

Figure 2. Control Head Monitor Dimensions

This component can be placed between the items listed below and one of the following Electric or Electric/Cable operated control heads (P/N: WK-890181-000, WK-897494-000, 82-486500-010, and 81-895630-000):

- 1-1/2”, 2”, and 3” cylinder discharge valve
- Nitrogen Pilot valve
- Nitrogen Driver valve
- Stackable Pressure Operated Control head (with special spacer)

WARNING

For US and Canada Explosion proof installations, seal all conduits within 18 inches from the end of the component.

2.1.1 Standards for US Explosion Proof Approval

Number	Issue Date
FM 3600	2011
FM 3615	2006
FM 3616	2011
FM 3810	2005
ANSI/ISA 60079-0	2013
ANSI/ISA 60079-1	2013
ANSI/ISA 60079-31	2013

US Hazardous Location Markings:

- Class I, Div 1, Groups CD
- Class I, Zone 1, AEx d IIB T6
- Class II, III, Div 1, Groups EFG
- Zone 21, AEx tb IIIC T85°C
- Ta = -40°C to 60°C

2.1.2 Standards for Canadian Explosion Proof Approval

Number	Issue Date
CSA C22.2 NO. 0.4	2013
CSA C22.2 NO. 0.5	2012
CSA C22.2 NO. 25	2014
CSA C22.2 NO. 30	2012
61010-1	2012
CAN/CSA 60079-0	2011
CAN/CSA 60079-1	2011

Canada Hazardous Location Markings:

- Class I, Div 1, Groups CD
- Class I, Zone 1, Ex d IIB T6
- Class II, III, Div 1, Groups EFG
- Zone 21, Ex tb IIIC T85°C
- Ta = -40°C to 60°C

2.2 Spacer, P/N 85-100000-002 (Optional)

A spacer, P/N 85-100000-002, must be used when installing the Control Head Monitor between and electric control head and the Stackable Pressure Operated Control head (P/N 82-878750-000). See Section 2.2 for more information.

3 INSTALLATION DETAILS

- Electric Control Head
- Electric/Cable Control Head
- Electric to N2 108 cu. in. Pilot Driver

3.1 Installation of Electric Control Heads (P/N WK-890181-000 and 82-486500-010)

Follow all instructions contained in the main body of the DIOM up to this section.

WARNING

Before installing a control head on an agent cylinder valve, ensure the control head is in the SET position (that is, the actuating pin is in the fully retracted or SET position). Failure to position the control head in the SET position will result in accidental agent cylinder discharge when the control head is installed on cylinder valve. Personal injury and/or property damage could occur.

Electric Control Head, P/N 82-486500-010 is designed for Kidde 1½ in, 2 in, and 2½ in agent cylinder valves only. Installing this control head on any other device (for example, pressure operated control head) will cause the device to malfunction when the control head is actuated.

1. Remove the protection cap from the agent cylinder actuation port. Ensure the control head is in SET position (that is, the actuating pin is in the fully retracted or SET position).
2. Insert the Control Head Monitor (P/N 85-100000-001) between the control head and the cylinder valve as shown in Figure 3 for the Electrical Control Head and Figure 5 for the Stackable Electric Control Head.
3. Install the electric control head on the cylinder actuation port. Tighten the swivel nut.

Note: When installed, the Control Head Monitor does not sit completely snug against the valve. This play allows for easier attachment of conduit to the component.

WARNING

The placement supervision signal is not a substitute for ensuring proper interlock of the actuator plunger to the valve core assembly. Make sure the control head is properly seated.

4. If installing the Stackable Electric Control Head (P/N 82-486500-010), install the Lever Operated Control Head to the top of the Stackable Electric Control Head.
5. Make all electrical connections as outlined in the DIOM.

WARNING

For US and Canada Explosion proof installations, seal all conduits within 18 inches from the end of the component.

Note: P/N 82-486500-010 is a polarized control head. Improper wiring will cause the device to malfunction.

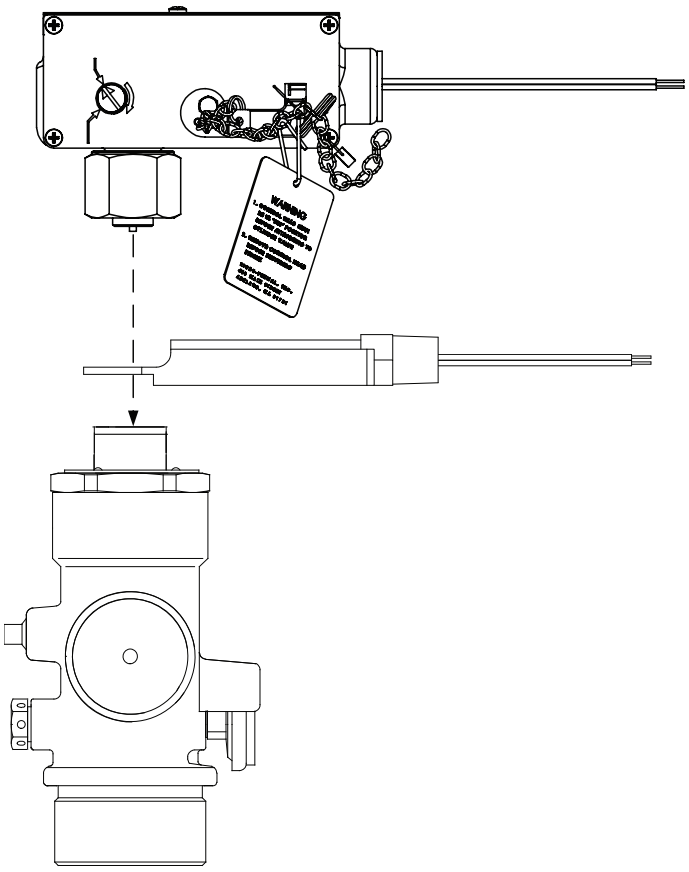

Figure 3. Order of Installation for Electric Control Head, P/N WK-890181-000

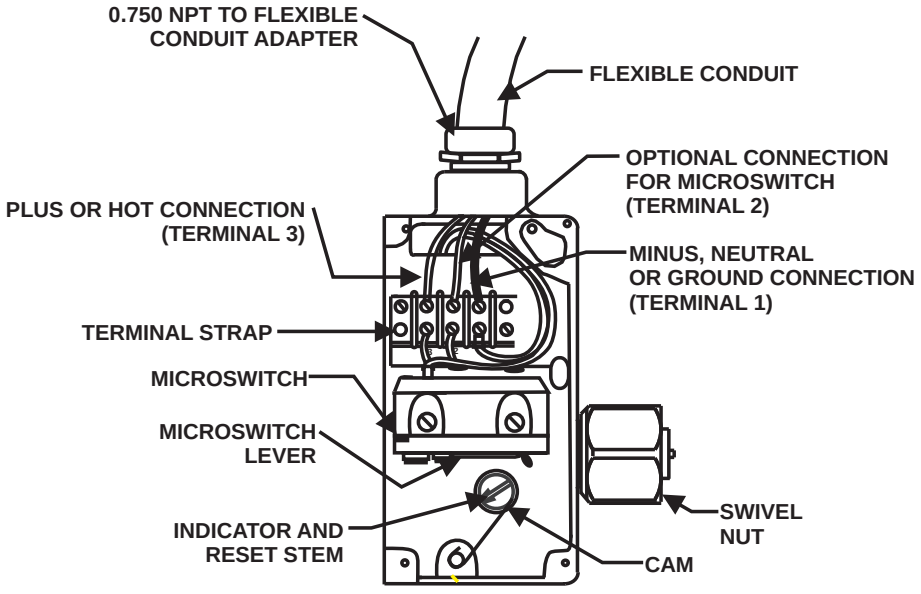

Figure 4. Electrical Connections for Control Head, P/Ns WK-890181-000

CAUTION

The stackable control head (P/N 82-486500-010) cannot be used with the 3-inch valve cylinder (P/Ns 90-100600-100, 90-100601-100, 90-100900-001 and 90-100901-001), the 108 cubic inch Nitrogen Pilot Cylinder or any size of Nitrogen Driver. The stackable control head does not have sufficient force to activate these valves and may result in system failure. Use the electric/manual control heads (P/Ns 8901XX) with the 3-inch valve (P/N 90-17000-000) or with other high pressure Kidde valves.

The stackable control head must be used in conjunction with a manual pull lever.

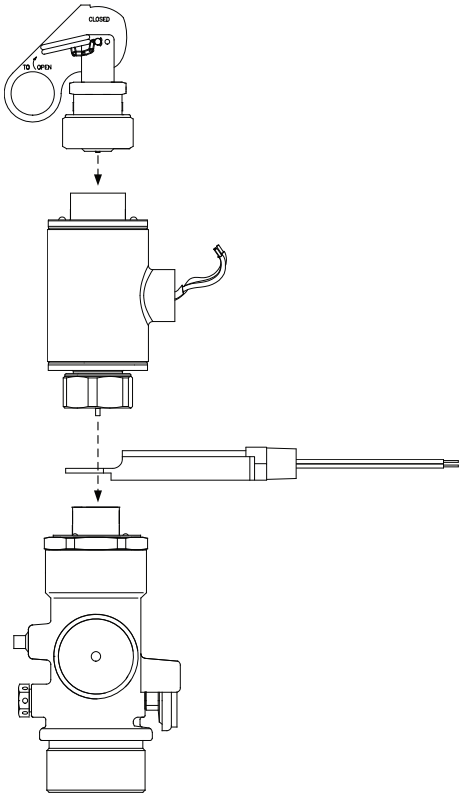

Figure 5. Order of Installation for Electric Control Head (Stackable Type), P/N 82-486500-010

3.2 Installation of Electric/Cable Operated Control Head, (P/N 81-895630-000 and WK-897494-000)

Follow all instructions contained in the main body of the DIOM up to this section. The following procedures must be performed before attaching a control head to a cylinder valve.

WARNING

Before installing a control head on a nitrogen driver cylinder valve, ensure the control head is in the SET position (that is, the actuating pin is in the fully retracted or SET position). Failure to position the control head in the SET position will result in accidental discharge and possible personal injury when the control head is installed on the driver valve.

1. Remove the four screws holding the cable housing cover on the control head. Remove the cover.
2. Position the control head in the approximately installed position at the agent cylinder valve control port but do not assemble onto the actuation port of the agent cylinder valve.
3. Check that the control head is in the SET position.
4. Assemble the pull cable conduit to the conduit connection on the control head.
5. Feed the cable into the control head through the hole in the operating lever.
6. Feed the cable through the cable clamp. Pull the cable taut, allowing approximately 1/4 in to 1/2 in clearance between the cable clamp and the operating lever. Tighten the set screws in the cable clamp to secure the cable to the clamp.
7. Cut off any excess cable.
8. Verify the manual remote cable operation to ensure control head actuates and all cable clamps are tight.
9. Pull the cable back to its normal set (non-operated) position.
10. Reset the control head.
11. Replace the control head cover.
12. Examine the seal wire at the safety pull pin. Make sure it is intact.
13. Insert the Control Head Monitor between the control head and the cylinder valve. This is similar to the order of installation shown in Figure 3.
14. Assemble the control head to the cylinder valve actuation port. Tighten the swivel nut securely.

Note: When installed, the Control Head Monitor does not sit completely snug against the valve. This play allows for easier attachment of conduit to the component.

WARNING

The placement supervision signal is not a substitute for ensuring proper interlock of the actuator plunger to the valve core assembly. Make sure the control head is properly seated.

15. Make all electrical connections as outlined in the DIOM.

WARNING

For US and Canada Explosion proof installations, seal all conduits within 18 inches from the end of the component.

3.3 Installation of Nitrogen Pilot Cylinder, P/N WK-877940-000 and Mounting Bracket, P/N WK-877845-000

Follow all instructions contained in the main body of the DIOM up to this section.

1. Locate the nitrogen cylinder mounting bracket in an area where the cylinder valve assembly and control head will be protected from inclement weather by a suitable total or partial enclosure, preferably adjacent to the agent storage cylinders.
2. Install the mounting bracket clamps and hardware. Install the nitrogen cylinder in position in a mounting bracket; tighten sufficiently to hold the cylinder in place while allowing the cylinder enough free play to be rotated.
3. Turn the cylinder until the valve discharge outlet is in the desired position. The nitrogen cylinder must be positioned so that control head is readily accessible for manual operation.
4. Securely tighten the mounting bracket clamps and hardware.
5. Attach the adapter (P/N WK-699205-010) and connect the nitrogen pilot lines.
6. Remove the protective cap from the cylinder valve actuation port.

WARNING

Ensure the control head is in the SET position (that is, the actuating pin is in the fully retracted or SET position) before attaching it to the cylinder valve. If the control head is not in the SET position, agent will discharge accidentally.

7. Insert the Control Head Monitor between the control head and the cylinder valve actuation port as shown in Figure 6.

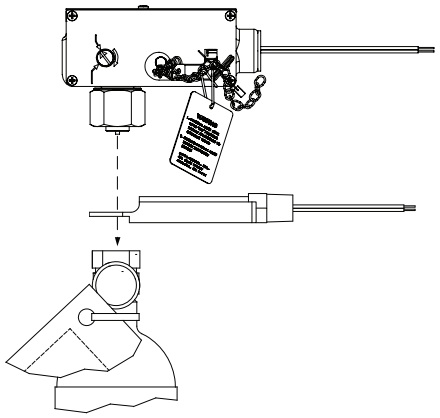

Figure 6. Order of Installation

8. Install the control head to the cylinder valve actuation port and tighten securely.

Note: When installed, the Control Head Monitor does not sit completely snug against the valve. This play allows for easier attachment of conduit to the component.

WARNING

The placement supervision signal is not a substitute for ensuring proper interlock of the actuator plunger to the pilot check assembly. Make sure the control head is properly seated.

9. Make all electrical connections as outlined in the DIOM.

WARNING

For US and Canada Explosion proof installations, seal all conduits within 18 inches from the end of the component.

3.4 Installation of Stackable Pressure Operated Control Heads (P/N 82-878750-000)

Follow all instructions contained in the main body of the DIOM up to this section.

Note: The Spacer (P/N: 85-100000-002) is only needed when installing an electric control head (P/N WK-890181-000, 81-895630-000, and 81-895630-000) onto a stackable pressure operated control head. The order of installation must be followed as outlined below.

1. Remove the protection cap from the cylinder actuation port.

WARNING

When attaching the pressure-operated control head to the valve, the swivel nut must be tightened to a torque of 55 ft-lb. Failure to tighten the swivel nut as directed may result in leakage during actuation.

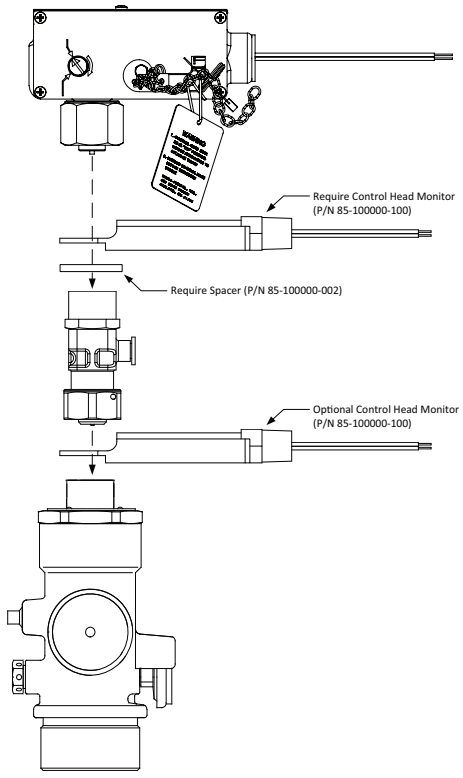

Figure 7. Pressure Operated Control Head Order of Assembly

2. Install a pressure operated control head with flexible actuation hose attached to the cylinder actuation port.
3. Insert the spacer (P/N 85-100000-002) on to top of the stackable pressure operated control head.
4. Insert the Control Head Monitor between the electric control head and the spacer as shown in Figure 7.

5. Install the electric control head to the top port of the stackable pressure operated control head and tighten securely.

WARNING

Ensure that the pilot line is not pressurized and the actuating pins are in the SET position (that is, the actuating pins are in the fully retracted or SET position). Failure to follow this procedure will result in accidental discharge and possible death, personal injury, and property damage when the control head is installed on the valve.

Note: When installed, the Control Head Monitor does not sit completely snug against the valve. This play allows for easier attachment of conduit to the component.

WARNING

The placement supervision signal is not a substitute for ensuring proper interlock of the actuator plunger to the valve core assembly. Make sure the control head is properly seated.

4 PREVENTIVE MAINTENANCE

Perform preventive maintenance per Table 1-1.

Table 1-1. Preventive Maintenance Schedule

Schedule	Requirement	Paragraph
Semi-Annually	Test electric control heads	4.1

4.1 Semi-Annual Electric Control Head Test

Electric control heads (including electric/cable operated combination control heads) must be tested semi-annually for proper operation. In addition, the Control Head Monitor must be tested to ensure it is functional. These tests can be performed without discharging the cylinders. Test one hazard area at a time completely before proceeding to the next, as follows:

WARNING

All control heads and Control Head Monitors must be removed from the cylinders before testing to prevent possible personal injury, death, or property damage in the event of accidental cylinder discharge.

1. Remove all electric control heads and Control Head Monitors from all cylinders serving the hazard area being tested. Let the electric control heads and Control Head Monitors hang freely from the flexible electric conduit connections. Leave all pressure operated control heads, and pilot actuation hoses attached to the cylinders. Attach the safety cap to the valve actuation port.
2. Check the control panel to see that the Control Head Monitor reports a supervision alarm to the panel.
3. Operate the system electrically. This can be done by actuating the system at the system control panel or from an electric pull station.
4. Ensure all electric control heads have operated, (that is, the indicator on the electric control head has moved to the RELEASED position). If any control heads have not operated, check the circuit for electric continuity to these particular heads and repeat the test. Replace all damaged heads. Repeat the test if any control heads have been replaced.

CAUTION

Control head must be reset to the SET position (fully retracted actuation pin) before reconnecting to a cylinder valve. Failure to follow this instruction will result in cylinder discharge when attempting to install the control head.

5. Observe the instructions on the caution label attached to each electric control head. Remove the safety cap. Re-Install the Control Head Monitor between the control head and corresponding valve. Re-attach all electric control heads to threaded port on cylinder valve or pressure operated control head. Tighten the swivel nut securely. Make certain each electric control head is in the SET position before reconnecting to the cylinders. Failure to follow this procedure will result in accidental discharge.

5 PARTS LIST

Part Number	Description
Control Head Monitor, with Explosion Proof Assembly	
85-100000-100	Control Head Monitor, with Explosion Proof Assembly
85-100000-002	Spacer, required when installing Control Head Monitor onto Stackable Pressure Operated Control Head

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06-236115-003 Rev. AB

06-237553-001
August 2016

Kidde Fire Systems®

2” Valve and Safety Burst Disc Rebuild Kit and Instructions

Addendum

UL LISTED
UL Listing File No. EX 4674

ULC LISTED
UL Listing File No. EX 4674

FM APPROVED
FM Approvals Project ID 3054754

Kidde Fire Systems

Jurisdiction: EAR
US ECCN: EAR99
This document contains technical data subject to the EAR

TABLE OF CONTENTS

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1 GENERAL

This document provides details for new 2” Valve and Safety Burst Disc Rebuild Kit (P/N 85-150100-000). In addition, the document provides updated post fire maintenance instructions for the 2” Valve. This addendum applies to the manuals listed in Table 1.

For other system details, see the associated manuals listed in Table 1.

Table 1. Manual Listing

Manual Title	Part Number	Revision
Kidde Fire Systems		
Kidde Engineered Fire Suppression System Designed for use with 3M™ Novec™ 1230 Fire Protection Fluid Design, Installation, Operation, and Maintenance Manual	06-236553-001	BB
Kidde Fire Systems® ECS Advanced Delivery Fire Suppression System with 3M™ Novec™ 1230 Fire Protection Fluid Design, Installation, Operation, and Maintenance Manual	06-237256-001	AA
Kidde Fire Systems® ECS Fire Suppression System with HFC-227ea Agent Design, Installation, Operation, and Maintenance Manual	06-236115-001	BA
Kidde Fire Systems® ECS Fire Suppression System with HFC-227ea Agent: Modular Balanced Design, Installation, Operation, and Maintenance Manual	06-236116-001	BA
Kidde Fire Systems® ECS Advanced Delivery Fire Suppression System with FM-200® Agent Design, Installation, Operation, and Maintenance Manual	06-236068-001	BA
Kidde Fire Systems, Marine Series		
Kidde Engineered Marine Fire Suppression System Designed for use with 3M™ Novec™ 1230 Fire Protection Fluid Design, Installation, Operation, and Maintenance Manual	06-236559-001	AC
Kidde Fire Systems® ECS Advanced Delivery Fire Suppression System Marine Series with 3M™ Novec™ 1230 Fire Protection Fluid	06-237257-001	AA
Kidde Fire Systems® ECS Fire Suppression System Marine Series with HFC-227ea Agent Design, Installation, Operation, and Maintenance Manual	06-236225-001	BA
Kidde Fire Systems® ECS Advanced Delivery Fire Suppression System Marine Series with FM-200® Agent Design, Installation, Operation, and Maintenance Manual	06-236595-001	BA
UTC India		
Kidde Engineered Fire Suppression System Designed for use with 3M™ Novec™ 1230 Fire Protection Fluid Design, Installation, Operation, and Maintenance Manual (For UTC India Specifications)	06-237127-600	AB
Kidde Fire Systems® ECS Fire Suppression System with FM-200® Agent: Design, Installation, Operation, and Maintenance Manual (For UTC India Specifications)	06-237298-001	BA

2 COMPONENT DESCRIPTIONS

2.1 2” Valve and Safety Burst Disc Rebuild Kit, P/N 85-150100-000

The 2” Valve and Safety Burst Disc Rebuild Kit should be used to rebuild all 2” Valves after a discharge, including replacing the safety burst disc.

Table 2. 2” Valve and Cylinder Rebuild Kit Contents

Description	Part Number
2" Valve and Safety Burst Disc Rebuild Kit includes: • Assembly, Piston, which includes: – Piston – Piston O-ring – Teflon Back-up O-ring – Seat O-ring • O-ring, Neck • O-ring, Cap • Disc - Safety, 2.0" Valve • Washer - Safety • Retainer - Safety Disc	85-150100-000

3 POST-FIRE MAINTENANCE

Some components in the agent valve assembly will need to be inspected and serviced before recharging the cylinder/valve assembly. All O-rings must be replaced whenever a valve is disassembled. Part numbers for items which may require replacement are listed in Table 3.

3.1 2” Valve Disassembly

WARNING **Before removing the valve, make certain all pressure has been relieved from the cylinder. To relieve any remaining pressure, make sure the cylinder is secure, then depress the pressure switch Schrader valve until all pressure is relieved.**

Note: Replace O-rings when rebuilding the valve. Never reuse old O-rings.

1. Remove the valve with the siphon tube from the cylinder.
2. Remove the cylinder neck O-ring (Item 2 in Figure 1) and discard the O-ring.
3. Remove the valve cap and spring. Remove the Cap O-ring (Item 1) and discard the O-ring.

Note: Remove all internal components of the agent valve from the top of the assembly. However, if there is excessive friction at the piston, the siphon tube may have to be removed and the piston assembly pushed out the valve body from the bottom.

4. Remove the piston assembly (Item 3).
5. Examine the Schrader valve core pin (Item 4) for any evidence of bending or other damage. Depress the pin and make certain it snaps back freely. Replace the valve core if necessary using a standard Schrader core wrench. When reinstalling a new Schrader core element, torque to 1½ to 3 in· lb (0.17 to .34 N-m).

CAUTION **After reinstalling a Schrader core, the distance from the top of the core pin to the control head seating surface must fall between the dimensions of 0.515 in to 0.565 in (13 mm to 14 mm) when in the “shut” or non-actuated position (see Figure 1).**

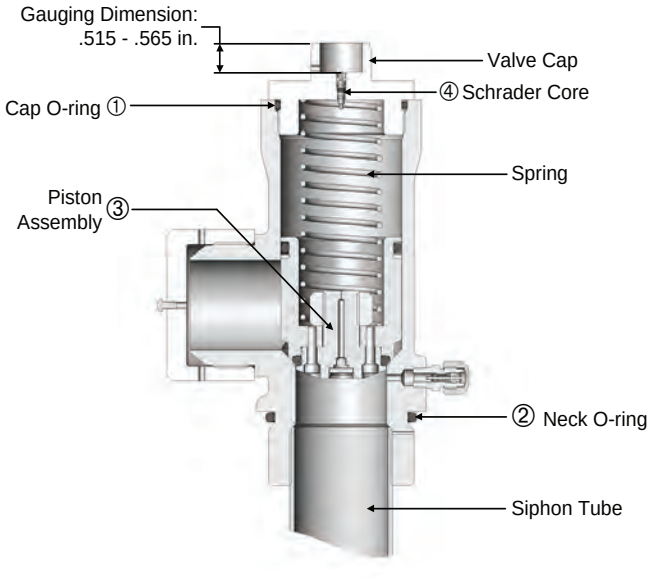

Figure 1. Valve Assembly

Table 3. Valve Components

Figure Item No.	Description	2” Valves Part Number
1	O-ring, cap	Included in Rebuild Kit
2	O-ring, neck	Included in Rebuild Kit
3	Piston Assembly	Included in Rebuild Kit
4	Schrader core	WK-220278-000

Table 4. Other Valve Components

Other Materials	Description
Lubricant	Parker Seal Co. Super-O-Lube or equivalent
Loctite Sealant	Loctite Corp. Sealant, Grade CV or equivalent
Locquic® Primer	Loctite Corp. Primer, Grade N or equivalent

3.2 2” Valve Assembly

Note: The items refer to Figure 1.

1. Inspect the cleanliness of lubricated O-rings on the new piston assembly. Re-lubricate O-rings if needed. Discard the old Piston Assembly, including the O-rings.
2. Press the new piston assembly (Item 3) into the valve body. When installing the new piston assembly, lightly lubricate the area of upper O-ring travel in valve body to ease installation. Do not lubricate near the outlet.
3. Install the spring.
4. Apply lubricant to the new Cap O-ring (Item 1). Install the new Cap O-ring onto the groove in the valve cap.
5. Screw the valve cap onto the valve body and torque to 50-55 ft-lbs (68-75 N-m).
6. Apply lubricant to the Neck O-ring (Item 2). Install the Neck O-ring onto the valve neck groove.
7. If you had to remove the siphon tube for valve disassembly, wire brush the siphon tube threads to remove the old Loctite® residue.
8. Apply a film of Loctite primer to the siphon tube threads and allow three to five minutes to dry.
9. Apply a film of Loctite sealant to the first several threads and reinstall the siphon tube.
10. Screw the valve and siphon tube onto the cylinder, and torque to 50 to 55 ft-lb (68 to 75 N-m).

3.3 Safety Burst Disc Replacement

CAUTION

Whenever the valve is rebuilt, the Safety Disc Assembly must be replaced. Refer to Figure 2 or Figure 3.

WARNING

Before removing the valve, make sure that all pressure has been relieved from the cylinder. To relieve any remaining pressure, restrain the cylinder and depress the pressure check in the Supervisory Pressure Switch.

Depending on the manufacture date of the valve, the safety disc is located either on the cylinder shoulder, adjacent to the cylinder valve or on the cylinder valve itself. Valves manufactured after April 2014 have the safety burst disc located on the cylinder shoulder. Valves manufactured before May 2014 have the safety burst disc located on the valve body. For the location of the date code, see Figure 2. Follow these steps to replace the safety burst disc.

1. Remove the safety disc retainer, safety disc, and safety disc washer from the cylinder or valve body. See Figure 2 and Figure 3. Discard the removed components.

Note: Do not remove the holder of the safety burst disc assembly from the cylinder shoulder.

2. Assemble the new safety disc retainer with a new safety disc and safety disc washer to the cylinder or valve body. Torque to the appropriate value listed in Table 5.

WARNING

Never install any type disc other than the one included with the rebuild kit. Installing an incorrect disc could result in violent rupture of the cylinder and serious injury.

Make sure that multiple safety discs are not stuck together. Installing more than one safety disc could result in violent rupture of the cylinder and serious injury.

Never reinstall a used safety disc and/or washer. Once the retainer has been removed or the valve has been rebuilt, the disc and washer must be replaced with new components.

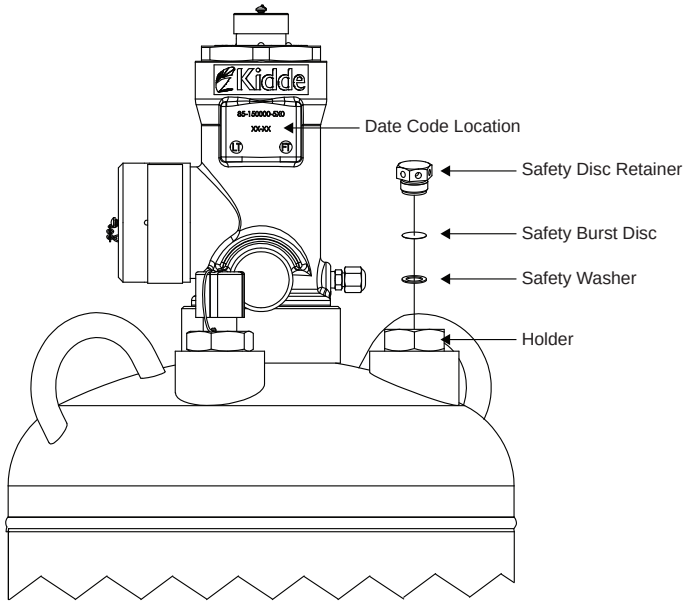

Figure 2. Installation of Safety Burst Disc on Cylinder (Valves Manufactured after April 2014)

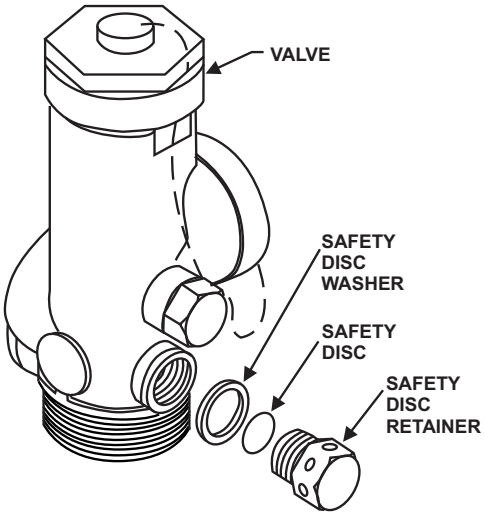

Figure 3. Installation of Safety Burst Disc on Valve (Valves Manufactured before May 2014)

Table 5. Safety Disc Replacement Information

Valve Size	Torque Valve	psig @ 70°F
2 in	38 ft lb	800-975

4 PARTS LIST

Part Number	Description
85-150100-000	2" Valve and Safety Burst Disc Rebuild Kit includes: • Assembly, Piston, which includes: – Piston – Piston O-ring – Teflon Back-up O-ring – Seat O-ring • O-ring, Neck • O-ring, Cap • Disc - Safety, 2.0" Valve • Washer - Safety • Retainer - Safety Disc

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06-236115-004
May 2016

Supplement to

Kidde Fire Systems® ECS Fire Suppression System with HFC-227ea Agent: Design, Installation, Operation, and Maintenance Manual Rev BA, P/N 06-236115-001

Stainless Steel Nozzles

UL LISTED
UL Listing File No. EX 4674

ULC LISTED
UL Listing File No. EX 4674

FM APPROVED
FM Approvals Project ID 3054754

Kidde Fire Systems

Jurisdiction: EAR
US ECCN: EAR99
This document contains technical data subject to the EAR

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1 GENERAL

Kidde Fire Systems® now offers Stainless Steel Nozzles as an alternative to the Brass Nozzles. Stainless Steel Nozzles can be used in sterilized areas, the food industry, pharmaceutical industry, medical facilities, and in harsh environments where the properties of Stainless Steel are more beneficial.

This document provides a component description and parts list for the new nozzles.

For other details, see the Kidde Fire Systems® ECS Fire Suppression System with HFC-227ea Agent: DIOM Rev BA, P/N 06-236115-001.

2 COMPONENT DESCRIPTIONS

2.1 Stainless Steel Discharge Nozzles

The 180° and 360° stainless steel discharge nozzles function similarly to the brass nozzles and are designed to provide the proper flow rate and distribution of agent to flood a hazard area. The 180° nozzle is engineered to provide a 180° discharge pattern for sidewall applications. The 360° nozzle offers a full 360° discharge pattern for installations where nozzles are located in the center of the hazard. See Figure 3 and Figure 4 and Table 1 and Table 2 for further information. For part numbers, see See “Stainless Steel Discharge Nozzle Parts List” on page 4.

Figure 1. 360° Stainless Steel Nozzle

Figure 2. 180° Stainless Steel Nozzle

Note: Installation details and coverage areas for the Stainless Steel Nozzle are the same as the Brass Nozzles. Please refer to the Kidde Fire Systems® ECS Fire Suppression System with HFC-227ea Agent: DIOM Rev BA, P/N 06-236115-001 for further details.

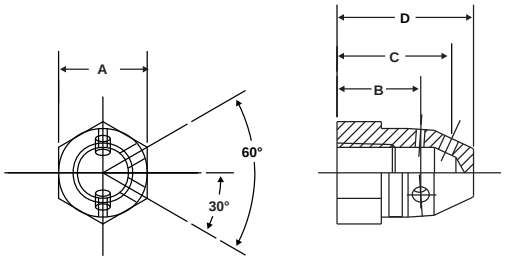

Figure 3. 180° Discharge Nozzle

Table 1. Dimensions–180° Discharge Nozzle

Pipe Size	A	B	C	D
½ in (12.70 mm)	1.25 in (31.75 mm)	1.187 in (30.15 mm)	1.625 in (41.28 mm)	1.937 in (49.20 mm)
¾ in (19.05 mm)	1.5 in (38.10 mm)	1.375 in (34.92 mm)	1.95 in (49.53 mm)	2.296 in (58.32 mm)
1 in (25.40 mm)	1.75 in (44.45 mm)	1.562 in (39.67 mm)	2.218 in (56.34 mm)	2.671 in(67.84 mm)
1¼ in (31.75 mm)	2.25 in (57.15 mm)	1.75 in (44.45 mm)	2.656 in (67.46 mm)	3.25 in (82.55 mm)
1½ in (38.10 mm)	2.5 in (63.5 mm)	1.95 in (49.53 mm)	2.95 in (74.93 mm)	3.625 in(92.07 mm)
2 in (50.80 mm)	3.0 in (76.2 mm)	1.968 in (49.98 mm)	2.875 in (73.02 mm)	3.656 in (92.86 mm)

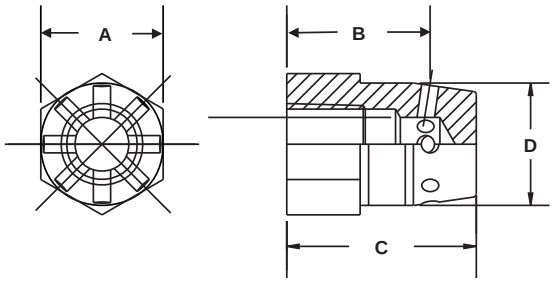

Figure 4. 360° Discharge Nozzle

Table 2. Dimensions–360° Discharge Nozzle

Pipe Size	A	B	C	D
½ in (12.70 mm)	1.250 in (31.75 mm)	1.468 in (37.30 mm)	1.937 in (49.20 mm)	1.250 in (31.75mm)
¾ in (19.05 mm)	1.500 in (38.10 mm)	1.578 in (40.08 mm)	2.125 in (53.97 mm)	1.500 in (38.10 mm)
1 in (25.40 mm)	1.750 in (44.45 mm)	1.718 in (43.64 mm)	2.375 in (60.32 mm)	1.750 in (44.45 mm)
1¼ in (31.75 mm)	2.250 in (57.15 mm)	1.950 in (49.53 mm)	2.751 in (69.88 mm)	2.250 in (57.15 mm)
1½ in (38.10 mm)	2.500 in (63.50 mm)	2.000 in (50.80 mm)	2.937 in (74.60 mm)	2.500 in (63.50 mm)
2 in (50.80 mm)	3.000 in (76.20 mm)	2.062 in (52.37 mm)	3.125 in (79.37 mm)	3.000 in (76.20 mm)

3 STAINLESS STEEL DISCHARGE NOZZLE PARTS LIST

WARNING **Only listed Kidde ECS System agent nozzles are to be used on Kidde ECS Systems. Failure to comply with this WARNING can result in unpredictable agent distribution.**

3.1 360 Degree Nozzles

Area (in^2)	360 Degree Nozzle Part Number					
	1/2 in NPT	3/4 in NPT	1 in NPT	1-1/4 in NPT	1-1/2 in NPT	2 in NPT
0.0774	90-194523-111					
0.0802	90-194523-113					
0.0845	90-194523-116					
0.0905	90-194523-120					
0.0982	90-194523-125					
0.1037	90-194523-129					
0.1162	90-194523-136					
0.1240	90-194523-141					
0.1303	90-194523-144					
0.1358	90-194523-147	90-194524-147				
0.1404	90-194523-150	90-194524-150				
0.1534	90-194523-156	90-194524-156				
0.1629	90-194523-161	90-194524-161				
0.1731	90-194523-166	90-194524-166				
0.1856	90-194523-172	90-194524-172				
0.1968	90-194523-177	90-194524-177				
0.2035	90-194523-180	90-194524-180				
0.2080	90-194523-182	90-194524-182				
0.2150	90-194523-185	90-194524-185				
0.2244		90-194524-189	90-194525-189			
0.2353		90-194524-194	90-194525-194			
0.2488		90-194524-199	90-194525-199			
0.2653		90-194524-206	90-194525-206			
0.2851		90-194524-213	90-194525-213			
0.3007		90-194524-219	90-194525-219			
0.3069		90-194524-221	90-194525-221			
0.3266		90-194524-228	90-194525-228			
0.3440		90-194524-234	90-194525-234			
0.3559		90-194524-238	90-194525-238			
0.3802			90-194525-246	90-194026-246		

Area (in^2)	360 Degree Nozzle Part Number					
	1/2 in NPT	3/4 in NPT	1 in NPT	1-1/4 in NPT	1-1/2 in NPT	2 in NPT
0.3927			90-194525-250	90-194526-246		
0.4150			90-194525-257	90-194526-250		
0.4280			90-194525-261	90-194526-257		
0.4433			90-194525-266	90-194526-261		
0.4649			90-194525-272	90-194526-266		
0.4821			90-194525-277	90-194526-272		
0.5284			90-194525-290	90-194526-277	90-194527-290	
0.5468			90-194525-295	90-194526-290	90-194527-295	
0.5731			90-194525-302	90-194526-295	90-194527-302	
0.6136			90-194525-313	90-194526-302	90-194527-313	
0.6274				90-194526-313	90-194527-316	
0.6555				90-194526-316	90-194527-323	
0.6765				90-194526-323	90-194527-328	
0.6926				90-194526-328	90-194527-332	
0.7221				90-194526-332	90-194527-339	
0.7424				90-194526-339	90-194527-344	
0.8053				90-194526-344	90-194527-358	
0.8115				90-194526-358	90-194527-359	
0.8509				90-194526-359	90-194527-368	90-194528-368
0.8836				90-194526-368	90-194527-375	90-194528-375
0.8930				90-194526-375	90-194527-377	90-194528-377
0.9362				90-194526-377	90-194527-386	90-194528-386
0.9587				90-194526-386	90-194527-391	90-194528-391
0.9903				90-194526-391	90-194527-397	90-194528-397
1.0255				90-194526-397	90-194527-404	90-194528-404
1.0717				90-194526-404	90-194527-413	90-194528-413
1.1183					90-194527-422	90-194528-422
1.2026					90-194527-438	90-194528-438
1.2901					90-194527-453	90-194528-453
1.3806					90-194527-469	90-194528-469
1.4742						90-194528-484
1.5708						90-194528-500
1.6705						90-194528-516
1.7733						90-194528-531
1.8791						90-194528-547
1.9880						90-194528-563
2.1000						90-194528-578
2.2151						90-194528-594
2.3332						90-194528-609

3.2 180 Degree Nozzles:

Area (in^2)	180 Degree Nozzle Part Number					
	1/2 in NPT	3/4 in NPT	1 in NPT	1-1/4 in NPT	1-1/2 in NPT	2 in NPT
0.0770	90-194513-109					
0.0810	90-194513-111					
0.0820	90-194513-113					
0.0875	90-194513-116					
0.0931	90-194513-120					
0.1030	90-194513-125					
0.1072	90-194513-129					
0.1190	90-194513-136					
0.1289	90-194513-141					
0.1342	90-194513-144	90-194514-144				
0.1384	90-194513-147	90-194514-147				
0.1428	90-194513-150	90-194514-150				
0.1605	90-194513-156	90-194514-156				
0.1694	90-194513-161	90-194514-161				
0.1779	90-194513-166	90-194514-166				
0.1909	90-194513-172	90-194514-172				
0.2049		90-194514-177				
0.2113		90-194514-180				
0.2177		90-194514-182	90-194515-182			
0.2215		90-194514-185	90-194515-185			
0.2313		90-194514-189	90-194515-189			
0.2405		90-194514-194	90-194515-194			
0.2597		90-194514-199	90-194515-199			
0.2744		90-194514-206	90-194515-206			
0.3005		90-194514-213	90-194515-213			
0.3080		90-194514-219	90-194515-219			
0.3128		90-194514-221	90-194515-221			
0.3364		90-194514-228	90-194515-228			
0.3504			90-194515-234			
0.3623			90-194515-238			
0.4039			90-194515-246	90-194516-246		

Area (in^2)	180 Degree Nozzle Part Number					
	1/2 in NPT	3/4 in NPT	1 in NPT	1-1/4 in NPT	1-1/2 in NPT	2 in NPT
0.4056			90-194515-250	90-194516-250		
0.4233			90-194515-257	90-194516-257		
0.4400			90-194515-261	90-194516-261		
0.4485			90-194515-266	90-194516-266		
0.4734			90-194515-272	90-194516-272		
0.4954			90-194515-277	90-194516-277		
0.5379			90-194515-290	90-194516-290	90-194517-290	
0.5636				90-194516-295	90-194517-295	
0.5967				90-194516-302	90-194517-302	
0.6382				90-194516-313	90-194517-313	
0.6439				90-194516-316	90-194517-316	
0.6787				90-194516-323	90-194517-323	
0.6875				90-194516-328	90-194517-328	
0.7254				90-194516-332	90-194517-332	
0.7401				90-194516-339	90-194517-339	
0.7884				90-194516-344	90-194517-344	
0.8439				90-194516-358	90-194517-358	90-194518-358
0.8439				90-194516-359	90-194517-359	90-194518-359
0.8767				90-194516-368	90-194517-368	90-194518-368
0.9047				90-194516-375	90-194517-375	90-194518-375
0.9311				90-194516-377	90-194517-377	90-194518-377
0.9588				90-194516-386	90-194517-386	90-194518-386
0.9896					90-194517-391	90-194518-391
1.0140					90-194517-397	90-194518-397
1.0498					90-194517-404	90-194518-404
1.1081					90-194517-413	90-194518-413
1.1699					90-194517-422	90-194518-422
1.2368					90-194517-438	90-194518-438
1.3374						90-194518-453
1.4146						90-194518-469
1.5114						90-194518-484
1.6264						90-194518-500
1.7045						90-194518-516
1.8205						90-194518-531
1.9075						90-194518-547
2.0304						90-194518-563
2.1566						90-194518-578

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