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Marine Carbon Dioxide

Version 2.4

Design, Installation, Operation and Maintenance Manual

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Kidde Fire Systems

FOREWORD

Note: This Kidde Fire Systems Marine Carbon Dioxide (CO_2) Design, Installation, Operation, and Maintenance manual, P/N 220610, is for use only by qualified and factory-trained personnel with working knowledge of applicable standards such as NFPA, USCG, as well as a working knowledge of Kidde Marine Carbon Dioxide (CO_2) Fire Suppression Systems. Kidde Fire Systems does not authorize or recommend use of this Manual by others.

The data contained herein is provided by Kidde Fire Systems as a guide only. It is not intended to be all inclusive and should not be substituted for professional judgement. Kidde Fire Systems believes the data to be accurate, but this data is provided without guarantee or warranty to its accuracy or completeness.

Kidde Fire Systems CO2 systems are to be designed, installed, inspected, maintained and tested by qualified, trained personal in accordance with the following:

1. Department of Transportation Code of Federal Regulations Title 46.
2. USCG Navigation and Vessel Inspection Circular NVIC 6-72, “Guide to Fixed Fire-Fighting Equipment aboard Merchant Vessels.”
3. Standard of the National Fire Protection Association No. 12 titled “CO2 Fire Extinguishing Systems” (latest edition).
4. International Convention for the Safety of Life at Sea (SOLAS), latest edition. (Applicable only where SOLAS rules apply.)

Note: If Code of Federal Regulations and National Fire Protection Association Standard 12 are in conflict and SOLAS Rules do not apply, the Code of Federal Regulations is the final authority. If all 3 rules apply, SOLAS rules govern. Contact USCG for rule interpretations.

5. All instructions, limitations, etc., contained in this manual, F-42171 (P/N 220610).
6. All information contained on the extinguishing system nameplates.
7. Storage, handling, transportation, service, and maintenance of cylinder assemblies shall be only by personnel trained in the proper procedures in accordance with the Safety Bulletins shown in the Foreword of this manual, and Compressed Gas Association* Pamphlets C-1, C-6, G-6, and P-1.
8. Walter Kidde Safety Bulletins Nos. 1 and 5 dated March 2, 1997.

*CGA pamphlets are published by the Compressed Gas Association, and can be found at:
http://www.cganet.com

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

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TERMS AND ABBREVIATIONS

ABS:	Absolute	N.C.:	Normally Closed
ADA:	Americans with Disabilities Act	NFPA:	National Fire Protection Association
AH:	Ampere Hour	N.O.:	Normally Open
AWG:	American Wire Gauge	N_2:	Nitrogen
BIL:	Basic Installation Level	P/N:	Part Number
C:	Common	PED:	Pressure Equipment Directive
CFM:	Cubic Feet per Minute	TC:	Transport Canada
CO_2:	Carbon Dioxide	TCF:	Temperature Correction Factor
DC:	Direct Current	TPED:	Transportable Pressure Equipment Directive
DOT:	Department of Transportation	USCG	United States Coast Guard
FM:	Factory Mutual	UL/ULI:	Underwriters Laboratories, Inc.
H_20:	Water	ULC:	Underwriters Laboratories of Canada
HVAC:	Heating, Venting and Air Conditioning	V:	Volts
Hz:	Hertz (Frequency)	Vac:	Volts AC
mA:	Milliamperes	Vdc:	Volts DC

MATERIAL SAFETY DATA SHEETS

Hard copies of the Material Safety Data Sheets (MSDS) are not included with this manual. The latest version of the MSDS you are searching for can 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

The Kidde Fire Systems Engineered Carbon Dioxide (CO_2) Fire Suppression System, uses pressurized equipment, and therefore you MUST notify personnel responsible or who may come into contact with the Engineered Carbon Dioxide (CO_2) Fire Suppression System, of the dangers associated with the improper handling, installation, maintenance, or use of this equipment.

Fire suppression service personnel must be thoroughly trained by you in the proper handling, installation, service and use of the equipment in compliance with applicable regulations and codes and following the instructions in this manual, any Safety Bulletins and also the cylinder nameplate.

Kidde Fire Systems has provided warnings and cautions at a number of locations throughout this manual. These warnings and cautions are not comprehensive, but provide a good guide as to where caution is required. These warnings and cautions are to be adhered to at all times. Failure to do so may result in serious injury.

Material Safety Data Sheets (MSDS) for nitrogen and CO_2 are available from Kidde Fire Systems. You should ensure your personnel are familiar with the information contained in these sheets.

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.

SUBJECT: SPECIFIC HAZARD

WARNING

Because carbon dioxide reduces the available oxygen in the atmosphere, it will not support life. Care must be taken, and appropriate alarms shall be used, to ensure that all personnel are evacuated from the protected space prior to discharging the system. Suitable warning signs must be prominently displayed in clear view at the point of entry into the protected area to alert people to the asphyxiation properties of carbon dioxide.

PROCEDURES FOR SAFELY HANDLING CYLINDERS

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 Fire Systems 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, owners manuals, service manuals, etc., that are provided with the individual systems.

The following safety procedures are minimal standards that must be adhered to at all times. These are not intended to be all inclusive.

Moving Cylinders: Cylinders must be shipped compactly in the upright position, and properly secured in place. Cylinders 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 while maintaining properly secured cylinders at all times.

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

Storage: Cylinders must be properly secured and safely stored in an upright position and in accordance with any applicable regulation, rule or law. Safe storage must include some protections from tipping or being knocked over.

Nothing in this manual is intended as a substitution for professional judgment and will not serve to absolve any professional from acting in a manner contrary to applicable professional standards.

For additional information on safe handling of compressed gas cylinders, see CGA Pamphlet P-1 titled “Safe Handling of Compressed Gases in Containers”. CGA pamphlets may be purchased from The Compressed Gas Association on their website www.cganet.com.

SUBJECT: PROCEDURES FOR SAFELY HANDLING 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.

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

Shipping Cap

1. Each cylinder is factory equipped with a shipping cap over the cylinder valve connected to the cylinder collar. The shipping cap is a safety device and will provide a controlled safe discharge when installed if the cylinder is actuated accidentally.
2. AT ALL TIMES, the shipping cap must be securely installed over the cylinder valve and the actuation port protection cap shall be attached unless the cylinders are connected into the system piping during filling or performing testing.

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. Position cylinder(s) in designed location and secure with cylinder bracket(s).
2. Remove safety (shipping) cap and actuation port protection cap.
3. Attach flex loops or swivel adapter to discharge heads. Connect assembly to system piping. Then attach assembly to cylinders.

WARNING **Flex hoses/swivel adapters must always be connected to the system piping and to the discharge heads before attaching the discharge heads to the cylinder valves in order to prevent injury in the event of inadvertent carbon dioxide discharge.**

4. Verify control head(s) are in the set position.

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

5. Install control head(s) on cylinder(s).

Removal From Service

1. Remove control head(s) from cylinder(s).
2. Remove discharge head from each cylinder valve.
3. Attach safety (shipping) protection cap and actuation port protection cap to each cylinder.

WARNING **Do not remove the cylinder from the bracketing if the safety and protection caps are missing. Obtain a new safety (shipping) cap from a local gas supplier. Obtain a new actuation port protection cap from Kidde Fire Systems.**

4. Remove cylinder from bracketing and properly secure to hand truck. Properly secure each cylinder for transport. Repeat for remaining cylinders.

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CHAPTER 1
GENERAL INFORMATION

1-1 INTRODUCTION

This manual is intended for use by qualified marine fire suppression specialists responsible for designing Kidde Fire Systems Marine Carbon Dioxide Systems aboard USCG inspected vessels. In addition to this manual, the system designer should be familiar with the NFPA Standard No. 12 (Carbon Dioxide Extinguishing Systems, latest edition), CFR Title 46 Shipping, Chapter I, Navigation and Vessel Inspection Circular No. 6-72 "Guide to Fixed Fire-Fighting Equipment Aboard Merchant Vessels," the rules for the applicable ship classification society (ie: ABS, DNV, ect.) and International Maritime Organization "International Maritime Convention for Safety of Life at Sea (SOLAS)." Note that SOLAS rules usually apply only to vessels that make international voyages.

1-2 GENERAL CHARACTERISTICS OF THE SYSTEM

Carbon dioxide fire suppression systems are used for applications where the potential property damage and business interruption from fire are high. Carbon dioxide can control and suppress fires in easily ignitable fast-burning substances such as flammable liquids. It is also used on fires involving electrically energized equipment and, in some instances, on fires in ordinary combustibles such as paper, cloth, and other cellulose materials.

Carbon dioxide is a colorless, odorless, electrically non-conductive gas with a density approximately 50% greater than air. When applied to a fire, it provides a blanket of heavy gas which reduces the oxygen content of the atmosphere to a point in which combustion can not be sustained.

WARNING

Carbon dioxide is present in the atmosphere. It is also a normal product of human and animal metabolism; human life cannot be sustained if this carbon dioxide is not expelled from the body. The concentration of carbon dioxide in the air governs the rate at which the carbon dioxide produced by the human metabolism is released from the lungs. An increasing concentration in the air where humans are present, therefore, can cause serious personal injury or death.

Carbon dioxide offers many advantages as a fire suppressant. It is a clean agent, does not leave a residue, and does not wet material or machinery upon which it is discharged, helping keep costly cleanup or downtime to a minimum. Carbon dioxide may be stored from 0°F (-18°C) to 130°F (54°C). Carbon dioxide does not deteriorate and is non-corrosive. It is readily available throughout the world and is inexpensive. Carbon dioxide is effective for the rapid suppression of Class A (surface or deep seated), B, and C fires and offers a wide range of hazard protection.

1-3 SYSTEM DESCRIPTION

Carbon dioxide is stored in steel cylinders as a liquid under its own vapor pressure which is approximately 850 psi at 70°F. This pressure is used to propel the agent out of the container and through the valve, piping, and nozzles during the discharge. When released, carbon dioxide will change from a liquid to a gas and expand. The ratio of this expansion is high; approximately 9 to 1. This allows a large volume of carbon dioxide to be stored in a small container, minimizing space taken up by the system equipment.

1-4 EXTINGUISHING PROPERTIES OF CARBON DIOXIDE

Carbon dioxide is highly efficient in suppressing surface fires including flammable liquids and solids. When introduced into the combustion zone, carbon dioxide causes almost immediate flame suppression. It suppresses the fire by reducing the oxygen concentration, the fuel vapor concentration, or both, in the vicinity of the fire to the point where these available concentrations are too low to support combustion. In general, a reduction of the oxygen concentration to 15 percent or less by volume is sufficient to extinguish most diffusion-flame fires in flammable liquids. The cooling effect is also helpful in certain applications, especially where carbon dioxide is applied directly on to the burning material.

When deep seated fires are encountered, a higher concentration of carbon dioxide and a much longer hold (retention) time are needed to allow any smoldering fires to be suppressed and to allow the material to cool to a temperature at which it will not re-ignite.

1-5 PHYSICAL PROPERTIES OF CARBON DIOXIDE

The physical properties of carbon dioxide are provided in Table 1-1.

Table 1-1. Physical Properties of Carbon Dioxide

Parameter	US Units	Metric Units
Molecular weight	44	44
Specific gravity, @ 32°F and 1 atm (0°C and 101 kPa abs)	1.524	1.524
Vapor density, @ 32°F and 1 atm (0°C and 101 kPa abs)	0.1234 lb./ft.^{3}	1.98 kg/m^3
Liquid density, @ 70°F (21°C)	47.6 lb./ft.^{3} (@ 70°F)	762 kg/m^3 (@ 21°C)
Triple point	-69.9°F / 75.1 psia	-56.6°C / 518 kPa abs
Sublimation temperature @ 1 atm (101 kPa abs)	-109.3°F @ 1 atm	-78.5°C
Critical temperature	87.9°F	31.1°C
Critical pressure	1071 psia	7382 kPa abs
Latent heat of sublimation, @ -109.3°F (-78.5°C)	245.5 BTU/lb.	199.0 kJ/kg
Latent heat of vaporization, @ 2°F (-17°C)	119.0 BTU/lb.	276.8 kJ/kg

1-6 CLEAN-UP

Since carbon dioxide is a gas, it can penetrate and spread to all parts of a fire area. As a gas or as a finely divided solid called 'snow' or 'dry ice', it will not conduct electricity and therefore, can be used on energized electrical equipment. It leaves no residue, thus eliminating cleanup of the agent itself.

For the safety of the personnel, the area should be thoroughly ventilated and purged with fresh air.

CHAPTER 2
SYSTEM DESIGN

2-1 GENERAL

USCG approved Kidde Marine CO2 systems provide suitable fire suppression for five distinct categories, depending on the nature of the hazard and the protected space. The categories are:

- Dry cargo spaces
- Enclosed ventilation systems for rotating electrical propulsion equipment
- Machinery spaces, pump rooms, paint lockers, etc.
- Vehicle cargo spaces
- Semi-portable hose reels

The CO2 requirements and discharge rates vary, depending on the nature of the protected space, and the gross volume of the compartment. The space must first be identified and assigned into one of the five categories listed above. Once categorized, the required amount of CO2 can be determined, along with discharge rates, pipe sizes, etc.

2-2 DRY CARGO SPACES

2-2.1 General

Cargo compartment fires generally involve Class A combustibles. The fire will generally start as a slow, smoldering type fire, producing large amounts of smoke. Once sufficient heat has developed, the fire will dramatically increase in intensity. A USCG approved fire detection system should be used to detect the fire while it is still in the smoldering stage.

Once a fire has been detected, all openings to the space must be closed. An initial amount of CO2 can then be discharged until a sufficient concentration has been developed to bring the fire under control. With the openings still sealed, additional CO2 can be discharged from time to time to maintain the proper concentration. The space is kept closed until the vessel reaches port. At port, the hold can be opened, the cargo can be removed, and final extinguishment can be accomplished with additional CO2, water, or other agents.

2-2.2 System Design

The amount of CO2 required can be determined by dividing the gross volume of the space (in cubic feet) by 30. The cargo space is defined as the volume between watertight or firescreen bulkheads, and from the tank top or lowest deck to the deck head of the uppermost space on which the cargo may be carried. If a trunk extends beyond such deck, the trunk volume must be included in determining the CO2 requirement. All tonnage openings can be considered as sealed for this purpose.

Because of the nature of the fire hazard, no specific discharge rates need be applied to these systems. However, the discharge piping to the various holds and between decks must not be less than 3/4 inch in size.

2-3 ELECTRICAL PROPULSION EQUIPMENT

2-3.1 General

Electrical propulsion equipment fires generally involve Class C combustibles, and can be deep seated in nature. Usually an initial discharge is provided to quickly suppress any surface flames, and an extended discharge is provided to maintain the CO2 concentration until the equipment can be stopped. This type of system generally involves two separate discharge lines and nozzles. On small systems, one common discharge line may be used for both the initial and extended discharge. If the initial discharge is such as to achieve the required concentration until the equipment is stopped, no delayed discharge is necessary.

2-3.2 System Design

The amount of CO2 required for the initial discharge can be determined by dividing the gross volume of the system by 10 (for spaces less than 2,000 cubic feet). For spaces equal to or greater than 2,000 cubic feet, divide the gross volume by 12. The initial discharge must be completed within two minutes.

The amount of CO2 required for the extended discharge is dependent on the gross volume, the time it takes to stop the equipment, and the amount of air movement in the system. Sufficient CO2 must be provided to maintain a minimum 25% concentration until the equipment can be stopped. Refer to NFPA 12 for guidance as to how the required amount of CO2 is calculated.

2-4 MACHINERY SPACES, PUMP ROOMS, PAINT LOCKERS, ETC.

2-4.1 General

Fires in machinery and similar spaces generally involve Class B combustibles. Contrary to cargo compartments, fires in machinery spaces develop rapidly and can become intense in a short period of time. For this reason, it is critical that CO2 be discharged quickly. Rapid discharge and extinguishment prevents the heat/fire from damaging equipment, bulkheads, and other structural members.

2-4.2 System Design

The amount of CO2 required for the compartment is equal to the gross volume of the space divided by the appropriate flooding factor shown in Table 2-1. If the flammable liquid can drain or spread to an adjacent space, the sum of the compartment volumes shall be used to determine the required amount of CO2. The system must be arranged to discharge CO2 simultaneously into both compartments.

The volume of the machinery space must exclude the normal machinery casing unless the boiler, internal combustion machinery, or fuel oil installations extends into the space. In such an instance, the volume shall include the top of the casing, or the next material reduction in casing area, whichever is lower.

The definition of “normal machinery casing” is a casing the area of which is less than 40% of the maximum area of the machinery space. “Material reduction in casing area” is defined as a reduction to at least 40% of the casing area. These definitions do not apply to vessels contracted for prior to October 1, 1959.

For vessels on an international voyage contracted for after May 26, 1965, the amount of CO2 for a space containing boilers and/or internal combustion machinery used for propulsion must be as follows: Divide the gross volume (excluding the casing) of the space by the appropriate factor referenced in Table 2-1 or divide the entire gross volume (casing included) by a factor

of 25, and use the larger of the two amounts. A minimum of 85% of the required amount of CO2 must be discharged in two minutes.

Table 2-1. CO2 Flooding Factors

Gross Volume (cu. ft.)	Flooding Factor (cu. ft./lb.)
0 - 500	15
501 - 1,600	16
1,601 - 4,500	18
4,501 - 50,000	20
Greater than 50,000	2

2-5 VEHICLE CARGO SPACES

2-5.1 General

Vehicle cargo (Ro/Ro) space fires generally involve Class A (rubber, plastics, and other ordinary combustibles), Class B (flammable liquids), and to a lesser extent, Class C combustibles. These type fires propagate slowly but become intense and grow rapidly as they progress. Care should be taken to quickly develop and maintain the CO2 concentration for a sufficient period of time to ensure complete extinguishment.

2-5.2 System Design

The amount of CO2 required is calculated by dividing the gross volume (in cubic feet) of the largest space by 22. Because of the nature of the fire hazard, 2/3 of the required amount of CO2 must be discharged within 10 minutes. Faster discharge times are permissible.

2-6 HOSE REEL SYSTEMS

2-6.1 General

In addition to the previously mentioned “fixed” type systems, hose reels provide a semi-portable means of discharging CO2 directly onto the burning material. Hose reel systems provide a large volume discharge, much greater than that available from hand-held portable fire extinguishers, and are intended for smaller hazard applications. Personnel evacuation and equipment shutdown may sometimes be avoided by the use of these semi-portable units. The units themselves are generally located within the protected space in an open area, so that all portions of the space may be covered to provide quick response to an emergency.

2-6.2 System Design

Sufficient CO2 is provided for at least a one minute discharge. The discharge is controlled by a hose mounted shut-off valve located directly upstream of the hand-held nozzle. The hose, which interconnects the shut-off valve with the reel/rack, is available in various sizes and lengths to meet the hazard requirements. The hose reel and rack are equivalent in terms of effectiveness, although the reel is easier to manipulate.

2-7 EFFECTS OF VENTILATION AND UNCLOSABLE OPENINGS

The proper control of a fire by a CO2 system depends on the integrity or “tightness” of the enclosed space. Any agent leakage from the space will reduce the effectiveness of the system. Large leaks or openings will render the system ineffective.

In spaces where a ventilation system is installed, the ventilation system must be shutdown prior to the CO2 discharges. This shutdown must be accomplished automatically by the operation of the CO2 system (via pressure operated switches or releases). Complete ventilation shutdown must be accomplished before the CO2 system is discharged. If the ventilation system cannot be shut down, an additional amount of CO2 must be added to compensate for the effects of the loss through the ventilation system.

Uncloseable openings in the space will also adversely affect the CO2 system. Depending on the quantity, size, and location of the openings, additional agent will be required. The amount of additional agent and the discharge rate shall be in accordance with NFPA 12. A discharge test is recommended to verify the effectiveness of the CO2 system and the integrity of the protected space.

2-8 CYLINDER SELECTION AND STORAGE

Once the amount of CO2 has been determined, the next step of the system design process is to determine the appropriate size and quantity of CO2 storage cylinder(s). Refer to Table 2-2 for selection of the appropriate cylinder size.

Table 2-2. Cylinder Configurations

Cylinder Capacity (lbm)	Figure Number
25	4-2
35	4-2
50	4-2
75	4-1
100	4-1

All cylinders on a common manifold must be of the same size. Cylinders should be located as near to the protected space as possible. The cylinders must be located outside the protected space, except for spaces which require no more than 300 lbs. of CO2. Cylinders installed outside the protected space must be in an accessible location to permit manual actuation in the event of fire (without the need to go through any of the protected spaces). The cylinders must be located such that the ambient storage temperature range falls between 0°F and 130°F. Additional heating or cooling of the space may be required to maintain this temperature range.

CO2 cylinders are equipped with a burst disc to relieve excessive pressure within the cylinder. If the cylinders are located adjacent to the protected space, enough heat may be conducted through bulkheads or decks to rupture the burst disc. Should this occur, the CO2 storage room would be filled with agent and little, if any, would be available to extinguish the fire. Therefore, common bulkheads and decks between CO2 storage rooms and protected spaces must be protected with A-60 structural insulation. Cylinders must not be located in any space that might be cut off or made inaccessible in the event of a fire in any of the spaces protected.

2-9 SYSTEM CONTROLS

System actuation can be accomplished by three methods:

- Automatic, via pneumatic heat actuated devices (for spaces which require no more than 300 lbs. of CO2).
- Remote-manual, via cable or pneumatic releases.
- Local-manual, via mechanical means at the storage cylinders themselves.

2-10 AUTOMATIC ACTUATION

For spaces requiring no more than 300 lbs. of CO2, the USCG permits the use of automatic actuation. This is accomplished by utilizing a pneumatic detection system. This system employs the rate-of-rise principle. A sudden increase in temperature will cause the system to actuate.

Heat actuators are located throughout the hazard, and are interconnected to pneumatic control heads (located on the pilot cylinders) via copper tubing. When the air within the heat actuator becomes heated due to a fire within the protected space the air expands and builds up pressure in the actuator. The pressure is then transmitted through the copper tubing to the pneumatic control heads. When sufficient pressure has built up (the amount ranges from one to six inches of water column), the pneumatic control heads will operate and discharge the system.

The pneumatic control heads are fitted with vents, so that slight changes in pressure, due to normal changes in ambient temperature, can be vented to atmosphere.

Heat detectors are installed no more than 10 feet from a bulkhead; spacing must not exceed 20 feet, center-to-center, or 400 square feet per detector.

2-11 REMOTE-MANUAL ACTUATION

Remote-manual actuation can be accomplished via cable or pneumatic releases. Cable operated pull boxes are available in various configurations. The pull boxes are connected to the control heads (located on the storage cylinders or stop valves) via 1/16 inch stainless steel cable. Corner pulleys are used to change direction of the cable routing. The cable should be routed in 3/8 inch schedule 40 pipe.

The USCG mandates that the maximum force required to operate the pull box may not be greater than 40 pounds, nor require a movement greater than 14 inches. No more than 15 corner pulleys and 100 feet of cable should be used with control head, P/N 81-979469-000 and 6 corner pulleys with any pneumatic control head. If other combinations of corner pulleys and lengths of cable are required, the 40 lb. maximum force and 14 inch maximum travel requirements must not be exceeded.

Table 2-3. Corner Pulley and Cable Limitations

Control Head	Type	Max. Number Corner Pulleys P/N 81-803808-000	Max. Cable Length, Ft.
81-979469-000	Cable Operated	15	100
81-872335-000	Pneumatic	6	100
81-872362-000	Pneumatic	6	100
81-872310-000	Pneumatic	6	100
81-872360-000	Pneumatic	6	100

As an alternate to the cable operated system, Kidde Fire Systems. also offers a pneumatic actuation system. The system consists of a nitrogen actuation cylinder, which is connected to

the CO2 pilot cylinders by pipe or tubing. Normally, the pneumatic system is used only when the maximum requirements for the cable system cannot be met. Limitations on pilot lines are shown in Table 2-4.

Table 2-4. Actuation Line Limitations

Pipe/Tubing Type	Maximum Length	
	English	Metric
1/4 in. Schedule 40	300 feet	91.4 meters
1/4 in. Schedule 80	436 feet	132.8 meters
1/4 in. O.D. x 0.035 wall	427 feet	130.0 meters
5/16 in. O.D. x 0.032 wall	436 feet	132.8 meters

2-12 DISCHARGE NOZZLES

Kidde Fire Systems offers three basic types of total flooding type discharge nozzles: Type “V,” “S,” and “M.”

2-12.1 Type “V” Nozzles

Type V nozzles have a 1/2-inch NPT inlet connection and are generally used with electrical propulsion equipment and ventilation systems. The V nozzle can accommodate CO2 flow rates up to approximately 100 lbs./min. The nozzles must be spaced approximately 15 to 20 feet apart. The nozzle(s) should be strategically located to provide optimum CO2 distribution. A strainer is provided with V nozzles that have orifice codes less than 5 to prevent foreign objects in the pipe from clogging the nozzle orifice. A flange and cover assembly is available for ease of installation and to prevent foreign objects from entering the piping network.

2-12.2 Type “S” Nozzles

Type S nozzles also have a 1/2 inch NPT inlet connection, and are generally used with machinery spaces, pump rooms, etc. The S nozzle can accommodate CO2 flow rates up to approximately 100 lbs./min. In addition to the standard S nozzle, flanged and zinc plated versions are available where installation requirements dictate. The nozzles must be spaced every 20 to 30 feet apart at a height equal to approximately 1/3 the height of the space. Additional tiers of nozzles may be required for spaces with multiple levels. Strainers are provided with those nozzles having orifice sizes less than 6. A flange and cover assembly is also available for the flanged S nozzle.

2-12.3 Type “M” Nozzles

For large machinery spaces and pump rooms where greater quantities of CO2 are required, type M nozzles are utilized. Having a 3/4 inch NPT inlet connection, the M nozzle will accommodate flow rates up to 225 lbs./min. The nozzles must be spaced every 20 to 30 feet apart at a height equal to approximately 1/3 the height of the space. Additional tiers of nozzles may be required for spaces with multiple levels. Strainers are provided with those nozzles having orifice sizes less than 6.

2-13 PIPE AND FITTINGS

Once the discharge nozzles have been selected and located, the distribution piping can be routed. The route utilizing the least amount of pipe and fittings must be used to minimize friction loss. The piping must extend at least two inches beyond the last nozzle of each nozzle header (branch line) to prevent clogging. All pipe and fittings must be galvanized inside and out.

Pipe and fittings must be in accordance with 46 CFR Subchapter F, Parts 54 through 56 as follows:

2-13.1 Pipe

Galvanized steel pipe shall conform to the following specifications:

- ASTM A-53 Type S (seamless) Grade A or B
- ASTM A-53 Type E (electric resistance welded) Grade A or B
- ASTM A-106 seamless Grade A, B or C

Stainless Steel pipe shall conform to the following specifications:

- ASTM A-312 seamless or welded, TP304 or TP316

If the above stainless steel pipe will utilize welded joints, then TP304L or TP316L may also be selected.

When utilizing either the above galvanized or stainless steel piping materials, pipe diameters 3/4" and smaller may be schedule 40 or schedule 80 and pipe diameters 1" and larger shall be schedule 80.

Alternate pipe materials, other than specified above, may be used provided the wall thickness is calculated in accordance with ASME B31.1 utilizing a 2800 psi design pressure.

ASTM A-120 or ASTM A-53 Class F (furnace weld) pipe shall not be used. All piping components shall have a 1,700F minimum melting point.

2-13.2 Fittings

Pipe fittings shall conform to any of the following specifications as applicable:

- ASTM A-197 material composition for malleable iron Class 300 fittings designed to ANSI B16.3
- ASTM A-395 material composition for ductile iron Class 1000 fittings designed to UCD 23, Section VIII ASME Code
- ASTM A-234 or A-105 material composition for forged steel fittings designed to ANSI B16.9 or ANSI B16.11
- ASTM A-182 TP304 or TP316 material composition for forged stainless steel fittings designed to ANSI B16.11

Alternate fitting materials, other than specified above, may be used provided the fitting meets or exceeds a 6000 psi burst pressure.

Tapered thread pipe joints shall be in accordance with ANSI B120.1 for pipe diameters 2" and smaller. Butt-welded joints shall be in accordance with Section IX of the ASME Boiler and Pressure Vessel Code and 46CFR56.70 for pipe diameters 2-1/2" and larger.

2-14 FLANGES

Flanges shall conform to any of the following specifications as applicable:

- ASTM A-181 material composition for flanges designed to ANSI B16.5.
- ASTM A-182 TP304 or ASTM A-182 TP316 for material composition for forged stainless steel flanges designed to ANSI B16.5

Class 300 flanged joints are acceptable downstream of any stop valve or in systems not utilizing stop valves. Class 600 flanged joints shall be used upstream of any stop valve

Gaskets, nuts and bolts shall be in accordance with ANSI B16.5.

Alternate materials for flanges, gaskets, nuts and bolts, other than specified above, may be used provided each flange, gasket, nut or bolt complies with ASME B31.1 and the flange meets or exceeds a 6000 psi burst pressure.

2-15 INSTALLATION TEST REQUIREMENTS

Upon completion of the piping installation, a pressure test must be done on the piping network. Test with CO2, nitrogen, or dry air. The CO2 cylinders must be disconnected and the manifold inlets plugged.

The piping from the cylinders to the directional (stop) valves must be pressurized to 1000 psi. With no additional gas being added, the pipe must maintain pressure for a two minute period. The maximum pressure loss permitted is 150 psi per minute.

The piping downstream of the directional (stop) valves must be tested in a similar manner with the exception that the initial pressure shall be 600 psi instead of 1000 psi. For the purpose of this test, the piping must be capped within the protected space at the first joint upstream of the nozzles.

For small, independent systems (e.g., protecting emergency generator rooms, paint lockers, etc.) the above test can be waived provided the piping is blown out with CO2, nitrogen or dry air of at least 100 psi and the cylinder is installed in the protected space.

2-16 PIPE AND NOZZLE SIZE CALCULATION

To determine the proper discharge pipe and nozzle sizes, the following method must be followed:

1. Determine the appropriate amount of CO2 required for the space as described in Section 2-2 through Section 2-6.
2. Calculate the nominal cylinder outlet area (sq. in.) by multiplying the lbs. of CO2 required by the factor 0.0022. The minimum nominal cylinder outlet area shall be 0.110 sq. in.
3. Using the amount of CO2 calculated in step 1, refer to Table 2-5 to determine the correct pipe size for each branch.
4. Using the size for the main supply pipe as determined in step 3, refer to Table 2-6 to obtain the internal area of that pipe size.
5. Calculate the equivalent nozzle orifice area by dividing 45% of the nominal cylinder outlet area (step 2) or 45% of the supply pipe area (step 4), whichever is smaller, by the total number of nozzles.
6. Referring to Table 2-10, compare the value calculated in Step 5 with the various equivalent nozzle areas available. Choose the closest area and corresponding orifice code number.
7. To calculate the total nozzle orifice area, multiply the equivalent nozzle area chosen in Step 6 by the total number of nozzles. The total equivalent nozzle orifice area should

not exceed 85%, nor be less than 35% of the nominal cylinder outlet area (Step 2), or the area of the supply pipe (Step 4), whichever is smaller.

Refer to Appendix C for an example of the calculation method.

2-17 DISCHARGE MANIFOLD

To assure proper actuation of slave cylinders, it is recommended that the cylinder manifold be sized based upon total pounds of CO2 discharging through that section of the manifold. Table 2-5 is to be used as a guide to determine the pipe sizes required.

Recommended maximum pipe size for straight pipe manifold is one pipe size smaller than the supply pipe, but in no case shall the manifold exceed 1½ inch in size.

Table 2-5. Minimum Pipe Size Determination

Maximum CO2 Quantity (lb.)	Nominal Pipe Size (in.)
100	1/2
225	3/4
300	1
600	1¼
1,000	1½
2,450	2
2,500	2½
4,450	3
10,450	4
20,900	5
33,600	6

Table 2-6. Internal Pipe Area (Sq. In.)

Nominal Pipe Size (inches)	Internal Area (sq. in.)
1/2	0.304
3/4	0.533
1	0.719
1¼	1.283
1½	1.767
2	2.953
2½	4.238
3	6.605
4	11.500
5	18.194
6	26.06

Note: The areas shown above are based on schedule 80 pipe, with the exception of 1/2 and 3/4 inch whose areas are based on schedule 40.

Table 2-7. Equivalent Lengths, Threaded Fittings and Miscellaneous Valves

Pipe Size, (in.)	Thru Tee TT	Side Outlet Tee ST	90 Deg. Elbow EL	Check Valve CV	Stop Valve SV
1/2	1.0	3.4	1.7	7	11
3/4	1.4	4.5	2.2	17	17
1	1.8	5.7	2.8	12	21
1¼	2.3	7.5	3.7	51	52
1½	2.7	8.7	4.3	57	34
2	3.5	11.2	5.5	165	76
2½	4.1	13.4	6.6	268	69*
3	5.1	16.6	8.2	795	216*
4	6.7	21.8	10.7	N/A	206
5	8.4	27.4	13.4	N/A	N/A
6	10.1	32.8	16.2	N/A	N/A

Note: *Equivalent length of 2½" and 3" pipe is for brass valve, P/N 81-890010-000. If piping requires 45 degree elbows, enter data as 90 degree elbows (e.g., two 45 degree elbows = one 90 degree elbow)

Table 2-8. Equivalent Lengths, Welded Fittings and Miscellaneous Valves

Pipe Size, (in.)	Thru Tee TT	Side Outlet Tee ST	90 Deg. Elbow EL	Check Valve CV	Stop Valve SV
1/2	0.7	2.1	0.8	7	11
3/4	0.9	2.8	1.1	17	17
1	1.1	3.5	1.4	12	21
1¼	1.5	4.6	1.8	51	52
1½	1.7	5.4	2.1	57	34
2	2.2	6.9	2.8	165	76
2½	2.7	8.2	3.3	269	69*
3	3.3	10.2	4.1	795	216*
4	4.4	13.4	5.4	N/A	206
5	5.5	16.8	6.7	N/A	N/A
6	6.6	20.2	8.1	N/A	N/A

Note: *Equivalent length of 2½" and 3" pipe is for brass valve, P/N 81-890010-000. If piping requires 45 degree elbows, enter data as 90 degree elbows (e.g., two 45 degree elbows = one 90 degree elbow).

Table 2-9. Miscellaneous Equivalent Lengths

Description	Pipe Size (in.)	Equivalent Length, Sch. 40 (ft.)	Equivalent Length, Sch. 80 (ft.)
25, 35, 50 lb. CO2 Cylinder with Valve P/N 981372 flexible hose P/N 252184 or swivel adapter P/N 932408, and discharge head P/N 872442 or 872450	1/2	73	37
75, or 100 lb. CO2 Cylinder with Valve P/N 840253 flexible hose P/N 251821 or swivel adapter P/N 932408, and discharge head P/N 872442 or 872450	1/2	31	16
Time Delay, P/N 871071	1/2	11	6
Time Delay, P/N 897636	3/4	15	8

Table 2-10. Nozzle Identification Chart

Orifice Code Number	Equivalent Single Orifice Diameter (in.)	Equivalent Single Orifice Area (in.)	Type S	Type M	Type V
1	1/32	0.0008	X	X	930066
1+	3/64	0.0017	X	X	933067
2	1/16	0.0031	803381	X	919309
2+	5/64	0.0047	803365	X	803327
3	3/32	0.0069	803366	X	929242
3+	7/64	0.0094	803367	X	803328
4	1/8	0.0123	803368	842319	915876
4+	9/64	0.0155	803369	842320	803329
5	5/32	0.0192	803370	942321	214721
5+	11/64	0.0232	803371	842322	214722
6	3/16	0.0276	803372	842323	214723
6+	13/64	0.0324	803373	842324	214724
7	7/32	0.0376	803374	842325	214725
7+	15/64	0.0431	803375	X	214726
8	1/4	0.0491	803376	842326	214727
8+	17/64	0.0554	803377	X	214728
9	9/32	0.0621	803378	842327	214729
9+	19/64	0.0692	803379	X	X
10	5/16	0.0767	803380	842328	X
11	11/32	0.0928	X	842329	X
12	3/8	0.1105	X	842330	X
13	13/32	0.1296	X	842331	X
14	7/16	0.1503	X	842332	X
15	15/32	0.1725	X	842333	X

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CHAPTER 3
SYSTEM ARRANGEMENTS

3-1 GENERAL

The USCG has different requirements for SOLAS class and non-SOLAS class vessels. SOLAS classification (compliance with SOLAS rules) is required for vessels that operate on international voyages. For guidance on applicability of regulations and order of precedence, please see the Foreword of this manual.

The following schematics depict typical USCG approved system arrangements. These schematics will assist the designer in selecting the proper arrangement and components to best suit a particular application. Table 3-1 provides the designer with a general system arrangement overview for quick reference purposes. Each arrangement is provided with a "sequence of events" description to explain the primary method of system operation.

Table 3-1. System Arrangement Details

Hazard Description	1	2	3	4	5	6
Single-Hazard	O	O	B	B	-	-
Multi-Hazard	-	-	-	-	B	B
Spaces with 300 lb. or Less	O	O	-	-	-	-
Spaces Greater Than 300 lb.	-	-	B	B	B	B
Cylinders Outside the Space	B	O	B	B	B	B
Cylinders Within the Space	-	O	-	-	-	-
One or Two Cylinders Required	O	O	-	-	-	-
Three or More Cylinders Required	-	-	B	B	B	B
Manual or Cable Operated	O	-	-	B	B	B
Pneumatically Operated	-	-	B	-	-	B
Automatically Operated	-	O	-	-	-	-
Key: O= USCG Rules Only B= USCG and SOLAS Rules						

3-2 DISCHARGE DELAY UNITS

The Kidde Fire Systems carbon dioxide system has traditionally used discharge delay units that use the extinguishing agent to generate the delay period of nominally 30 or 60 seconds. These units are still listed and approved and will remain available for the foreseeable future. However as a result of changes in the regulatory environment Kidde Fire Systems has included it's nitrogen driven discharge delay unit in the carbon dioxide product line and arrangements for this edition of the manual. The nitrogen delay provides improved performance with a set-up that was configured to meet the current regulatory approach to acceptability criteria.

The USCG follows NFPA 12 guidance on the acceptable tolerance for the actual discharge delay period observed during testing. This guidance requires the actual delay to be no less than the stated nominal delay period and no more than the nominal delay plus 20%. Local inspectors

may accept CO2 delay units that exceed the positive end of the tolerance. One reason for this is the capability of discharge delay to be by-passed using the attached control head. However they are unlikely to accept a unit that cycles too quickly.

In this chapter there are four new arrangements that illustrate alternative methods of system configuration using the nitrogen discharge delay units. Each of the new arrangements offers the same functionality. We recommend that the nitrogen delay be considered for new applications to reduce the incident of problems during inspections and other periodic testing.

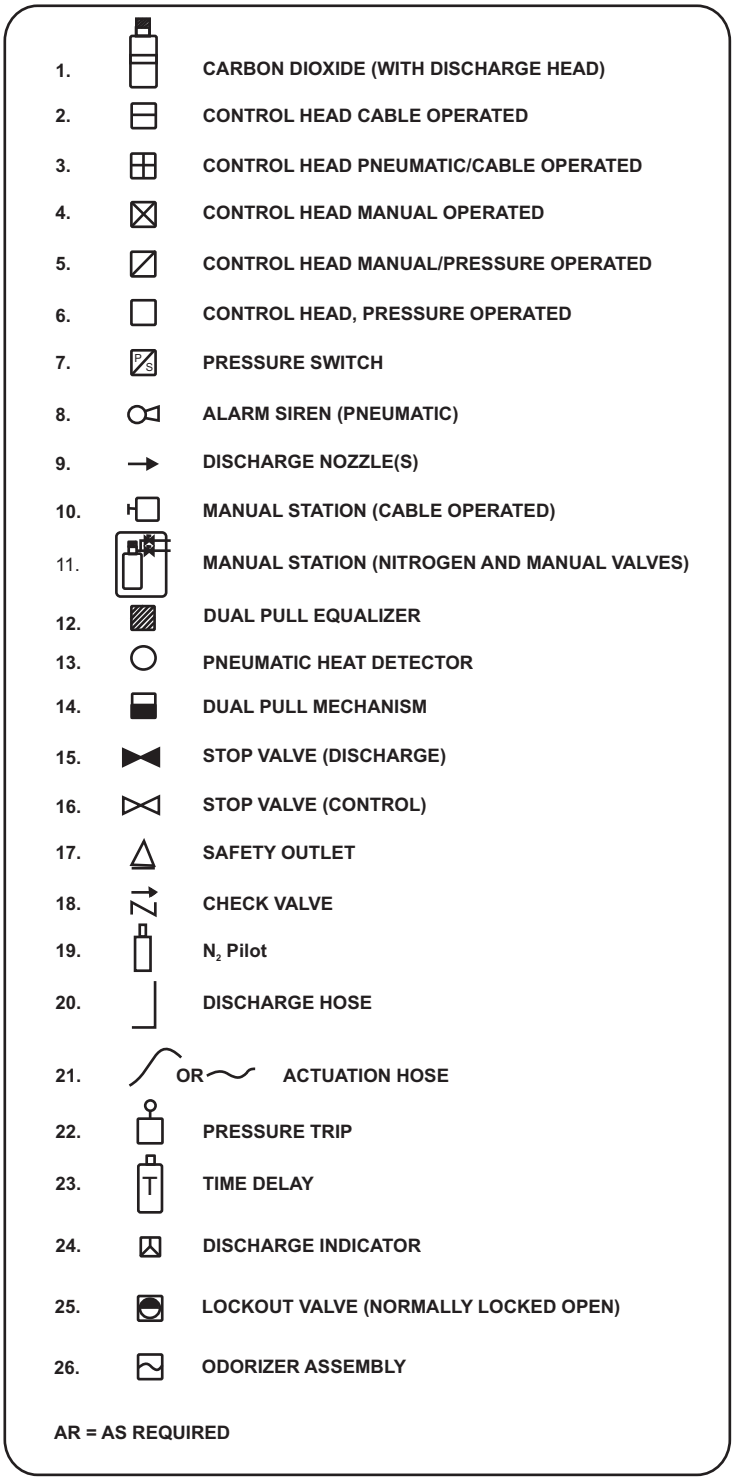


Figure 3-1. Symbol Legend

3-3 ARRANGEMENT NUMBER 1

Arrangement Number 1 is a system protecting a single space, requiring no more than 300 lb. of CO2. One, two, or three cylinders are required, with storage located outside the protected space. System actuation is accomplished by means of cable operation. An emergency method of operation is provided at the cylinder location. All the control heads are equipped with a manual operating lever with a lead wire sealed pull-pin to preclude accidental operation. In the event the cable operated pull-box fails to discharge the system, personnel can be instructed to activate the system via this manual operating lever.

Primary system activation is accomplished using the remote located, cable pull box. After it has been verified that no personnel are in the space, the cable pull box is operated. This causes the cable control head located on the pilot CO2 cylinder to operate, causing the cylinder to discharge. The discharged CO2 is directed to a pressure operated switch, which shuts down ventilation and/or equipment, an odorizer assembly, which injects a scent of wintergreen into the CO2 agent, and then to a pneumatic operated siren (optional). The siren warns personnel of the discharge. The agent is then directed into the space via the pipe and nozzle network. An optional lockout valve is shown. When a lockout valve is installed, it shall be located as shown and both a safety outlet and a discharge indicator shall be installed upstream of the lockout valve. An operational sign, P/N 06-231867-379, shall be installed with all lockout valves to provide operational instructions for the lockout valve.

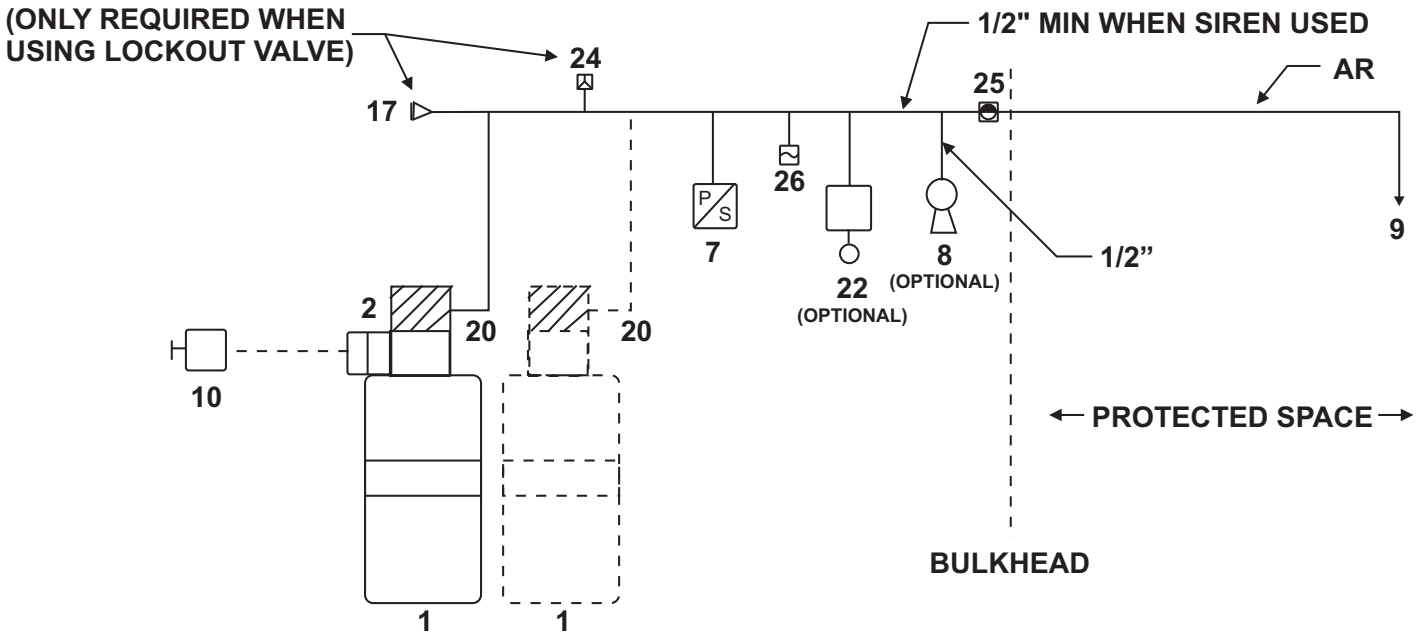


Figure 3-2. Arrangement Number 1

3-4 ARRANGEMENT NUMBER 2

This arrangement is similar to Arrangement Number 1, with a few exceptions. In this case system actuation can be accomplished automatically by the pneumatic heat detector. The cylinders are located within the space and the pressure switch is located outside. Refer to the previous arrangement for operating description.

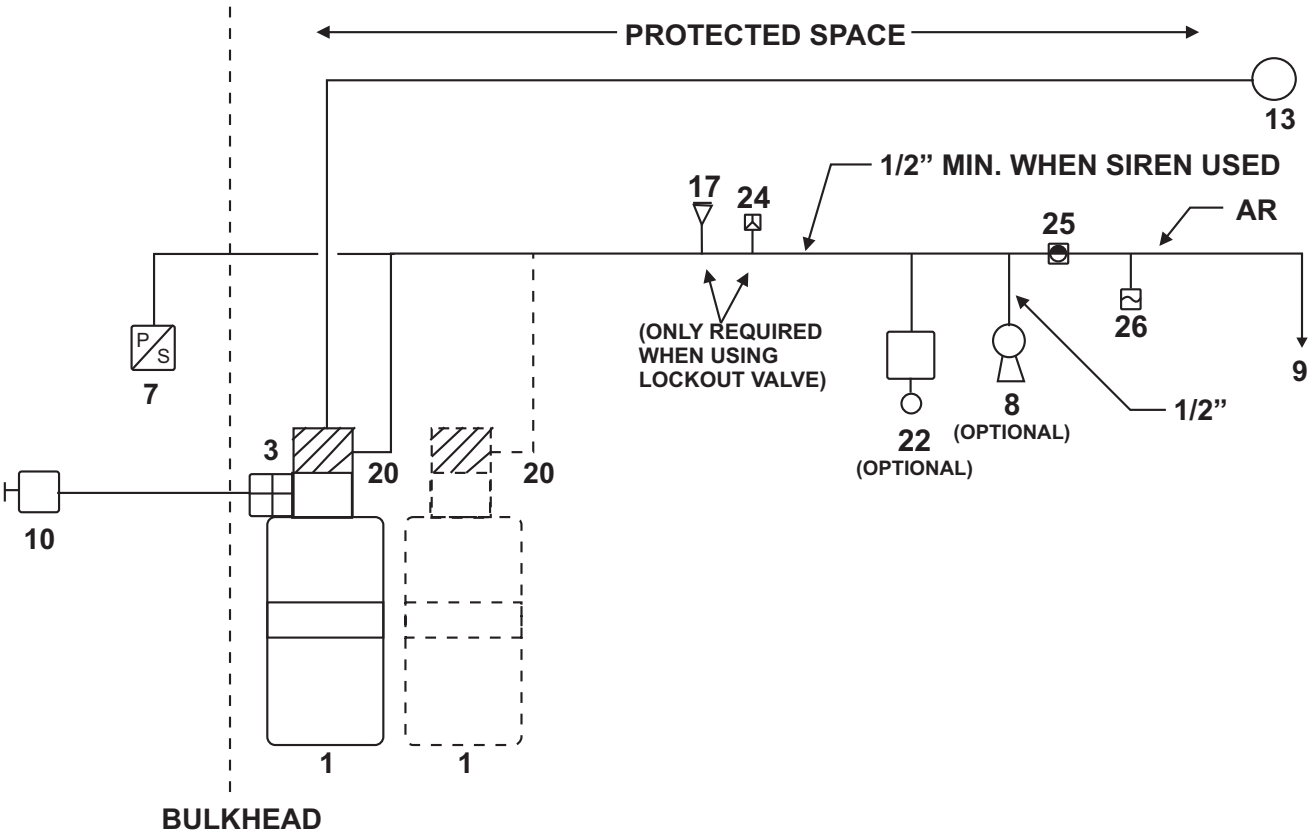


Figure 3-3. Arrangement Number 2

3-5 ARRANGEMENT NUMBER 3A, WITH CO2 DISCHARGE DELAY

Arrangement Number 3A is designed for protection of a single space, requiring more than 300 lbs. of CO2. Three or more cylinders are required, with storage located outside the space. Actuation is accomplished pneumatically, using a nitrogen pilot cylinder.

System actuation is initiated by operating the lever control head mounted on the nitrogen cylinder and opening the accompanying ball valve. The nitrogen pressure is transmitted to the pressure control heads located on the CO2 cylinders, causing the cylinders to discharge.

The CO2 is discharged into the manifold, and is directed to the normally closed stop valve. A portion of the discharge is routed to the pressure switch, siren and discharge delay. This will cause the pressure switch to operate, and the alarm to sound. The time delay will begin to cycle, and upon completion, will open. This portion of the discharge will be routed to the lever/pressure control head on the stop valve, causing the stop valve to open. The main portion of the discharge will then pass through the stop valve and be directed to the nozzles.

Personnel must be instructed to actuate the stop valve manually, by operating the lever/pressure control head in the event of a time delay failure.

A safety relief is provided in the event the cylinders have discharged and the stop valve does not operate. If pressure build-up in the manifold becomes excessive, the safety relief will rupture, venting the pressure to the atmosphere.

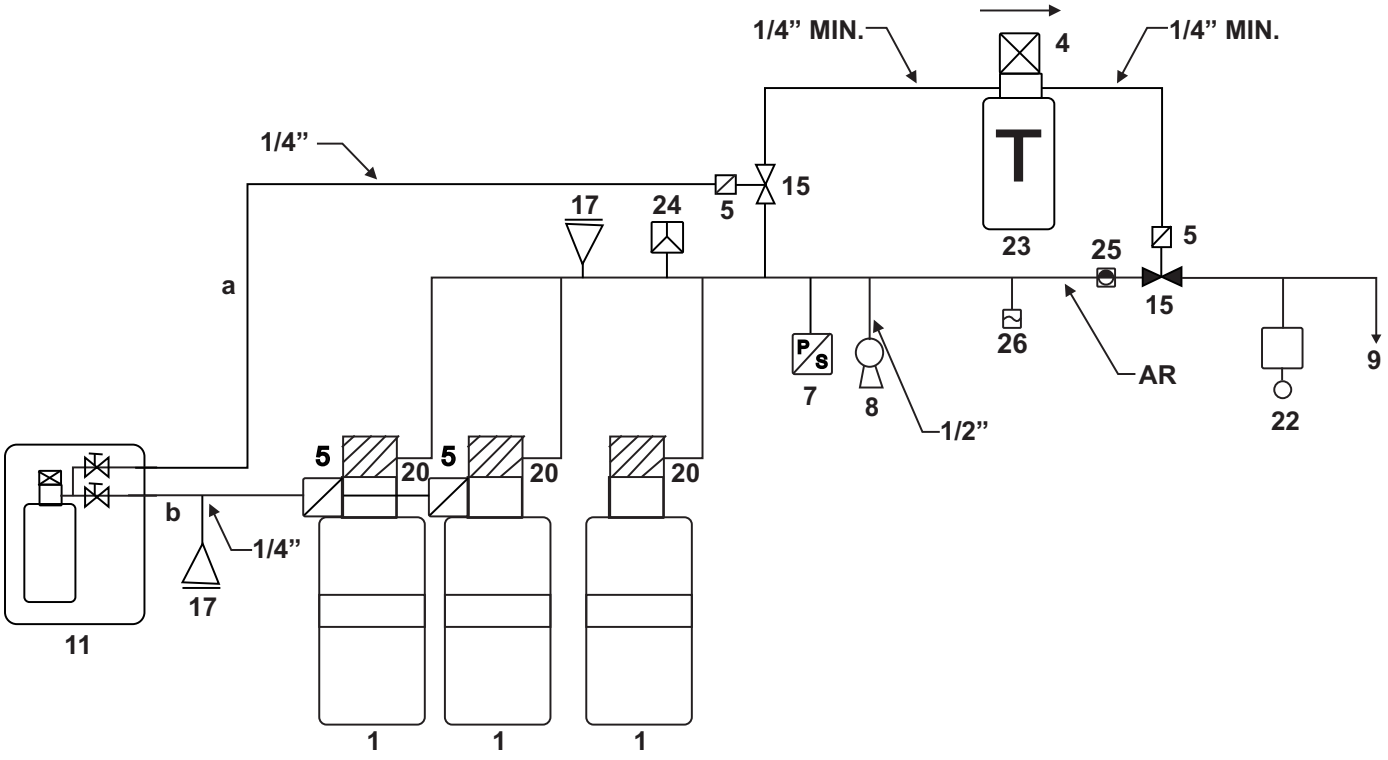


Figure 3-4. Arrangement Number 3A

Note: The total length of the stop valve actuating line (a) plus the cylinder actuation line (b) shall not exceed the lengths published in Table 2-4 (a + b).

3-6 ARRANGEMENT NUMBER 3B, WITH N2 DISCHARGE DELAY

Arrangement Number 3B is designed for protection of a single space, requiring more than 300 lbs. of CO2. Three or more cylinders are required, with storage located outside the space. Actuation is accomplished pneumatically, using a nitrogen pilot cylinder.

System actuation is initiated by operating the lever control head mounted on the nitrogen cylinder and opening the accompanying ball valve. The nitrogen pressure is transmitted to the pressure control heads located on the CO2 cylinders, causing the cylinders to discharge.

The CO2 is discharged into the manifold, and is directed to the normally closed stop valve. A portion of the discharge is routed to the pressure switch, siren and discharge delay. This will cause the pressure switch to operate, and the alarm to sound. The time delay will begin to cycle, and upon completion, will open. This portion of the N2 discharge will be routed to the lever/pressure control head on the stop valve, causing the stop valve to open. The main portion of the discharge will then pass through the stop valve and be directed to the nozzles.

Personnel must be instructed to actuate the stop valve manually, by operating the lever/pressure control head in the event of a time delay failure.

A safety relief is provided in the event the cylinders have discharged and the stop valve does not operate. If pressure build-up in the manifold becomes excessive, the safety relief will rupture, venting the pressure to the atmosphere.

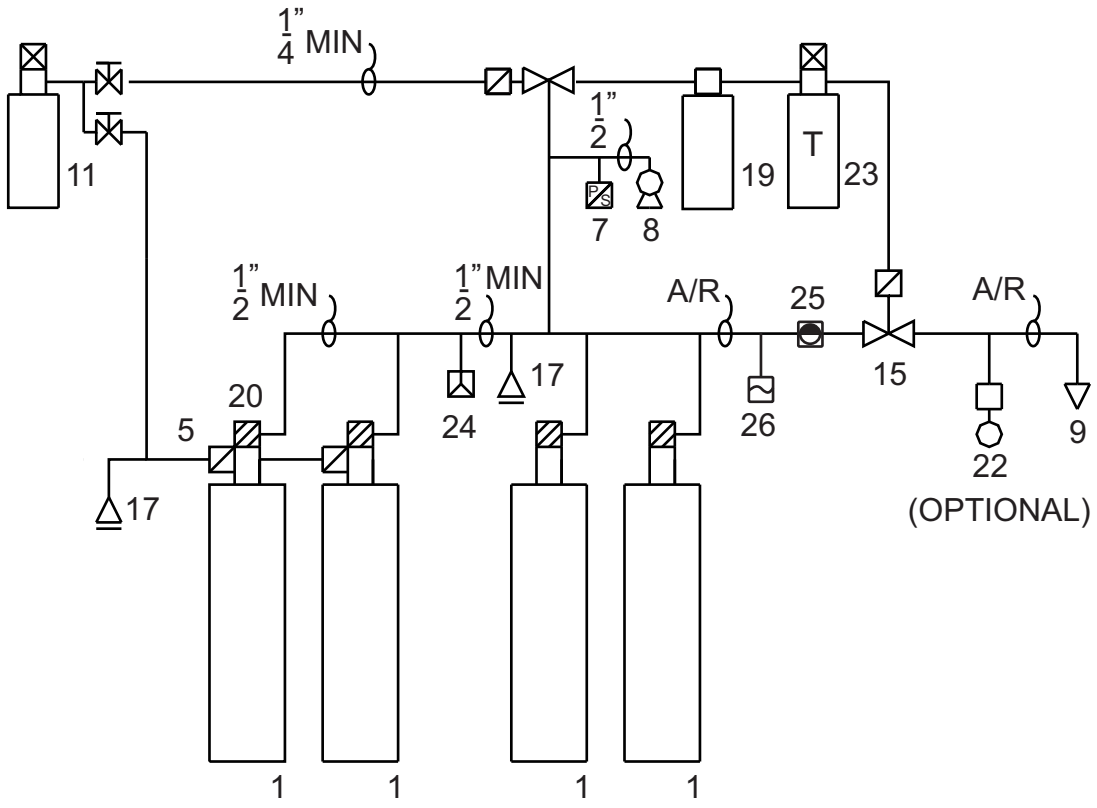


Figure 3-5. Arrangement Number 3B, with N2 Discharge Delay

Note: The total length of the stop valve actuating line (a) plus the cylinder actuation line (b) shall not exceed the lengths published in Table 2-4 (a + b). The N2 pilot and time delay shall be installed with four feet or less of tubing/pipe between them. The time delay outlet and stop valve control must be less than or equal to 225' of pipe/tubing.

3-7 ARRANGEMENT NUMBER 4A, WITH CO2 DELAY

Arrangement Number 4A is similar to Number 3A, except remote actuation is accomplished using cable pull. Two pull boxes are required, one to operate the CO2 cylinders, and one to operate a control stop valve. The normally closed control stop valve is used to route a portion of the discharge to the time delay. This is required to provide the two separate and distinct actions mandated for system operation. A cable control head is mounted on the control stop valve for actuation purposes.

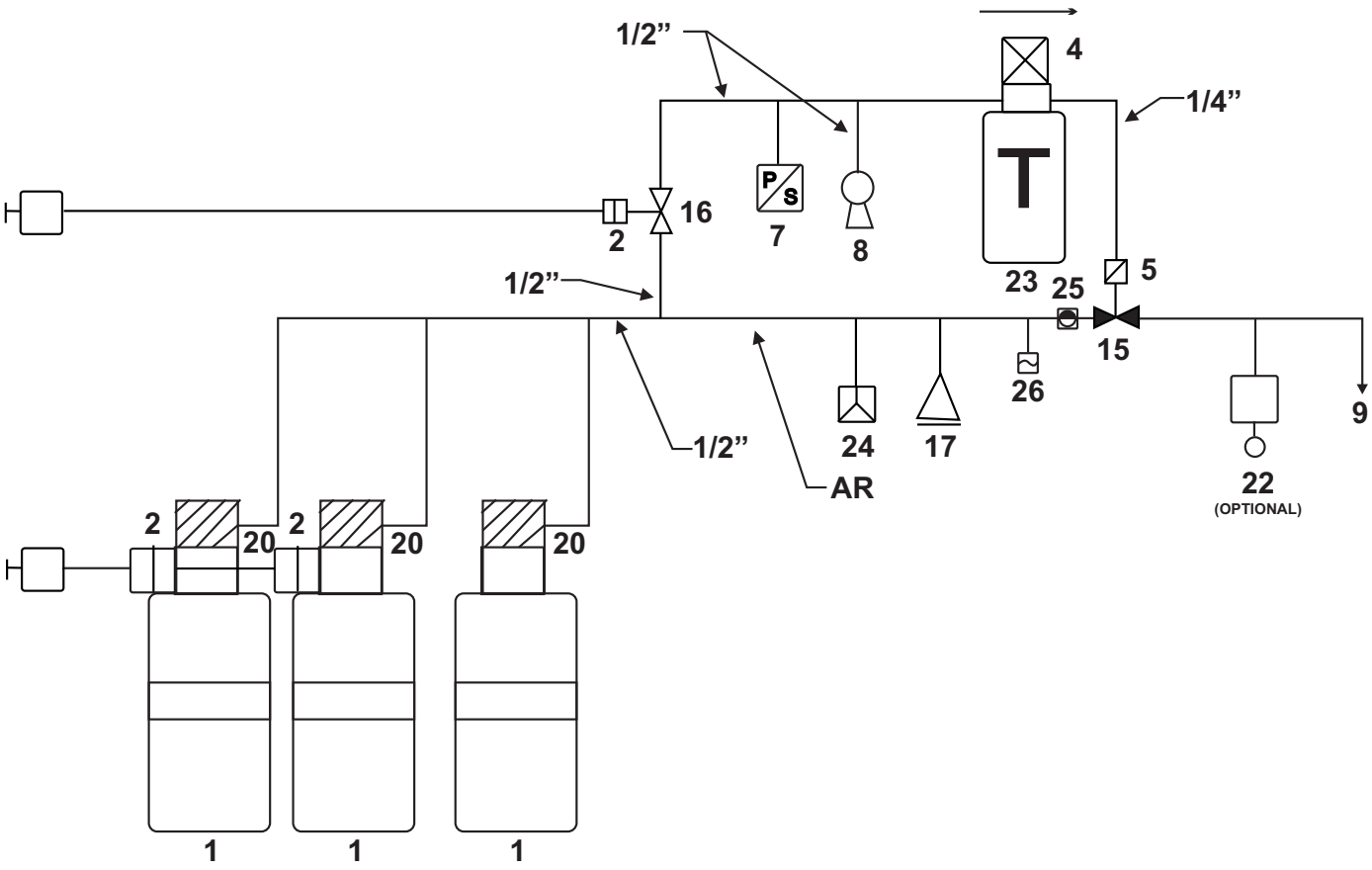


Figure 3-6. Arrangement Number 4A

3-8 ARRANGEMENT NUMBER 4B, WITH N2 DELAY

Arrangement Number 4B is similar to Number 4A, except remote actuation is accomplished using cable pull. Two pull boxes are required, one to operate the CO2 cylinders, and one to operate a nitrogen pilot cylinder. The nitrogen pilot cylinder is fitted with a cable operated control head. The nitrogen pressure is routed to the discharge delay which when cycled opens the normally closed stop valve in the N2 manifold. The siren and pressure switch are operated by CO2 in the manifold released by the cylinder pull box.

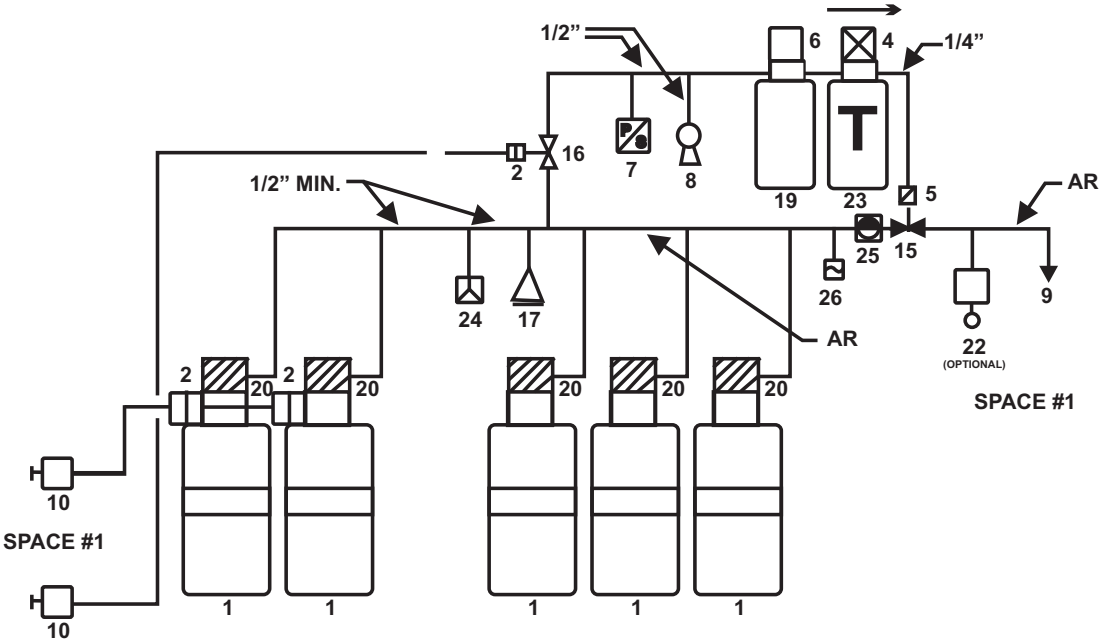


Figure 3-7. Arrangement No. 4B, with N2 Delay

Note: The total length of the stop valve actuating line (a) plus the cylinder actuation line (b) shall not exceed the lengths published in Table 2-4 (a + b). The N2 pilot and time delay shall be installed with four feet or less of tubing/pipe between them. The time delay outlet and stop valve control must be less than or equal to 225' of pipe/tubing.

3-9 ARRANGEMENT NUMBER 5A, WITH CO2 DELAY

Arrangement Number 5A is a system arrangement for protection of more than one space with a common cylinder grouping. Each space requires more than 300 lb. of CO2, with cylinder location outside the space. Three or more cylinders are required, with actuation accomplished by cables.

Cable pull boxes are grouped in pairs, with one operating the CO2 cylinders and one operating the control stop valve. The cylinder pull boxes for each space are interconnected by a dual pull mechanism. This allows for “common” cable run to the cylinders.

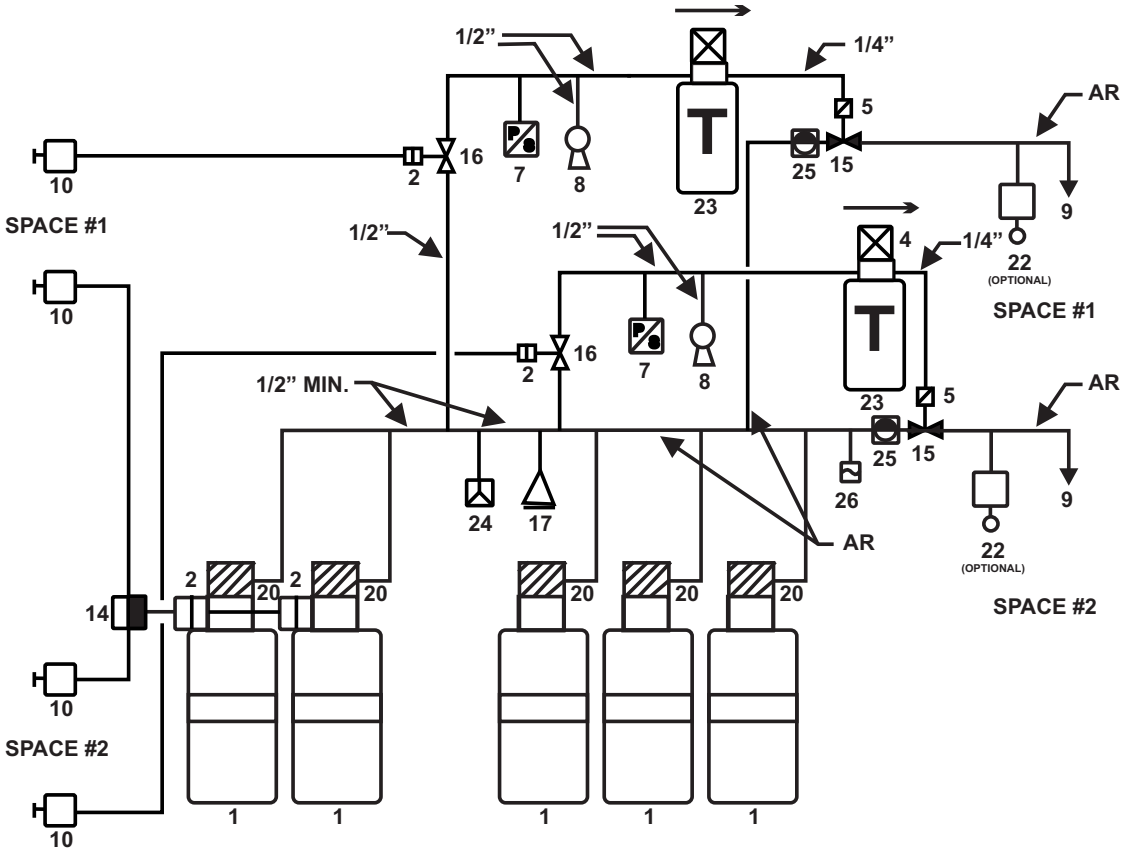


Figure 3-8. Arrangement Number 5A with CO2 Delay

Note: The total length of the stop valve actuating line (a) plus the cylinder actuation line (b) shall not exceed the lengths published in Table 2-4 (a + b). The N2 pilot and time delay shall be installed with four feet or less tubing/pipe between them. The time delay outlet and stop valve control must be less than or equal to 225' of pipe/tubing.

3-10 ARRANGEMENT NUMBER 5B, WITH N2 DELAY

Arrangement Number 5B is a system arrangement for protection of more than one space with a common cylinder grouping. Each space requires more than 300 lb. of CO2, with cylinder location outside the space. Three or more cylinders are required, with actuation accomplished by cables.

Cable pull boxes are grouped in pairs, with one operating the master CO2 cylinders and the other operating a ½" stop valve, which allows pressure from the CO2 cylinder manifold to drive a CO2 siren, actuate pressure operated switches and trips, and actuate an N2 pilot cylinder. In turn, pressure from the N2 pilot cylinder cycles through the discharge delay and operates the pressure control head affixed to the stop valve in the CO2 discharge manifold.

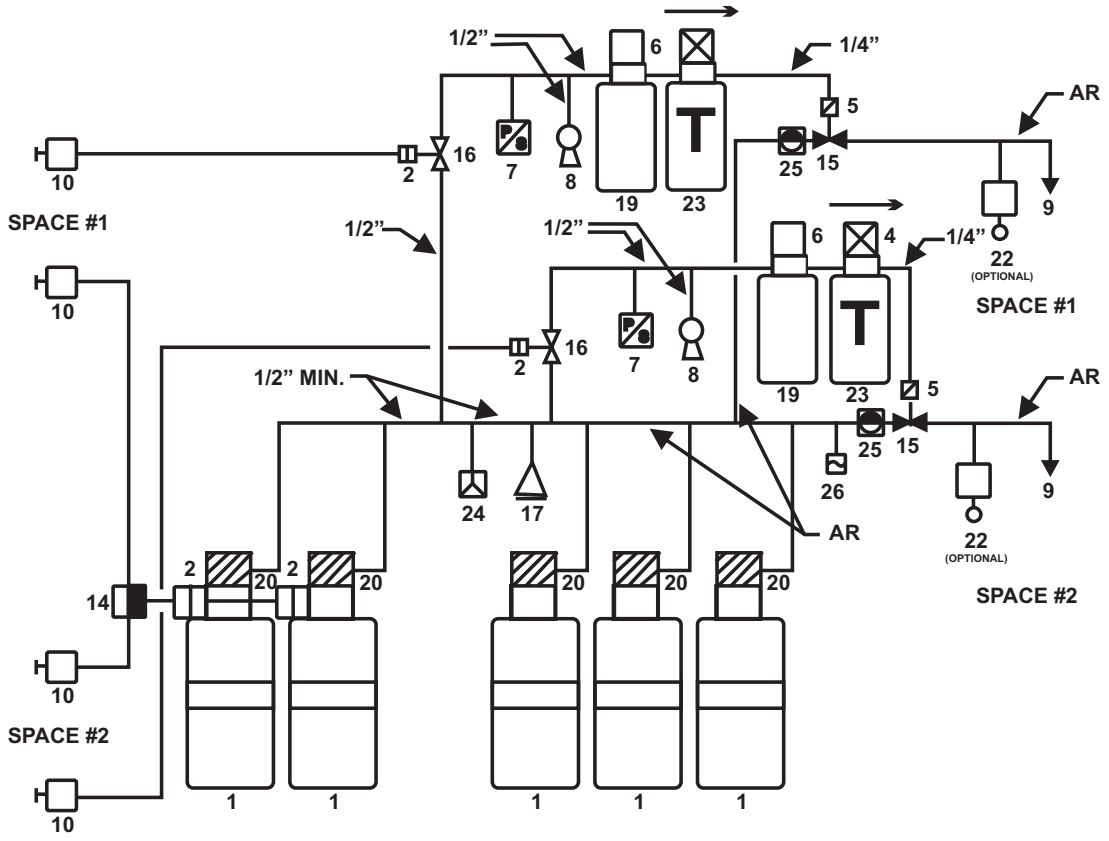


Figure 3-9. Arrangement Number 5B with N2 Delay

Note: The total length of the stop valve actuating line (a) plus the cylinder actuation line (b) shall not exceed the lengths published in Table 2-4 (a + b). The N2 pilot and time delay should be installed with four feet or less of tubing/pipe between them. The time delay outlet and stop valve control must be less than or equal to 225' of pipe/tubing.

3-11 ARRANGEMENT NUMBER 6A, WITH CO2 DELAY

This arrangement is similar to Arrangement Number 5A, with the exception that the system is pneumatically operated instead of valve operated. A common pilot line is routed to the cylinders from the remote nitrogen cylinders. Check valves are provided in the pilot line to prevent pressure from being routed to unnecessary areas.

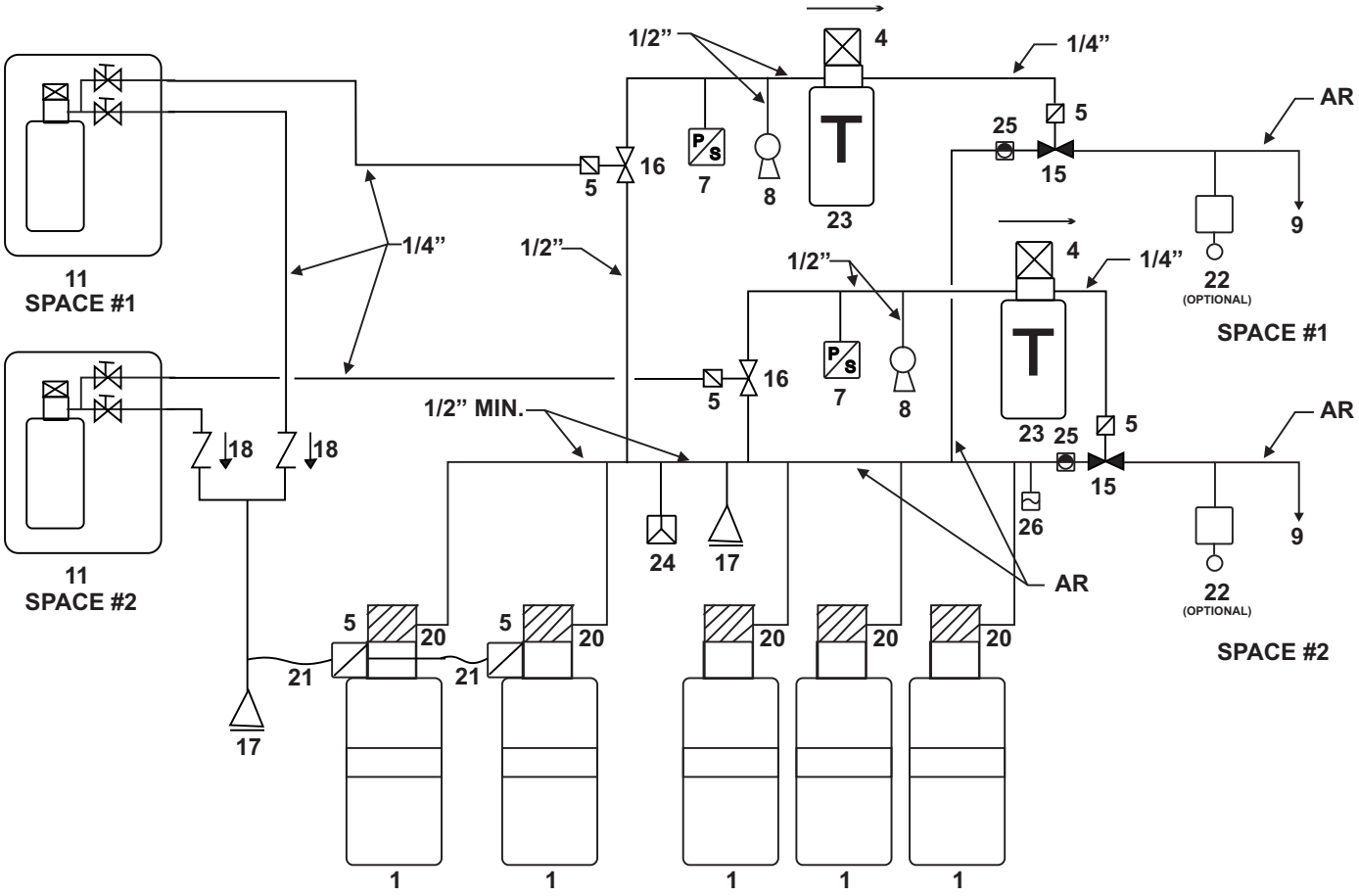


Figure 3-10. Arrangement Number 6A, with CO2 Delay

3-12 ARRANGEMENT NUMBER 6B, WITH N2 DELAY

This arrangement is similar to Arrangement Number 5B, with the exception that the system is pneumatically operated instead of valve operated. A common pilot line is routed to the cylinders from the remote nitrogen cylinders. Check valves are provided in the pilot line to prevent pressure from being routed to unnecessary areas.

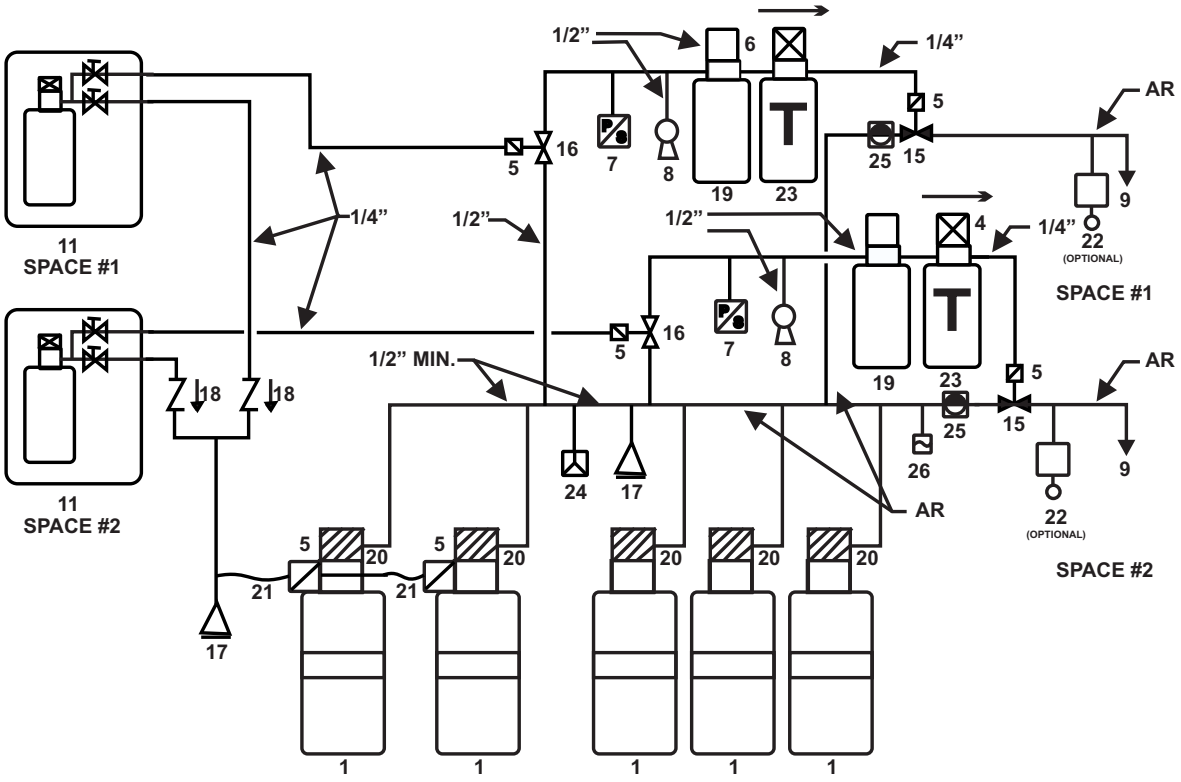


Figure 3-11. Arrangement Number 6B, with N2 Delay

Note: The total length of the stop valve actuating line (a) plus the cylinder actuation line (b) shall not exceed the lengths published in Table 2-4 (a + b). The N2 pilot and time delay should be installed with four feet or less of tubing/pipe between

CHAPTER 4
COMPONENT DESCRIPTIONS

4-1 FIRE SUPPRESSION SYSTEM COMPONENTS

This chapter provides detailed descriptions of the components comprising the Kidde Fire Systems Marine CO_2 fire suppression system. The information is arranged in the following categories:

- CO_2 storage
- Actuation components
- Check valves
- Directional (Stop) valves
- Lockout valves
- Discharge nozzles
- Auxiliary equipment
- Instruction and warning plates
- Hose reel and rack systems

4-2 CO_2 STORAGE

Kidde Fire Systems high pressure carbon-dioxide fire suppression systems use liquid carbon dioxide agent stored under its own vapor pressure in seamless steel cylinders at ambient temperature. Each cylinder is equipped with a valve having a connection for attachment of a discharge head. The discharge heads attach to the distribution piping by means of flexible hoses or a swivel adapter.

Actuation of the suppression system is initiated by one or more control heads which are attached to the control ports on the valve(s) of the pilot cylinder(s). Actuation of the pilot cylinders creates sufficient pressure in the discharge manifold to operate the remaining cylinders in the system.

Single or dual cylinder suppression systems utilize cylinder straps to secure the storage cylinders to walls or other rigid structural members. Specially designed racks are utilized for multiple cylinder systems to secure the cylinders, absorb the discharge reactions, and to facilitate system servicing and maintenance.

WARNING

Pressurized (charged) cylinders are extremely hazardous and if not handled properly are capable of violent discharge. This could result in bodily injury, death, or property damage. Always handle carbon dioxide cylinders according to the instructions in this manual.

4-2.1 Cylinder and Valve Assemblies

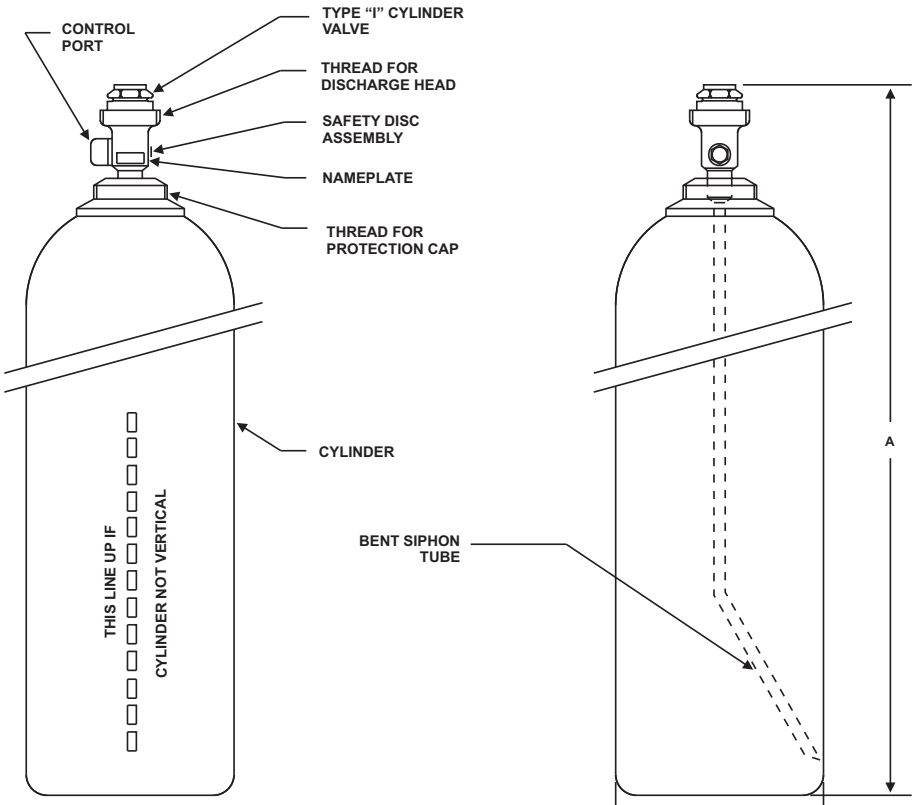
Carbon dioxide agent is stored in steel cylinders as a liquid under its own vapor pressure and at ambient temperature. Each cylinder is equipped with a forged brass valve assembly which contains a safety disc device (Table 4-1) for protection against over pressurization due to elevated temperatures. Each valve is equipped with a side port that serves both as a fill connection and as a control port for attachment of system actuators. The control port is designed to accept all of the control heads listed in this manual.

The threaded connection on the top of each valve mates with a discharge head to allow agent release and distribute the CO_2 from the cylinder into the discharge piping.

Five cylinder and valve assemblies are available, ranging in capacity from 25 lb. to 100 lb. of carbon dioxide. The 25, 35, and 50 lb. cylinders (Figure 4-1) are equipped with a 1/2-inch discharge valve, Part. No. WK-981372-000 (Figure 4-3); the 75 and 100 lb. cylinders (Figure 4-2) have a 5/8-inch discharge valve, Part No. WK-840253-000 (Figure 4-4).

WARNING

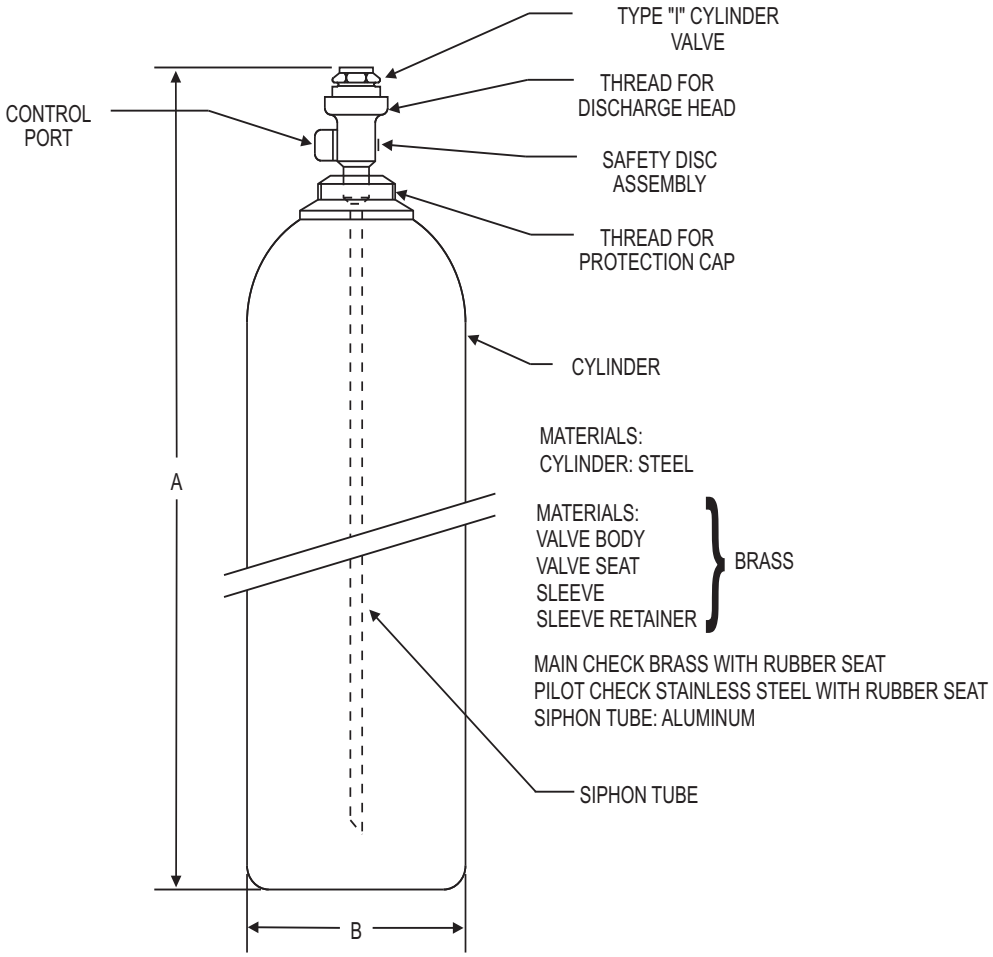
The cylinders are factory-equipped with a protection cap threaded securely over the valve assembly. This device is a safety feature and provides protection during shipment and handling. This cap must be installed at all times, except when the cylinders are connected into the system piping or being filled. Do not move or handle a carbon dioxide cylinder unless the protection cap is installed.



PART NUMBER	CYLINDER CO_2 CAPACITY		VALVE SIZE	SAFETY DISC	SIPHON TUBE	DIM. "A" (HEIGHT)		DIM. "B" (DIAMETER)		CYLINDER VOLUME		NOMINAL CHGD. WEIGHT		DOT RATING
	lbs.	kg				in.	mm	in.	mm	$in.^3$	m^3	lbs.	kg	
81-982548-000	50	22.6	1/2 in.	WHITE	BENT	55.25	1396	8.50	215	2300	0377	155	70.3	3AA-2015
81-982547-000	35	15.8	1/2 in.	WHITE	BENT	39.25	997	8.50	215	1510	0247	114	51.7	3AA-2015
81-870486-000	25	11.3	1/2 in.	WHITE	BENT	29.63	750	8.50	215	1040	0170	84	38.1	3AA-2015

Figure 4-1. 25 through 50 lb. Carbon Dioxide Cylinders, Bent Siphon Tube

Note: Horizontal or Vertical Installation



PART NUMBER	CYLINDER CO_2 CAPACITY		VALVE SIZE	SAFETY DISC	SIPHON TUBE	DIM. "A" (HEIGHT)		DIM. "B" (DIAMETER)		CYLINDER VOLUME		NOMINAL CHGD. WEIGHT		DOT RATING
	lbs.	kg				in.	mm	in.	mm	$in.^3$	m^3	lbs.	kg	
81-870269-000	100	45.3	5/8 in.	RED	STRAIGHT	62	1570	10.55	267	4070	0.0667	288	130.6	3AA - 2300
81-870287-000	75	34.0	5/8 in.	RED	STRAIGHT	60	1520	9.22	233	3055	0.0501	205	92.9	3AA - 2300

Figure 4-2. 75 and 100 lb. Carbon Dioxide Cylinder, Straight Siphon Tube

4-2.1.1 VALVES

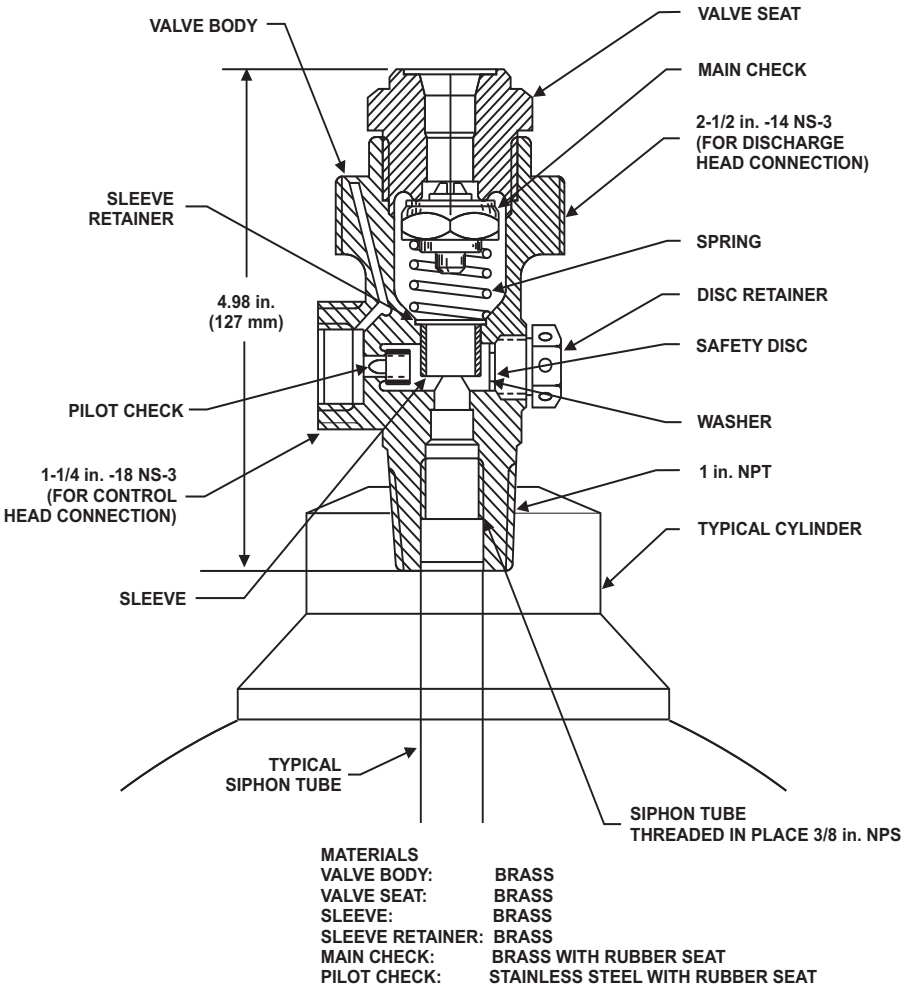


Figure 4-3. I/2-inch Type "I" Cylinder Valve

Table 4-1. Safety Disc Information

Description	Part Number	Cylinder Size	Identification	Burst Pressure
Safety Disc and Washer	81-902048-000	25, 35, and 50 lb.	White	2650 to 3000 psi @ 160°F
Safety Disc and Washer	81-903684-000	75 and 100 lb.	Red	3150 to 3500 psi @ 160°F

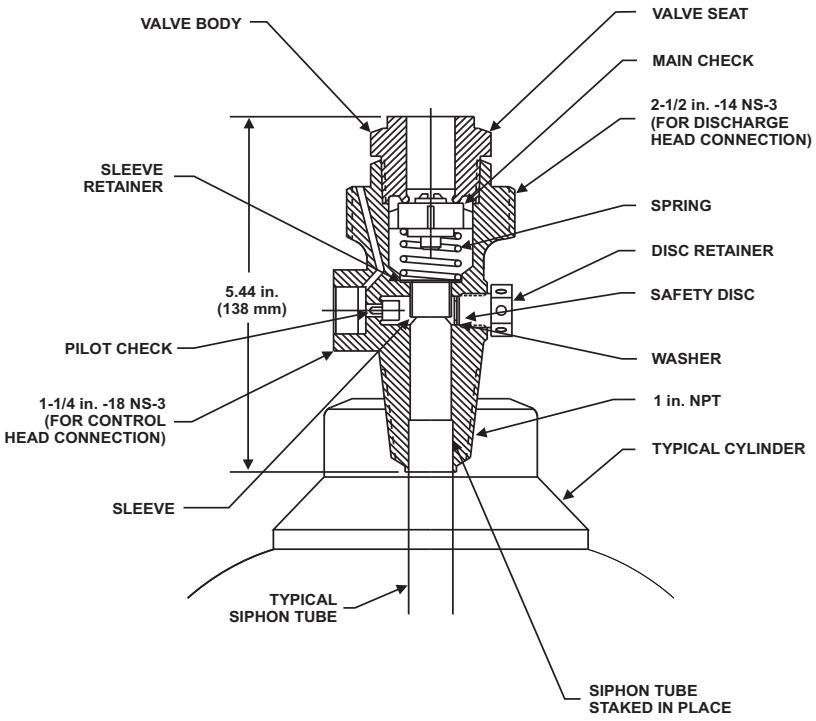
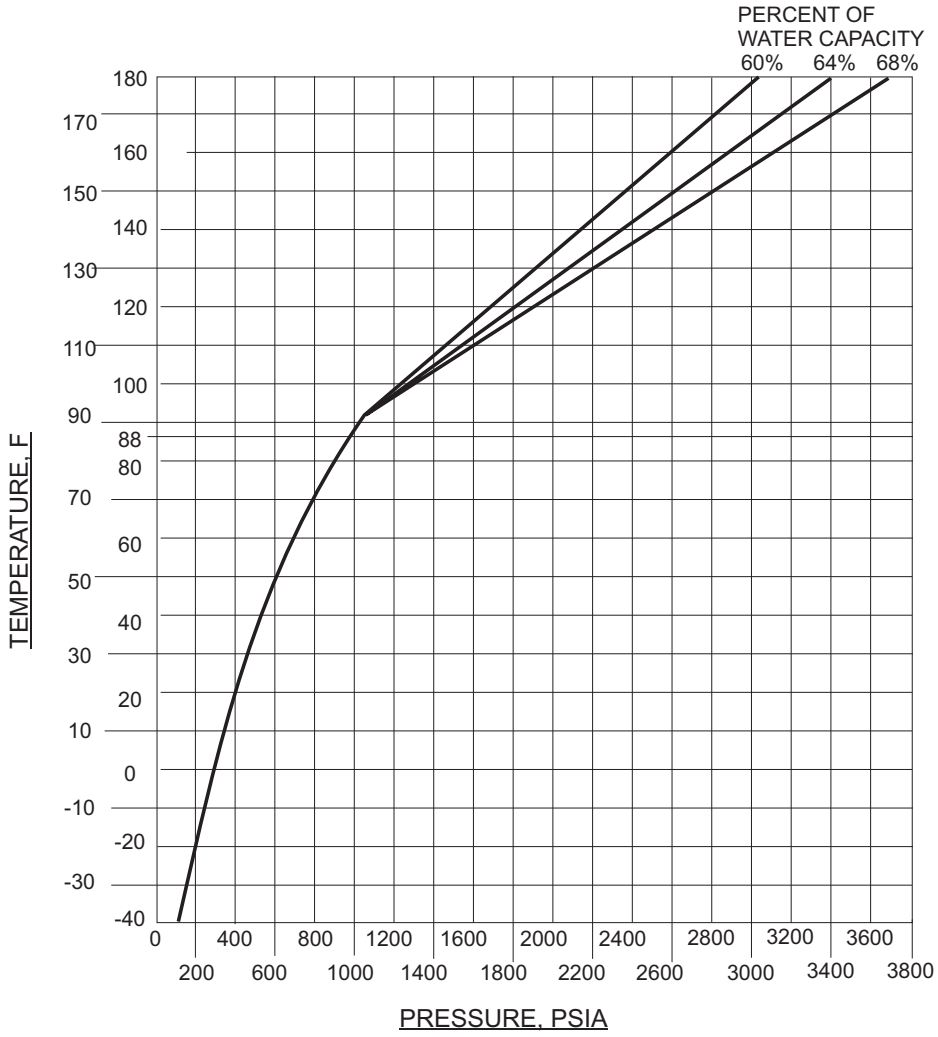


Figure 4-4. 5/8-inch Type “I” Cylinder Valve

4-2.1.2 CYLINDER FILLING

The relationship of cylinder pressure as a function of temperature and fill density is shown in Figure 4-5. In high pressure CO_2 systems the cylinder pressure is directly related to the ambient temperature at the storage location. The pressure is also affected by the fill density or percent fill. This is the ratio (expressed in percent), of the weight of carbon dioxide to the water capacity of the cylinder, expressed in pounds as shown in Table 4-2. The fill density commonly used is between 60 and 68 percent. The US Department of Transportation (DOT) and Transport Canada (TC) limits the maximum fill density to 68% for carbon dioxide.

Care must be taken not to over fill the cylinders above their rated capacity. Over filling is an unsafe practice, is in violation of DOT/TC regulations, and will create rapid increases in pressure for small increases in temperature. Over filling will cause premature actuation of the pressure relief device and result in the loss of the cylinder contents.



$$\% \text{ of } H_2O \text{ capacity} = \frac{\text{Rated } CO_2 \text{ capacity of cylinders (in lbs)}}{H_2O \text{ capacity of cylinders (in lbs) at } 60^0 \text{ F}} \times 100$$

Critical temperature of $CO_2 = 88^0$ F

Figure 4-5. Pressure vs. Temperature for CO_2 Cylinders

Table 4-2. CO_2 and H_20 Capacity Correlation

Rated CO_2 Capacity of Cylinder (lb)	H_20 Capacity (%)
25	67
35	64
50	60
75, 100	68

4-2.2 Discharge Heads

Each cylinder and valve assembly must be equipped with a discharge head at installation to actuate the cylinder valve. The discharge head is assembled to the top of the cylinder valve and contains a spring-loaded piston which when actuated by carbon dioxide pressure is designed to depress the main check in the valve and discharge the contents of the cylinder. The piston provides the necessary mechanical advantage to open the valve's main check. The discharge outlet is designed to mate with a flexible hose or swivel adapter for connection to the distribution piping. The discharge head also contains an integral stop check whose function is to automatically prevent the loss of carbon dioxide during system discharge in the event that a cylinder is removed from the distribution piping. Two different style discharge heads are available:

- Plain-nut discharge head
- Grooved-nut discharge head

4-2.2.1 PLAIN-NUT DISCHARGE HEAD

The plain-nut discharge head, Part No. WK-872450-000 (Figure 4-6), discharges the contents of the cylinder upon activation of its associated control head or upon application of pressure entering through the outlet. The plain-nut discharge head is used on each cylinder (Figure 4-7) of a multiple-cylinder system.

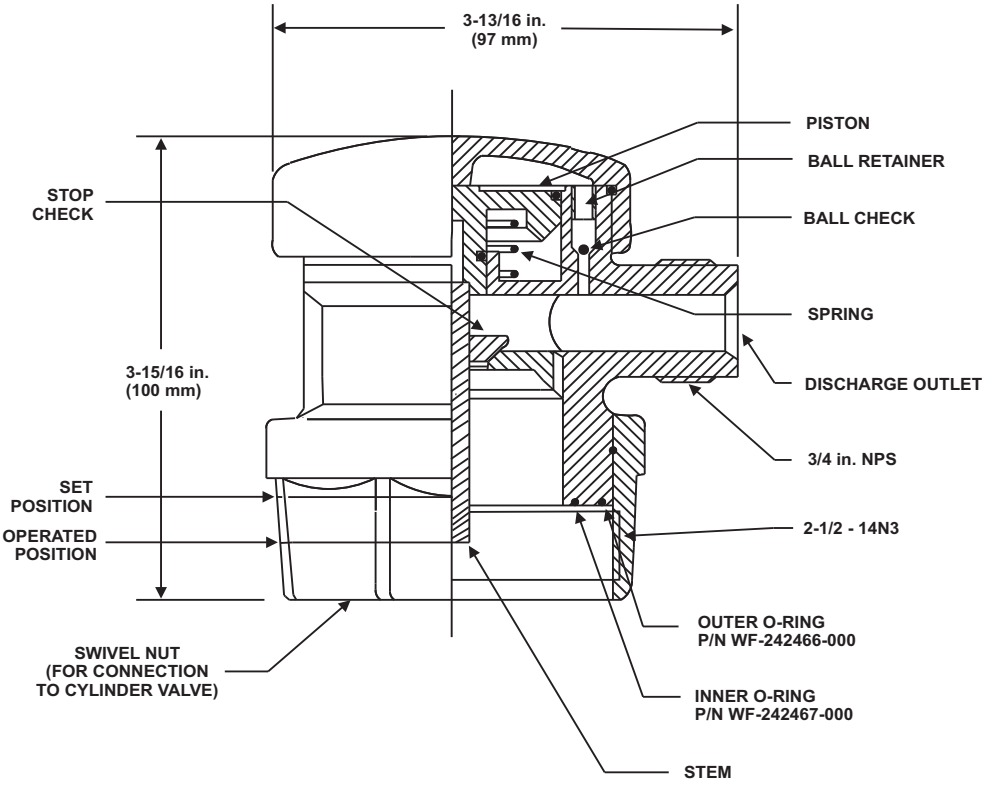
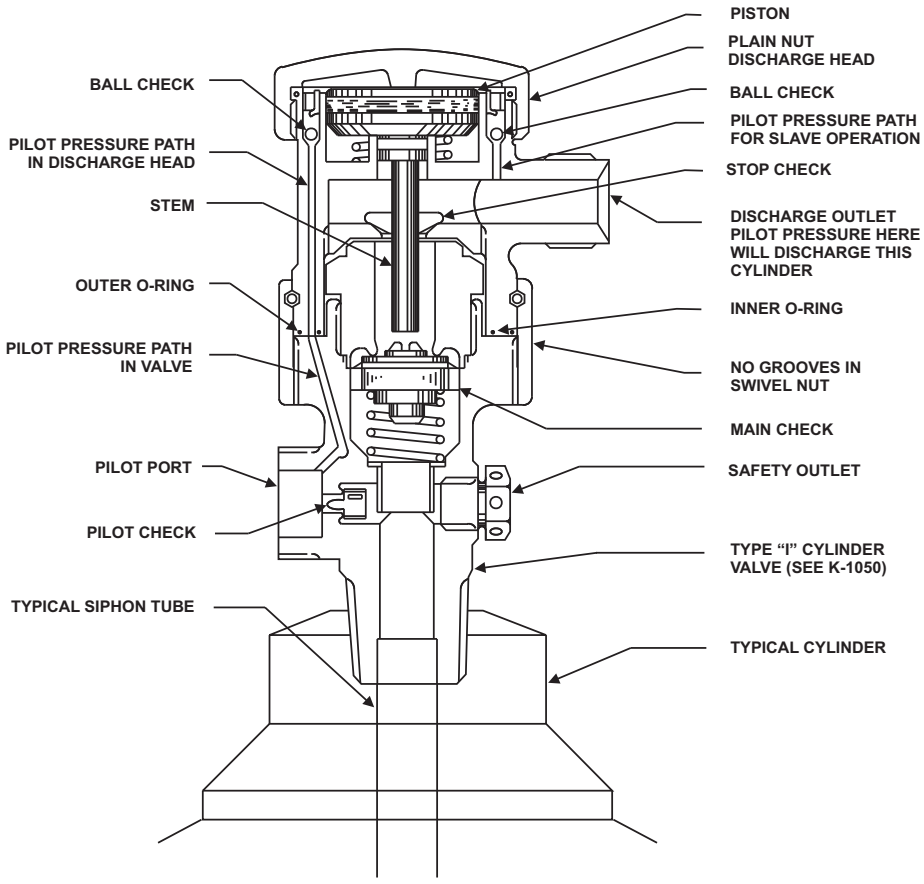


Figure 4-6. Discharge Head, Plain Nut



CAUTION

NEVER CONNECT DISCHARGE HEAD TO CYLINDER VALVE WITHOUT FLEX LOOP ATTACHED TO DISCHARGE OUTLET AND CONNECTED TO SYSTEM PIPING. ARRANGEMENT AS SHOWN IS FOR ILLUSTRATION PURPOSES ONLY.

Figure 4-7. Installation of Plain Nut Discharge Head to Cylinder Valve

4-2.2.2 GROOVED-NUT DISCHARGE HEAD

The grooved-nut discharge head, Part No. 81-872442-000 (Figure 4-8), can only be actuated by a control head. Pressure entering the outlet will not actuate the cylinder. Grooved-nut discharge heads are only used for single-cylinder, or connected single cylinder main and reserve systems (Figure 4-9).

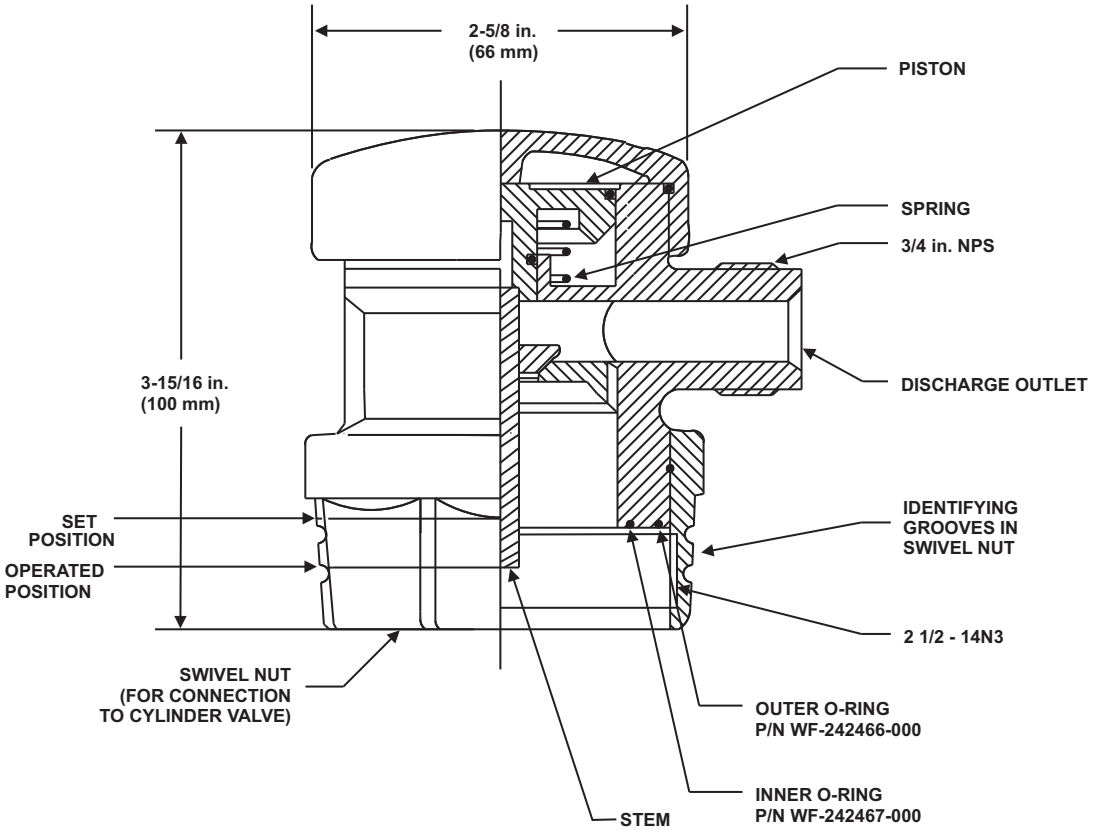
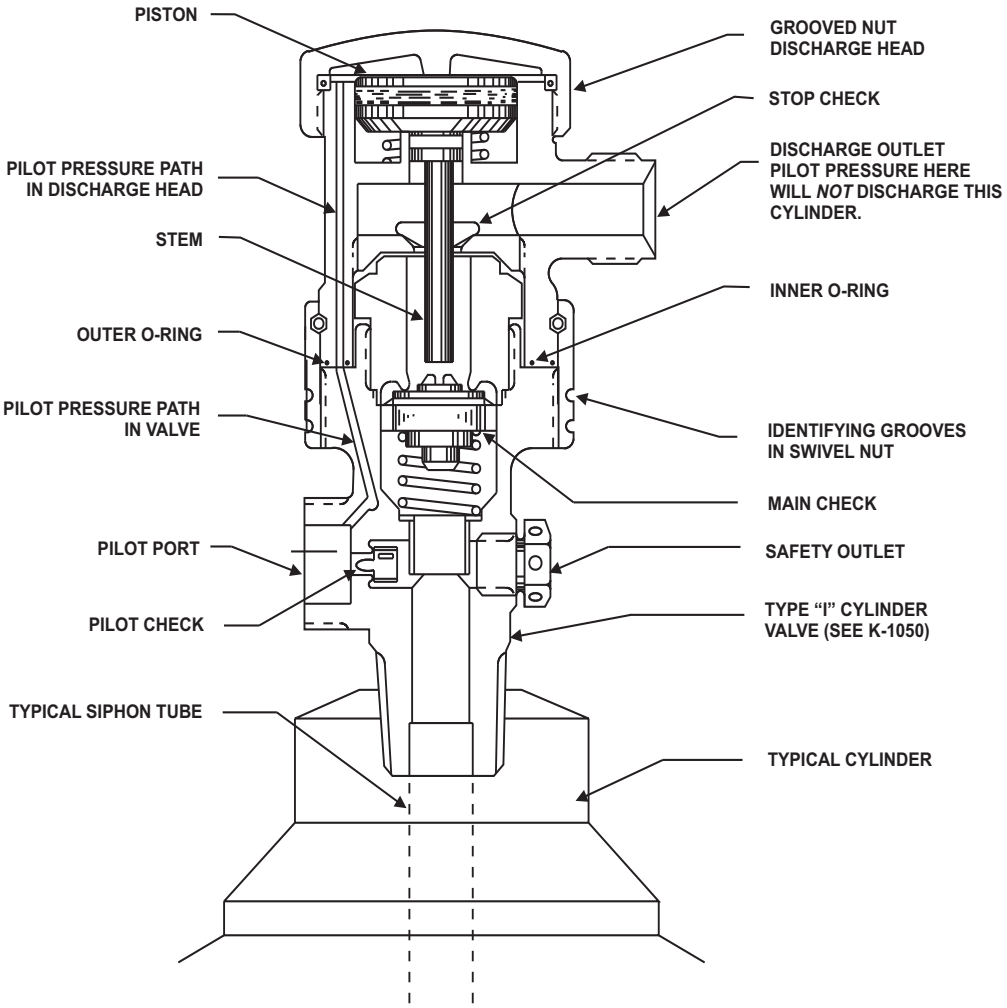


Figure 4-8. Discharge Head, Grooved Nut

WARNING

The discharge head must be permanently connected into the system piping. Never attach the discharge heads to the cylinder valves until the cylinders are secured in brackets or racking. Under no circumstances is the discharge head to remain attached to the cylinder valve after removal from service, during shipment, handling, storage, or during filling. Failure to follow these instructions could result in serious bodily injury, death, or property damage.



CAUTION

NEVER CONNECT DISCHARGE HEAD TO CYLINDER VALVE WITHOUT FLEX LOOP ATTACHED TO DISCHARGE OUTLET AND CONNECTED TO SYSTEM PIPING. ARRANGEMENT AS SHOWN IS FOR ILLUSTRATION PURPOSES ONLY.

Figure 4-9. Installation of Grooved Nut Discharge Head to Cylinder Valve

4-2.3 Flexible Hoses

Flexible discharge hoses are used to provide the interconnection between the discharge head and the distribution manifold or piping. The hoses are made of wire-reinforced rubber.

The 1/2-inch flex hose, Part No. 81-252184-000 (Figure 4-10), is used with the 25, 35, and 50 lb. cylinders.

The 3/4-inch flex hose, Part No. WK-251821-000 (Figure 4-11), is used with the 75 and 100 lb. cylinders.

WARNING

Flexible hoses must always be connected to the system piping and to the discharge heads before attaching the discharge heads to the cylinder valves, in order to prevent injury in the event of inadvertent carbon dioxide discharge.

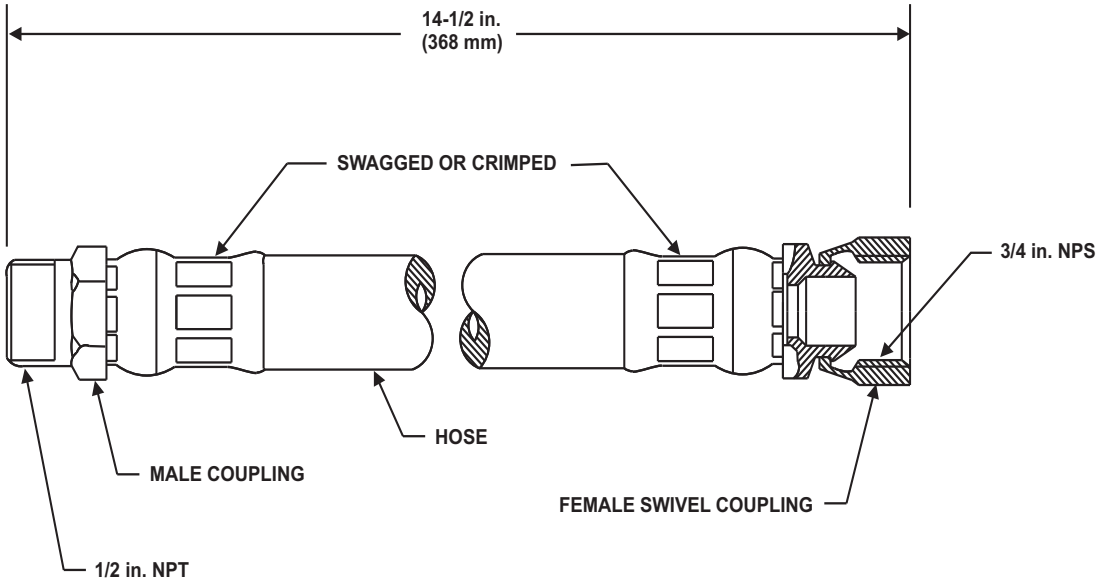


Figure 4-10. 1/2-inch Flex Hose

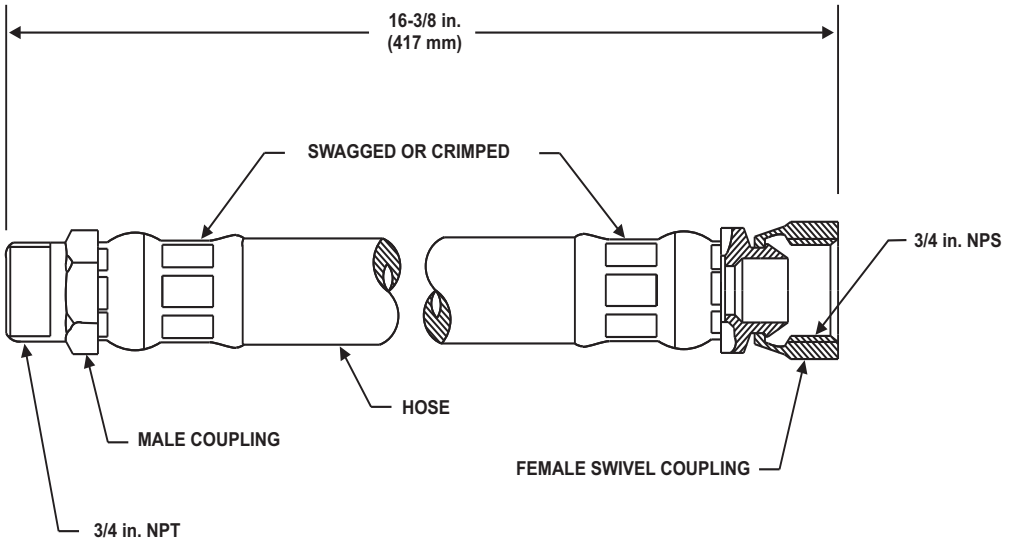


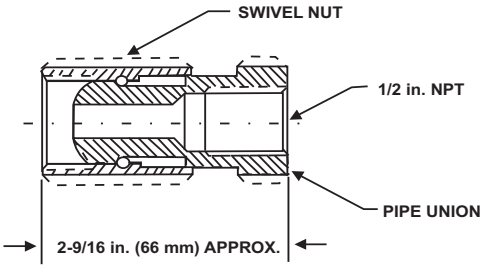
Figure 4-11. 3/4-inch Flex Hose

4-2.4 Swivel Adapter

A swivel adapter, Part No. WK-934208-000 (Figure 4-12), can be substituted for a flexible hose in a single-cylinder suppression system. It is used to connect the discharge head to the distribution piping.

WARNING

The swivel adapter must always be connected to the system piping and to the discharge head before attaching the discharge head to the cylinder valve in order to prevent injury in the event of inadvertent carbon dioxide discharge.



MATERIAL: BRASS

Figure 4-12. Swivel Adapter

4-2.5 Manifold “Y” Fitting

The manifold “Y” fitting, Part No. 81-207877-000 (Figure 4-13), is used in place of a pipe manifold to connect a two (2) cylinder system or for connecting a single cylinder main and reserve system.

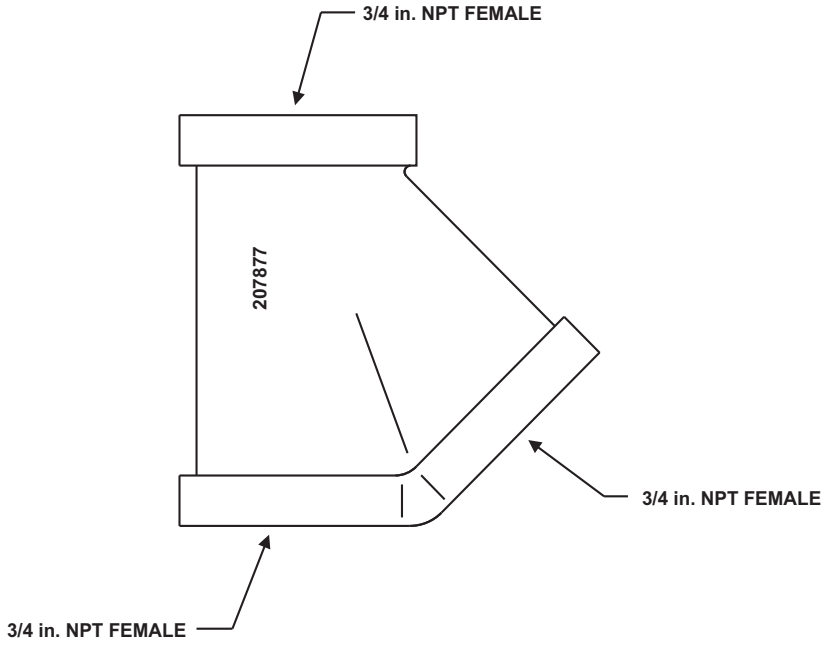


Figure 4-13. Manifold “Y” Fitting

4-2.6 Cylinder Mounting Hardware

Straps are available for securing single or double cylinders against a wall or other supporting structure. Free standing arrangements are not available. If walls are not available, a simple free standing support can be built up from the floor.

Specially designed racks are available to secure multiple cylinders in various arrangements. The racks consist of metal framework with cradles, clamps and spacers to support the cylinders, and also includes cylinder weighing bars to facilitate service and maintenance.

4-2.6.1 SINGLE OR DOUBLE CYLINDER ARRANGEMENTS

4-2.6.1.1 Single Cylinder Straps.

The dimensions for single cylinder straps (Figure 4-14) are provided in Table 4-3.

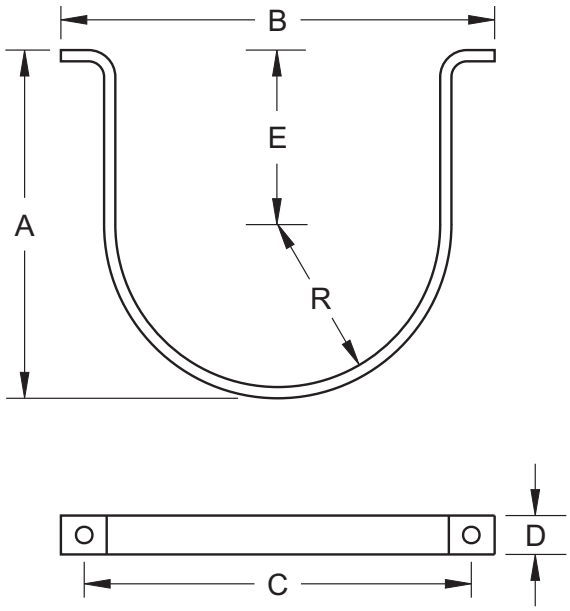


Figure 4-14. Single Cylinder Straps

Table 4-3. Single Cylinder Strap Dimensions

Part Number	Cylinder Size	A		B		C		D		E		R	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
WK-270014-000	25, 35, & 50 1040/2300	7.94	202	11.5	292	10.4	264	1.00	25.4	3.50	88.9	4.25	108
81-626690-000	75	5.63	143	12.3	312	11.1	282	1.25	31.8	3.75	95.2	4.63	118
WK-270157-000	100	10.0	254	14.0	356	12.4	315	1.75	44.4	4.50	114	5.31	135

4-2.6.1.2 Double Cylinder Straps

The dimensions for double cylinder straps (Figure 4-15) are provided in Table 4-4.

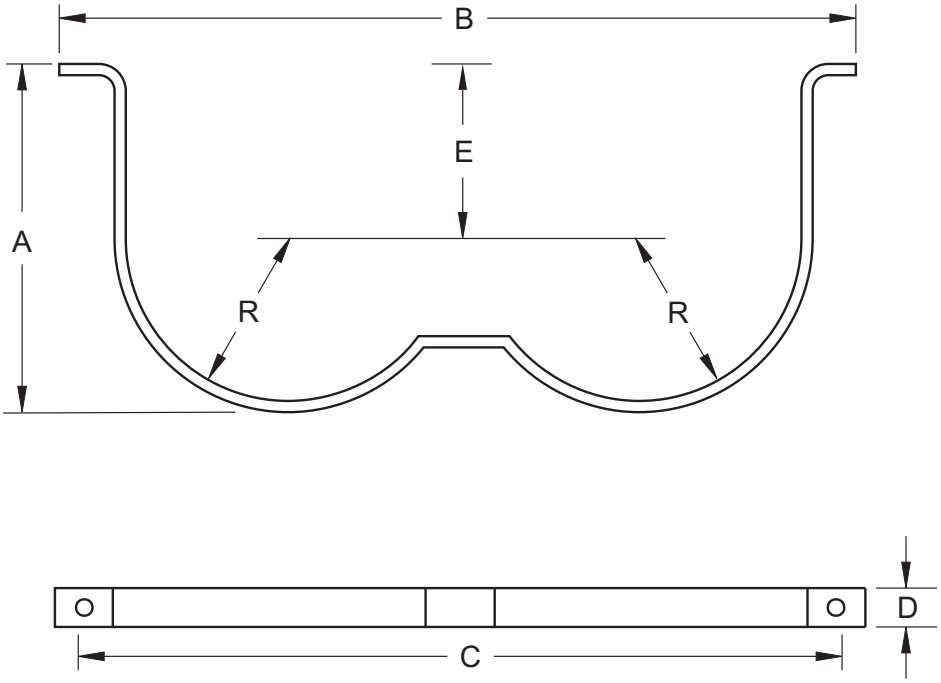


Figure 4-15. Double Cylinder Straps

Table 4-4. Double Cylinder Strap Dimensions

Part Number	Cylinder Size	A		B		C		D		E		R	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
WK-241219-000	50 & 75 1040/2300	7.75	197	22.8	579	21.5	546	1.75	44.4	2.88	73.1	4.63	118
WK-241254-000	100	10.3	262	25.6	650	24.3	617	1.75	44.4	4.72	120	5.28	134

4-2.6.2 MULTIPLE CYLINDER ARRANGEMENTS

Three different styles of framing arrangements are available to provide flexibility of installation for installation of three or more cylinders:

Arrangement A: This style (Figure 4-16) is used for a single row of cylinders, that can be either wall mounted or free standing.

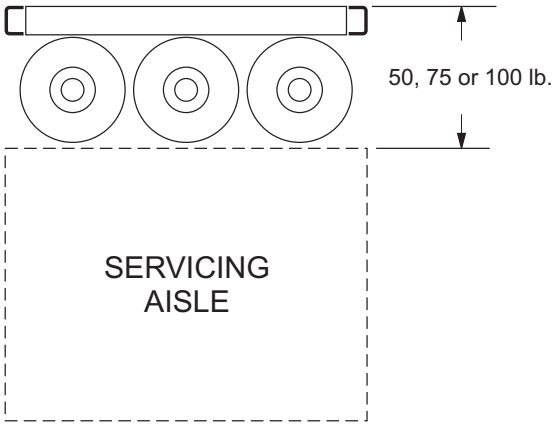


Figure 4-16. Multiple Cylinder Mounting, Arrangement A

Arrangement B: This style (Figure 4-17) provides for one row of cylinders on each side of the framing. This arrangement is free standing and requires two aisles. It has the advantage of permitting free access to any cylinder without disturbing any other cylinder.

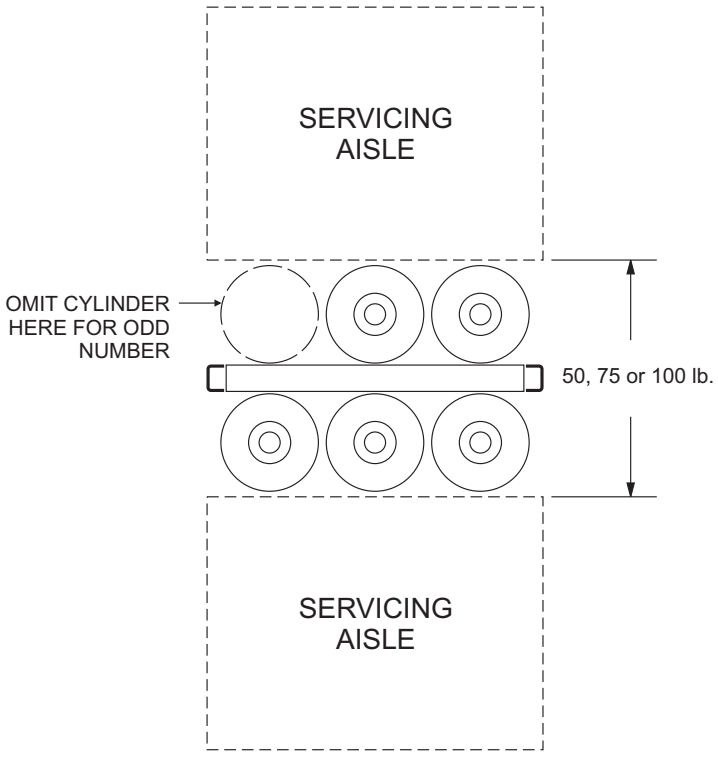


Figure 4-17. Multiple Cylinder Mounting, Arrangement B

Arrangement C: This style (Figure 4-18) provides for a double row of cylinders on the same side of the framing. This arrangement can be free standing or wall mounted. It is generally used when the cylinders are to be wall mounted and sufficient space is not available to arrange them in a single row.

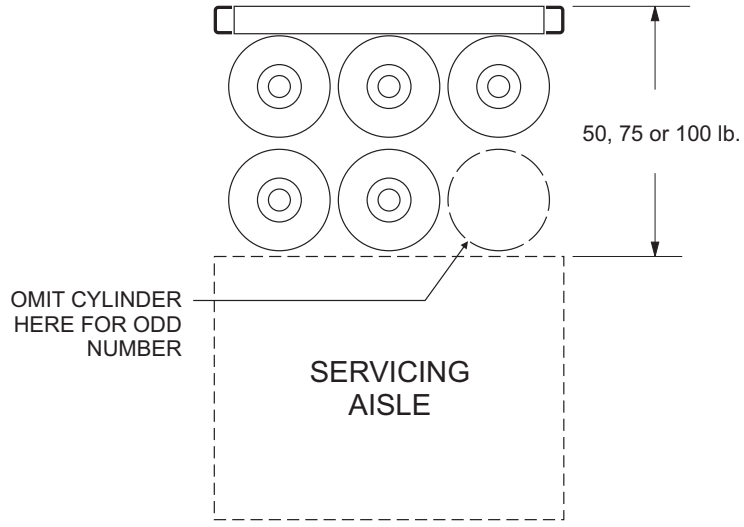


Figure 4-18. Multiple Cylinder Mounting, Arrangement C

Larger quantities of cylinders can be accommodated by adding additional framing. All framing is supplied with pre-drilled mounting holes. Any combination of cylinder stowage, junction box installation, pneumatic selector valve installation and cylinder manifold support can be accommodated by the holes in the framing. All bolts and nuts are supplied as part of the framing. Drilling is not required at the job site in order to erect the bracketing. In addition the cylinder manifolds are arranged to be fastened to the framing.

4-2.6.2.1 Cylinder Rack and Framing, Example Arrangement

The components comprising a single-row rack and frame (Arrangement A) for six cylinders (Framing Kit 81-010001-006) are identified in the highlighted column of Table 4-5 and illustrated in Figure 4-19. Complete parts information concerning the components required for all single- and double-row rack and framing arrangements are contained in Table 8-19, Table 8-20 and Table 8-21 and illustrated in Figure 4-4 through Figure 4-20

Table 4-5. Framing Kits - One Row, 3 through 15 Cylinders

Number of Cylinders		3	4	5	6	7	8	9	10	11	12	13	14	15
Kit Number 81-010001-XXX		-003	-004	-005	-006	-007	-008	-009	-010	-011	-012	-013	-014	-015
Part No.	**Description**	**Quantity Supplied in Kit**												
WK-271566-000	Post	2	2	2	3	3	3	3	3	4	4	4	4	4
WK-241211-000	Gusset	2	2	2	2	2	2	2	2	2	2	2	2	2
WK-207281-000	Channel Support	2	2	2	5	5	5	5	5	8	8	8	8	8
WK-271563-000	3 Cylinder Channel	1	—	—	2	1	—	—	—	1	—	—	—	—
WK-271564-000	4 Cylinder Channel	—	1	—	—	1	2	1	—	2	3	2	1	—
WK-271565-000	5 Cylinder Channel	—	—	1	—	—	—	1	2	—	—	1	2	3
WK-271561-000	CRADLE	3	4	5	6	7	8	9	10	11	12	13	14	15
WK-271567-000	1 Row Weigh Bar Bracket	2	2	2	3	3	3	3	3	4	4	4	4	4
WK-243796-000	3 Cylinder Weigh Bar	1	—	—	2	1	—	—	—	1	—	—	—	—
WK-243797-000	4 Cylinder Weigh Bar	—	1	—	—	1	2	1	—	2	3	2	1	—
WK-243798-000	5 Cylinder Weigh Bar	—	—	1	—	—	—	1	2	—	—	1	2	3
WK-241105-000	Front Clamp	2	2	3	3	4	4	5	5	6	6	7	7	8
WK-243795-000	Rack Rod 1 Row	2	2	3	3	4	4	5	5	6	6	7	7	8
ADDITIONAL PARTS TO ORDER FOR MAIN & RESERVE - NOT INCLUDED IN KITS														
WK-241105-000	Front Clamp	—	2	—	4	—	4	—	6	—	6	—	8	—
WK-243795-000	Rack Rod 1 Row	—	2	—	4	—	4	—	6	—	6	—	8	—
HARDWARE - NOT SUPPLIED BY KIDDE FIRE SYSTEMS														
—	3/8-inch -16 x 1-inch Long Bolt	16	16	16	26	26	26	26	26	36	36	36	36	36
—	3/8-inch -16 Nut	16	16	16	26	26	26	26	26	36	36	36	36	36
Main	1/2-inch -13 x 1-inch Long Bolt	2	3	3	4	4	5	5	6	6	7	7	8	8
M & R	1/2-inch -13 x 1-inch Long Bolt	—	3	—	3	—	5	—	5	—	7	—	7	—
Main	1/2-inch-13 Nut	8	9	12	13	16	17	20	21	24	25	28	29	32
M & R	1/2-inch-13 Nut	—	9	—	15	—	17	—	23	—	25	—	31	—
—	1/2-inch Washer	2	2	2	2	2	2	2	2	2	2	2	2	2
Note: No hardware listed for fastening framing to floor or wall.														

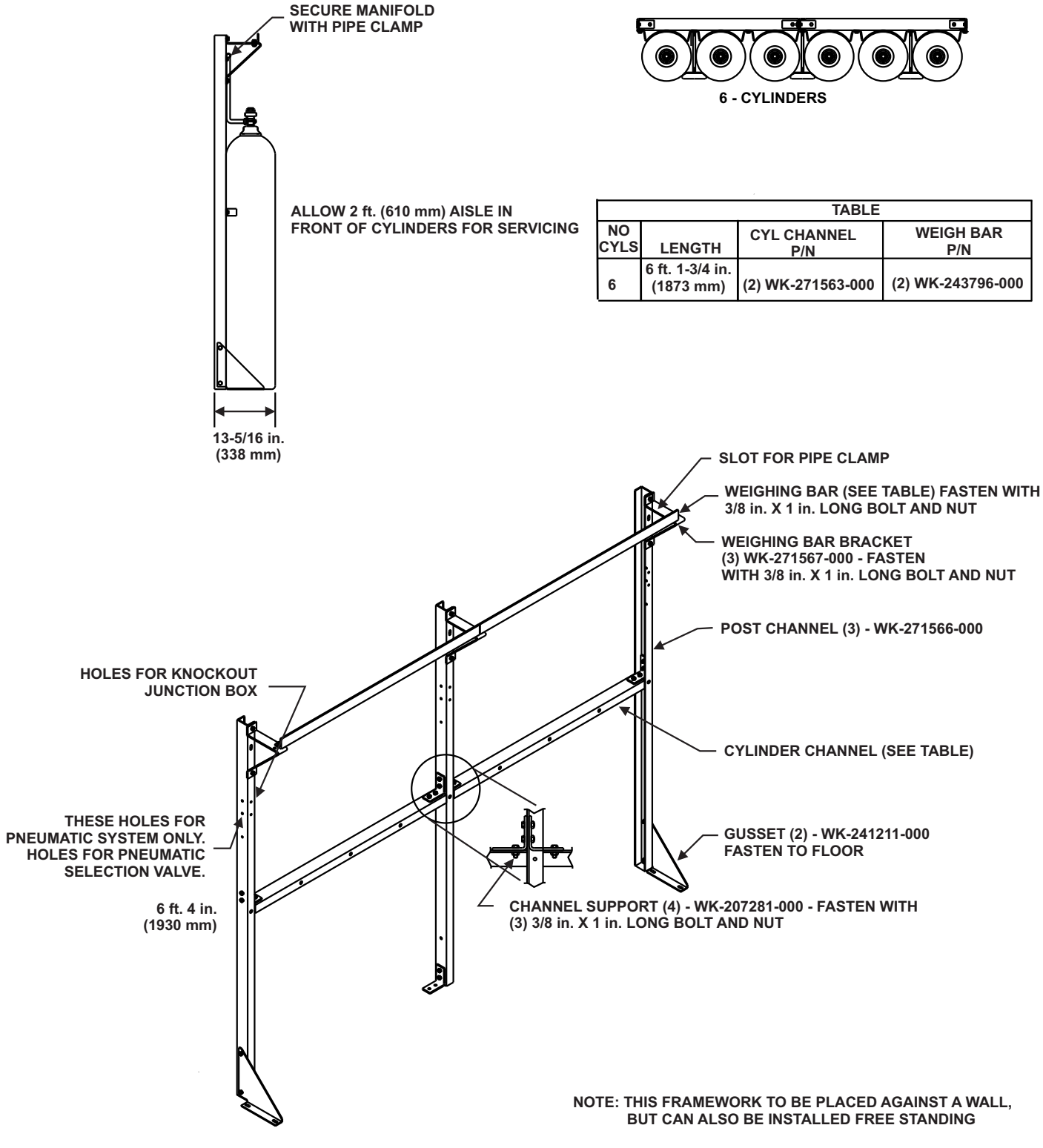


TABLE			
NO CYLS	LENGTH	CYL CHANNEL P/N	WEIGH BAR P/N
6	6 ft. 1-3/4 in. (1873 mm)	(2) WK-271563-000	(2) WK-243796-000

Figure 4-19. Cylinder Rack and Framing, Example Arrangement

4-3 ACTUATION COMPONENTS

Actuation of the suppression system is initiated by use of control head(s). Control heads are components that attach to the control ports of the carbon dioxide cylinder valves. The control head initiates the suppression system discharge by opening the cylinder valve's pilot check. This allows carbon dioxide to pressurize the discharge head piston, which opens the main check in the valve and discharges the contents of the cylinder.

One control head is used for CO_2 systems having one or two cylinders. A minimum of two control heads are required for suppression systems that have three or more carbon dioxide cylinders.

Control heads are also used in conjunction with pressure operated time delays, stop valves, and pneumatic transmitters to control the flow of carbon dioxide throughout the piping network. All of the control heads are self-venting in the set position to prevent accidental discharge in the event of a slow build-up of pressure in a pilot line or a slow leak at the pilot check of the cylinder valve.

WARNING **Control heads must be in the set position before attaching to the cylinder valves to prevent accidental carbon dioxide discharge.**

4-3.1 Lever-Operated Control Head

The lever-operated control head, Part No. WK-870652-000 (Figure 4-20), is used for small, manually-actuated suppression systems using one or two carbon dioxide cylinders. It is also used as an emergency manual release device for pressure operated control heads and used in conjunction with components such as pressure operated time delays and directional (stop) valves.

This control head is equipped with an operating lever secured in the closed position by a safety pull pin and seal wire. The lever can be rotated to the open position by removing the safety pin. This will discharge a cylinder, bypass a time-delay period, or open a directional (stop) valve.

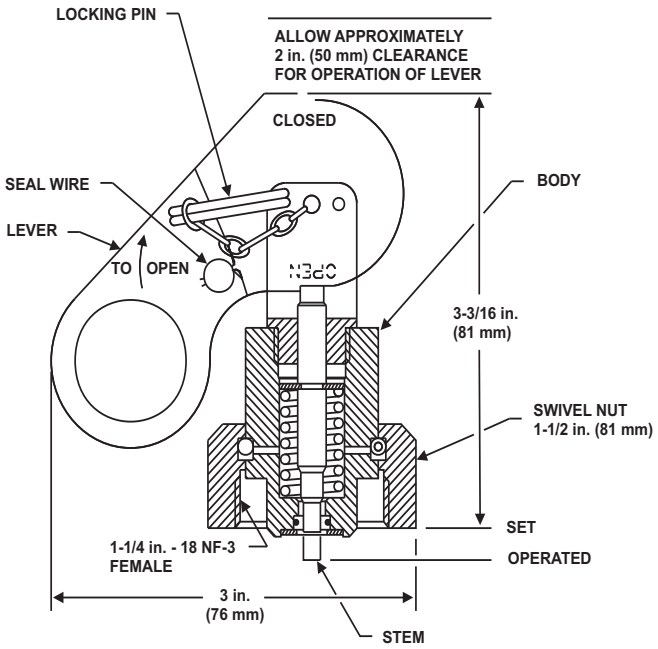


Figure 4-20. Lever-Operated Control Head

4-3.2 Cable-Operated Control Head

The cable-operated control head, Part No. 81-979469-000 (Figure 4-21 and Figure 4-22), is a mechanical device that allows for remote manual actuation of carbon dioxide cylinders, stop valves, and directional valves by means of signals transmitted via pull boxes and cables. A manual lever is also provided on the control head for local operation.

A tension force transmitted by a cable will cause the control head's cable clamp and wheel assembly to travel linearly and depress the actuating pin to open the pilot check on a cylinder valve or directional (stop) valve.

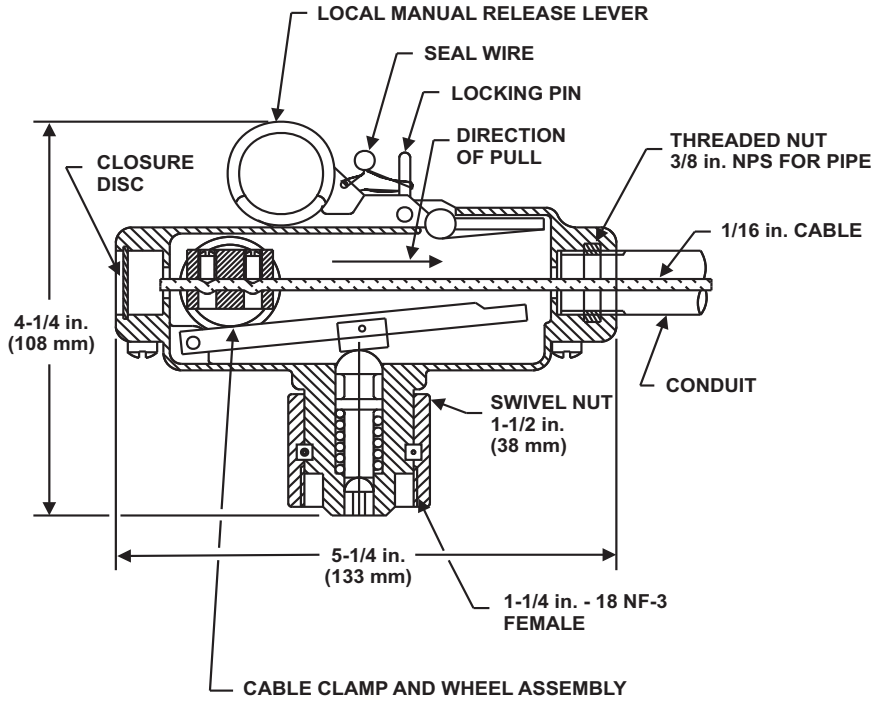


Figure 4-21. Cable-Operated Control Head

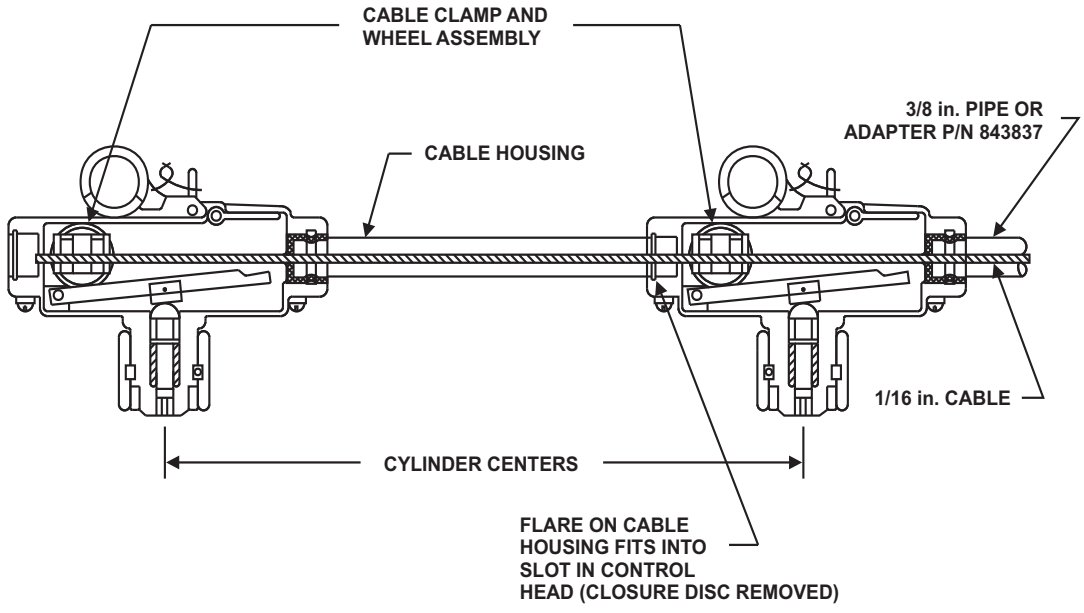


Figure 4-22. Cable-Operated Control Heads in Tandem

4-3.3 Manual Control Equipment

All carbon dioxide fire suppression systems are equipped with one or more manually-operated release stations. These stations are located in easily accessible positions around the protected area or equipment, and activation of any station should permit full operation of the system.

4-3.3.1 MECHANICAL PULL BOX

The mechanical pull box, Part No. 81-871403-000 (Figure 4-23), is a cable connected, pull-handle-type remote release station used for actuating carbon dioxide cylinders and associated directional (stop) valves. The pull box is designed to transmit a force via a 1/16-inch cable to the cable operated control heads attached to the pilot CO_2 cylinders and the appropriate flow-control valves. A hammer is attached to the pull box, and operation is accomplished by breaking the glass front with the hammer and pulling the handle.

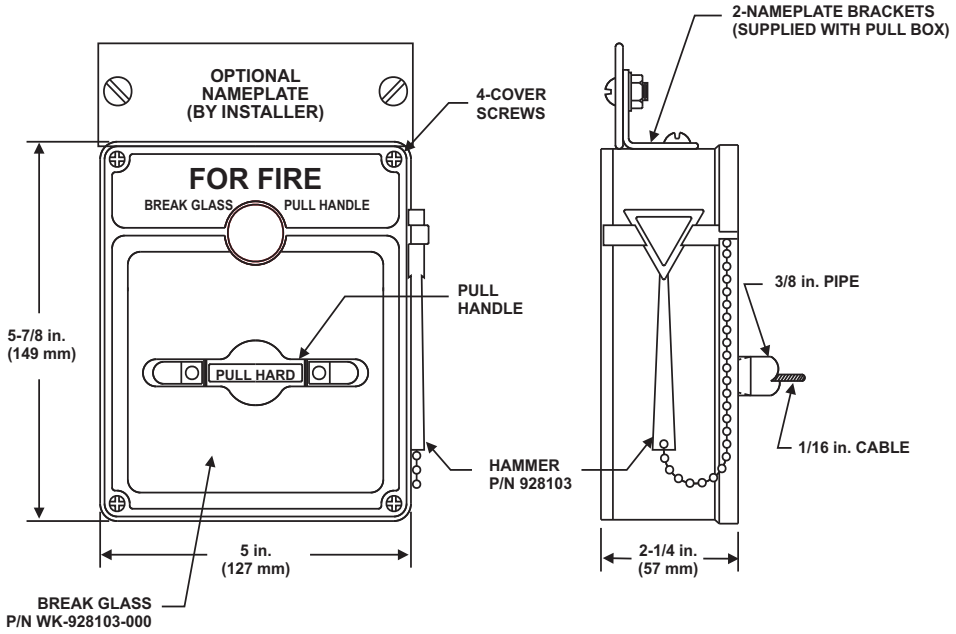


Figure 4-23. Mechanical Pull Box

4-3.3.2 MECHANICAL PULL BOX Z-BRACKET

The mechanical pull box Z-bracket, Part No. 81-605320-000 (Figure 4-24) is used to attach the mechanical pull box to a wall or a rigid structural member. This bracket provides sufficient offset of the pull box from its mounting surface to allow penetration from behind by the cabling system.

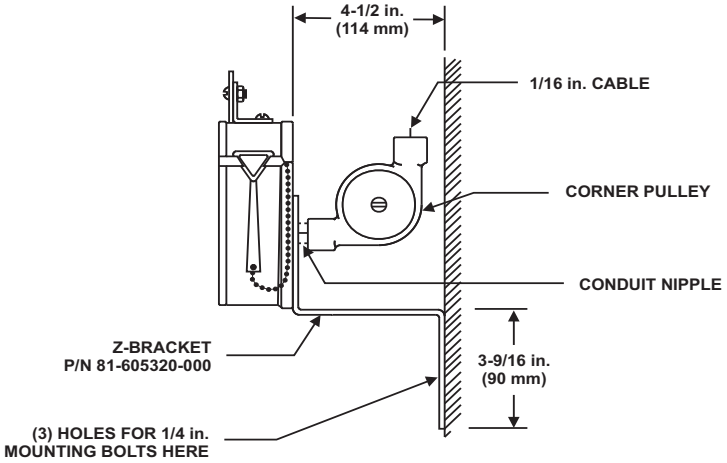


Figure 4-24. Mechanical Pull Box Bracket

4-3.3.3 CORNER PULLEYS

Corner pulleys (Figure 4-25) are used at every change in direction of cable lines and prevent binding to ensure smooth operation. Part No. 81-803808-000 is used for all watertight applications; Part No. WK-844648-000 is used for all industrial applications.

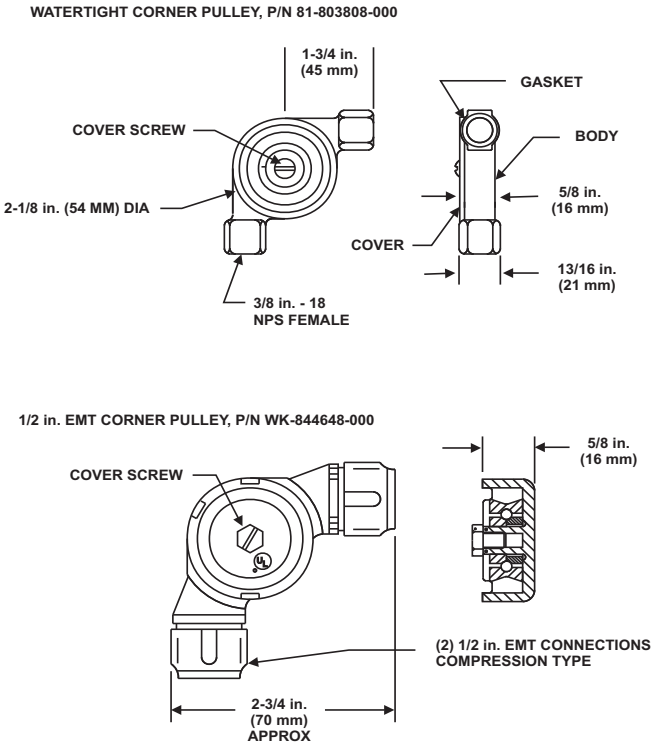


Figure 4-25. Corner Pulleys

4-3.3.4 ADAPTER

The adapter, Part No. WK-843837-000 (Figure 4-26), is used to connect 1/2-inch EMT to components with 3/8-inch NPS outlets such as the cable operated control head and the dual pull equalizer. This adapter has a 1/2-inch female EMT connector on one end and a 3/8-inch NPS male connector on the other end.

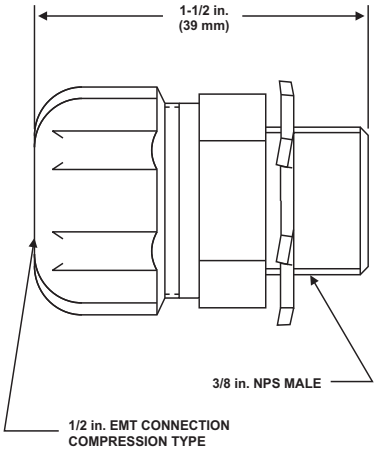


Figure 4-26. EMT Adapter

4-3.3.5 CABLE HOUSING

A cable housing (Figure 4-27) is required when the suppression system consists of three or more cylinders and utilizes two cable-operated control heads. The cable housing protects the interconnecting cable between the two cable-operated control heads and secures the two heads in a fixed position. The length of the cable housing (see Table 4-6) is determined by the size of the cylinders used in the suppression system.

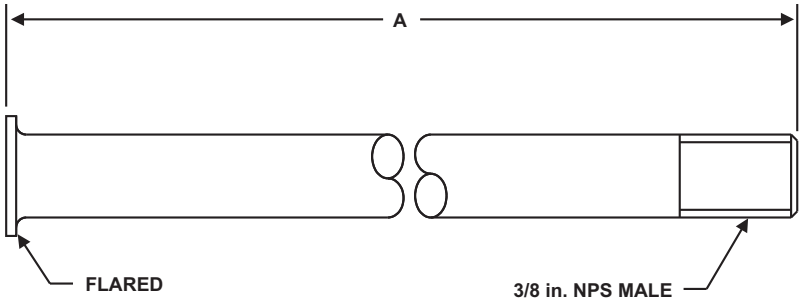


Figure 4-27. Cable Housing

Table 4-6. Cable Housing Part Numbers

Part Number	Cylinders Used With		Cylinder Centers		"A" Dimension	
	lb.	kg	in.	mm	in.	mm
WK-331570-000	25-35	11.3 - 15.8	9.5	241	5.12	130
WK-202355-000	50 - 75	22.6 - 34.0	10.0	254	5.62	143
WK-200822-000	100	45.3	11.625	295	7.12	181

4-3.3.6 DUAL PULL MECHANISM

The dual pull mechanism, Part No. 81-840058-000 (Figure 4-28), performs a similar function as the tee pulley. It is used to branch a pull cable line to two remote release stations, and is used for cables that are run in 3/8-inch pipe.

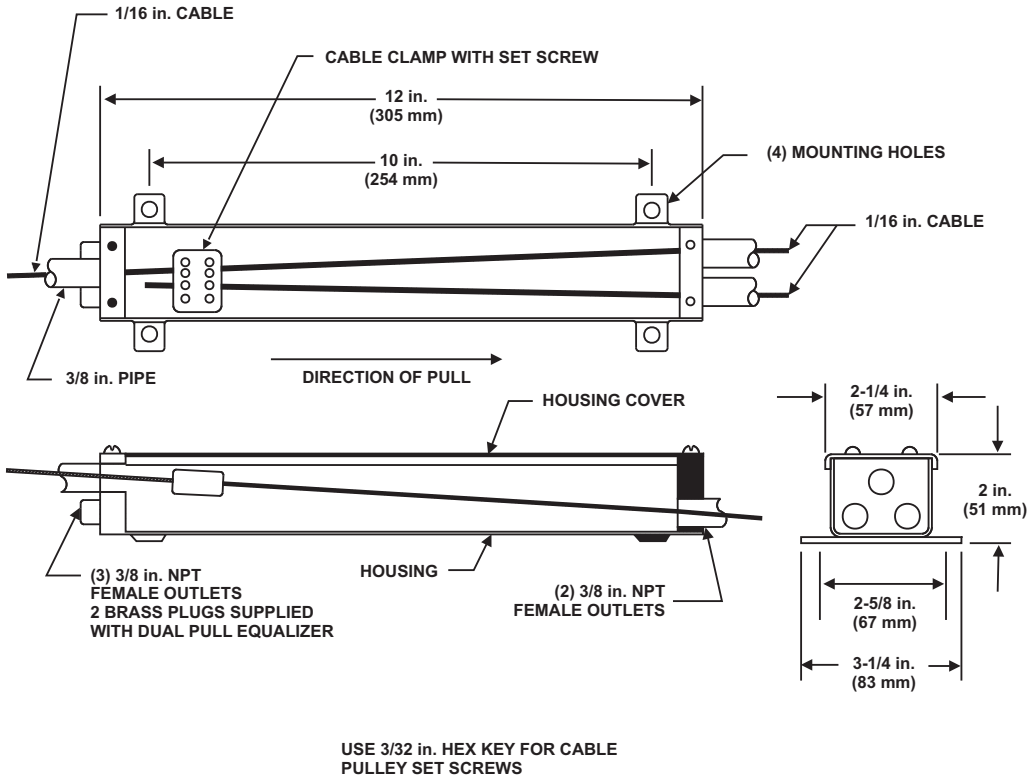


Figure 4-28. Dual Pull Mechanism

4-3.3.7 DUAL PULL EQUALIZER

The dual pull equalizer, Part No. 81-840051-000 (Figure 4-29), is used to equalize the force transmitted via a pull cable to two separate remote control head locations. It contains a pulley mechanism to equalize the cable travel to assure that the control heads fully actuate at both locations.

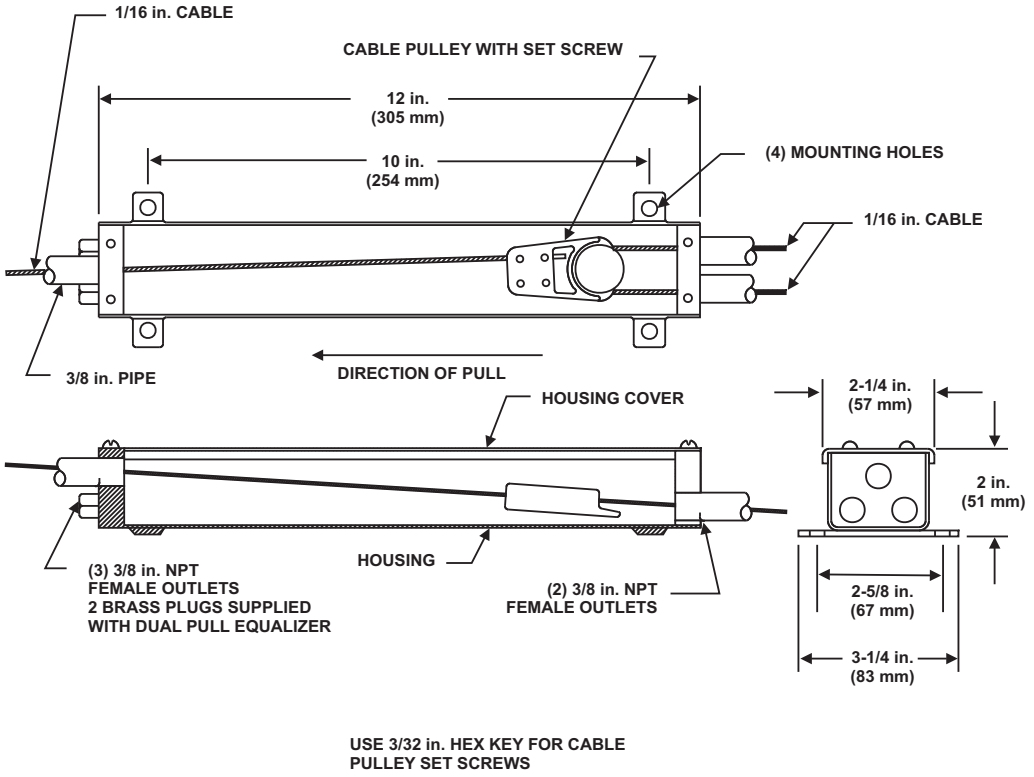


Figure 4-29. Dual Pull Equalizer

4-3.3.8 1/16-INCH PULL CABLE

The 1/16-inch Pull Cable functions as a control cable used to interconnect mechanically actuated components. The cable is made of 1/16-inch O.D., stainless-steel having a multi-strand construction and is available in the lengths identified in Table 4-7.

Table 4-7. 1/16-inch Pull Cable Lengths

Length (feet)	Part Number
50	06-118316-050
100	06-118316-100
250	06-118316-150
350	06-118316-350
500	WK-219649-000

4-3.4 Pneumatic Control Heads

The pneumatic control head (Figure 4-30) is a non-electric mechanical device that allows for automatic actuation of carbon dioxide cylinders, stop valves, and directional valves by means of pressure pulses transmitted from heat-actuated detectors (HADs) via copper tubing. These control heads can also be remotely activated using a cable attached from the control head to a cable operated manual pull station. The control heads are also equipped with a manual lever for emergency local operation.

Pneumatic control heads operate on the rate-of-temperature-rise principle. This means that a sudden increase in the temperature must occur to cause the control head to operate.

The control head must be used in conjunction with a pneumatic heat detection system (rate-of rise) and operates as follows: A pneumatic HAD is connected to the control head by copper tubing. As the temperature changes, the pressure within the detector varies. If the pressure increases rapidly, as in the event of fire, a diaphragm in the pneumatic control head will trip a lever mechanism, causing the control head to operate. The pneumatic control head is fitted with a vent so that slight changes in pressure due to normal changes in ambient temperature can be vented to atmosphere. The sensitivity of the pneumatic control head is determined by the internal pressure required to trip the control head lever. This pressure is called the setting and is measured in inches of water. Vent sizes are rated in terms of the time (in seconds) required to relieve two inches of water column pressure in the diaphragm chamber. The higher the vent setting, the smaller the actual size of the vent. A control head with a high setting is actually a very sensitive device.

The combination of diaphragm and vent settings for pneumatic control heads are shown in Table 4-8.

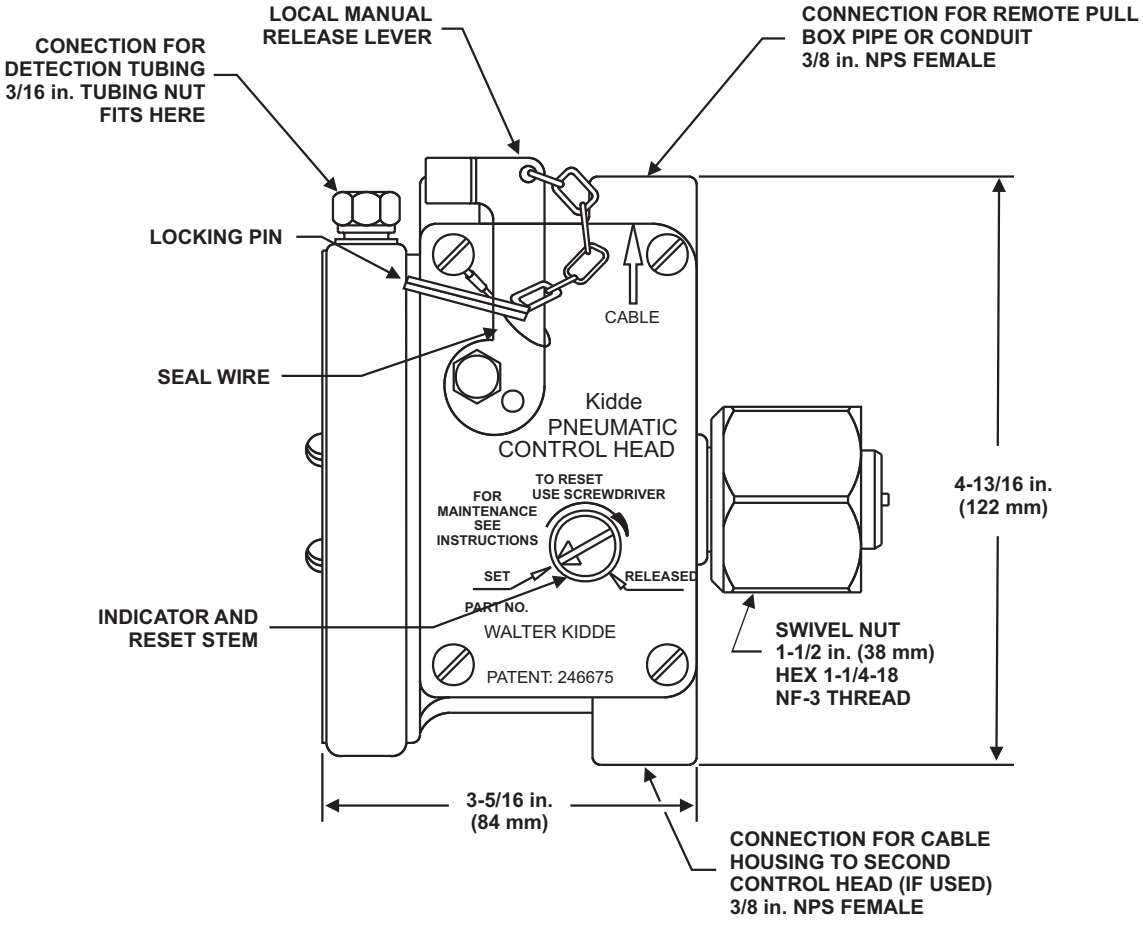


Figure 4-30. Pneumatic Control Head

Table 4-8. Pneumatic Rate of Rise Control Head Setting Information

Part Number of Control Head	Pressure Setting (Inches of H_20)	Vent Number	Temperature (°F) Rise per Minute for Number of Actuators Exposed to Heat				Part Number of Vent	Application
			1	2	3	4		
81-872335-000	3 in.	5	28.2	15.0	10.0	0.6	WK-802745-000	Moderate Temp. Change Only; Controlled Environment
81-872365-000	6 in.	5	56.5	28.2	20.0	15.0	WK-802745-000	Standard Marine. Outside Weather/Machinery Spaces
81-872362-000	6 in.	2	141.0	70.5	47.0	35.3	WK-802742-000	Rapidly Changing Temperature. Ex. Ovens, Ductwork, Cold Climates
81-872330-000	3 in.	__	__	__	__	__	__	__
81-872360-000	6 in.	__	__	__	__	__	__	__

4-3.4.1 TANDEM PNEUMATIC CONTROL HEAD

As previously stated, two or more pilot cylinders are required for suppression systems consisting of three or more cylinders. When two pneumatic control heads are used to actuate a bank of cylinders, one control head must be of the type having a vent, and the second must be a tandem control head. The tandem pneumatic control head (Figure 4-31) is identical to the regular pneumatic control head except that its detection chamber has no vent. Thus, all the compensation for normal environmental pressure changes is performed by the vented pneumatic control head. The diaphragm pressure setting of the tandem control head is chosen to match that of its corresponding vented pneumatic control head. The two diaphragm chambers are interconnected via 3/16-inch copper tubing. If the system is to be actuated remotely via a pull box and cable, the manual cable control is connected to both the pneumatic and tandem control heads.

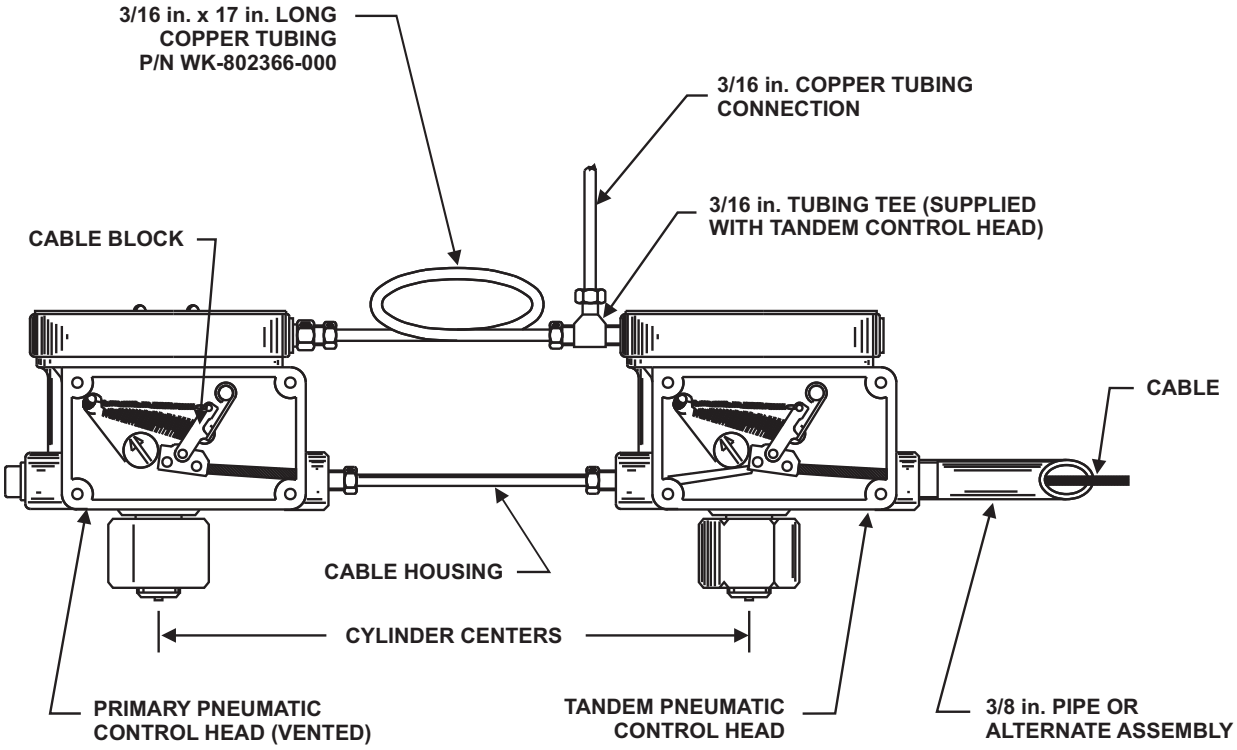


Figure 4-31. Tandem Pneumatic Control Head

4-3.5 Components for Pneumatic Actuation Systems

Pneumatic (rate-of-rise) systems utilize a variety of specialized components to control the actuation of a carbon dioxide suppression system.

4-3.5.1 PNEUMATIC CABLE HOUSING

A pneumatic cable housing (Figure 4-32) is required when a pneumatic control head and a tandem control head are installed for simultaneous actuation by a remote pull box and cable. The housing protects the interconnecting cable between the two pneumatically-operated control heads and to secure the heads in a fixed position. The length of the cable housing (see Table 4-9) is determined by the size of the cylinders used in the suppression system.

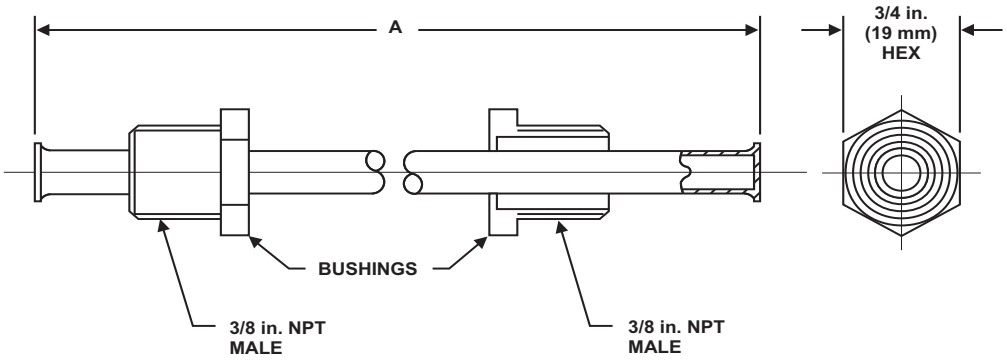


Figure 4-32. Pneumatic Cable Housing

Table 4-9. Pneumatic Cable Housing Part Numbers

Part Number	Cylinders Used With		Cylinder Centers		"A" Dimension	
	lb.	Kg	in.	mm	in.	mm
81-840044-000	25 - 35	11.3 - 15.8	9.5	241	4.68	119
81-840398-000	50 - 75	22.6 - 34.0	10.0	254	5.19	132
81-841739-000	100	45.3	11.625	295	6.82	173

4-3.5.2 HEAT ACTUATED DETECTOR

The pneumatic heat-actuated detector (HAD), Part No. WK-841241-000 (Figure 4-33), consists of a sealed hollow brass chamber having no moving parts. The detector is connected to the pneumatic control head(s) by copper tubing. The air pressure in the detector increases upon a rapid rate-of-rise in temperature, such as in the event of a fire. This pressure increase is transmitted to the pneumatic control head(s) via the copper tubing, causing the control head to actuate the system. The pneumatic heat detector, tubing, and pneumatic control head(s) system is vented to prevent normal ambient temperature changes from actuating the system.

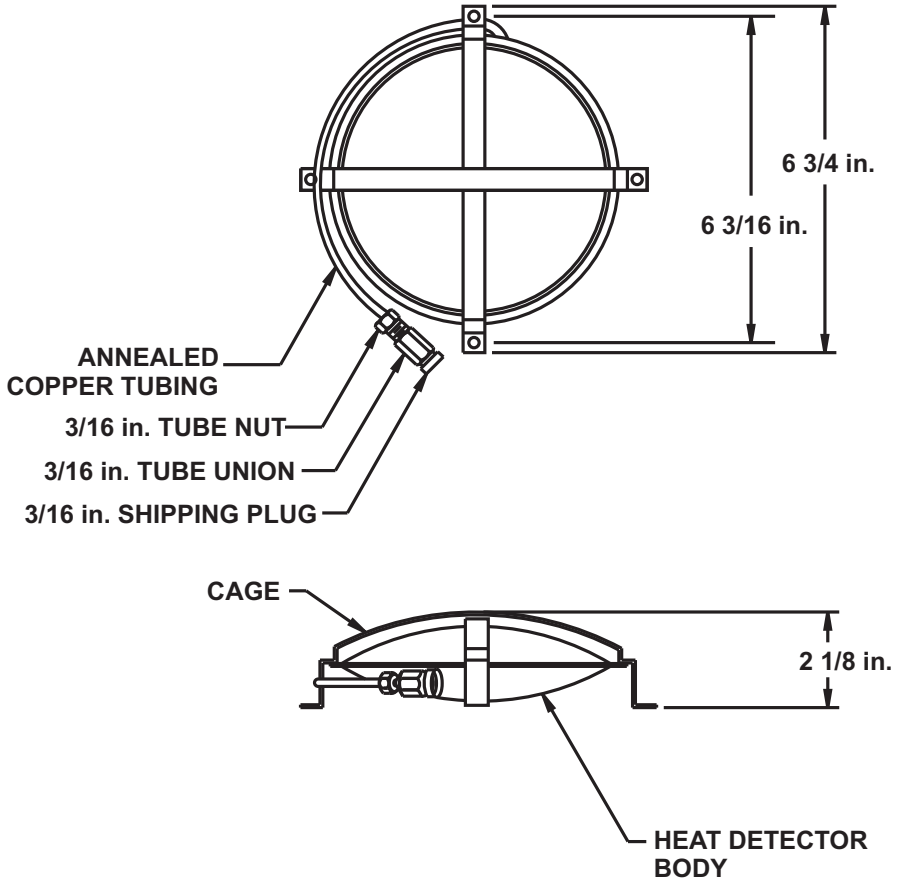


Figure 4-33. Heat Actuated Detector (HAD), Marine

4-3.5.3 3/16-INCH COPPER TUBING

3/16-inch heavy wall copper tubing (Figure 4-34) is used to interconnect the heat actuated detectors with each other and back to the pneumatic control head(s). The tubing is available in 17-in, 46-in and 12-ft lengths as indicated in Table 4-10. Typically, the 17-in length is used to interconnect tandem pneumatic control heads. The 46-in and 12-ft lengths are used to interconnect the heat actuated detectors and also back to the pneumatic control head(s).

In a given tubing arrangement, the maximum allowed overall length of 3/16" tubing is 100-ft (30.48-m).

The tubing is furnished with both ends flared. It is fitted with a tube fitting and protection cap to prevent entrance of moisture or foreign matter. Because the tubing is difficult to flare, Kidde-Fenwal, Inc. recommends the entire length be used. Excess tubing should be taken up by coiling.

Table 4-10. 3/16-inch Copper Tubing Part Numbers

Part Number	Length
WK-802366-000	17 in. (432 mm)
WK-802486-000	Length 12-ft (3657 mm)
81-802367-000	46 in. (1168 mm)

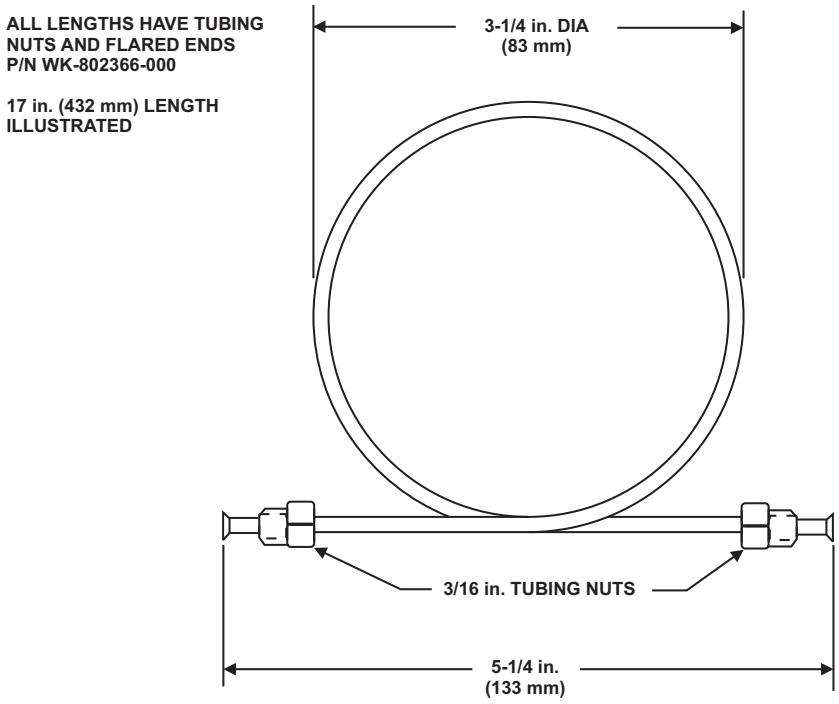
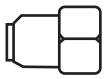


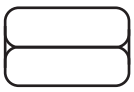
Figure 4-34. Copper Tubing

4-3.5.3.1 Fittings

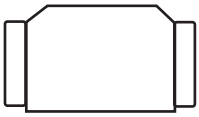
Fittings (Figure 4-35) are available to join segments of 3/16-inch copper tubing together or to connect to either pneumatic control heads or heat actuated detectors. The pneumatic control heads and heat actuated detectors are factory fitted with 3/16-in tubing nuts.



3/16 in. TUBING NUT
P/N WF-528103-000



3/16 in. UNION WITHOUT NUTS
P/N WK-528103-600



3/16 in. TEE WITHOUT NUTS
P/N WK-528103-700

Figure 4-35. Fittings

4-3.5.3.2 Rubber Grommet

The rubber grommet, Part No. WK-207825-000, is used to support and seal a 3/16-inch tubing penetration into a junction box.

4-3.6 Pressure Operated Control Heads

Pressure operated control heads utilize the pressure from either a CO_2 or nitrogen cylinder to actuate CO_2 cylinder valves or directional (stop) valves.

4-3.6.1 PRESSURE OPERATED CONTROL HEAD

This control head, Part No. 82-878737-000 (Figure 4-36), consists of a spring-loaded piston-and-stem assembly housed in a brass body. The body has a threaded inlet port that connects to the pressure line, and a swivel nut for connection to a control port. The supplied pressure actuates the spring-loaded piston-and-stem assembly to engage the pilot check of the control port to which it is connected.

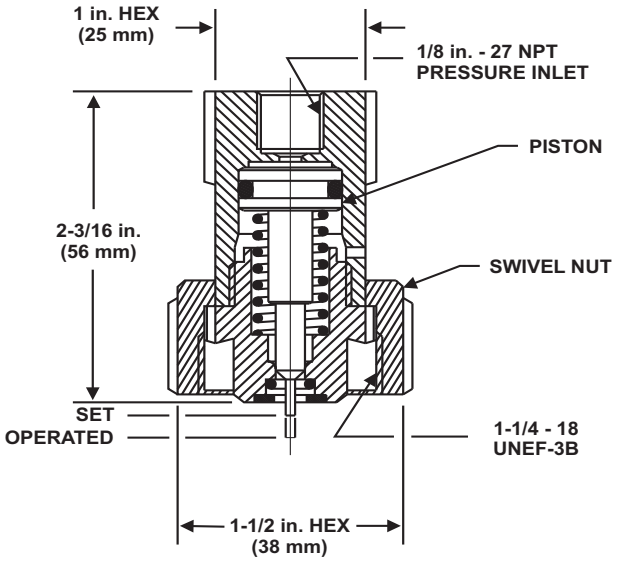


Figure 4-36. Pressure Operated Control Head

4-3.6.2 LEVER AND PRESSURE OPERATED CONTROL HEAD

The lever and pressure operated control head, Part No. 82-878751-000 (Figure 4-37), consists of a spring-loaded piston-and-stem assembly housed in a brass body, and a lever for emergency manual operation. The body has a threaded inlet port that connects to the pressure line and a swivel nut for connection to a control port. The supplied pressure, or manual operation of the lever, actuates the spring-loaded piston-and-stem assembly to engage the pilot check of the control port to which it is connected.

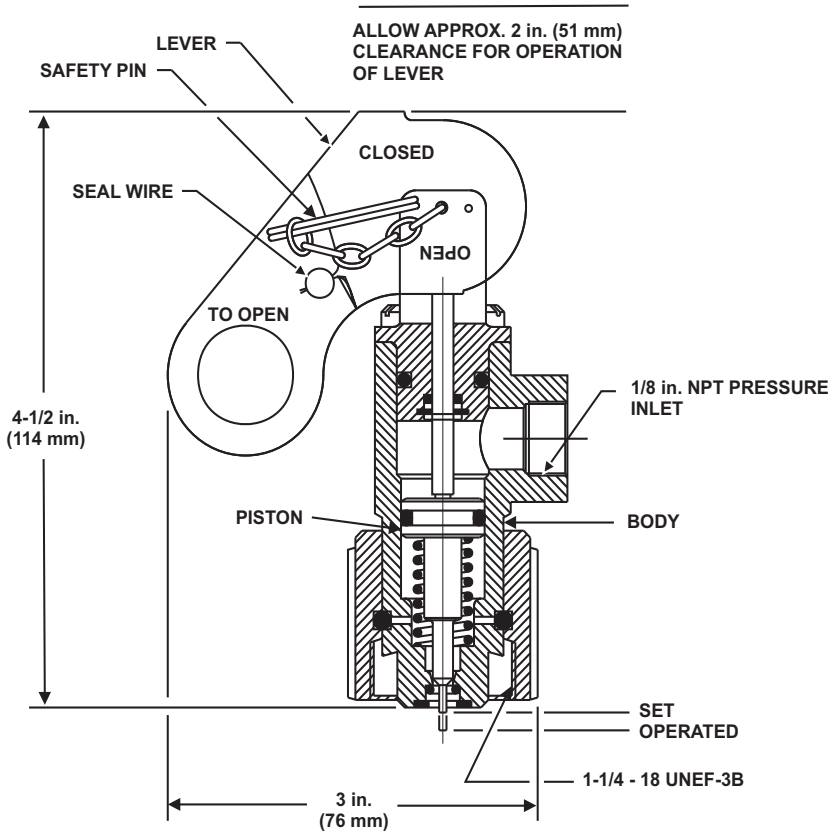


Figure 4-37. Lever and Pressure Operated Control Head

4-3.6.3 STACKABLE PRESSURE OPERATED CONTROL HEAD

The stackable pressure operated control head, Part No. 82-878750-000 (Figure 4-38), is similar in design and construction to the lever and pressure operated control head. It offers a stackable design and is used where a cable operated or electric/mechanical control head is also required.

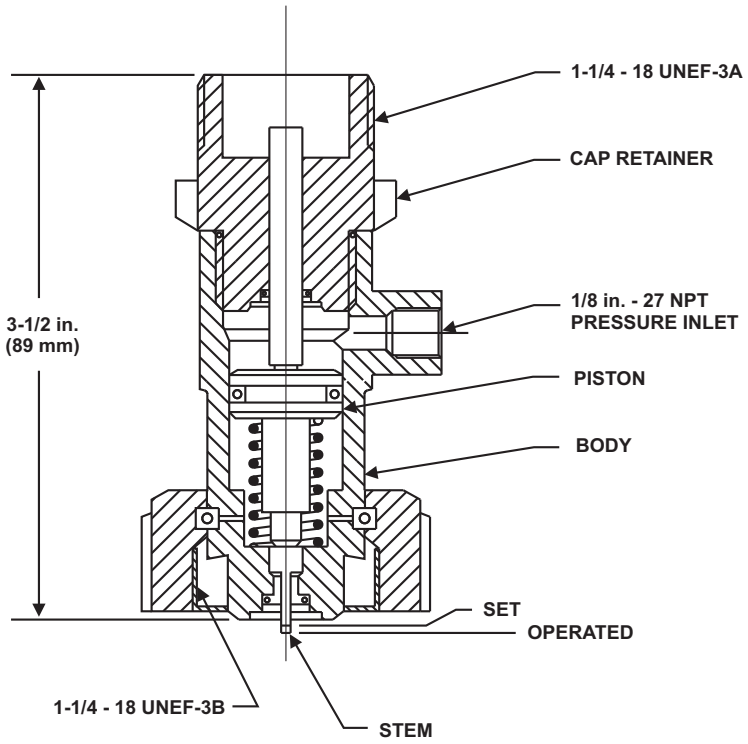


Figure 4-38. Stackable Pressure Operated Control Head

4-3.7 Components for Pressure Operated Actuation Systems

4-3.7.1 NITROGEN PILOT CYLINDER AND BRACKET

Nitrogen pilot cylinders supply pressure to operate (via pressure operated control heads) CO_2 pilot cylinders, stop valves, N_2 discharge delays or N_2 pressure operated sirens. Three different sized cylinder capacities are provided for use with CO_2 systems. Each cylinder is of steel material and designed in accordance with USDOT and TC requirements. Each cylinder is factory pressurized to 1800-psig @ 70F and fitted with a pressure gauge and pressure relief device. Either pipe, tube or flexible hose connects each pilot cylinder to the pressure operated control head(s).

4-3.7.1.1 Nitrogen Pilot Cylinder, 108 cu. in.

The 108 cu. in. N_2 Pilot Cylinder (P/N WK-877940-000) can be used to operate CO_2 pilot cylinders, stop valves, a N_2 discharge delay or a N_2 pressure operated siren. Any compatible control head can be fitted to the cylinder to provide the desired means of operation. The cylinder valve has a 1/8-in NPT outlet. Any of the 1/8-in NPT x 5/16-in flare fittings can be used to connect the valve to the corresponding actuation line. The cylinder is secured using the wall mount bracket (P/N WK-877845-000).

4-3.7.1.2 Nitrogen Pilot Cylinder, 1040 cu. in.

The 1040 cu. in. N_2 Pilot Cylinder (P/N 90-101040-000) can be used to operate CO_2 pilot cylinders, stop valves or multiple N_2 pressure operated sirens. Any compatible control head can be fitted to the cylinder to provide the desired means of operation. The cylinder has a 5/8-in Type "I" style valve affixed with a pressure gauge. In addition to the control head, this valve requires attachment of a discharge head to allow discharge of the cylinder contents. The ½-in NPT N_2 discharge hose (P/N 06-118207-00X) connects the discharge head to the corresponding actuation line. The cylinder is secured using the single cylinder strap (P/N WK-270014-000). Approved for use in environments from 32°F to 130°F.

4-3.7.1.3 Nitrogen Pilot Cylinder, 2300 cu. in.

The 2300 cu. in. N_2 Pilot Cylinder (P/N 90-102300-000) can be used to operate CO_2 pilot cylinders, stop valves or multiple N_2 pressure operated sirens. Any compatible control head can be fitted to the cylinder to provide the desired means of operation. The cylinder has a 5/8-in Type "I" style valve affixed with a pressure gauge. In addition to the control head, this valve requires attachment of a discharge head to allow discharge of the cylinder contents. The ½-in NPT N_2 discharge hose (P/N 06-118207-00X) connects the discharge head to the corresponding actuation line. The cylinder is secured using the single cylinder strap (P/N WK-270014-000) or the dual cylinder strap (P/N WK-241219-000). Approved for use in environments from 32°F to 130°F.

4-3.7.1.4 Nitrogen Discharge Hoses, 3/4 in., P/N 06-118207-00X

The 3/4 in. flexible hose is used to connect the discharge head with the distribution manifold or piping. The hose is manufactured from reinforced rubber and is supplied with crimp-on 3/4 in. NPT fittings, a fixed male and swivel female connector (see Figure 4-39 and Table 4-11).

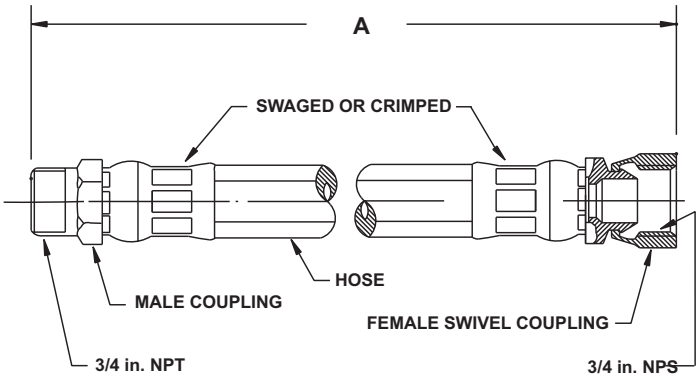


Figure 4-39. Flex Hose, 3/4 in.

Table 4-11. Flex Hose Dimensions

Part Number	Dimension A	
	in.	mm
06-118207-002	14.75	375
06-118207-001	18.00	457

4-3.7.2 ACTUATION HOSE

The actuation hose (Figure 4-40), is used to connect a pilot cylinder to pressure operated control heads or actuation tubing. The 1/4-inch flexible hose is constructed with wire-braided reinforcements and swivel nuts at both ends for ease of assembly. The hose is available in two lengths as shown in Table 4-12.

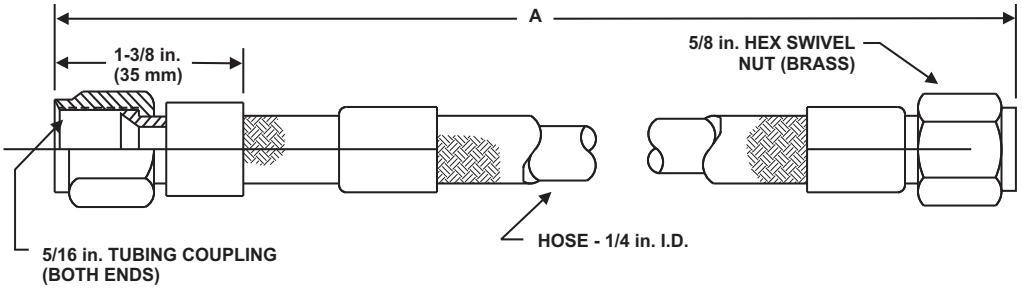


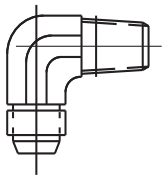
Figure 4-40. 1/4-inch Actuation Hose

Table 4-12. 1/4-inch Actuation Hose Part Numbers

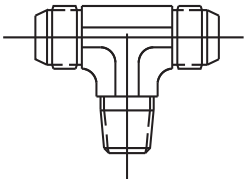
Part Number	Dimension "A"
WK-264986-000	30
WK-264987-000	22

4-3.7.3 FITTINGS

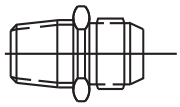
Fittings (Figure 4-41) are available to interconnect the actuation hose to the pressure operated control head(s) or actuation tubing.



MALE ELBOW
1/8 in. NPT x 5/16 in. TUBING
P/N WK-699205-030



MALE BRANCH TEE
1/8 in. NPT x 5/16 in. TUBING
P/N WK-699205-050



MALE CONNECTOR
1/8 in. NPT x 5/16 in. TUBING
P/N WK-699205-010

Figure 4-41. Fittings

4-4 CHECK VALVES

Check valves are required for fire suppression systems that are equipped with a main and reserve set of carbon dioxide cylinders. They are installed in each discharge manifold to isolate the main and reserve cylinders from each other.

Check valves are also employed in directional valve systems that use a common set of carbon dioxide cylinders to protect areas or equipment of unequal sizes. The check valves divide the cylinder group into subsets for discharge of the required amounts of carbon dioxide into the protected areas or equipment.

4-4.1 Check Valves (1/4-inch through 3/8-inch)

The 1/4-inch and 3/8-inch check valves (Figure 4-42) are also used in Nitrogen or CO_2 pilot lines; part numbers and dimensions are provided in Table 4-13.

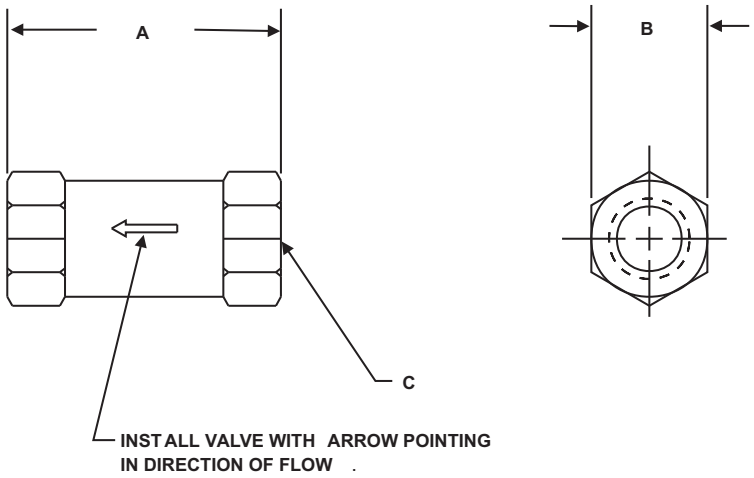


Figure 4-42. Check Valves (1/4-inch and 3/8-inch)

Table 4-13. Check Valve Dimensions (1/4-inch through 3/8-inch)

Part Number	Valve Size	Pipe Thread "C"	"A"		"B"	
			in.	mm	in.	mm
WK-264985-000	1/4 in.	1/4 in. - 18 NPT	2.00	51	0.81	21
WK-261193-000	3/8 in.	3/8 in. - 18 NPT	2.35	60	1.00	25

4-4.2 Check Valves (1/2-inch through 2-inch)

The 1/2-inch through 1 1/4-inch check valves (Figure 4-43) are in-line valves and consist of a threaded brass body which houses a spring loaded piston; part numbers and dimensions are provided in Table 4-14. The piston permits flow through the valve in one direction only.

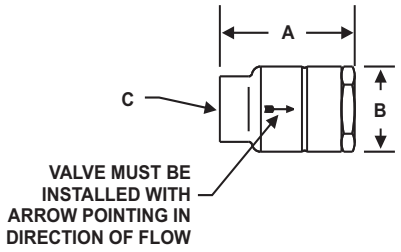


Figure 4-43. Check Valves (1/2-inch to 1-1/4-inch)

Table 4-14. Check Valve Dimensions (1/2-inch through 1-1/4-inch)

Part Number	Valve Size	Pipe Thread "C"	"A"		"B"	
			in.	mm	in.	mm
81-800327-000	1/2 in.	1/2 in. - 14 NPT	3.34	85	2	51
81-800266-000	3/4 in.	3/4 in. - 14 NPT	3.34	85	2	51
WK-800443-000	1 in.	1 in. - 11.5 NPT	3.97	101	3.18	81
81-800444-000	1-1/4 in.	1-1/4 in. - 11.5 NPT	3.97	101	3.18	81

The 1-1/2-inch and 2-inch check valves (Figure 4-44) consist of a brass body which houses a spring loaded stop check; part numbers and dimensions are provided in Table 4-15. The stop check permits flow in one direction only.

These valves are fitted with threaded inlet and outlet ports.

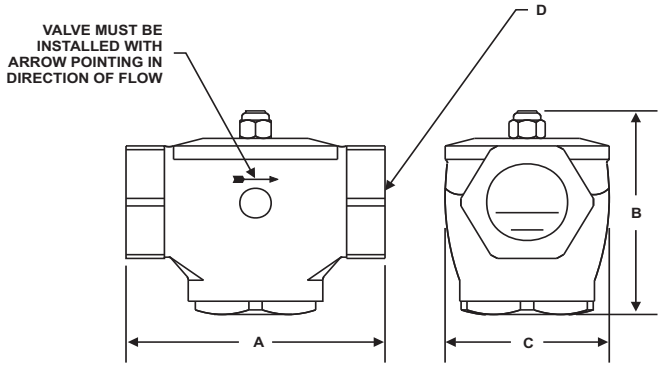


Figure 4-44. Check Valves (1-1/2-inch to 2-inch)

Table 4-15. Check Valve Dimensions (1-1/2-inch through 2-inch)

Part Number	Valve Size	Pipe Thread "D"	"A"		"B"		"C"	
			in.	mm	in.	mm	in.	mm
81-870152-000	1-1/2 in.	1-1/2 in. - 11.5 NPT	7.50	151	6.28	160	4.75	121
81-870151-000	2 in.	2 in. - 11.5 NPT	7.50	151	6.28	160	4.75	121

4-4.3 Check Valves (2 1/2-inch through 3-inch)

The 3-inch check valve, Part No. 81-870100-000 (Figure 4-45) is similar in construction and operation to the 1 1/2-inch and 2-inch check valves.

This valve has flanged inlet and outlet ports and requires two appropriately sized welding neck flanges and gaskets for connection to either 2 1/2-inch or 3-inch distribution piping.

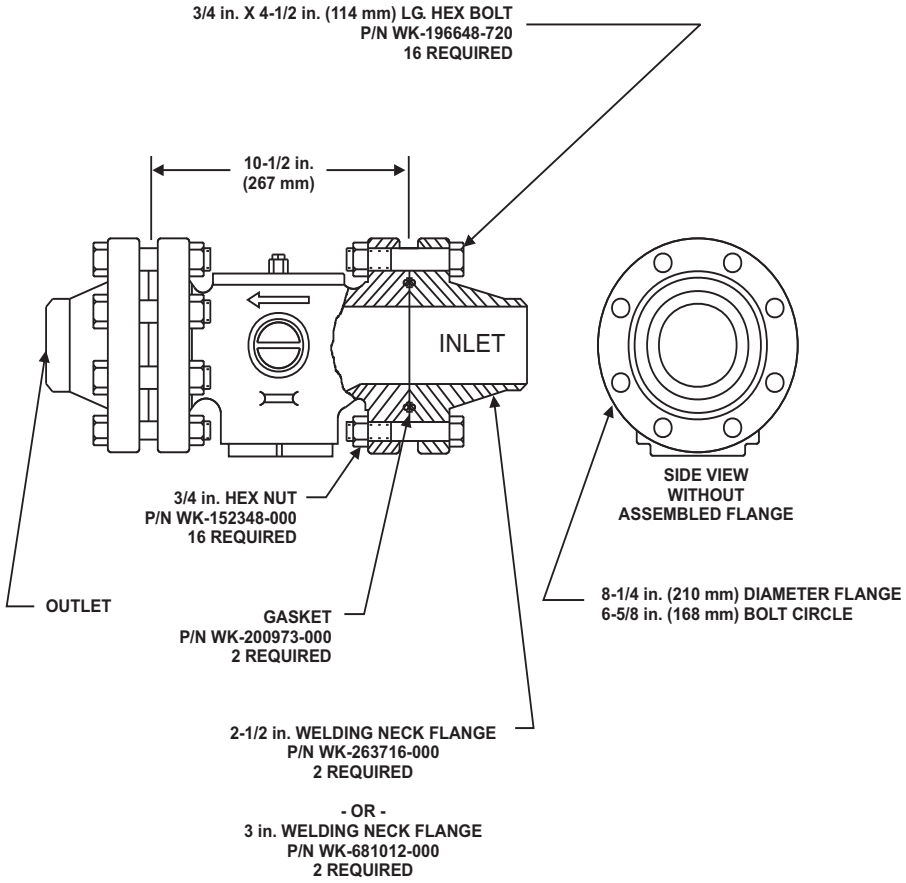


Figure 4-45. Check Valves (2 1/2-inch to 3-inch)

4-4.3.1 2 1/2-INCH WELDING NECK FLANGE

The 2 1/2-inch welding neck flange, Part No. WK-263716-000 (Figure 4-45), is required to attach the 3-inch check valve to 2 1/2-inch distribution piping. Two flanges are required per valve.

4-4.3.2 3-INCH WELDING NECK FLANGE

The 3-inch welding neck flange, Part No. WK-681012-000 (Figure 4-45), is required to attach the 3-inch check valve to 3-inch distribution piping. Two flanges are required per valve.

4-4.3.3 3-INCH FLANGE GASKET

The 3-inch flange gasket, Part No. WK-200973-000 (Figure 4-45) is required to seal the connection between the 3-inch check valve and either the 2 1/2-inch or 3-inch welding neck flange. Two gaskets are required per valve.

4-4.3.4 NUTS AND BOLTS

3/4-inch hex nuts, Part No. WK-152308-000 (Figure 4-45), and 3/4-inch by 4 1/2-inch long bolts, Part No. WK-196648-720 (Figure 4-45), are required to connect the 2 1/2-inch or 3-inch welding neck flanges to the 3-inch check valve. A total of 16 nuts and bolts are required per check valve.

4-5 DIRECTIONAL (STOP) VALVES

Directional (stop) valves find two primary applications in carbon dioxide systems. The first application is in multi-hazard systems which share a common carbon dioxide suppression system. Directional valves are used to route the carbon dioxide from the shared supply to the individual areas or equipment being protected.

The second application for these valves is as a life safety device to prevent the accidental discharge of carbon dioxide into a normally-occupied area. The stop valve prevents the flow of carbon dioxide until the attached control head is operated.

All Kidde Fire Systems directional (stop) valves operate on a differential-pressure principle, utilizing the pressure of the discharging carbon dioxide to open the stop check and allow flow through the valve. All valves automatically reset (close) after discharge is completed.

CAUTION **Directional (stop) valves do NOT prevent flow in the direction opposite the arrow.**

CAUTION **All control heads must be in the set position before attaching to the directional (stop) valves, in order to prevent accidental CO_2 discharge.**

4-5.1 Directional (Stop) Valves (1/2-inch through 2-inch)

The 1/2-inch through 2-inch size directional valves (Figure 4-46) have bronze bodies which house a stop check and an actuating piston, along with an external port for attachment of a control head (part numbers and dimensions are provided in Table 4-16). Actuation of a control head allows the discharged carbon dioxide to apply pressure to the actuating piston to open the stop check.

These directional valves have threaded inlet and outlet ports for connection to the distribution piping.

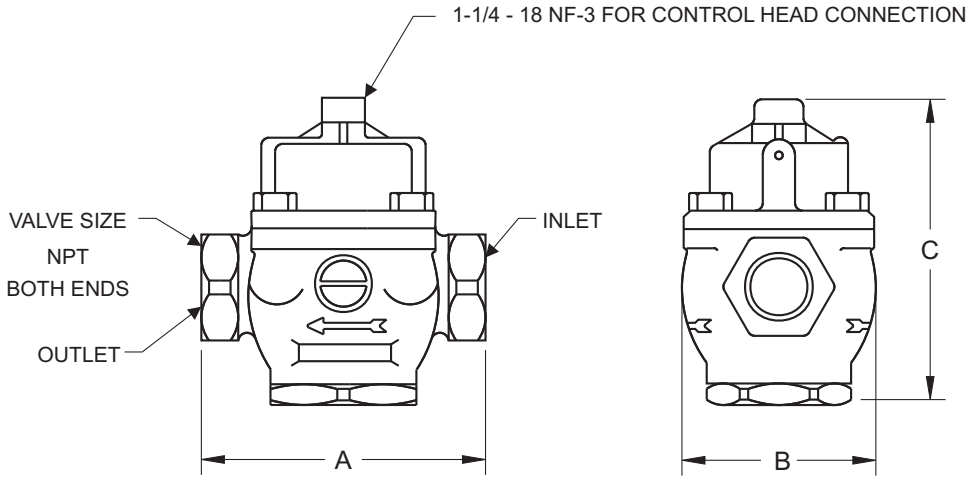


Figure 4-46. Directional (Stop) Valves (1/2-inch through 2-inch)

Table 4-16. Check Valve Dimensions (1 1/2-inch through 2-inch)

Part Number	Valve Size	Pipe Thread "D"	"A"		"B"		"C"	
			in.	mm	in.	mm	in.	mm
81-870023-000	1/2 in.	1/2 in. - 14 NPT	3.75	95	2.50	64	4.68	119
81-870022-000	3/4 in.	3/4 in. - 14 NPT	4.25	108	2.81	71	5.68	144
81-870122-000	1 in.	1 in. - 11.5 NPT	5.50	140	3.62	92	6.87	175
81-870032-000	1-1/4 in.	1-1/4 in. - 11.5 NPT	5.50	140	3.62	92	6.87	175
81-800123-000	1-1/2 in.	1-1/2 in. - 11.5 NPT	7.50	191	4.75	121	8.43	214
81-800049-000	2 in.	2 in. - 11.5 NPT	7.50	191	4.75	121	8.43	214

4-5.2 Directional (Stop) Valves (2 1/2-inch through 4-inch)

The 3-inch and 4-inch directional valves, Part Nos. 81-890010-000 and 81-890208-000 respectively (Figure 4-47 and Figure 4-48), are similar in construction and operation as the 1/2-inch through 2-inch size directional valves. These valves have flanged inlet and outlet ports and require two appropriately-sized flanges and gaskets for connection to the distribution piping.

4-5.2.1 2 1/2-INCH AND 3-INCH VALVES

For the 3-inch valve, Part No. 81-890010-000 (Figure 4-47), see Paragraph 4-4.3.1 through Paragraph 4-4.3.4 for descriptions of the components required for connection to 2 1/2-inch and 3-inch piping.

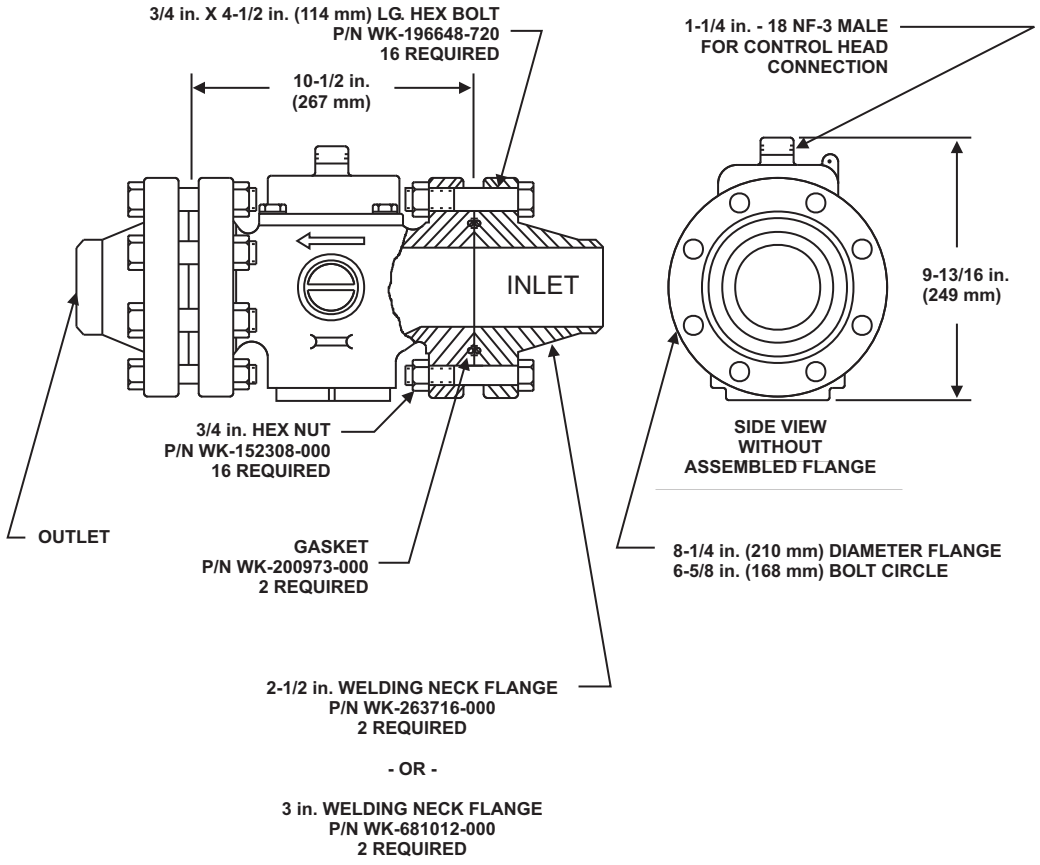


Figure 4-47. Directional (Stop) Valves (2-1/2-inch and 3-inch)

4-5.2.2 4-INCH VALVE

The 4-inch valve, Part No. 81-890208-000 (Figure 4-48), has flanged inlet and outlet ports that require the flanges, gaskets and fasteners described in Paragraph 4-5.2.3, Paragraph 4-5.2.4 and Paragraph 4-5.2.5 for connection to the distribution piping.

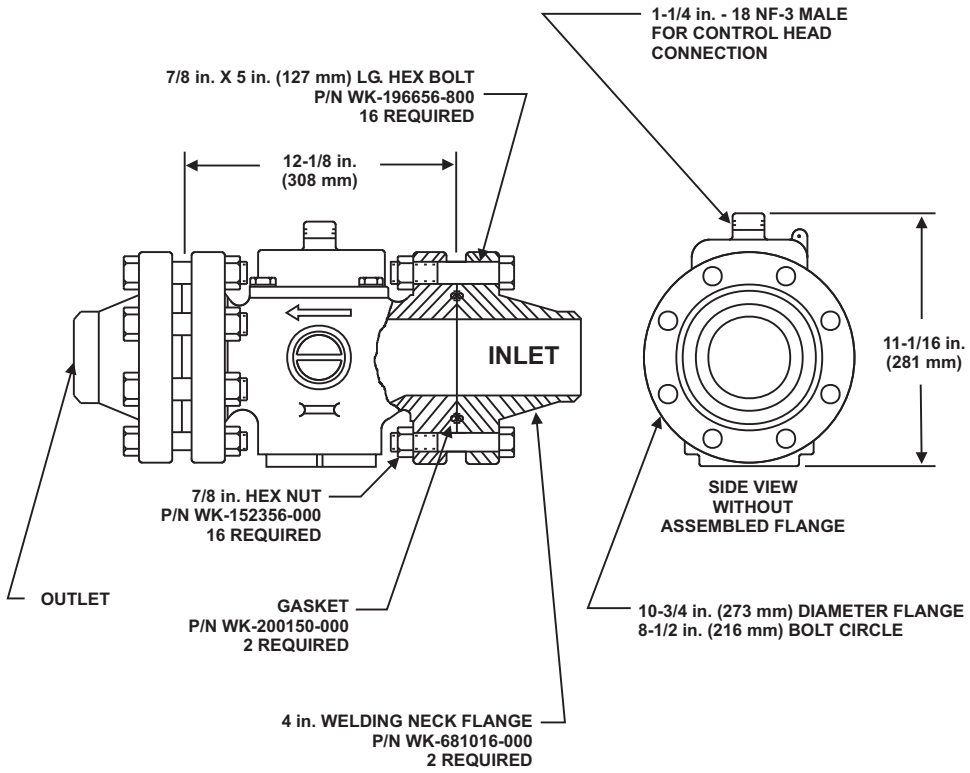


Figure 4-48. Directional (Stop) Valve (4-inch)

The 4-inch valve has flanged inlet and outlet ports that require the following flanges, gaskets and fasteners for connection to the distribution piping.

4-5.2.3 4-INCH FLANGE

The 4-inch welding neck flange, Part No. WK-681016-000 (Figure 4-48), is required to attach the 4-inch directional (or stop) valve to 4-inch distribution piping. Two flanges are required per valve.

4-5.2.4 4-INCH GASKET

The 4-inch flange gasket, Part No. WK-200150-000 (Figure 4-48), is required to seal the connection between the 4-inch directional valve and the 4-inch welding neck flange. Two gaskets are required per valve.

4-5.2.5 NUTS AND BOLTS

7/8-inch hex nuts, Part No WK-152356-000 (Figure 4-48), and 7/8-inch by 5-inch long bolts, Part No. WK-196656-800 (Figure 4-48), are required to connect the 4-inch welding neck flanges to the 4-inch directional valve. A total of 16 nuts and bolts are required per valve.

4-6 LOCKOUT VALVES

A lockout valve is a manually operated valve installed between the CO_2 manifold and the discharge pipe to the protected area. The lockout valve can be locked in the closed position to prevent carbon dioxide from discharging into the protected area. The lockout valve shall be installed at the end of the CO_2 manifold or, if a common manifold protects multiple hazards, after each selector valve.

The lockout valve consists of a stainless steel valve with threaded ends and is available with or without limit switches. A lockout valve is required with each CO2 system that is protecting a hazard with a volume greater than 6000-cu.ft.. Kidde Fire Systems recommends installing a lock out valve with each CO2 system regardless of size.

An operational sign, P/N 06-231867-379, shall be installed with all lockout valves to provide operational instructions for the lockout valve.

4-6.1 Lockout Valves without Limit Switches

The lockout valve without limit switches (Figure 4-49) is available in sizes 1/4” thru 2”. The part numbers and dimensions are provided in Table 4-17.

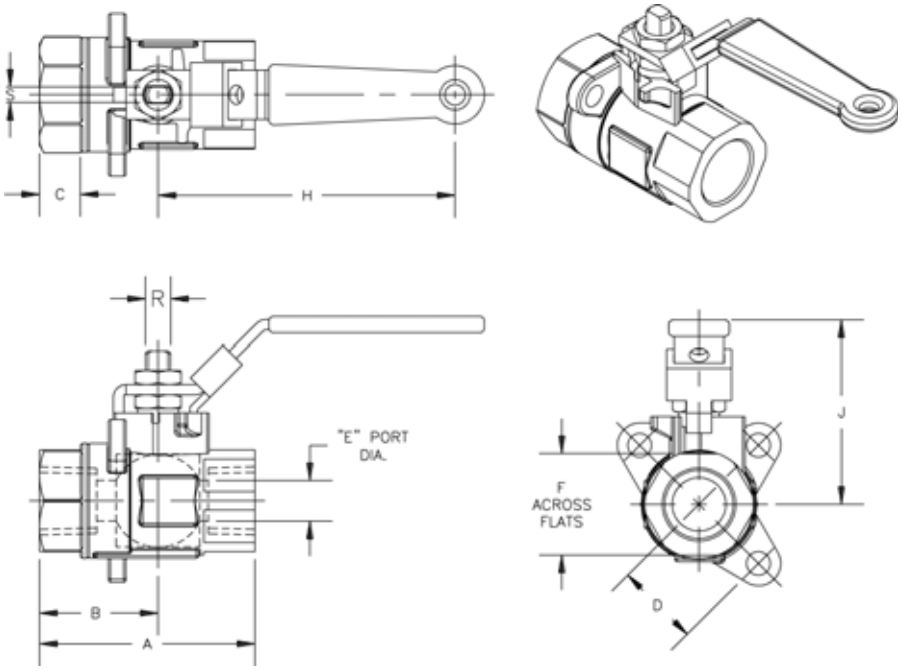


Figure 4-49. Lockout Valves without Limit Switches

Table 4-17. Stainless Steel Lockout Valves without Limit Switches Dimensions and Part Numbers

Valve Size	part number	Approximate Dimensions (inches)										Approx. WT (lb)	Valve Style
		A	B	C	D	E	F	H	J	R	S		
1/4”	10611104	2.73	1.55	0.50	1.03	0.50	1.25	4.00	2.26	0.31	0.19	1.1	Reduced Port
1/2”	10611100	2.73	1.55	0.50	1.03	0.50	1.25	4.00	2.26	0.31	0.19	1.1	Reduced Port
3/4”	10611101	3.50	1.92	0.50	1.38	0.88	1.63	5.50	3.10	0.50	0.31	2.7	Full Port
1”	10611099	3.60	1.92	0.50	1.38	0.88	1.75	5.50	3.10	0.50	0.31	2.8	Reduced Port
1 1/4”	10611102	3.93	2.10	0.56	1.63	1.00	2.00	5.50	3.23	0.50	0.31	3.7	Reduced Port
1 1/2”	10611098	4.55	2.47	0.75	1.88	1.25	2.38	7.00	3.93	0.63	0.38	5.0	Reduced Port
2”	10611103	4.94	2.66	0.75	2.12	1.50	2.88	7.00	4.12	0.63	0.38	6.8	Reduced Port

4-6.2 Lockout Valves with Limit Switches

The lockout valve with 2 SPDT limit switches and indicator(Figure 4-50) is available in sizes 1/4" thru 2". The part numbers and dimensions are provided in Table 4-18.

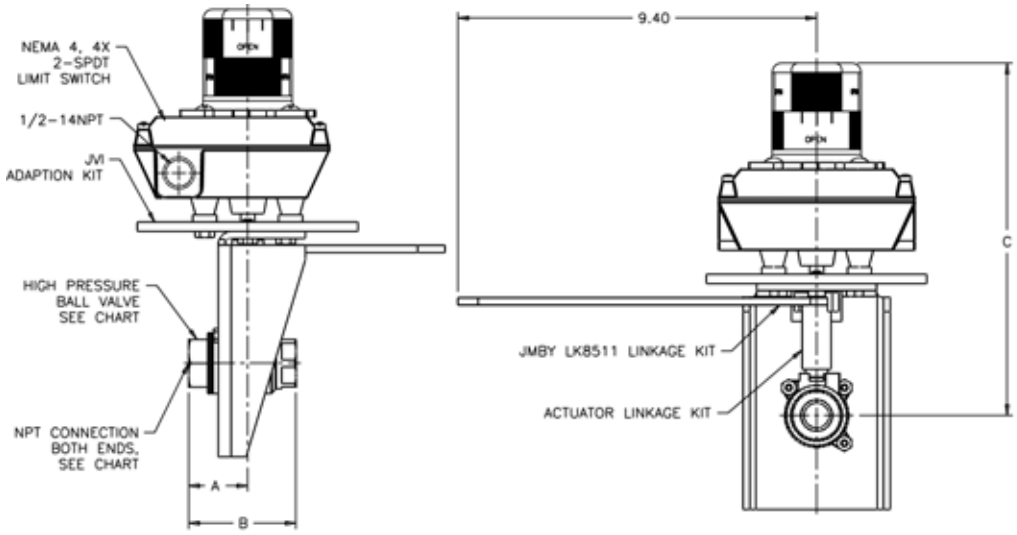


Figure 4-50. Lockout Valves with Limit Switches

Table 4-18. Stainless Steel Lockout Valves with Limit Switches Dimensions and Part Numbers

Valve Size	ASSY P/N	Ball Valve P/N	Dimensions			Approx. WT (lb)
			A	B	C	
1/4"	10611106	10611004	1.55	2.73	9.25	7
1/2"	10611107	10611100	1.55	2.73	9.25	7
3/4"	10611108	10611101	1.92	3.50	9.25	8
1"	10611109	10611099	1.92	3.60	9.25	9
1 1/4"	10611110	10611102	2.10	3.93	9.85	10
1 1/2"	10611111	10611098	2.47	4.55	10.05	12
2"	10611112	10611103	2.66	4.94	10.25	12

4-6.3 Lockout Valve with Explosion Proof Limit Switches

The lockout valve with 2 SPDT explosion proof limit switches and indicator(Figure 4-51) is available in sizes 1/4" thru 2". The part numbers and dimensions are provided in Table 4-19.

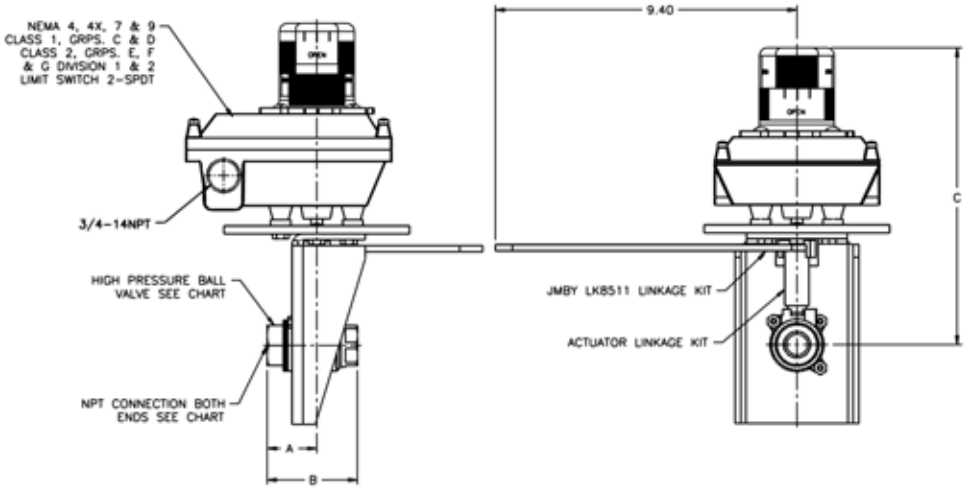


Figure 4-51. Lockout Valve with Explosion Proof Limit Switches

Table 4-19. Stainless Steel Lockout Valve with Explosion Proof Limit Switches Dimensions and Part Numbers

Valve Size	ASSY P/N	Ball Valve P/N	Dimensions			Approx. WT (lb)
			A	B	C	
1/4"	10611113	10611004	1.55	2.73	9.25	7
1/2"	10611114	10611100	1.55	2.73	9.25	7
3/4"	10611115	10611101	1.92	3.50	9.25	8
1"	10611116	10611099	1.92	3.60	9.25	9
1 1/4"	10611117	10611102	2.10	3.93	9.85	10
1 1/2"	10611118	10611098	2.47	4.55	10.05	12
2"	10611119	10611103	2.66	4.94	10.25	12

4-6.4 CO2 System Lockout Valve Operational Sign

An operational sign, P/N 06-231867-379, shall be installed with all lockout valves to provide operational instructions for the lockout valve. The sign is 9" x 5", made of Aluminium.

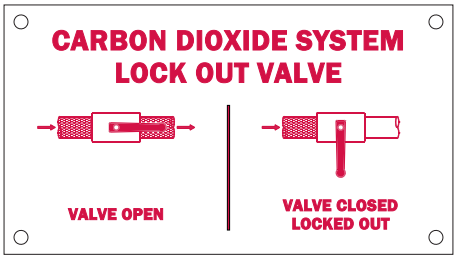


Figure 4-52. CO2 System Lockout Valve Operational Sign

4-7 DISCHARGE NOZZLES

Discharge nozzles control the distribution of carbon dioxide into the protected area or onto the protected equipment (or process). Kidde Fire Systems discharge nozzles are designed to provide the proper combination of flow rate and discharge pattern to protect vital equipment in a total-flooding manner or on a local application basis.

Kidde Fire Systems discharge nozzles are marked to identify the nozzle and show the nozzle's equivalent single orifice diameter. The equivalent diameter refers to the orifice diameter of a "standard" single orifice type nozzle having the same flow rate as the Kidde Fire Systems nozzle.

The orifice code numbers indicate the equivalent single-orifice diameter in 1/32-inch increments. A plus (+) symbol is used to indicate a 1/64-inch increment.

4-7.1 Multijet Nozzle, Type S

The type S multijet nozzles (listed in Table 4-20) have a female 1/2-inch NPT inlet connection for attaching to the CO_2 distribution piping. Strainers are provided with nozzles having orifice code numbers from 2 to 5+.

Type S nozzle sizes and styles are summarized in Table 4-20.

Table 4-20. Type S Nozzles

Orifice Code No.	S	S-Zinc	S-Flanged
2	803381	803897	802990
2+	803365	803881	802974
3	803366	803882	802975
3+	803367	803883	802976
4	803368	803884	802977
4+	803369	803885	802978
5	803370	803886	802979
5+	803371	803887	802980
6	803372	803888	802981
6+	803373	803889	802982
7	803374	803890	802983
7+	803375	803891	802984
8	803376	803892	802985
8+	803377	803893	802986
9	803378	803894	802987
9+	803379	803895	802988
10	803380	803896	802989

The basic type S nozzle (Figure 4-53) has a red painted cold-rolled steel body. A zinc plated finish is available as an option. (previous versions were offered with a cadmium plating.)

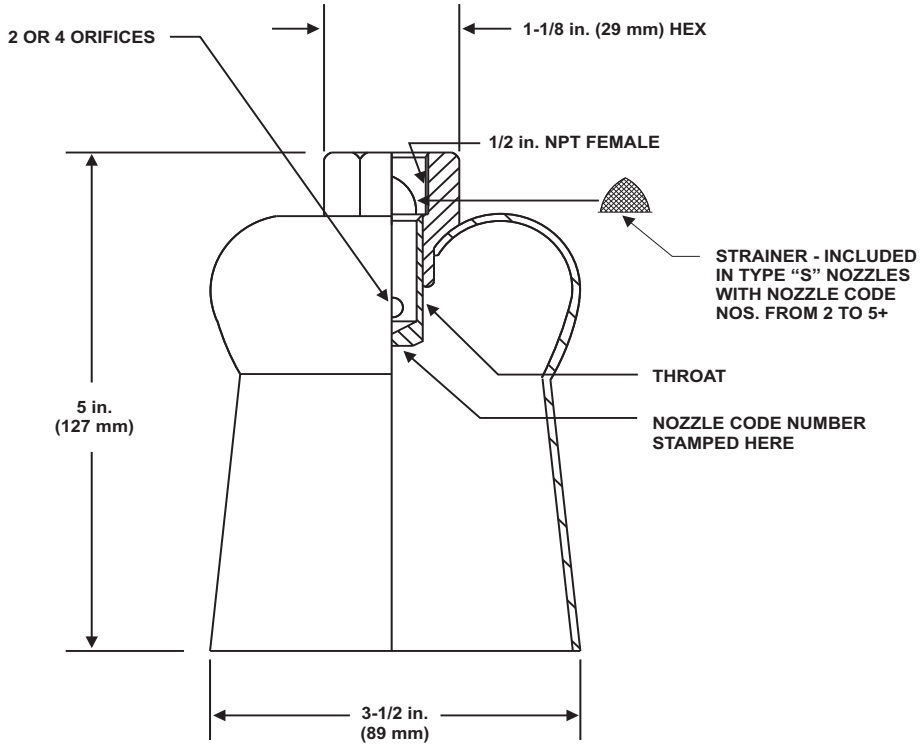


Figure 4-53. Multijet Nozzle, Type S

A flanged type S nozzle (Figure 4-54) and flanged mounting kit are also available for mounting the nozzle on the exterior of a duct or enclosure. The flanged mounting kit includes a frangible disc which ruptures upon discharge to allow flow from the nozzle. The flanged nozzle and mounting kit may be used to prevent particulate and liquid matter from clogging the orifices. The flanged nozzle body is painted red.

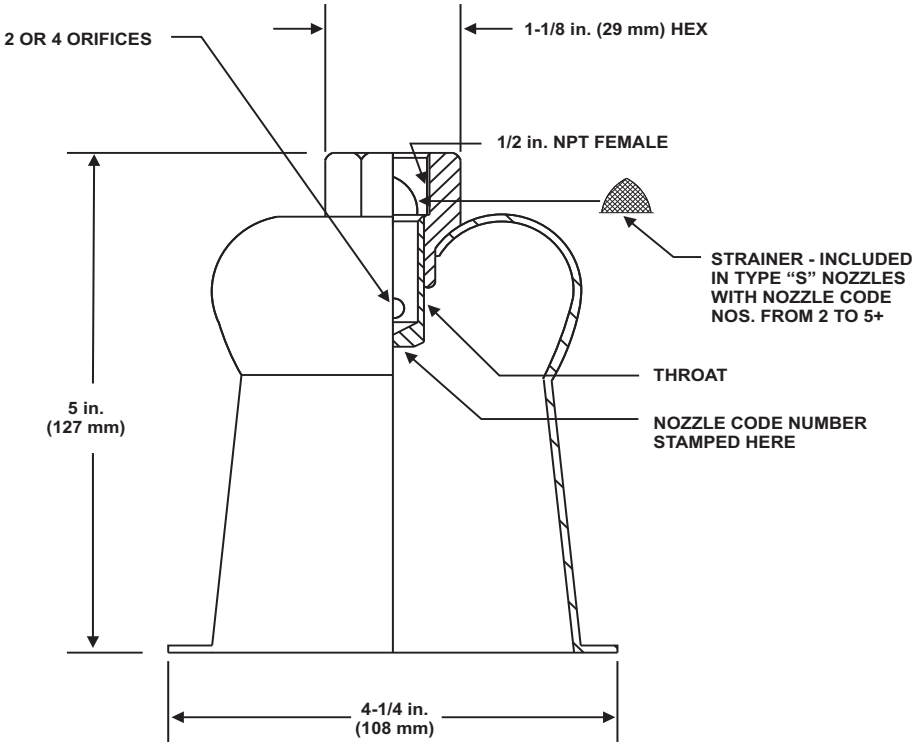


Figure 4-54. Multijet Nozzle, Type S Flanged

4-7.1.1 FLANGED NOZZLE MOUNTING KIT, TYPE S NOZZLE

The flanged mounting kit, Part No. 81-803330-000 (Figure 4-55, Figure 4-56 and Figure 4-57), contains two holding rings and a gasket (Part No. WK-201004-000) required to install a frangible disc on the S-nozzle outlet, or for installation of this nozzle to a duct or an enclosure.

Table 4-21. Flanged Nozzle Mounting Kit BOM

Description	Quantity
Disc, Aluminum, Part Number WK-310020-000	2
Gasket, Part Number WK-201004-000	1
Ring Tapped	1
Ring Holding	2
Bolt, 5/16 in. -18 x 1/2 in.	3
Flat Head Screw - 5/16 in. -18 x 7/8 in.	3
Lockwasher — 5/16 in.	6
Nut, Hex 5/16 in. -18	3

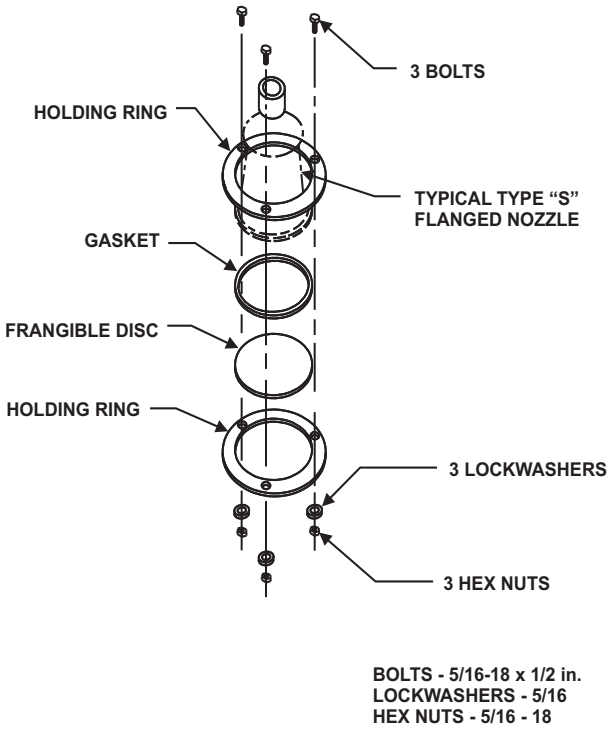


Figure 4-55. Flanged Nozzle Mounting Kit (Orifice Protection Only)

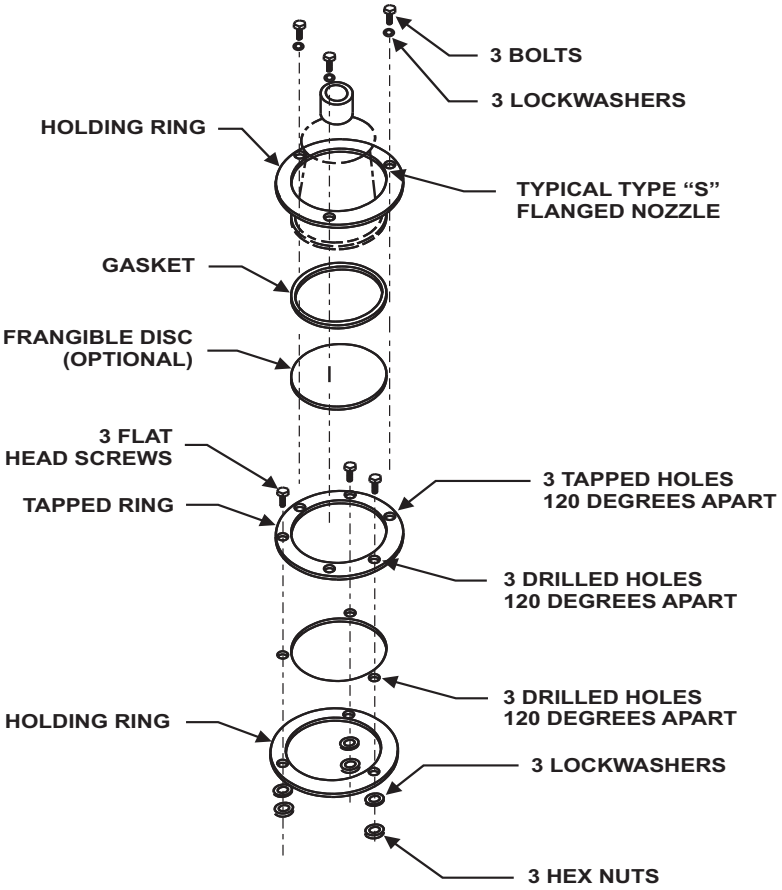


Figure 4-56. Flanged Nozzle Mounting Kit (Duct or Enclosure Mounting)

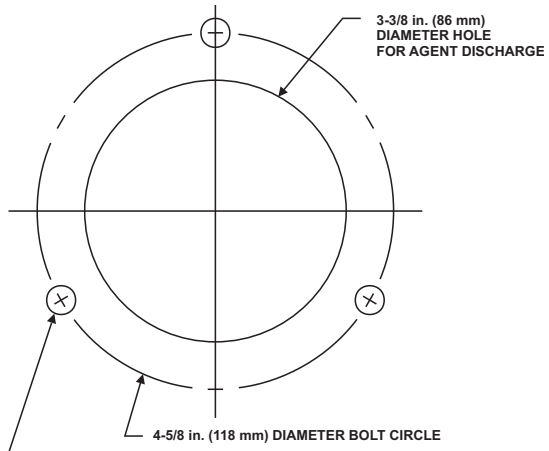


Figure 4-57. Flange Mounting Hole Pattern

4-7.1.2 ALUMINUM DISC

A frangible aluminum disc, Part No. WK-310020-000 (Figure 4-55 and Figure 4-56), is available to prevent the entry of particulate matter into a type S nozzle. This disk is included with the Flanged Nozzle Mounting Kit, Part No. 81-803330-000.

4-7.1.3 STAINLESS STEEL DISC

A frangible stainless steel disc, Part No. 81-220299-000 (Figure 4-55 and Figure 4-56), is available to prevent the entry of particulate matter into a type S nozzle.

4-7.2 Multijet Nozzle, Type M

The type M multijet nozzle (Figure 4-58) is similar in design and operation to the type S nozzle, and is used for applications requiring higher flow rates than those attainable with the type S nozzle. Strainers are provided with nozzles having orifice code numbers from 4 to 5+. The nozzle body is longer than the type S body in order to accommodate the higher flow rates. The type M nozzle has a red painted cold-rolled steel body. The Type M multijet nozzles have a 3/4 inch NPT inlet connection for attaching to the CO_2 distribution piping.

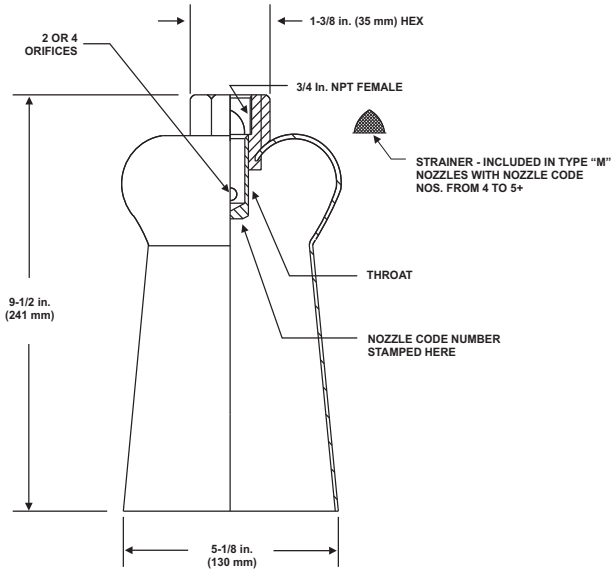


Figure 4-58. Multijet Nozzle, Type M

The type M nozzles are summarized in Table 4-22.

Table 4-22. Type M Nozzles

Size	Part Number
4	842319
4+	842320
5	842321
5+	842322
6	842323
6+	842324
7	842325
8	842326
9	842327
10	842328
11	842329
12	842330
13	842331
14	842332
15	842333

4-7.3 Vent Nozzle, Type V

The type V vent nozzle (Figure 4-59) is a single-orifice nozzle used to discharge a jet of carbon dioxide into an enclosure such as a duct. Strainers are provided with nozzles having orifice code numbers from 1 to 4+. The type V nozzles are only used for total flooding applications.

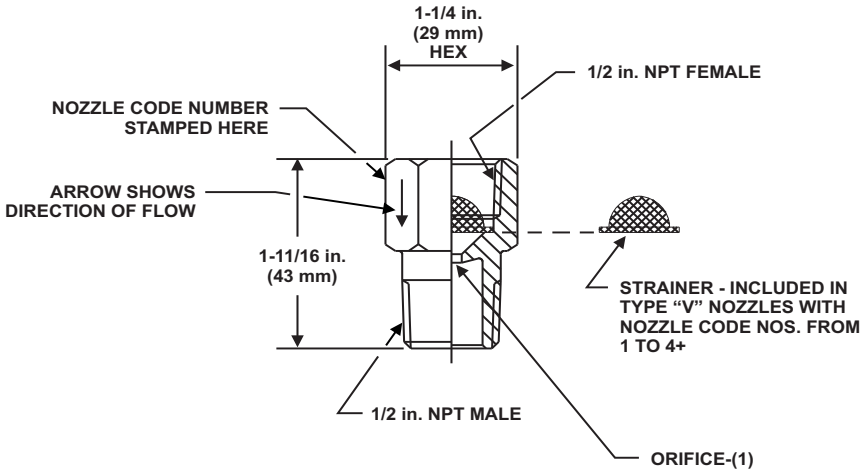


Figure 4-59. Vent Nozzle, Type V

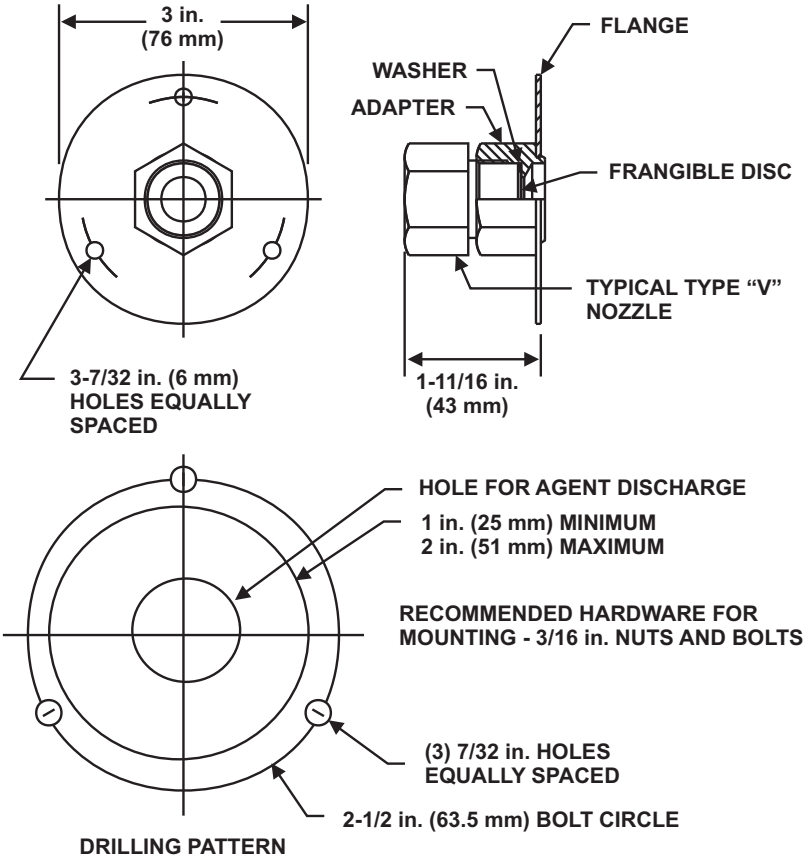
The sizes are summarized in Table 4-23.

Table 4-23. Type V Vent Nozzles

Orifice Code No.	V	V-Stainless
1	930066	81098656
1+	930067	81098657
2	919309	81098658
2+	803327	81098659
3	929242	81098660
3+	803328	81098661
4	915876	81098662
4+	803329	81098663
5	214721	81098664
5+	214722	81098665
6	214723	81098666
6+	214724	81098667
7	214725	81098668
7+	214726	81098669
8	214727	81098670
8+	214728	81098671
9	214729	81098672

4-7.3.1 FLANGE AND COVER ASSEMBLY, TYPE V NOZZLE

The flange and cover assembly, Part No. 81-844492-000 (Figure 4-60), contains a flanged adapter, a washer, and a frangible disc for the installation of a vent nozzle to a duct or an enclosure. The aluminum frangible disc is designed to prevent the entry of particulate matter into the vent nozzle's orifice. Both the frangible disc (Part No. WK-260885-000) and the washer (Part No. WK-260884-000) can be purchased separately.



NOTE: A FULL-SIZE TEMPLATE IS AVAILABLE ONLINE FROM KIDDE. REFERENCE DATASHEET K-81-1141

Figure 4-60. Flange and Cover Assembly, Type "V" Nozzle

4-8 AUXILIARY EQUIPMENT

Auxiliary equipment consists of supplementary items required for a fully-functional carbon dioxide system, such as pressure switches and trips, pressure operated time delays, sirens, and warning and instruction plates.

4-8.1 Pressure Operated Switches

Pressure operated switches (Figure 4-61 and Figure 4-62) are connected to the distribution piping and utilize the pressure of the discharging carbon dioxide for activation. The carbon dioxide actuates a pressure operated stem which toggles the electrical switch. Each switch can also be operated manually by pulling up on the stem. These switches are used to enunciate alarms, to shut down ventilation and/or other electrical equipment and to turn on electrical automatic dampers or other electrical equipment. Each pressure switch must be manually reset, by pushing down on the stem to return the switch to the set position. The minimum operating pressure required is 50 PSI.

Pressure switches are available in standard (Part No. 81-486536-000) and explosion proof (Part No. 81-981332-000) models. The standard switch is three-pole, double-throw; the explosion proof switch is three-pole, single-throw.

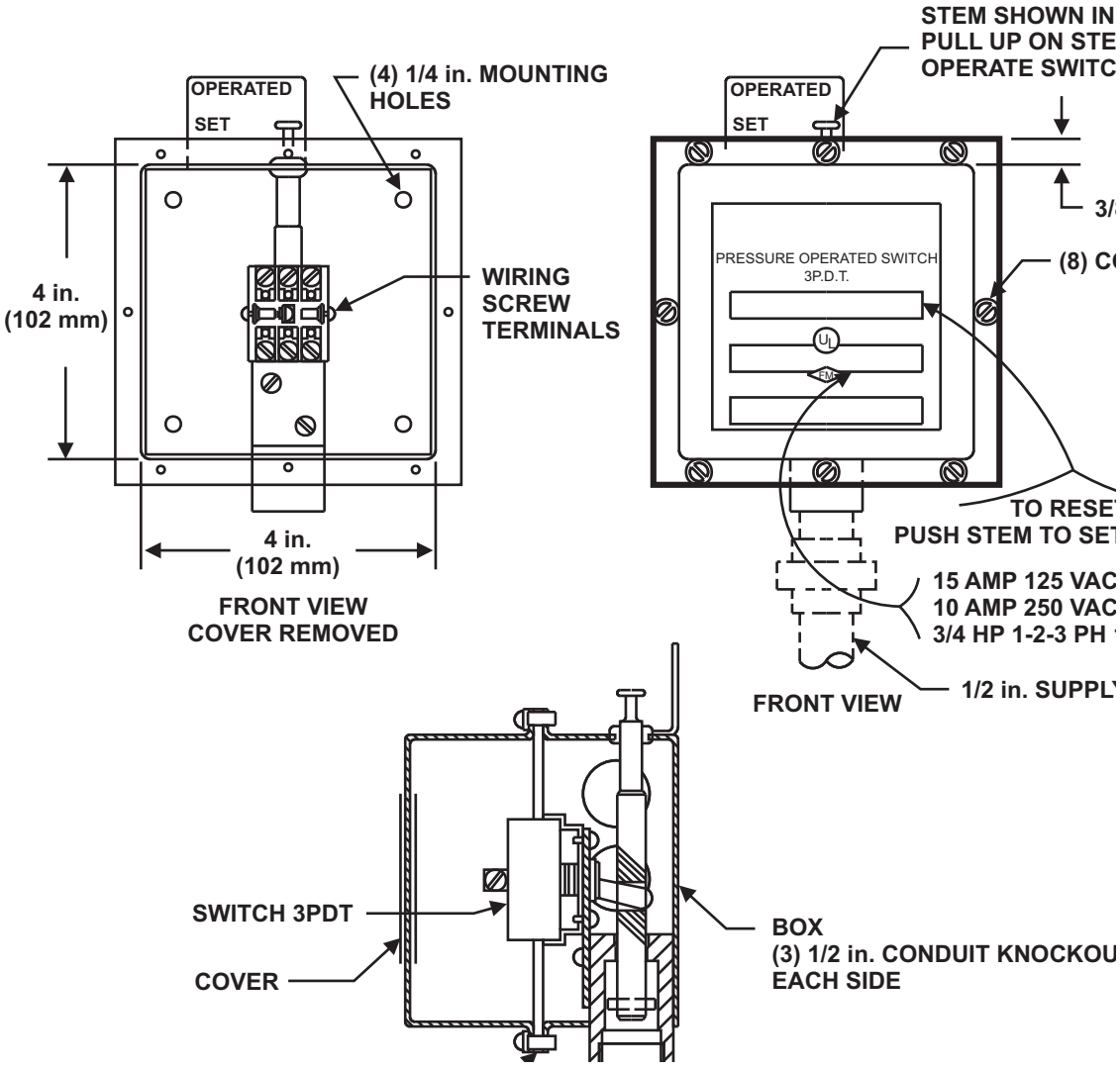


Figure 4-61. Pressure Operated Switch

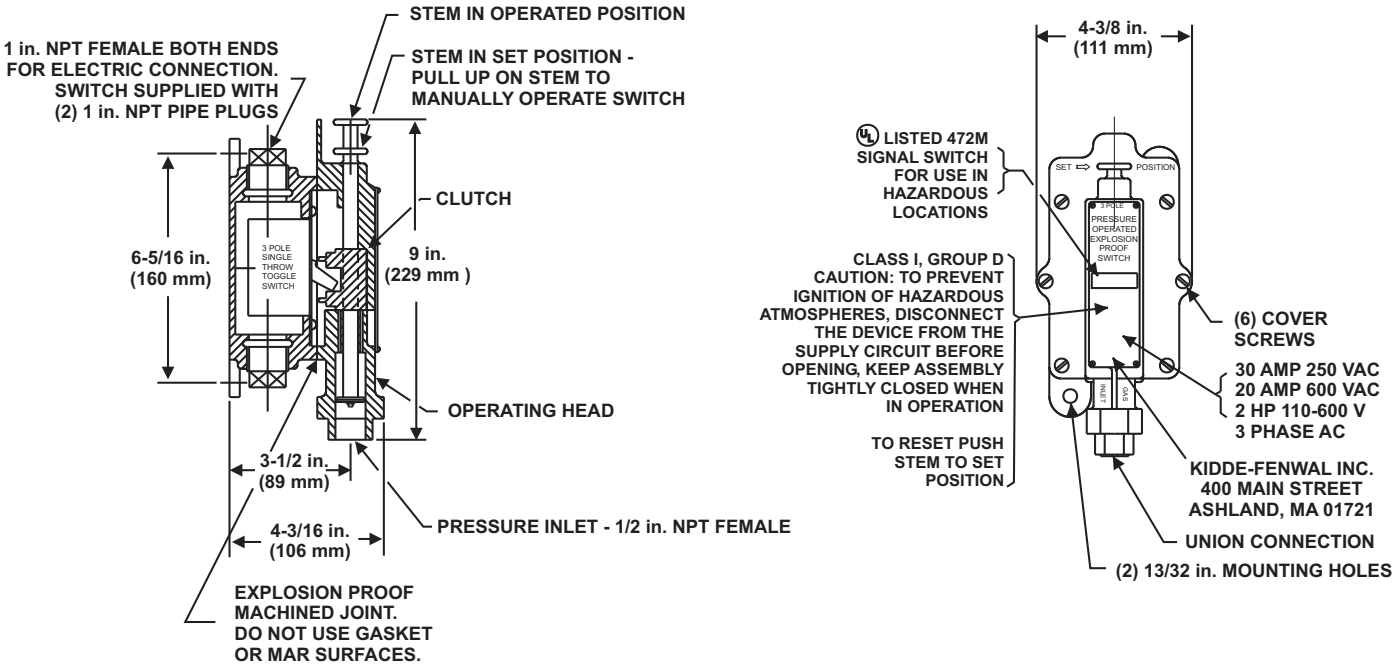


Figure 4-62. Pressure Operated Switch, Explosion Proof

4-8.2 Pressure Operated Trip

The pressure operated trip, Part No. 81-874290-000 (Figure 4-63), is connected to the distribution piping and utilizes carbon dioxide pressure for actuation. The carbon dioxide pressure displaces a spring-loaded piston to disengage a holding ring from the stem connected to the piston. (Typical applications of the pressure operated trip are addressed in Paragraph 3-15.2.)

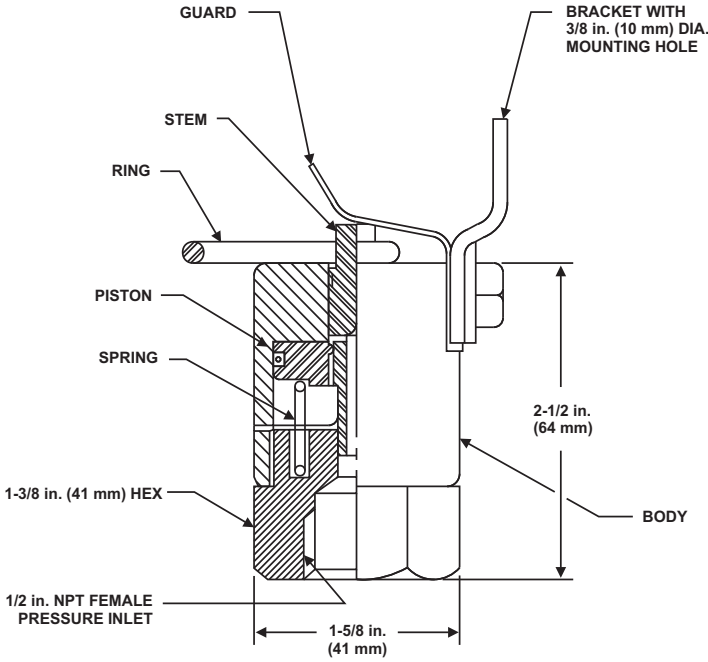


Figure 4-63. Pressure Operated Trip

4-8.3 Pneumatic Discharge Delay

This pneumatic discharge delay (Figure 4-64 through Figure 4-66) uses CO_2 system pressure or N_2 actuation pressure to provide a pneumatic (automatic mechanical) means to delay the CO_2 discharge for a pre-determined period. The pneumatic discharge delay consists of a metering tube, a cylinder, and a differential pressure operated valve with a control port for attaching a compatible control head. This assembly is installed downstream of pressure operated equipment, but upstream of the nozzle, to allow alarms to sound, and equipment and ventilation to shut down prior to the carbon-dioxide discharge.

Discharge delay assemblies are available with non-adjustable, factory pre-set delay periods. Attachment of a compatible control head allows the delay period to be bypassed. Without a control head the delay period cannot be bypassed.

CO_2 discharge delay units require liquid CO_2 to function properly. When designing large CO_2 systems, Kidde cautions the designer to be aware of the logistics required to perform the functional test of the system at commissioning and subsequent inspection intervals. In such cases, the CO_2 amount required to charge the entire manifold and still ensure liquid CO_2 is delivered to the delay unit may become difficult to provide. It may be advantageous to use a single $HPCO_2$ cylinder (suggest 35-lbm) dedicated to solely discharge into the delay unit.

Table 4-24. Pneumatic Discharge Delay Part Numbers

Part Number	Description
81-871071-000	CO2 Discharge Delay, 30 Second
81-897636-000	CO2 Discharge Delay, 60 Second
81-871072-001	N2 Discharge Delay, 30 Second (For Use w/108-cuin N2 Cylinder Only)
81-871072-002	N2 Discharge Delay, 60 Second (For Use w/108-cuin N2 Cylinder Only)

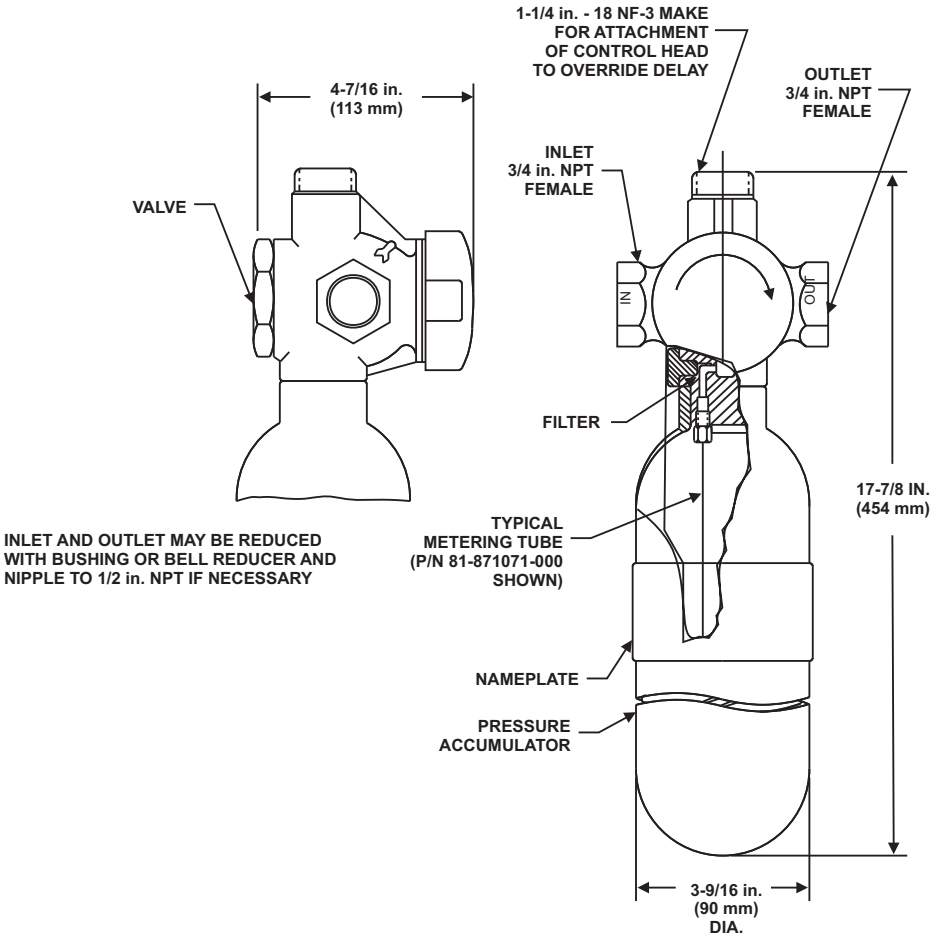


Figure 4-64. Pneumatic Discharge Delay

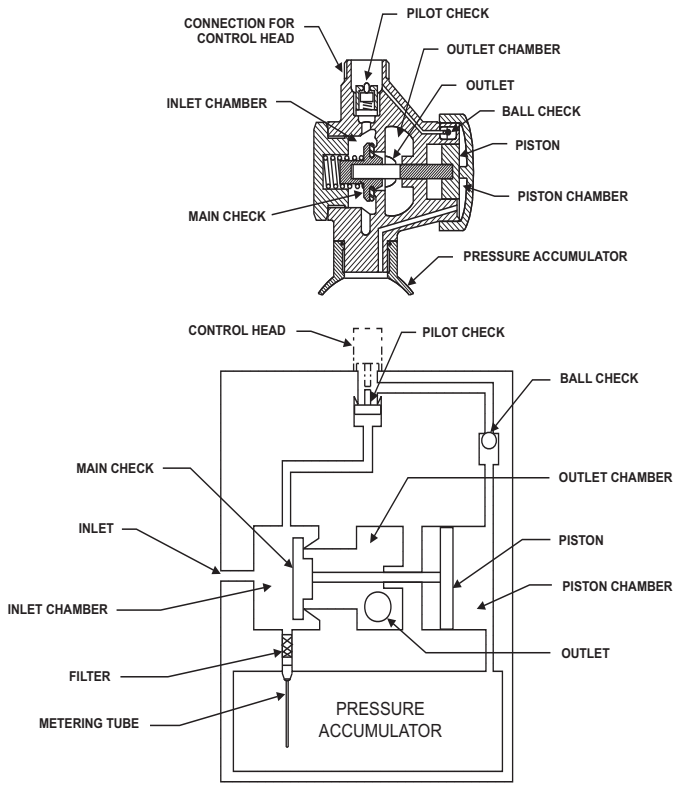


Figure 4-65. Pneumatic Discharge Delay, Detail

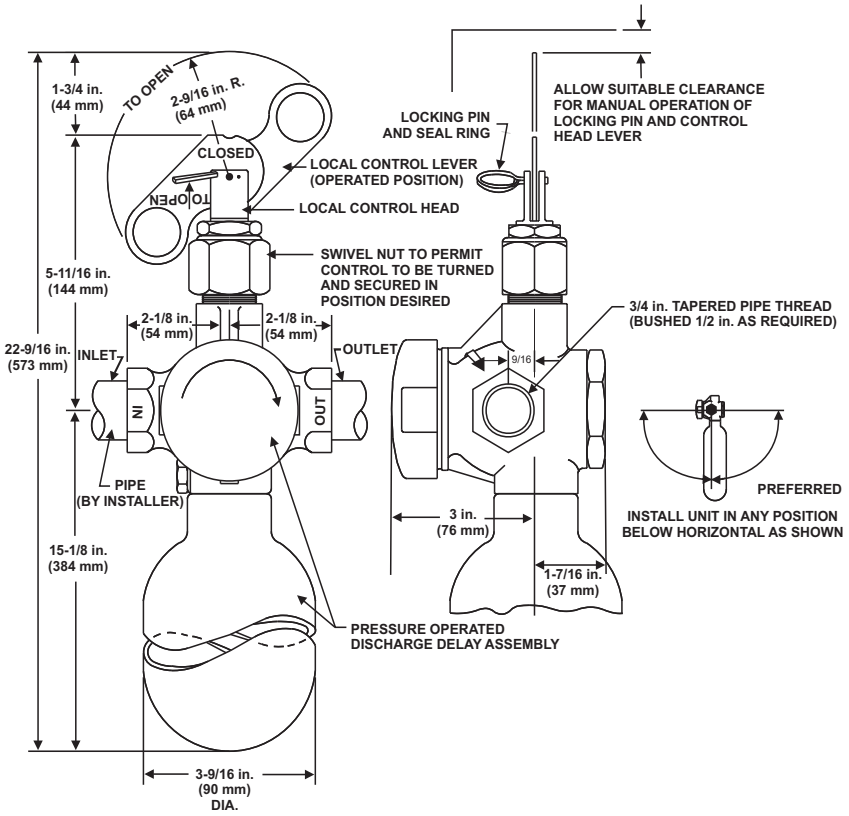


Figure 4-66. Pneumatic Discharge Delay with Manual Control Head

4-8.3.1 DISCHARGE DELAY AND PRE-DISCHARGE ALARM

Per USCG, a space protected by Kidde Engineered System having a volume in excess of 6000 $ft.^3$ (170 m^3) must be equipped with a time delay and a predischarge alarm. This will allow personnel time to evacuate the protected space and ensure that ventilation and machinery have been shutdown prior to agent release.

If a space of less than 6000 $ft.^3$ (170 m^3) does not have a readily accessible horizontal means of escape, then the system must include a discharge delay.

In order to comply with IMO MSC. 1/Circ 1267, the time delay and pre-discharge alarm should operate for the period of time necessary to completely evacuate the space, but not less than 20 seconds, before the extinguishing agent is released. An audible and visual warning must be provided automatically upon system discharge into any occupied space or space in which personnel have access.

Table 4-25. USCG Requirements

Protected Hazard	Discharge Delay Required	Siren Required	Minimum Required Siren Duration	Siren Power Source
>6000-cuft	Yes	Yes	20-sec	Gas - CO2/N2
<6000-cuft & horizontal egress	No*	No*		
<6000-cuft & vertical egress	Yes	Yes		

*Not required by USCG but KFS suggests including.

Table 4-26. SOLAS Requirements

Protected Hazard	Discharge Delay Required	Siren Required	Minimum Required Siren Duration	Siren Power Source[1]
All	Yes	Yes	20-sec	Gas - CO2/N2/Air* or Electric*

1. Reference vessel class approval for specific requirements

*Air/Electric Operated Sirens by Others

4-8.4 Pressure Operated Siren

The pressure operated sirens provide a mechanical means to generate an audible alarm. The flow of carbon dioxide (P/N 81-981574-000) or nitrogen (P/N 90-981574-001) into the siren spins a rotor and creates a high pitch and high decibel sound. The audible alarm warns personnel of an impending CO2 discharge and the need to immediately evacuate the protected area prior to the discharge. In order to provide a pre-discharge warning, the siren supply line shall be installed upstream of the discharge delay.

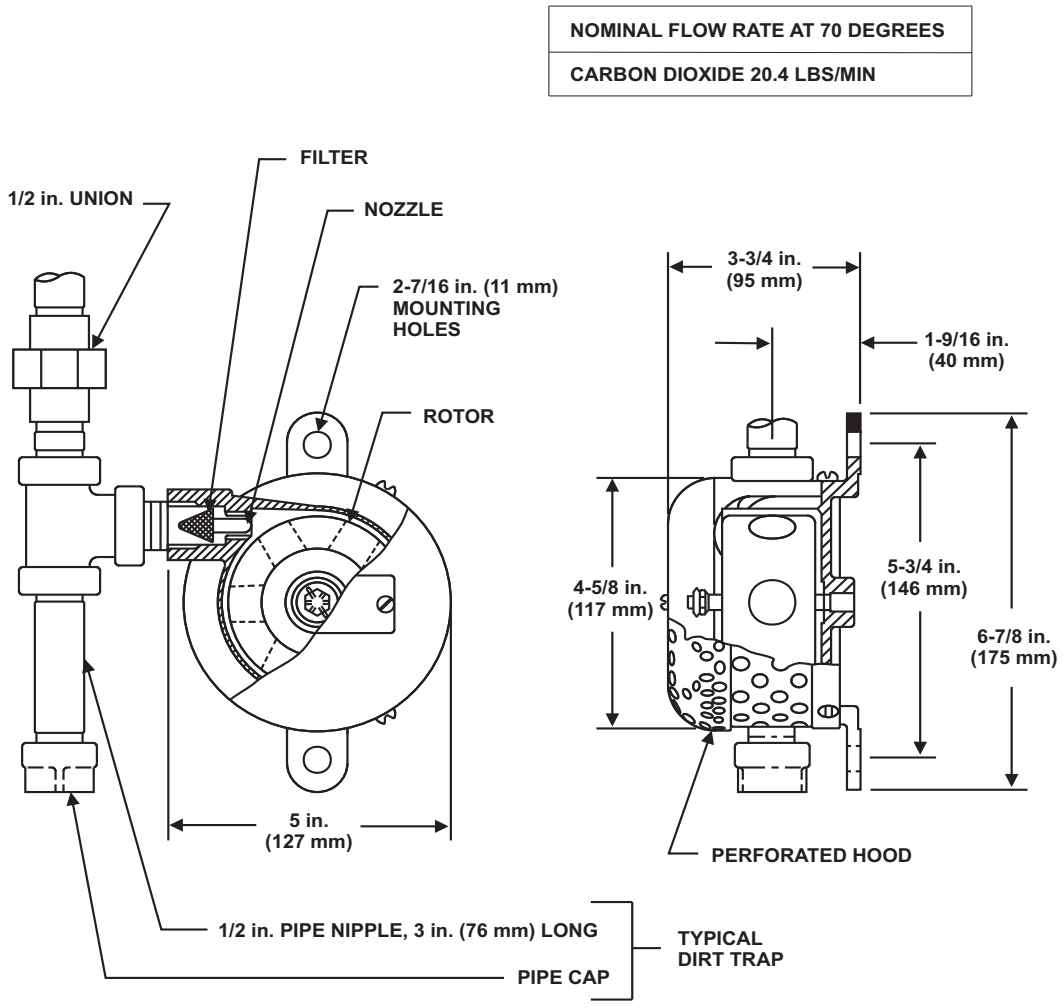


Figure 4-67. Pressure Operated Siren

Note: Only the N2 operated siren can be used for DNV type approved vessels.

4-8.5 Safety Outlet

The safety outlet, Part No. 81-803242-000 (Figure 4-68), consists of a safety disc housed in a threaded body. The safety disc is designed to relieve at a pressure of 2400 to 2800 PSIG (166 to 194 Bar).

The safety outlet is utilized in systems with directional (stop) valves and lockout valves where the design of the system creates a closed section of piping. The safety outlet is installed in the piping upstream of the stop valve (s) to prevent over pressurization in the event of entrapment of CO_2 in the closed pipe segment.

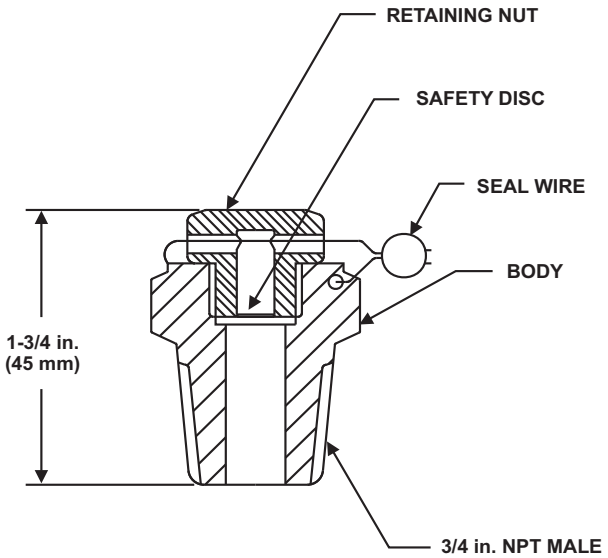


Figure 4-68. Safety Outlet

4-8.6 Discharge Indicator

The discharge indicator, Part No. 81-967082-000 (Figure 4-69), must be installed in the discharge piping to visually indicate a system discharge. In the set position, the discharge indicator acts as a vent allowing CO_2 pressure that may have accumulated in the manifold (due to a leaking cylinder valve) to vent to atmosphere. The discharge indicator is required for all systems.

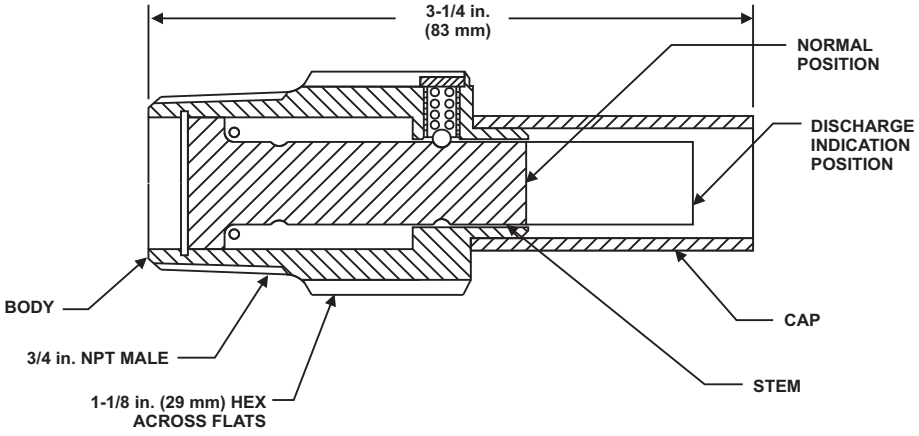


Figure 4-69. Discharge Indicator

4-8.7 Odorizer Assembly

The odorizer assembly injects a scent of wintergreen into the carbon dioxide during a discharge. Upon discharge, the carbon dioxide pressure ruptures a burst disc to release the scent of wintergreen. This scent warns personnel in the vicinity of the area protected by the fire suppression system that carbon dioxide gas is present. An odorizer assembly is required with each CO_2 system regardless of size.

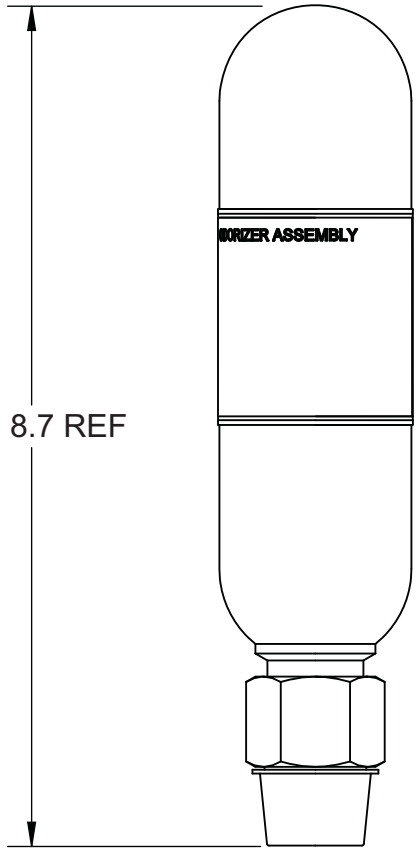


Figure 4-70. Odorizer Assembly

4-8.8 Weigh Scale

A weigh scale, Part No. 81-982505-000 (Figure 4-71) is available for weighing the CO_2 cylinders in place without disconnecting them from the cylinder manifold. The weigh scale is used in conjunction with the weigh bars that form part of the framing.

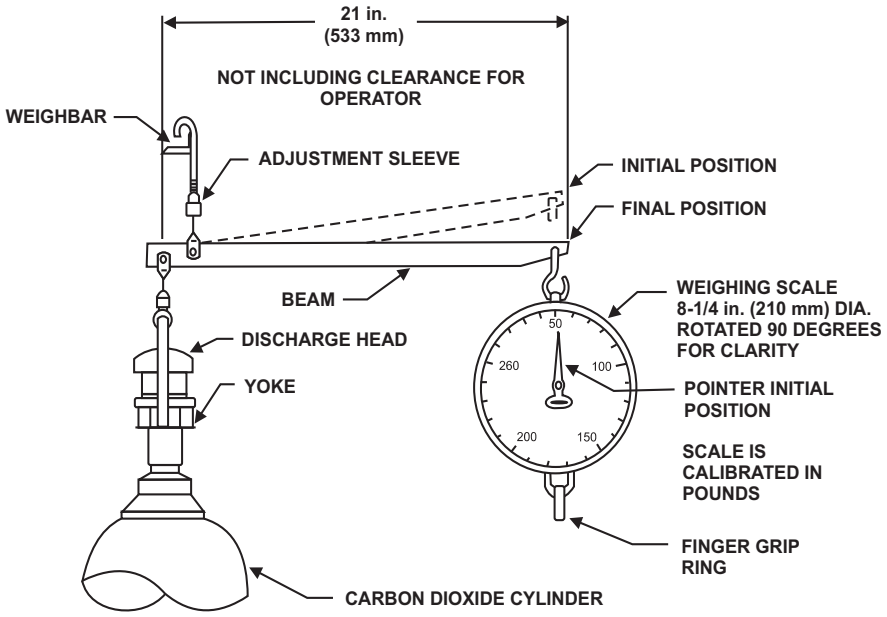


Figure 4-71. Weigh Scale

4-8.9 Recharge Adapter

The recharge adapter, Part No. WK-933537-000 (Figure 4-72), is used to fill the CO_2 cylinder assemblies. The adapter is attached to the cylinder valve pilot port connection during cylinder charging.

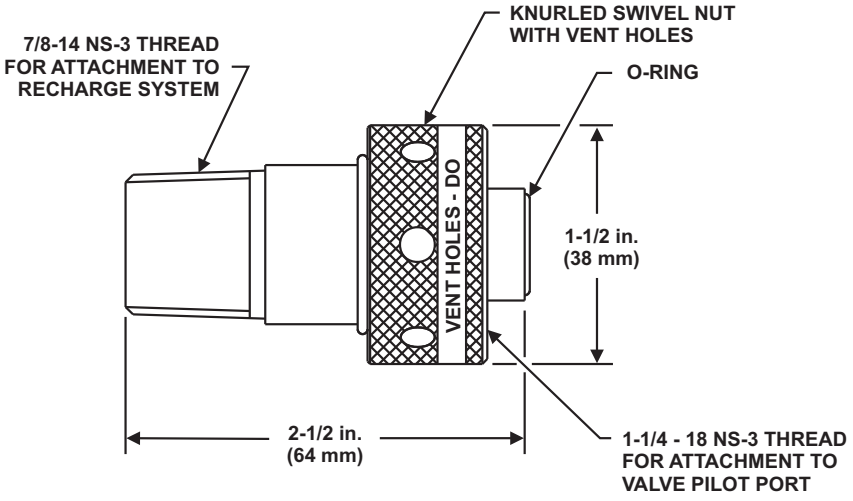


Figure 4-72. Charging Adapter

4-8.10 Blow-Off Fixture

The blow-off fixture, Part No. 81-930117-000 (Figure 4-73), is used to relieve the CO_2 cylinder assemblies of pressure. The blow-off fixture threads onto the cylinder valve pilot port and opens the pilot check for controlled discharge.

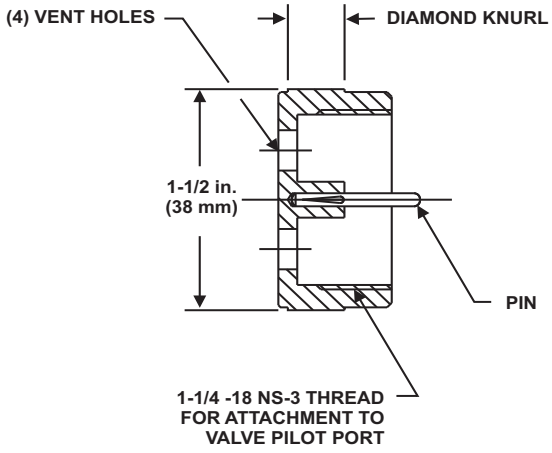


Figure 4-73. Blow-Off Fixture

4-9 INSTRUCTION AND WARNING PLATES

Instruction and warning plates are available for installation throughout the protected area and at the cylinder storage area to provide operating instructions and appropriate precautions in the event of an emergency.

4-9.1 Main and Reserve Nameplates

The main and reserve nameplates, Part Nos. WK-310330-000 and WK-310340-000 respectively (Figure 4-74), are used to identify the primary and backup carbon dioxide suppression.

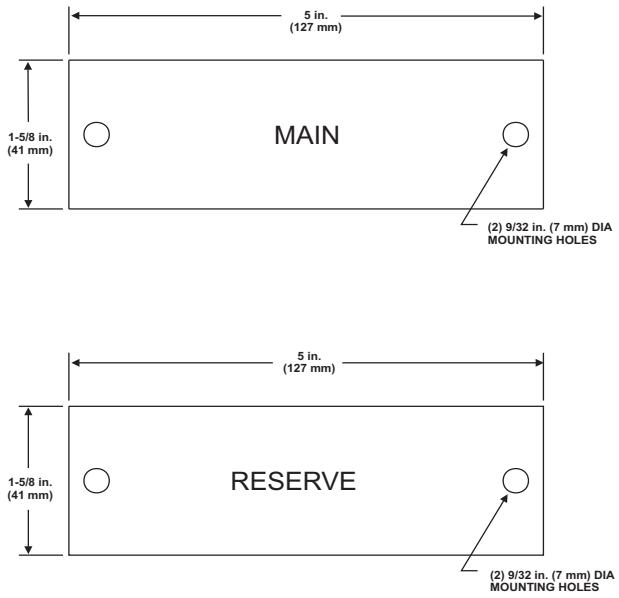


Figure 4-74. Main and Reserve Nameplates

4-9.2 Warning Signs

There are six different safety warning signs with wording specific to each application.

4-9.2.1 VACATE WARNING SIGN, P/N 06-231866-851

The sign shown in Figure 4-75 shall be used in every protected space.[◆]

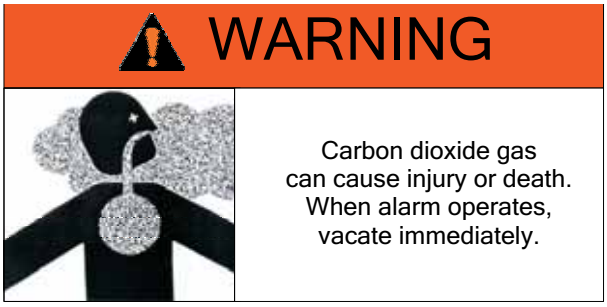


Figure 4-75. Sign in Every Protected Space[◆]

4-9.2.2 DO NOT ENTER WARNING SIGN, P/N 06-231866-852

The sign shown in Figure 4-76 shall be used at every entrance to protected space.[◆]

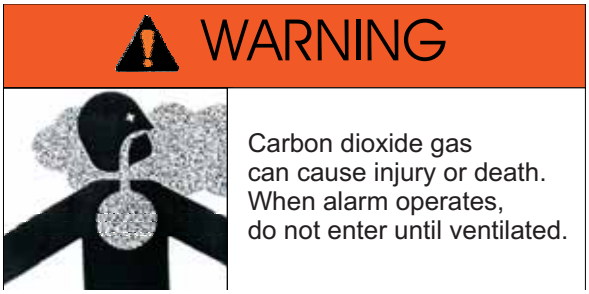


Figure 4-76. Sign at Every Entrance to Protected Space[◆]

4-9.2.3 ODORIZER WARNING SIGN, P/N 06-231866-853

The sign shown in Figure 4-77 shall be used at every entrance to protected space for systems provided with a wintergreen odorizer assembly.[◆]

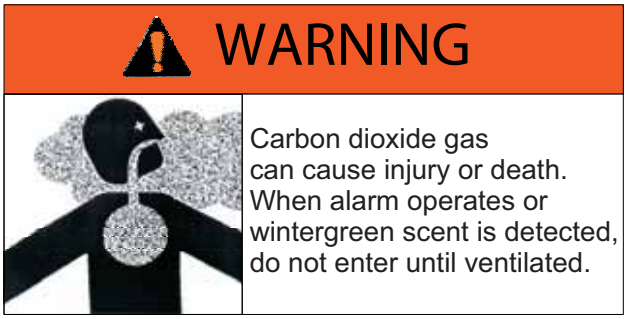


Figure 4-77. Sign at Every Entrance to Protected Space for Systems with an Odorizer Assembly[◆]

4-9.2.4 MIGRATION WARNING SIGN, P/N 06-231866-854

The sign shown in Figure 4-78 shall be used at every nearby space where carbon dioxide can accumulate to hazardous levels.[♦]

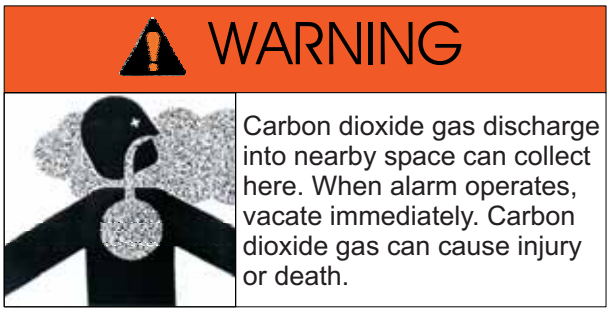


Figure 4-78. Sign in Every Nearby Space Where CO_2 Can Accumulate to Hazardous Levels[♦]

4-9.2.5 STORAGE WARNING SIGN, P/N 06-231866-855

The sign shown in Figure 4-79 shall be used outside each entrance to carbon dioxide storage rooms.[♦]

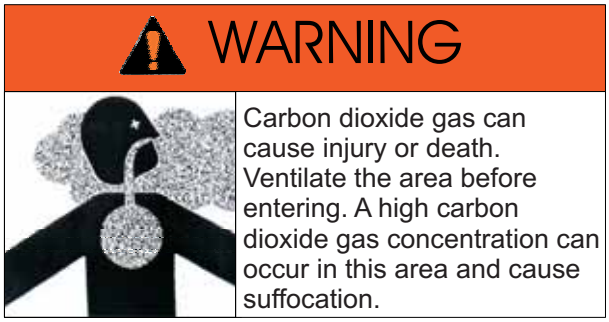


Figure 4-79. Sign Outside Each Entrance to CO_2 Storage Rooms[♦]

4-9.2.6 ACTUATION WARNING SIGN, P/N 06-231866-856

The sign shown in Figure 4-80 shall be used at each manual actuation station.[♦]

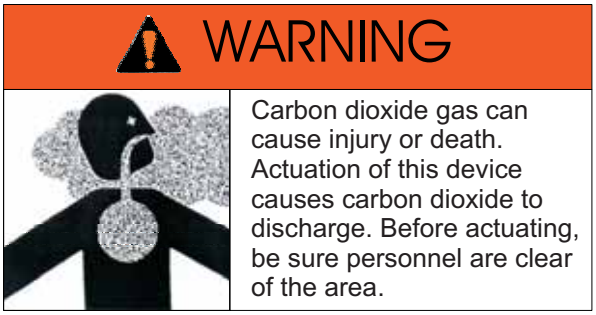


Figure 4-80. Sign at Each Manual Actuation Station[♦]

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4-10 HOSE REEL AND RACK SYSTEMS

The carbon dioxide hose reel and hose rack systems, Part Nos. as listed in Table 4-27 (Figure 4-81 through Figure 4-85), can be used to manually protect small hazard areas, as a stand-alone system or as a backup to an automatic fixed pipe system. The system consists of a carbon dioxide supply, hose reel or rack, and the required size and length of hose connected to a horn and valve assembly. The hose reel is furnished in a painted red finish.

Table 4-27. Hose Reel and Rack System Part Numbers

Part Number	Description
WK-994058-000	Reel, Red
WK-909000-000	Hose Reel Coupling Nut (required for 994058)
81-919842-000	Rack
81-907757-000	Hose, 1/2 in. x 25 ft. (7.5 m)
81-961966-000	Hose, 1/2 in. x 50 ft. (15 m)
81-918990-000	Hose, 3/4 in. x 25 ft. (7.5 m)
81-918435-000	Hose, 3/4 in. x 50 ft. (15 m)
WK-834900-000	Hose-to-Hose Thread Protector (Ferrule)
81-980564-000	Horn/Valve Assembly
81-960099-000	Clip, Handle
81-939000-000	Clip, Horn
WK-282386-000	Instruction Plate, Model HR-1

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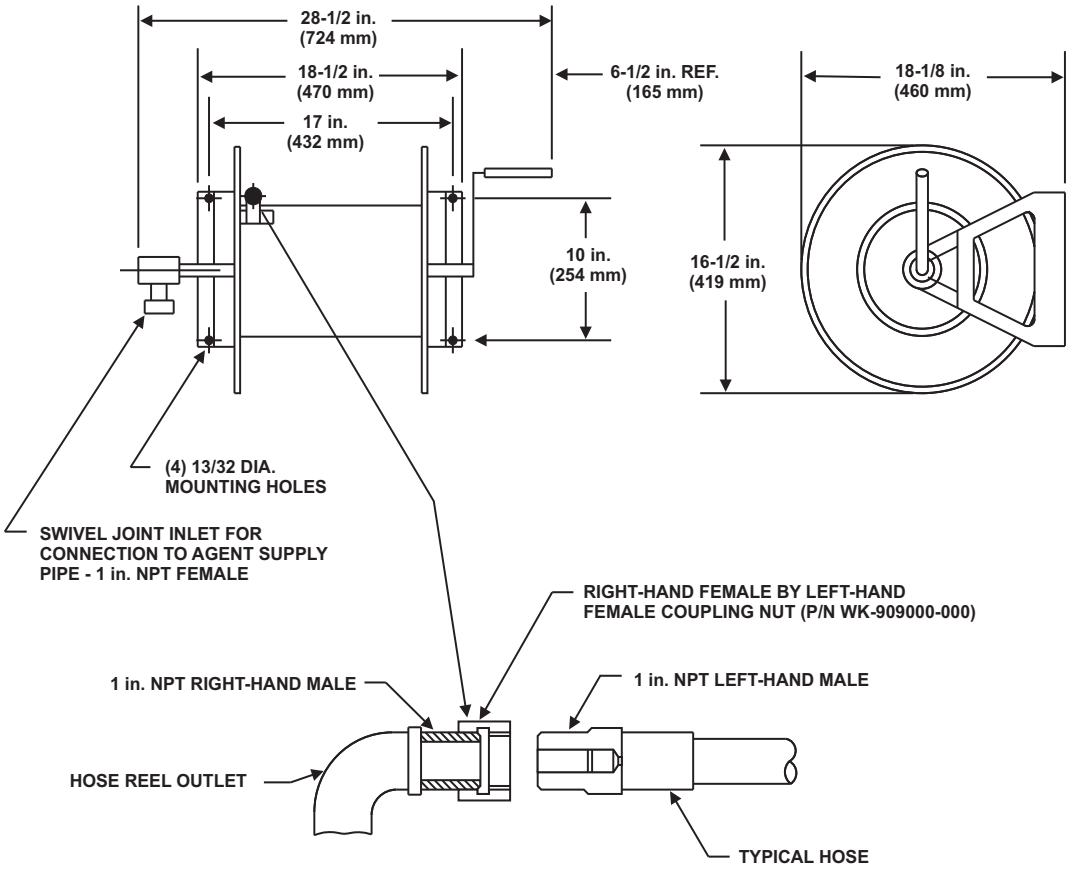


Figure 4-81. Hose-to-Hose Reel Connection

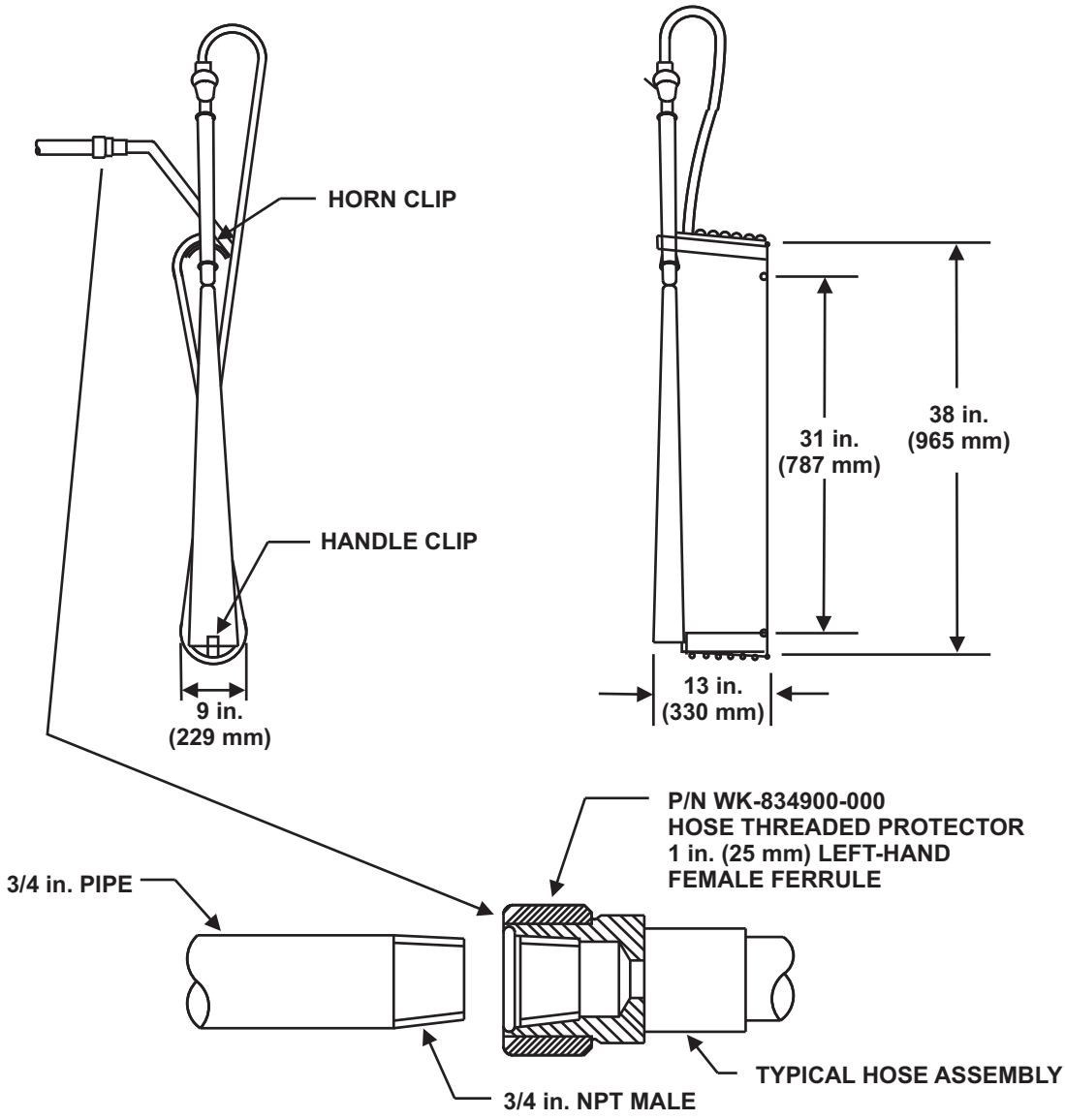


Figure 4-82. Hose-to-Pipe Rack Connection

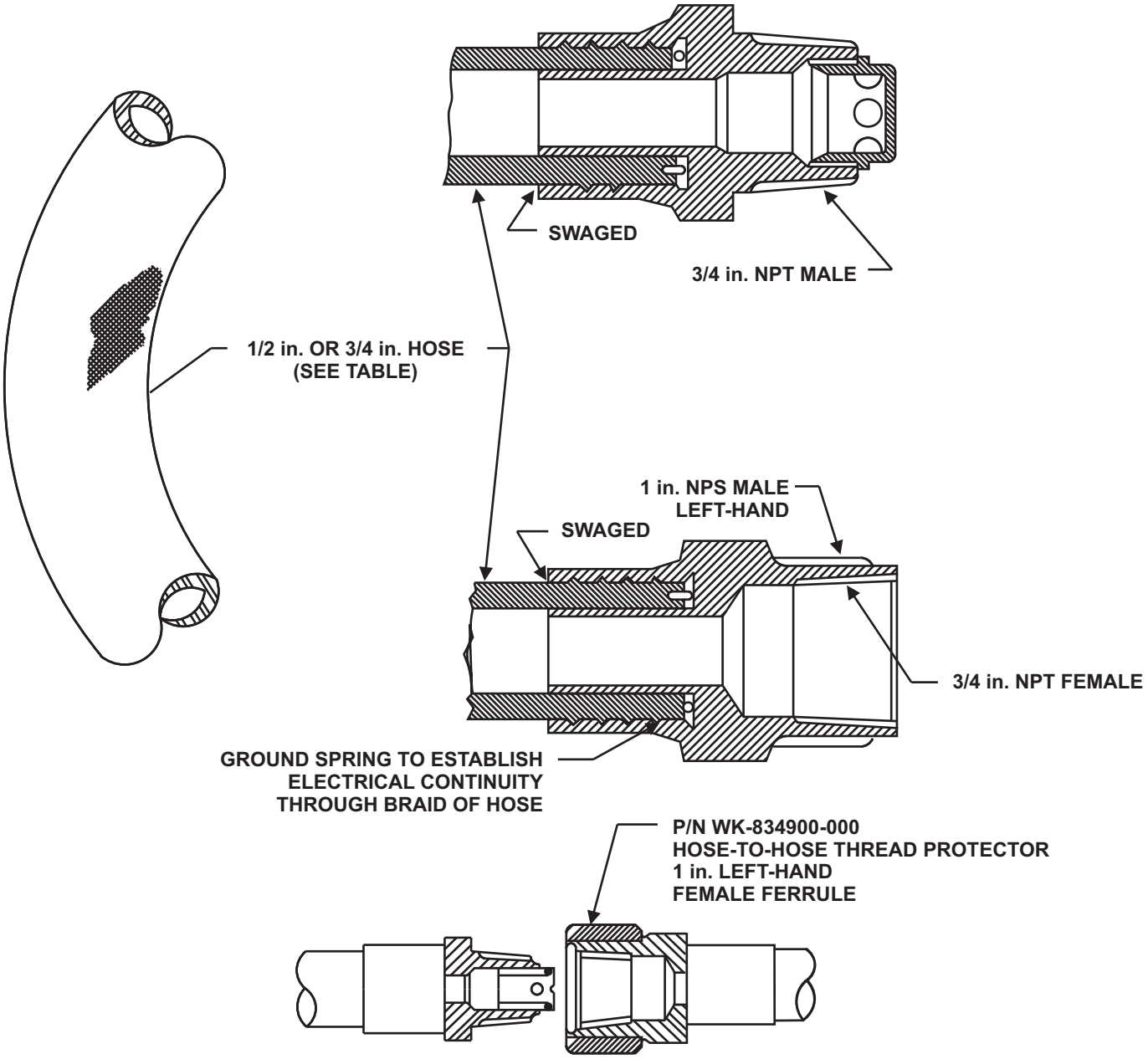


Figure 4-83. Hose Assembly

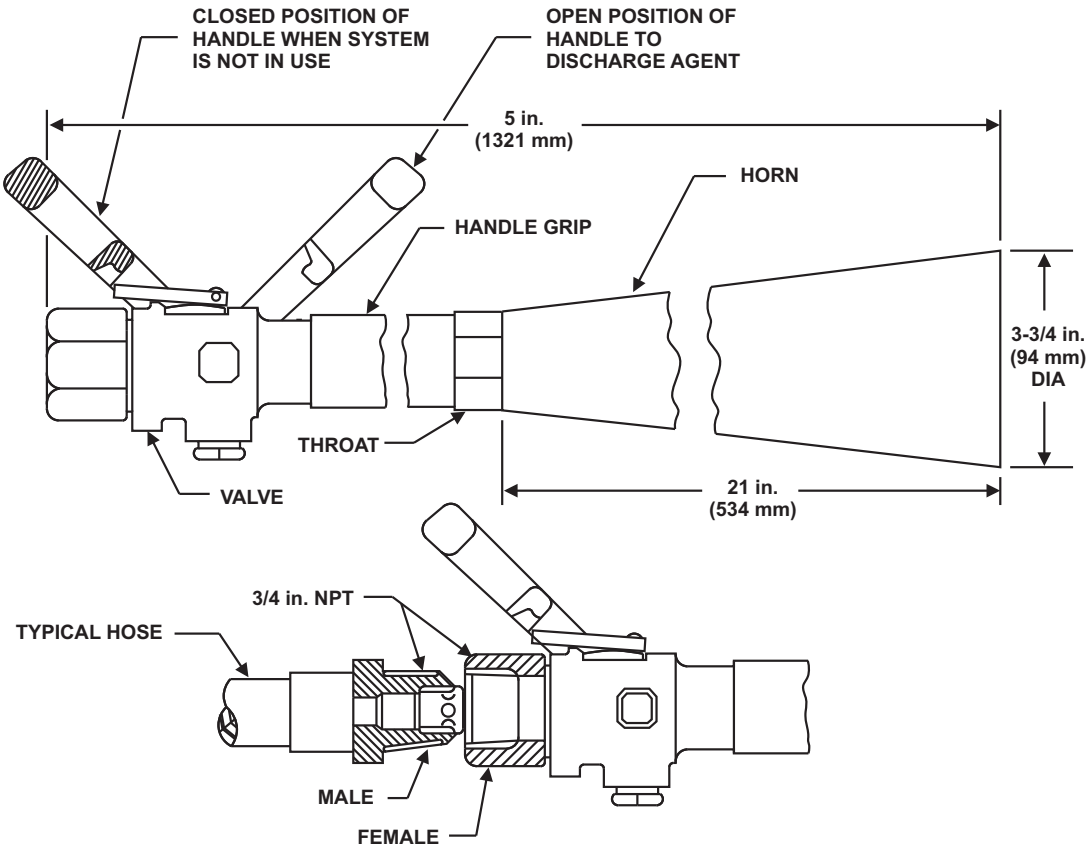


Figure 4-84. Horn and Valve Assembly

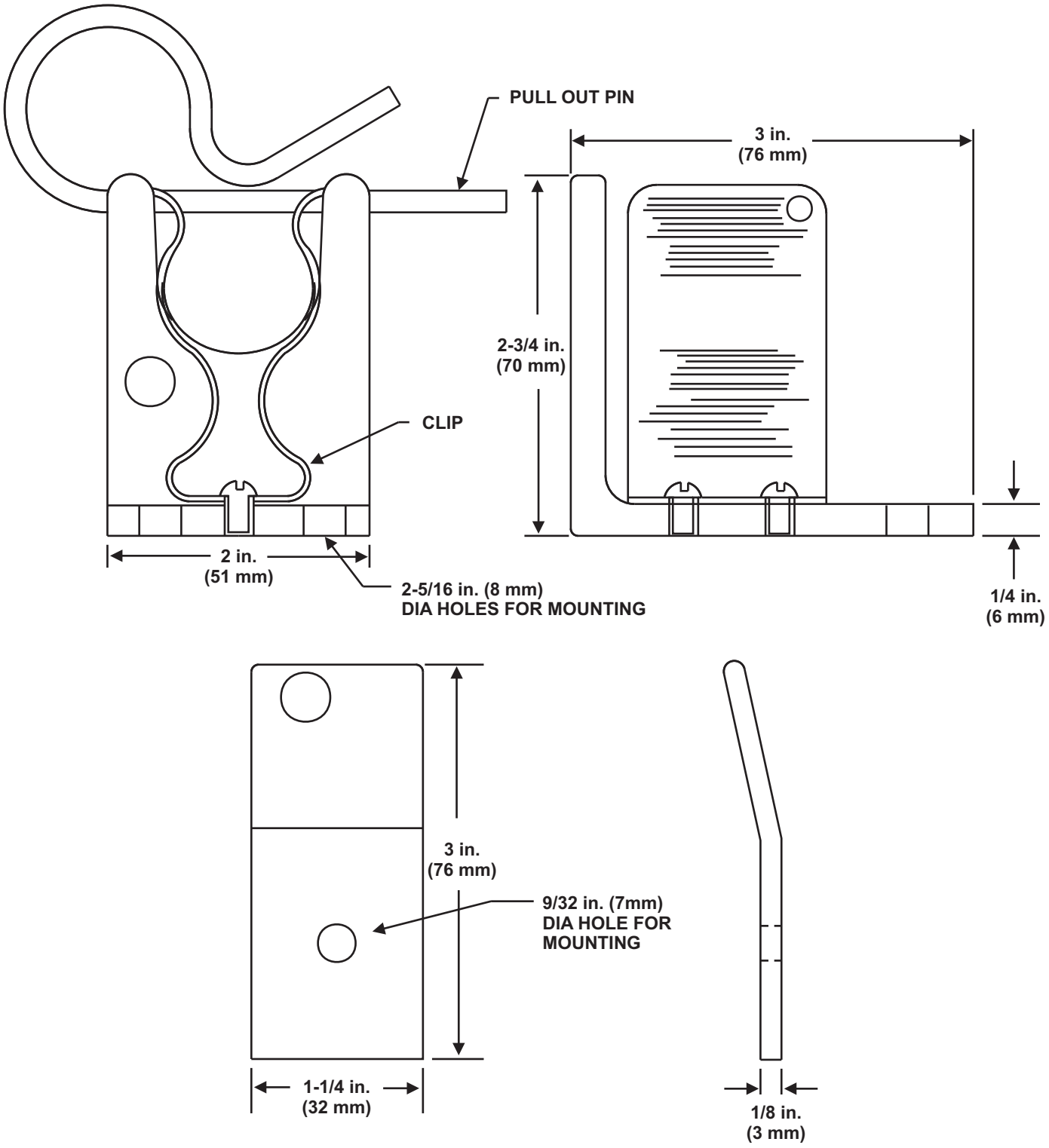
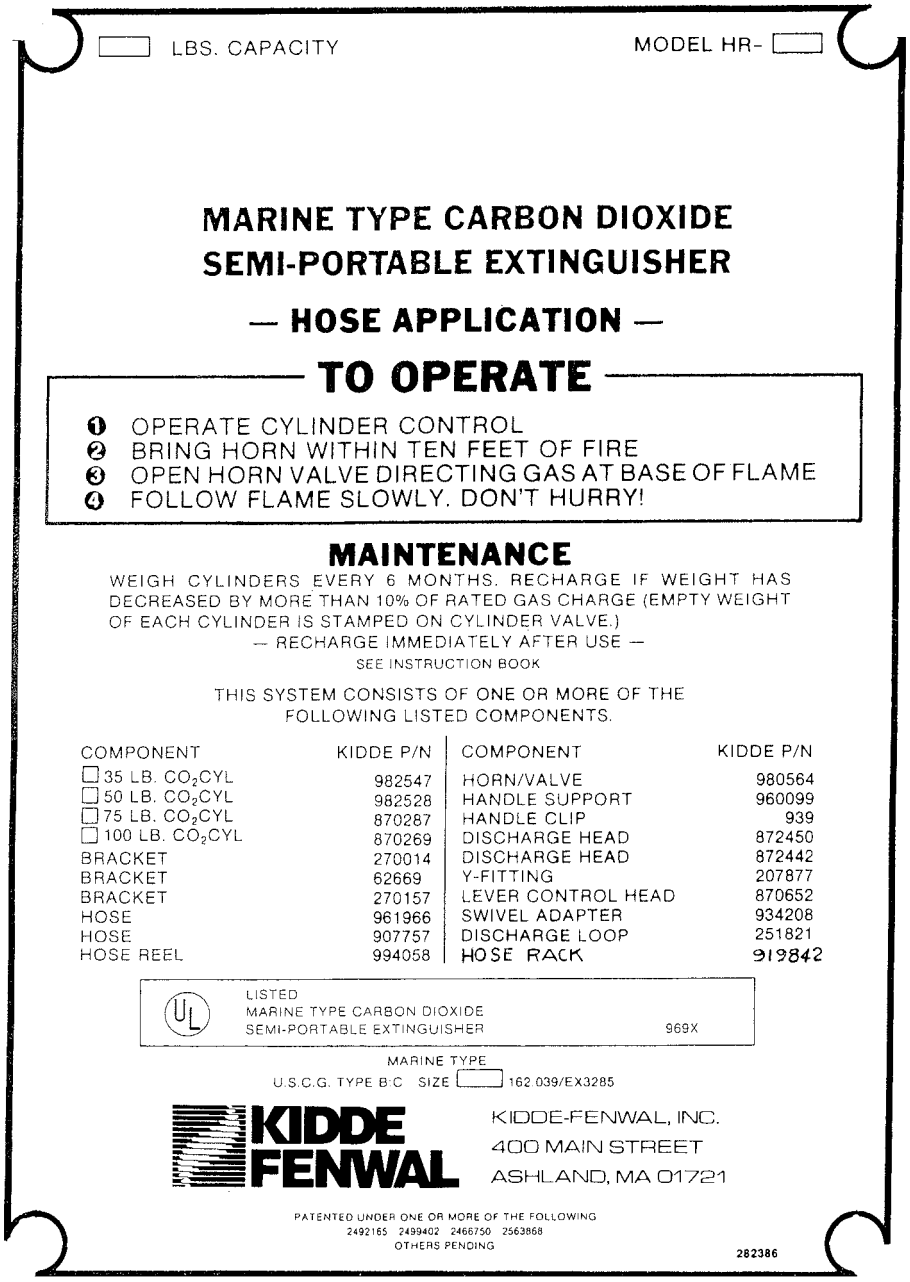


Figure 4-85. Handle and Horn Clips



☐ LBS. CAPACITY MODEL HR- ☐

MARINE TYPE CARBON DIOXIDE SEMI-PORTABLE EXTINGUISHER

— HOSE APPLICATION —

TO OPERATE

1. OPERATE CYLINDER CONTROL
2. BRING HORN WITHIN TEN FEET OF FIRE
3. OPEN HORN VALVE DIRECTING GAS AT BASE OF FLAME
4. FOLLOW FLAME SLOWLY. DON'T HURRY!

MAINTENANCE

WEIGH CYLINDERS EVERY 6 MONTHS. RECHARGE IF WEIGHT HAS DECREASED BY MORE THAN 10% OF RATED GAS CHARGE (EMPTY WEIGHT OF EACH CYLINDER IS STAMPED ON CYLINDER VALVE.)

— RECHARGE IMMEDIATELY AFTER USE —

SEE INSTRUCTION BOOK

THIS SYSTEM CONSISTS OF ONE OR MORE OF THE FOLLOWING LISTED COMPONENTS.

COMPONENT	KIDDE P/N	COMPONENT	KIDDE P/N
☐ 35 LB. CO_2 CYL	982547	HORN/VALVE	980564
☐ 50 LB. CO_2 CYL	982528	HANDLE SUPPORT	960099
☐ 75 LB. CO_2 CYL	870287	HANDLE CLIP	939
☐ 100 LB. CO_2 CYL	870269	DISCHARGE HEAD	872450
BRACKET	270014	DISCHARGE HEAD	872442
BRACKET	62669	Y-FITTING	207877
BRACKET	270157	LEVER CONTROL HEAD	870652
HOSE	961966	SWIVEL ADAPTER	934208
HOSE	907757	DISCHARGE LOOP	251821
HOSE REEL	994058	HOSE RACK	919842

LISTED
MARINE TYPE CARBON DIOXIDE
SEMI-PORTABLE EXTINGUISHER 969X

MARINE TYPE
U.S.C.G. TYPE B:C SIZE ☐ 162.039/EX3285

KIDDE FENWAL

KIDDE-FENWAL, INC.
400 MAIN STREET
ASHLAND, MA 01721

PATENTED UNDER ONE OR MORE OF THE FOLLOWING
2492165 2499402 2466750 2563868
OTHERS PENDING

282386

Figure 4-86. Model HR-1 Instruction Plate

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CHAPTER 5
EQUIPMENT INSTALLATION

5-1 GENERAL

This section contains installation instructions for Kidde Fire Systems. fixed carbon dioxide systems as well as hose reel and rack systems. Please refer to Section 4 for component descriptions and corresponding part numbers.

Equipment installation shall be such that the components are located and arranged to facilitate inspection, testing, recharging and any other required maintenance that may be necessary. Components must not be located where they will be subject to severe weather conditions, mechanical, chemical, or other damage which could render them inoperative.

5-2 DISCHARGE PIPE, TUBING, AND FITTINGS

Pipe, tubing and fittings must be installed in strict accordance with the system drawings and good commercial practices. The piping between the cylinders and discharge 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 prior to installation.

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 tape or thread 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 nonflammable organic compound.

All piping must be blown out with dry nitrogen, carbon dioxide, or compressed air prior to installing the discharge nozzles. Dirt traps must be installed at the end of each nozzle header, or branch line. Test manifold and piping in accordance with the requirements in Section 2-14. The piping system must be securely braced to account for discharge reaction forces and thermal expansion/contraction. Care must be taken to ensure the piping is not subjected to vibration, mechanical, or chemical damage. Refer to ANSI B-31.1 for additional bracing requirements.

5-3 PNEUMATIC ACTUATION PIPE AND TUBING

The pneumatic actuation tubing must be 1/4 inch O.D. stainless steel (0.035 inch wall thickness) or 1/4 inch, galvanized schedule 40 or 80 pipe. The pipe or tubing must be routed in the most direct manner, with a minimum of fittings. Pipe fittings must be in accordance with the requirements listed in Section 2-13. Tubing fittings can be flared or compression type. The pressure/temperature ratings of the fitting manufacturer must not be exceeded.

Piping and tubing must be reamed free of burrs and ridges after cutting, threading or flaring. Upon assembly, pipe or tubing must be blown out with dry nitrogen, CO2 or compressed air. It must be securely braced and isolated from vibration, mechanical, or chemical damage.

5-4 RATE-OF-RISE DETECTOR AND TUBING

Install the rate-of-rise detector on the overhead of the protected space as shown on the system drawings. Secure tubing every 18 inches with clips provided. Connect the detectors to the control head with 3/16 inch tubing provided by Kidde Fire Systems. See Section 5-15 and Figures 4-12 through 4-15 for details of the tubing and fittings required. Test and inspect in accordance with Chapter 7.

5-5 CHECK AND STOP VALVES

Install the check and stop valves as shown on the system drawings. Apply Teflon tape or pipe compound to male threads, excluding the first two threads. Valves greater than 2 inches in size are provided with flanged outlets.

Note: All valves must be installed with the arrow on the valve body pointing in the proper direction of the flow.

5-6 DISCHARGE MANIFOLD

Securely attach the discharge manifold to the bulkhead or other structural member. The manifold must level and the inlets align to connect to the cylinder valves. Manifolds greater then 2 inches in size must be welded. Refer to Paragraph 2-13 for pipe and fitting material requirements.

5-7 CO2 CYLINDER ASSEMBLIES

The CO2 cylinders must be located as close to the protected space as possible. Cylinders may be located within the protected space providing that no more than 300 lbs. of CO2 is required and automatic actuation is provided. If the cylinders are located adjacent to the protected space, the common bulkhead between the two spaces must be insulated and constructed to A-60 class.

Cylinders must be located in an environment protected from the weather and where the ambient storage does not exceed 130°F, nor fall below 0°F. External heating or cooling may be required to maintain this temperature range.

Position cylinders in designated location and secure in place with mounting hardware provided. Cylinders shall be floor supported on an elevated platform at least 2 inches above the deck.

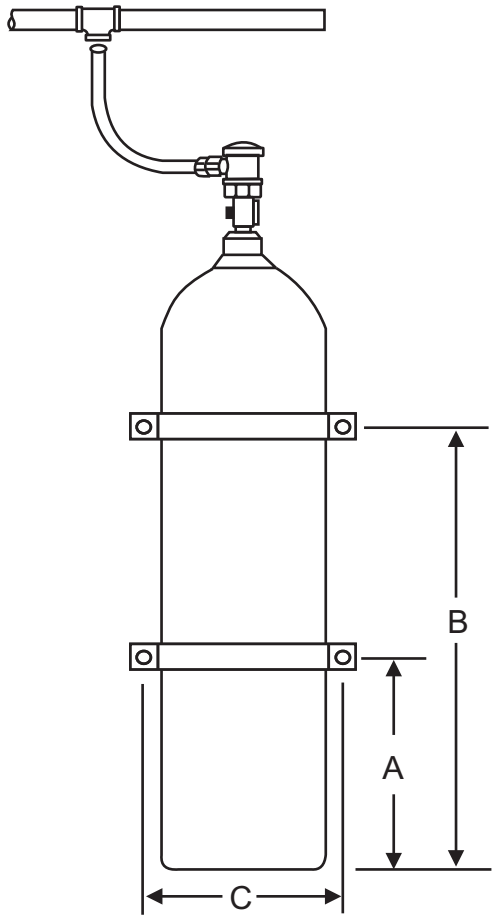
Tables 5-1 through 5-5 contain a list of the parts and part numbers for Framing kits and Oak Rack assemblies.

Table 5-1. Oak Racking Assemblies

		WK-005001-00X				WK-075001-00X				WK-075021-00X				WK-010001-00X			WK-010021-00X		
		1R/1S				1R/1S				2R/1S				1R/1S			2R/1S		
		50 lb Cylinder				75 lb Cylinder				75 lb Cylinder				100 lb Cylinder			100 lb Cylinder		
Part Number	**Description**	**2**	**3**	**4**	**5**	**2**	**3**	**4**	**5**	**4**	**6**	**8**	**10**	**2**	**3**	**4**	**4**	**6**	**8**
81-241218-000	Bracket, Weigh Bar 1 Row x 050/075# Cyl	2	2	2	2	2	2	2	2	-	-	-	-	-	-	-	-	-	-
81-241220-000	Bracket, Weigh Bar 2 Row x 050/075# Cyl	-	-	-	-	-	-	-	-	2	2	2	2	-	-	-	-	-	-
WK-271567-000	Bracket, Weigh Bar 1 Row x 100# Cyl	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	-	-	-
WK-271568-000	Bracket, Weigh Bar 2 Row x 100# Cyl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2
WK-207283-000	Weigh Bar, 3 x 50/75 lb Cylinder	1	1	-	-	1	1	-	-	2	2	-	-	-	-	-	-	-	-
81-207284-000	Weigh Bar, 4 x 50/75 lb Cylinder	-	-	1	-	-	-	1	-	-	-	2	-	-	-	-	-	-	-
WK-207285-000	Weigh Bar, 5 x 50/75 lb Cylinder	-	-	-	1	-	-	-	1	-	-	-	2	-	-	-	-	-	-
WK-243796-000	Weigh Bar, 3 x 100 lb Cylinder	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	2	-
WK-243797-000	Weigh Bar, 4 x 100 lb Cylinder	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2
WK-149593-380	Nut & Bolt, 1/2" x 13"	2	4	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WK-149593-390	Nut & Bolt, 1/2" x 15"	-	-	-	-	2	4	4	4	-	-	-	-	2	4	4	-	-	-
WK-149593-810	Nut & Bolt, 1/2" x 23"	-	-	-	-	-	-	-	-	2	4	4	4	-	-	-	-	-	-
WK-149595-630	Nut & Bolt, 1/2" x 27"	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	4	4
WK-151924-000	Nut, 3/8"	6	6	6	6	6	6	6	6	8	8	8	8	6	6	6	8	8	8
WK-149124-160	Bolt, 3/8" x 1"	6	6	6	6	6	6	6	6	8	8	8	8	6	6	6	8	8	8
WK-151932-000	Nut, 1/2"	4	4	4	6	4	4	4	6	4	4	4	6	4	4	4	4	4	4
WK-149132-480	Bolt, 1/2" x 3"	4	4	4	6	4	4	4	6	4	4	4	6	4	4	4	4	4	4
WK-157732-000	Washer, 1/2"	6	8	8	10	6	8	8	10	6	8	8	10	6	8	8	6	8	8
81-269500-000	Washer, 1/2" Rectangular	2	4	4	4	2	4	4	4	2	4	4	4	2	4	4	2	4	4
WK-681300-000	Back Oak Rack, 50 lb Cyl x 2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WK-681800-000	Back Oak Rack, 50 lb Cyl x 3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WK-682300-000	Back Oak Rack, 50 lb Cyl x 4	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WK-682800-000	Back Oak Rack, 50 lb Cyl x 5	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WK-855300-000	Back Oak Rack, 75 lb Cyl x 2	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-	-
WK-855800-000	Back Oak Rack, 75 lb Cyl x 3	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-
WK-856300-000	Back Oak Rack, 75 lb Cyl x 4	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-
WK-856800-000	Back Oak Rack, 75 lb Cyl x 5	-	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-
WK-243600-000	Back Oak Rack, 100 lb Cyl x 2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-
WK-243610-000	Back Oak Rack, 100 lb Cyl x 3	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-
WK-243620-000	Back Oak Rack, 100 lb Cyl x 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2
WK-855400-000	Inter Oak Rack, 75 lb Cyl x 2	-	-	-	-		-	-	-	2	-	-	-	-	-	-	-	-	-
WK-855900-000	Inter Oak Rack, 75 lb Cyl x 3	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
WK-856400-000	Inter Oak Rack, 75 lb Cyl x 4	-	-	-	-	-	-		-	-	-	2	-	-	-	-	-	-	-
WK-856900-000	Inter Oak Rack, 75 lb Cyl x 5	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
WK-243660-000	Inter Oak Rack, 100 lb Cyl x 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
WK-243670-000	Inter Oak Rack, 100 lb Cyl x 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
WK-243680-000	Inter Oak Rack, 100 lb Cyl x 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Table 5-1. Oak Racking Assemblies

		WK-005001-00X				WK-075001-00X				WK-075021-00X				WK-010001-00X			WK-010021-00X		
		1R/1S				1R/1S				2R/1S				1R/1S			2R/1S		
		50 lb Cylinder				75 lb Cylinder				75 lb Cylinder				100 lb Cylinder			100 lb Cylinder		
Part Number	**Description**	**2**	**3**	**4**	**5**	**2**	**3**	**4**	**5**	**4**	**6**	**8**	**10**	**2**	**3**	**4**	**4**	**6**	**8**
WK-679500-000	Front Oak Rack, 50 lb Cyl x 2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WK-680000-000	Front Oak Rack, 50 lb Cyl x 3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WK-680500-000	Front Oak Rack, 50 lb Cyl x 4	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WK-681000-000	Front Oak Rack, 50 lb Cyl x 5	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WK-855500-000	Front Oak Rack, 75 lb Cyl x 2	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-	-
WK-856000-000	Front Oak Rack, 75 lb Cyl x 3	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-
WK-856500-000	Front Oak Rack, 75 lb Cyl x 4	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-
WK-857000-000	Front Oak Rack, 75 lb Cyl x 5	-	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-
WK-243630-000	Front Oak Rack, 100 lb Cyl x 2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-
WK-243640-000	Front Oak Rack, 100 lb Cyl x 3	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-
WK-243650-000	Front Oak Rack, 100 lb Cyl x 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2

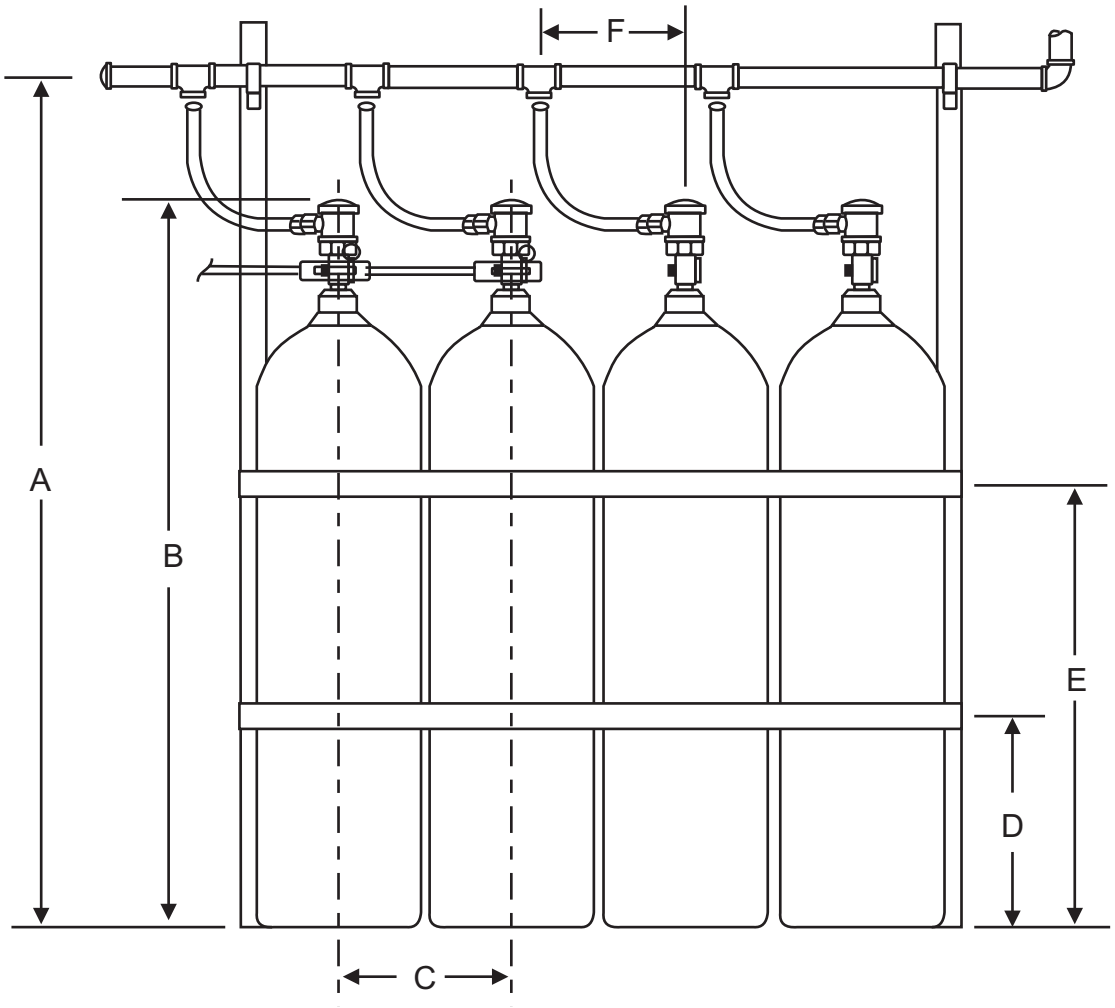


Cylinder Size	A*	B*	C
25 Lbs.	8	18	10.37
35 Lbs.	10	27	10.37
50 Lbs.	12-14	42-44	10.37
75 Lbs.	12-14	42-46	10.37
100 Lbs.	12-14	46-48	12.40

NOTE: All dimensions are in inches.

* = ±1/2“

Figure 5-1. Cylinder Strap Installation, Typical

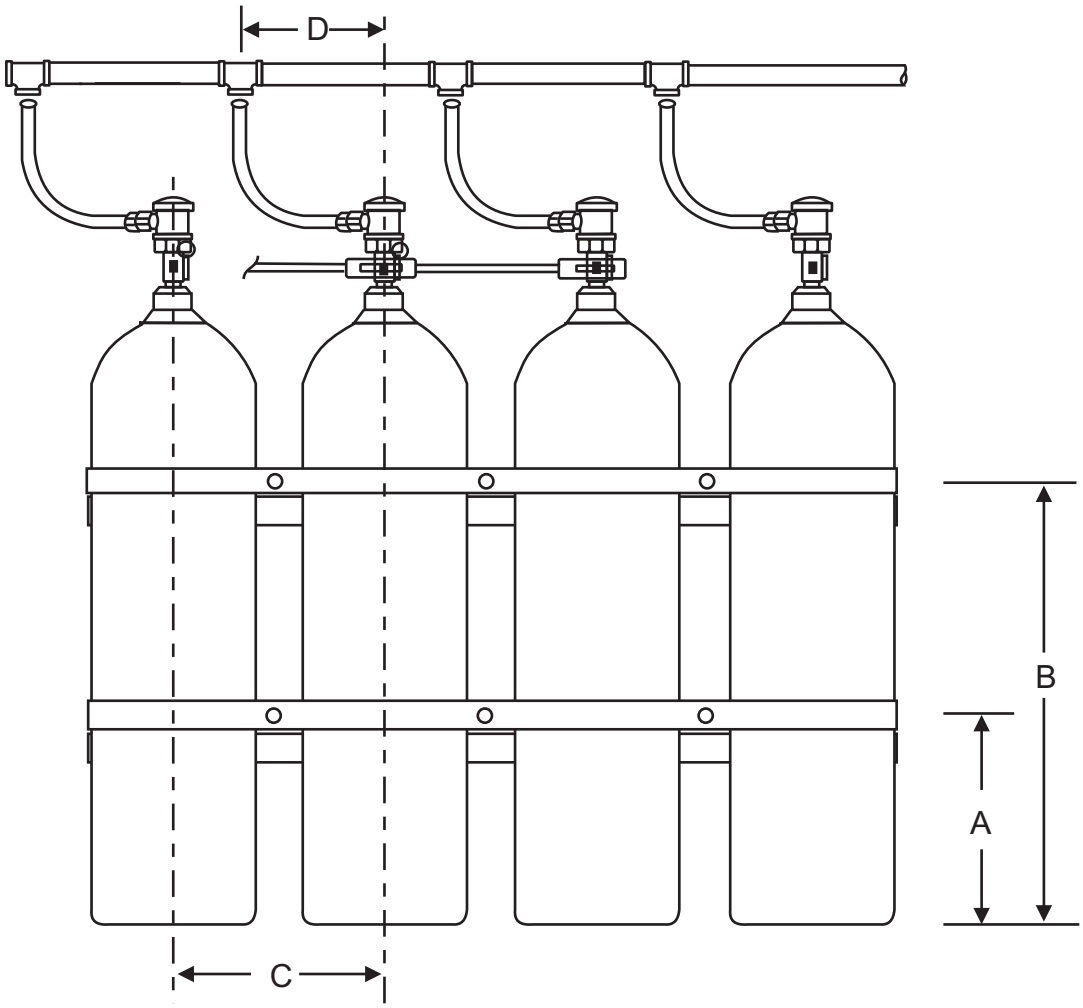


Cylinder Size	A*	B*	C	D*	E*	F
50 Lbs.	66	57	10.0	12	36	8-3/4
75 Lbs.	71	62	10.0	12	40	11-3/8
100 Lbs.	73	64	11.5	12	42	11-3/8

NOTE: All dimensions are in inches.

* = ±1/2“

Figure 5-2. Metal Cylinder Framing Installation, Typical



Cylinder Size	A*	B*	C	D
50 Lbs.	12	36	9.5	8.75
75 Lbs.	12	42	10.0	11.37
100 Lbs.	12	44	11.5	11.37

NOTE: All dimensions are in inches.

* = ±1/2“

Figure 5-3. Oak Racking Installation, Typical

5-8 SWIVEL ADAPTER

Install swivel adapter in system piping. Tighten securely.

WARNING **Connect swivel adapter into system piping before connecting to Carbon Dioxide cylinder valve.**

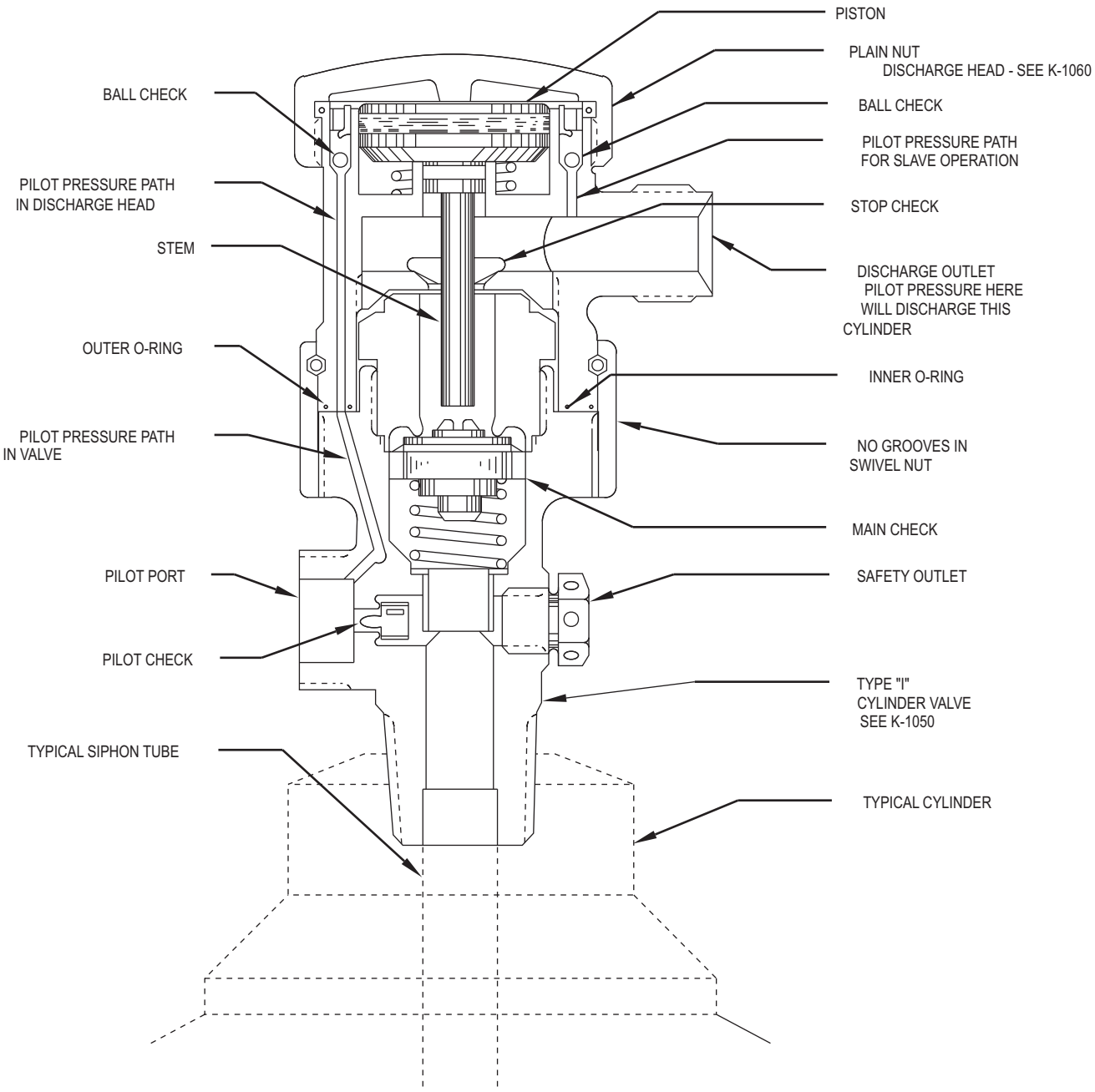
5-9 DISCHARGE HEAD TO CYLINDER VALVE

Install discharge head as follows:

1. Wipe off cylinder valve sealing surface.
2. Verify that O-rings are installed in the mating surface grooves at the bottom of the swivel nut cavity. O-rings must be free of dirt or other contaminants. The O-rings have been lightly greased at the factory and should not require further greasing.
3. Make certain the discharge port is clean and unobstructed.
4. Install discharge head on cylinder valve. Tighten securely.

CAUTION

The discharge head must be permanently connected into the system piping. Do not assemble the discharge head to the cylinder valve until the cylinder is secured in the cylinder bracketing.



CAUTION

NEVER CONNECT DISCHARGE HEAD TO CYLINDER VALVE WITHOUT FLEX LOOP ATTACHED TO DISCHARGE OUTLET AND CONNECTED TO SYSTEM PIPING. ARRANGEMENT AS SHOWN IS FOR ILLUSTRATION PURPOSES ONLY.

Figure 5-4. Installation of Plain Nut Discharge Head to Cylinder Valve

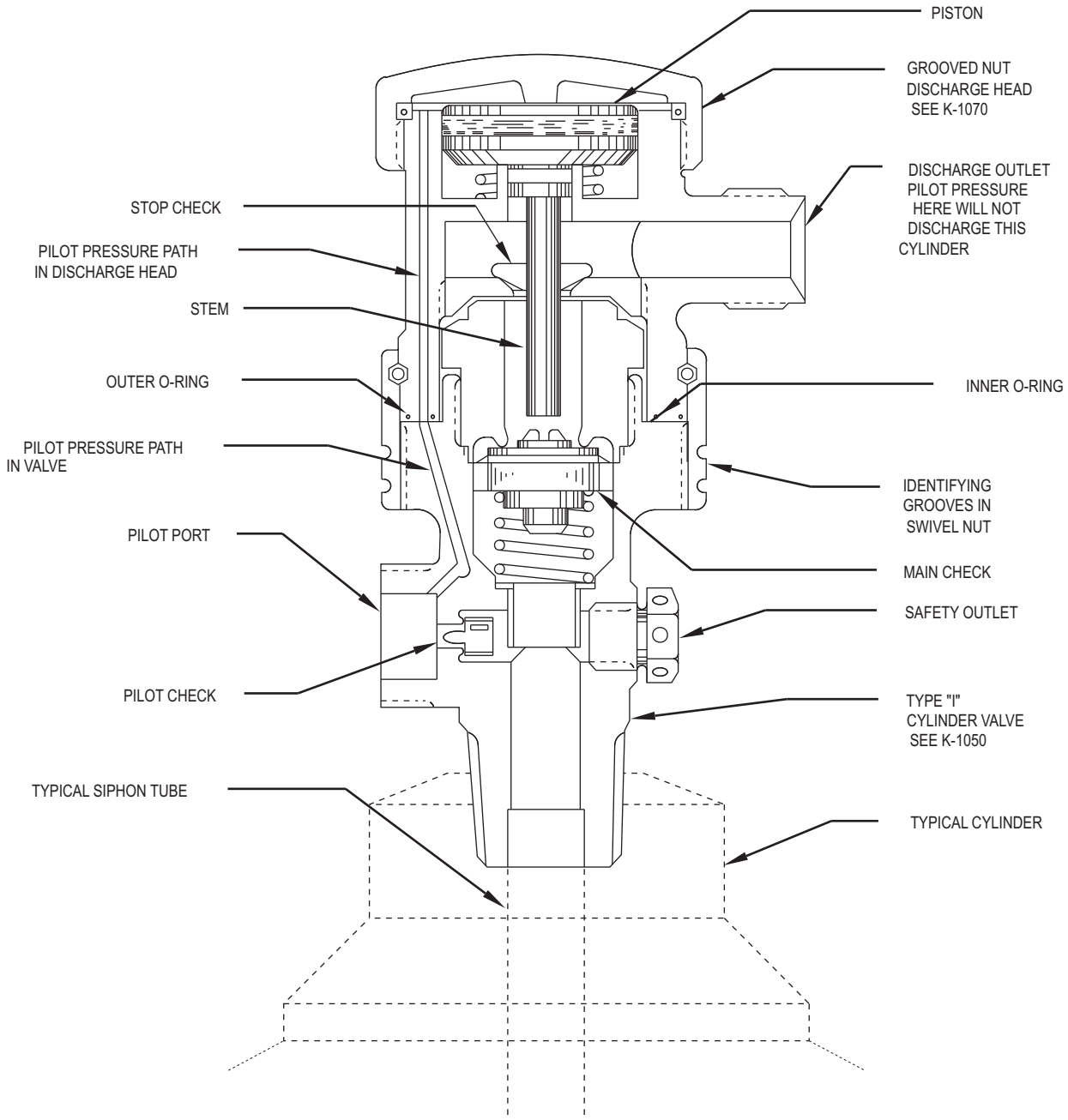


Figure 5-5. Installation of Grooved Nut Discharge Head to Cylinder Valve

5-10 INSTALLATION OF FLEXIBLE DISCHARGE HOSE TO PIPING

Connect the discharge hose to the piping or manifold as shown on system drawings. apply Teflon tape or pipe dope to all male threads. Cylinders may have to be loosened to assure proper alignment. Make certain that no kinks are present in the hose.

WARNING **Always connect the flexible discharge hose into the manifold first before connecting to the discharge hose.**

5-11 REMOTE PULL CABLE COMPONENTS

A maximum of 15 corner pulleys and 100 feet of cable may be used to connect the remote pull box to a cable operated control head and a maximum of six corner pulleys and 100 feet of cable may be used to connect the remote pull box to a pneumatic control head.

Locate the remote pull boxes as shown on the system installation drawings. 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. At each change in pipe direction, install a corner pulley. Do not bend the pipe. A dual-pull equalizer must be installed where one pull box operates two controls.

Beginning at the pull boxes, remove the covers of the first corner pulley. Feed the 1/16 inch cable through the pulley into the 3/8 inch pipe. Connect one end of the cable to the cable fastener in the pull box. 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. Reattach the corner pulley covers. Make certain the control heads are in the SET position. Install the control head to the cylinder or stop valves.

After installation is complete, test remote cable actuation for travel and pull force. Ensure the installation does not exceed the 40 lbs., 14 inch requirement.

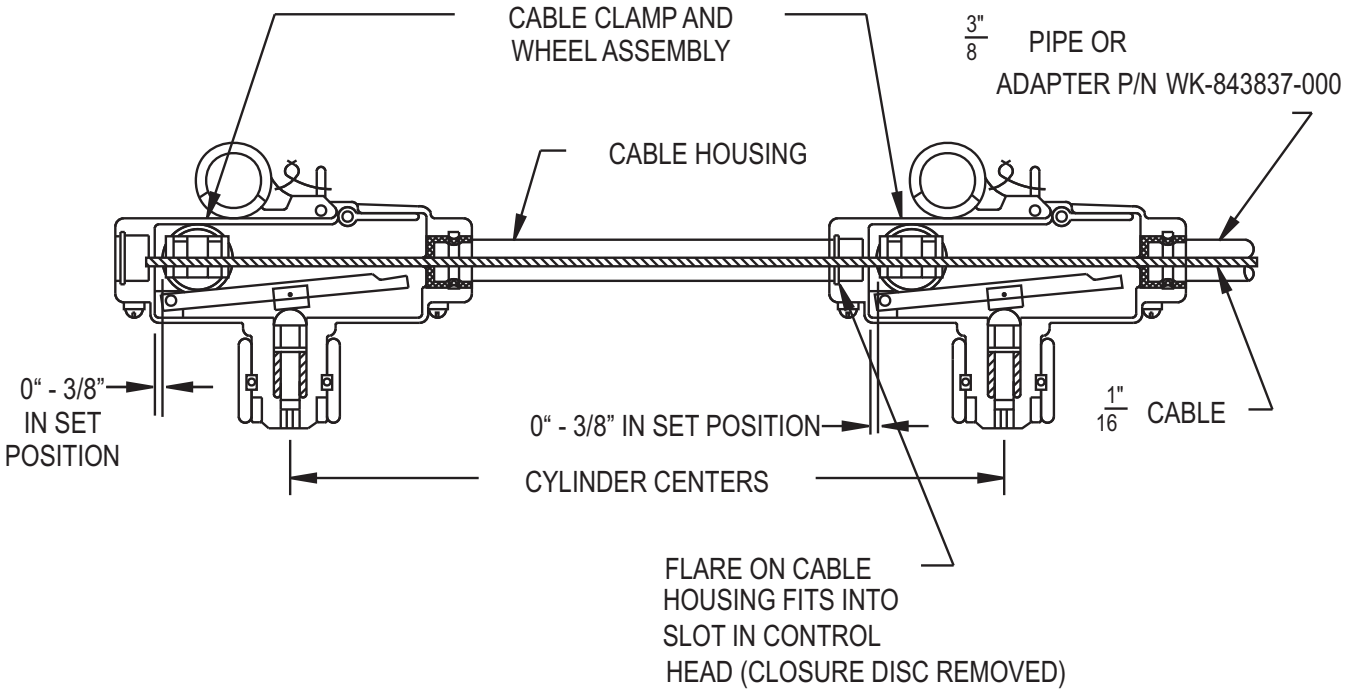


Figure 5-6. Installation of Tandem Cable Operated Control Heads

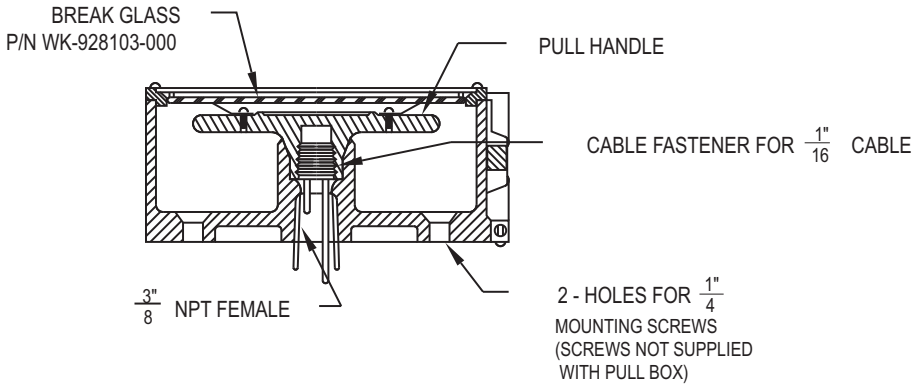


Figure 5-7. Installation of Break Glass Pull Box, P/N 81-871403-00

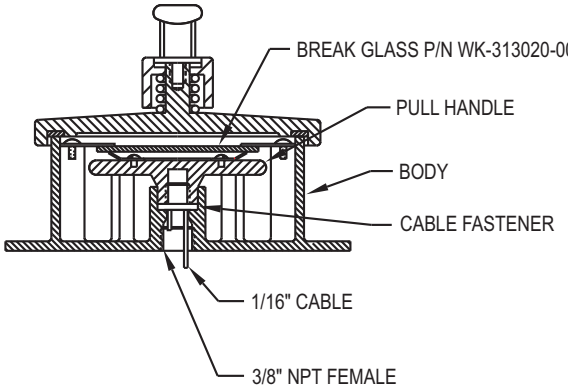


Figure 5-8. Installation of Watertight Pull Box, P/N 81-870087-000

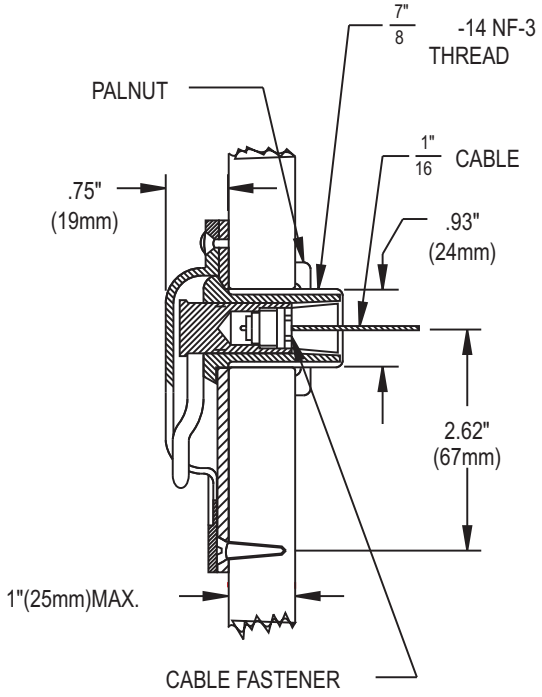


Figure 5-9. Installation of Flush Pull Box, Yacht Type, P/N 81-840098-000

5-12 CABLE OPERATED CONTROL HEAD

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

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

CAUTION

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

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

5-13 LEVER OPERATED CONTROL HEAD

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

5-14 LEVER/PRESSURE OPERATED CONTROL HEAD

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

5-15 PNEUMATIC DETECTOR

Pneumatic detectors must be installed on the ceiling; UNDER NO CIRCUMSTANCES are detectors to be installed on the underside of beams. Refer to installation drawing(s) for quantity and location of detectors.

Connect the detectors to the control head with 3/16 inch tubing provided by Kidde-Fenwal, Inc. Secure tubing every 18 inches with clips provided. The actuator tubing furnished with this system is of special extra heavy construction and is especially resistant to damage. The tubing is furnished in approximately 12 foot lengths with both ends flared. It is fitted with a tube fitting and protection cap to prevent entrance of moisture or foreign matter. Because the tubing is difficult to flare, Kidde-Fenwal, Inc. recommends the entire length be used. Excess tubing should be taken up by coiling. See Figures 4-12 through 4-15 for details of the tubing and fittings required. Test and inspect detector in accordance with Chapter 7, Maintenance.

WARNING

Do not use any type of copper tubing other than that which is supplied by Kidde-Fenwal. This tubing is a special grade of tubing. Ordinary tubing is very easily damaged and may cause failure of the system.

Note: If tubing is installed in an area where it may be subjected to mechanical damage, it is permissible to run the tubing through 1/2 EMT to protect tubing from damage.

5-16 PNEUMATIC CONTROL HEAD

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

1. Remove pilot port outlet protection cap from valve of cylinder to be equipped with control head.
2. Be sure control head is in SET position.
3. Arrow on reset stem should line up with SET arrow on nameplate.
4. Connect pneumatic detector tubing securely to diaphragm chamber of control head.

Note: If remote pull box is supplied, proceed with Steps 5 through 7.

5. Connect control cable conduit to control head. Remove control head nameplate, exposing manual release chamber.
6. Loosen screws on cable clamp and feed cable through hole. Tighten the set screws securely, allowing the cable to sag a little. Do not pull the cable taut. Cut off excess cable.
7. Make certain locking pin and seal wire have been assembled to nameplate. Local control lever should be parallel with nameplate. Assemble nameplate to control head, being sure to fit the small shaft into the cover bearing and the large pin under the trip lever.

WARNING

Before installing control head on CO_2 cylinder valve, ensure control head is in "SET" position. Failure to position control head in "SET" position will result in accidental CO_2 cylinder discharge when control head is installed on cylinder valve.

8. Assemble control head to actuation port outlet. Tighten swivel coupling nut securely.

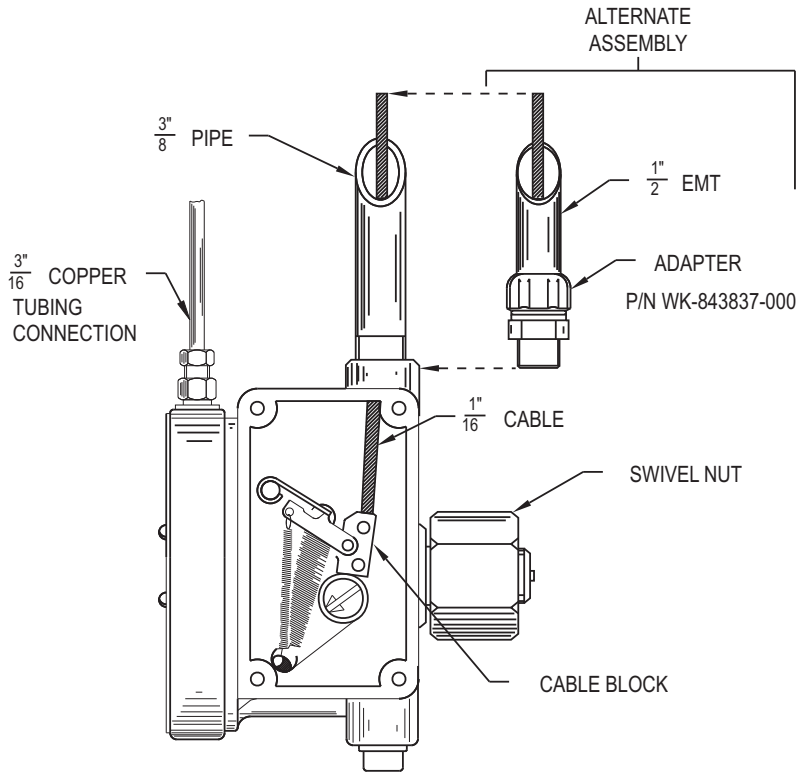


Figure 5-10. Installation Detail, Pneumatic Control Head

5-17 PRESSURE SWITCHES

Pressure switches must be connected to the pilot piping or discharge manifolds as shown on the system drawings. The preferred mounting position is upright, as shown on Figures 5-1, 5-2, and 5-3. Both the standard and explosion-proof pressure switches have 1/2 inch NPT pressure inlets to connect to the piping. The electrical connections are either 1/2 inch conduit knockouts or 1 inch NPT fittings.

5-18 DISCHARGE TIME DELAY

The time delays are pre-set at the factory; however the actual delay period is dependant on the specific installation, ambient temperatures and the test methodology. USCG requires that a time delay must be tested during commissioning and inspection. To meet the pass criteria, the tested delay period must fall in the range minus zero percent and plus twenty percent (-0%, +20%) of the factory rated value. This range is based on the guidance provided in NFPA 12:2000 Standard on Carbon Dioxide Extinguishing Systems.

USCG recognizes that the range of installation configurations coupled with the inherent variability of metered carbon dioxide as a timing medium make compliance with this specification challenging. In general some allowance may be granted for delay periods that exceed the twenty-percent figure since the time delay unit (P/N 81-871071-000, or P/N 81-897636-000) can be bypassed using the lever operated control head (P/N 870652). Delay periods less than the factory rated value are not acceptable since they potentially compromise the safe egress of personnel from the protected space.

When using an N_2 operated discharge delay, only the 108-cuin N_2 cylinder shall be used to drive the delay. The 108-cuin N_2 cylinder and discharge delay may be interconnected using either ¼" Sched80 stainless steel pipe or 5/16" x 0.032wall stainless steel tubing. In either case, a maximum length of 4-ft is allowed.

CO_2 discharge delay units require liquid CO_2 to operate properly. To ensure proper flow of liquid CO_2 during commissioning of large systems, Kidde suggests testing with a CO_2 quantity equal to at least 10% of the normally connected CO_2 quantity. Kidde cautions installers to be aware of the CO_2 consumed by any pressure operated sirens and account for this consumption when testing the discharge delay units. When testing the discharge delay, Kidde also suggests using test cylinders fitted with the appropriate Kidde Type I valve, siphon tube, discharge head and flex loop. Kidde requires the test cylinder to always be fitted with a siphon tube.

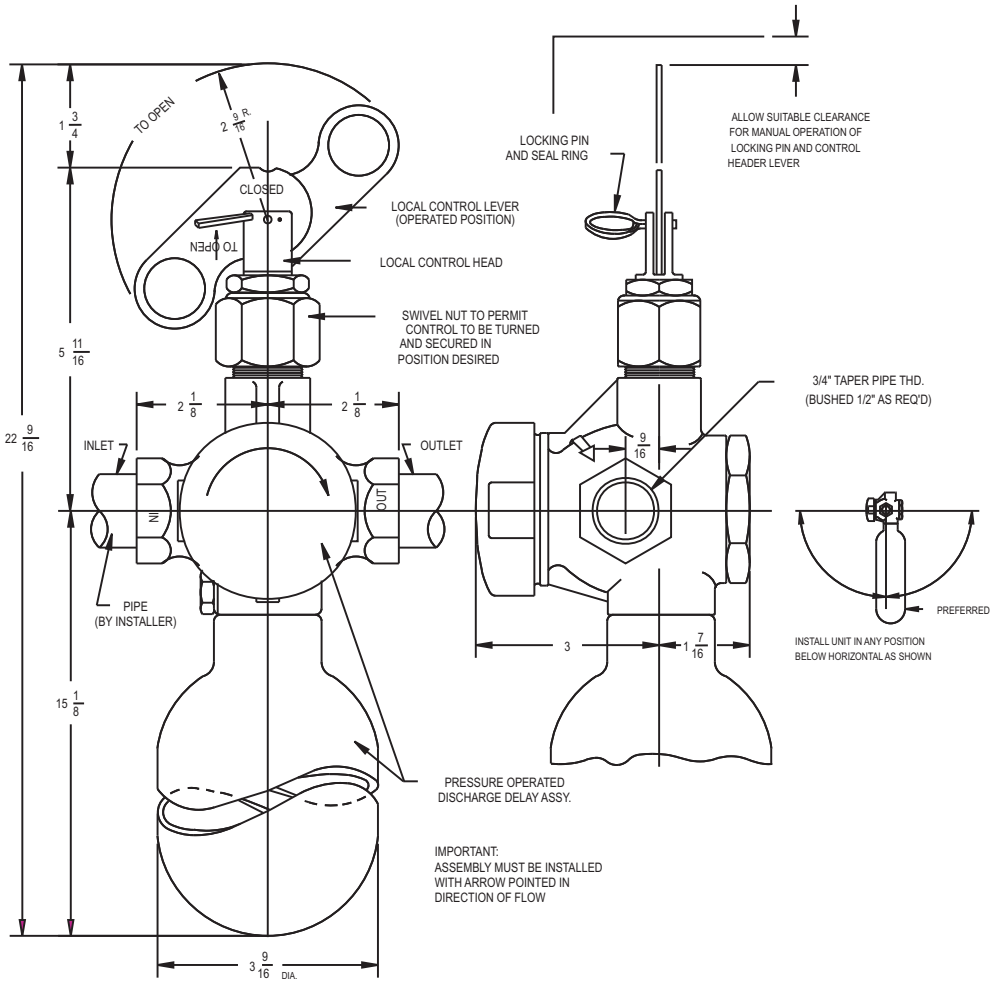


Figure 5-11. Installation Detail, Pneumatic Control Head

5-18.1 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**
- **a 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.

5-19 MANUAL PNEUMATIC ACTUATION STATION

1. Locate nitrogen cylinder mounting bracket in area where cylinder/valve assembly and control head will be protected from inclement weather by a suitable total or partial enclosure.
2. Install mounting bracket clamps and hardware. Install nitrogen cylinder in position in mounting rack; tighten sufficiently to hold cylinder in place while allowing cylinder enough free play to be manually rotated.
3. Remove nitrogen cylinder valve protection cap.
4. Manually rotate cylinder until cylinder valve discharge outlet is in desired position.

CAUTION

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

5. Securely tighten mounting bracket clamps and hardware.
6. Attach adapter (P/N WK-699205-010) and connect nitrogen pilot lines as shown in Figure 5-11.
7. Remove protective cap from cylinder valve actuation port.
8. Install control head to cylinder valve actuation port; tighten securely.

WARNING

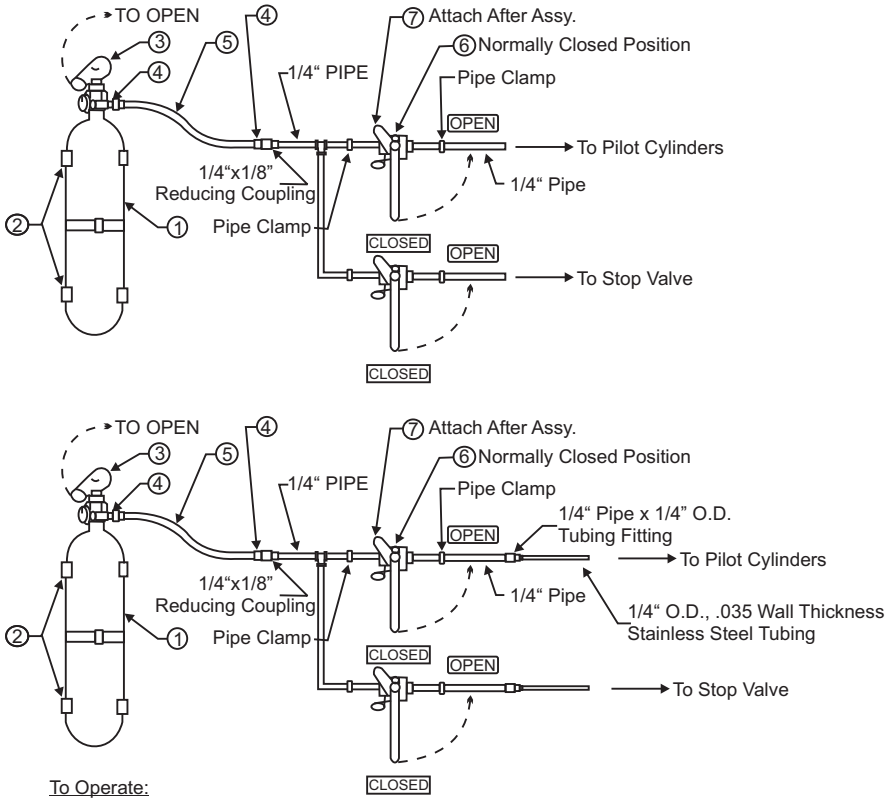
Before installing control head on CO2 cylinder valve, ensure control head is in "SET" position. Failure to position control head in "SET" position will result in accidental CO2 cylinder discharge when control head is installed on cylinder valve.

ENSURE CONTROL HEAD IS IN THE SET POSITION BEFORE ATTACHING TO CYLINDER VALVE. FAILURE OF CONTROL HEAD TO BE IN SET POSITION WILL RESULT IN ACCIDENTAL CO2 SYSTEM DISCHARGE.

9. Return protection cap to storeroom.
10. Install ball valve, P/N WK-283888-000, in actuation piping. Ensure ball valve is in the closed position. Install seal wire as shown in Figure 5-11.
11. Install flexible hose to nitrogen cylinder assembly; tighten securely. Connect flexible hose to actuation piping using adapter P/N WK-699205-010. Tighten securely.

WARNING

Before installing control head on CO2 cylinder valve, ensure control head is in "SET" position. Failure to position control head in "SET" position will result in accidental CO2 cylinder discharge when control head is installed on cylinder valve.



To Operate:

1. Pull Pin in Lever Control Head ③
2. Rotate Lever to “OPEN” Position
3. Rotate Ball Valve ⑥ Handles to “OPEN” Position

Bill of Material List

① Nitrogen Cylinder, P/N WK-877940-000

② Cylinder Bracket, P/N WK-877845-000

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

④ Adapter, P/N WK-699205-010

⑤ Flexible Hose, P/N WK-264986-000 or WK-264987-000

⑥ Ball Valve, P/N WK-283888-000

⑦ Seal Wire, P/N WK-152620-000

Items 1 through 7 furnished by Kidde-Fenwal, Inc. All other parts furnished and installed by others.

Figure 5-12. Installation Detail, Pneumatic Actuation Station

5-20 SAFETY OUTLET

The safety outlet must be installed upstream of any stop valve. Connection to the piping is made with a 3/4 inch NPT fitting. Attach the wrench to the body of the safety outlet. Do not tighten, or loosen the retaining nut containing the safety disc.

5-21 PRESSURE OPERATED SIRENS

Kidde Marine CO2 systems can be equipped with either CO2 or N2 pressure operated sirens.

Note: Only the N2 operated siren can be used for DNV type approved vessels.

5-21.1 Pressure Operated Siren, CO2

The pressure operated sirens must be installed throughout the protected space. Connect alarm to the pilot piping with 1/2 inch Schedule 40 pipe. Install a dirt trap and union as shown on Figure 4-43.

Based on flow rates and pressure drop, the maximum number of pressure operated sirens which can be operated by a cylinder is two (2). The total length of 1/2 inch pipe cannot exceed 250 feet.

Pressure operated siren agent consumption is approximately 20 lbs. per minute. The quantity of carbon dioxide agent must be adjusted to compensate for carbon dioxide expended during siren operation.

5-21.2 Pressure Operated Siren, N_2

The pressure operated sirens must be installed throughout the protected space. Connect alarm to the pilot piping with 1/4 inch Schedule 40 pipe or 1/4 inch Schedule 80 galvanized steel pipe, or 5/16 x 0.032 stainless steel tubing. Install a dirt trap and union as shown on Figure 4-43.

A 1040 cu. in. nitrogen tubing can operate up to four (4) sirens with up to 500 feet of tube or pipe. A 2,300 cu. in. nitrogen cylinder can operate up to ten (10) sirens with up to 500 feet of tube or pipe.

5-22 PRESSURE TRIP

Install the pressure trip on the discharge manifold or piping in the horizontal position as shown on the system drawings and Figure 4-18. Connect the trip to the discharge piping with 1/2 inch schedule 40 pipe. The minimum operating pressure required is 75 psi. The maximum load on the retaining ring is 100 lbs.

5-23 DISCHARGE INDICATOR

If required, 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 as shown on Figure 4-53.

5-24 DISCHARGE NOZZLES

After the piping has been blown free of debris, install the discharge nozzles in strict accordance with the system drawings. Make certain that the correct nozzle type part number and orifice size is installed in the proper location.

5-25 HOSE REEL/RACK

Hose reel or rack must be installed in a location where access to the hose and discharge horn is unobstructed. In addition, the hose reel or rack location must allow fire fighting personnel to reach all hazard areas protected by the system, such as fuel pumps, electrical apparatus, etc. with the hose and discharge horn.

Install the hose rack or reel system as follows:

1. Attach cylinder strap anchors securely to the bulkhead (see installation drawings), measuring from the bottom of the cylinder. When necessary, allow for a chock to be placed under the cylinder to prevent corrosion.
2. Set the cylinder in place, leaving protection cap in place. Secure cylinder in place with cylinder straps and attaching hardware. Tighten bolts hand tight.
3. Remove protection cap from cylinder valve. Turn cylinder so the safety outlet is facing the bulkhead. Tighten cylinder strap bolts securely. Remove top and side protection caps from the cylinder valve.
4. Mount the hose rack or reel as shown in Figures 5-12 and 5-13.
5. For remote control systems only:
    a. Install the break glass pull box adjacent to the rack or reel.
    b. The control cable must be enclosed in standard 3/8 inch size hot dipped galvanized steel or standard weight brass pipe or conduit. Run control cable through piping to cylinder(s) in the most direct manner possible using corner pulley P/N 81-803808-000 at all changes in direction.

CAUTION

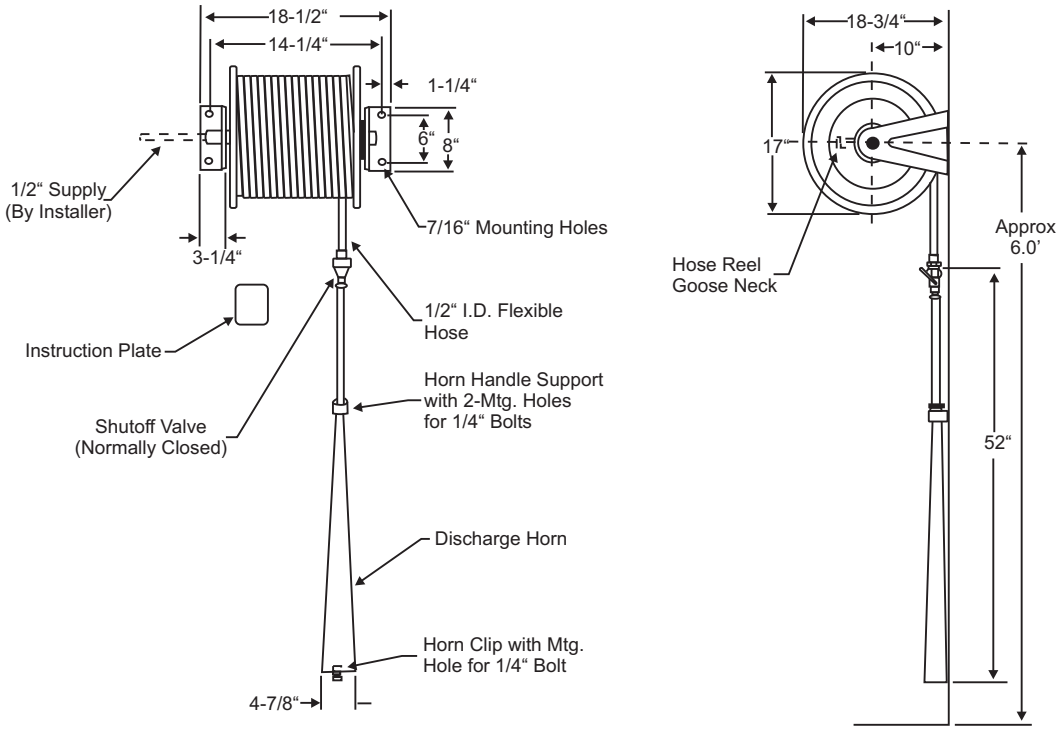
Bends or offsets are not permitted.

    c. Connect cable to cable operated control head as described previously.
6. Connect carbon dioxide cylinders to the distribution piping in accordance with Figures 5-10 and 5-11 as applicable. When making connections, the use of pipe dope or red lead is not permissible. Tighten all connections securely using a wrench.
7. Connect the horn securely to the hose. Place horn in the mounting clips provided. The temporary shutoff on the horn must be in the CLOSED position.
8. Verify that control head is in the “SET” position. Mount control head to the control head outlet on the cylinder valve.

WARNING

Lever or Cable Operated control heads must be in the “SET” position before installing on the cylinder valve. Failure to position control head in “SET” position will result in accidental cylinder discharge when control head is installed on cylinder valve.

9. After horn, valve, and piping are connected, install discharge head on cylinder valve as previously described in this section.
10. Connect flexible discharge hose to discharge head outlet



NOTE:
Reel is usually mounted with hose unwinding from back & supply line on left side. If supply is to come from the right tighten gooseneck one half turn.

Figure 5-13. Figure 5-12. Installation Detail, Typical Reel System

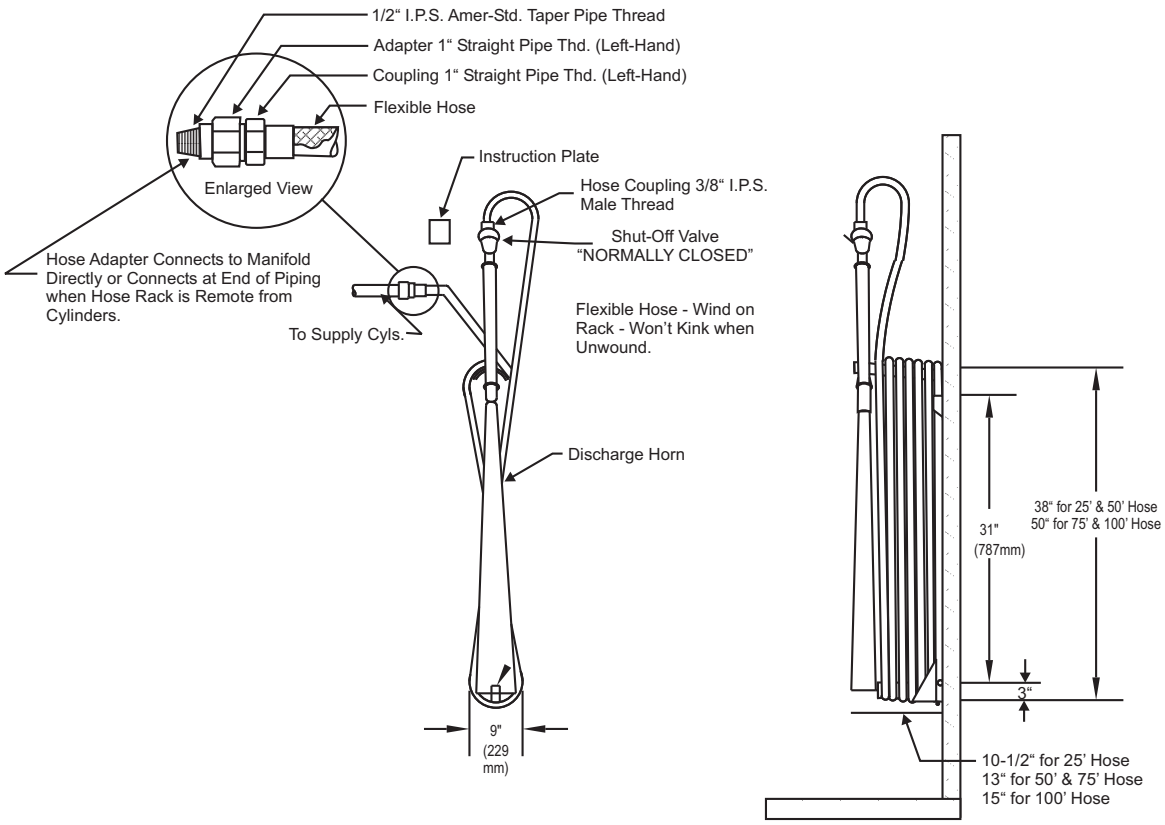


Figure 5-14. Figure 5-13. Installation Detail, Typical Hose Rack System.

5-25.1 Lockout Valves

The lockout valve must be located in the discharge manifold prior to the stop valve or selector valves. All valves should be easily accessible. Lockout valves can be installed in either the vertical or horizontal position using good pipe fitting practices. Place two to three wraps of Teflon tape on male threads of pipe. A union is recommended after the valve to facilitate future service work. The valve should be locked in the “open” position using a padlock. An operational sign, P/N 06-231867-379, shall be installed with all lockout valves to provide operational instructions for the lockout valve.

Figure 5-15 shows the lockout valve wiring diagram when the ball valve is in the fully open position.

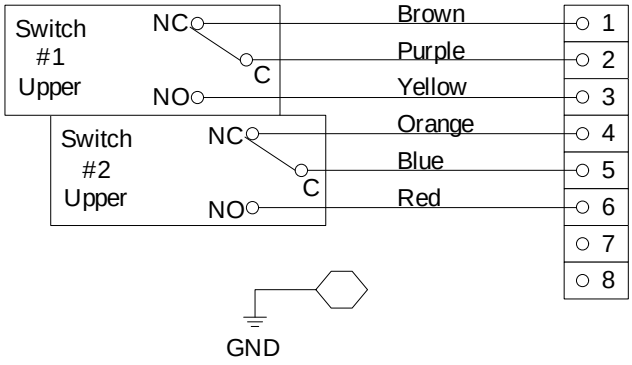


Figure 5-15. Wiring Diagram for Lockout Valve when Ball Valve is in Fully Open Position

5-25.2 Pressure Operated Sirens

Either CO_2 pressure operated sirens or Nitrogen pressure operated sirens may be used with the CO_2 suppression system. However, the installation requirements for each siren style are unique. Refer to the following sections for proper installation guidance for each style.

5-25.2.1 CO_2 PRESSURE OPERATED SIREN

The CO_2 pressure operated siren (Figure 5-16) shall be located in accordance with the installation plan. Connect the CO_2 siren to the pilot piping with 1/2-inch schedule 40 pipe.

- When used with a CO2 discharge delay, the siren supply line shall be installed upstream of the CO2 discharge delay.
- Typically located inside the protected space.
- Install a dirt trap and union as shown in Figure 5-16.
- Maximum 250 feet of 1/2-inch pipe between the Siren and the manifold.

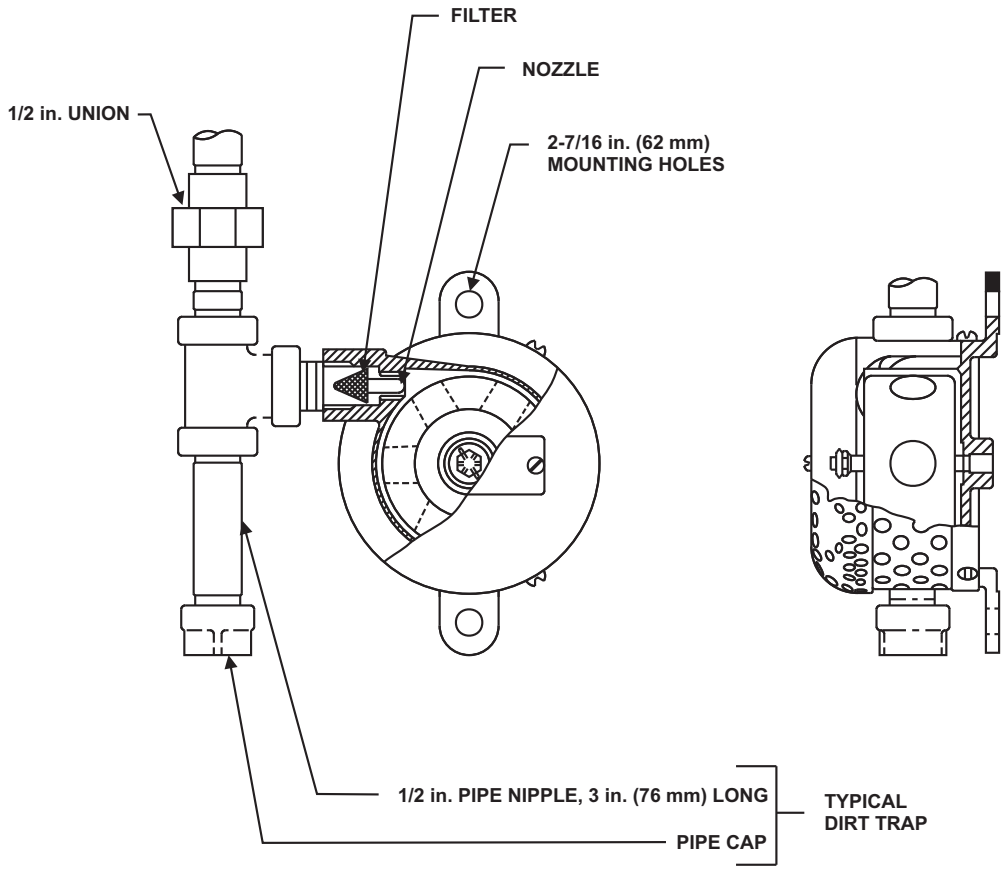


Figure 5-16. Pressure Operated Siren

5-25.2.2 N_2 PRESSURE OPERATED SIREN

The N_2 pressure operated siren (Figure 5-16) shall be located in accordance with the installation plan. Connect the N_2 siren in accordance with requirements corresponding to the siren driver cylinder noted in Table 5-2:

Table 5-2. Siren Driver Cylinder Actuation Limits

Pilot Cylinder Size	Siren Part Number	Number of Sirens per Siren Driver	Maximum Length of 1/4 in. Sch. 80 Pipe	Maximum Length of 1/4 in. Sch. 40 Pipe	Maximum Length of 5/16 in. x 0.032 in. Wall Tubing
108 cu. in.	90-981574-001	1	90 ft.	90 ft.	90 ft.
1040 cu. in.	90-981574-001	4	500 ft.	500 ft.	500 ft.
2300 cu. in.	90-981574-001	10	500 ft.	500 ft.	500 ft.
2 x 2300 cu. in.	90-981574-001	20	500 ft.	500 ft.	500 ft.

- Never connect a pipe supplying CO_2 to the N_2 pressure operated siren.
- The N_2 siren supply line shall start from a dedicated siren driver cylinder, which is separate from the system nitrogen pilot cylinder.
- Typically located inside the protected space.
- Install a dirt trap and union as shown in Figure 5-16.

5-25.3 Odorizer

When used, odorizer assemblies should be located immediately downstream of each selector valve. For systems protecting a single hazard, a single odorizer assemble can be located immediately downstream of the discharge manifold.

Odorizer assemblies must be attached to the discharge piping in the upright position. The odorizer assembly requires approximately 9” of clearance. Odorizer assemblies connect to a 3/4” NPT fitting.

1. Install the 3/4” NPT fitting where the odorizer assembly will be located.
2. Screw the odorizer assembly to the 3/4” NPT fitting.

CAUTION

To prevent damaging the odorizer assembly during testing, it is recommended that the odorizer assembly not be installed until after system testing of the discharge piping is complete. For periodic maintenance after the system has been installed and in use, remove the odorizer assembly prior to any testing of the discharge piping.

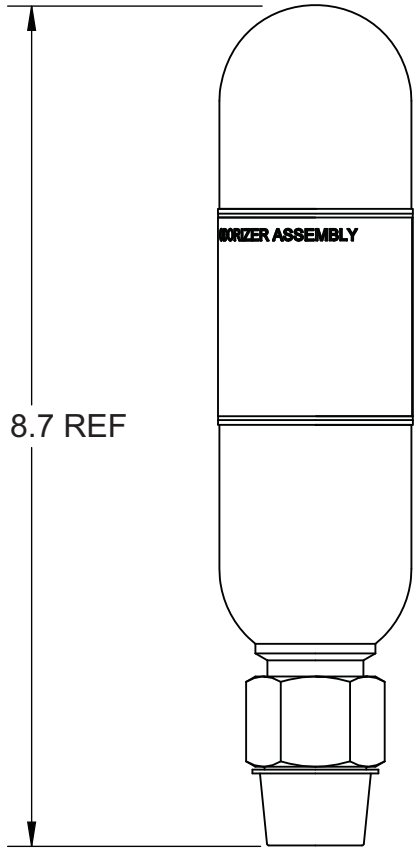


Figure 5-17. Odorizer Installation

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CHAPTER 6
OPERATION

6-1 FIXED SYSTEMS

6-1.1 Automatic Operation

When a system is operated automatically by the pneumatic detection system, all that is required of personnel is to evacuate the hazard area promptly, closing all doors, hatches, etc.

6-1.2 Remote Manual Mechanical Operation

Operate system as follows:

WARNING **USCG regulation mandates two separate controls for system operation. System will not discharge into the protected space unless both pull stations are operated.**

1. Evacuate all personnel from the hazard area immediately, close all hatches, doors, etc.
2. Proceed to cable pull stations for appropriate hazard.
3. Operate the control head cable station and the control valve cable pull station.
4. Notify appropriate personnel of emergency condition.

WARNING **If time delay fails to operate, operate manual control head lever installed on time delay to discharge system immediately.**

6-1.3 Remote Manual Pneumatic Operation

Operate system as follows:

WARNING **USCG Regulations mandates two separate controls for system operation. System will not discharge into the protected space unless both the nitrogen cylinder control head and both ball valves are operated.**

1. Evacuate all personnel from the hazard area immediately, close all hatches, doors, etc.
2. Proceed to remote pneumatic station for appropriate hazard.
3. Operate the Control head mounted on the nitrogen actuation cylinder.
4. OPEN both ball valves installed in the actuation piping downstream of the nitrogen cylinder.
5. Notify appropriate personnel of emergency condition.

WARNING **If time delay fails to operate, operate manual control head lever installed on time delay to discharge system immediately.**

6-1.4 Local Manual Operation

Operate system as follows:

CAUTION **This manual control is not part of the normal system actuation mode and should only be used in a last resort, emergency condition.**

1. Evacuate all personnel from the hazard area immediately, close all hatches, doors, etc.
2. Proceed to the cylinder(s) for the hazard fire.
3. Remove the locking pin from the cylinder control head.
4. Rotate lever up (rotate in a counterclockwise direction).
5. Proceed to hazard area control valve. Remove locking pin from control valve control head. Rotate lever clockwise.

WARNING **If time delay fails to operate, operate manual control head lever installed on time delay to discharge system immediately.**

6-2 HOSE REEL OR RACK SYSTEMS

Operate semi-portable hose reel or rack systems as follows:

6-2.1 Local Manual Operation

1. Proceed to carbon dioxide cylinder(s).
2. Remove the locking pin from the cylinder control head. Rotate lever to actuate.
3. Unwind hose from reel or rack. Approach fire carefully. Do not allow hose to lie in the path of the flames.
4. Point horn at hazard. Open horn valve by pushing stirrup handle forward.
5. Direct carbon dioxide discharge at base of the flames. As flames recede, follow slowly. Follow detailed instructions below.

6-2.1.1 SURFACE FIRES

1. Direct carbon dioxide discharge close to the edge of the fire nearest you. DO NOT point the horn at the center of the flame. If the hose horn must be aimed into a inaccessible fire, the horn must be in the OPEN position.
2. Sweep the horn slowly back and forth across the base of the flames. Chase flames slowly as the fire is extinguished. For bulkhead fires, direct the discharge at the bottom and gradually work upward as the fire recedes.
3. Continue discharging carbon dioxide until all smoldering material is covered with carbon dioxide “snow.”

6-2.1.2 ELECTRICAL FIRES - SWITCHBOARDS, MOTORS, ETC

Discharge carbon dioxide into all openings on burning substances. Continue to discharge carbon dioxide until flames have been extinguished and the burned material is coated with carbon dioxide “snow.” This will prevent any incandescent material from re-igniting.

While it is not necessary to de-energize equipment before discharging carbon dioxide onto electrical fires, equipment must be de-energized as soon as possible after system discharge to prevent the fire from spreading.

6-2.1.3 POST DISCHARGE

1. After the fire has been extinguished, leave the horn valve open to relieve all pressure from the hose.
2. Perform post fire maintenance outlined in Chapter 7.

6-2.2 Remote Manual Operation

If system is equipped with a remote cable pull station, operate system as follows:

1. Proceed to cable pull station. Break glass using attached hammer.
2. Pull handle to operate cylinder control head.
3. Unwind hose from rack or reel and discharge system as described in Section 6-2.1.

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CHAPTER 7
INSPECTION AND MAINTENANCE

WARNING

Storage, handling, transportation, service, and maintenance of cylinder assemblies shall be only by personnel trained in the proper procedures in accordance with the Safety Bulletins shown in the Foreword, and Compressed Gas Association* Pamphlets C-1, C-6, G-6, and P-1.

***CGA pamphlets are published by the Compressed Gas Association, and can be found at:**

http://www.cganet.com

WARNING

Before performing maintenance procedures, refer to the Material Safety Data Sheet found can be found online at the Kidde Fire Systems website (www.kiddefiresystems.com) and the Safety Bulletins in the Foreword of this manual.

WARNING

All pressurized equipment must be isolated from actuation devices prior to performing system maintenance. Observe all safety precautions applicable to handling Carbon Dioxide and Nitrogen pressurized equipment. Recharge of Carbon Dioxide and Nitrogen cylinder/valve assemblies must be accomplished only by qualified Kidde Fire Systems Distributors.

7-1 GENERAL

The fire extinguishing systems require proper care to ensure normal operation at all times. Periodic inspections must be made to determine the exact condition of the system equipment. A regular program of systematic maintenance must be established for proper operation of all carbon dioxide systems. A periodic maintenance schedule must be followed and an inspection log maintained for ready reference. At a minimum, the log must record:

- inspection interval,
- inspection procedure performed,
- maintenance performed, if any, as a result of inspection, and
- name of inspector performing task.

If inspection indicates areas of rust or corrosion are present, immediately clean and repaint the area. Perform cylinder hydrostatic pressure testing in accordance with Section 7-4 of this manual.

7-2 PREVENTIVE MAINTENANCE

Perform preventive maintenance as instructed in Table 7-1.

Table 7-1. Preventive Maintenance Schedule

Schedule	Requirement	Paragraph Reference
Monthly	Inspect hazard area system components	7-3
	Check nitrogen cylinder pressure	7-3
Semi-Annually	Check carbon dioxide cylinder weight(s)	7-4
	Verify odorizer cartridge	7-5
	Test pressure switch(s)	7-6
Every 2 Years	Blow out distribution piping	7-7.2
	Test pneumatic detection system	7-7.3
Every 5 Years	Inspect and/or hydrostatically test CO2 cylinder	7-8
	nitrogen cylinder	7-8.1
	flexible hoses	7-8.2

7-3 MONTHLY INSPECTION PROCEDURES

1. Make a general inspection survey of all cylinders and equipment for damaged or missing parts. If equipment requires replacement, refer to Paragraph 7-16.
2. Ensure access to hazard areas, remote nitrogen or cable pull stations, discharge nozzles, and cylinders is unobstructed and that there are no obstructions to the operation of the equipment or distribution of CO2.
3. Inspect 1/4 inch flexible actuation hoses for loose fittings, damaged threads, cracks, distortion, cuts, dirt and frayed wire braid. Tighten loose fittings, replace hoses with stripped threads or other damage. If necessary, clean parts as directed in Section 7-14. Inspect flexible actuation hose adapters for stripped threads and damage. Replace damaged adapters, inspect couplings and tees for tightness. Tighten coupling if necessary. Replace damaged parts.
4. Inspect CO2 cylinder pressure operated control heads for physical damage, deterioration, corrosion, distortion, cracks, dirt and loose couplings. Tighten loose couplings. Replace control head if damage is found. If necessary, clean as directed in Section 7-14.
5. Inspect CO2 cylinder and valve assembly (see Figures 4-1 and 4-2) for leakage, physical damage such as cracks, dents, distortion, and worn parts. If necessary, clean cylinder and associated parts as directed in Section 7-14.
6. Inspect cylinder straps, cradles and attaching hardware for loose, damaged, or broken parts, corrosion, oil, grease, grime, etc. Tighten loose hardware, replace damaged parts. If necessary, clean as directed in Section 7-14.
7. Inspect 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 Section 7-14.
8. Inspect discharge manifold for physical damage, corrosion and dirt. Inspect manifold support brackets and clamps for looseness and damage. Inspect connections to manifold for tightness. Inspect check valves where applicable for deformation, leakage, cracks, wear, corrosion, and dirt. Secure loose parts; replace damaged parts. If necessary, clean as directed in Section 7-14.
9. Inspect discharge nozzles for dirt and physical damage. Replace damaged nozzles. If nozzles are dirty or clogged, refer to Section 7-15.

CAUTION

Nozzles must never be painted. The part number of each nozzle is stamped on the nozzle. Nozzles must be replaced by nozzles of the same part number. Nozzles must never by interchanged, since random interchanging of nozzles could adversely affect proper CO2 distribution within a hazard area.

10. Inspect pressure switches for deformation, cracks, dirt or other damage. Replace switch if damage is found.
11. Check nitrogen cylinder for proper operating pressure. If pressure loss (adjusted for temperature exceeds 10%, recharge with nitrogen to 1,800 psig at 70°F.

7-4 SEMI-ANNUAL WEIGHING OF CARBON DIOXIDE CYLINDERS

WARNING

The Carbon Dioxide cylinders are equipped with a high rate discharge valve, which when actuated, will open, remain open, and cannot be closed. Accidental actuation of the discharge valve on an unsecured, disconnected cylinder will result in a discharge thrust capable of propelling the cylinder to velocities that will cause severe property damage and bodily injury. It is, therefore, extremely important that the exact sequence of cylinder removal always be followed. Further cylinder removal or cylinder replacement must always be supervised to assure full compliance with the instructions in this manual.

1. Remove control head at the coupling nut only (if control head not present, proceed to Step 3).
2. Attach protection cap to the actuation port.
3. Loosen cylinder framing so that cylinders can move freely.
4. Hook scale on weighing angle and slip yoke under discharge head. Adjust lever as shown in attached diagram (Figure 7-1).
5. Pull down until cylinder is just clear of floor and lever is horizontal.
6. Read weight directly off scale (scale is calibrated to compensate for leverage). Empty cylinder weight is stamped on the cylinder valve body; therefore, deduct empty weight from scale reading. Also, deduct 3.75lbs for weight of discharge head. The result is the amount (charge weight) of liquid carbon dioxide in the cylinder.
7. If charge weight loss exceeds 10%, proceed as follows:
    a. Disconnect discharge head from cylinder valve (discharge head must be left connected to the discharge hose and system piping to prevent injury in the event of discharge).
    b. Install the valve protection cap on cylinder
    c. forward charged cylinder WITH DISCHARGE HEAD AND CONTROL HEAD REMOVED AND SAFETY CAP AND PROTECTION CAP INSTALLED to a recognized Kidde Fire Systems distributor.
8. After all carbon dioxide cylinders have been weighed, tighten clamps.
9. Reinstall control heads on cylinders.
10. Tighten control head nuts securely.

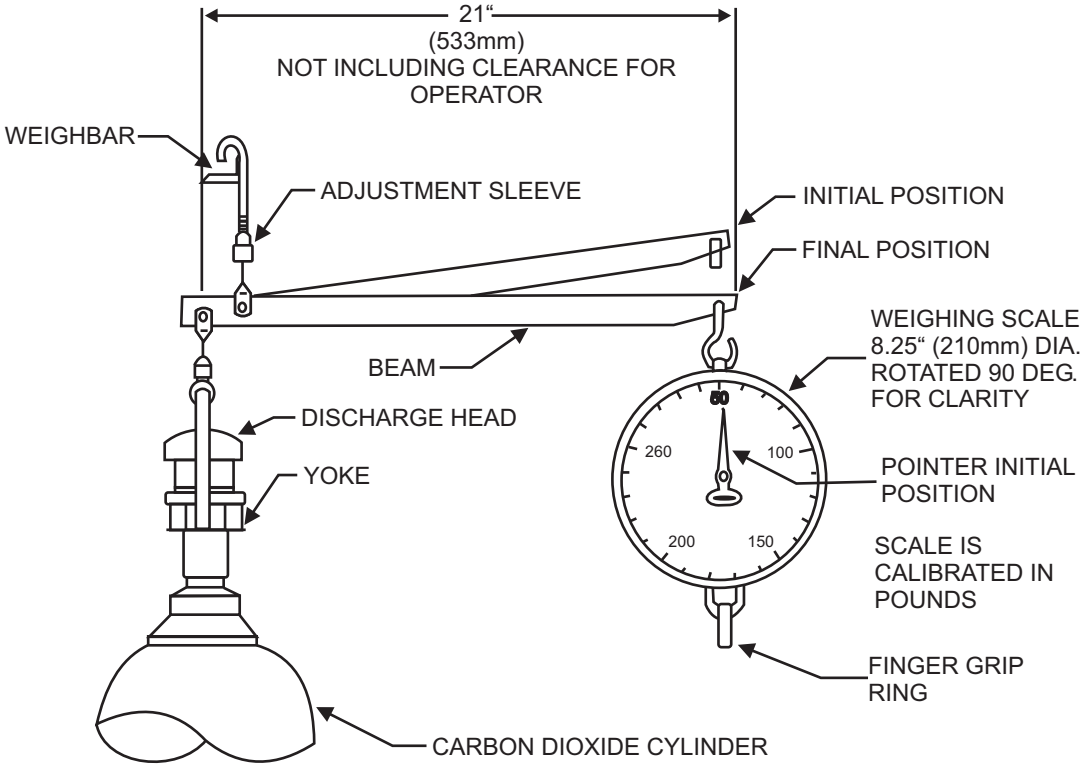


Figure 7-1. Weighing Carbon Dioxide Cylinder Using Scale P/N 81-982505-000

7-5 VERIFY ODORIZER ASSEMBLY

Verify the odorizer assembly as follows:

1. Remove the odorizer assembly.
2. Check to make sure the burst disc is intact.
3. Reattach the odorizer assembly. If the burst disc has ruptured, replace the odorizer assembly.

7-6 PRESSURE SWITCH TEST

Perform pressure switch test as follows:

1. Contact appropriate personnel and obtain authorization for shutdown.
2. Check that hazard area operations controlled by pressure switch are operative.
3. Manually operate switch by pulling up on plunger and verify that hazard area operations controlled by pressure switch shutdown.
4. Return pressure switch to “SET” position.
5. Re-activate all systems shutdown by pressure switch (power and ventilation systems, compressors, etc.)

7-7 TWO YEAR INSPECTION

7-7.1 Equipment Inspection

Perform the procedures described in:

- Paragraph 7-3
- Paragraph 7-4

7-7.2 Distribution Piping Blow Out

Before blowing out system, remove pipe caps from the ends of the distribution piping to allow any foreign matter to blow clear. In addition, remove any frangible discs from vent or flanged nozzles (if installed). Blow out all distribution piping with dry air or CO_2 to make sure there are no obstructions.

WARNING

Do not use water or oxygen to blow out pipe lines. The use of oxygen is especially dangerous as the possible presence of even a minute quantity of oil may cause an explosion.

1. Remove all discharge heads from the carbon dioxide cylinders.
2. Remove all pipe caps on dirt traps from distribution piping to allow any foreign matter to blow clear.
3. Remove all frangible discs (if installed).

WARNING

Do not disconnect discharge head(s) from flexible hose(s). Discharge of CO_2 system will cause flexible hose, without discharge head attached, to flail violently, resulting in possible equipment damage and severe bodily injury to personnel.

4. Discharge test cylinder into system manifold. Use of CO_2 or dry air is acceptable. Discharge duration is to be of sufficient length to insure that all piping is blown clear.
5. Reinstall all pipe caps and frangible discs as required.
6. Reconnect all discharge heads to CO_2 cylinder valves.

7-7.3 Pneumatic Detection System Tests

CAUTION

Before conducting any of the tests outlined below first remove the discharge heads from the cylinders equipped with pneumatic control heads. Then remove the pneumatic control heads from the cylinder valves. This will prevent discharge of the system upon accidental operation of a control head. When tandem heads are used, back-off each head at the same time before attempting to remove either head from the cylinder valves. Do not allow the control heads to rotate out of position.

7-7.3.1 PNEUMATIC CONTROL HEAD TEST - PRESSURE SETTING

Note: The tests to be performed using Manometer Test Set Kidde Fire Systems Part No. 81-840041-000.

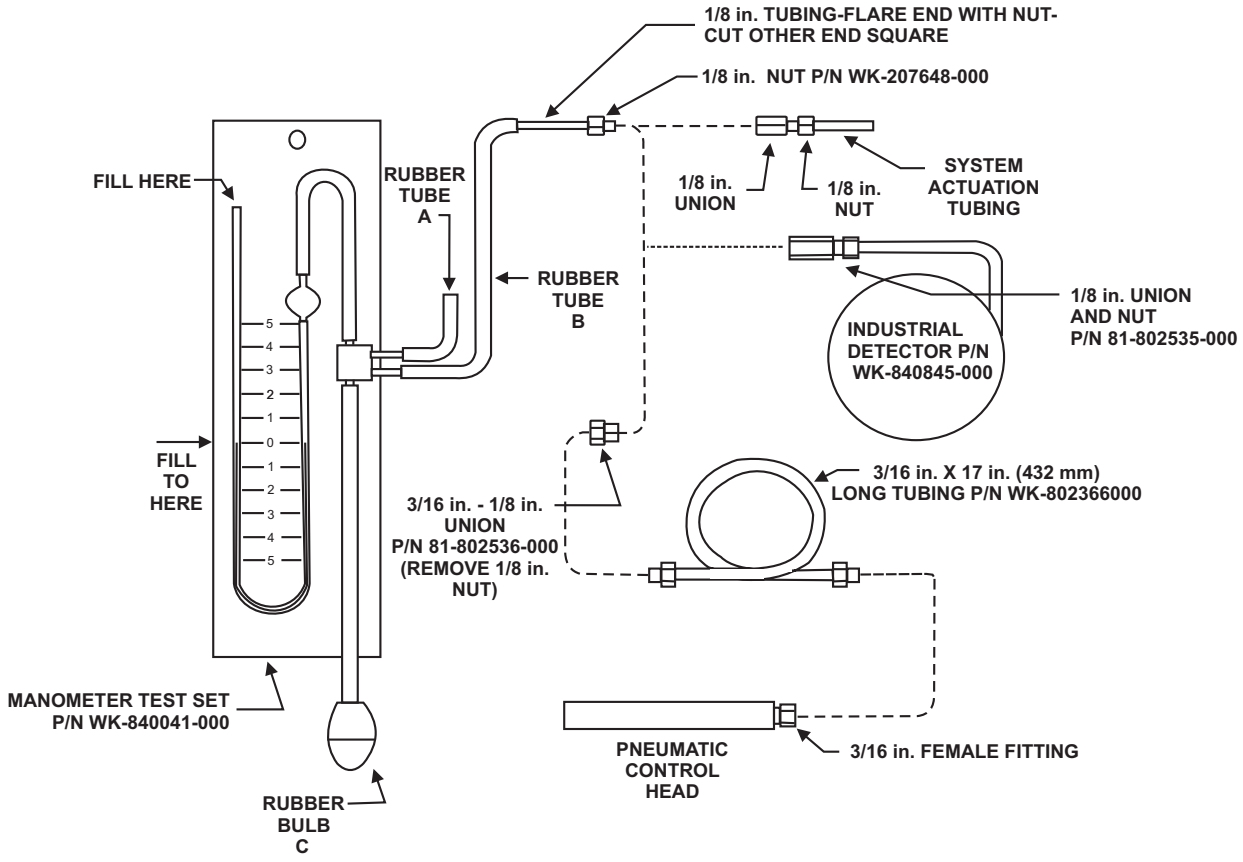


Figure 7-2. Manometer Pneumatic Detection

1. Connect the test fitting of the manometer test set to the diaphragm chamber of the control head.
2. Make certain sufficient clearance is provided at mounting nut so control head will not be damaged upon operation.
3. If control head has been operated, reset by placing screwdriver in reset stem and turning clockwise until stem locks in position. This occurs when the arrow on the reset stem is lined up with the “SET” arrow on the nameplate.
4. Slight resistance will be met just before stem locks.
5. Use manometer test set Part No. 81-840041-000, and pour water into the open glass tube until the water level in both tubes is exactly at the zero mark.
6. Close off the rubber tube “A” by squeezing tightly with the fingers or use a crimp clamp. Apply pressure by gradually squeezing the rubber bulb "C". The control head should operate at the factory pressure setting with +/- 10% tolerance allowed. The pressure required to operate the control head is the difference, in inches, between the water levels in the two tubes, and is equal to twice the reading of either tube.

CAUTION

After the control head has operated, be sure to release rubber tube "A" first before allowing the rubber bulb "C" to expand to normal; otherwise, water may be drawn into the tubing and control head, causing serious problems.

7-7.3.2 CONTROL HEAD VENT TEST

Before disconnecting manometer from the control head, the vent must be tested. To test the vent for correct calibration, perform the following steps:

1. Squeeze rubber bulb "C" about halfway or enough to achieve sufficient vacuum for test. Then close tube "A" by pinching with fingers or crimp clamp.
2. Let bulb expand gradually to its normal shape. This creates a partial vacuum, causing the manometer water level to change, indicating inches of vacuum applied to the control head. The vacuum must be more than a minimum of 3 inches in order to observe a drop from 3 inches to 1 inch.
3. The water column will recede to "0" level as air passes through the vent. The vent setting is the time required (in seconds) for the water column to drop 2 inches from a level of 3 inches to 1 inch on both legs (or from 1-1/2 inches to 1/2 inch on each leg) of the U-Tube manometer. This is also known as the calibrated rate of flow. For example, if the time required to pass the above amount of water is 5 seconds, the control head vent is "No. 5". When vents are tested in control heads, the time will vary due to the added volume in the control head diaphragm chamber, and a No. 5 vent will test 5-7 seconds, which is acceptable. If a vent time reads much higher, it will increase system sensitivity; if a vent time reads much lower, it will decrease system sensitivity and may not be acceptable. Repeat above procedure for testing tandem control head, if installed. Since there is no vent in the tandem control head, the vacuum should hold.
4. Disconnect manometer test set from the control head, test fitting "A". Reset the control head by turning the reset stem to its “SET” position.

Note: For accuracy, Kidde Fire Systems test set Part No. 81-840041-000 must be used.

7-7.3.3 TEST FOR LEAKAGE OF SYSTEM TUBING AND DETECTORS

1. Connect the test fitting of the manometer to the pneumatic detector tubing at the control head connection nut.
2. Squeeze the rubber bulb "C" fully. Close off the open rubber tube "A". Very gradually, release the rubber bulb to its normal shape. This will cause the water level in the two tubes to change, and a maximum vacuum will develop. Hold a minimum of 8 inches vacuum, the difference between the two sides of the "U" tube, or 4 inches on each side of the "U" tube.
3. If all connections are absolutely tight, the water level will remain in the position taken in paragraph 2 above and will not change as long as the rubber tube "A" is held closed. Observe the level of the water for at least one minute, and then release the rubber tube "A". It is absolutely essential the water level remain the same as long as the rubber tube is held closed. Even a slow, steady fall of the water level is serious, for it indicates a leak which may prevent automatic operation of the system. Disconnect the test set from the detector tubing. After tests have been completed, reset the control heads.

WARNING **When using hot or boiling water, exercise care when immersing the Pneumatic Detector Actuating Chamber. Do not stand directly beneath the water container.**

4. Functional Test of the Detection System. Hold a container of hot or boiling water under the heat detector, immersing the actuating chamber in the water. At least 50% of the detector should be immersed. The water must be at least 100°F above the ambient temperature. Note the time between the application of the hot water to the detector and the operation of the control head. The control head should operate in approximately 15 seconds. Do not apply heat for more than 15 seconds. The detector is not functioning if the control head has not operated within this time.

   When testing two control heads connected in tandem, both may not operate simultaneously. Both control heads should operate within 30 seconds if the heat is sustained.

5. The heat test should be performed on each heat detector. Between each test, wait about ten minutes for the system to return to normal, and then reset the control head(s). To reset, insert screwdriver in reset stem and turn clockwise until the stem locks in position with the arrow on reset stem lining up with the "Set" arrow on the nameplate. (Slight resistance will be met just before the stem locks.)
6. If the application of heat does not cause the control head to operate within 15 seconds, remove the container of water and investigate the cause.

7-7.3.4 TROUBLESHOOTING OF PNEUMATIC DETECTION SYSTEM

Failure of the pneumatic detection system to operate when applying heat to the detectors may be caused by:

- Insufficient heat applied to the detector
- Leakage in the tubing system (tubing connections not tight).
- Obstruction in the tubing.

The manometer can be used to assist in trouble shooting the system as follows:

1. Install manometer in system tubing at pneumatic control head connection. Replace union connection with a control head "T." Connect manometer tube B to the "T" fitting. Close open tube A of the manometer with a crimp clamp. The manometer is now an integral part of the system and provides a visual record of pressure to which system is subjected by heat or cold at the detector.
2. The installation of the manometer as described above provides a visual indication of the pressure build-up within the system and will assist in determining if there is sufficient or insufficient pressure build-up during the test of the system.

7-8 5 YEAR AND 12 YEAR INSPECTION AND TEST GUIDELINES

7-8.1 Carbon Dioxide and Nitrogen Cylinders

The United States' Code of Federal Regulations (CFR) Title 49 - Transportation and Canada's Transport Canada (TC) Transport of Dangerous Goods Act (TDG) Part 5 govern the design, fabrication, testing and stamping of hazardous goods transported over all public ways (roads, rail, boat, etc.). When filled, CFR49/TDG classify Kidde cylinders as hazardous goods. In any case of information within this section conflicting with CFR49/TDG, the requirements of CFR49/TDG take precedence over the instructions provided within this section.

All Kidde cylinders are designed, fabricated, tested and stamped in compliance with CFR49/TDG.

7-8.1.1 CARBON DIOXIDE CYLINDERS

Kidde CO2 cylinders shall comply with CFR49/TDG requirements while in transit and shall comply with NPFA 12 requirements while installed.

All Kidde CO2 cylinders shall be qualified for use over public ways in accordance with CFR49/TDG as applicable. Per CFR49/TDG, qualified cylinders shall not have a hydrostatic test date stamp that is more than five (5) years old. Cylinders with a date stamp more than 5 years old shall be re-qualified in accordance with CFR49/TDG prior to shipment.

While installed, NPFA 12 allows CO2 cylinders to remain in service for a maximum of twelve (12) years from the last stamped hydrostatic test date. At the end of the 12 year period, cylinders shall be removed from service, vented (emptied) and re-qualified in accordance with CFR49/TDG before returning to service. The applicable sections of this manual shall be followed when removing, venting or reconnecting cylinders to service.

7-8.1.2 NITROGEN CYLINDERS

Kidde N2 cylinders shall comply with CFR49/TDG requirements while in transit and shall comply with NPFA 12 requirements while installed.

All Kidde N2 cylinders shall be qualified for use over public ways in accordance with CFR49/TDG as applicable. Per CFR49/TDG, qualified cylinders shall not have a hydrostatic test date stamp that is more than allowed period of time. CFR49/TDG define the allowed period of time as ten (10) years for 3AA cylinders with a water capacity of 125-lbm (3,467 cu. in.) or less. CFR49/TDG define the allowed period of time as five (5) years for 3AA cylinders with a water capacity greater than 125-lbm (3,467 cu. in.). Cylinders with a date stamp older than the allowed period of time shall be re-qualified in accordance with CFR49/TDG prior to shipment.

While installed, NPFA 12 allows N2 cylinders to remain in service indefinitely.

Any cylinder (CO2/N2/Other) shall be re-qualified immediately if the cylinder shows evidence of distortion, damage, cracks, corrosion or mechanical damage. Any cylinder failing requalification shall be destroyed. The applicable sections of this manual shall be followed when removing, venting or reconnecting cylinders to service.

7-8.2 Flexible Hoses

Flexible hoses must be hydrostatic pressure tested every five years in accordance with the requirements in NFPA 12.

7-8.3 Cleaning

Remove dirt from metallic parts using a lint-free cloth moistened with dry cleaning solvent. Dry parts with clean, dry, lint-free cloth or air blow dry. Wipe non-metallic parts with clean, dry lint-free cloth. Clean and paint steel parts as required.

7-8.4 Nozzle Service

Service nozzles after use as follows:

1. Clean outside of nozzles with rag or soft brush.
2. Examine discharge orifices for damage or blockage. If nozzles appear to be blocked, unscrew nozzles and clean by immersing in dry cleaning solvent and drying thoroughly with lint-free cloth. Replace damaged nozzles. Nozzles must be replaced with same part number. Clean and paint steel nozzle bowls as required.
3. Examine nozzle frangible discs (if installed). Replace damaged or ruptured frangible discs.

7-9 REPAIRS

Replace all damaged parts found during inspection. Replacement procedures for carbon dioxide and nitrogen cylinders are provided below. Since replacement for other system components are simple, refer to installation drawings and component drawings provided in Chapter 4 for guidance.

7-9.1 Removal of Cylinders

7-9.1.1 CO2 CYLINDERS

WARNING

When removing charged cylinders, always disconnect the discharge heads first. This will eliminate the possibility of discharging the CO2, resulting in possible equipment damage or injury to personnel.

These instructions must be carefully performed in the exact order given when any cylinder or group of cylinders is removed at any time.

4. Remove discharge heads from all cylinder valves by loosening mounting nuts (right hand thread).
5. Remove all control heads from the cylinder valves by loosening mounting nut (right hand thread). On two cylinder installations, swing discharge head and hose away from cylinder and allow to hang.
6. Screw large top protection cap to threads on top of cylinder valve. Cap control head outlet by screwing on side protection cap.
7. Remove cylinder racks.
8. Remove cylinder(s).

WARNING

Cylinder cap must be screwed on to prevent damage to cylinder valve during removal. Damage to cylinder valve could cause cylinder discharge, causing possible equipment and property damage or injury to personnel. This cap is not included in the empty weight of the cylinder.

7-9.1.2 NITROGEN PILOT CYLINDERS

1. Remove control head from nitrogen cylinder valve.
2. Install protection cap on nitrogen cylinder actuation port.
3. Loosen flexible actuation hose and remove adapter (Part No. WK-699205-010) from the cylinder valve outlet.
4. Open bracket strap and remove nitrogen cylinder from bracket.

7-9.2 Installation of Cylinders

7-9.2.1 CO2 CYLINDERS

WARNING

When installing charged cylinders, always replace the discharge heads last. This will eliminate the possibility of discharging the CO2, resulting in possible equipment damage or injury to personnel.

These instructions must be carefully performed in the exact order given when any cylinder or group of cylinders is installed at any time.

1. Place fully charged cylinder in cylinder rack before removing cylinder cap.
2. Install the cylinder racks and tighten bolts only enough to allow for turning of cylinder as may be required later.
3. Remove the cylinder cap and top protection cap from cylinder valve. Remove the side protection caps from the cylinder valves to be equipped with control heads. Return all caps to the storeroom. Assemble fixed system control head and tighten mounting nut.

4. Turn cylinder so that the control head outlet points in the proper direction; tighten bolts of cylinder racks securely.
5. Make certain all control heads have been reset as follows:
   - Return level to SET position. The plunger should fully recede into the control head body. Replace any control head that fails to reset properly.
   - Replace locking pin and install new seal wire.
6. Install control heads on cylinder valves. Tighten mounting nuts.
7. Assemble discharge heads to cylinder valves and tighten mounting nuts.

WARNING

To avoid accidental discharge, do not install the discharge heads until control heads have been installed on the cylinder valves.

7-9.2.2 NITROGEN CYLINDERS

1. Install nitrogen cylinder in position in mounting rack.
2. Tighten sufficiently to hold cylinder in place while allowing cylinder enough free play to be manually rotated.
3. Remove nitrogen cylinder valve protection cap.
4. Manually rotate cylinder until cylinder valve discharge outlet is in desired position.

CAUTION

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

5. Securely tighten mounting bracket clamps and hardware.
6. Remove protective cap from cylinder valve control head port.
7. Remove pipe plug and reconnect flexible actuation hose to cylinder valve outlet port.
8. Install control head to cylinder valve; tighten securely.

7-10 POST FIRE MAINTENANCE

After a CO2 discharge, qualified fire suppression system maintenance personnel must perform post fire maintenance as directed in this section. Observe all warnings, especially those pertaining to the length of elapsed time before entering the hazard area.Recharge all carbon dioxide and nitrogen cylinders immediately after use.

WARNING

Do not enter a space with an open flame or lighted cigarette. The possible presence of flammable vapors may cause reignition of vapors or explosion.

For deep seated hazards, the space must be kept tightly closed for 20 to 60 minutes after system discharge. Be sure fire is completely extinguished before ventilating area. Before permitting anyone to enter the space, ventilate area thoroughly or use self-contained breathing apparatus.

1. Return all cylinders to a recognized Kidde Fire Systems distributor or other qualified refill agency.
2. Recharge cylinders in accordance with procedures outlined in this manual.
3. Reset all control heads. Replace any control head that fails to reset properly. Install locking pins. Replace seal wires.

WARNING

Verify control head is in "SET" position with plunger fully retracted before installing on a charged cylinder. Control head in the "Released" position with plunger extended will cause cylinder to discharge, resulting in possible property or equipment damage, personal injury, or death.

4. If system was operated using a nitrogen pilot cylinder, remove the control head from the nitrogen cylinder. This will vent nitrogen pressure from the actuation piping and reset the lever/pressure operated control heads on the carbon dioxide cylinders.
5. Replace broken glass in remote pull stations.
6. Replace all discharged odorizer assemblies.

7-11 CYLINDER RECHARGE

CO_2 cylinders must not be recharged without a retest if more than five (5) years have elapsed since the last test. Retest shall be in accordance with the requirements of 49 CFR. After retest, cylinder must be thoroughly dried and free of any water vapor.

WARNING

Under no circumstances while performing either cylinder recharge or leak test should a carbon dioxide cylinder have a discharge head or control head attached to the cylinder valve. When removing Carbon Dioxide cylinders, observe the following:

- **Each cylinder is factory equipped with a valve protection cap threaded securely over the valve assembly. This cap is a safety device which protects the valve from damage during cylinder handling.**
- **This device must be installed at all times, except when the cylinder is connected into the system piping or being filled.**
- **The valve protection cap must be stored in a secure space and made readily available for use. Never move or handle cylinder without the cap installed.**

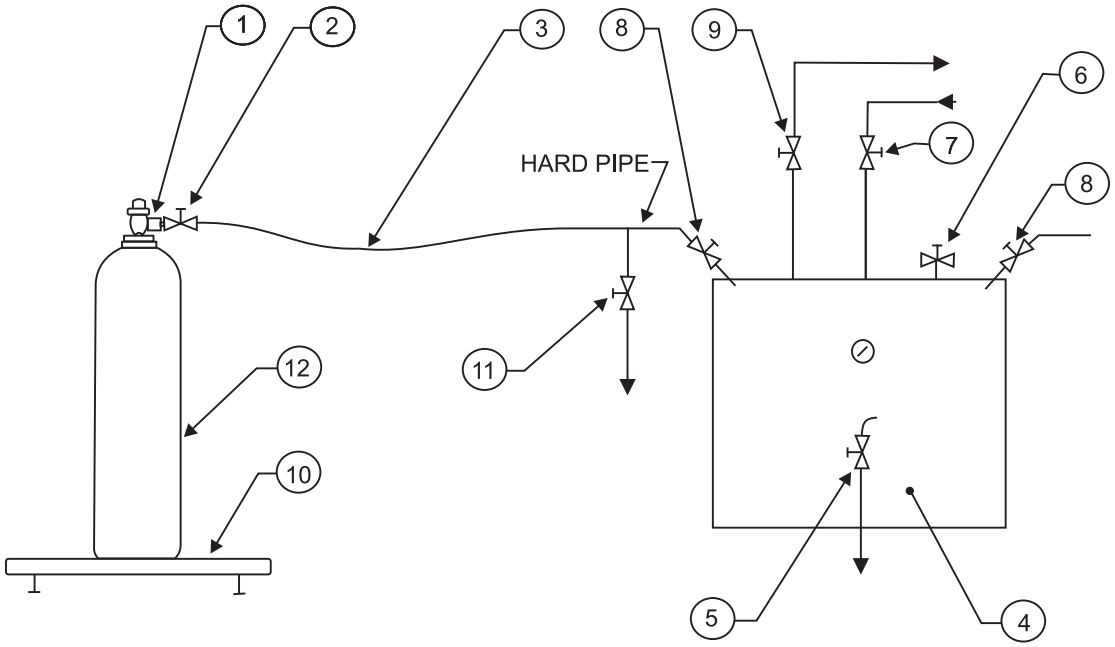
7-11.1 CO_2 Cylinders

Note: CO_2 cylinders are filled by weight only, not by pressure.

CAUTION

CO_2 cylinders are filled with the required quantity using an approved transfer pump. DO NOT use dry ice converters as this may allow water vapor to enter the cylinder, causing internal corrosion.

1. Securely clamp cylinder to a rigid structure.
2. Blow cylinder down through pilot check port to vent off all remaining CO_2 agent.
3. Set empty cylinder (12) on scale (10). Connect charging adapter (1) to the cylinder pilot port.
4. Close vent valve (11), open supply valve (7), main control valve (6), and station valve (8). Record tare weight of the cylinder assembly (12) (with flexible line attached) on cylinder record tag.
5. Open flexible line control valve (2) and observe the weighing scale dial. When the scale weight reaches the sum of the charge weight and the previously recorded tare weight, shut off the flexible line control valve (2) and the main control valve (5). Open the vent valve (11) to vent the CO_2 from the flexible line. Disconnect the flexible line adapter and observe the full weight of the cylinder and valve assembly (12). Record full weight on the cylinder record tag.
6. The charged cylinder is now ready for leak test.



1. Recharge Adapter
2. Flexible Line Control Valve
3. Flexible Hose
4. Cylinder Filling Unit
5. Vent Valve
6. CO_2 Main Control Valve
7. CO_2 Supply Inlet Control Valve
8. CO_2 Station Valve
9. Return Line Valve
10. Weight Scale
11. Vent Valve
12. CO_2 Cylinder/Valve Assembly

Figure 7-3. Carbon Dioxide Cylinder Recharge Schematic

7-11.2 Carbon Dioxide Cylinder Leak Test

1. Leak test cylinder either by immersing in water using a bell jar over the valve to detect for leaks or
2. Apply soap solution to all pressure connections and observe for bubble leaks.

7-11.3 Nitrogen Cylinders

Nitrogen cylinders must be recharged when cylinder pressure gauge indicates pressure is below normal (1800 psig at 70°F (21°C)) or as adjusted for temperature (as shown on Figure 7-4) or immediately after discharge. Nitrogen used for charging must comply with Federal Specification BB-N-411, Grade A, Type 1. Copies of this specification may be obtained from: Global Engineering Documents, 2625 S. Hickory St., Santa Ana, CA 92707.

Recharge nitrogen cylinders as follows:

WARNING

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

WARNING

Before recharging, 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.

1. Remove cylinder valve protection cap.
2. Install nitrogen cylinder charging adapter (P/N WK-844347-000) to cylinder valve control head port and plug valve outlet port with 1/8" NPT pipe plug.
3. Connect nitrogen recharging supply hose to adapter. Tighten securely.
4. Open nitrogen recharging control valve slowly until full nitrogen flow is obtained.
5. Monitor recharging supply pressure gauge. Close recharging control valve when gauge indicates the proper cylinder pressure (1,800 psi at 70°F).
6. Allow cylinder to cool to ambient temperature and recheck nitrogen cylinder indicated pressure.
7. Open valve and add additional nitrogen as necessary to obtain full cylinder charge at ambient temperature (1,800 psi).
8. Close valve and remove supply hose and charging adapter from nitrogen cylinder.
9. Using a soap solution, thoroughly check nitrogen cylinder valve for leakage. Bubbles appearing in soap solution indicate leakage and shall be cause for rejection of cylinder.
10. At completion of leak test, thoroughly clean and dry cylinder valve.
11. Ensure cylinder valve control head port is clean and dry.
12. Install protective cap to control head port and install cylinder valve protective cap.
13. Install charged cylinder as instructed previously.

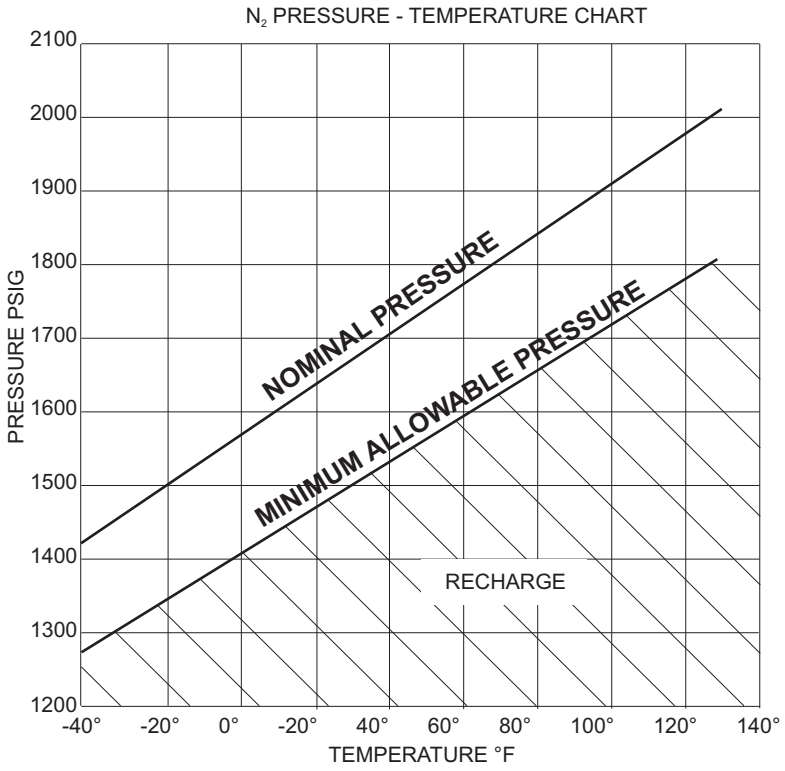


Figure 7-4. Nitrogen Temperature vs. Pressure Data

7-12 HOSE REEL OR RACK SYSTEM

1. Verify the hose horn valve is in the OPEN position to relieve all pressure from hose.
2. Close horn valve.
3. Inspect hose and horn valve for fire damage. Replace if damage is found.
4. Rewind hose on rack or reel. Place horn in clip.
5. Reset control head. Reinstall locking pin. Replace seal wire.

WARNING

Verify control head is in "SET" position with plunger fully retracted before installing on a charged cylinder. Control head in the "RELEASED" position with plunger extended will cause cylinder to discharge, resulting in possible property or equipment damage, personal injury, or death.

6. If hose reel or rack system was operated using a cable pull station, replace broken pull station glass.
7. Remove empty cylinder(s). Reinstall charged cylinder(s) as instructed previously.

CHAPTER 8
PARTS LIST

8-1 USCG APPROVED PARTS

This chapter identifies the USCG approved parts comprising the Kidde Fire Systems carbon dioxide fire suppression system. The information is grouped as follows:

- Cylinders and Associated Equipment (Table 8-1)
- Manual and Pressure Control Equipment (Table 8-2)
- Remote Control Equipment, Cable (Table 8-3)
- Pneumatic Control Equipment (Table 8-4)
- Check Valves (Table 8-5)
- Directional (Stop) Valves (Table 8-6)
- Lockout Valves (Table 8-7)
- Hose Equipment (Table 8-8)
- Auxiliary Equipment (Table 8-9)
- Maintenance and Repair Parts (Table 8-10)
- Carbon Dioxide Nozzles (Table 8-11)
- Nozzle Identification (Table 8-12)
- Carbon Dioxide Nozzles, Accessories (Table 8-13)
- CO_2 Valves Maintenance, Repair and Spare Parts (Table 8-14)
- Oak Rack Kits (Table 8-15)
- Oak Rack Parts(Table 8-16)

Table 8-1. Cylinders and Associated Equipment

Part No.	Description
81-870486-000	25 lb. (11.3 kg) Cylinder & Valve Assembly, Bent Siphon
81-982547-000	35 lb. (15.9 kg) Cylinder & Valve Assembly, Bent Siphon
81-982548-000	50 lb. (22.7 kg) Cylinder & Valve Assembly, Bent Siphon
81-870287-000	75 lb. (34.0 kg) Cylinder & Valve Assembly, Straight Siphon
81-870269-000	100 lb. (45.4 kg) Cylinder & Valve Assembly, Straight Siphon
81-100067-003	100 lb. (USCG) Cylinder & Valve Assembly, Straight Siphon
81-100067-004	100 lb. (SOLAS) Cylinder & Valve Assembly, Straight Siphon
81-872450-000	Discharge Head, Plain Nut
81-872442-000	Discharge Head, Grooved Nut
WK-251821-000	Flexible Hose, 3/4-inch Outlet
81-252184-000	Flexible Hose, 1/2-inch Outlet
81-207877-000	Manifold “Y” Fitting
WK-934208-000	Swivel Adapter, 1/2-inch NPT

Table 8-2. Manual and Pressure Control Equipment

Part No.	Description
WK-870652-000	Lever Operated Control Head
82-878751-000	Lever and Pressure Operated Control Head
82-878737-000	Pressure Operated Control Head
82-878750-000	Pressure Operated Control Head, Stackable
WK-264987-000	Actuation Hose, 22-inch
WK-264986-000	Actuation Hose, 30-inch
WK-699205-050	Male Branch Tee, 5/16-inch Flare x 1/8-inch NPT
WK-699205-030	Male Elbow, 5/16-inch Flare x 1/8-inch NPT
WK-699205-010	Male Connector, 5/16-inch Flare x 1/8-inch NPT
81-979469-000	Cable Operated Control Head
WK-331570-000	Cable Housing, 25 and 35 lb. Cylinders
WK-202355-000	Cable Housing, 50 and 75 lb. Cylinders
WK-200822-000	Cable Housing, 100 lb. Cylinders
WK-877940-000	Nitrogen Pilot Cylinder, 108 $in.^3$ (1770 cc), no pressure switch
06-129773-001	Nitrogen Pilot Cylinder, 108 $in.^3$ (1770 cc) With Supervisory Pressure Switch, Normally Open Under Pressure
06-129773-002	Nitrogen Pilot Cylinder, 108 $in.^3$ (1770 cc) With Supervisory Pressure Switch, Normally Closed Under Pressure
WK-877845-000	Mounting Bracket, Nitrogen Pilot Cylinder
WK-283888-000	Ball Valve, 1/4-inch, Marine

Table 8-3. Remote Control Equipment, Cable

Part No.	Description
81-840098-000	Pull Box, Flush, 3/8-inch Pipe (Yacht Type)
81-871403-000	Pull Box, Surface 3/8-inch Pipe (Break Glass)
81-870087-000	Pull Box, Surface, 3/8-inch Pipe (Water Tight)
81-605320-000	Pull Box Bracket (81-871403-000)
81-803808-000	Corner Pulley, 3/8-inch Pipe (Water Tight)
81-840058-000	Dual Pull Mechanism, 3/8-inch Pipe
81-840051-000	Dual Pull Equalizer, 3/8-inch Pipe (1/16-inch Cable Only)
06-118316-100	1/16-inch Cable 100 ft. Roll
WK-219649-000	1/16-inch Cable 500 ft. Roll

Table 8-4. Pneumatic Control Equipment

Part No.	Description
81-872335-000	Pneumatic Control Head, 3-inch 5 seconds
81-872365-000	Pneumatic Control Head, 6-inch 5 seconds
81-872362-000	Pneumatic Control Head, 6-inch 2 seconds
81-872310-000	Pneumatic Control Head, Tandem 1-inch
81-872330-000	Pneumatic Control Head, Tandem 3-inch
81-872360-000	Pneumatic Control Head, Tandem 6-inch
WK-841241-000	Pneumatic Heat Detector (3/16-inch Tubing, Marine)
81-840044-000	Cable Housing, 25 and 35 lb. Cylinders
81-840398-000	Cable Housing, 50 and 75 lb. Cylinders
81-841739-000	Cable Housing, 100 lb. Cylinders
WK-207825-000	Rubber Grommet
WK-802366-000	Tubing, 3/16-inch x 17-inch (432 mm)
81-802367-000	Tubing, 3/16-inch x 46-inch (1168 mm)
WK-802486-000	Tubing, 3/16-inch x 12 feet (3.7 m)
WF-528103-000	Tubing Nut, 3/16-inch (Marine)
WK-528103-700	Tee, 3/16-inch without Nuts (Marine)
WK-528103-600	Union, 3/16-inch without Nuts (Marine)
WK-150530-000	Tubing Clip (Marine)
WK-802742-000	Vent, 2 Second
81-802743-000	Vent, 3 Second
WK-802745-000	Vent, 5 Second
WK-802746-000	Vent, 10 Second
WK-200370-000	Vent Plug
WK-209145-000	Wrench, Vent Plug
WK-207875-000	Flaring Tool, 1/8-inch Tubing

Table 8-5. Check Valves

Part No.	Description
WK-264985-000	Check Valve, 1/4"
WK-261193-000	Check Valve, 3/8"
81-800327-000	Check Valve, 1/2"
81-800266-000	Check Valve, 3/4"
WK-800443-000	Check Valve, 1"
81-800444-000	Check Valve, 1-1/4"
81-870152-000	Check Valve, 1-1/2"
81-870151-000	Check Valve, 2"
81-870100-000	Check Valve, 3" FLG (order flgs separately)

Table 8-6. Directional (Stop) Valves

Part No.	Description
81-870023-000	Stop Valve, 1/2”
81-870022-000	Stop Valve, 3/4”
81-870122-000	Stop Valve, 1”
81-870032-000	Stop Valve, 1-1/4”
81-870123-000	Stop Valve, 1-1/2”
81-870049-000	Stop Valve, 2”
81-890010-000	Stop Valve, 3” Flanged Brass (Order Flanges Separately)
81-890208-000	Stop Valve, 4” Flanged Brass (Order Flanges Separately)
WK-263716-000	2-1/2” Flange (For Welded Pipe)
WK-681012-000	3” Flange (For Welded Pipe)
WK-200973-000	Gasket, for 2-1/2” & 3” Flanges
WK-196648-720	Bolt, 3/4“ x 4-1/2” Hex, 2-1/2” & 3” Flanges
WK-152348-000	Nut, 3/4” Hex, for 2-1/2” & 3” Flanges
WK-681016-000	4” Flange (For Welded Pipe)
WK-200150-000	4” Gasket, for 4” Flanges
WK-196656-800	Bolt, 7/8” x 5” Hex, for 4” Flanges
WK-152356-000	Nut, 7/8” Hex, for 4” Flanges

Table 8-7. Lockout Valves

Part No.	Description
10611104	SS Lock-Out Valve, 1/4"
10611100	SS Lock-Out Valve, 1/2"
10611101	SS Lock-Out Valve, 3/4"
10611099	SS Lock-Out Valve, 1"
10611102	SS Lock-Out Valve, 1-1/4"
10611098	SS Lock-Out Valve, 1-1/2"
10611103	SS Lock-Out Valve, 2"
10611106	SS Lock-Out Valve, 1/4" (w/limit switch & Indicator)
10611107	SS Lock-Out Valve, 1/2" (w/limit switch & Indicator)
10611108	SS Lock-Out Valve, 3/4" (w/limit switch & Indicator)
10611109	SS Lock-Out Valve, 1" (w/limit switch & Indicator)
10611110	SS Lock-Out Valve, 1-1/4" (w/limit switch & Indicator)
10611111	SS Lock-Out Valve, 1-1/2" (w/limit switch & Indicator)
10611112	SS Lock-Out Valve, 2" (w/limit switch & Indicator)
10611113	SS Lock-Out Valve, 1/4" (w/XP&WP limit switch & Indicator)
10611114	SS Lock-Out Valve, 1/2" (w/XP&WP limit switch & Indicator)
10611115	SS Lock-Out Valve, 3/4" (w/XP&WP limit switch & Indicator)

Table 8-7. Lockout Valves (Continued)

Part No.	Description
10611116	SS Lock-Out Valve, 1" (w/XP&WP limit switch & Indicator)
10611117	SS Lock-Out Valve, 1-1/4" (w/XP&WP limit switch & Indicator)
10611118	SS Lock-Out Valve, 1-1/2" (w/XP&WP limit switch & Indicator)
10611119	SS Lock-Out Valve, 2" (w/XP&WP limit switch & Indicator)
06-231867-379	CO_2 System Lockout Valve Operational Sign

Table 8-8. Hose Equipment

Part No.	Description
WK-994058-000	Reel - Standard Paint - Red Enamel
WK-909000-000	Coupling Nut, Hose Reel (Required for 994058)
81-919842-000	Rack
81-907757-000	Hose, 1/2-inch x 25 feet (7.5 m)
81-961966-000	Hose, 1/2-inch x 50 feet (15 m)
81-918990-000	Hose, 3/4-inch x 25 feet (7.5 m)
81-918435-000	Hose, 3/4-inch x 50 feet (15 m)
WK-834900-000	Hose to Hose Thread protector (Ferrule)
WK-980564-000	Horn/Valve Assembly
81-960099-000	Clip, Handle
81-939000-000	Clip Horn
WK-282386-000	Instruction Plate, Model HR-1
WK-405710-000	Instruction Manual

Table 8-9. Auxiliary Equipment

Part No.	Description
81-486536-000	Pressure Switch, 3 Pole Double Throw
81-981332-000	Pressure Switch, 3 Pole Single Throw (Ex. Proof)
81-874290-000	Pressure Trip
81-871071-000	CO2 Discharge Delay, 30 Second
81-897636-000	CO2 Discharge Delay, 60 Second
81-981574-000	CO2 Siren, Pressure Operated
81-871072-001	N2 Discharge Delay, 30 Second (For Use w/108-cuin N2 Cylinder Only)
81-871072-002	N2 Discharge Delay, 60 Second (For Use w/108-cuin N2 Cylinder Only)
90-101040-000	1040 cu. in. Nitrogen Cylinder (Pilot, Siren Driver)
90-102300-100	2300 cu. in. Nitrogen Siren Driver Cylinder
90-981574-001	N2 Siren, Pressure Operated (For Use with 108/1040/2300-cuin N2 Cylinders Only)
81-803242-000	Safety Outlet, 3/4-inch NPT 2400-2800 PSI (165-193 bars)
81-967082-000	Discharge Indicator, 3/4-inch NPT (Brass)

Table 8-9. Auxiliary Equipment (Continued)

Part No.	Description
WK-31033-000	Nameplate, "Main"
WK-310340-000	Nameplate, "Reserve"
WK-404070-000	Record Card
WK-281704-000	Operating Instructions Plate, without Stop Valve
WK-281705-000	Operating Instructions Plate, with Stop Valve
81-897600-000	Odorizer Assembly
06-231866-851	Vacate Warning Sign
06-231866-852	Do Not Enter Warning Sign
06-231866-853	Odorizer Warning Sign
06-231866-854	Migration Warning Sign
06-231866-855	Storage Warning Sign
06-231866-856	Actuation Warning Sign
81-800125-000	Yacht Systems Instructions, Automatic
81-933931-000	Yacht Systems Instructions, Manual

Table 8-10. Maintenance and Repair Parts

Part No.	Description
WF-242466-000	O-ring, Outer, Discharge Head
WF-242467-000	O-ring, Inner, Discharge Head
WF-152620-000	Seal Wire
WK-907042-000	Replacement Hammer, Clip & Chain, Pull Box 870087
WK-802394-000	Handle, Pull Box 871403
WK-200863-000	Breakable Cover, Pull Box 840098
WK-928103-000	Replacement Glass, Pull Box 871403
WK-313020-000	Replacement Glass, Pull Box 870087
WK-312950-000	Handle, Pull Box 870087
WK-312960-000	Latch, Pull Box 870087
WK-318190-000	Groove-Pin, Pull Box 870087
WK-662890-000	Beam, Pull Box 870087
WK-933073-000	Protective Cap, Vented
81-982505-000	Weigh Scale
WK-933537-000	Recharge Adapter
81-930117-000	Blow off Fixture
WK-840041-000	Manometer Test Set

Table 8-11. Carbon Dioxide Nozzles

Part No.	Description
*	Multijet, Type S, 1/2-inch NPT
*	Multijet, Type S, Zinc plated, 1/2-inch NPT
*	Multijet, Type S, Flanged, 1/2-inch NPT
*	Multijet, Type M, 3/4-inch NPT
*	Vent, Type V, 1/2-inch NPT
* See Table 8-12 for part numbers.	

Table 8-12. Nozzle Identification

Size	S	S-Zinc	S-Flanged	M	V	V-Stainless
1	X	X	X	X	930066**	81098656
1+	X	X	X	X	930067	81098657
2	803381	803397	802990	X	919309	81098658
2+	803365	803881	802974	X	803327	81098659
3	803367	803882	802975	X	929242	81098660
3+	803367	803883	802976	X	803328	81098661
4	803368	803884	802977	842319	915876	81098662
4+	803369	803885	802978	842320	803329	81098663
5	803370	803886	802979	842321	214721	81098664
5+	803371	803887	802980	842322	214722	81098665
6	803372	803888	802981	842323	214723	81098666
6+	803373	803889	802982	842324	214724	81098667
7	803374	803890	802983	842325	214725	81098668
7+	803375	803891	802984	X	214726	81098669
8	803376	803892	802985	842326	214727	81098670
8+	803877	803893	802986	X	214728	81098671
9	803378	803894	802987	842327	214729	81098672
9+	803379	803895	802988	X	X	X
10	803380	803896	802989	842328	X	X
11	X	X	X	842329	X	X
12	X	X	X	842330	X	X
13	X	X	X	842331	X	X
14	X	X	X	842332	X	X
15	X	X	X	842333	X	X

Table 8-13. Carbon Dioxide Nozzles, Accessories

Part No.	Description
81-803330-000	Flanged Mounting Kit, Type S Nozzle

Table 8-13. Carbon Dioxide Nozzles, Accessories (Continued)

Part No.	Description
WK-310020-000	Aluminum Disc for Flanged Type S Nozzle
81-220299-000	Stainless Steel Disc for Flanged Type S Nozzle
WK-201004-000	Disc Gasket for Flanged Type S Nozzle
81-844492-000	Flange and Cover Assembly, Type V Nozzle
WK-260884-000	Washer, for the Type V Nozzle
WK-260885-000	Disc, for the Type V Nozzle

Table 8-14. CO_2 Valves Maintenance, Repair and Spare Parts

WK-981372-000	1/2-inch "I" Valve, 25, 35 & 50 lb. Cylinders
WK-840253-000	5/8-inch "I" Valve, 75 & 100 lb. Cylinders
81-902048-000	Safety Disc (White) and Washer, 25, 35 & 50 lb. Cylinders
81-903684-000	Safety Disc (Red) and Washer, 75 & 100 lb. Cylinders
WK-295500-000	Nut - Safety Disc
WK-923066-000	Pilot Check
WK-932636-000	Main Check, 1/2-inch "I" Valve
WK-800760-000	Main Check, 5/8-inch "I" Valve
WK-326420-000	Gasket
WK-326410-000	Spring
WK-202805-000	Sleeve
WK-202804-000	Retainer, Sleeve
WK-202490-000	Valve Seat
WK-203874-000	Siphon Tube, 25 lb. Cylinder
WK-346050-000	Siphon Tube, 35 lb. Cylinder
WK-346060-000	Siphon Tube, 50 lb. Cylinder
WK-202497-000	Siphon Tube, 75 lb. Cylinder
WK-202332-000	Siphon Tube, 100 lb. Cylinder

Table 8-15. Oak Rack Kits

Part Number	Description
WK-005001-002	Kit, 050# Cyl Oak Rack (1R/1S) x 02
WK-005001-003	Kit, 050# Cyl Oak Rack (1R/1S) x 03
WK-005001-004	Kit, 050# Cyl Oak Rack (1R/1S) x 04
WK-005001-005	Kit, 050# Cyl Oak Rack (1R/1S) x 05
WK-007501-002	Kit, 075# Cyl Oak Rack (1R/1S) x 02
WK-007501-003	Kit, 075# Cyl Oak Rack (1R/1S) x 03
WK-007501-004	Kit, 075# Cyl Oak Rack (1R/1S) x 04
WK-007501-005	Kit, 075# Cyl Oak Rack (1R/1S) x 05
WK-007521-004	Kit, 075# Cyl Oak Rack (2R/1S) x 04
WK-007521-006	Kit, 075# Cyl Oak Rack (2R/1S) x 06
WK-007521-008	Kit, 075# Cyl Oak Rack (2R/1S) x 08
WK-007521-010	Kit, 075# Cyl Oak Rack (2R/1S) x 10
WK-010001-002	Kit, 100# Cyl Oak Rack (1R/1S) x 02
WK-010001-003	Kit, 100# Cyl Oak Rack (1R/1S) x 03
WK-010001-004	Kit, 100# Cyl Oak Rack (1R/1S) x 04
WK-010021-004	Kit, 100# Cyl Oak Rack (2R/1S) x 04
WK-010021-006	Kit, 100# Cyl Oak Rack (2R/1S) x 06
WK-010021-008	Kit, 100# Cyl Oak Rack (2R/1S) x 08

Table 8-16. Oak Rack Parts

Part Number	Description
WK-207283-000	Weigh Bar, 3 x 50/75 lb Cylinder
81-207284-000	Weigh Bar, 4 x 50/75 lb Cylinder
WK-207285-000	Weigh Bar, 5 x 50/75 lb Cylinder
WK-243796-000	Weigh Bar, 3 x 100 lb Cylinder
WK-243797-000	Weigh Bar, 4 x 100 lb Cylinder
81-241218-000	Bracket, Weigh Bar 1 Row x 050/075# Cyl
81-241220-000	Bracket, Weigh Bar 2 Row x 050/075# Cyl
WK-271567-000	Bracket, Weigh Bar 1 Row x 100# Cyl
WK-271568-000	Bracket, Weigh Bar 2 Row x 100# Cyl
WK-149124-160	Bolt, 3/8" x 1"
WK-149132-480	Bolt, 1/2" x 3"
WK-149593-380	Nut & Bolt, 1/2" x 13"
WK-149593-390	Nut & Bolt, 1/2" x 15"
WK-149593-810	Nut & Bolt, 1/2" x 23"
WK-149595-630	Nut & Bolt, 1/2" x 27"
WK-151924-000	Nut, 3/8"

Table 8-16. Oak Rack Parts

Part Number	Description
WK-151932-000	Nut, 1/2"
WK-157732-000	Washer, 1/2"
81-269500-000	Washer, 1/2" Rectangular
WK-679500-000	Front Oak Rack, 50 lb Cyl x 2
WK-680000-000	Front Oak Rack, 50 lb Cyl x 3
WK-680500-000	Front Oak Rack, 50 lb Cyl x 4
WK-681000-000	Front Oak Rack, 50 lb Cyl x 5
WK-681300-000	Back Oak Rack, 50 lb Cyl x 2
WK-681800-000	Back Oak Rack, 50 lb Cyl x 3
WK-682300-000	Back Oak Rack, 50 lb Cyl x 4
WK-682800-000	Back Oak Rack, 50 lb Cyl x 5
WK-855500-000	Front Oak Rack, 75 lb Cyl x 2
WK-856000-000	Front Oak Rack, 75 lb Cyl x 3
WK-856500-000	Front Oak Rack, 75 lb Cyl x 4
WK-857000-000	Front Oak Rack, 75 lb Cyl x 5
WK-855400-000	Inter Oak Rack, 75 lb Cyl x 2
WK-855900-000	Inter Oak Rack, 75 lb Cyl x 3
WK-856400-000	Inter Oak Rack, 75 lb Cyl x 4
WK-856900-000	Inter Oak Rack, 75 lb Cyl x 5
WK-855300-000	Back Oak Rack, 75 lb Cyl x 2
WK-855800-000	Back Oak Rack, 75 lb Cyl x 3
WK-856300-000	Back Oak Rack, 75 lb Cyl x 4
WK-856800-000	Back Oak Rack, 75 lb Cyl x 5
WK-243630-000	Front Oak Rack, 100 lb Cyl x 2
WK-243640-000	Front Oak Rack, 100 lb Cyl x 3
WK-243650-000	Front Oak Rack, 100 lb Cyl x 4
WK-243660-000	Inter Oak Rack, 100 lb Cyl x 2
WK-243670-000	Inter Oak Rack, 100 lb Cyl x 3
WK-243680-000	Inter Oak Rack, 100 lb Cyl x 4
WK-243600-000	Back Oak Rack, 100 lb Cyl x 2
WK-243610-000	Back Oak Rack, 100 lb Cyl x 3
WK-243620-000	Back Oak Rack, 100 lb Cyl x 4

APPENDIX A
USCG CERTIFICATE

U. S. Department of Homeland Security
United States Coast Guard
Certificate of Approval

Coast Guard Approval Number: 162.038/1/0 Expires: 26 June 2018

CARBON DIOXIDE TYPE FIRE EXTINGUISHING SYSTEM

KIDDE-FENWAL INC.
400 MAIN STREET
ASHLAND MA 01721

High Pressure Marine Carbon Dioxide Fire Extinguishing Systems.

Identifying Data: Marine Design, Installation, Operation, and Maintenance Manual P/N 220610, Version 2.4, UL File EX923, dated January 2013, and UL report Project 05NK27198 File EX923, revised 1 November 2005.

Follow-up Program: UL.

Previously: Walter Kidde, Div. of Kidde, Inc.

Approval valid only for products from above factory location.

This certificate supersedes and extends Approval No. 162.038/1/0 dated 30 November 2008, to add approved lockout valves and odorizing units to version 2.4 of the manufacturer's design manual.

*** END ***

THIS IS TO CERTIFY THAT the above named manufacturer has submitted to the undersigned satisfactory evidence that the item specified herein complies with the applicable laws and regulations as outlined on the reverse side of this Certificate, and approval is hereby given. This approval shall be in effect until the expiration date hereon unless sooner canceled or suspended by proper authority.

GIVEN UNDER MY HAND THIS 26th DAY OF JUNE 2013, AT WASHINGTON D.C.

K. J. HEINZ
Chief, Lifesaving and Fire Safety Division
BY DIRECTION OF THE COMMANDANT

DEPT. OF HOMELAND SECURITY, USCG, CGHQ-10030
(REV. 3-03)

TERMS: The approval of the item described on the face of the Certificate has been based upon the submittal of satisfactory evidence that the item complies with the applicable provisions of the navigation and shipping laws and the applicable regulations in Title 33 and/or Title 46 of the Code of Federal Regulations. The approval is subject to any conditions noted on this Certificate and in the applicable laws and regulations governing the use of the item on vessels subject to Coast Guard inspection or on other vessels and boats.

Consideration will be given to an extension of this approval provided application is made 3 months prior to the expiration date of this Certificate.

The approval holder is responsible for making sure that the required inspections or tests of materials or devices covered by this approval are carried out during production as prescribed in the applicable regulations.

The approval of the item covered by this certificate is valid only so long as the item is manufactured in conformance with the details of the approved drawings, specifications, or other data referred to. No modification in the approved design, construction, or materials is to be adopted until the modification has been presented for consideration by the Commandant and confirmation received that the proposed alteration is acceptable.

NOTICE: Where a manufacturer of safety-at-sea equipment is offering for sale to the maritime industry, directly or indirectly, equipment represented to be approved, which fails to conform with either the design details or material specifications, or both, as approved by the Coast Guard, immediate action may be taken to invoke the various penalties and sanctions provided by law including prosecution under 46 U.S.C. 3318, which provides:

"A person that knowingly manufactures, sells, offers for sale, or possesses with intent to sell, any equipment subject to this part *(Part B. of Subtitle II of Title 46 U.S.C.)*. and the equipment is so defective as to be insufficient to accomplish the purpose for which it is intended, shall be fined not more than $10,000, imprisoned for not more than 5 years or both."

APPENDIX B
OBSOLETE EQUIPMENT

B-1 INTRODUCTION

This appendix contains information concerning equipment and components that were previously provided as part of the system or as an option for the system but are no longer available for procurement.

The obsolete items contained in this appendix are:

- Smoke Accumulator
- "Y" Check Valve
- Throttle Check Valve

B-2 SMOKE ACCUMULATOR

The smoke accumulator is used as a smoke sampling device and as a a carbon dioxide nozzle in a cargo-hold suppression system.

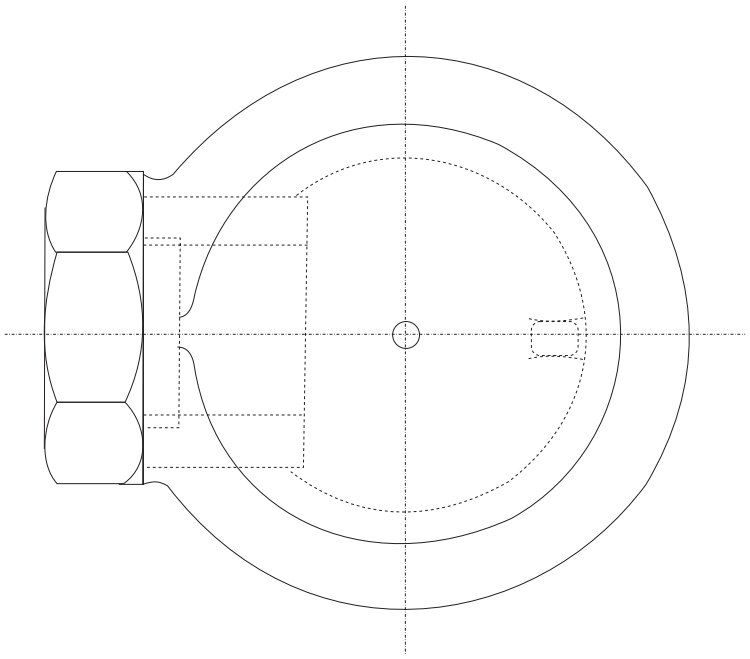


Figure B-1. Smoke Accumulator, P/N 63339

B-3 "Y" CHECK VALVE

The "Y" check valve is used to isolate two carbon dioxide cylinders from a larger bank of cylinders in a cargo-hold suppression system. This allows one to discharge two cylinders at a time in a multiple cylinder installation.

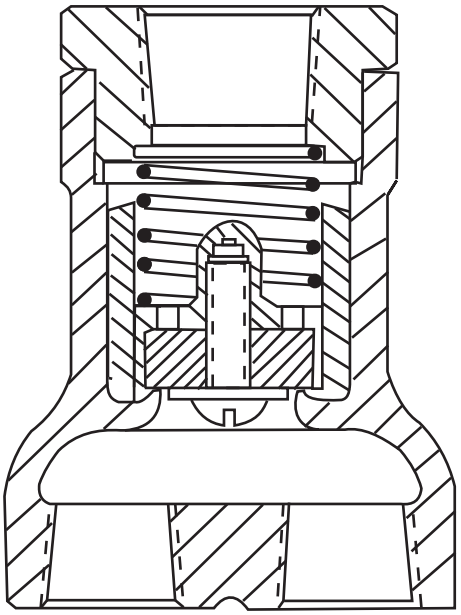


Figure B-2. "Y" Check Valve, P/N 800759

B-4 THROTTLE CHECK VALVE

The throttle check valve is a combination tee and check valve used to isolate two pilot cylinders in a cargo-hold suppression system. The installation of this device allows one to discharge two cylinders at a time without operating the pilot cylinders and causing a discharge of all cylinders.

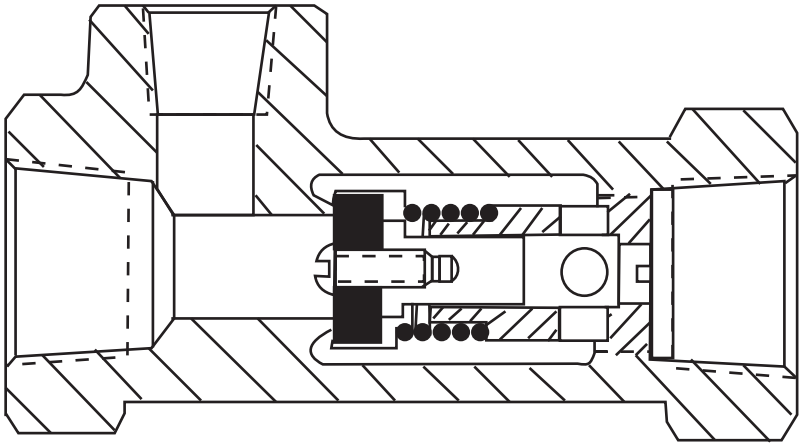


Figure B-3. Throttle Check Valve, P/N 934710

APPENDIX C
SAMPLE CO2 CALCULATIONS

C-1 GENERAL

This section describes the calculation methods that are used to determine the quantity of CO2 required as well as pipe and nozzle sizes. These methods are the same as those described in the US Coast Guard Navigation and Vessel Inspection Circular (NVIC) 6-72, Part II.

Example (See Figure 8-1)

To illustrate the calculation methods, assume that the protected enclosure is a machinery space with a volume of 12,000 ft3.

From Section 2-15 Step 1:

Determine CO2 quantity required, refer to Sections 2-2 through 2-6. From Table 2-1 for 12,000 ft3, use flooding factor = 20 ft3/lb:

Qty = Volume/Flooding factor

Qty = 12,000 ft3/20 ft3/lb.

Qty = 600 lbs. CO2

From Section 2-15, Step 2:

A. Calculate the Nominal Cylinder Area:

Nom. Cylinder Area = Qty CO2 x 0.0022

Nom. Cylinder Area = 600 lbs x 0.0022

Nom. Cylinder Area = 1.32 in2

B. Determine Supply Pipe Area:

The minimum supply pipe for 600 lbs. CO2 = 1-1/4" pipe (Table 2-5). Internal pipe area of 1-1/4" pipe = 1.283 in2 (See Table 2-6).

C. Compare the nominal cylinder outlet area to the supply pipe and select the smaller of the two. In this example, the supply pipe area is smaller; therefore, the nozzle orifice area must be based on this smaller value of 1.283 in2.

From Section 2.15, Step 5:

A. Select the nozzle orifice sizes by multiplying the area selected in Step 2C above by 45%; then divide by the total number of nozzles. In this case, assume (4) nozzles of equal size:

(1.283 x .45)/4 = 0.144in2/nozzle

From Section 2.15, Step 6:

A. Then, select the nozzle with the closest equivalent single orifice area (see Table 2-7):

Use Code 14 with area = 0.1503 in2

B. Calculate total equivalent nozzle orifice area:

0.1503 in2 x 4 = 0.6012 in2

From Section 2.15, Step 7:

A. Calculate the percent total nozzle orifice area to supply pipe area:

% = Total Nozzle Orifice Area x 100%

Supply Pipe Area

% = 0.6012 in2 x 100% = 46.9% of supply pipe area

1.283 in2

B. Compare the calculated percent total nozzle orifice area to the minimum 35% and maximum 85% allowed. Since the calculated value in this example falls within the stated range the nozzle selection is satisfactory. If the calculated value falls outside of this range, the nozzles must be resized until the calculated value does satisfy this criteria.

From Section 2.15, Step 8 Determine Pipe Sizes:

A. The quantity of CO2 delivered by each nozzle can be assumed to be directly proportional to the ratio of the individual nozzle orifice area to the total nozzle orifice area multiplied by the quantity of CO2 supplied.

In this example, all four nozzles are the same size and can be considered to deliver an equal amount of CO2:

600 lbs/4 = 150 lbs/nozzle

B. Determine the quantity of CO2 carried by each pipe section, then select a pipe size for each pipe section using Table 2-5:

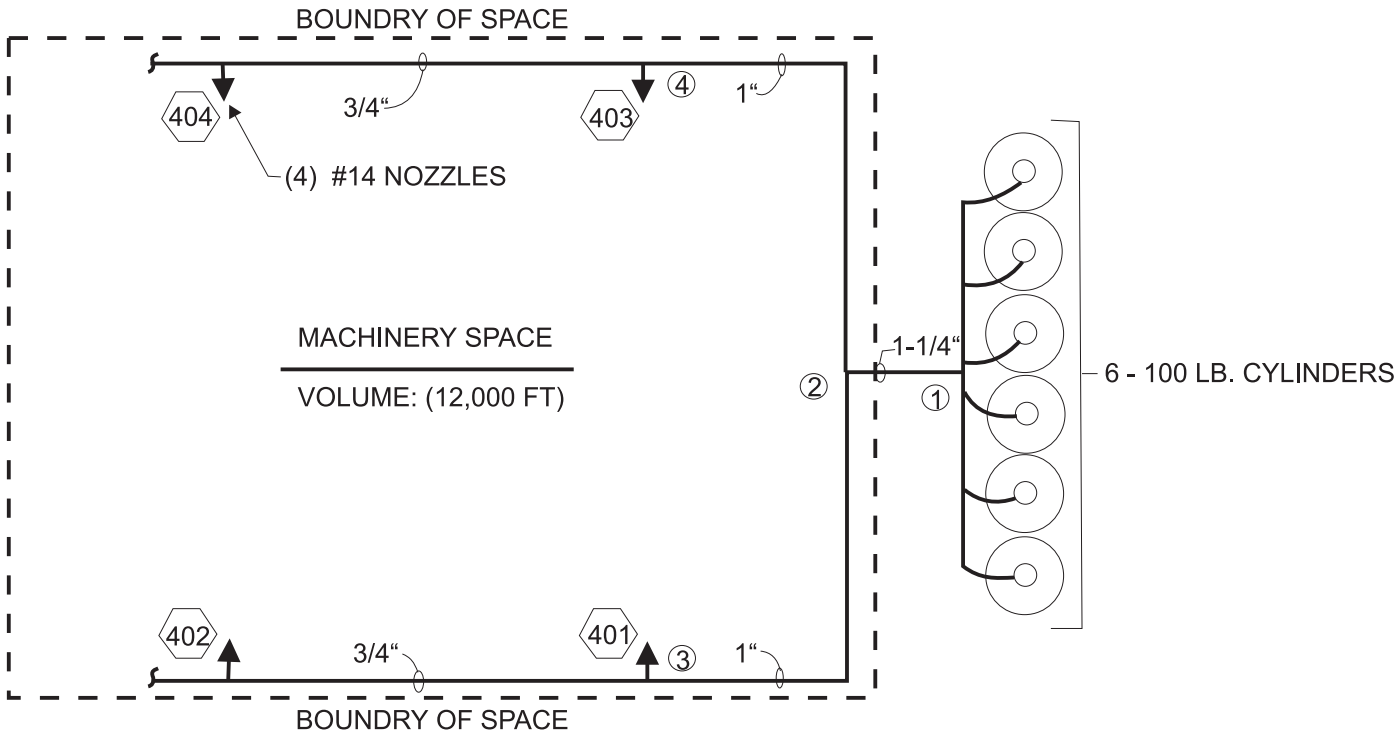


Figure C-1. Installation Example

Table C-1. Flow Calculation for Installation Example

Section	Flow	Pipe Size
Section 1 - 2	600	1-1/4"
Section 2 - 3	300	1"
Section 3 - 401	150	3/4"
Section 3 - 402	150	3/4"
Section 2 - 4	300	1"
Section 4 - 403	150	3/4"
Section 4 - 404	150	3/4"

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Kidde is a registered trademark of Kidde-Fenwal, Inc.

Kidde Fire Systems

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P/N 220610 Rev. DA

P/N 81-220610-002
September 2013

Supplement to Marine Carbon Dioxide

Version 2.4

Design, Installation, Operation and Maintenance Manual Rev. DA (P/N 220610)

Kidde Fire Systems

FOREWORD

The following material is supplemental to the above referenced manual and represents additional information to detail a specific product required by the International Maritime Organization (IMO).

Note: All references, unless otherwise stated, relate to the Kidde Marine Carbon Dioxide Version 2.4 Design, Installation, Operation and Maintenance Manual, P/N 220610.

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

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

MATERIAL SAFETY DATA SHEETS

Hard copies of the Material Safety Data Sheets (MSDS) are not included with this manual. The latest version of the MSDS you are searching for can be found online at the Kidde Fire Systems website (www.kiddefiresystems.com). Use the built-in navigation links to view the desired sheet.

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TABLE OF CONTENTS

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LIST OF FIGURES

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LIST OF TABLES

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CHAPTER 1
INTRODUCTION

1-1 INTERNATIONAL MARITIME ORGANIZATION RELEASING CABINETS

The International Maritime Organization (IMO) requires locating the two system controls within a release box clearly identified for the particular protected space. Furthermore, IMO requires that the two controls to incorporate a mistake-proof sequence of operation so that a person cannot operate Control 2 before Control 1. Control 1 commands the stop valve to open. Control 2 commands the suppression cylinders to open. Class Society (ABS, DBV, LRS, etc) inspected vessels follow IMO requirements.

Kidde Fire Systems offers two actuations styles (N2 or Cable Actuation) in various configurations to meet this IMO requirement. Kidde offers both actuation styles factory fitted within a CRES304 NEMA 4X cabinet or within a fiberglass NEMA 4X cabinet. Both cabinets have a clear front window for ease of inspection. Additionally, Kidde provides an IMO compliant interlock assembly, for either actuation style, used to outfit a cabinet provided by the system installer.

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CHAPTER 2
SYSTEM DESIGN

2-1 DESIGN CONSIDERATION

When planning the location of the IMO Releasing Cabinets, consider the following:

- Locate IMO Releasing Cabinet(s) per the system installation drawing designed in accordance with applicable regulations.
- Each IMO Releasing Cabinet needs clearance for the front door.
  - Stainless Steel IMO Steel Cabinet for Nitrogen Release, (P/N 81-840206-100) requires a clearance of 20".
  - Stainless Steel IMO Cabinet for Cable Release (P/N 81-840206-200) requires a clearance of 12".
  - Fiberglass IMO Cabinet for Nitrogen Release, (P/N 81-840206-101) requires a clearance of 20".
  - Fiberglass IMO Cabinet for Cable Release (P/N 81-840206-201) requires a clearance of 12".
- The IMO Interlock Assembly for Nitrogen Release requires a clearance within the cabinet.
  - Kidde recommends a 6-in clearance from the lever operated control head base to the inside of the supplied cabinet.

For general system design considerations, see Chapter 2 of the Kidde Fire Systems Marine Carbon Dioxide Version 2.4 Design, Installation, Operation and Maintenance Manual (P/N: 220610).

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CHAPTER 3
SYSTEM ARRANGEMENTS

3-1 GENERAL

These system arrangements illustrate two systems, one using an IMO Release Cabinet with Nitrogen Pilot Cylinders, one with an IMO Releasing Cabinet with Cable Pull Stations. For more arrangements, see Chapter 3 of the Kidde Fire Systems Marine Carbon Dioxide Version 2.4 Design, Installation, Operation and Maintenance Manual (P/N: 220610).

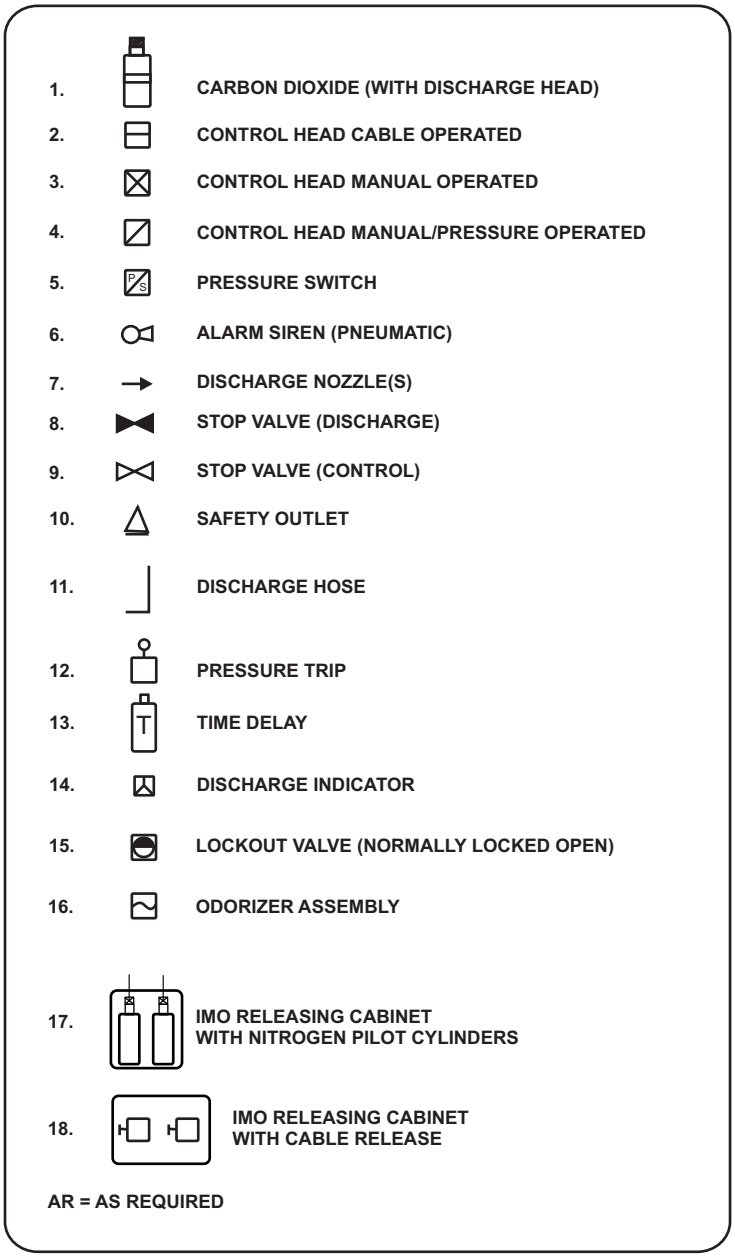

Figure 3-1. Symbol Legend

3-2 ARRANGEMENT NUMBER 1, WITH CO2 DISCHARGE DELAY

Arrangement Number 1 is designed for protection of a single space, requiring more than 300 lbs. of CO2. Three or more cylinders are required, with storage located outside the space. Actuation is accomplished pneumatically, using a nitrogen pilot cylinder.

System actuation is initiated by operating the lever control head mounted on the nitrogen cylinders in the IMO Release Cabinet. The nitrogen pressure is transmitted to the pressure control heads located on the CO2 cylinders, causing the cylinders to discharge.

The CO2 is discharged into the manifold, and is directed to the normally closed stop valve. A portion of the discharge is routed to the pressure switch, siren and discharge delay. This will cause the pressure switch to operate, and the alarm to sound. The time delay will begin to cycle, and upon completion, will open. This portion of the discharge will be routed to the lever/pressure control head on the stop valve, causing the stop valve to open. The main portion of the discharge will then pass through the stop valve and be directed to the nozzles.

Personnel must be instructed to actuate the stop valve manually, by operating the lever/pressure control head in the event of a time delay failure.

A safety relief is provided in the event the cylinders have discharged and the stop valve does not operate. If pressure build-up in the manifold becomes excessive, the safety relief will rupture, venting the pressure to the atmosphere.

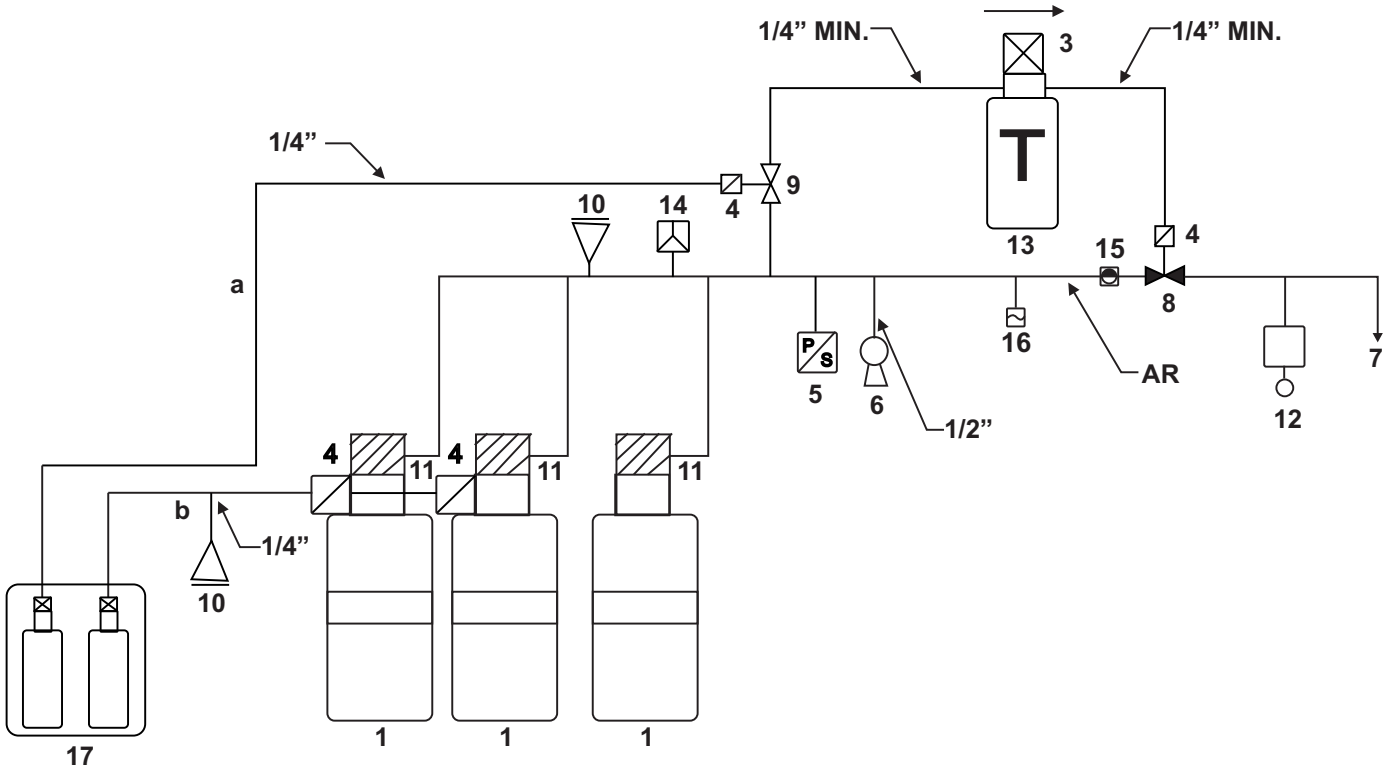

Figure 3-2. Arrangement Number 1

The total length of the stop valve actuating line (a) plus the cylinder actuation line (b) shall not exceed the lengths published in Chapter 2 of the Kidde Fire Systems Marine Carbon Dioxide Version 2.4 Design, Installation, Operation and Maintenance Manual (P/N: 220610).

3-3 ARRANGEMENT NUMBER 2, WITH CO2 DISCHARGE DELAY

Arrangement Number 2 is designed for protection of a single space, requiring more than 300 lbs. of CO2. Three or more cylinders are required, with storage located outside the space. Actuation is accomplished pneumatically, using a nitrogen pilot cylinder.

System actuation is initiated by operating the cable release pull stations mounted in the IMO Release Cabinet, opening the stop valves and causing the cylinders to discharge.

The CO2 is discharged into the manifold, and is directed to the normally closed stop valve. A portion of the discharge is routed to the pressure switch, siren and discharge delay. This will cause the pressure switch to operate, and the alarm to sound. The time delay will begin to cycle, and upon completion, will open. This portion of the discharge will be routed to the lever/pressure control head on the stop valve, causing the stop valve to open. The main portion of the discharge will then pass through the stop valve and be directed to the nozzles.

Personnel must be instructed to actuate the stop valve manually, by operating the lever/pressure control head in the event of a time delay failure.

A safety relief is provided in the event the cylinders have discharged and the stop valve does not operate. If pressure build-up in the manifold becomes excessive, the safety relief will rupture, venting the pressure to the atmosphere.

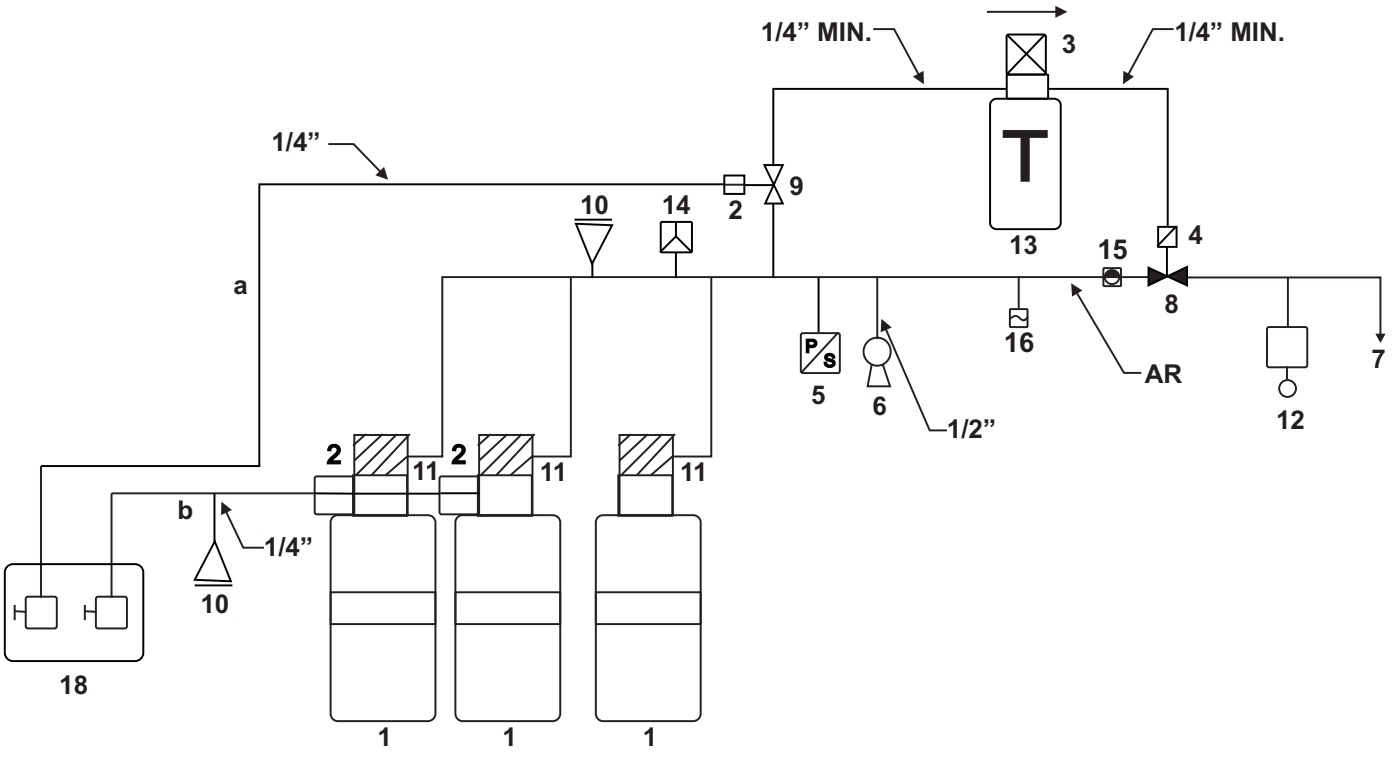

Figure 3-3. Arrangement Number 2

The total length of the stop valve actuating line (a) plus the cylinder actuation line (b) shall not exceed the lengths published in Chapter 2 of the Kidde Fire Systems Marine Carbon Dioxide Version 2.4 Design, Installation, Operation and Maintenance Manual (P/N: 220610).

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CHAPTER 4
COMPONENT DESCRIPTIONS

4-1 STAINLESS STEEL IMO CABINET FOR NITROGEN RELEASE (P/N 81-840206-100)

This NEMA 4X cabinet, constructed from CRES304 material, is factory fitted with a pair of cylinder brackets (WK-877845-000) and IMO compliant interlock components. When outfitted with the 108-cuin N2 pilot cylinders (ex. P/N WK-877940-000) and lever operated control head (P/N WK-870652-000), the left hand cylinder pressurizes the actuation line for Control 1 and the right hand cylinder pressurizes the actuation line for Control 2. Operation of Control 1 provides sufficient clearance to remove the lock rod from Control 2 and allow its operation. The cabinet door contains a window to allow convenient inspection of the N2 cylinders and control heads. The door incorporates a slot/keyed latch.

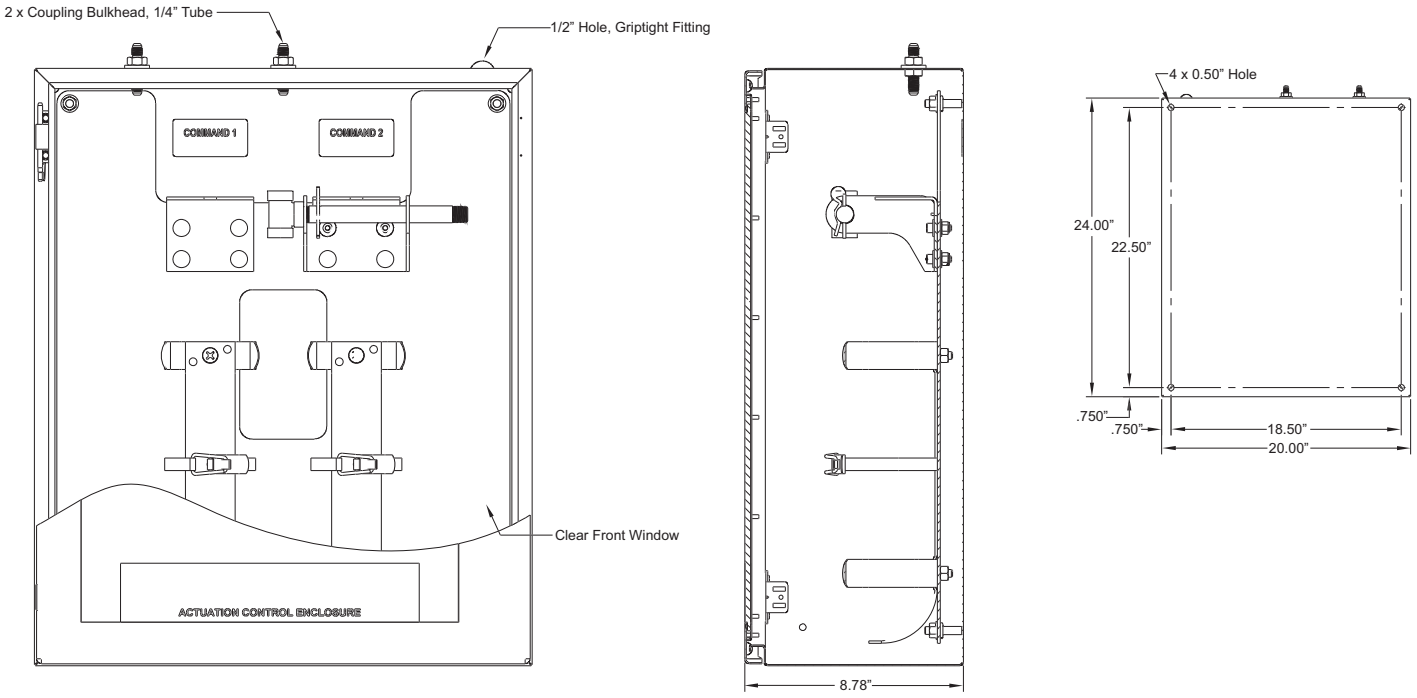


Figure 4-1. Stainless Steel IMO Releasing Cabinet for Nitrogen Release

4-2 STAINLESS STEEL IMO CABINET FOR CABLE RELEASE (P/N 81-840206-200)

This NEMA 4x cabinet, constructed from CRES304 material, is factory fitted with a pair of cable pull stations and a pair of water-tight corner pulleys (P/N 81-803808-000). The left hand pull station operates Control 1. The right hand pull station operates Control 2. Operation of Control 1 provides sufficient clearance to remove the lock rod from Control 2 and allow its operation. The cabinet door contains a window to allow convenient inspection of the cable pull stations. The door incorporates a slot/keyed latch.

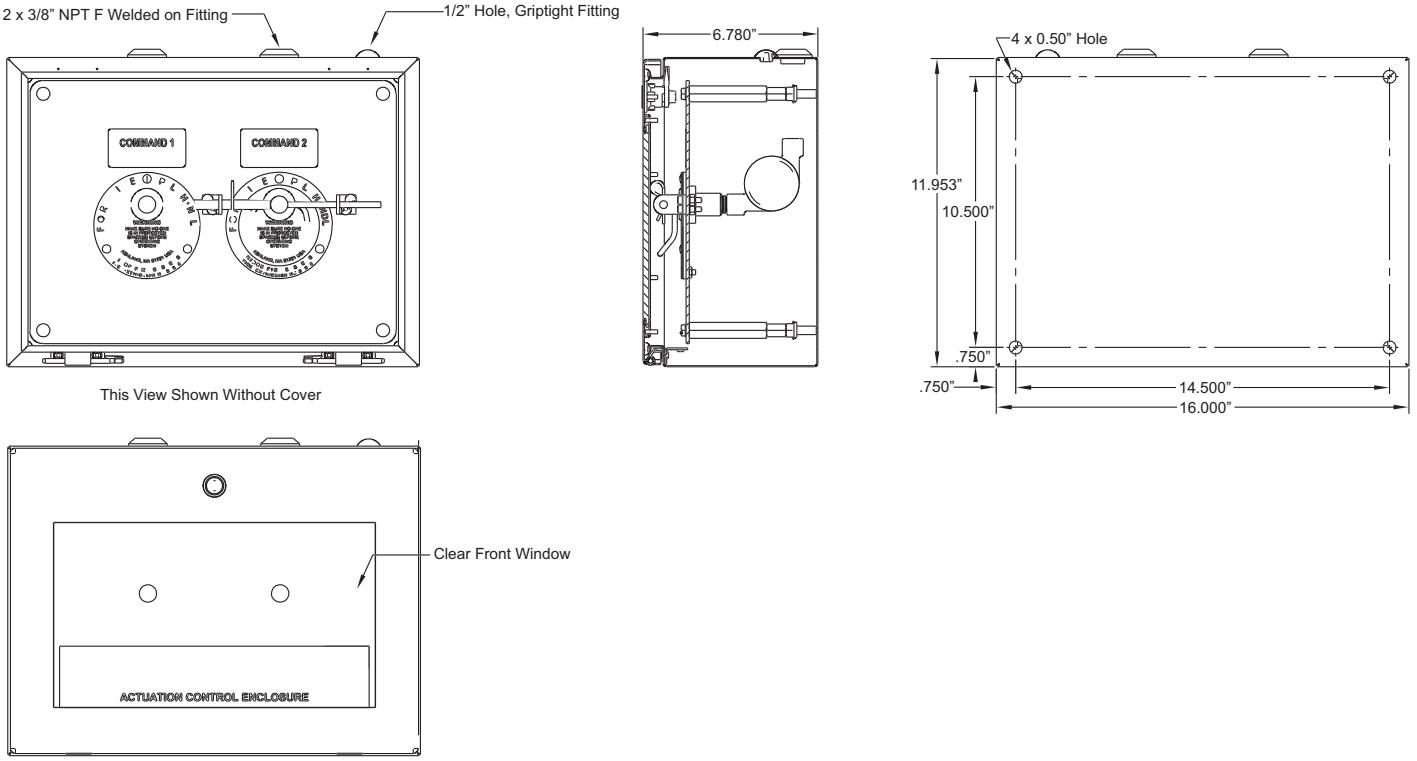


Figure 4-2. Stainless Steel IMO Releasing Cabinet for Cable Release

4-3 FIBERGLASS IMO CABINET FOR NITROGEN RELEASE (P/N 81-840206-101)

This NEMA 4X cabinet, constructed from fiberglass material, is factory fitted with a pair of cylinder brackets (WK-877845-000) and IMO compliant interlock components. When outfitted with the 108-cuin N2 pilot cylinders (ex. P/N WK-877940-000) and lever operated control head (P/N WK-870652-000), the left hand cylinder pressurizes the actuation line for Control 1 and the right hand cylinder pressurizes the actuation line for Control 2. Operation of Control 1 provides sufficient clearance to remove the lock rod from Control 2 and allow its operation. The cabinet door contains a window to allow convenient inspection of the N2 cylinders and control heads. The door incorporates a quick release latch.

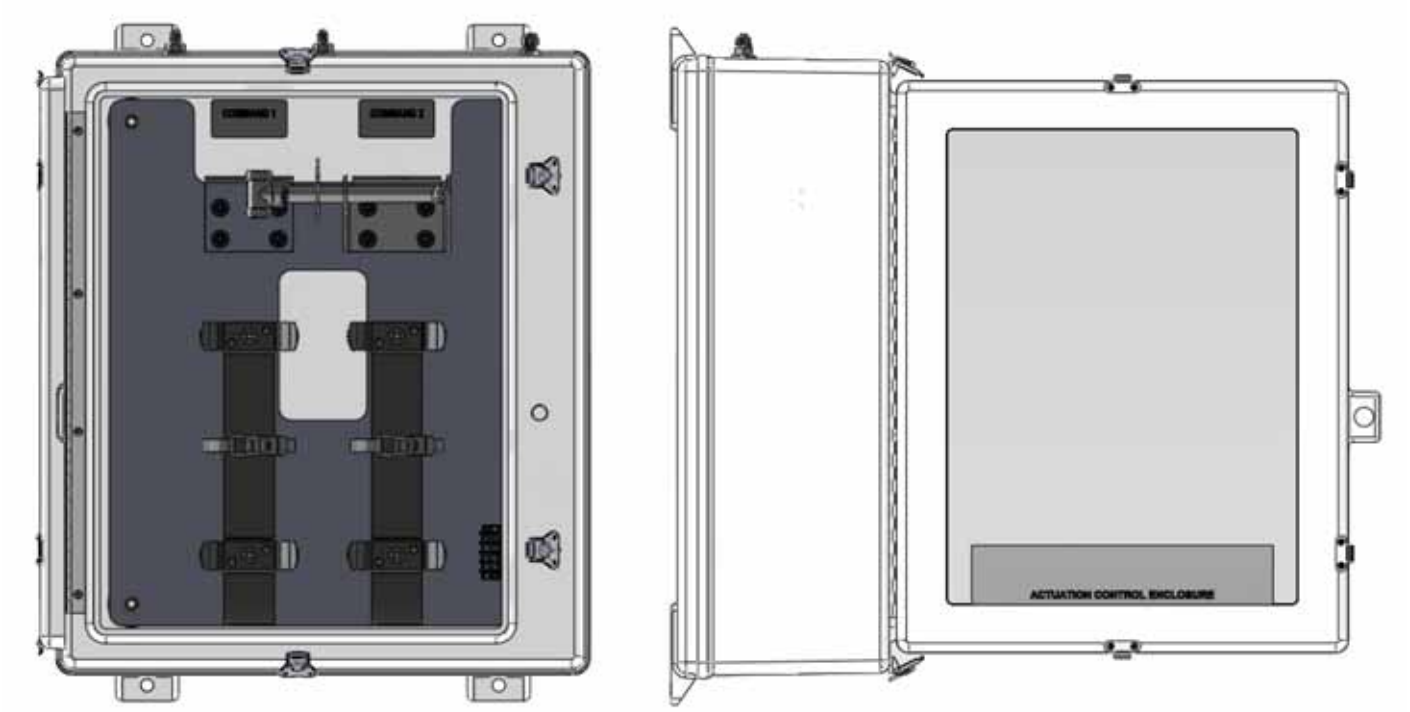


Figure 4-3. Fiberglass IMO Releasing Cabinet for Nitrogen Release

Table 4-1. Dimensions for Fiberglass IMO Releasing Cabinet for Nitrogen Release

Cabinet	Dimension
81-840206-101	24” H x 20” W x 10” D

4-4 FIBERGLASS IMO CABINET FOR CABLE RELEASE (P/N 81-840206-201)

This NEMA 4x cabinet, constructed from CRES304 material, is factory fitted with a pair of cable pull stations and a pair of water-tight corner pulleys (P/N 81-803808-000). The left hand pull station operates Control 1. The right hand pull station

operates Control 2. Operation of Control 1 provides sufficient clearance to remove the lock rod from Control 2 and allow its operation. The cabinet door contains a window to allow convenient inspection of the cable pull stations. The door incorporates a quick release latch.

Figure 4-4. Fiberglass IMO Releasing Cabinet for Cable Release

Table 4-2. Dimensions for Fiberglass IMO Releasing Cabinet for Cable Release

Cabinet	Dimension
81-840206-201	12” H x 12” W x 7.5” D

4-5 INTERLOCK ASSEMBLY FOR NITROGEN RELEASE (P/N 81-840206-001)

This interlock assembly utilizes a backplane constructed of 11GA CRES304 material and is factory fitted with a pair of cylinder brackets (WK-877845-000) and the same IMO compliant interlock components as used with the cabinet assembly. This assembly can be utilized with a cabinet supplied by the installer. When outfitted with the 108-cuin N2 pilot cylinders (ex. P/N WK-877940-000) and lever operated control head (P/N WK-870652-000), the left hand cylinder pressurizes the actuation line for Control 1 and the right hand cylinder pressurizes the actuation line for Control 2. Operation of Control 1 provides sufficient clearance to remove the lock rod from Control 2 and allow its operation.

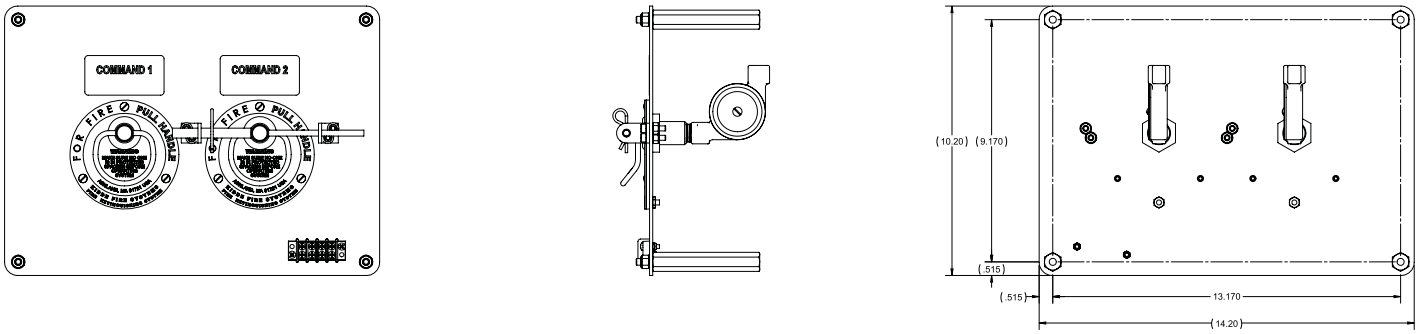


Figure 4-5. Interlock Assembly for Nitrogen Release

4-6 INTERLOCK ASSEMBLY FOR CABLE RELEASE (P/N 81-840206-002)

This interlock assembly utilizes a backplane constructed of 11GA CRES304 material and is factory fitted with a pair of cable pull stations and water-tight corner pulleys (P/N 81-803808-000) and the same IMO compliant interlock components as used with the cabinet assembly. This assembly can be utilized with a cabinet supplied by the installer. The left hand pull station operates Control 1. The right hand pull station operates Control 2. Operation of Control 1 provides sufficient clearance to remove the lock rod from Control 2 and allow its operation.

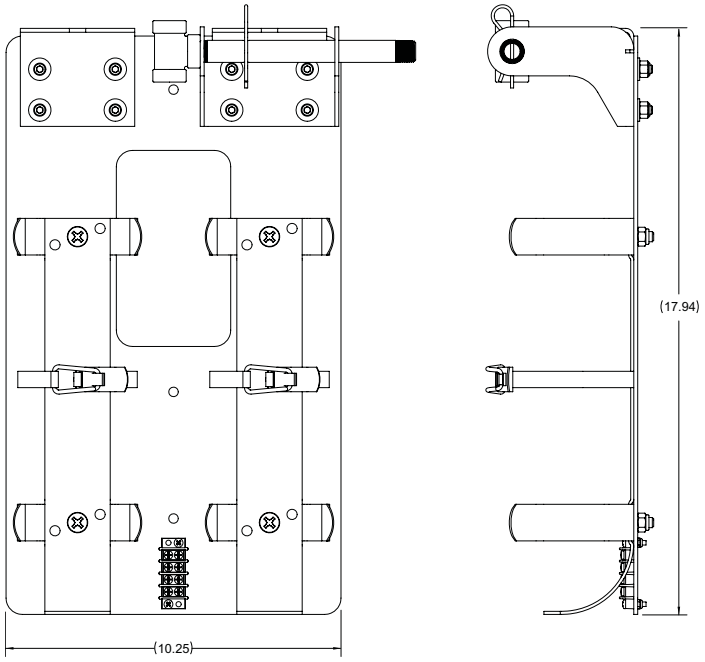


Figure 4-6. Interlock Assembly for Cable Release

4-7 MICROSWITCH (P/N 81-486804-206)

This microswitch consists is a Form C 6A style switch, incorporating a roller contact. The switch can be installed into any of the IMO cabinets to signal the shipboard fire alarm panel when the cabinet door is opened.

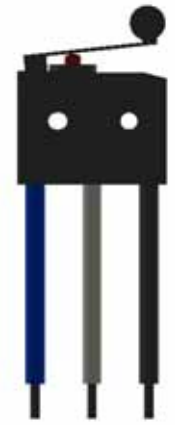
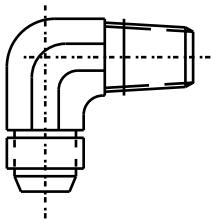


Figure 4-7. Microswitch

4-8 N2 CYLINDER FITTING & HOSE

4-8.1 Elbow Fitting, 1/8" NPT x 3/16" (P/N 06-118284-001)

This brass fitting connects to the 1/8" NPT outlet on the 108-cuin N2 cylinder valve.



1/8" ELBOW
1/8" NPT X 3/16" TUBING
P/N 06-118284-001

Figure 4-8. Elbow Fitting, 1/8" NPT x 3/16"

4-8.2 Flexible Hose, 3/16" (P/N 06-118193-003)

This hose connects the 3/16" fitting affixed to the N2 pilot cylinder to the system actuation line.

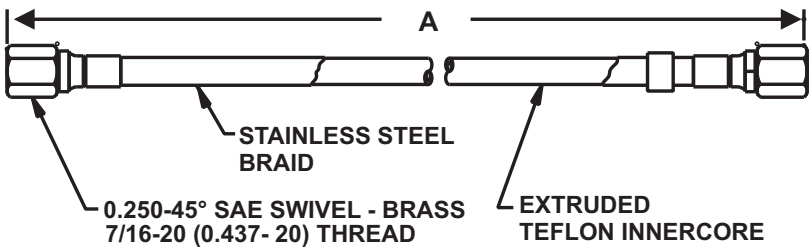


Figure 4-9. Flexible Hose

CHAPTER 5
EQUIPMENT INSTALLATION

5-1 GENERAL

For instructions on general installation procedures, see Chapter 5 of the Kidde Fire Systems Marine Carbon Dioxide Version 2.4 Design, Installation, Operation and Maintenance Manual (P/N: 220610).

Note: Locate IMO Releasing Cabinet(s) per the system installation drawing designed in accordance with applicable regulations.

5-2 INSTALLING IMO RELEASING CABINET WITH CABLE PULL STATIONS

1. Open front cover and remove the backing plate of the IMO Releasing Cabinet.
2. Mount the IMO Releasing Cabinet as shown on the system installation drawings. Mounting location must support the weight of the IMO Releasing Cabinet.
3. Connect cable piping to the two 3/8" NPT Female connections at the top of the IMO Releasing Cabinet.
4. For each pull box, run cable through the corner pulley and to the cable fastener on the pull box.
5. Reattach the backing plate of the IMO Releasing Cabinet.
6. Take up and trim cable slack before crimping the cable fastener and affixing to the pull station.

5-3 INSTALLING IMO RELEASING CABINET WITH NITROGEN PILOT

1. Mount the IMO Releasing Cabinet as shown on the system installation drawings. Mounting location must support the weight of the IMO Releasing Cabinet.
2. Install nitrogen cylinders in mounting brackets. Rotate cylinders until valve outlets are in desired position.
3. Tighten mounting bracket strap.
4. Remove protection cap from cylinder valve control head port.
5. 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. Ensure all protective caps and actuation fittings are removed to expose the two flats on the valve body
6. 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. Position the control head in the desired orientation and hand tighten the hex-nut a ¼ turn past hand tight.
7. Align right side control head within guide bracket and install to cylinder valve.
8. Install lock rod through the guide bracket and control head lever. Ensure proper alignment.
9. Connect the flexible hose to the Coupling Bulkhead.
10. Connect a 3/16" x 1/8" NPT elbow (Part No. 06-118284-000) to the cylinder valve outlet port.
11. Connect the flexible hose to the elbow.
12. Align left side control head within guide bracket and install to cylinder valve.
13. Repeat steps 6 through 11 for the other nitrogen pilot cylinder.

14. Connect system hose, tubing, or pipe (per installation drawing) to the other side of the coupling bulkhead outside the IMO Releasing Cabinet.

5-4 INSTALLING IMO INTERLOCK ASSEMBLY FOR CABLE RELEASE

1. Install the assembly into the supplied cabinet using fasteners and bracket materials appropriate for shipboard use (corrosion resistant and shock/vibration exposure).
2. Follow Steps 3 through 6 in Section 5-2.

5-5 INSTALLING IMO INTERLOCK ASSEMBLY FOR NITROGEN RELEASE

1. Install the assembly into the supplied cabinet using fasteners and bracket materials appropriate for shipboard use (corrosion resistant and shock/vibration exposure).
2. Kidde requires providing a 6-in clearance from the base of the control head to the top of the supplied cabinet.
3. Follow Steps 2 through 14 in Section 5-3.

5-6 INSTALLING THE MICROSWITCH

Install the microswitch in accordance with the work instructions provided from the factory.

CHAPTER 6
OPERATION

6-1 OPERATING IMO RELEASING CABINET WITH NITROGEN PILOT CYLINDERS STATION

Operate IMO Release Cabinet with N2 Pilot Cylinders station as follows:

WARNING

USCG regulation mandates two separate controls for system operation. System will not discharge into the protected space unless both pull stations are operated.

1. Evacuate all personnel from the hazard area immediately, close all hatches, doors, etc.
2. Proceed to IMO Releasing Cabinet for appropriate hazard.
3. Open the door to the IMO Release Cabinet with N2 Pilot Cylinders Station.
4. Pull up on the control head handle labeled Command 1 to open Stop Valves.
5. Remove Safety Bolt Retaining Pin and slide Safety Bolt to the left until it is fully removed from its bracket.
6. Pull up on the control head the handle labeled Command 2 to discharge CO2 agent.
7. Notify appropriate personnel of emergency condition.

WARNING

If time delay fails to operate, operate manual control head lever installed on time delay to discharge system immediately.

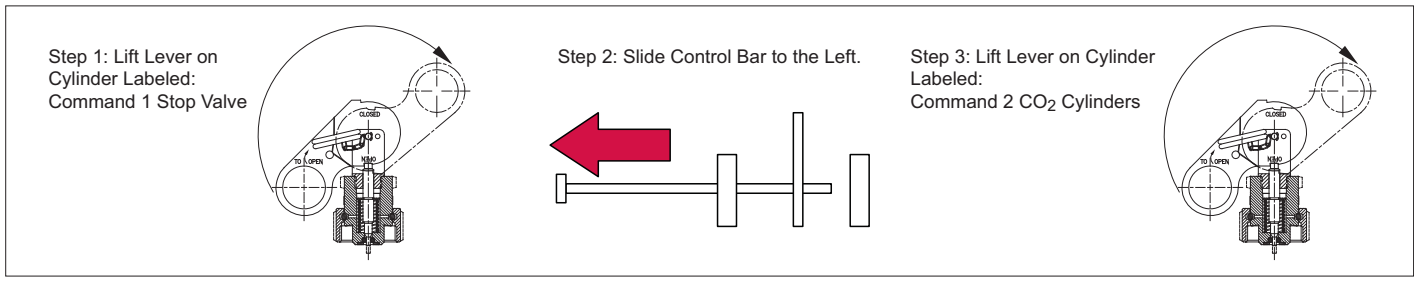


Figure 6-1. IMO Releasing Cabinet with Nitrogen Pilot Cylinders Operational Sign

6-2 OPERATING IMO RELEASING CABINET WITH CABLE PULL STATION

Operate IMO Release Cabinet with cable pull station as follows:

WARNING

USCG regulation mandates two separate controls for system operation. System will not discharge into the protected space unless both pull stations are operated.

1. Evacuate all personnel from the hazard area immediately, close all hatches, doors, etc.
2. Proceed to IMO Releasing Cabinet for appropriate hazard.
3. Open the door to the IMO Release Cabinet with Cable Pull Station.
4. Pull out the handle labeled Command 1 to open Stop Valves.
5. Remove Safety Bolt Retaining Pin and slide Safety Bolt to the left until it is fully removed from its bracket.
6. Pull out the handle labeled Command 2 to discharge CO2 agent.
7. Notify appropriate personnel of emergency condition.

WARNING

If time delay fails to operate, operate manual control head lever installed on time delay to discharge system immediately.

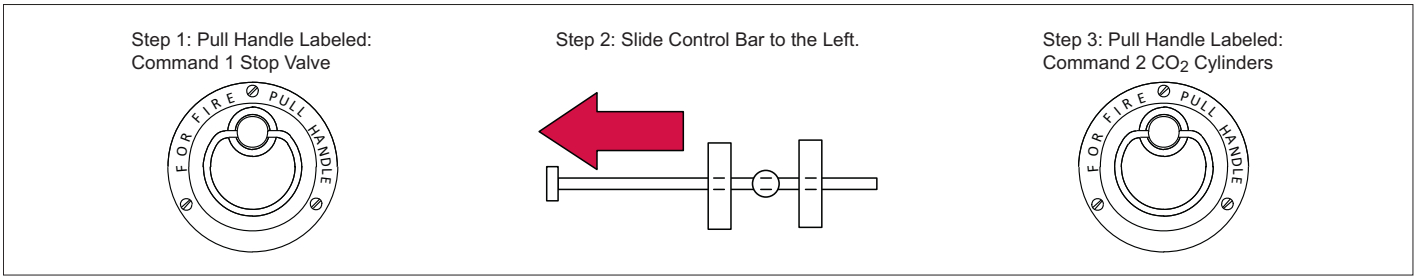


Figure 6-2. IMO Releasing Cabinet with Cable Pull Station Operation Sign

CHAPTER 7
INSPECTION AND MAINTENANCE

7-1 GENERAL

Refer to Chapter 7 of the Kidde Fire Systems Marine Carbon Dioxide Version 2.4 Design, Installation, Operation and Maintenance Manual (P/N: 220610) for maintenance requirements pertaining to Cable Stations or Nitrogen Stations and pertinent parts.

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CHAPTER 8
PARTS LIST

8-1 IMO INTERLOCK PARTS LIST

Table 8-1. IMO Interlock Parts List

Part No.	Description
81-840206-100	Stainless Steel IMO Cabinet, N2 Release
81-840206-200	Stainless Steel IMO Cabinet, Cable Release
81-840206-101	Fiberglass IMO Cabinet, N2 Release (quick release latch)
81-840206-201	Fiberglass IMO Cabinet, Cable Release (quick release latch)
81-840206-001	IMO Interlock Assy, N2 Release
81-840206-002	IMO Interlock Assy, Cable Release
06-118284-001	Elbow, 3/16" x 1/8" NPT
06-118193-003	Flexible hose, 3/16" x 22" OAL
81-486804-206	Microswitch

Note: See the Kidde Fire Systems Marine Carbon Dioxide Version 2.4 Design, Installation, Operation and Maintenance Manual (P/N: 220610) for lever operated control head and 108-cuin N2 cylinder part numbers.

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APPENDIX A
USCG CERTIFICATE

U. S. Department of Homeland Security
United States Coast Guard
Certificate of Approval

Coast Guard Approval Number: 162.038/1/0 Expires: 26 June 2018

CARBON DIOXIDE TYPE FIRE EXTINGUISHING SYSTEM

KIDDE-FENWAL INC.
400 MAIN STREET
ASHLAND MA 01721

High Pressure Marine Carbon Dioxide Fire Extinguishing Systems.

Identifying Data:

1. Marine Design, Installation, Operation, and Maintenance Manual P/N 220610, Version 2.4 dated January 2013 & supplement thereto, dated September 2013; and

2. UL report Project 05NK27198 File EX923, revised 1 November 2005.

Follow-up Program: UL.

Previously: Walter Kidde, Div. of Kidde, Inc.

Approval valid only for products from above factory location.

This certificate supersedes Approval No. 162.038/1/0 dated 26 June 2013, to include IMO remote release supplement to version 2.4 of the manufacturer's design manual.

*** END ***

THIS IS TO CERTIFY THAT the above named manufacturer has submitted to the undersigned satisfactory evidence that the item specified herein complies with the applicable laws and regulations as outlined on the reverse side of this Certificate, and approval is hereby given. This approval shall be in effect until the expiration date hereon unless sooner canceled or suspended by proper authority.

GIVEN UNDER MY HAND THIS 25th DAY OF SEPTEMBER 2013, AT WASHINGTON D.C.

K. J. HEINZ
Chief, Lifesaving and Fire Safety Division
BY DIRECTION OF THE COMMANDANT

DEPT. OF HOMELAND SECURITY, USCG, CGHQ-10030
(REV. 3-03)

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