P/N 45-NOVMAR-001
June 2012

Kidde Engineered Marine Fire Suppression System

Designed for use with

3M™ Novec™ 1230 Fire Protection Fluid

Design, Installation, Operation and Maintenance Manual

USCG Approval Number: 162.161/9/0

UL LISTED

UL Listing File
No. EX 4674

Kidde Fire Systems

A UTC Fire & Security Company

P/N 45-NOVMAR-001
June 2012

FOREWORD

Note: This Manual, P/N 45-NOVMAR-001, is to be used by qualified and factory-trained personnel, knowledgeable of NFPA standards and any other applicable standards in effect.

This manual is intended to clearly and accurately reflect the Kidde Engineered Fire Suppression System designed for use with 3M™ Novec™ 1230 Fire Protection Fluid. This publication describes the operation, installation and maintenance of this system.

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

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

Kidde-Fenwal, Inc.
400 Main Street
Ashland, MA 01721
Phone: (508) 881-2000
Toll Free: (800) 872-6527
Fax: (508) 881-8920

TERMS AND ABBREVIATIONS

AH:	Ampere Hour	N.C.:	Normally Closed
AHJ:	Authority Having Jurisdiction	NFPA:	National Fire Protection Association
AWG:	American Wire Gauge	NFPA 2001:	Standard on Clean Agent Fire Extinguishing Systems, Current edition*
CO_2:	Carbon Dioxide	N.O.:	Normally Open
DC:	Direct Current	NOAEL	No Adverse Effect Level
FM:	Factory Mutual	P/N:	Part Number
H_20:	Water	UL/ULI:	Underwriters Laboratories, Inc.
HVAC:	Heating, Venting and Air Conditioning	ULC:	Underwriters Laboratories of Canada
Hz:	Hertz (Frequency)	USCG	United States Coast Guard
IMO:	International Marine Organization	V:	Volts
LOAEL:	Lowest Adverse Effect Level	Vac:	Volts AC
mA:	Milliamperes	Vdc:	Volts DC

* Current edition in effect as of the original published date, which is 2012 for this manual.

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 potentiality hazardous situation which, if not avoided, could result in property or equipment damage.**

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CHAPTER 1
GENERAL INFORMATION

1-1 INTRODUCTION

Kidde Engineered Fire Suppression System designed for use with 3M™ Novec™ 1230 Fire Protection Fluid is listed for marine use by Underwriters Laboratories, Inc. (UL). This manual describes the processes and procedures for the design, installation, operation and maintenance of systems intended for vessels subject to inspection by the United States Coast Guard (USCG) and designed in accordance with the applicable maritime regulations, according to the regulatory Authority Having Jurisdiction (AHJ). This could include the USCG, International Marine Organization (IMO) and/or the National Fire Protection Agency (NFPA) 2001, in addition to local regional flag or administration authority regulations. Refer to the local AHJ for information on the accepted design regulations.

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

The system designer must become thoroughly familiar with the User's Manual for Kidde Engineered Fire Suppression System Flow Calculation Program (P/N 45-NOVMAR-001) in order to learn the proper procedures for applying the input parameters to the program. There are a number of limitations to these input parameters which must be observed if accurate results are to be obtained.

Kidde Engineered Systems combine an environmentally safe fire suppression agent (Novec 1230 fluid), effective control devices and specially developed components for fast agent discharge. The resulting rapid suppression of a fire reduces physical damage and products of combustion to the lowest possible level. These systems are electrically, pressure and/or cable operated, with a design discharge time of between six and ten seconds.

1-2 SYSTEM DESCRIPTION

1-2.1 Applications

Kidde Engineered Systems are primarily used to protect critical machinery spaces where fire suppression must be extremely rapid, the risk to personnel minimized and/or on-board space is minimal. The agent is colorless, has low odor and is electrically non-conductive. Novec 1230 fluid has an excellent material compatibility profile.

The discharge of Novec 1230 fluid is achieved in six to ten seconds, in accordance with NFPA 2001. Complete discharge is therefore at least six times faster than CO_2 or inert agents. Rapid discharge and extinguishment limits the risk to personnel, the threat to continued vessel operation and damage to the equipment, structure and property on board.

The Environmental Protection Agency (EPA) has declared Novec 1230 fluid safe for personnel at fire suppression design concentrations of up to 10.0% v/v.

Knowing that the available space for marine fire suppression systems is generally limited, Kidde Engineered Systems are designed to be space efficient. A wide range of agent storage cylinder capacities are available. Due to the high efficiency of the agent (requiring typically only 5.85% concentration by volume), a typical system requires considerably less space than a conventional CO_2 system.

Typically protected areas include:

- Engine rooms
- Pump rooms
- Control rooms
- Generator rooms
- Turbine enclosures
- Flammable liquid storage rooms

Kidde Engineered Systems are designed and extensively tested to extinguish fires of the following classes of fire:

- Class A: Surface fires in wood or other cellulose material (not suitable for use in cargo holds or for deep seated Class A fires)
- Class B: Flammable liquid fires (see Table 3-1)
- Class C: Energized electrical equipment

Note: The USCG IMO testing of Kidde Engineered Systems included Class A materials to prove that the system could protect supplemental risk materials within a predominantly Class B fire scenario. The USCG listing reflects this application scenario per the test protocol of MSC Circular 848 and MSC. 1/Circ. 1267.

For hazards beyond the scope described above, the designer must consult Kidde Fire Systems and the AHJ on the suitability of Novec 1230 fluid for the protection, necessary design concentration and personnel exposure implications.

Novec 1230 fluid shall not be used on fires involving the following materials, unless they have been tested to the satisfaction of the USCG or the AHJ:

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

1-2.1.1 OPERATING TEMPERATURE RANGE LIMITATIONS

The operating temperature range for all components in Kidde Engineered System 32°F to 130°F (0°C to 54°C). The Kidde Engineered Fire Suppression System Flow Calculation Program is designed for a 70°F (21°C) container operating/storage temperature. Therefore, the container operating and storage temperature must be in the range of 60°F to 80°F (16°C to 27°C) for a single unbalanced system protecting two or more separate hazards. If the container operating/storage temperature is outside this range, an insufficient quantity of agent may be discharged from one or more nozzles. Marine applications typically protect single- or multiple-hazard areas that have direct volumetric communication, in which case container temperature conditioning is not necessary.

1-2.2 Extinguishing Agent

Novec 1230 fluid is a fluorinated ketone (FK-5-1-12) Dodecafluoro-2-methylpentan-3-one) compound of carbon, fluorine and oxygen ($CF_3CF_2C(O)CF(CF_3)_2$). It is colorless, electrically non-conductive and has a low odor. It suppresses fire by a combination of chemical and physical mechanisms with minimal affect on the available oxygen. This allows people to see and breathe, permitting them to leave the fire area safely.

Novec 1230 fluid is acceptable for use in occupied spaces when used in accordance with the United States Environmental Protection Agency (EPA) Significant New Alternatives Policy (SNAP) program rules.

Although Novec 1230 fluid is considered non-toxic to humans in concentrations necessary to extinguish most fires, certain safety considerations should be observed when applying and handling the agent. The discharge of Novec 1230 fluid may create a hazard to people from the undecomposed agent itself and from the decomposition products which result when the agent is exposed to fire or other hot surfaces. Exposure to the agent is generally of less concern than is exposure to the decomposition products. Unnecessary exposure to the agent or the decomposition products should be avoided.

Refer to Tables 1-1 and 1-2 for selected physical properties of Novec 1230 fluid.

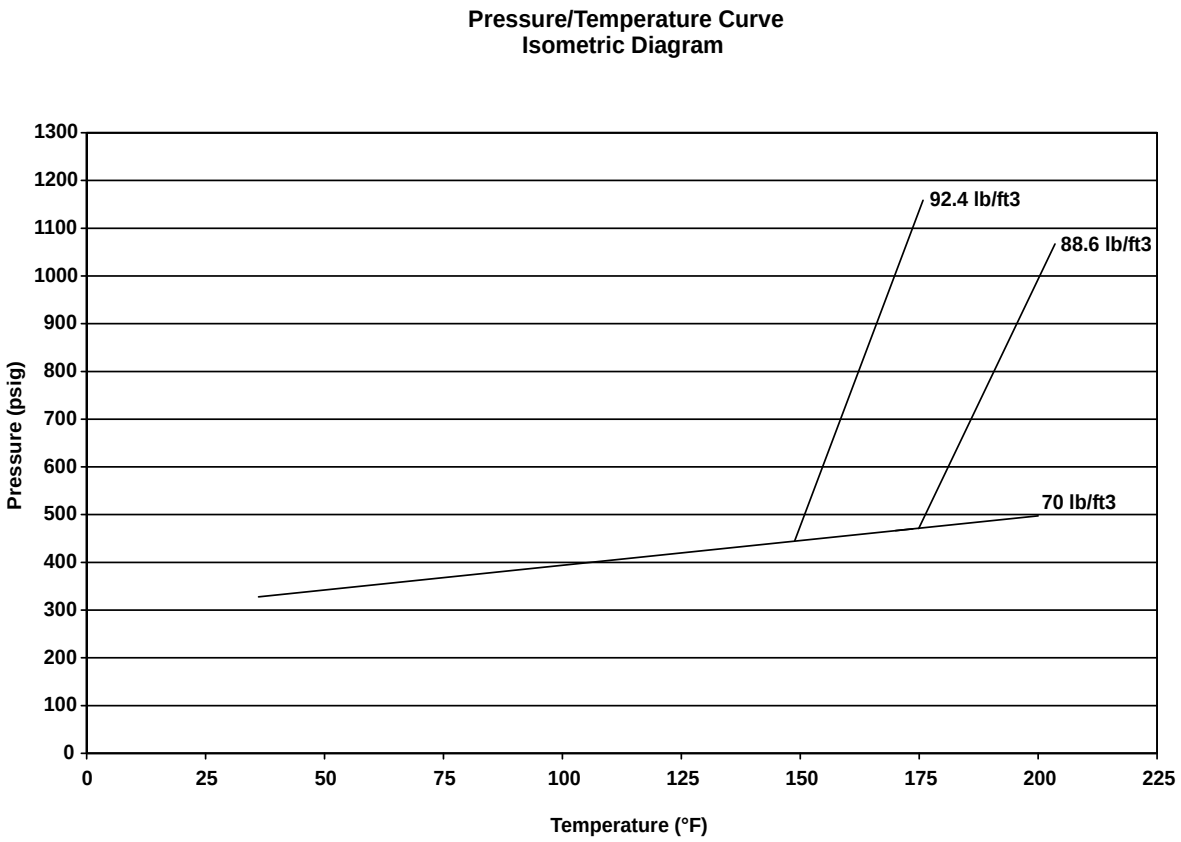

Figure 1-1. Pressure/Temperature Curve for Novec 1230 Fluid, English Units

Table 1-1. Physical Properties of Novec 1230 Fluid, English Units

Element	Units	Measurement
Molecular Weight	N/A	316.04
Boiling Point at 1 atm	°F	120.6
Freezing Point	°F	-162.4
Critical Temperature	°F	335.6
Critical Pressure	psia	270.44
Critical Volume	$ft.^3/lb.$	0.0251
Critical Density	$lb./ft.^3$	39.91
Specific Heat, Liquid at 77°F	Btu/lb./°F	0.2634
Specific Heat, Vapor at Constant Pressure (1 atm) and 77°F	Btu/lb./°F	0.2127
Heat of Vaporization at Boiling Point	Btu/lb.	37.9
Thermal Conductivity of Liquid at 77°F	Btu/h.-ft.-°F	0.034
Viscosity, Liquid at 77°F	lb./ft.-hr.	1.452
Relative Dielectric Strength at 1 atm at, 77°F (N_2 = 1)	N/A	2.3
Solubility, by Weight, of Water in Agent at 70°F	%	<0.001%

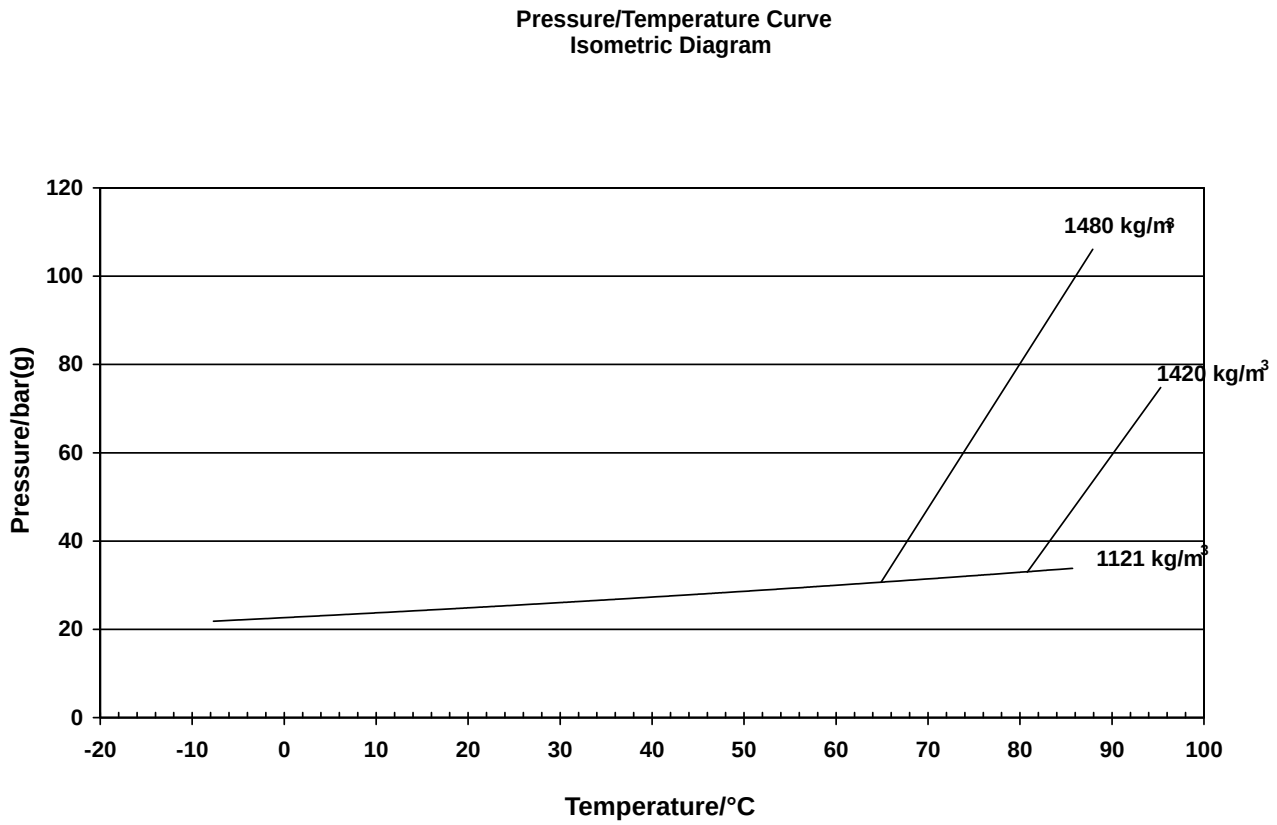

Figure 1-2. Pressure/Temperature Curve for Novec 1230 Fluid, Metric Units

Table 1-2. Physical Properties of Novec 1230 Fluid, Metric Units

Element	Units	Measurement
Molecular Weight	N/A	316.04
Boiling Point at 760 mm Hg	°C	49.2
Freezing Point	°C	-108.0
Critical Temperature	°C	168.7
Critical Pressure	bar	18.65
Critical Volume	cc/mole	494.5
Critical Density	kg/m^3	639.1
Specific Heat, Liquid at 25°C	kJ/kg°C	1.103
Specific Heat, Vapor at Constant Pressure (1 atm) and 25°C	kJ/kg°C	0.891
Heat of Vaporization at Boiling Point at 25°C	kJ/kg°C	88.0
Thermal Conductivity of Liquid at 25°C	W/m°C	0.059
Viscosity, Liquid at 25°C	centipoise	0.39
Relative Dielectric Strength at 1 atm at 734 mm Hg, 25°C (N2 = 1.0)	N/A	2.3
Solubility, by Weight, of Water in Agent at 21°C	%	<0.001%

1-2.2.1 TOXICITY

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

Novec 1230 fluid has been evaluated for cardiac sensitization in accordance with test protocols approved by the United States Environmental Protection Agency (U.S. EPA). The EPA's SNAP Program classifies Novec 1230 fluid as acceptable for use as a total flooding agent in occupied spaces with specific limitations. Refer to the SNAP program rules or NFPA 2001 for more information. Novec 1230 fluid has been judged acceptable by the U.S. EPA for use in occupied spaces when used in accordance with the guidance of NFPA 2001. In accordance with NFPA 2001, Kidde Engineered Systems are designed for use with agent vapor concentrations up to ten percent volume in air are permitted. See NFPA 2001, Edition 2012, Sect. 1-5, *Safety.* Concentrations up to the LOAEL are allowed, but a means to limit exposure times to 5 minutes must be provided. Per NFPA 2001, Edition 2012, the Novec 1230 fluid accepted LOAEL and NOAEL limit is as follows:

Table 1-3. EPA Accepted LOAEL and NOAEL

LOAEL	10%
NOAEL	10%

Although Novec 1230 fluid has negligible toxicity in concentrations needed to suppress most fires, certain safety considerations must be observed when applying and handling the agent. Always consult Kidde before using Novec 1230 fluid should at concentarations above the LOAEL.

1-2.2.2 DECOMPOSITION

During combustion of Novec 1230 fluid at high temperatures, hazardous decomposition or by-products (halogen acids) are produced. If Novec 1230 fluid is discharged in 10 seconds or less, flames will be extinguished rapidly and the amount of by-products produced will be minimal.

1-2.2.3 CLEANLINESS

Novec 1230 fluid is clean and leaves no residue, thereby eliminating costly after-fire clean-up and keeping expensive downtime to a minimum. Most materials such as steel, stainless steel, aluminum, brass and other metals as well as plastics, rubber and electronic components are unaffected by exposure to Novec 1230 fluid.

1-2.2.4 OTHER SAFETY CONSIDERATIONS

The high pressure discharge of Novec 1230 fluid from a system nozzle can create noise loud enough to be startling. The high velocity discharge can be significant enough to dislodge objects located directly in the discharge path. Enough turbulence may be created in the enclosure to move unsecured paper and other light objects. Direct contact with the vaporizing agent discharged from a nozzle will have a chilling effect on objects, and can cause frostbite burns to the skin in extreme cases.

Novec 1230 fluid itself is colorless. Discharge of Novec 1230 fluid into a humid atmosphere may cause fog and reduce visibility for a short time.

1-2.2.5 STORAGE

Novec 1230 fluid is stored in steel containers at 360 PSIG at 70°F (25 bar at 21°C) as a liquid with nitrogen added to improve the discharge characteristics. The pressure of the stored Novec 1230 fluid varies substantially with temperature changes, as illustrated in Figure 1-1. When discharged, the Novec 1230 fluid liquid vaporizes at the discharge nozzles and is uniformly distributed as it enters the fire area.

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CHAPTER 2
COMPONENT DESCRIPTIONS

2-1 INTRODUCTION

This chapter provides a functional description of the components and assemblies of the Kidde Engineered Fire Suppression System designed for use with 3M™ Novec™ 1230 Fire Protection Fluid.

2-2 FUNCTIONAL DESCRIPTION

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

• Cylinder/Valve Assembly (Including Pressure Indicator)	• Dual-Loop Bleed Kit
• Liquid Level Indicator (Optional on Larger-Capacity Cylinders)	• Tees, Elbows and Adapters
• Cylinder Mounting Hardware	• Pressure Actuation Fittings
• Control Heads (Pressure, Manual Lever, Cable and Pneumatic)	• Flexible Discharge Hose
• Dual-Pull Mechanism and Equalizer	• Valve Outlet Adapters
• Corner Pulley Units	• Check Valves, 1/4 in. and 3/8 in.
• Pneumatic Detector	• Swing Check Valves
• Pneumatic Tubing and Fittings	• Stop Valves
• Remote Pull Stations	• Pressure Operated Switches
• Nitrogen Pilot Cylinder (108 cu. in.), Bracket and Fitting	• Pressure Operated Trip
• Nitrogen Pilot System Cylinders (1040 and 2300 cu. in.)	• Discharge Indicator
• Nitrogen Discharge Heads	• Supervisory Pressure Switch
• Nitrogen Discharge Hoses	• Discharge Nozzles
• Nitrogen Manifold "Y" Fitting	• Safety Outlets
• Nitrogen Cylinder Straps	• Swing Check Valves
• Nitrogen Time Delay Units	• Warning and Instruction Nameplates
• Nitrogen Pressure Operated Siren	• Hydrostatic Test Adapter
• Pilot Nitrogen Ball Valve, 1/4 in.	• Recharge Adapters
• Flexible Actuation Hose	• Seating Adapter
• Master Cylinder Adapter Kit	

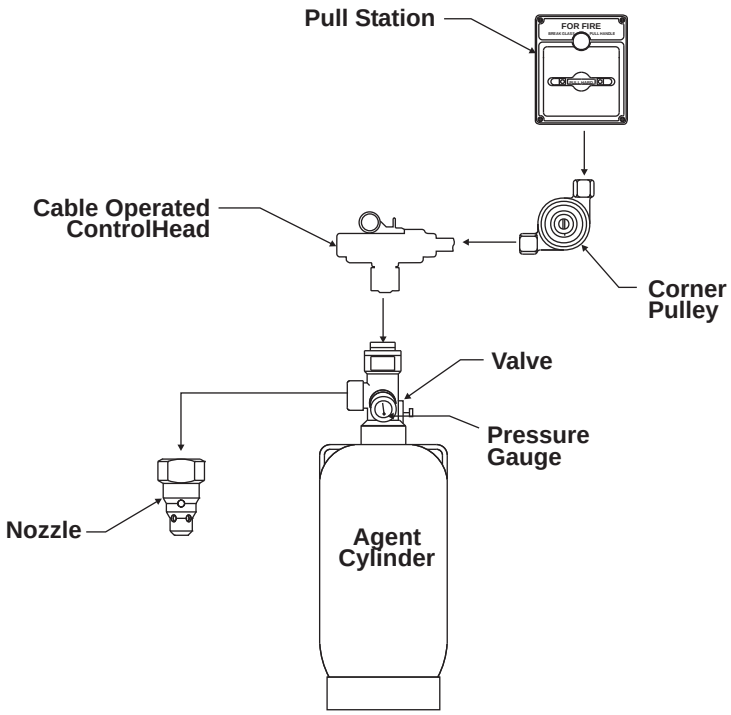


Figure 2-1. General Arrangement of a Typical Kidde Engineered System

2-3 COMPONENT DESCRIPTIONS

2-3.1 Kidde Engineered System Cylinder/Valve Assembly

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

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

WARNING

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

Figure 2-2 represents typical cylinder assemblies. Refer to Table 2-1 for the cylinder dimensions.

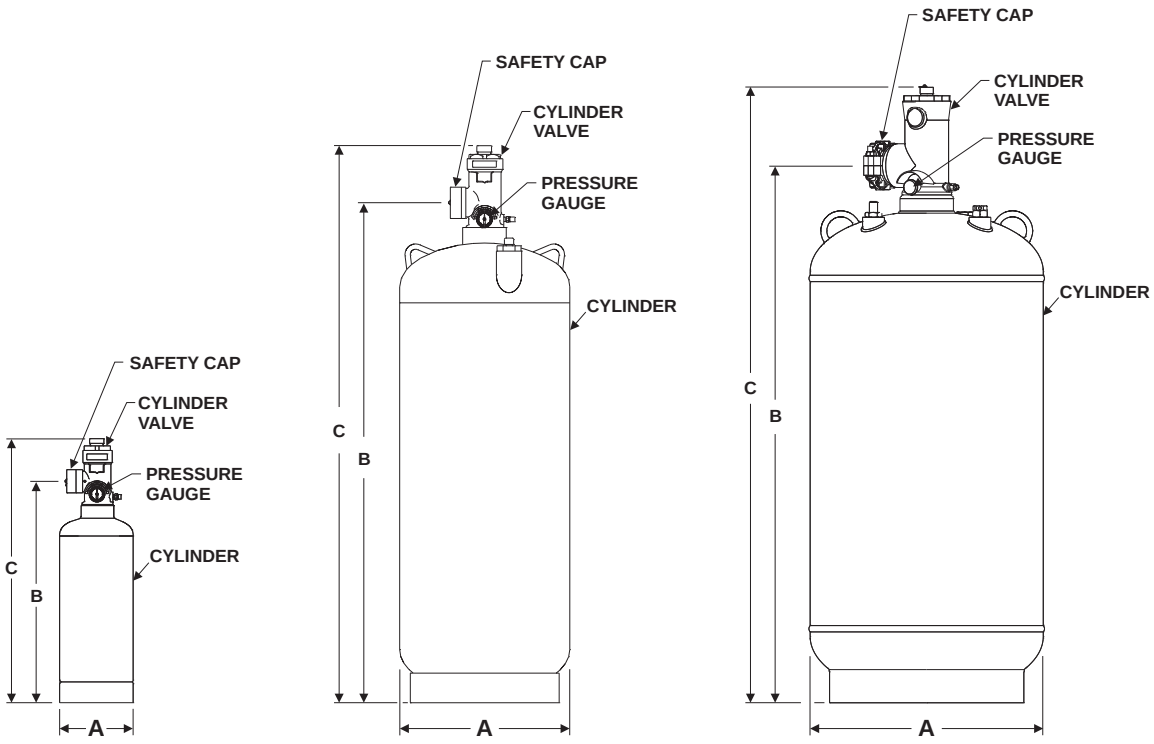


Figure 2-2. Typical Cylinder Assemblies

Table 2-1. Dimensions, Novec 1230 fluid Cylinder/Valve Assemblies for Vertical Installation Only

Part Number	Valve	w/LLI	Height (C)		Diameter (A)		Volume		Valve Outlet Height (B)	
			in.	m	in.	m	$ft.^3$	m^3	in.	m
45-200010-001	1½ in.	No	17.30	0.44	7.07	0.18	0.167	0.0047	13.3	0.36
45-200020-001	1½ in.	No	24.97	0.64	7.07	0.18	0.286	0.0081	21.0	0.53
45-200040-001	1½ in.	No	26.76	0.68	9.00	0.23	0.572	0.0162	22.8	0.58
45-200070-001	1½ in.	No	38.83	0.99	9.00	0.23	1.000	0.0283	34.9	0.89
45-200121-001	1½ in.	Yes	35.93	0.92	12.75	0.33	1.788	0.0506	32.0	0.81
45-200125-001	1½ in.	No	35.93	0.92	12.75	0.33	1.788	0.0506	32.0	0.81
45-200200-001	2 in.	No	52.75	1.34	12.75	0.33	2.859	0.0810	47.5	1.21
45-200201-001	2 in.	Yes	52.75	1.34	12.75	0.33	2.859	0.0810	47.5	1.21
45-200350-001	2 in.	No	58.36	1.49	16.00	0.41	5.000	0.1416	53.1	1.35
45-200351-001	2 in.	Yes	58.36	1.49	16.00	0.41	5.000	0.1416	53.1	1.35
45-200600-001	3 in.	No	58.00	1.47	22.00	0.56	8.680	0.246	50.5	1.28
45-200601-001	3 in.	Yes	58.00	1.47	22.00	0.56	8.680	0.246	50.5	1.28
45-200900-001	3 in.	No	70.00	1.78	24.00	0.61	13.000	0.368	62.0	1.57
45-200901-001	3 in.	Yes	70.00	1.78	24.00	0.61	13.000	0.368	62.0	1.57

The Kidde Engineered System equipment listed herein is designed for an operating temperature range of 32°F to 130°F (0°C to 54°C). Table 2-2 shows the container temperature-pressure relationship based on a maximum fill density of 70 lb./ft.3 (1121 kg/m^3). The Kidde Engineered Fire Suppression System Flow Calculation Program is designed for a 70°F (21°C) container operating/storage temperature. Therefore, the container operating and storage temperature must be in the range of 60°F to 80°F (16°C to 27°C) for a single unbalanced system protecting two or more separate hazards. If the container operating and storage temperature is outside this range, an insufficient quantity of agent may be discharged from one or more discharge nozzles.

If desired, the 125, 200, 350, 600 and 900 lb. cylinders can be provided with an integral liquid level indicator (see Paragraph 2-3.2).

Table 2-3 charts the fill range for Kidde Engineered System cylinder and valve assemblies in vertical installations.

As a reference guide, Table 2-4 provides the equivalent lengths for all the Kidde Engineered System cylinder and valve assemblies. The numbers shown in the table represent the equivalent length through the cylinder valve with the flex hose or without the flex hose, depending on the application. This table can also be found in the Kidde Engineered Fire Suppression System Flow Calculation Program.

Table 2-2. Container Temperature-Pressure Correlation
(Based on a Cylinder Fill Density of 70 lb./ft.^{3} or 1121 kg/m^3)

Temperature		Nominal Charge, Pressure	
°F	°C	PSIG	Bar
0	-18	310	21.4
10	-12	317	21.9
20	-7	324	22.3
32	0	333	23.0
40	4	339	23.4
50	10	346	23.9
60	16	353	24.3
70	21	360	24.8
80	27	367	25.3
90	32	374	25.8
100	38	381	26.3
110	43	388	26.8
120	49	396	27.3
130	54	403	27.8

Table 2-3. Fill Range for Kidde Engineered System Cylinder/Valve Assemblies, Vertical Installation Only

Part Number	Fill Range		Empty Weight		Gross Weight			
					Min. Fill		Max. Fill	
	lb.	kg	lb.	kg	lb.	kg	lb.	kg
45-200010-001	6-11	2.7-5.0	25	11	31	13.7	36	16.0
45-200020-001	12-23	5.4-10.4	31	14	43	19.4	54	24.4
45-200040-001	20-40	9.1-18.1	38	17	58	26.1	78	35.1
45-200070-001	35-70	15.9-31.8	52	24	87	39.9	122	55.8
45-200121-001	63-125	28.6-56.7	98	45	161	73.6	223	101.7
45-200125-001	63-125	28.6-56.7	98	45	161	73.6	223	101.7
45-200200-001	100-200	45.4-90.7	133	60	233	105.4	333	150.7
45-200201-001	100-200	45.4-90.7	133	60	233	105.4	333	150.7
45-200350-001	175-350	79.4-158.8	201	91	376	170.4	551	249.8
45-200351-001	175-350	79.4-158.8	203	92	378	171.4	551	250.8
45-200600-001	300-600	136.1-272.2	362	165	662	301.1	962	437.2
45-200601-001	300-600	136.1-272.2	367	165	667	301.1	962	437.2
45-200900-001	455-910	206.4-412.8	505	230	960	436.4	1415	642.8
45-200901-001	455-910	206.4-412.8	505	230	960	436.4	1415	642.8

Table 2-4. Cylinder, Equivalent Lengths

Part Number	Nomenclature	Discharge Outlet	Equivalent Length w/ Valve Outlet Adapter		Equivalent Length w/ Flex Hose	
			ft.	m	ft.	m
45-200010-001	10 lb. Cylinder	1½ in.	40.9	12.5	45.2	13.8
45-200020-001	20 lb. Cylinder	1½ in.	40.9	12.5	45.2	13.8
45-200040-001	40 lb. Cylinder	1½ in.	40.9	12.5	45.2	13.8
45-200070-001	70 lb. Cylinder	1½ in.	40.9	12.5	45.2	13.8
45-20012X-001	125 lb. Cylinder	1½ in.	40.9	12.5	45.2	13.8
45-20020X-001	200 lb. Cylinder	2 in.	19.7	6.0	22.7	6.9
45-20035X-001	350 lb. Cylinder	2 in.	19.7	6.0	22.7	6.9
45-20060X-001	600 lb. Cylinder	3 in.	22.7*	6.9*	36.3	11.1
45-20090X-001	900 lb. Cylinder	3 in.	22.7*	6.9*	36.3	11.1

Note: All equivalent lengths given in Schedule 40, black pipe.

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

Figures 2-3 and 2-4 represent the 1½ in. through 3 in. valve arrangements.

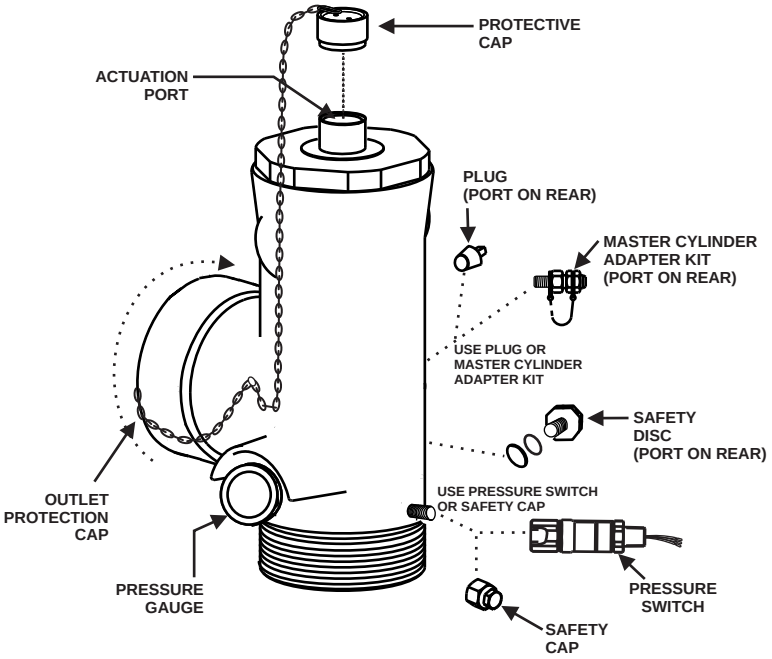


Figure 2-3. 1½ in. and 2 in. Valve General Arrangement

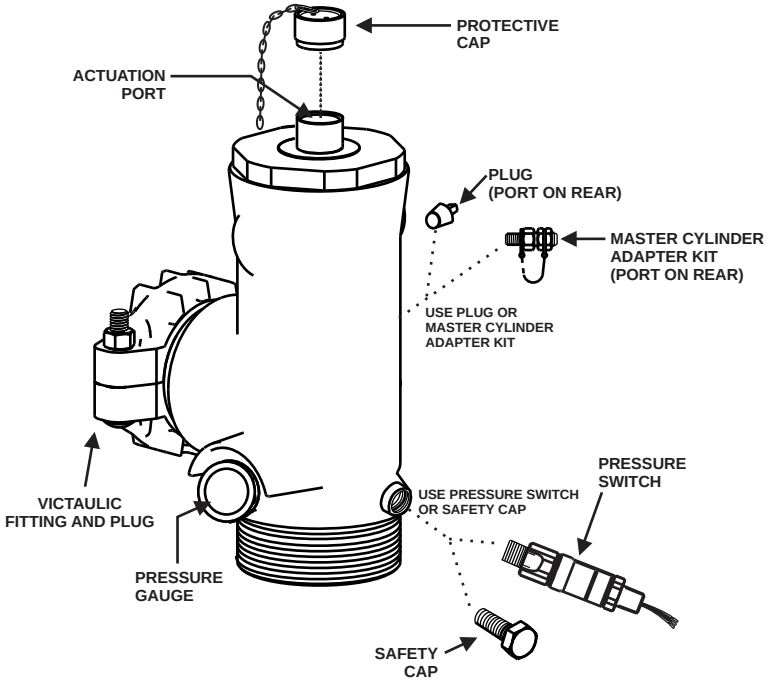


Figure 2-4. 3 in. Valve General Arrangement

2-3.2 Liquid Level Indicator

The optional liquid level indicator consists of a hollow metal tube inserted into a special fitting in the top of the 125, 200, 350, 600 or 900 lb. Kidde Engineered System cylinder. See Table 2-5 for part number information. The indicator is provided with a graduated tape which senses the position of a toroidal magnet encased within an internal float riding on the liquid surface. The graduations on the tape indicate the liquid level within the cylinder (see Figure 2-5).

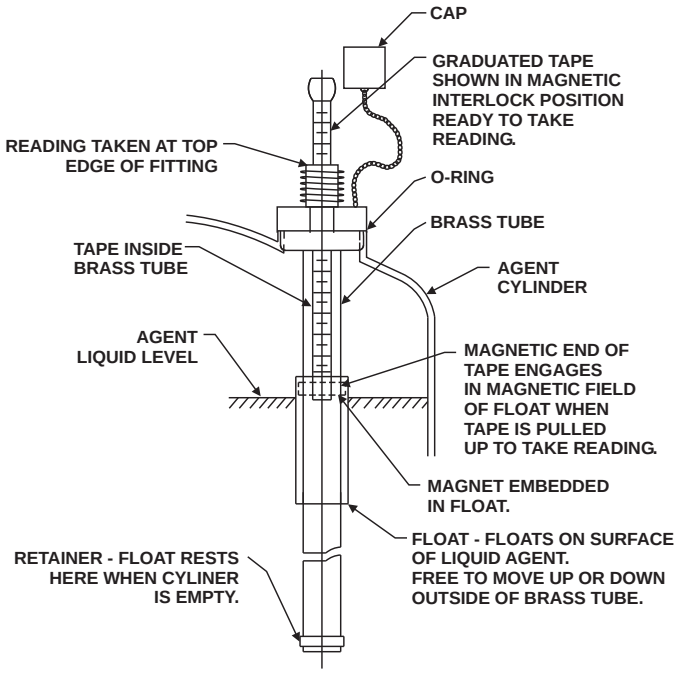


Figure 2-5. Liquid Level Indicator

Table 2-5. Liquid Level Indicator Part Numbers

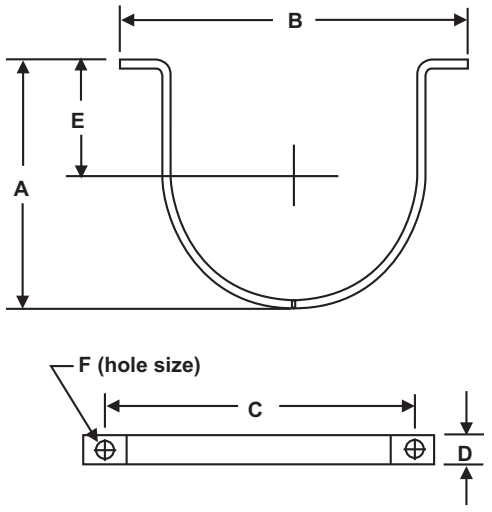
Cylinder	Liquid Level Part Number
125 lb.	06-235681-001
200 lb.	WK-283894-000
350 lb.	WK-283894-000
600 lb.	WK-283894-000
900 lb.	06-118266-001

2-3.3 Cylinder Mounting Hardware

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

Cylinder straps (P/N WK-283945-000, WK-283934-000, 06-235317-001, WK-281866-000, WK-294651-000 and 06-236125-001) are available for all size cylinders. See Figure 2-6 and Tables 2-6 and 2-7.

Cylinders of 125 lb. capacity and above are further supported with cylinder cradles (P/N 06-235431-001, WK-281867-000, WK-294652-000, and 06-118300-001). See Figure 2-7 and Tables 2-8 and 2-9.



Note: Material–Painted Steel

Figure 2-6. Cylinder Mounting Straps

Table 2-6. Dimensions–Cylinder Mounting Straps

Part Number	Cylinder Size	Cylinder O.D.	A	B	C	D	E	F
WK-283945-000	10, 20 lb.	7.07	6.48	9.62	8.62	1.00	2.78	0.437
WK-283934-000	40, 70 lb.	9.00	8.16	11.69	10.69	1.00	3.50	0.437
06-235317-001	125, 200 lb.	12.75	12.94	16.18	14.56	1.75	5.59	0.625
WK-281866-000	350 lb.	16.00	15.50	19.50	17.88	1.75	7.25	0.625
WK-294651-000	600 lb.	22.00	21.56	25.75	24.12	1.75	10.25	0.625
06-236125-001	900 lb.	24.00	24.83	27.75	26.00	1.75	12.13	0.625
Note: Dimensions are in inches.								

Table 2-7. Dimensions–Cylinder Mounting Straps, Metric

Part Number	Cylinder Size	Cylinder O.D.	A	B	C	D	E	F
WK-283945-000	10, 20	180	165	244	219	25	71	11.1
WK-283934-000	40, 70	229	207	297	272	25	89	11.1
06-235317-001	125, 200	319	329	411	370	44	142	15.9
WK-281866-000	350	406	394	495	454	44	184	15.9
WK-294651-000	600	559	548	654	613	44	260	15.9
06-236125-001	900	610	619	705	660	44	308	15.9
Note: Dimensions are in millimeters.								

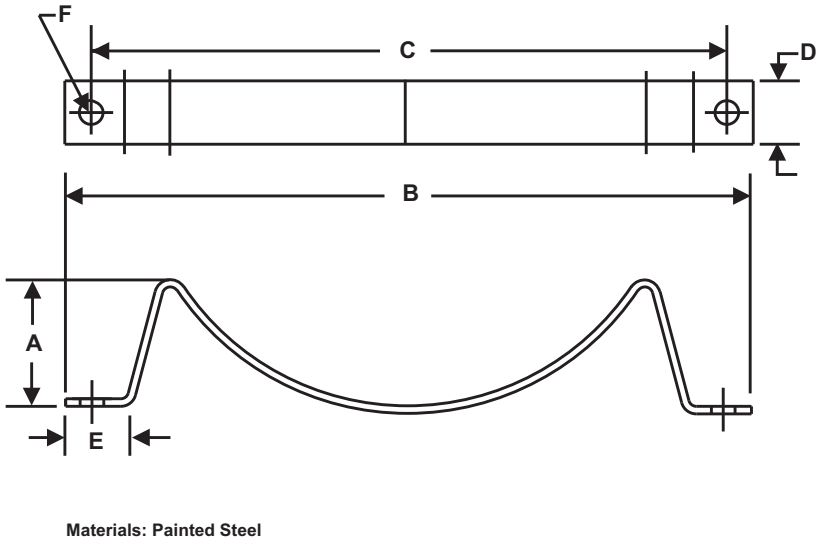


Figure 2-7. Cylinder Cradles

Table 2-8. Dimensions–Cylinder Cradles

Part Number	Cylinder Capacity	Cylinder O.D.	A	B	C	D	E	F
06-235431-001	125, 200	12.75	3.20	16.25	15.00	1.50	1.312	0.562
WK-281867-000	350	16.00	3.58	19.24	18.00	1.50	1.340	0.562
WK-294652-000	600	22.00	4.75	25.24	24.00	1.75	1.340	0.562
06-118300-001	900	24.00	5.18	27.74	26.00	1.75	1.680	0.625
Note: Dimensions are in inches.								

Table 2-9. Dimensions–Cylinder Cradles, Metric

Part Number	Cylinder Capacity	Cylinder O.D.	A	B	C	D	E	F
06-235431-001	125, 200	324	81	413	381	38	33	14
WK-281867-000	350	406	91	489	457	38	34	14
WK-294652-000	600	559	121	641	610	45	34	14
06-118300-001	900	610	132	705	660	45	43	16
Note: Dimensions are in millimeters.								

2-3.4 Lever/Pressure Control Heads

2-3.4.1 LEVER OPERATED CONTROL HEAD, P/N WK-870652-000

The lever operated control head is equipped with an operating lever, secured in the closed position by a safety pull pin. When the safety pin is removed, the lever can be manually rotated to the open position, thereby activating the cylinder or valve on which it is installed. The lever operated control head is self-venting to prevent accidental system discharge (see Figure 2-8).

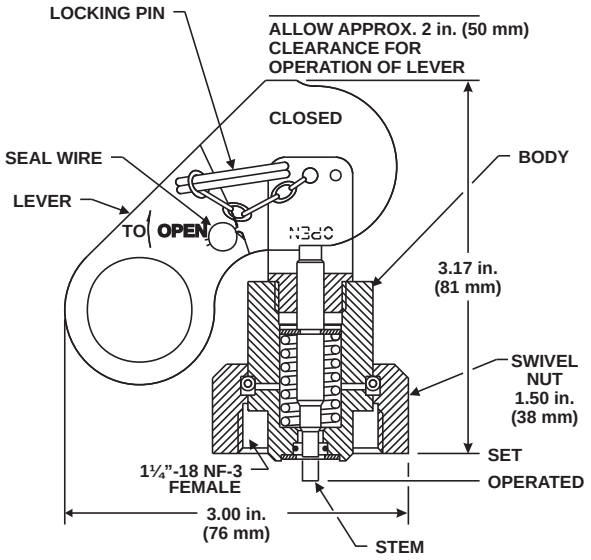


Figure 2-8. Lever Operated Control Head

2-3.4.2 LEVER/PRESSURE OPERATED CONTROL HEAD, P/N 82-878751-000

The lever/pressure operated control head allows manual or pressure actuation of several system components, including Kidde Engineered System cylinder valves and nitrogen actuators. The lever/pressure operated control head is self-venting to prevent accidental system discharge (see Figure 2-9).

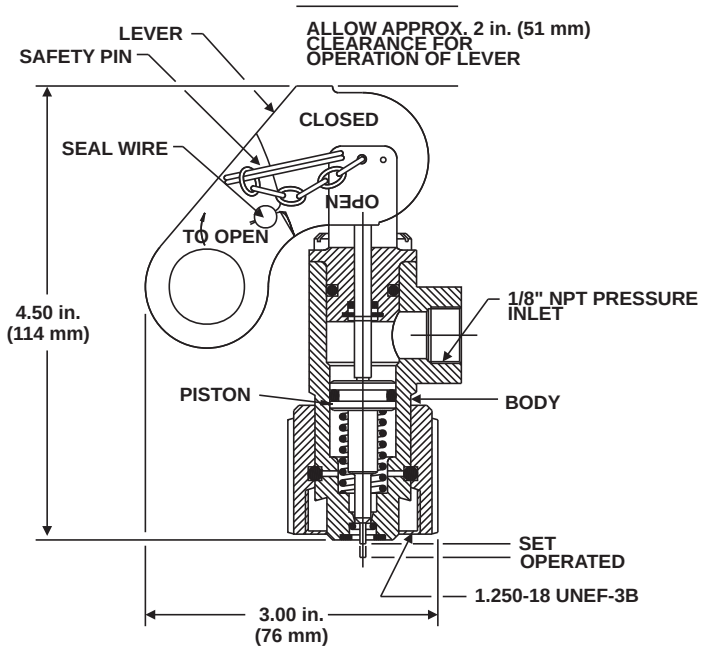


Figure 2-9. Lever/Pressure Operated Control Head

2-3.4.3 PRESSURE OPERATED CONTROL HEAD, P/N 82-878737-000 AND P/N 82-878750-000

The pressure operated control head, P/N 82-878737-000, allows for pressure actuation of Kidde Engineered System cylinders and is mounted directly on top of the Kidde Engineered System cylinder valve (see Figure 2-10). The pressure operated control head, P/N 82-878750-000, offers a stackable design and is used where an electric/mechanical control head actuation is also required on the same cylinder (see Figure 2-11). The pressure operated control head is self-venting to prevent accidental system discharge.

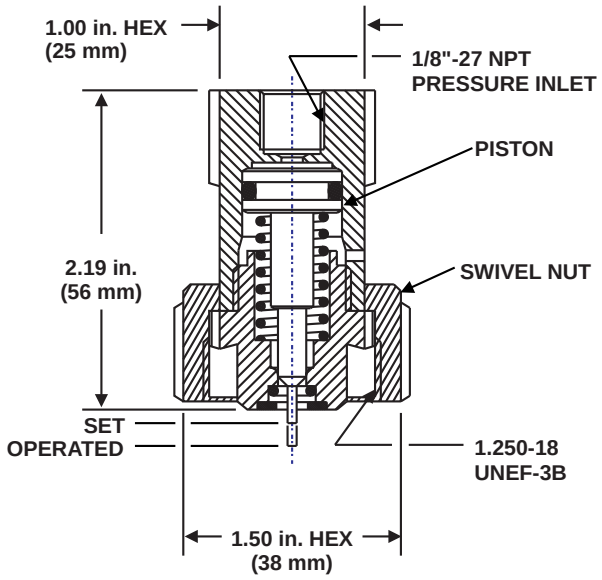


Figure 2-10. Pressure Operated Control Head

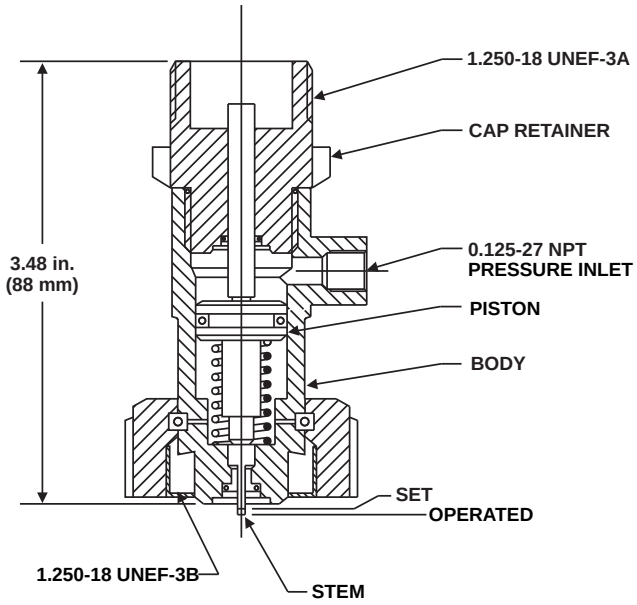


Figure 2-11. Stackable Pressure Operated Control Head

2-3.5 Cable Operated Control Heads and Ancillaries

2-3.5.1 CABLE OPERATED CONTROL HEAD, P/N 81-979469-000

The cable operated control head is used for systems designed for manual operation only. It mounts directly on top of the Kidde Engineered System cylinder valve and is operated either remotely from a cable manual pull station or locally using the manual lever on the control head. The cable operated control head is self-venting to prevent accidental system discharge (see Figure 2-12).

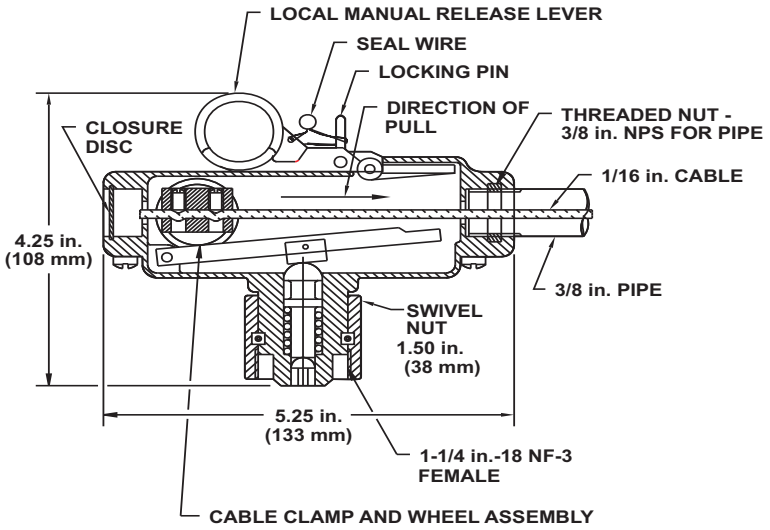


Figure 2-12. Cable Operated Control Head

2-3.5.2 DUAL-PULL MECHANISM, P/N 81-840058-000

The dual-pull mechanism is used where two remote cable pull stations are required for a single system. The cables from each station are secured in a clamping block within the unit, allowing a single control cable to be routed to the cylinder control head (see Figure 2-13).

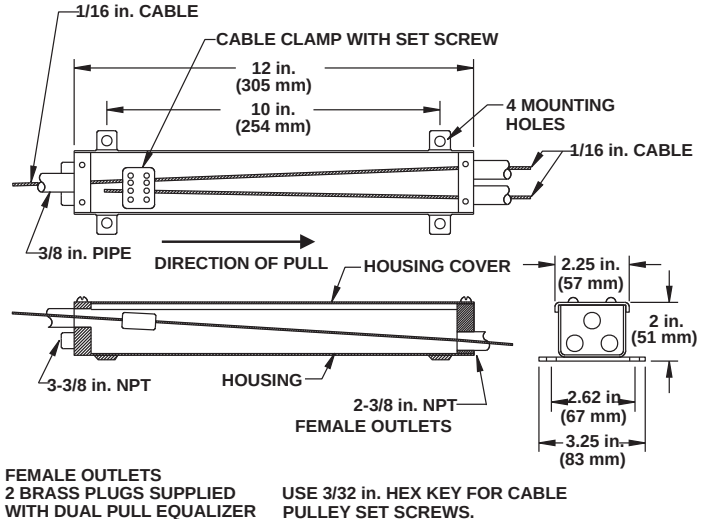


Figure 2-13. Dual-Pull Mechanism

2-3.5.3 DUAL-PULL EQUALIZER, P/N 81-840051-000

The dual-pull equalizer is used where two control-heads are to be operated by a single control cable and remote cable pull station. A single cable is routed from the first control head through the pulley installed in the unit, and is terminated in the second control head (see Figure 2-14).

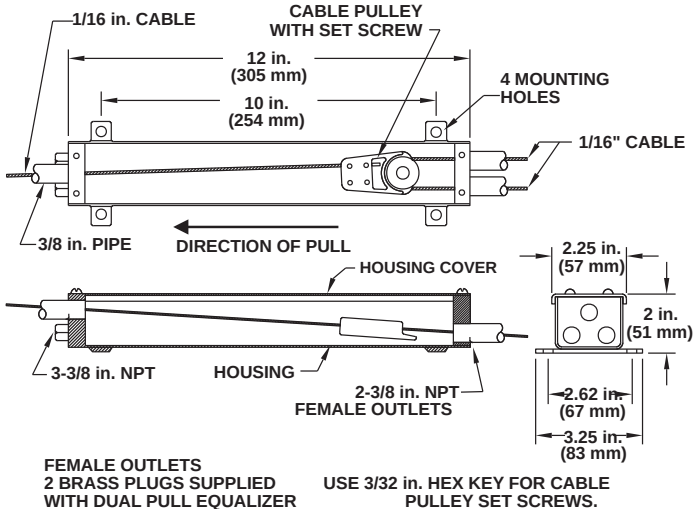


Figure 2-14. Dual-Pull Equalizer

2-3.5.4 CORNER PULLEY, WATERTIGHT, P/N 81-803808-000

Corner pulleys are used to change direction of pull cables, therefore preventing binding and ensuring smooth operation. The unit is fitted with a rubber gasket to prevent the ingress of contaminants.

2-3.6 Pneumatic Control and Detection

2-3.6.1 PNEUMATIC CONTROL HEAD, P/NS 81-872335-000, 81-872365-000, 81-872362-000, 81-872330-000 AND 81-872360-000

The pneumatic control head is a non-electrical mechanical device that allows for automatic actuation of pilot cylinder valves, stop valves and Kidde Engineered System cylinder valves by means of pressure pulses transmitted from heat-actuated detectors (HADs) via capillary tubing. The pneumatic control head can also be actuated via remote cable or by local manual lever (see Figure 2-15 and Table 2-10.

The pneumatic control system incorporates a control head, capillary and tubing plus one or more detectors that operate on the rate-of-rise principle. The system is vented to allow gradual changes of temperature to be accommodated. This means that only rapid increases (i.e., fire) in temperature will result in actuation.

There are three primary pneumatic control head factory settings. A setting is comprised of the pressure setting and vent setting. The pressure setting is expressed in terms of inches of water (either 3 in. or 6 in.). The higher the pressure setting, the higher the rise in pressure within the control circuit needs to be in order for the control head to operate. The vent setting is expressed in seconds and indicates the time taken to relieve a pressure equal to two inches of water. The higher the vent setting, the smaller the vent area and the more sensitive the unit becomes to changes in temperature.

Where two control heads are required, the second unit installed is a tandem unit with an identical pressure setting, but without a vent.

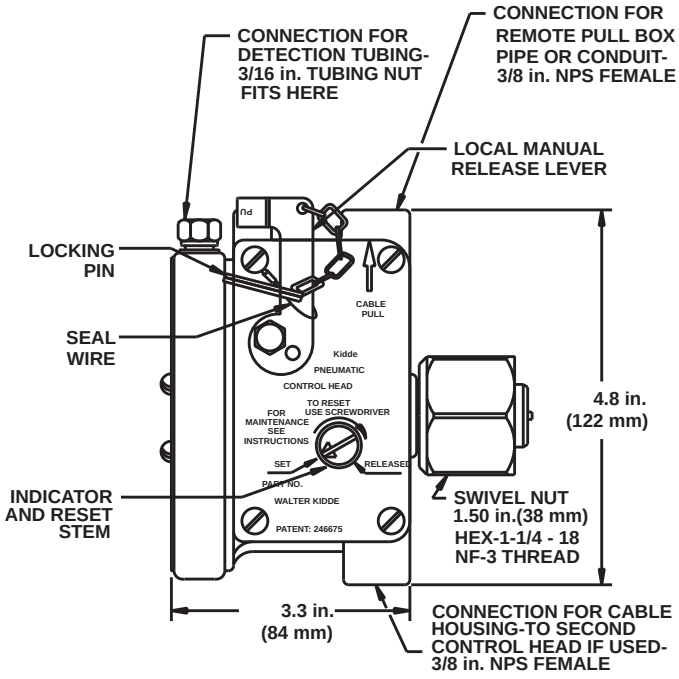


Figure 2-15. Pneumatic Control Head

Table 2-10. 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.	__	__	__	__	__	__	__

2-3.6.2 PNEUMATIC DETECTOR, P/N WK-841241-000

The pneumatic heat-actuated detector (HAD) consists of a sealed hollow brass chamber with no moving parts. The detector is connected to the pneumatic control head(s) by copper capillary tubing (see Figure 3-18). To improve performance, the detector can be installed on the heat collector (P/N 31272). 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 capillary tubing, causing the control head to operate and actuate the system. The control head vent prevents normal ambient temperature fluctuations from causing system operation. Up to four HAD units can be used in a single system (refer to Table 2-10).

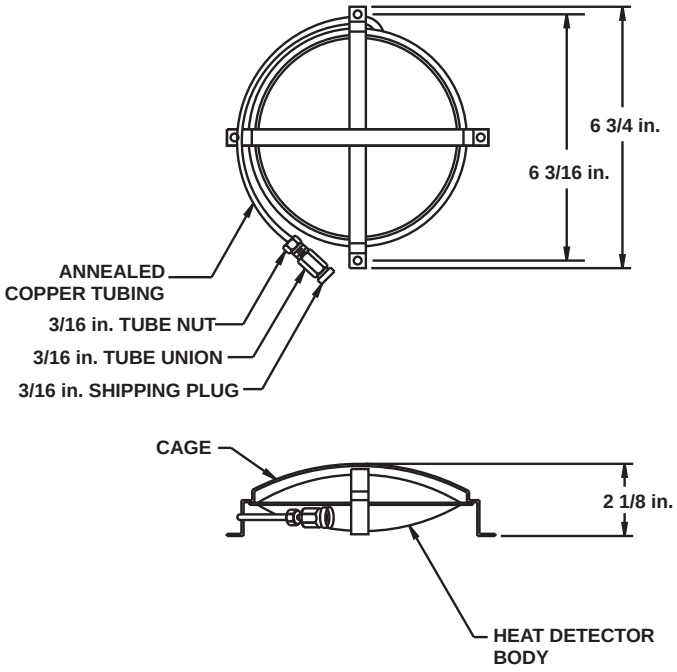


Figure 2-16. Pneumatic Heat-Actuated Detector (HAD)

2-3.6.3 PNEUMATIC DETECTION TUBING AND FITTINGS

Copper Capillary tubing, 3/16 in., is used to interconnect the pneumatic control head(s) and HAD(s). Four pre-prepared lengths are available measuring 17 in., 46 in. and 12 feet. Each length of tubing is flared at each end with tubing nuts installed. Figure 2-17, Figure 2-18 and Table 2-11 detail the tubing and fittings that are available.

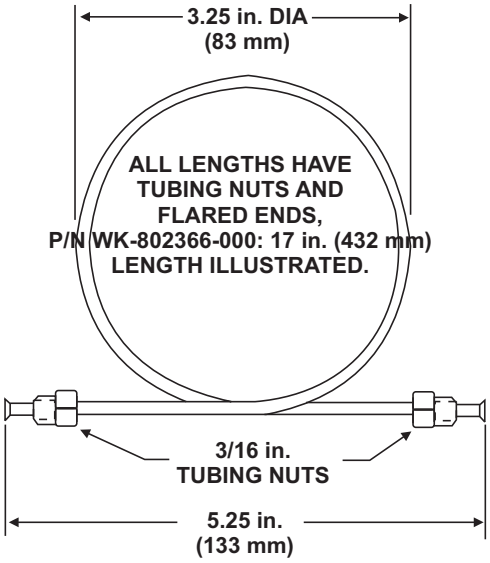


Figure 2-17. Pneumatic Detection System Tubing, 3/16 in.

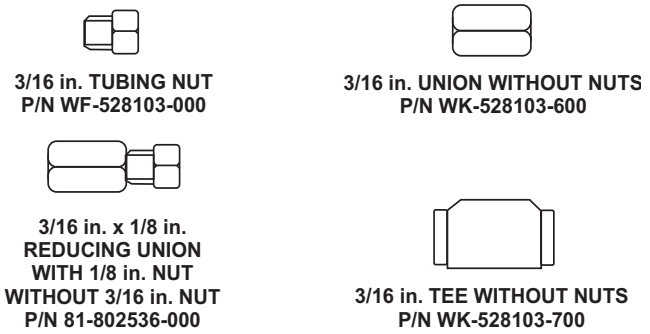


Figure 2-18. Pneumatic Detection System Tubing Fittings

Table 2-11. Pneumatic Tubing and Fittings

Part Number	Description
WK-802366-000	Pneumatic tubing, 3/16 in., 17 in. (0.43 m)
81-802367-000	Pneumatic tubing, 3/16 in., 46 in. (1.17 m)
WK-802486-000	Pneumatic tubing, 3/16 in., 12 in.(3.66 m)
WF-528103-000	Tubing nut, 3/16 in.
WK-528103-600	3/16 in. union, w/out nuts
81-802536-000	3/16 in. x 1/8 in. reducing union
WK-528103-700	3/16 in. tee w/out nuts

2-3.7 Remote Pull Stations

2-3.7.1 CABLE MANUAL PULL STATION, SURFACE, P/N 81-871403-000

The surface type remote cable manual pull station is a cable operated device. To actuate the Kidde Engineered System system, break the glass plate on the box using the attached hammer and pull the handle (see Figure 2-19).

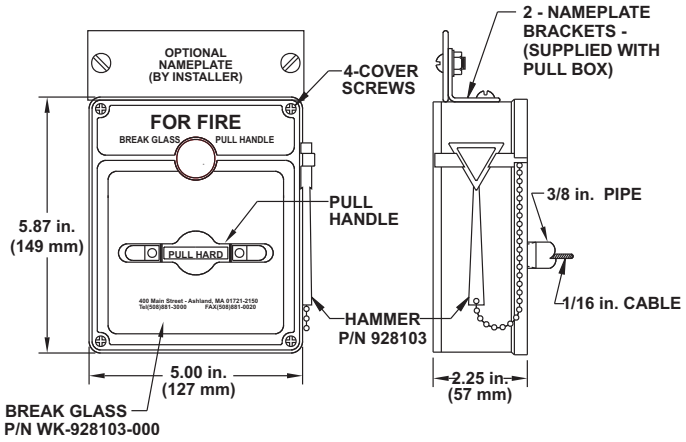


Figure 2-19. Cable Manual Pull Station

2-3.7.1.1 "Z" Bracket for Standard Break Glass Pull Box (P/N 81-871403-000), P/N 81-605320-000

The “Z” bracket is used to mount the standard break glass pull box (P/N 81-871403-000) where clearance is required for the corner pulley (P/N 81-803808-000) behind the unit (see Figure 2-20).

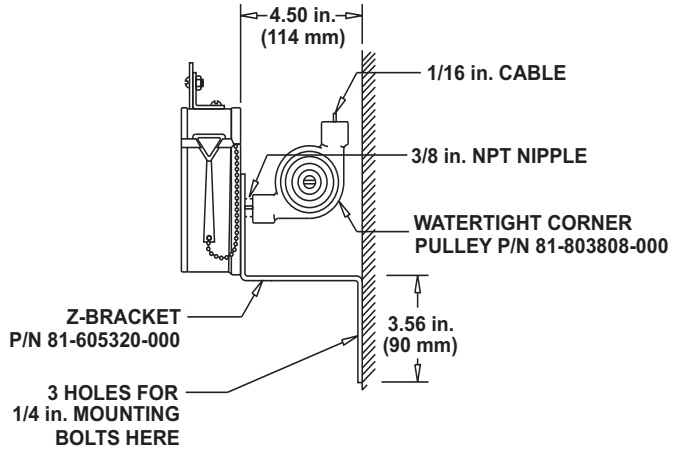


Figure 2-20. Break Glass Pull Box used with "Z" Bracket

2-3.7.2 WATERTIGHT PULL BOX, P/N 81-870087-000

The watertight pull box is equipped with a hinged protective cover that protects the unit from the ingress of moisture and accidental damage (see Figure 2-21). To gain entry to unit, the handle is rotated clockwise and the front cover opened. The attached hammer is then used to break the glass as per the Standard Break Glass Pull Box, P/N 81-871403-000 (refer to Figure 2-20).

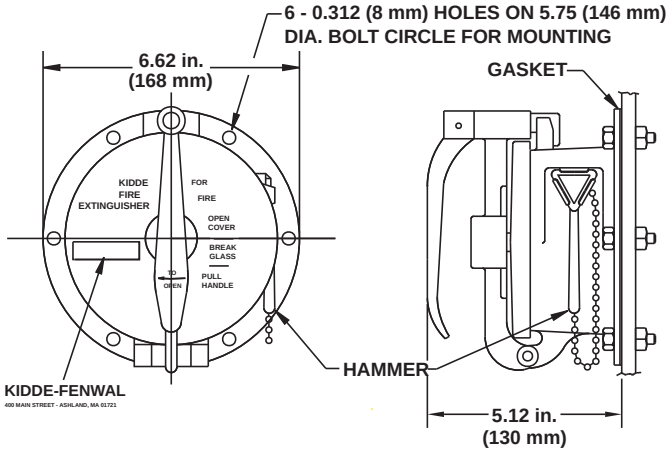


Figure 2-21. Watertight Pull Box

2-3.7.3 FLUSH MOUNT PULL BOX, YACHT TYPE, P/N 81-870098-000

The flush mount pull box is a compact unit that can be flush mounted to a bulkhead, provided there is clearance behind for conduit and/or corner pulley(s). The unit is fitted with a transparent frangible shield, through which the handle can be seen and grasped through a cutout. The shield must be broken to pull the handle and attached cable (see Figure 2-22).

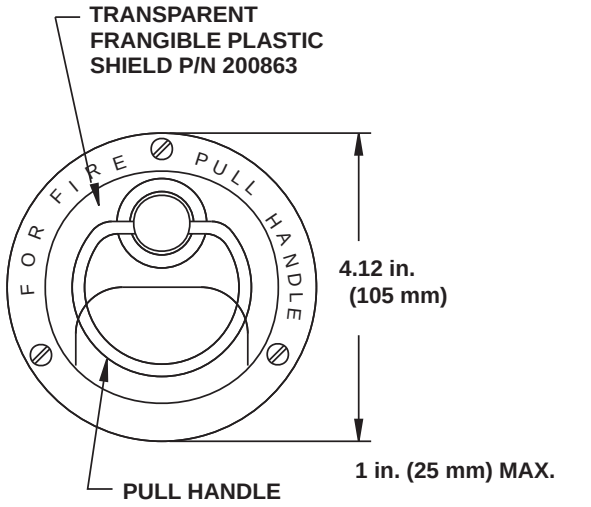


Figure 2-22. Flush Mount Pull Box, Yacht Type

2-3.8 Nitrogen Pilot System and Pressure Driven Accessories

2-3.8.1 NITROGEN ACTUATOR, MOUNTING BRACKET AND ADAPTER, P/N WK-877940-000, P/N WK-877845-000 AND P/N WK-699205-010 RESPECTIVELY

The 108 cu. in. pilot nitrogen cylinder comprises a seamless steel cylinder manufactured to Department of Transportation (DOT) requirements. The discharge valve is machined brass. No siphon tube is installed. The nominal charge pressure is 1800 PSIG at 70°F (124 bar gauge at 21°C).

An optional supervisory pressure switch is installed on container P/N WK-877940-200. This switch is incorporated into the pressure gauge. See Paragraph 2-3.8.9.

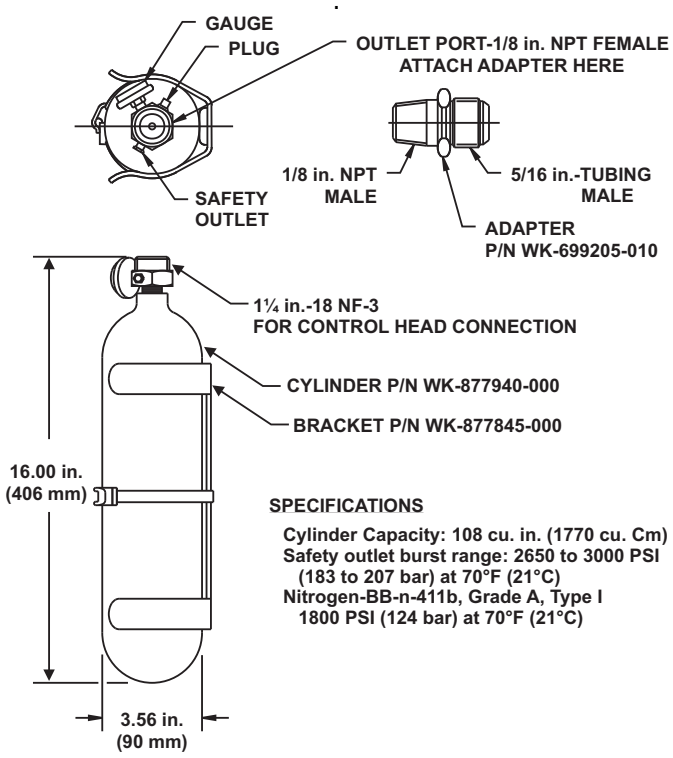


Figure 2-23. Nitrogen Actuator, Mounting Bracket and Adapter

2-3.8.2 NITROGEN PILOT CYLINDER SIREN DRIVERS, 1040 CU. IN. (P/N 90-101040-000) AND 2300 CU. IN. (P/N 90-102300-100)

The 1040 cu. in. and 2300 cu. in. pilot nitrogen system cylinders are comprised of seamless steel cylinders manufactured to Department of Transportation (DOT) requirements. The discharge valve is forged brass and has a nominal 5/8 in. discharge path. The assembly is installed without a siphon tube. The nominal charge pressure is 1800 PSIG at 70°F (124 bar gauge at 21°C).

An optional supervisory pressure switch is installed on container P/N 90-101040-200 and P/N 90-102300-200. This switch is incorporated into the pressure gauge. See Paragraph 2-3.8.9.

The valve is fitted with a safety burst disc to protect against over-pressurization. A horizontal axial threaded connection on the side of the valve is utilized for filling and for actuation. The threaded portion of the upper valve is where the discharge head is located (see Figure 2-24 and Table 2-12).

WARNING

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

Pilot nitrogen cylinders (1040 and 2300 cu. in.) are factory-equipped with a protection cap threaded securely over the valve assembly. The device is a safety feature and provides protection during shipping and handling. The cap must be installed at all times, except when the cylinder is connected into the system piping or is being filled. Do not move or handle a cylinder unless the protection cap is installed. Ensure that the protection cap is retained in a safe place close to the installed cylinder on the vessel.

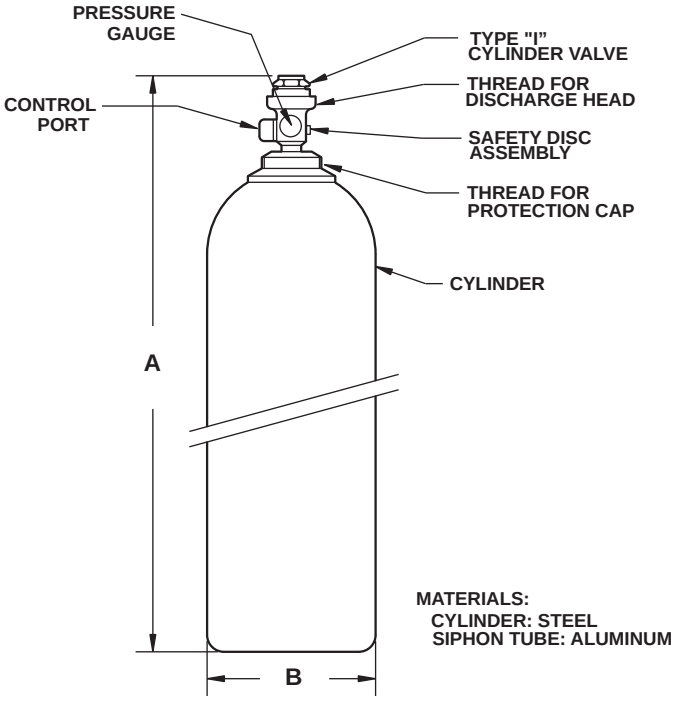


Figure 2-24. Nitrogen Pilot Cylinder (1040 and 2300 cu. in.)

Table 2-12. Nitrogen Pilot System Cylinder Dimensions

Cylinder Size	Dimension A		Dimension B	
	in.	mm	in.	mm
1040 cu. in.	30	760	8.5	215
2300 cu. in.	55	1390	8.5	215

2-3.8.3 NITROGEN DISCHARGE HEADS, PLAIN NUT, P/N WK-872450-000, AND GROOVED NUT, P/N 81-872442-000

The plain nut discharge head is installed on the nitrogen discharge valve. It provides an outlet path for the nitrogen with a threaded connection for a discharge hose or swivel. The head is fitted with a piston, check and stem assembly. A pressure tapping in the outlet of the head allows pressure in nitrogen manifold to open the attached nitrogen valve. A second pilot path is provided which connects the actuation port with the discharge head. When a control head operates the pilot check situated at the bottom of the pilot port the escaping pressure is routed to the discharge head, which operates the main valve. See Figures 2-25 and 2-26 for more details.

The grooved nut discharge head is the same as the plain nut discharge head, but the pilot path from the discharge outlet is blocked so that discharge pressure will not operate the head. The unit is differentiated from the plain nut head by two grooves cut in the main body hex (the position of the grooves is indicated in Figures 2-25 and 2-26).

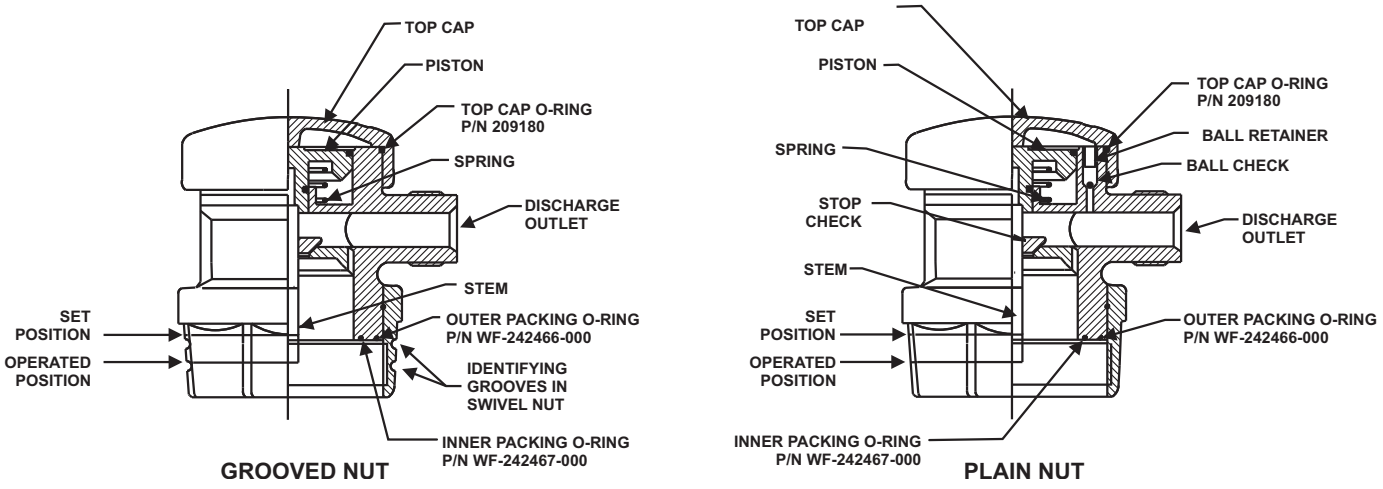


Figure 2-25. Discharge Heads, Plain Nut and Grooved Nut

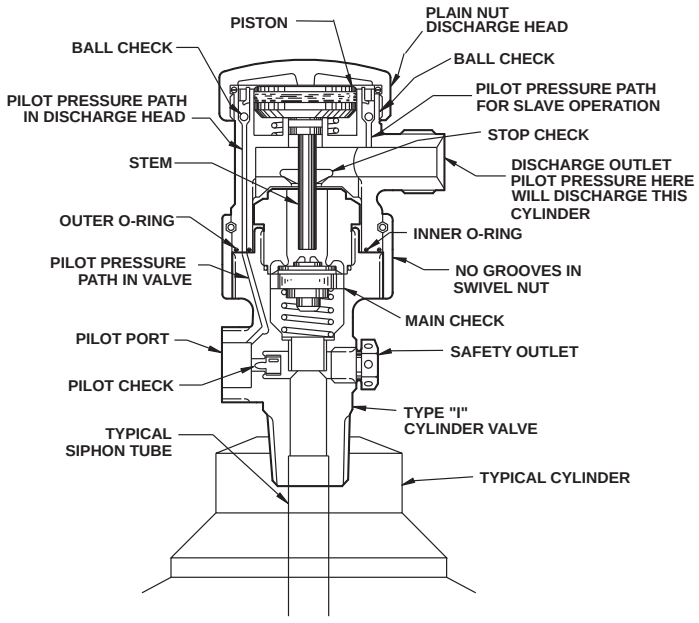


Figure 2-26. Assembly of Plain Nut Discharge Head to Type "I" Cylinder Valve

2-3.8.4 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 2-27 and Table 2-13).

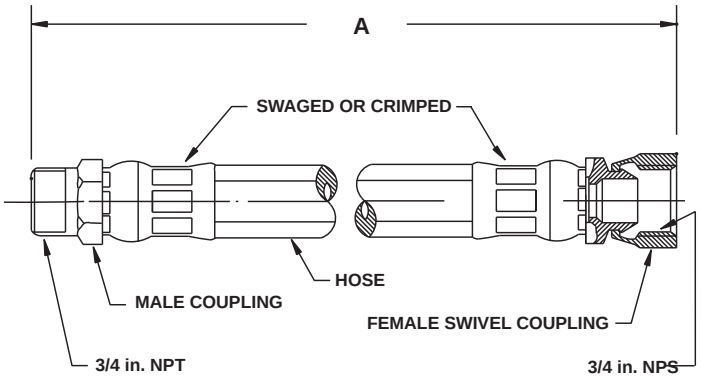


Figure 2-27. Flex Hose, 3/4 in.

Table 2-13. Flex Hose Dimensions

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

2-3.8.5 NITROGEN MANIFOLD "Y" FITTING, P/N 81-207877-000

The manifold “Y” fitting is a three-way fitting made of galvanized malleable iron. This "Y" fitting allows for the connection of two pilot nitrogen cylinders into one point in the manifold or piping (see Figure 2-28).

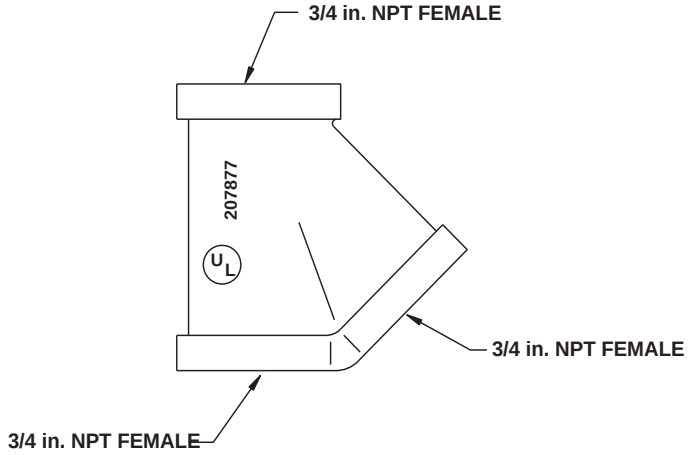


Figure 2-28. Manifold "Y" Fitting

2-3.8.6 CYLINDER STRAPS FOR NITROGEN PILOT CYLINDERS, P/N WK-270014-000 AND P/N WK-241219-000

A single loop steel strap is used to support single cylinders in a vertical position (P/N WK-270014-000, see Figure 2-29) and a double strap unit can be used for two cylinders (P/N WK-241219-000, see Figure 2-30).

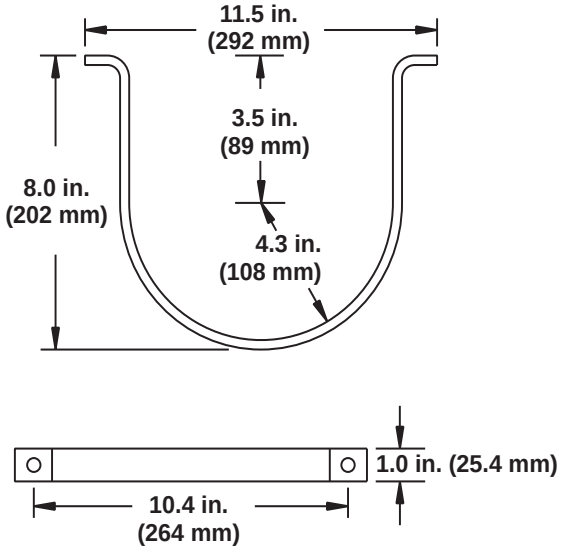


Figure 2-29. Single Cylinder Strap

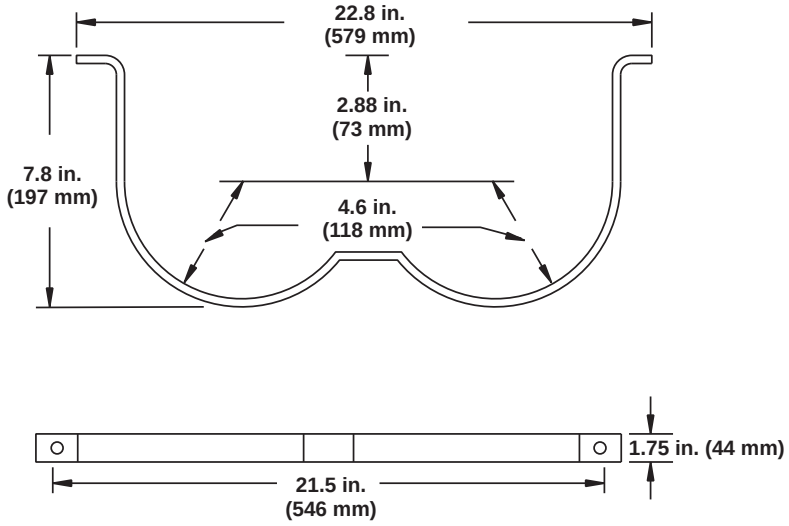


Figure 2-30. Double Cylinder Strap

2-3.8.7 NITROGEN DISCHARGE DELAYS, P/N 81-871072-001, P/N 81-871072-002, P/N 81-871072-003 AND P/N 81-871072-004

This device utilizes nitrogen system pressure to provide a pneumatic (automatic mechanical) means to delay the release of pilot media by a predetermined period following the initial actuation event. The time delay consists of a metering tube, a cylinder and a differential pressure-operated valve with a control port. The control port allows the connection of a lever operated control head that can be operated to bypass the delay.

Four versions are available with factory preset (non-adjustable) delay. See Figure 2-31 and Table 2-14 for more details.

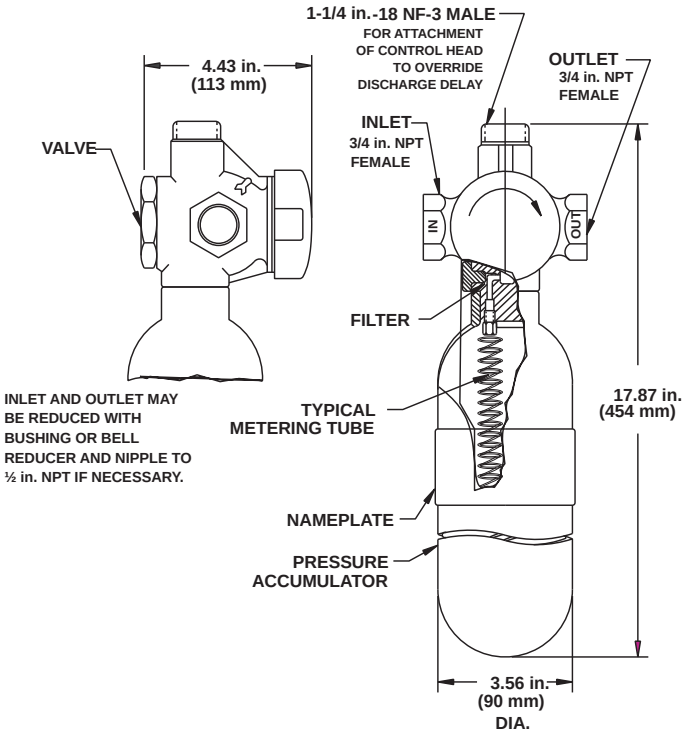


Figure 2-31. Discharge Delays (30/60 sec.)

Table 2-14. Discharge Delays

Part Number	Agent	Nominal Delay Time Approx.	Type of Metering Tube
81-871072-001	Nitrogen	34 sec.	Curled
81-871072-002	Nitrogen	61 sec.	Curled
81-871072-003	Nitrogen	35 sec.	Curled
81-871072-004	Nitrogen	68 sec.	Curled

2-3.8.8 NITROGEN PRESSURE OPERATED SIREN, P/N 90-981574-001

The pressure operated siren is connected into the nitrogen manifold and provides a high-pitch, high-decibel sound during discharge as the internal rotor is spun and as nitrogen flows through and out of the unit. The unit is primarily used as a pre-discharge alarm to warn personnel to evacuate the protected space. See Figure 2-32 and Table 2-15 for more details.

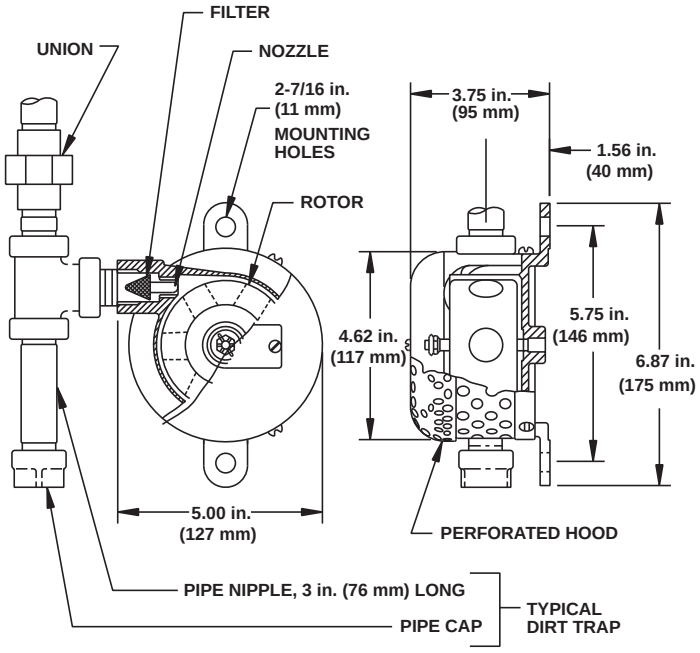


Figure 2-32. Pressure Operated Siren

Table 2-15. Pressure Operated Siren Nominal Flow Rate

Type of Agent	Nominal Flow Rate at 70°F (21°C)
Nitrogen	0.5 to 0.9 lb./min. (0.23 to 0.4 kg/min.)

2-3.8.9 SUPERVISORY SWITCH-IN-GAUGE, P/N 06-118238-001

The Switch-in-Gauge unit provides a NO (Normally Open) switched contact that is NC (Normally Closed) under normal operating pressure. It is designed to trip when the pressure within the nitrogen cylinder is outside of the standard operating range (1623 to 2062 PSI [112 to 142 bar]).

Note: A fault indication is not necessarily an indication of a loss of pressure—all cylinder pressure readings must be corrected for temperature.

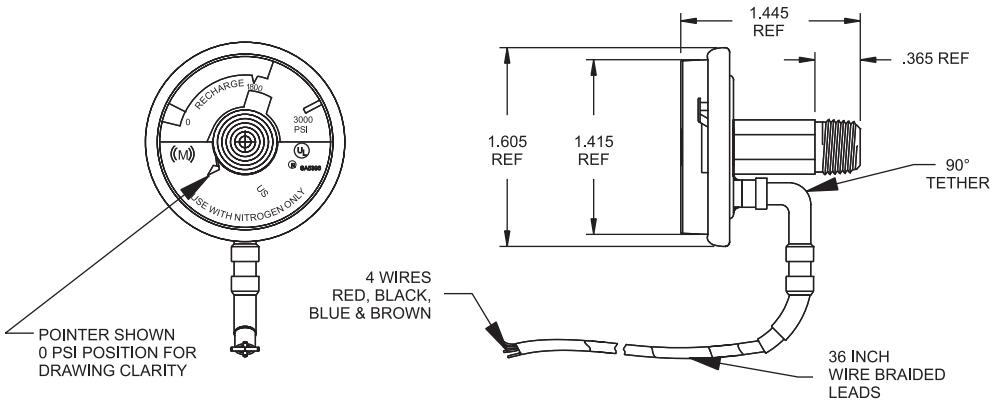


Figure 2-33. Supervisory Switch-in-Gauge

2-3.8.10 NITROGEN ACTUATION CIRCUIT VENT, P/N WK-284051-000

The nitrogen vent is a 1/4 in. NPT fitting that is installed in closed or partially closed sections of nitrogen actuation circuits. The small orifice allows pressure to bleed from the circuit over time without affecting operation of the system.

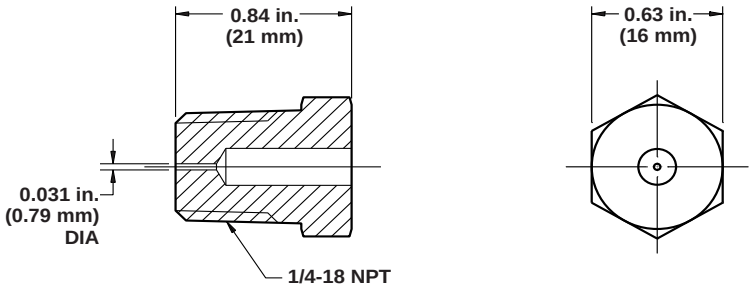


Figure 2-34. Nitrogen Actuation Circuit Vent

2-3.9 Actuation Accessories

2-3.9.1 FLEXIBLE ACTUATION HOSE, P/N WK-264986-000, P/N WK-264987-000 AND P/N 06-236215-001

The flexible actuation hose is used in multiple cylinder systems. Pilot pressure is directed to a pressure operated control head on each Kidde Engineered System cylinder valve using a 1/4-inch actuation hose (see Figure 2-35 and Table 2-16).

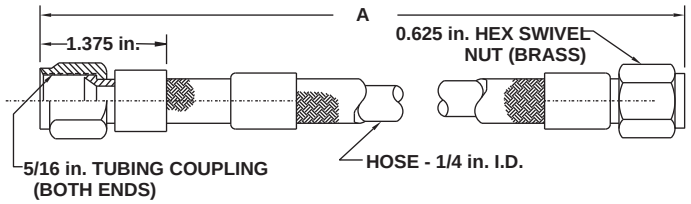


Figure 2-35. Flexible Actuation Hose (P/N WK-264986-000 and P/N WK-264987-000)

Table 2-16. Dimensions, Flexible Actuation Hose

Part Number	Dimension A	
	in.	mm
WK-264986-000	30	762
06-236215-001	34	762
WK-264987-000	22	558.8
Note: For heavy-duty applications, use P/N 06-236215-001 which is constructed of corrugated stainless steel.		

2-3.9.2 MASTER CYLINDER ADAPTER KIT, P/N 82-844895-000

The master cylinder adapter kit provides a means of connecting a flexible actuation hose to the master and slave cylinder and valve assemblies. The adapter kit is provided with a cap intentionally chained to the adapter to prevent loss while in service; do not remove the cap from the chain. The kit also contains a pressure sensitive label which is placed on the cylinder valve after adapter installation (see Figure 2-36).

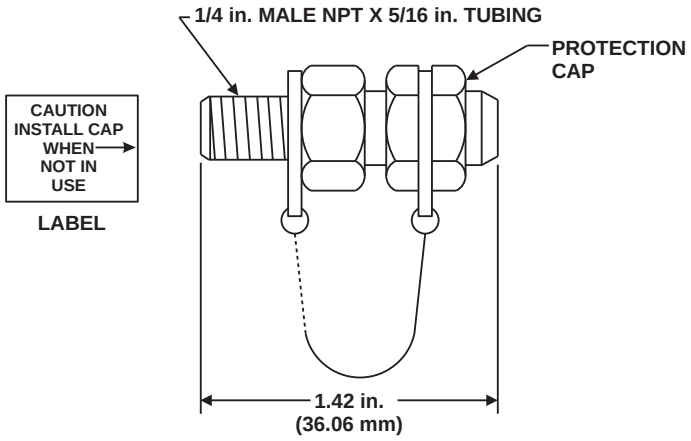


Figure 2-36. Master Cylinder Adapter Kit

2-3.9.3 DUAL-LOOP BLEED KIT, P/N 06-129978-001

Where dual-actuation loops are required, a dual-loop bleed kit is required at each cylinder location. The kit is comprised of a four-way fitting, a bleed valve, two 1/4 in. check valves, a bleed with cap and the necessary adapters to allow the connection of the dual-lines at the agent cylinder location. This assembly allows for the connection of two pilot lines to a single pressure operated control head. The check valves isolate the circuits from each other, and the bleed allows safe relief of pressure from the fittings following discharge. The contents of the kit are illustrated in Figure 2-37; refer to Table 2-17 for individual components.

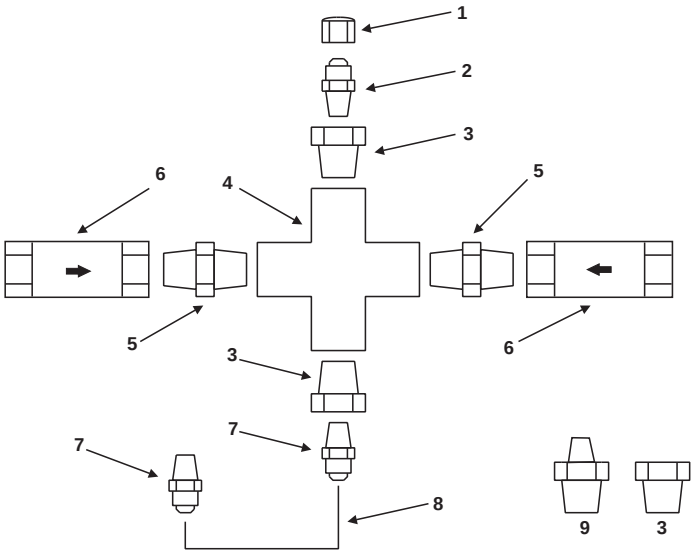


Figure 2-37. Dual-Loop Bleed Kit, Full Kit Contents

Table 2-17. Dual-Loop Bleed Kit Components

Item	Qty. in Kit	Description	Part Number
1	1	Cap 7/16 in. (1/4 in. SAE Flare) 1/4 in. Tube	WK-263304-000
2	1	Bleed Fitting 1/8 in. NPT x 7/16 in. (1/4 in. Tube)	WK-263303-000
3	3	1/4 in. NPT M x 1/8 in. NPT F	06-118318-001
4	1	4-Way 1/4 in. F	06-118319-001
5	2	1/4 in. NPT M x 1/4 in. NPT M	06-118320-001
6	2	1/4 in. Check Valve	WK-264985-000
7	2	1/8 in. NPT x 7/16 in. (1/4 in. Tube)	06-118191-001
8	Not Included	1/4 in. Actuation Hose, H. Duty, 34 in. Long	06-236215-001
9	1	1/4 in. NPT M x 1/8 in. NPT M	06-118321-001

2-3.9.4 TEES, ELBOWS AND ADAPTERS

Tees, elbows and adapters connect actuation hoses to pressure operated control heads in multiple cylinder system installations (see Figure 2-38).

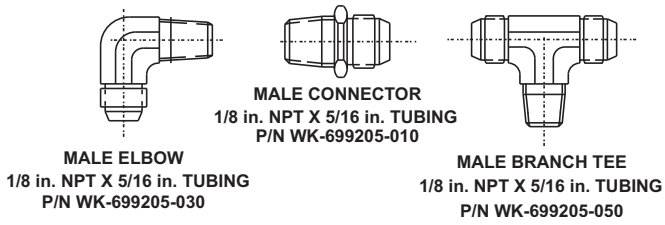


Figure 2-38. Tees, Elbows and Adapters

2-3.9.5 PILOT NITROGEN BALL VALVE, P/N WK-283888-000

The pilot valve is a stainless steel high-pressure 1/4 in. ball valve with integral mounting bracket used to isolate pilot nitrogen cylinders from the actuation circuit. A locking pin and a seal wire are provided to ensure the valve can be opened by deliberate action only (see Figure 2-39).

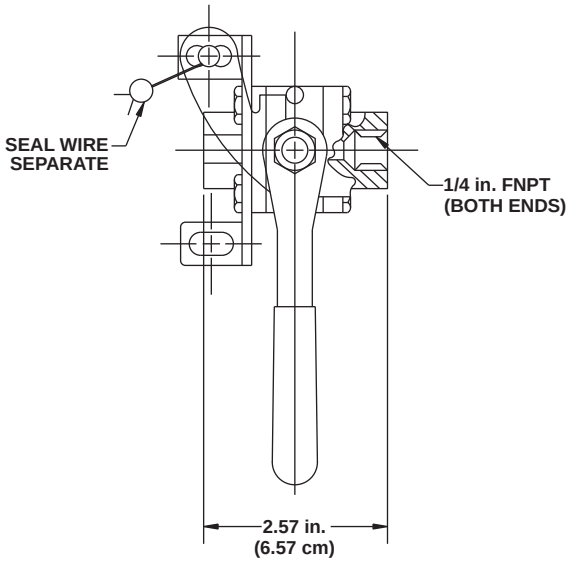


Figure 2-39. Pilot Nitrogen Ball Valve

2-3.10 Discharge Accessories

2-3.10.1 FLEXIBLE DISCHARGE HOSE, P/N WK-283898-000, P/N WK-283899-000 AND P/N 06-118225-001

Kidde Engineered System agent is routed from the storage cylinders to the discharge piping by a flexible 1½ in. or 2 in. rubber covered hose with wire braided reinforcements. The hose is connected to the discharge outlet of the Kidde Engineered System cylinder valve and terminates at the system piping or discharge manifold (see Figure 2-40, Figure 2-41 and Table 2-18).

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

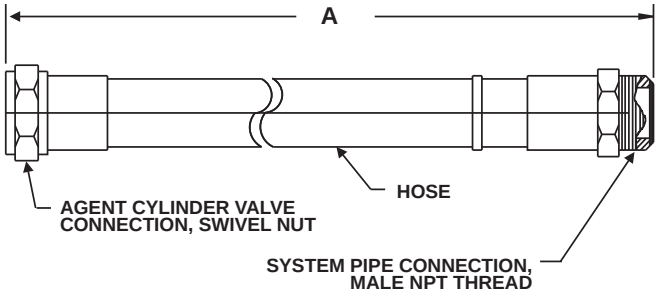


Figure 2-40. 1½ in. and 2 in. Flexible Discharge Hoses

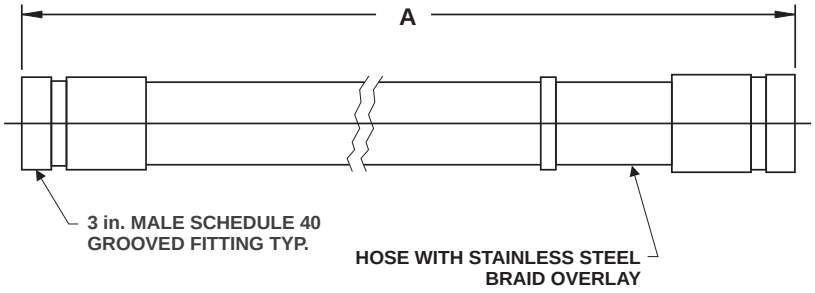


Figure 2-41. 3 in. Flexible Discharge Hose

Table 2-18. Dimensions, Flexible Discharge Hoses

Part Number	Hose Size	Dimension A		Min. Bend Radius	
		in.	mm	in.	mm
WK-283898-000	1½ in.	24	609.6	10.5	266.7
WK-283899-000	2 in.	31	787.4	13.5	342.9
06-118225-001	3 in.	54	1372.0	24.0	610.0

2-3.10.2 VALVE OUTLET ADAPTERS, P/N WK-283904-000 AND P/N WK-283905-000

A valve outlet adapter connects the cylinder valve outlet to the discharge piping when a flexible discharge hose is not used (see Figure 2-42 and Table 2-19).

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

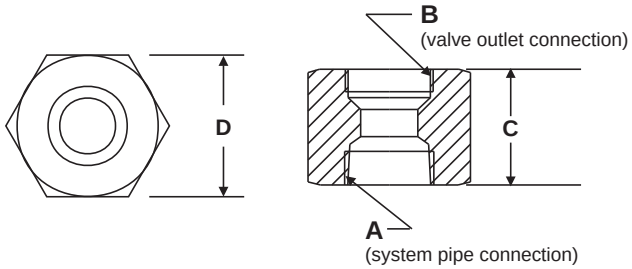


Figure 2-42. Valve Outlet Adapter

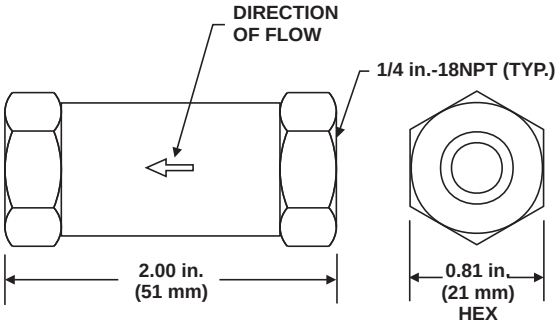
Table 2-19. Dimensions, Valve Outlet Adapter

Part Number	Size	A	B	C		D	
				in.	mm	in.	mm
WK-283904-000	1½ in.	1½ in.–11½ NPT	1.875 in.-12 UNJ	2.69	68.33	2.50 HEX	63.50
WK-283905-000	2 in.	2 in.–11½ NPT	2.500 in.-12 UNJ	3.12	79.25	3.00 HEX	76.20

2-3.10.3 CHECK VALVE, 1/4-INCH, P/N WK-264985-000 AND 3/8-INCH, P/N WK-261193-000

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

1/4-inch check valves are installed in the pilot manifold to ensure the proper number of cylinders are discharged and in dual-loop actuation arrangements (see Figure 2-43 and 2-44 and Table 2-20).



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

Figure 2-43. Check Valve, 1/4 in.

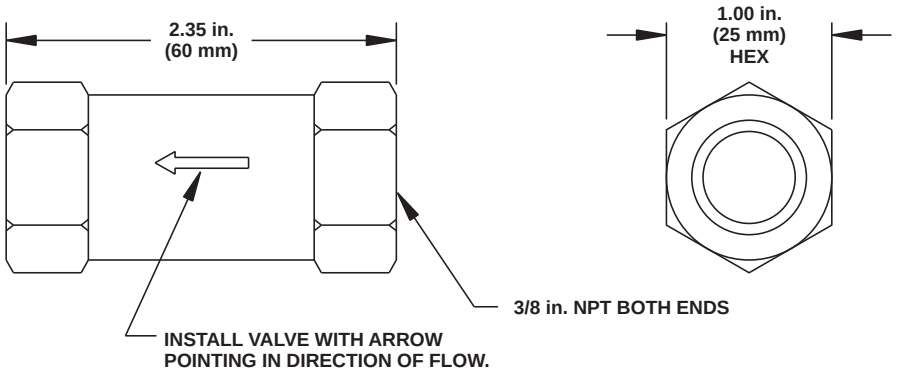


Figure 2-44. Check Valve, 3/8 in.

Table 2-20. 1/4 in. and 3/8 in. Check Valve Technical Data

Working Pressure	0 to 5000 PSIG (0 to 345 bar)
Proof Pressure	10,000 PSIG (690 bar)
Cracking Pressure	2 to 4 PSIG (0.14 to 0.28 bar)
Operating Temperature	-40°F to 250°F (-40°C to 121°F)

2-3.10.4 MANIFOLD EL-CHECKS, P/N WK-877690-000 AND P/N 82-878743-000

Manifold El-checks are installed at the discharge manifold in a multiple cylinder arrangement to allow removal of any Kidde Engineered System cylinder from the manifold while still retaining a closed system. The 2-inch El-check is used on the 10 through 350 lb. size cylinders; the 2½-inch El-check is used with the 600 lb. size cylinder (see Figure 2-45 and Table 2-21).

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

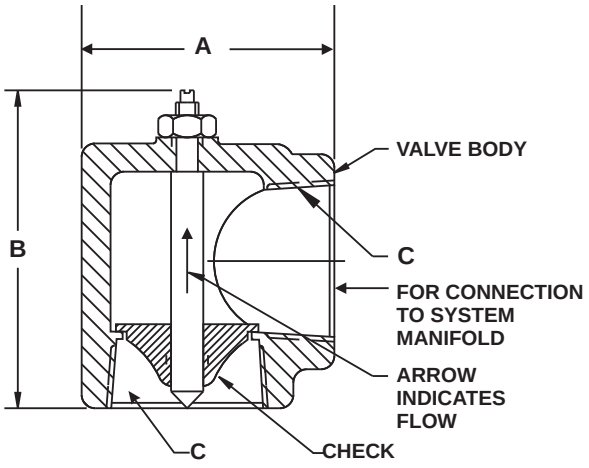


Figure 2-45. Manifold El-Checks

Table 2-21. Dimensions, Manifold El-Checks

Part Number	Size	A	B	C
WK-877690-000	2 in.	3.93 in. (99.80 mm)	4.88 in. (123.95 mm)	2 in.–11½ NPT
82-878743-000	2½ in.	4.96 in. (119.00 mm)	5.76 in. (146.30 mm)	2½ in.–8 NPT

2-3.10.5 CHECK VALVES

Note: See Table 2-22 for check valve data.

Check valves are used where a connected main/reserve configuration or multiple pilot containers are required. Check valves are essentially one-way valves and can be used in sections of the pipe network designed to flow CO2, N2 or Novec 1230 fluid. Pipe size limitations for the media being flowed apply to the selected check valve. If a check valve is used in the Kidde Engineered System discharge pipework, then it must be properly modeled in the flow calculation software to ensure accurate discharge prediction.

The following check valve sizes, 1/2 in., 3/4 in., 1 in., 1¼ in., 1½ in. and 2 in. (P/N 81-800327-000, WK-800266-000, WK-800443-000, WK-800444-000, WK-870152-000 and WK-870151-000), have female threaded outlet ports. The standard 3 in. check valve (P/N 81-870100-000) is a flanged valve. Where a 2½ in. check valve is required, a 3 in. check can be used with 2½ in. flanges. Refer to Figures 2-46 and 2-47 for details of available flanges, gasket and fasteners. The piston/check assembly is sprung, and forward bias discharge pressure allows media to flow. Reverse bias pressure applies force to the piston/check preventing flow.

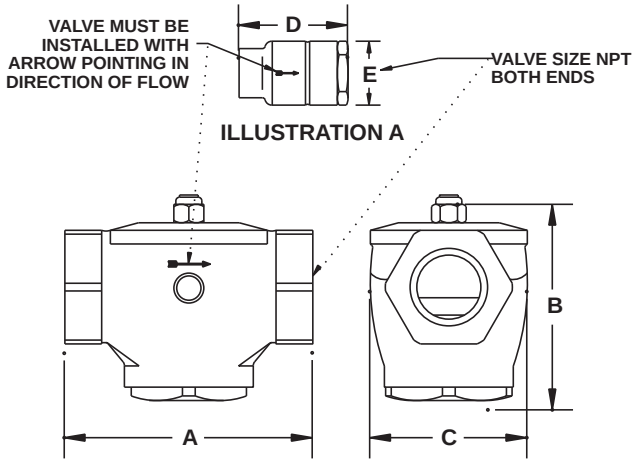


Figure 2-46. Check Valves, 1/2 in. thru 2 in.

Table 2-22. Check Valve Data

Part Number	Valve Size	Illustration (Figure 2-46)	A		B		C		D		E	
			in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
81-800327-000	1/2 in.	A	–	–	–	–	–	–	3.34	85	2.00	51
WK-800266-000	3/4 in.	A	–	–	–	–	–	–	3.34	85	2.00	51
WK-800443-000	1 in.	A	–	–	–	–	–	–	3.97	101	3.18	81
WK-800444-000	1¼ in.	A	–	–	–	–	–	–	3.97	101	3.18	81
WK-870152-000	1½ in.	B	7.50	151	6.28	160	4.75	121	–	–	–	–
WK-870151-000	2 in.	B	7.50	151	6.28	160	4.75	121	–	–	–	–

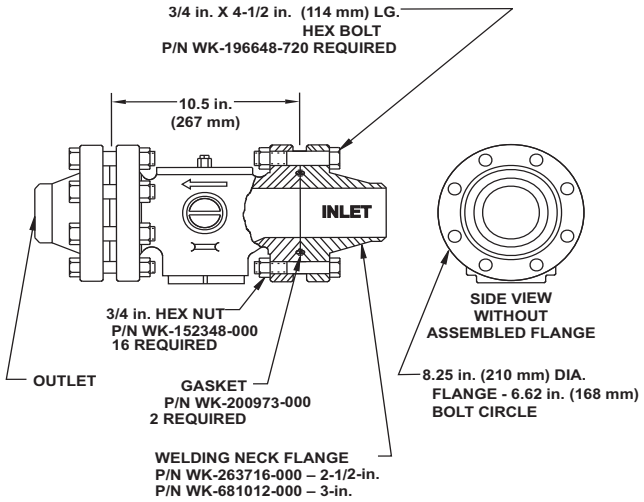


Figure 2-47. Check Valves, 2½ in. and 3 in.

Two low loss swing-check valves are available: the 2 in. (P/N 06-118213-001) and 3 in. (P/N 06-118058-001). These units are equipped with female threaded ports (see Figure 2-48).

WARNING

Swing check valves P/N 06-118213-001 and 06-118058-001 must only be used in sections of pipework designed to flow Novec 1230 fluid. Incorrect usage could result in failure of the valve, cause personal injury and/or damage to property.

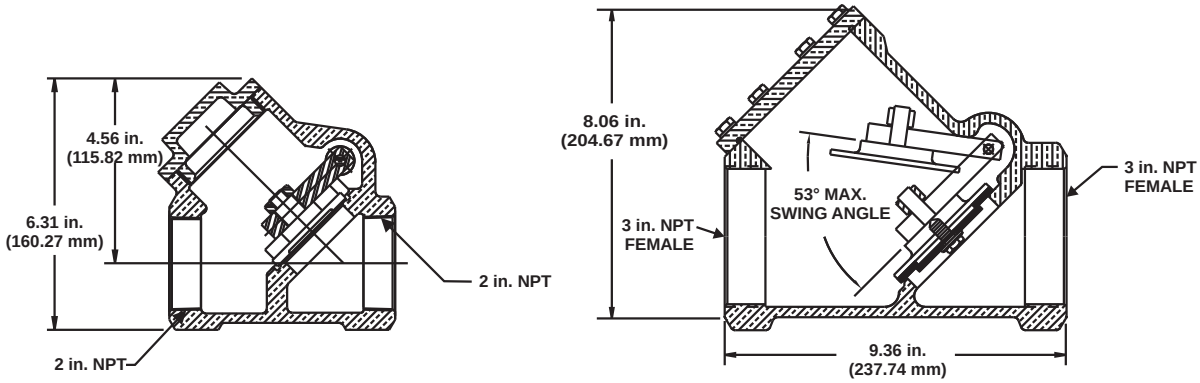


Figure 2-48. 2 in. and 3 in. Swing Check Valves

Table 2-23. Check Valves, Equivalent Lengths

Part Number	Nomenclature	Pipe Type	Equivalent Length	
			ft.	m
81-800327-000	Check Valve, ½ in. NPT	40 T & 40 W	5.40	1.7
81-800266-000	Check Valve, ¾ in. NPT	40 T & 40 W	16.00	4.9
WK-800443-000	Check Valve, 1 in. NPT	40 T & 40 W	8.80	2.7
81-800444-000	Check Valve, 1¼ in. NPT	40 T & 40 W	36.70	11.2
81-870152-000	Check Valve, 1½ in. NPT	40 T & 40 W	19.40	5.9
81-870151-000	Check Valve, 2 in. NPT	40 T & 40 W	45.10	13.8
81-870100-000	Check Valve, 3 in. NPT	40 T & 40 W	141.30	43.1
06-118213-001	Swing Check, 2 in.	40T & 40 W	13.40	4.1
06-118058-001	Swing Check, 3 in.	40 T & 40 W	20.80	6.3
WK-877690-000	2 in.EL Check	40 T & 40 W	12.20	3.7
82-878743-000	2½ in. ELCheck	40 T & 40 W	13.5	4.11
WK-877690-000 and WK-283899-000	2 in. ELCheck and Flex Hose	40 T & 40 W	15.2	4.63
82-878743-000 and WK-283900-000	2½ in. ELCheck and Flex Hose	40 T & 40 W	17.5	5.33

2-3.10.6 STOP (DIRECTION) VALVES

Note: See Table 2-24 for stop valve data.

Stop (direction) valves are used where isolation of a section of pilot manifold or discharge piping is required, but where the valve must be opened locally or remotely to allow passage of agent. A typical application is where two hazards are protected by a single cylinder or cylinder bank and stop valves are used to route the agent to only the selected hazard. Stop valves can be used to control CO_2, Nitrogen or Novec 1230 fluid. Pipe size limitations for the media being flowed apply to the selected stop valve. If a stop valve is used in the Kidde Engineered System discharge pipework, then it must be properly modeled in the flow calculation software to ensure accurate discharge prediction.

Each stop valve has a control port for the connection of a lever, lever/pressure or cable operated control head. The installed control head with lever control facilitates the opening of the valve either locally or remotely and is required by USCG.

CAUTION **Always use a control head fitted with a manual local release lever on a stop valve to allow the valve to be opened manually in an emergency. Do not use the pressure (only) control head (P/N 878737) on a stop valve for this reason.**

The following stop valve sizes, 1/2 in., 3/4 in., 1 in., 1¼ in., 1½ in. and 2 in. (P/Ns 81-870023-000, 81-870022-000, 81-870122-000, 81-870032-000, 81-870123-000 and 81-870049-000) have female threaded outlet ports. The 3 in. (P/N 81-890010-000) and 4 in. stop valves (P/N 81-890208-000) are flanged. If a 2½ in. stop valve is required, a 3 in. stop can be used with 2½ in. flanges. Refer to Figures 2-49, 2-50 and 2-51 for details of available flanges, gaskets and fasteners.

Note: Stop valves do not prevent backflow; a check valve must be used where this functionality is required.

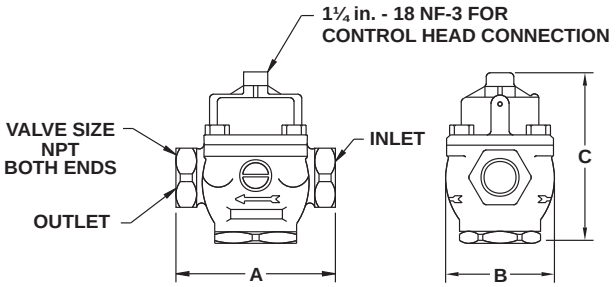


Figure 2-49. 1/2 in. Thru 2 in. Stop (Direction) Valves
Note: Refer to Table 2-24 for dimensions.

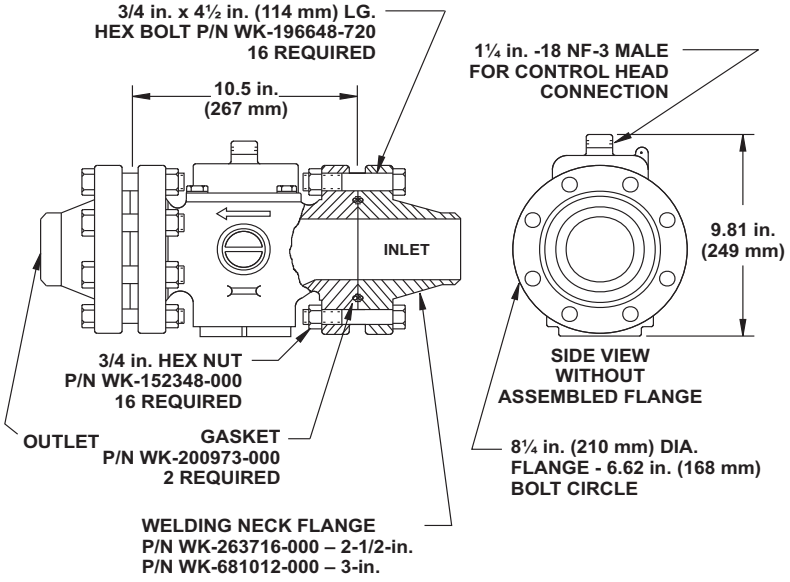


Figure 2-50. 3 in. (2½ in.) Stop (Direction) Valves

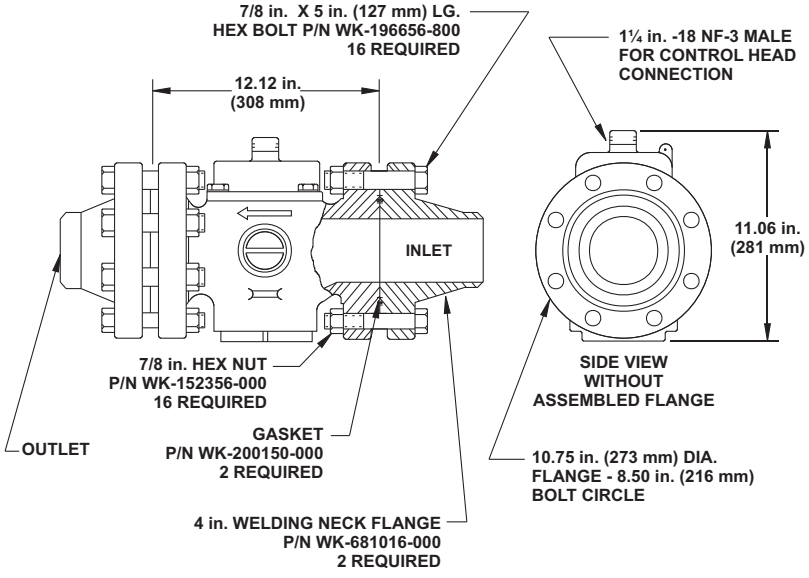


Figure 2-51. 4 in. Stop (Direction) Valve

Table 2-24. Stop Valves

Part Number	Valve Size NPT	A		B		C		Equivalent Length	
		in.	mm	in.	mm	in.	mm	ft.	m
81-870023-000	1/2 in.	3.75	95	2.50	64	4.68	119	11	3.4
81-870022-000	3/4 in.	4.25	108	2.81	71	5.68	144	17	5.2
81-870122-000	1 in.	5.50	140	3.62	92	6.87	175	21	6.4
81-870032-000	1¼ in.	5.50	140	3.62	92	6.87	175	52	15.9
81-870123-000	1½ in.	7.50	191	4.75	121	8.43	214	34	10.4
81-870049-000	2 in.	7.50	191	4.75	121	8.43	214	76	23.2
81-890010-000	2½ in.	See Figure 2-50						69	21.0
81-890010-000*	3 in.	See Figure 2-50						216	65.8
81-890208-000	4 in.	See Figure 2-51						206	62.8
*__Note:__ 2½ in. valve is a 3 in. valve with 2½ in. flanges.									

2-3.10.7 3-WAY CROSS-OVER VALVES

Note: See Tables 2-25 and 2-26 for cross-over valve data.

The 3-Way Cross-Over Valve is for use in systems where separate systems protect individual spaces (i.e., a twin hull catamaran with port and starboard systems protecting port and starboard engine rooms). It is suitable for systems that must comply with IMO High Speed Craft (HSC) code requirements. An arrangement of two cross-over valves in the distribution piping will allow agent from one system to be released through the distribution piping of the other system. Refer to Paragraph 4-2.5 for details on this configuration.

The valve has a rotor valve design with a plated steel body and rotor with stainless steel fittings and mounting hardware. A gear operator unit is installed via a coupling and is secured via a mounting kit to studs in the valve body. Pipe connections are made via grooved fittings. The position display disc, located on the upper face of the gear operator, indicates the orientation of the internal porting. An 8 in. hand-wheel is installed to facilitate rapid position changes and a spring detent provides a positive location at the middle position of the 180-degree porting.

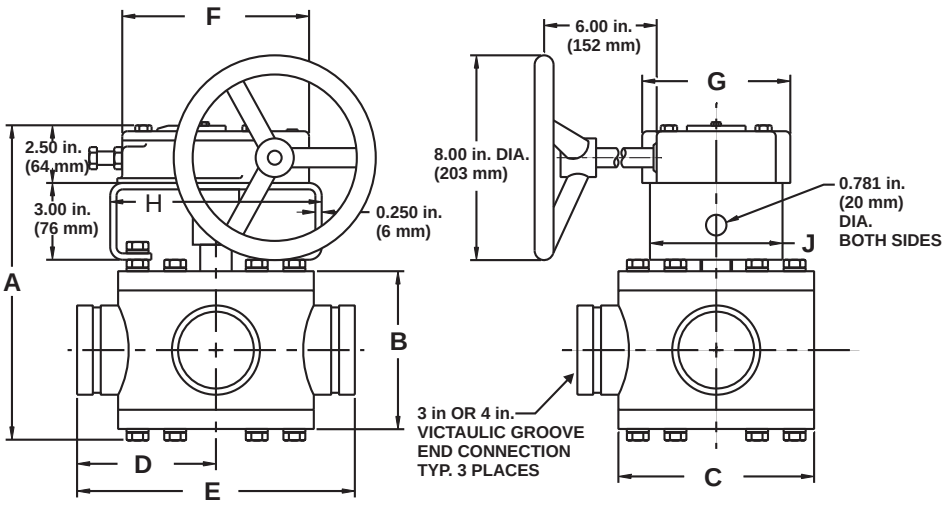


Figure 2-52. 3-Way Cross-over Valve

Table 2-25. 3-Way Cross-over Valve Dimensions

Part Number	Nominal Size	Dimensions* [in.(mm)]								
		A	B	C	D	E	F	G	H	J
90-300007-000	3 in.	12.56 (319)	6.16 (156)	7.75 (197)	5.50 (140)	11.00 (279)	6.12 (155)	5.00 (127)	8.38 (213)	5.25 (133)
90-300008-000	4 in.	14.62 (371)	8.00 (203)	10.00 (254)	6.69 (170)	13.38 (340)	7.50 (191)	6.50 (165)	10.63 (270)	5.50 (140)
*Note: Dimensions are approximate for the entire assembly.										

Table 2-26. 3-Way Cross-over Valve Specifications

Part Number	Nominal Size	Material		Inlets	Port	T-Flow Equivalent Length	L-Flow Equivalent Length
		Valve Body	Seat/Packing				
90-300007-000	3 in.	ENP Carbon Steel	PTFE	Victaulic	Full	5.00 ft. (1.52 m)	26.01 ft. (7.93 m)
90-300008-000	4 in.	ENP Carbon Steel	PTFE	Victaulic	Full	7.73 ft. (2.36 m)	32.42 ft. (9.88 m)

2-3.10.8 PRESSURE OPERATED SWITCHES, P/N 81-486536-000 AND P/N 81-981332-000

Pressure switches operate from system pressure upon discharge to energize or de-energize electrically operated equipment. Pressure switches may be used to shut down machinery and ventilation or to annunciate system discharge (see Figures 2-53 and 2-54).

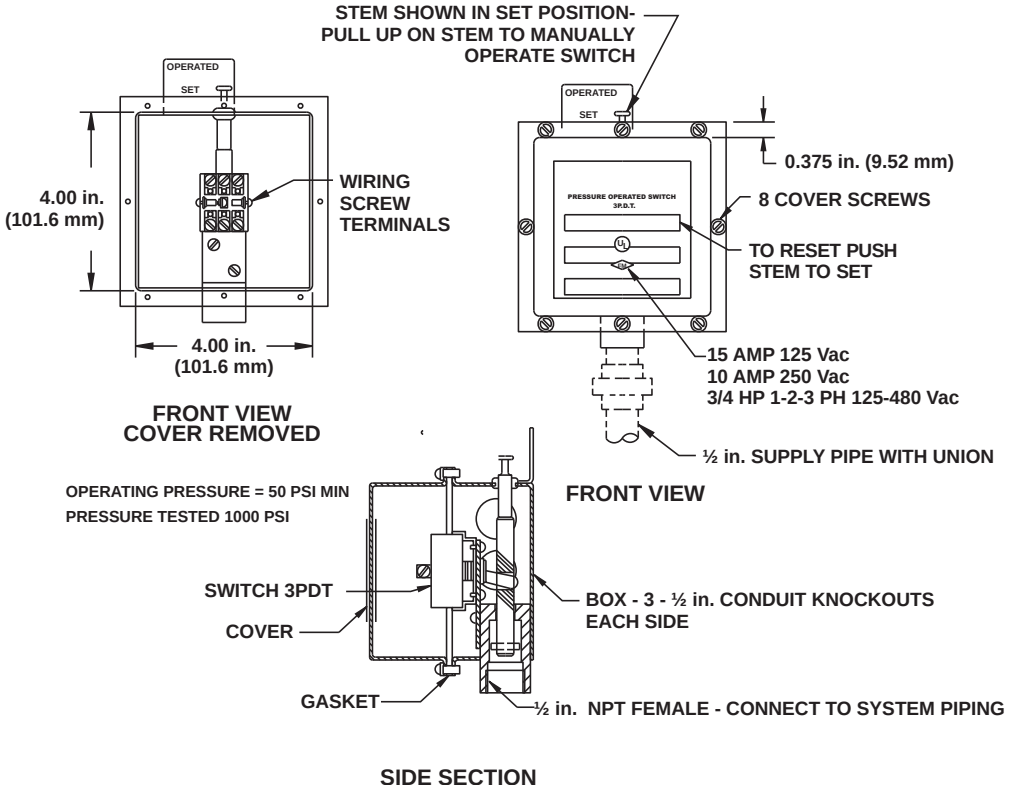


Figure 2-53. Pressure Operated Switch

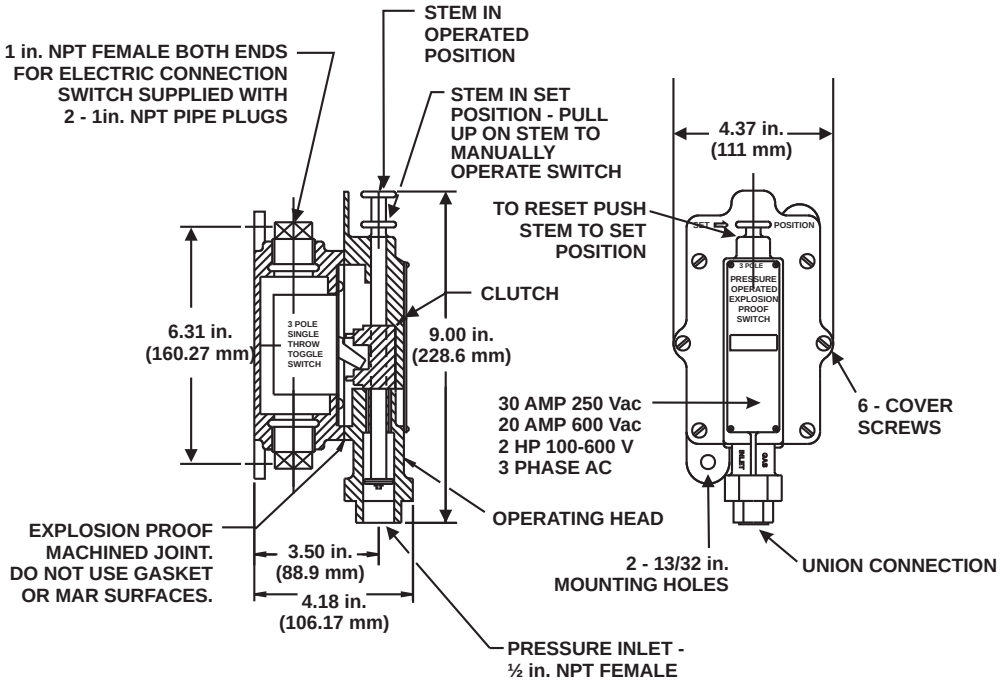


Figure 2-54. Pressure Operated Switch, Explosion Proof

2-3.10.9 PRESSURE OPERATED TRIP, P/N 81-874290-000

Pressure operated trips are used to close off the hazard space upon system discharge. The trips, operated by system pressure, are designed to release self-closing units for doors, windows and dampers. The maximum load to be attached to a pressure trip is 100 lb. (45.36 kg). This is based on a minimum pressure of 75 PSIG (50.7 bar gauge) at the pressure trip (see Figure 2-55).

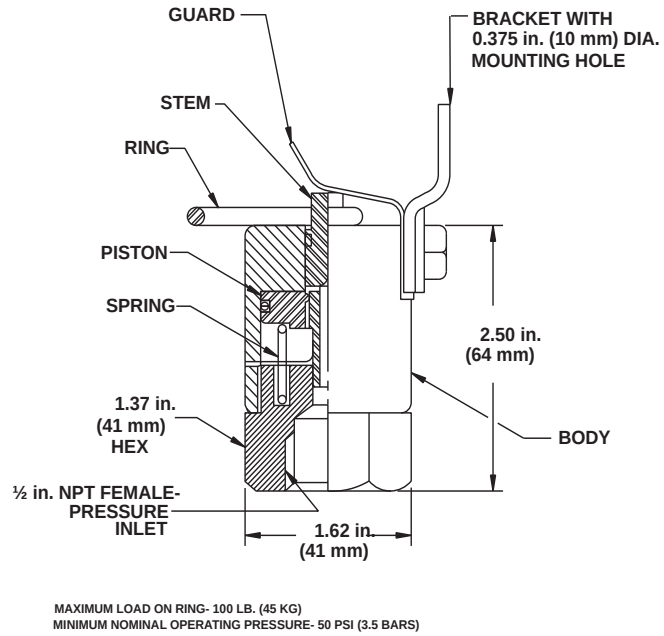


Figure 2-55. Pressure Operated Trip

2-3.10.10 DISCHARGE INDICATOR, P/N 81-967082-000

The 3/4 in. brass discharge indicator may be installed in the discharge piping to visually indicate a system discharge. When in the SET position, the discharge indicator acts as a vent (see Figure 2-56).

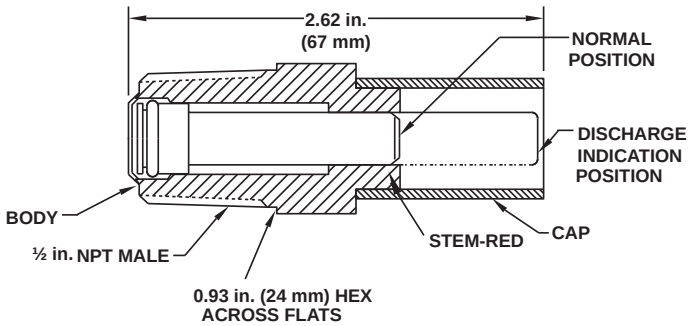


Figure 2-56. Discharge Indicator

2-3.10.11 SUPERVISORY PRESSURE SWITCH,1½ IN. TO 2 IN. VALVES, P/N 06-118262-001

The supervisory pressure switch is intended to detect a fall in pressure in the Kidde Engineered System cylinder (see Figure 2-57). The cylinder supervisory pressure switch can be wired for either normally-open or normally-closed operation, depending on installation requirements. The cylinder supervisory pressure switch can be installed on 10 lb. through 350 lb. capacity Kidde Engineered System cylinders. If the pressure inside the cylinder falls below 305 PSIG (21 bar gauge), the switch contacts will transfer and invoke a "trouble" signal at the control panel.

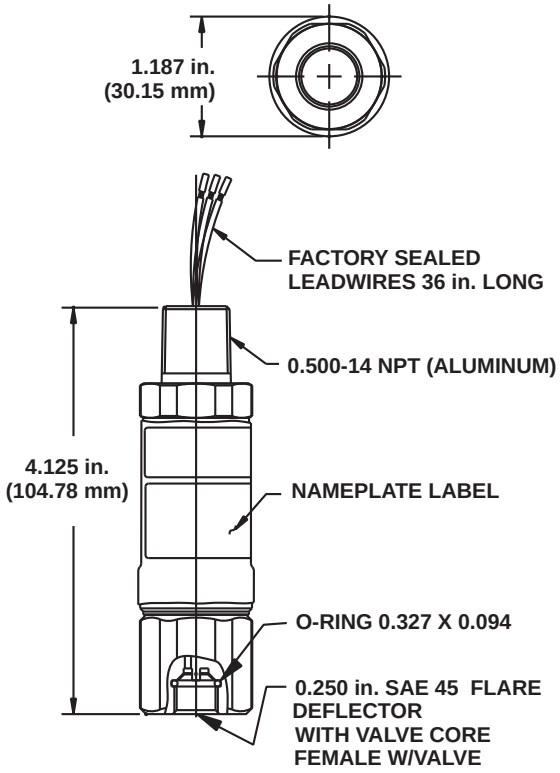


Figure 2-57. Supervisory Pressure Switch,1½ in. to 2 in. Valves

2-3.10.12 SUPERVISORY PRESSURE SWITCH, 3 IN. VALVES, P/N 06-118263-001

The supervisory pressure switch is intended to detect a fall in pressure in the Kidde Engineered System cylinder (see Figure 2-58). The supervisory pressure switch can be wired for either normally-open or normally-closed operation, depending on installation requirements. The cylinder supervisory pressure switch can be installed on 600 lb. through 900 lb. capacity Kidde Engineered System cylinders with a 3 in. discharge valve. If the pressure inside the cylinder falls below 305 PSIG (21 bar gauge), the switch contacts will transfer and invoke a "trouble" signal at the control panel.

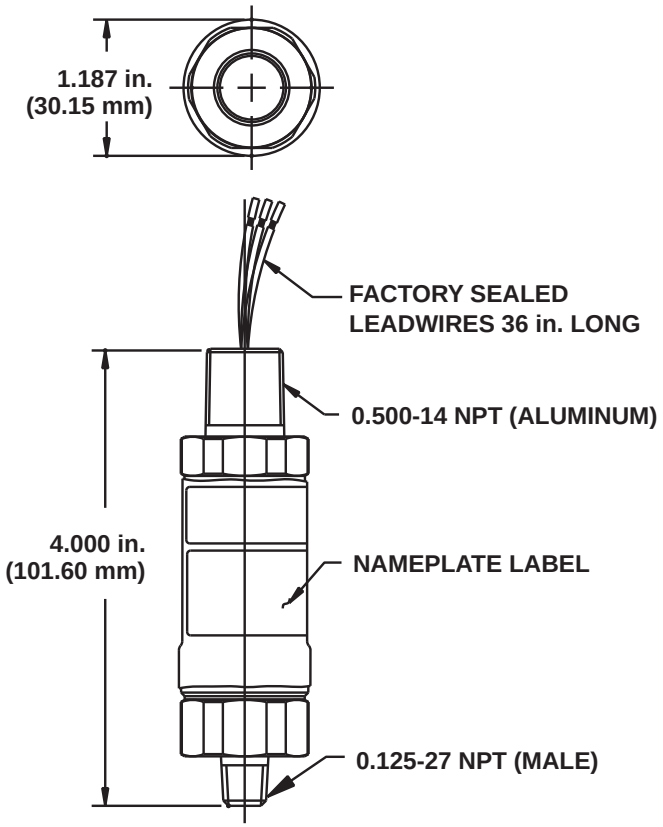


Figure 2-58. Supervisory Pressure Switch, 3 in. Valves

2-3.10.13 DISCHARGE NOZZLES

The 180° and 360° discharge nozzles are designed to provide the proper flow rate and distribution of Kidde Engineered System to flood a hazard area. The 180° nozzle is engineered to provide a 180° discharge pattern for sidewall applications; the 360° nozzle offers a full 360° discharge pattern for installations where nozzles are located in the center of the hazard. Both nozzles are available in either Brass or Stainless Steel. For a complete list of nozzle part numbers, refer to Chapter 8.

Note: The 1/4 in. nozzle is neither UL Listed nor FM Approved.

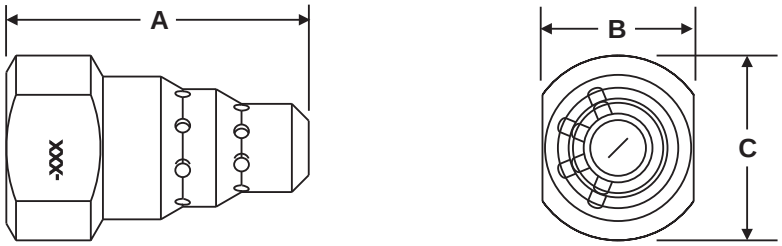


Figure 2-59. 180° Discharge Nozzle

Table 2-27. Dimensions–180° Discharge Nozzle

Pipe Size	Dimensions					
	A		B		C	
1/4 in. (6 mm)	1.91 in.	49mm	1.03 in.	26mm	0.88 in.	22mm
3/8 in. (10 mm)	2.03 in.	52 mm	1.00 in.	25 mm	1.19 in.	30 mm
1/2 in. (13 mm)	2.25 in.	57 mm	1.13 in.	29 mm	1.38 in.	35 mm
3/4 in. (19 mm)	2.69 in.	68 mm	1.38 in.	35 mm	1.63 in.	41 mm
1 in. (25 mm)	2.88 in.	73 mm	1.63 in.	41 mm	1.94 in.	49 mm
1¼ in. (32 mm)	3.29 in.	83 mm	2.00 in.	51 mm	2.38 in.	60 mm
1½ in. (38 mm)	3.63 in.	92 mm	2.25 in.	57 mm	2.69 in.	68 mm
2 in. (51 mm)	4.50 in.	114 mm	3.00 in.	76 mm	3.50 in.	89 mm

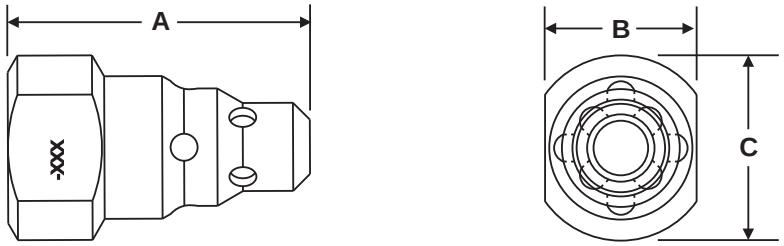


Figure 2-60. 360° Discharge Nozzle

Table 2-28. Dimensions–360° Discharge Nozzle

Pipe Size	Dimensions					
	A		B		C	
1/4 in. (6 mm)	1.91 in.	49mm	1.03 in.	26mm	0.88 in.	22mm
3/8 in. (10 mm)	2.03 in.	52 mm	1.00in.	25 mm	1.19 in.	30 mm
1/2 in. (13 mm)	2.25 in.	57 mm	1.13 in.	29 mm	1.38 in.	35 mm
3/4 in. (19 mm)	2.69 in.	68 mm	1.38 in.	35 mm	1.63 in.	41 mm
1 in. (25 mm)	2.88 in.	73 mm	1.63 in.	41 mm	1.94 in.	49 mm
1¼ in. (32 mm)	3.29 in.	83 mm	2.00 in.	51 mm	2.38 in.	60 mm
1½ in. (38 mm)	3.63 in.	92 mm	2.25 in.	57 mm	2.69 in.	68 mm
2 in. (51 mm)	4.50 in.	114 mm	3.00 in.	76 mm	3.50 in.	89 mm

2-3.10.14 SAFETY OUTLETS, P/N 81-803242-000 AND P/N 82-844346-000

These units are designed to protect against over-pressurization in closed sections of discharge pipework, i.e., manifolds. The correct unit must be selected for the agent in use. See Figure 2-61 and Table 2-29 for more information.

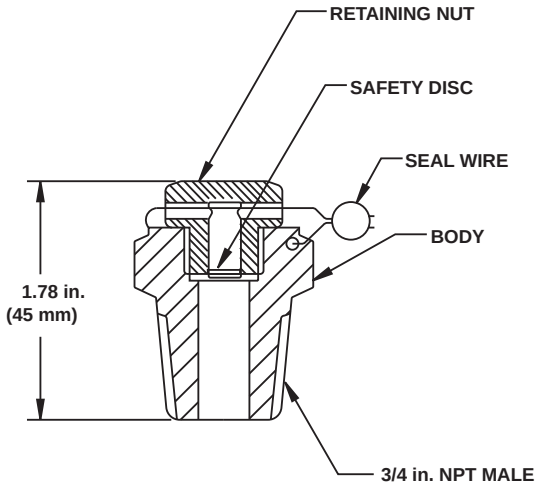


Figure 2-61. Safety Outlets

Table 2-29. Safety Outlets

Part Number	Agent	Pressure Relief Operates at	
		PSIG	Bar
81-803242-000	N_2 / CO_2	2400 to 2800	166 to 193
82-844346-000	Novec 1230 fluid	750 to 900	52 to 62

2-3.11 Warning and Instruction Name Plates

2-3.11.1 KIDDE ENGINEERED SYSTEM 'WARNING' NAMEPLATE, P/N 06-231866-760

Figure 2-62 illustrates the Kidde Engineered System warning nameplate. This label should be affixed at the access ways into a protected area.

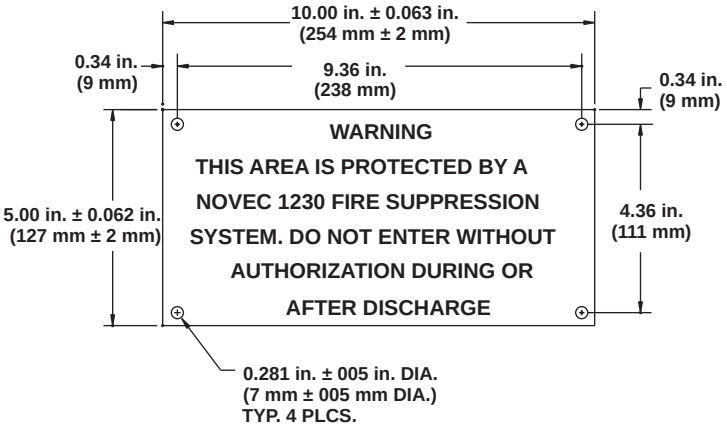
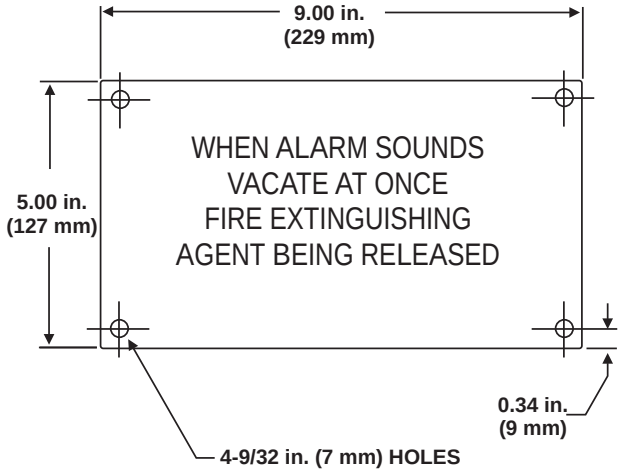


Figure 2-62. Kidde Engineered System Warning Nameplate

2-3.11.2 'AGENT RELEASE' WARNING NAMEPLATE, P/N WK-218270-000

Figure 2-63 illustrates the 'Agent Release' warning nameplate. This nameplate is an alternative, non-agent specific warning.



Note: Use 1/4 in. hardware for fastening.
Material: Aluminum with red paint letters.

Figure 2-63. Agent Release Warning Nameplate

2-3.11.3 'MAIN' AND 'RESERVE' NAMEPLATES, P/N WK-310330-000 AND P/N WK-310340-000

Figure 2-64 illustrates the Main and Reserve nameplates. These nameplates should be attached at the cylinder location and/or control station(s) to ensure that the individual systems are clearly identified.

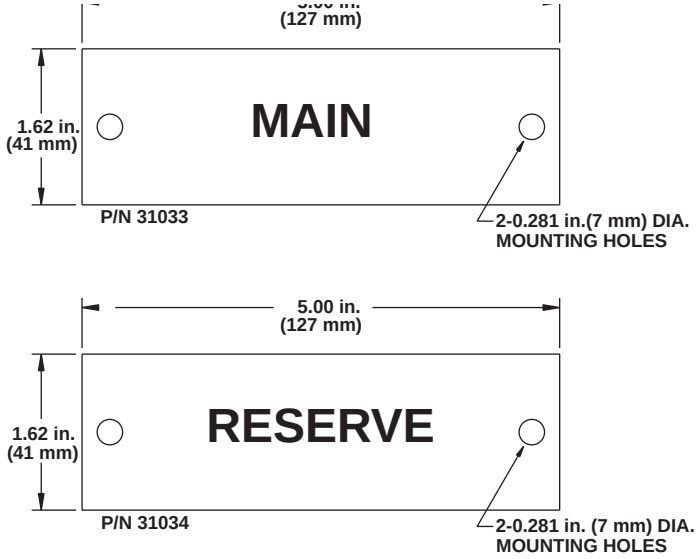


Figure 2-64. Main and Reserve Nameplates

2-3.12 Other Accessories

2-3.12.1 HYDROSTATIC TEST ADAPTERS

The hydrostatic pressure test adapter is installed on the Kidde Engineered System cylinder in place of the cylinder valve when the cylinder is to be hydrostatically pressure tested. For cylinder test requirements, see Paragraph 6-5.1 and 6-5.3 of this manual.

2-3.12.2 KIDDE ENGINEERED SYSTEM CYLINDER RECHARGE ADAPTERS

The Kidde Engineered System recharge adapter is installed in the cylinder discharge outlet during the cylinder charging procedure. This adapter is used for refilling the cylinder with Novec 1230 fluid agent and super pressurizing the cylinder with nitrogen (see Figure 2-65 and Table 2-30).

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

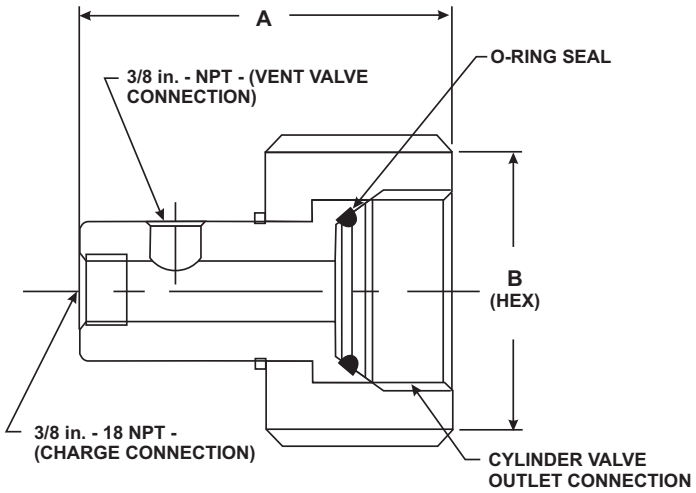


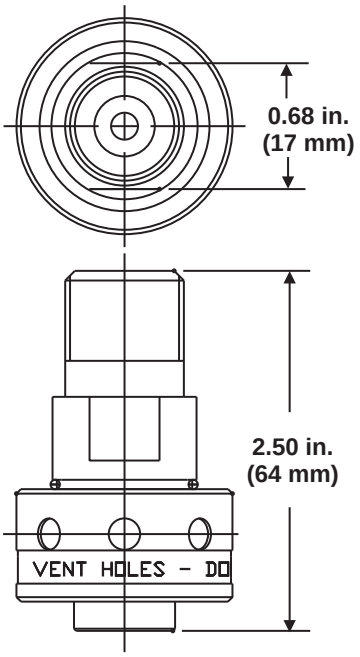
Figure 2-65. Cylinder Recharge Adapters

Table 2-30. Dimensions–Cylinder Recharge Adapters

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

2-3.12.3 KIDDE ENGINEERED SYSTEM CYLINDER SEATING ADAPTER, P/N 933537

The Kidde Engineered System seating adapter is installed on the cylinder actuation port during the cylinder charging procedure. This adapter is used for seating the valve assembly after charging and super pressurization is complete.



2-3.13 Detectors and Control Panels

The USCG rules do not allow the use of electrically triggered detection and control systems.

Refer to Kidde Fire Systems for guidance on system design and component selection where the AHJ responsible for the vessel allows or specifies electrical and/or automatic detection and/or control.

CHAPTER 3
SYSTEM DESIGN

3-1 INTRODUCTION

This chapter is intended for system designers. It outlines the steps needed to design the system, including the limitations imposed on the design by the system hardware.

Note: Unless otherwise stated, the system design information detailed in this chapter meets the requirements of the United States Coast Guard (USCG). The designer is responsible for ensuring compliance with the applicable approval requirements. Design variations that do not meet USCG requirements are explicitly marked.

3-2 DESIGN PROCEDURE

3-2.1 General Design Procedure

The design of a Kidde Engineered Fire Suppression System designed for use with 3M™ Novec™ 1230 Fire Protection Fluid is best accomplished by breaking the design process into a number of discrete steps. The design process should be followed in the order presented, since some design steps rely on information developed in preceding steps. The steps in the process are:

1. Perform a hazard analysis and survey of the protected area.
2. Determine the design concentration required for the hazard.
3. Calculate the volume of the protected area.
4. Calculate the amount of agent required.
5. Determine agent cylinder location.
6. Locate Nozzles
7. Evaluate pipe routing
8. Pipe Size and Layout
9. Determine Required Components

Note: The complexity of agent flow formulas does not allow for any simple method of manual calculation. For this reason, the flow calculations and design criteria described in this manual have been programmed into a computer software program.

CAUTION **Kidde Engineered Fire Suppression System Flow Calculation Program is the only calculation method to be used with Kidde Engineered System equipment. No other calculation method is authorized by or acceptable to Kidde.**

Note: The system designer must become thoroughly familiar with the User's Manual for Kidde Engineered Fire Suppression System Flow Calculation Program (P/N 45-NOVMAR-001) to determine the proper procedures for applying the input parameters to the Kidde Engineered Fire Suppression System Flow Calculation Program. There are a number of limitations to these input parameters which must be observed if accurate results are to be obtained. Most of these limitations are constrained in the program, however, there are certain restrictions that must be addressed by the system designer before applying the input data. The following paragraphs describe the essential design parameters and design limitations which must be considered.

3-2.1.1 HAZARD ANALYSIS

A complete survey of the protected area should be performed and all hazards within the area should be listed. The types of hazards present will determine the concentration of agent required to properly protect the area. Refer to Paragraph 3-2.1.2 for information on determining the minimum design concentration required for the protected area.

1. Ventilation systems that move air in or out of the protected space must be shutdown and dampers closed prior to discharge.
2. Machinery operating inside the protected space should be shutdown prior to discharge. Internal combustion machinery that draws intake air from the protected space must be shutdown prior to discharge.

3-2.1.2 MINIMUM DESIGN CONCENTRATION

The risk areas that are protected by Kidde Engineered Systems are predominantly Class B hazards. Class A and Class C materials/hazards are often also present and present a supplemental risk. The USCG Approval reflects this fire risk scenario (i.e. predominantly Class B hazards).

Class B hazards are protected using a design concentration 30% higher than the minimum extinguishing concentration (refer to Table 3-1 for the design concentration for a number of common Class B hazards).

Note: Concentrations of less than 5.85% shall not be used for USCG Approved applications protecting Category A machinery spaces (Class B hazard). Novec 1230 fluid is not suitable for deep-seated hazards and must not be used to protect cargo holds.

Novec 1230 fluid can be used to protect mission critical, high-value equipment in spaces where USCG do not require fixed systems. Examples include computer centers and communication rooms on oceanographic vessels.

The hazards in these spaces are typically Class A or Class C. The recommended design concentration for these spaces is 4.70%. Refer to NFPA 2001, current edition, for further guidance.

Using the list of hazards prepared during the survey of the protected area, determine the design concentration for each hazard listed. The hazard with the highest design concentration from your list will be used when you determine the amount of suppression agent required.

For materials not listed in Table 3-1, please consult the factory.

Table 3-1. Class B Suppression Design Concentrations

Fuel	Extinguishing Concentration	Design Concentration, % v/v
1-Propanol	5.40	7.02
Acetone	4.31	5.85
Acetonitrile	2.90	5.85
Cyclohexane	4.50	5.85
Denatured Alcohol	5.31	6.90
Diesel	**4.50**	**5.85**
Diethl Ether	4.85	6.31
Ethanol	5.49	7.14
Ethyl Acetate	4.70	6.11
Gasoline	**4.50**	**5.85**
Isooctane	4.70	6.11
Isopropanol	4.90	6.37
Methanol	6.49	8.44
Methyl Ethyl Ketone	4.51	5.86
Methyl Tert Butyl Ether	4.58	5.95
n-Butanol	4.88	6.34
n-Heptane	4.50	5.85
n-Pentane	4.70	6.11
Octane	4.40	5.85
Pyrrolidine	4.69	6.10
Technical (Commercial) Heptane	4.30	5.85
Tetrahydrofuran	5.00	6.50
Toluene	3.50	5.85
Transformer Oil (Voltesso)	4.50	5.85

3-2.1.3 VOLUME CALCULATION

To meet USCG Approval requirements, the volume of the hazard used to calculate agent quantity shall be the gross volume (i.e., no deduction used for impermeable objects within the hazard, refer to MSC Circ. 848 and MSC. 1/Circ. 1267) unless a door fan integrity test is conducted.

For non-USCG applications, refer to the AHJ or contact Kidde Fire Systems.

When determining volume, the volume of free air contained in the air receivers should be added to the volume of the hazard. This is to provide adequate protection in the event that the air in the receivers is released into the protected space. The volume contained in air units with overboard discharge does not need to be taken into account.

3-2.1.4 CALCULATE AMOUNT OF AGENT REQUIRED

To find the total quantity of Novec 1230 fluid required at a specific temperature and concentration, multiply the hazard area volume by the multiplier from Table 3-2 or Table 3-3 that correspond to the design temperature and concentration desired.

Note: The agent required must be based on the lowest expected ambient temperature in the protected space. Care must be taken that the calculated concentration for normally occupied spaces at the highest expected ambient temperature in the space does not exceed the value of 10.0% per NFPA 2001.

Note: The information in Tables 3-2 and 3-3 is given for estimating purposes only. The Kidde Engineered Fire Suppression System Flow Calculation Program calculates the agent quantity based on the volume, design concentration and temperature data entered by the designer. Refer to the Kidde Engineered Fire Suppression System Flow Calculation Program User's Manual (P/N 45-NOVMAR-001) for further information.

Table 3-2. Novec 1230 Fluid Total Flooding Concentration Factors (W/V), Imperial

Temp T (°F)[b]	Specific Vapor Volume (ft.^{3}/lb.)[c]	Weight Requirements of Hazard Volume, W/V (lb./ft.^{3})[a] Design Concentration (% per Volume)[d]										
		4.00	4.55	5.00	5.50	5.85	6.00	7.00	8.00	9.00	10.00	11.00
-20	0.93678	0.0445	0.0509	0.0562	0.0621	0.0663	0.0681	0.0803	0.0928	0.1056	0.1186	0.1319
-10	0.96119	0.0433	0.0496	0.0548	0.0606	0.0646	0.0664	0.0783	0.0905	0.1029	0.1156	0.1286
0	0.98560	0.0423	0.0484	0.0534	0.0591	0.0630	0.0648	0.0764	0.0882	0.1003	0.1127	0.1254
10	1.01001	0.0413	0.0472	0.0521	0.0576	0.0615	0.0632	0.0745	0.0861	0.0979	0.1100	0.1224
20	1.03442	0.0403	0.0461	0.0509	0.0563	0.0601	0.0617	0.0728	0.0841	0.0956	0.1074	0.1195
30	1.05883	0.0394	0.0450	0.0497	0.0550	0.0587	0.0603	0.0711	0.0821	0.0934	0.1049	0.1167
32	1.06371	0.0392	0.0448	0.0495	0.0547	0.0584	0.0600	0.0708	0.0817	0.0930	0.1045	0.1162
40	1.08324	0.0385	0.0440	0.0486	0.0537	0.0574	0.0589	0.0695	0.0803	0.0913	0.1026	0.1141
50	1.10765	0.0376	0.0430	0.0475	0.0525	0.0561	0.0576	0.0680	0.0785	0.0893	0.1003	0.1116
60	1.13206	0.0368	0.0421	0.0465	0.0514	0.0549	0.0564	0.0665	0.0768	0.0874	0.0981	0.1092
70	1.15647	0.0360	0.0412	0.0455	0.0503	0.0537	0.0552	0.0651	0.0752	0.0855	0.0961	0.1069
80	1.18088	0.0353	0.0404	0.0446	0.0493	0.0526	0.0541	0.0637	0.0736	0.0838	0.0941	0.1047
90	1.20529	0.0346	0.0395	0.0437	0.0483	0.0516	0.0530	0.0624	0.0721	0.0821	0.0922	0.1025
100	1.22970	0.0339	0.0388	0.0428	0.0473	0.0505	0.0519	0.0612	0.0707	0.0804	0.0904	0.1005
110	1.25411	0.0332	0.0380	.0420	0.0464	0.0495	0.0509	0.0600	0.0693	0.0789	0.0886	0.0986
120	1.27852	0.0326	0.0373	0.0412	0.0455	0.0486	0.0499	0.0589	0.0680	0.0774	0.0869	0.0967
130	1.30293	0.0320	0.0366	0.0404	0.0447	0.0477	0.0490	0.0578	0.0667	0.0759	0.0853	0.0949
140	1.32734	0.0314	0.0359	0.0397	0.0438	0.0468	0.0481	0.0567	0.0655	0.0745	0.0837	0.0931
150	1.35175	0.0308	0.0353	0.0389	0.0431	0.0460	0.0472	0.0557	0.0643	0.0732	0.0822	0.0914
160	1.37616	0.0303	0.0346	0.0382	0.0423	0.0452	0.0464	0.0547	0.0632	0.0719	0.0807	0.0898
170	1.40057	0.0297	0.0340	0.0376	0.0416	0.0444	0.0456	0.0537	0.0621	0.0706	0.0793	0.0882
180	1.42498	0.0292	0.0335	0.0369	0.0408	0.0436	0.0448	0.0528	0.0610	0.0694	0.0780	0.0867
190	1.44939	0.0287	0.0329	0.0363	0.0402	0.0429	0.0440	0.0519	0.0600	0.0682	0.0767	0.0853
200	1.47380	0.0283	0.0323	0.0357	0.0395	0.0422	0.0433	0.0511	0.0590	0.0671	0.0754	0.0839
210	1.49821	0.0278	0.0318	0.0351	0.0388	0.0415	0.0426	0.0502	0.0580	0.0660	0.0742	0.0825
220	1.52262	0.0274	0.0313	0.0346	0.0382	0.0408	0.0419	0.0494	0.0571	0.0650	0.0730	0.0812

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

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

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

[c] T [temperature (°F)] = the design temperature in the hazard area

[d] s [specific volume (ft.^{3}/lb.)] = specific volume of superheated agent vapor can be approximated by the formula:

$$s = 0.9856 + 0.002441\ T$$

where T = temperature (°F)

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

Table 3-3. Novec 1230 Fluid Total Flooding Concentration Factors (W/V), Metric

Temp T (°C)[b]	Specific Vapor Volume s (m^3/kg)[c]	Weight Requirements of Hazard Volume, W/V (kg/m^3)[a] Design Concentration (% per Volume)[d]										
		4.00	4.55	5.00	5.50	5.85	6.00	7.00	8.00	9.00	10.00	11.00
-20	0.06092	0.6840	0.7825	0.8640	0.9554	1.0200	1.0478	1.2356	1.4274	1.6235	1.8239	2.0289
-15	0.06229	0.0669	0.7653	0.8450	0.9344	0.9975	1.0247	1.2084	1.3960	1.5878	1.7838	1.9842
-10	0.06366	0.6545	0.7488	0.8268	0.9143	0.9761	1.0027	1.1824	1.3660	1.5536	1.7454	1.9415
-5	0.06503	0.6407	0.7330	0.8093	0.8950	0.9555	0.9816	1.1575	1.3372	1.5209	1.7086	1.9006
0	0.06640	0.6275	0.7179	0.7926	0.8765	0.9358	0.9613	1.1336	1.3096	1.4895	1.6734	1.8614
5	0.06777	0.6148	0.7034	0.7766	0.8588	0.9168	0.9419	1.1106	1.2831	1.4594	1.6395	1.8237
10	0.06914	0.626	0.6895	0.7612	0.8418	0.8987	0.9232	1.0886	1.2577	1.4304	1.6070	1.7876
15	0.07051	0.5909	0.6761	0.7464	0.8254	0.8812	0.9052	1.0675	1.2332	1.4026	1.5758	1.7528
20	0.7188	0.5797	0.6632	0.7322	0.8097	0.8644	0.8880	1.0471	1.2097	1.3759	1.5457	1.7194
25	0.07325	0.5688	0.6508	0.7185	0.7945	0.8482	0.8714	1.0275	1.1871	1.3501	1.5168	1.6873
30	0.07462	0.5584	0.6388	0.7053	0.7799	0.8327	0.8554	1.0087	1.1653	1.3253	1.4890	1.6563
35	0.07599	0.5483	0.6273	0.6926	0.7659	0.8176	0.8399	0.9905	1.1443	1.3014	1.4621	1.6264
40	0.07736	0.5386	0.6162	0.6803	0.7523	0.8031	0.8251	0.9729	1.1240	1.2784	1.4362	1.5976
45	0.07873	0.5292	0.6055	0.6685	0.7392	0.7892	0.8107	0.9560	1.1044	1.2561	1.4112	1.5698
50	0.08011	0.5202	0.5950	0.6570	0.7266	0.7757	0.7968	0.9396	1.0855	1.2346	1.3871	1.5429
55	0.08148	0.5114	0.5850	0.6460	0.7143	0.7626	0.7834	0.9238	1.0673	1.2139	1.3637	1.5170
60	0.08285	0.5029	0.5754	0.6353	0.7025	0.7500	0.7705	0.9085	1.0496	1.1938	1.3412	1.4919
65	0.08422	0.4948	0.5660	0.6250	0.6911	0.7378	0.7579	0.8938	1.0325	1.1744	1.3194	1.4676
70	0.08559	0.4868	0.5569	0.6149	0.6800	0.7260	0.7458	0.8794	1.0160	1.1556	1.2982	1.4441
75	0.08696	0.4792	0.5482	0.6053	0.6693	0.7145	0.7340	0.8656	1.0000	1.1373	1.2778	1.4213
80	0.08833	0.4717	0.5397	0.5959	0.6589	0.7035	0.7226	0.8522	0.9845	1.1197	1.2579	1.3993
85	0.08970	0.4645	0.5314	0.5868	0.6489	0.6927	0.7116	0.8391	0.9694	1.1026	1.2387	1.3779
90	0.09107	0.4575	0.5234	0.5779	0.6391	0.6823	0.7009	0.8265	0.9548	1.0860	1.2201	1.3572
95	0.09244	0.4507	0.5157	0.5694	0.6296	0.6722	0.6905	0.8142	0.9407	1.0699	1.2020	1.3370
100	0.09381	0.4442	0.5081	0.5610	0.6204	0.6623	0.6804	0.8024	0.9269	1.0543	1.1844	1.3175

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

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

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

[c] T [temperature (°C)] = the design temperature in the hazard area

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

$s = 0.0664 + 0.0002741 T$

where T = temperature (°C)

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

3-2.1.5 LOCATE CYLINDERS

Locate cylinders based on the following:

- Number of cylinders required.
- Storage temperature/environmental considerations, such as weather, area classification and corrosive environment.
- Accessibility for installation and removal for refill.
- Deck plate or bulkhead loading.
- AHJ requirements.
- Vessel weight distribution.

3-2.1.5.1 Storage Temperature

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

3-2.1.5.2 Operating/Storage Temperature Range

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

Marine applications typically protect single- or multiple-hazard areas that have direct volumetric communication, in which case container temperature conditioning is not necessary.

3-2.1.5.3 System Operating Pressure

The nominal pressure of the Kidde Engineered System agent cylinder is 360 PSIG @ 70°F (25 bar gauge @ 21°C).

3-2.1.5.4 Cylinder Storage Outside the Protected Space

Cylinders located outside the protected space should be located as close to the space as possible. The cylinders should be readily accessible so as to allow personnel to operate the manual actuation of the cylinder(s). If remote actuation is used, the local manual release must still be accessible for personnel.

The temperature of the cylinders may need to be controlled by heating or cooling to keep the cylinders within the limits specified in Paragraphs 3-2.1.5.2 and 3-2.1.5.1.

Cylinders stored outside the space are usually located in a single area, but may be distributed according to the space available on the vessel. The agent storage cylinders may be installed on a common manifold (central storage) or in a modular arrangement. A modular system consists of cylinder(s) with dedicated piping and nozzle(s), with each group being activated simultaneously via a common actuation circuit. If a modular arrangement is required, consult with the local Authority Having Jurisdiction (AHJ) to ensure that this arrangement is permitted for the designated vessel.

Note: All system cylinders discharging into a single space must be configured to operate simultaneously. All system cylinders installed on a common manifold must be the same capacity, be charged to the same pressure and contain the same mass of agent (see Paragraph 3-2.1.5.5).

3-2.1.5.5 Cylinder Storage Inside the Protected Space

Cylinders can be stored inside the protected space where the volume of the space is less than 6000 ft.3 (170 m3) and the system is configured per Paragraph 3-2.6.

USCG allowed locating cylinders within protected spaces exceeding 6000 ft3 (170 m3) from 2003 to 2007, however in late 2007 the USCG decided to restrict this practice and move to a case-by-case approval only. Since the USCG is effectively restricting the installation of agent cylinders within the protected space, the relevant design information for this approach has been moved to Appendix C in this manual. Please contact Applications Engineering for more information on the specific requirements for your project.

3-2.1.6 LOCATE NOZZLES

Nozzle location should be determined prior to laying out the distribution piping, as the location of the nozzles will determine the length of pipe and number of elbows and tees required.

Locate nozzles based on the following:

- Compartment height (16 ft., 4 in. [5.00 m] maximum, 1 ft. [0.30 m] minimum).
- Nozzle area coverage (see Paragraphs 3-2.1.6.1 and 3-2.1.6.2).
- Special hazard area layout considerations.

3-2.1.6.1 Nozzle Placement

There are two basic Kidde nozzle configurations:

1. The 360° nozzle provides a full 360° discharge pattern and is designed for placement in the center of the nozzle's coverage area.
2. The 180° nozzle provides a 180° discharge pattern and is designed for placement along the side of the nozzle's coverage area.

Note: Where the area to be covered is greater than the coverage provided by a single nozzle, multiple nozzles should be used.

3-2.1.6.2 Nozzle Limitations

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

Note: An "**s**" symbol after a design limitation indicates that the calculation software checks this parameter.

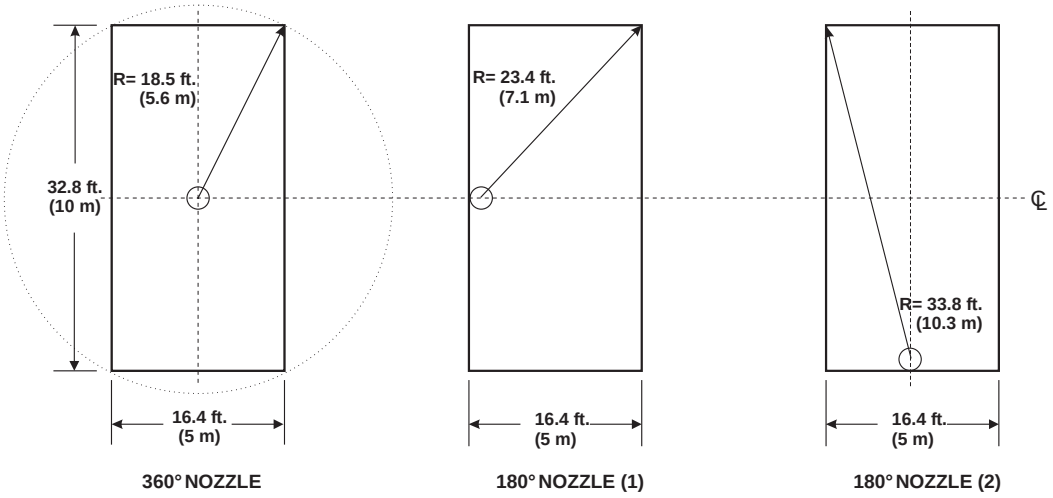


Figure 3-1. Nozzle Placement and Coverage

- Orientation–Nozzles must be mounted perpendicular to the deck or bilge surface and oriented with the discharge apertures radiating symmetrically outward from the pipe network.
- Nozzle Orifice Vertical Clearance–Nozzles must be installed so that the discharge apertures are located or more than 18 in. (152 to 457 mm) below the overhead deck.
- Maximum Height–The maximum protected height for a single row of nozzles is 16.4 ft. (5.0 m).

  Nozzles may be tiered to accommodate enclosures with enclosure heights greater than 16.4 ft. (5.0 m).
- Bilge–Where bilges are open (where openings allow free communication into the main protected space), they are part of the protected space and require no additional nozzles. Where bilges are closed, they must be protected with a dedicated nozzle network.

Note: A bilge is open and is protected as part of the enclosure above, the nozzle height coverage shall be measured from the top of the enclosure (above the nozzle) to the lowest section of the bilge.

- Minimum Enclosure Height–The minimum height for an enclosed space protected with one or more nozzles is 12 in. (0.30 m).
- 180° Nozzles–180° nozzles must be located 6 in. (0.15 m) or less from a bulkhead, with the discharge aperture directed away from the

bulkhead. The nozzle shall be located as close to the center of the bulkhead (or section of bulkhead) as possible, but at least one-third of the way along the bulkhead.

180° nozzles have a maximum coverage area of 538 ft.2 (50 m2). If a 180° nozzle has a maximum throw of 32.8 ft. (10 m), then the maximum coverage width cannot exceed 16.4 ft. (5 m). If a 180° nozzle has a maximum coverage width of 32.8 ft. (10 m), then the maximum throw of the nozzle cannot exceed 16.4 ft. (5 m). Examples of both extremes are depicted in Figure 3-1.

180° nozzles may be used in a back-to-back configuration. When nozzles are used in this configuration, they should be placed 1 to 2 ft. (0.3 m to 0.6 m) apart.

- 360° Nozzles–360° nozzles must be located as close to the center of the enclosure (or subdivision thereof) as possible. 360° nozzles have a maximum coverage area defined as any rectangle that can be inscribed within a circle radius of 18.5 ft. (5.6 m), i.e., the radius is equal to the diagonal of a rectangle that is 16.4' x 8.2'. Refer to Figure 3-1.
- Multiple Nozzles–Nozzles whose discharge patterns will intersect should be placed at least 6 ft. (1.8 m) apart to assure adequate agent distribution.
- Bulkheads and Obstructions–To ensure full and rapid atomization of the Kidde Engineered System, agent nozzles should be placed at least 4 to 6 ft. (1.22 to 1.83 m) from significant obstructions or bulkheads.

Limits on Nozzle Conditions:

- Minimum average nozzle pressure–The nozzle pressure must be a minimum of 60.3 PSIG (4.2 bar) for the nozzle to effectively disperse the agent and mix the agent into the air of the enclosure being protected. **s**
- Maximum arrival time imbalance–The difference between liquid arrival times at two of the nozzles exceed the 2.0 seconds allowed. **s**
- Maximum runout time imbalance–The difference between nozzle liquid runout times at two of the nozzles exceed the 6.2 second (or 60% of the discharge time) allowed maximum. **s**

3-2.1.6.3 Nozzle Orifice Area

Only the Kidde Engineered Fire Suppression System Flow Calculation Program can be used to determine the required nozzle orifice area.

The maximum orifice area to pipe area ratio is as follows:

- The ratio between the nozzle orifice area for a 360° nozzle at the given node and the pipe cross sectional area for the pipe segment preceding that nozzle is 0.85, or 85%, **s**
- The ratio between the nozzle orifice area for a 180° nozzle at the given node and the pipe cross sectional area for the pipe segment preceding that nozzle is 0.85, or 85%. **s**

The minimum orifice area to pipe area ratio is as follows:

- The ratio between the nozzle orifice area for a 360° nozzle at the given node and the pipe cross sectional area for the pipe segment preceding that nozzle is 0.20, or 20%. **s**
- The ratio between the nozzle orifice area for a 180° nozzle at the given node and the pipe cross sectional area for the pipe segment preceding that nozzle is 0.20, or 20%. **s**

Nozzles are available in nominal pipe sizes of 1/4 in., 3/8 in., 1/2 in., 3/4 in., 1 in., 1¼ in., 1½ in. and 2 in.

Note: 1/4 in. nozzles are not UL listed.

3-2.1.7 EVALUATE PIPE ROUTING

Locate piping based on the following:

- Cylinder location.
- Nozzle location.
- Obstructions and personnel access within hazard.
- Structural members for bracing the pipe.

3-2.1.8 PIPE SIZE AND LAYOUT

Identify system layout with the following details:

- Piping isometric.
- Dimensions of all pipe sections.
- Location and specification of all fittings.
- Note all elevation changes.

3-2.1.8.1 Maximum Percentage of Agent in Pipe

The flow software checks to see whether the percent agent in pipe does not exceed 99.9%. If this condition is not met, the software will display a warning. The system designer should correct the total pipe volume.

3-2.1.8.2 Tee Flow Splits

Flow splits at tee junctions are sensitive to gravity. Even though turbulent flow exists, there is a tendency for the vapor phase to migrate to the upper portion of the pipe leaving a more dense medium at the bottom of the pipe. For this reason, the limitations in Figure 3-2 must be observed.

Note: An "**s**" symbol after a design limitation indicates that the calculation software checks this parameter.

Requirements for Tee Flow Splits:

1. Bull head tees must have both outlets in the horizontal plane. The inlet to a bull head tee may approach in a horizontal, vertically up or vertically down direction.
2. Side tees must have the inlet and both outlets all in the horizontal plane.
3. Elbows either before a tee, or after, which split to a separate hazard must be located a minimum distance of 10 pipe diameters (nominal) before the tee.
4. Tee splits going to separate hazards from a common supply line must be spaced a minimum of 10 pipe diameters (nominal) apart.
5. Minimum flow out of a side tee branch is 10% of total flow at the tee.
6. For flow splits less than 25%, the split shall be done through a side tee with the smaller flow going through the side tee member. The minimum flow through the side tee member is 10%. The maximum flow through the tee is 90%.
7. For flow splits equal to or greater than 35%, the split shall be done through a bull head tee. The maximum flow split through a bull head tee is 75%.

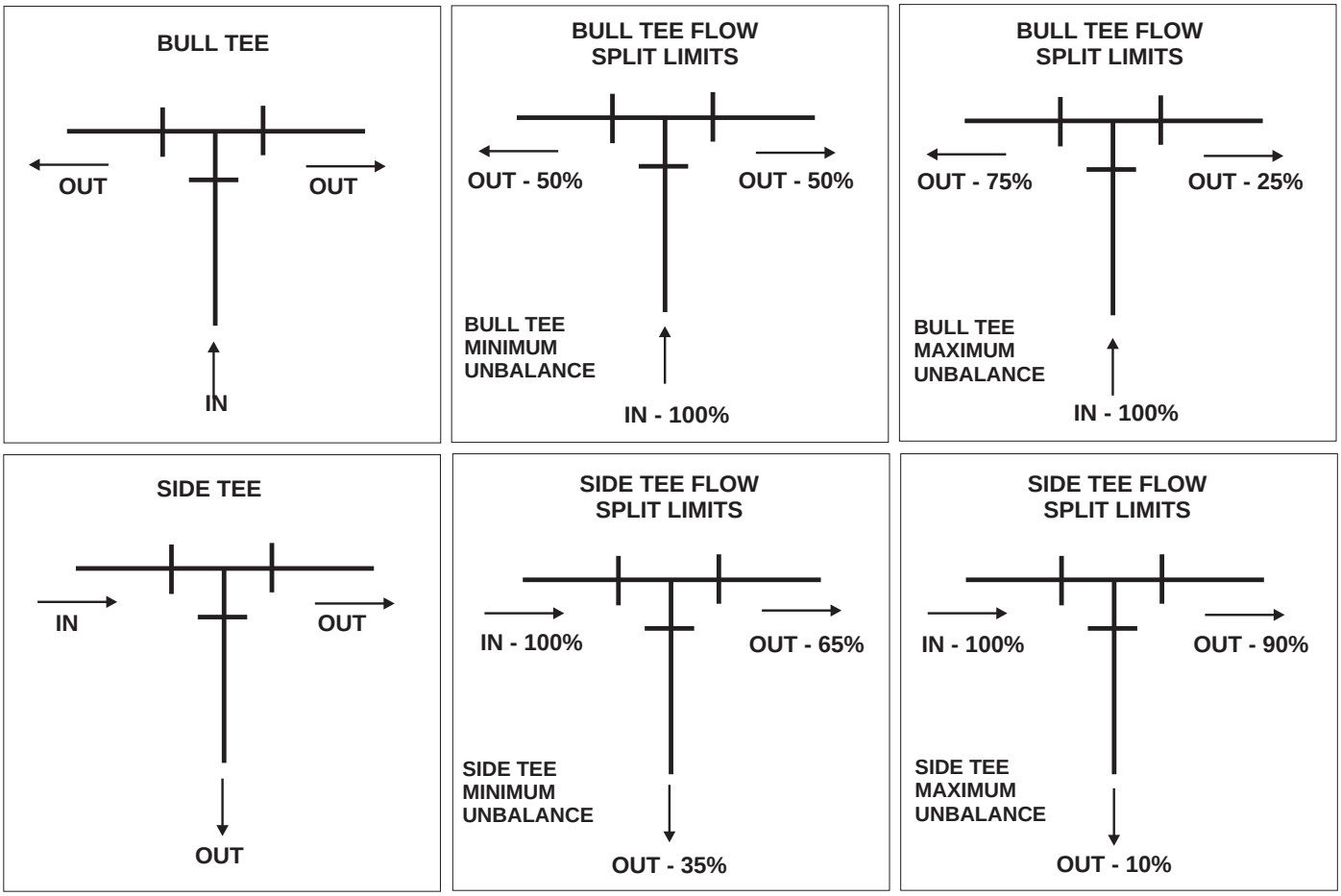


Figure 3-2. Acceptable Tee Flow Splits for Kidde Engineered System

Table 3-4. 10 Pipe Diameters

Pipe Size	10 Pipe Diameters		
	feet	feet and inches	meters
1/4 in. (6 mm)	0.21 ft.	0 ft., 2½ in.	0.06 m
3/8 in. (10 mm)	0.31 ft.	0 ft., 4 in.	0.10 m
1/2 in. (15 mm)	0.42 ft.	0 ft., 5 in.	0.15 m
3/4 in. (20 mm)	0.63 ft.	0 ft., 7½ in.	0.20 m
1 in. (25 mm)	0.83 ft.	0 ft., 10 in.	0.25 m
1¼ in. (32 mm)	1.04 ft.	1 ft., 1/2 in.	0.32 m
1½ in. (40 mm)	1.25 ft.	1 ft., 3 in.	0.40 m
2 in. (50 mm)	1.67 ft.	1 ft., 8 in.	0.50 m
2½ in. (65 mm)	2.08 ft.	2 ft., 1 in.	0.65 m
3 in. (80 mm)	2.50 ft.	2 ft., 6 in.	0.80 m
4 in. (100 mm)	3.33 ft.	3 ft., 4 in.	1.00 m
5 in. (125 mm)	4.17 ft.	4 ft. 2½ in.	1.25 m
6 in. (150 mm)	5.00 ft.	5 ft., 0 in.	1.50 m

3-2.1.8.3 Duration of Discharge

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

3-2.1.8.4 Pipe Sizing

Table 3-5 may be used as an estimating guide for sizing distribution piping. This table is intended for use as a guide only. The Kidde Engineered Fire Suppression System Flow Calculation Program must be used for the final design.

Table 3-5. Pipe Size vs. Flow Rate

Pipe Size Nominal	Schedule 40 Pipe				Schedule 80 Pipe			
	Minimum Flow Rate for All Sections Leading to a Tee		60% of Flow Rates for All Sections Ending With a Nozzle		Minimum Flow Rate for All Sections Leading to a Tee		60% of Flow Rates for All Sections Ending With a Nozzle	
	lb./sec.	kg/sec.	lb./sec.	kg/sec.	lb./sec.	kg/sec.	lb./sec.	kg/sec.
1/4 in. (9 mm)	0.68	0.31	0.41	0.19	0.30	0.14	0.18	0.08
3/8 in. (10 mm)	1.55	0.70	0.93	0.42	1.06	0.48	0.64	0.29
1/2 in. (15 mm)	2.58	1.17	1.55	0.70	1.95	0.88	1.17	0.53
3/4 in. (20 mm)	4.53	2.05	2.72	1.23	3.68	1.67	2.21	1.00
1 in. (25 mm)	7.29	3.31	4.37	1.98	6.08	2.76	3.65	1.65
1¼ in. (32 mm)	12.67	5.75	7.60	3.45	10.83	4.91	6.50	2.95
1½ in. (40 mm)	17.46	7.92	10.48	4.75	15.06	6.83	9.04	4.10
2 in. (50 mm)	29.82	13.53	17.89	8.12	25.96	11.78	15.58	7.07
2½ in. (65 mm)	44.06	19.99	26.44	11.99	38.51	17.47	23.11	10.48
3 in. (80 mm)	71.34	32.36	42.80	19.42	62.96	28.56	37.78	17.13
3½ in. (90 mm)	98.32	44.60	58.99	26.76	87.46	39.67	52.48	23.80
4 in. (100 mm)	129.28	58.64	77.57	35.18	115.87	52.56	69.52	31.53
5 in. (125 mm)	205.71	93.31	123.43	55.99	187.31	84.96	112.39	50.98
6 in. (150 mm)	286.54	129.97	171.92	77.98	262.77	119.19	157.66	71.51

Note: The pipe friction factor embodied in the energy conservation equation used to calculate pressure drop for two-phase flow in fire protection systems is based on the premise that highly turbulent flow is present in the pipeline. Also, a high degree of turbulence must be maintained in pipe sections that approach dividing points. The pipe size that can be used for a given flow rate is thus based upon the minimum flow rate required to maintain complete turbulence.

This limitation is tabulated in the Table and is automatically taken into consideration when the computer selects pipe sizes for the system. Flow rates as low as 60% of the tabulated minimum rates may be used in branch lines that lead directly to nozzles with no intervening flow division.

3-2.1.9 MANIFOLDS

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

1. A connected reserve supply of Novec 1230 fluid fluid is required.
2. The quantity of agent required is greater than the maximum fill of a single cylinder and modular pipe work (i.e., each cylinder having its own separate discharge pipe work) is not practical or acceptable.

When manifolds are used, the following shall be observed:

- All cylinders are of the same size and agent fill.
- Each cylinder must have a check valve to prevent back flow of agent through the discharge hose, in the event that the system is discharged while a cylinder is removed for maintenance.

3-2.1.10 DETERMINE REQUIRED COMPONENTS

- Cylinder size, quantity and fill requirements (refer to Tables 2-1 and 2-2).
- Cylinder framing, mounting brackets, etc.
- Actuation, control and warning system equipment required.
- Other system requirements, such as machinery shutdowns, pressure switches, etc.

3-2.2 System Actuation Principles

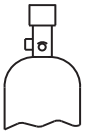
Kidde Engineered System Systems can be configured in a number of different ways. The actuation arrangement chosen will vary according to the individual vessel requirements in conjunction with the requirements of the AHJ. The four primary actuation arrangements are:

1. Local manual operation.
2. Remote manual operation via cable pull.
3. Remote manual operation via stored pressure release pilot cylinders.
4. Automatic operation via mechanical pneumatic detection/control.

Arrangements 2, 3 and 4 must be capable of actuation by local manual control. Arrangement 4 can only be used for spaces equal to, or smaller than, 6000 ft.^{3} (170 m^3).

Unless the protected space is less than 6000 ft.^{3} (170 m^3), and has a suitable horizontal escape, a predischarge alarm (and therefore mechanical delay) must be provided, as well as a means to shut down ventilation and/or machinery.

In this paragraph, the basic system operating principles have been described. Many installed arrangements include elements from one or more basic arrangements.


AGENT CYLINDER


N_2 PILOT CYLINDER
108 CU. IN.


CONTROL HEAD, CABLE OPERATED*


CONTROL HEAD, LEVER OPERATED


CONTROL HEAD, PNEUMATICALLY OPERATED*


CONTROL HEAD, LEVER/PRESSURE OPERATED


CONTROL HEAD, PRESSURE OPERATED*


PRESSURE SWITCH


PRESSURE TRIP


STOP VALVE, PRESSURE OPERATED


STOP VALVE, CABLE OPERATED


PNEUMATIC HEAT DETECTOR


CORNER PULLEY


CO2 Release Cabinet


N_2 PILOT CYLINDER
1040 AND 2300 CU. IN.


TIME DELAY


SIREN, PRESSURE OPERATED


DISCHARGE NOZZLE


SAFETY OUTLET


DISCHARGE INDICATOR


EL-CHECK


BALL VALVE


MANUAL STATION, CABLE OPERATED


STOP VALVE, OPTIONAL CONTROL


DUAL-PULL EQUALIZER


CHECK VALVE


BLEED VALVE


VENT, N_2

*CONTROL HEAD IS EQUIPPED WITH MANUAL
RELEASE LEVER TO ENABLE LOCAL ACTUATION

Figure 3-3. Key to Symbols Used in Arrangements Schematics

3-2.3 Local Manual Actuation

In this configuration, the Kidde Engineered System cylinder valve is fitted with a lever operated control head. The control head requires two distinct actions (removal of safety pin and lever operation) to mechanically operate the valve and release agent.

If more than one Kidde Engineered System cylinder must be actuated by local manual release (where manual release is the primary release mechanism), it is inadequate to fit manual release heads on each Kidde Engineered System cylinder. In this case, a master cylinder must be selected. The master will be fitted with the manual release and subsequent slave cylinders will be actuated using the pressure of the master cylinder. See Paragraph 3-2.5.2.3 for details.

3-2.3.1 LOCAL MANUAL ACTUATION EXAMPLE

Note: Refer to Figure 3-4 for this arrangement.

In this arrangement, a single Kidde Engineered System cylinder is installed outside the protected space. The cylinder is fitted with a lever operated control head. A pressure switch is installed in the discharge pipework with the option of a discharge indicator and/or pressure trip, depending on the functionality required.

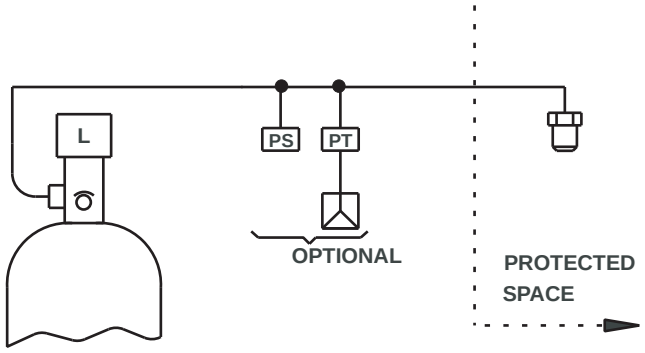


Figure 3-4. Basic Lever Arrangement

3-2.4 Remote Manual Actuation - Cable

In this configuration, a cable operated control head is fitted to the valve on the Kidde Engineered System cylinder. The control head is a mechanical device that allows local manual operation or a remote cable pull station to release the agent.

The cable operating equipment can be combined in many ways to provide manual remote operation points for a number of system configurations. There are three different pull box designs that provide solutions for a variety of control locations. The cable operated control head can be fitted directly to a Kidde Engineered System cylinder valve, a nitrogen pilot cylinder valve or a direction (stop) valve, as required.

A single cable pull station can be used to operate two control heads using a dual-pull equalizer (P/N 840051). A single control head can be operated by either of two control stations using a dual-pull mechanism (P/N 840058).

3-2.4.1 CABLE ACTUATION EXAMPLES

3-2.4.1.1 Basic Cable Operation Example

Note: Refer to Figure 3-5 for this arrangement.

In this arrangement, a single Kidde Engineered System cylinder is installed outside the protected space. The cylinder is fitted with a cable operated control head connected via corner pulleys to a remote pull station. A pressure switch is installed in the discharge pipework with the option of a discharge indicator and/or pressure trip, depending on the functionality required.

The primary actuation method is via the remote pull station. If this were to fail, the backup manual lever on the cable operated control head installed on the Kidde Engineered System cylinder would operate the system. See Paragraph 3-2.4.2 for details of the maximum length of cable, and number of pulleys that can be used in one system.

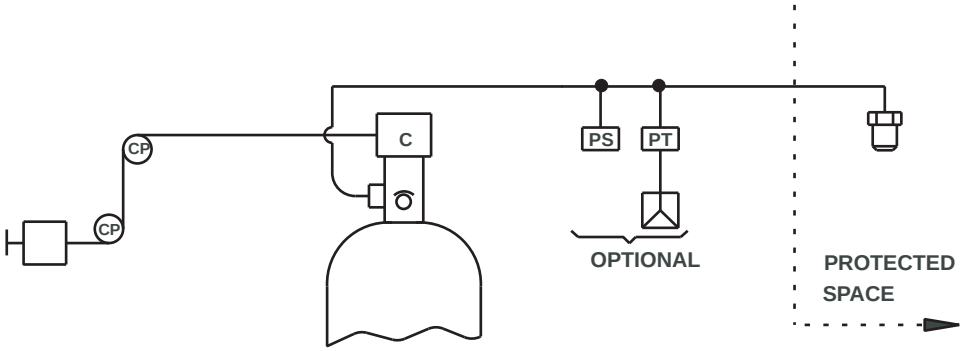


Figure 3-5. Basic Cable Arrangement

3-2.4.1.2 Complex Cable Operation Example

Note: Refer to Figure 3-6 for this arrangement.

In this arrangement, a bank of three Kidde Engineered System cylinders are located outside of the protected space. The agent cylinders are installed on a common discharge manifold and each contains the same mass of agent. A mechanical siren and time delay are required, so a pilot nitrogen configuration would be used. See Paragraph 3-2.5.2.2 for actuation limits for pilot nitrogen actuation circuits.

The pilot nitrogen arrangement consists of two nitrogen cylinders. The pilot cylinder is fitted with a cable operated control head that is operated via a remote pull station (control number 1).

A pilot nitrogen manifold connects the pilot cylinder to the siren driver, the discharge delay unit, and any of the following optional equipment: pressure switch, safety outlet, pressure trip and pressure indicator (as required). A second pull station (control number 2) operates a stop valve via a cable operated control head. The stop valve is located upstream of the discharge delay. The discharge delay is equipped with a lever operated control head to enable the delay to be bypassed. The outlet of the discharge delay is routed to pressure operated control heads installed on the agent cylinders.

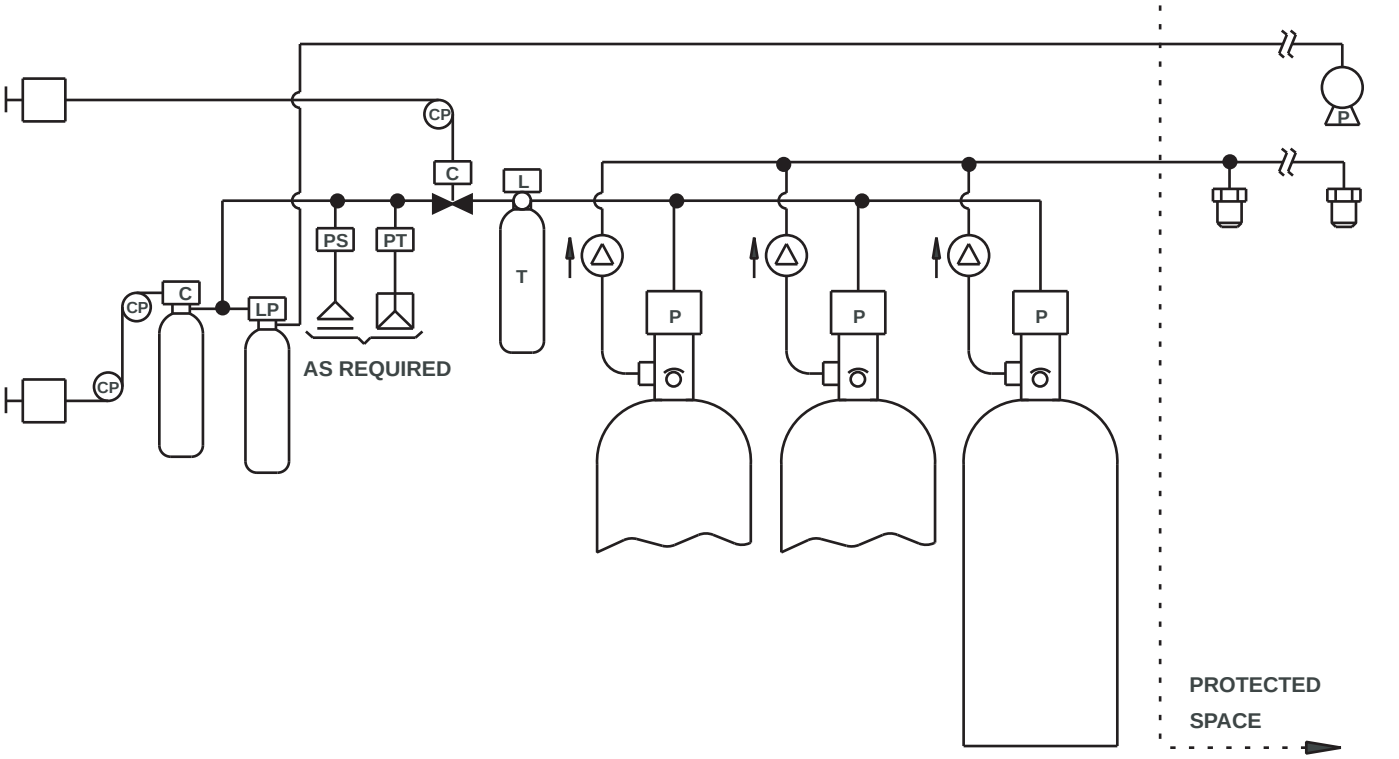


Figure 3-6. Complex Cable Arrangement

3-2.4.2 CABLE ACTUATION LIMITATIONS

Cable and pneumatic control heads fitted with cable pulls are subject to certain limitations. The pull boxes are connected to the control heads 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 galvanized pipe. Refer to Table 3-6 for corner pulley and cable length limitations. In addition, the maximum force required to operate a cable pull may not be greater than 40 lb., nor require a movement greater than 14 inches. If any 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 3-6. Corner Pulley and Cable Limitations

Control Head Type	Control Head Part Number	Maximum Number of P/N 803808	Maximum Cable Length (ft.)
Cable Operated	979469	15	100
Pneumatic	872318	6	100
Pneumatic	872335	6	100
Pneumatic	872365	6	100
Pneumatic	872362	6	100
Pneumatic	872310	6	100
Pneumatic	872360	6	100

Note: Where a dual-pull mechanism or dual-pull equalizer is used, the total cable length and total number of corner pulleys are used to determine compliance with the stated limitations. The dual-pull equalizer further counts as one additional corner pulley.

3-2.5 Remote Manual Operation - Stored Pressure Release

In this configuration, a pilot cylinder charged with Nitrogen is connected via pipe/tubing to pressure operated control head(s) installed on the agent cylinder(s). A control head is fitted to the pilot cylinder to mechanically operate the system.

Pilot pressure operating equipment can be combined in many ways to provide manual remote operation points for a number of system configurations. Nitrogen pilot cylinders are used to operate agent cylinder(s) directly, to operate second stage pilot nitrogen cylinders, or to drive pressure operated sirens.

3-2.5.1 STORED PRESSURE ACTUATION EXAMPLES

3-2.5.1.1 Basic Pressure Operated Example

Note: Refer to Figure 3-7 for this arrangement.

In this arrangement, two Kidde Engineered System cylinders are installed outside the protected space. The agent cylinders are installed on a common discharge manifold, and each contains the same mass of agent. The primary (master) cylinder is fitted with a lever/pressure operated control head which is connected to a pilot nitrogen circuit. The secondary (slave) cylinder is fitted with a pressure operated control head which is connected to the master cylinder slave actuation port.

The pilot nitrogen circuit consists of a pilot nitrogen cylinder and valve assembly fitted with a lever operated control head connected via pilot tubing to a 1/4 in. ball valve. A pressure switch can be installed in the circuit outside the space, with the option of a discharge indicator and/or pressure trip installed in the agent pipe work as required.

The primary actuation method is to operate the lever operated control head on the nitrogen pilot cylinder followed by the operation of the ball valve.

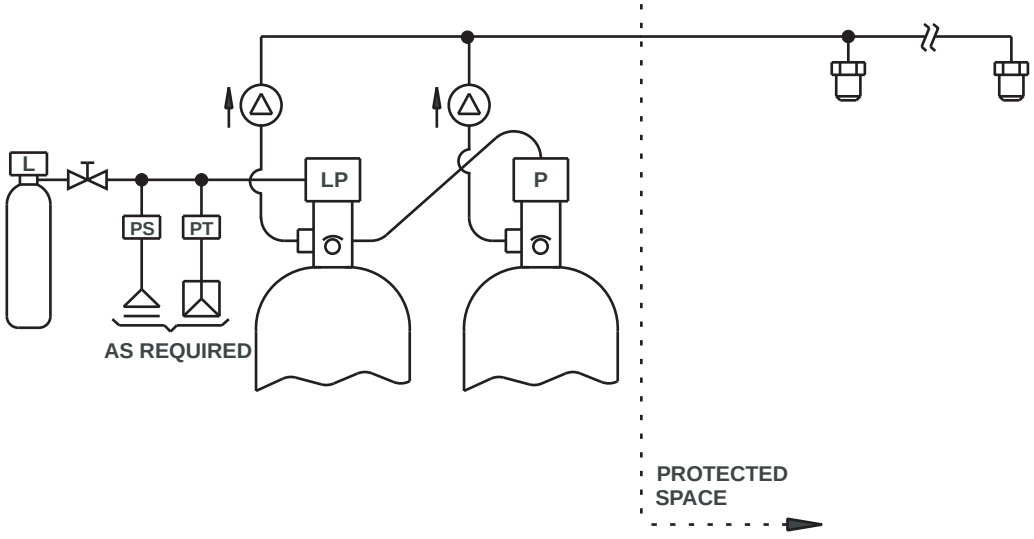


Figure 3-7. Basic Pressure Arrangement

3-2.5.1.2 Complex Pressure Operated Example

Note: Refer to Figure 3-8 for this arrangement.

In this arrangement, three Kidde Engineered System cylinders are installed outside the protected space. The agent cylinders are of different capacities and contain different quantities of agent. The pipe work from each agent cylinder feeds separate nozzles covering separate enclosures of the protected space, or divisions of the protected space that are covered more effectively by using dedicated pipework.

The master cylinder is fitted with a lever/pressure operated control head connected to the pilot circuit. Three mechanical sirens and a time delay are required. The pilot circuit includes two remote pilot cylinders, a local primary pilot cylinder and a siren driver cylinder.

The remote stage consists of pilot nitrogen cylinder and valve assemblies fitted with lever operated control heads connected via pilot tubing to the primary pilot and stop valve respectively.

The pilot nitrogen manifold connects the pilot cylinder to the discharge delay unit, and any of the following optional equipment: pressure switch, safety outlet, pressure trip and pressure indicator (as required). The stop valve is located upstream of the discharge delay and is fitted with a lever/pressure operated control head. The discharge delay is equipped with a lever operated control head to enable the delay to be bypassed. The outlet of the discharge delay is routed to the lever/pressure operated control head installed on the master (agent) cylinder.

The primary actuation method is to operate the local pilot cylinder, stop valve and control heads directly. A secondary emergency option is to operate the lever/pressure operated control head on the master cylinder.

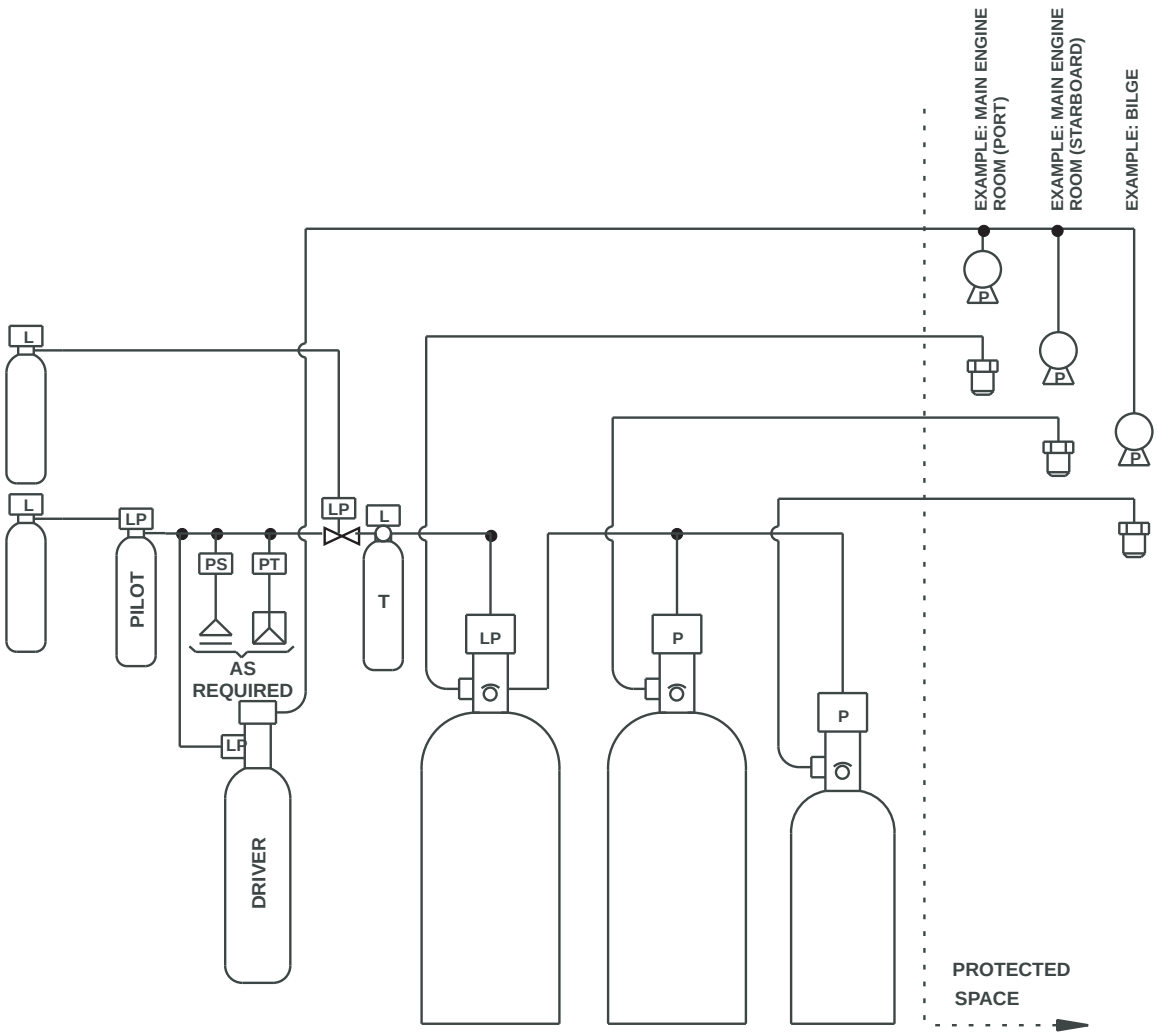


Figure 3-8. Complex Pressure Arrangement

3-2.5.2 STORED PRESSURE ACTUATION LIMITATIONS

3-2.5.2.1 Two-Stage Extended Circuit Pressure Actuation

Note: Refer to Figure 3-9 for this arrangement.

In this arrangement, the actuation line length and protected space complexity (typical with agent cylinders located in the space) requires a two-stage nitrogen actuation scheme (Refer to Appendix C). This entails the use of a second set of pilot cylinders located between the primary pilot cylinders and the agent cylinders. The second stage cylinders can be co-located in the protected space with the agent cylinders. The second-stage is operator transparent, that is, no additional control input is required to operate the system.

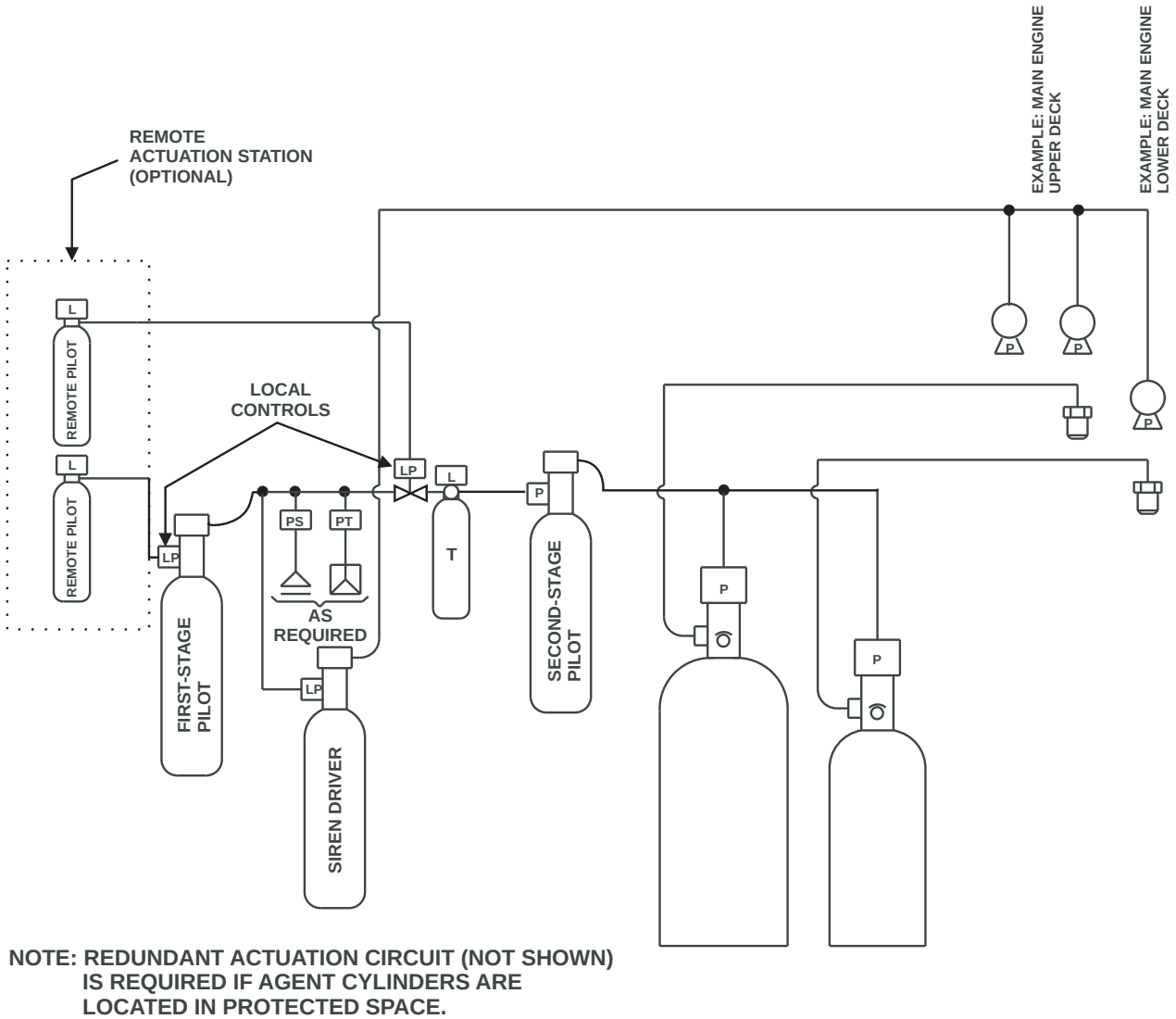


Figure 3-9. Two-Stage Extended Circuit Pressure Operated Example (Required When Single-Stage Distance Limitations are Exceeded)

3-2.5.2.2 Nitrogen Actuation Circuit Design and Limitations

The two available nitrogen pilot cylinders can be used to actuate different maximum number of agent cylinders, siren driver cylinders and ancillary components with a set maximum length of pilot tubing or pipe. For single stage arrangement limitations, refer to Figure 3-10 and Tables 3-7 and 3-8. Only the 1040 cu. in. pilot cylinder can be used in a two-stage actuation arrangements.

The nitrogen siren driver cylinder(s) in a system do not have to be the same size as the pilot cylinders. For example, a 108 cu. in. pilot cylinder can be used to operate a 2300 cu. in. siren driver.

Agent cylinders actuated by nitrogen pilot can be close-coupled or not close-coupled without affecting the overall number of cylinders that can be actuated, or the length of actuation tube or pipe that can be used.

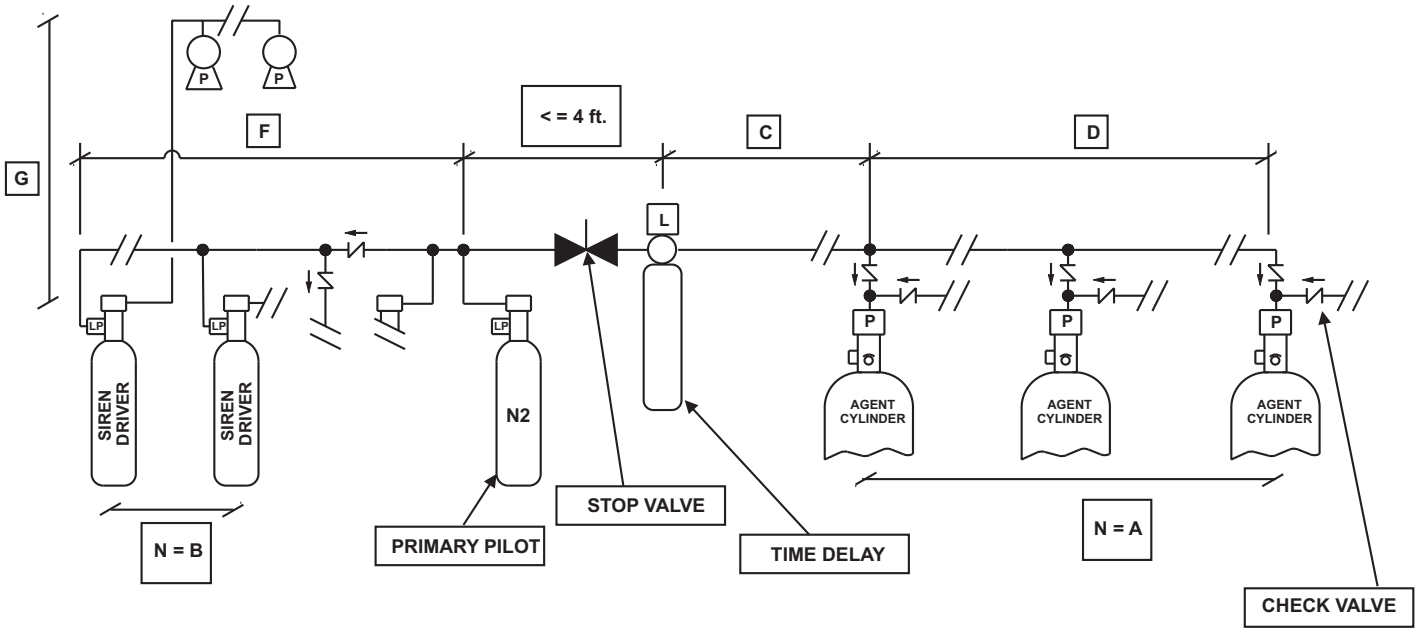


Figure 3-10. Single-Stage Actuation System Limits, Nitrogen Pressure

Table 3-7. Single-Stage Pilot Cylinder Actuation Cylinder, Driver and Ancillary Limits (Refer to Figure 3-10)

Detail	108 cu. in.	1040 cu. in.	2300 cu. in.
Pilot/Siren Driver Cylinder Part Number	WK-877940-000	90-101040-000	90-102300-100
Pilot Cylinder Capability	Yes	Yes	No
Siren Driver Capability	Yes	Yes	Yes
Number of Agent Cylinders **(A)**	10	15	
Number of Siren Drivers **(B)**	2	3	
Length of Actuation Pipe to First Agent Cylinder **(C)**	75 ft.	75 ft.	
Length of Actuation Pipe From First to Last Agent Cylinder **(D)**	150 ft.	175 ft.	
Total Actuation Circuit Length **= E (C + D)**	225 ft.	250 ft.	
Length of Actuation Pipe to Siren Driver(s) **(F)**	20 ft.	90 ft.	
Siren Driver: Number of Sirens	1	4	10
Siren Driver: Length of Siren Piping **(G)**	90	500	500
Time Delay	34/61	35/68	

Table 3-8. Single-Stage Pilot Cylinder Actuation Cylinder. Tubing/Piping Limits

Pilot Cylinder Size	Part Number	Maximum Total Length of 1/4 in. Sch. 80 Pipe (ss)	Maximum Total Length of 5/16 in. x 0.032 in. Tube (ss)
108 cu. in.	WK-877940-000	225 ft.	225 ft.
1040 cu. in.	90-101040-000	250 ft.	250 ft.

3-2.5.2.3 Master/Slave Pressure Actuation Limitations

Two modes of pressure actuation of the Kidde Engineered System cylinders are available; close-coupled and not close-coupled.

For close-coupled cylinders using pressure from a single master Kidde Engineered System cylinder (see Figures 3-11), a maximum of fifteen slave cylinders can be actuated by that one master cylinder using pressure operated control heads on the slave cylinders. For close coupled cylinders, the slave cylinder operation will be through pilot flexible hoses.

For cylinders that are not close coupled, a maximum of four slave cylinders (maximum five cylinders in a group) can be actuated by that one master cylinder using pressure operated control heads on the slave cylinders. Operation will be through a 5/16 in. O.D. x 0.035 in. wall stainless steel tubing actuator line having a maximum total length of 800 feet (244 m) or 400 feet (122 m) of 1/4 in. Schedule 40 pipe.

These limitations apply to master/slave for use where cylinders are located outside the protected space only.

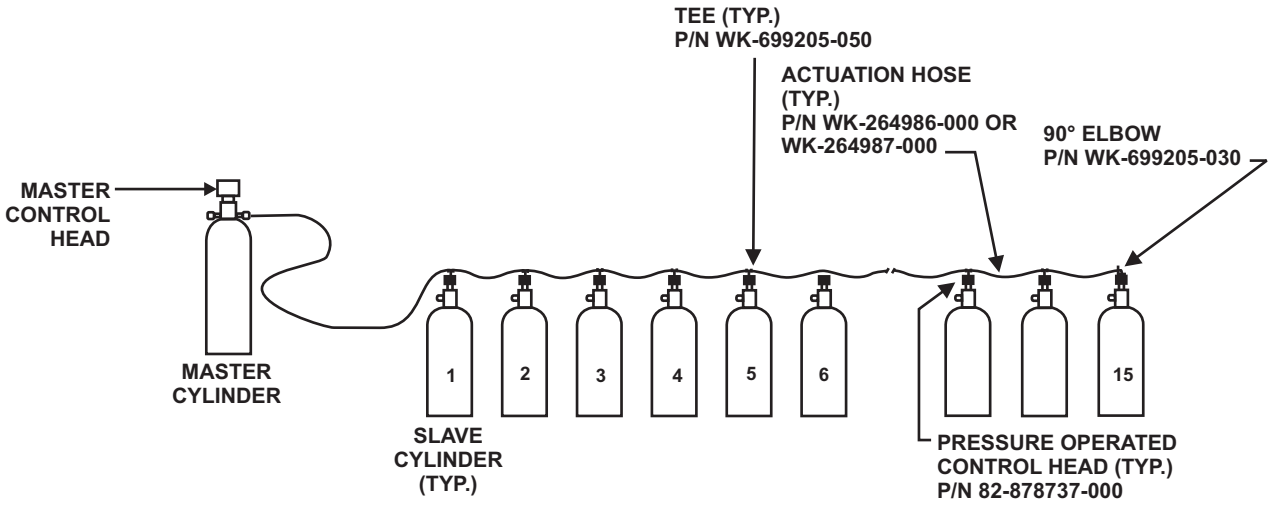


Figure 3-11. Pressure Actuation Using Pressure from 1 Master Nitrogen Driver Cylinder to Actuate a Maximum of Fourteen Slaves (Fifteen Sets Total), Close Coupled

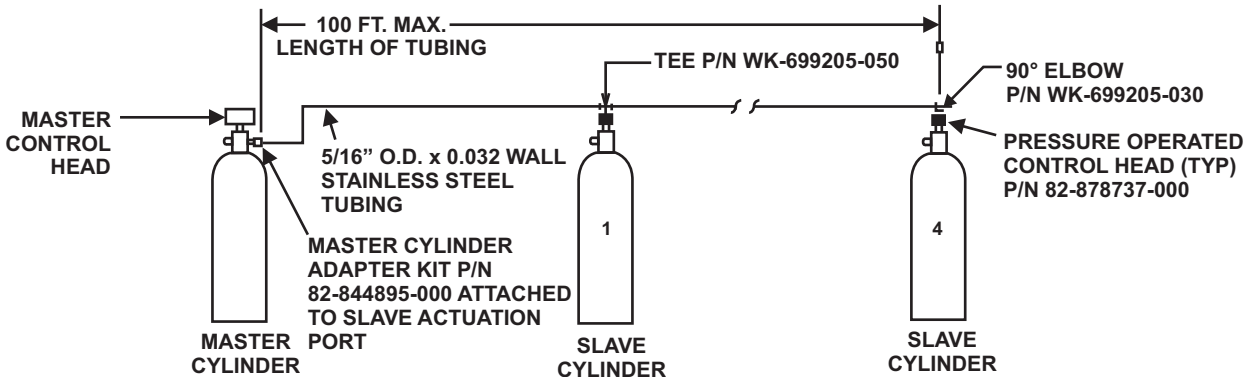


Figure 3-12. Pressure Actuation Using Pressure from 1 Master Nitrogen Driver Cylinder to Actuate a Maximum of Fourteen Slaves (Fifteen Sets Total), Not Close Coupled

3-2.5.2.4 Nitrogen Pressure Operated Siren Limitations And Siren Driver Limitations

The pressure operated siren (P/N 90-981574-001) consumes approximately 0.5 to 0.9 lb. (0.23 to 0.5 kg) of nitrogen per minute. Each siren driver cylinder can operate one or more sirens. Table 3-9 indicates the number of sirens that can be installed on a line from any one siren driver; the total length of actuation pipe that can be used must not exceed the limits shown in this table.

108 cu. in. and 1040 cu. in. siren driver cylinders cannot be manifolded. A maximum of two 2300 cu. in. siren drivers can be manifolded to provide up to twenty sirens on one circuit. No other manifold combination is permitted.

Table 3-9. 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.

3-2.5.2.5 Remote Nitrogen Pilot Cylinders

Where a 108 cu. in. nitrogen pilot cylinder is used as a remote actuator that operates a main pilot cylinder, the following piping/tubing limitations apply:

Table 3-10. Remote Nitrogen Pilot Cylinder 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

3-2.5.2.6 Using Multiple Nitrogen Cylinders

Two or more remotely located pilot nitrogen cylinders can be used to actuate the Kidde Engineered System described in Paragraph 3-2.5.2.3, provided that:

- 1/4 in. check valves (P/N WK-264985-000) shall be installed at the intersection of each pilot line to the main actuator line (see Figure 3-13).
- The total length of actuator line from each nitrogen pilot cylinder to the Kidde Engineered System cylinders shall not exceed the limitation specified in Paragraph 3-2.5.2.5.

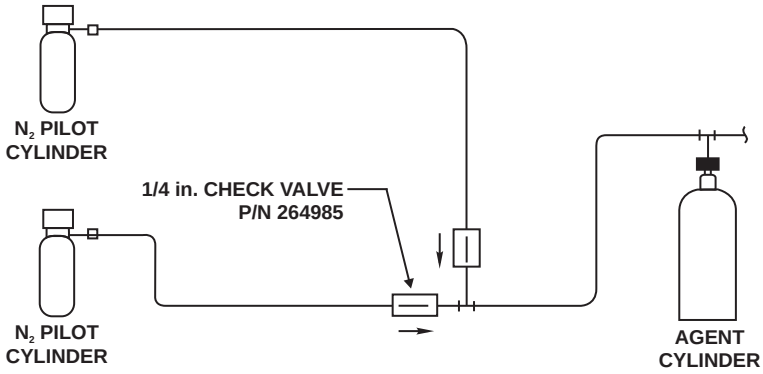


Figure 3-13. Multiple Pilot Nitrogen Actuation Cylinders

3-2.5.2.7 Pressure Trip Limitations

The maximum load to be attached to pressure trip (P/N 81-874290-000) is 100 lb. (based on a minimum pressure of 75 PSIG [5 bar gauge] at the pressure trip).

3-2.6 Automatic Actuation: Mechanical Pneumatic Detection/Control

In this configuration, a pneumatic control head is installed on the Kidde Engineered System master cylinder or the pilot cylinder (depending on the configuration). The pneumatic control head is connected to one or more mechanical rate-of-rise detectors via 3/16 in. tubing. A rapid local rise of temperature causes a pressure differential between the detector circuit and the control head that causes the head to operate. The control head requires two distinct actions to mechanically operate the system.

3-2.6.1 AUTOMATIC/PNEUMATIC ACTUATION EXAMPLES

Note: Refer to Figure 3-14 for this arrangement.

In this arrangement, a single Kidde Engineered System cylinder is installed inside the protected space. The cylinder is fitted with a pneumatic operated control head. The pneumatic control cable connection is utilized and is connected to dual-pull mechanism, allowing the connection of two remote manual pull stations.

The pneumatic diaphragm connection on the pneumatic control head is connected via capillary tubing to two pneumatic detectors (one to four detectors can be used, depending on the space being protected).

Depending on the functionality required, a pressure switch, discharge indicator and/or pressure trip could be installed in the discharge pipework.

The system will actuate if the rate-of-rise of temperature in the protected space is higher than the design set point. If manual activation is required, the system can be operated from either of the manual pull stations (and locally at the cylinder location provided the cylinder is located outside of the protected space.)

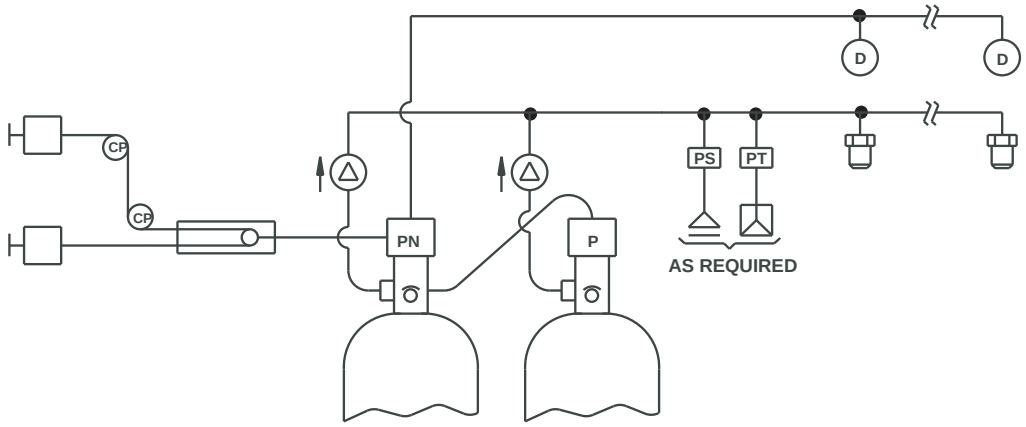


Figure 3-14. Automatic Arrangement

3-2.6.2 AUTOMATIC/PNEUMATIC ACTUATION LIMITATIONS

The connection between the pneumatic control head and the detector must be made using 3/16 in. tubing and fittings (see Paragraph 2-3.6.3). Each circuit is limited to a maximum of four detectors. If an automatic system is required with a discharge delay and/or pressure operated siren, the pneumatic control head is then fitted to the pilot cylinder, and the remaining actuation circuit is as per a pressure operated system.

3-2.7 Ancillary Components

This section details the component arrangement required to complete typical systems employing either one or more of the operating principles outlined in Paragraphs 3-2.3 through 3-2.6.

The 108 cu. in. and 1040 cu. in. nitrogen cylinders each have a dual-purpose: as pilot cylinders (i.e., used to actuate a number of agent cylinders, a number of siren driver cylinders and ancillary pressure-operated devices) or as a siren driver cylinder(s) to operate one or more pressure operated siren(s) (P/N 90-981574-001, refer to Paragraph 3-2.5.2.4 for all limitations). A 2300 cu. in. cylinder is designed for siren driving only.

CAUTION

The 108 cu. in. and 1040 cu. in. nitrogen actuation arrangement cylinders are designed to operate either as pilot cylinders or as siren drivers, but not as both. Using a pilot (driver) cylinder to operate agent cylinder control heads, time delays (and any other ancillaries) and drive pressure-operated siren(s) is not permissible and could result in a failure of the system to operate.

3-2.7.1 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 3-11. 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 3-12. 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

3-2.7.2 NITROGEN OPERATED MECHANICAL DISCHARGE DELAY AND PRESSURE OPERATED SIREN

Where a mechanical-pneumatic discharge delay is required, a nitrogen discharge delay should be installed. The delay units are driven by pilot nitrogen and are matched to the driving pilot cylinder (108 cu. in. or 1040 cu. in.). Two delay period options are available for each pilot cylinder/delay combination (see Table 3-13).

WARNING **Nitrogen discharge delay units can only be driven by nitrogen and must only be used with nitrogen pilot cylinder(s). Use with other media will prevent the correct delay from being observed.**

A pre-discharge mechanical-pneumatic alarm can be provided by using one or more nitrogen pressure-operated siren(s). The siren(s) are driven by separate siren driving cylinder(s) that are actuated using the system pilot circuit. The nitrogen pressure operated siren, P/N 90-981574-001, is not interchangeable with the Kidde CO_2 pressure operated siren, P/N 81-981574-000.

CAUTION **Only one 90-981574-001 siren can be driven from one 108 cu. in. siren driver cylinder. The connection of more than one siren to a 108 cu. in. cylinder could result in insufficient alarm volume and/or duration of operation.**

Table 3-13. Delay Period Options

Discharge Delay Part Number	Nominal Delay	For Use With	Part Number
81-871072-001	34 sec.	108 cu. in.	WK-877940-000
81-871072-002	61 sec.	108 cu. in.	WK-877940-000
81-871072-003	35 sec.	1040 cu. in.	90-101040-000
81-871072-004	68 sec.	1040 cu. in.	90-101040-000

3-2.7.3 VENTING ACTUATION CIRCUITS

3-2.7.3.1 General Requirements

In sections of nitrogen actuation circuits that can retain pressure after discharge, it is recommended that a vent be installed to allow this residual pressure to be vented.

For pilot circuits that are driven by a 108 cu. in. nitrogen pilot cylinder, use either a vent fitting (P/N WK-284051-000) or a manual bleed valve (P/N WK-263303-000) and cap (P/N WK-263304-000).

For pilot circuits driven by a 1040 cu. in. nitrogen pilot cylinder, use a vent fitting (P/N WK-284051-000).

A vent fitting (P/N WK-284051-000) will start venting as soon as the system is operated, whereas a manual bleed valve (P/N WK-263303-000) requires an operator to manually vent pressure.

3-2.7.3.2 Dual-Loop Fitting Venting: Special Requirements

The dual-loop fitting kit includes the manual bleed valve (P/N 263303). This unit is installed to allow venting of pressure that is retained between the two check valves and the control head following a discharge. The residual pressure is vented after a discharge by manually depressing the valve core. Before venting the dual-loop fitting, ensure that the main lines have been bled or fully vented. If the main lines have not been bled then the entire line will have to be vented through the dual-loop fitting.

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CHAPTER 4
INSTALLATION

4-1 INTRODUCTION

This chapter is intended for system installers. It outlines the steps needed to properly install Kidde Engineered Fire Suppression System designed for use with 3M™ Novec™ 1230 Fire Protection Fluid.

4-2 INSTALLATION OF COMPONENTS

4-2.1 General

All Kidde Engineered System equipment must be installed to facilitate proper inspection, testing, manual operation, recharging and any other required maintenance as may be necessary. Equipment must not be subject to severe weather conditions or mechanical, chemical or other damage which could render the equipment inoperative. Equipment must be installed in accordance with NFPA Standard 2001, current edition and with appropriate marine regulations and good engineering practice.

WARNING

The Kidde Engineered System cylinder and valve assemblies must be handled, installed and serviced in accordance with the instructions contained in this paragraph and Compressed Gas Association (CGA) pamphlets C-1, C-6 and P-1. CGA pamphlets may be obtained from: Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202. Failure to follow these instructions can cause Kidde Engineered System cylinders to violently discharge, resulting in severe injury, death and/or property destruction.

4-2.2 Distribution Piping and Fittings

4-2.2.1 THREADS

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

4-2.2.2 PIPE

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

4-2.2.2.1 Ferrous Piping

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

CAUTION

Ordinary cast-iron pipe, steel pipe conforming to ASTM A-120, or nonmetallic pipe must not be used.

4-2.2.2.2 Piping Joints

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

4-2.2.2.3 Fittings

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

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

CAUTION

The calculation software has only been verified for use with the piping, inside pipe diameter and fittings specified in this manual. When unspecified piping and fittings are used for unbalanced systems, there is a risk that the system will not supply the required quantity of Novec 1230 fluid.

4-2.3 Installation of Pipe and Fittings

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

Note: Strict piping rules regarding flow splits to multiple hazards must be adhered to. Please refer to Paragraph 3-2.1.8.2 of this manual for proper tee installations.

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

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

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

USCG requires that a pressure test of the installed discharge pipework be carried out prior to commissioning.

The test pressure specified is one and a half times the storage pressure at 70°F (21°C). For the Kidde Engineered System, the test pressure is equal to 540 PSIG (37.3 bar gauge).

Pressurize with air or nitrogen for two minutes; do not use oxygen or water. The maximum allowable loss is 150 PSI/min. (10.3 bar/min.).

WARNING

Extreme caution should be used before, during and after a system pipework pressure test. USCG requires a full pressurization to 1.5 times the normal system cylinder operating pressure. Personnel must vacate all areas through which the system pipework runs. The failure of a system pipework element during a pressure test could result in damage to property, serious injury or death.

Where USCG requirements need not be met (verify with the AHJ), test in accordance with NFPA 2001:2004 Edition requirements. That is, pneumatically pressurize for ten minutes at 40 PSIG (2.76 bar gauge) with a pressure loss of less than, or equal to, 20% at the end of the test period being acceptance criteria.

4-2.4 Installation of Check and Stop (Direction) Valves

Install standard check valves and stop valves in horizontal or vertical orientation. Swing checks must be installed in accordance with Figure 4-1.

Apply Teflon® tape or pipe compound to all male threads, except the first two full threads. Non-swing check and stop valves greater than 2 in. are flanged and should be installed with the appropriate gaskets, flanges and fasteners.

CAUTION

All check and stop (direction) valves must be installed with the arrow, cast in the valve body, pointing in the direction of flow.

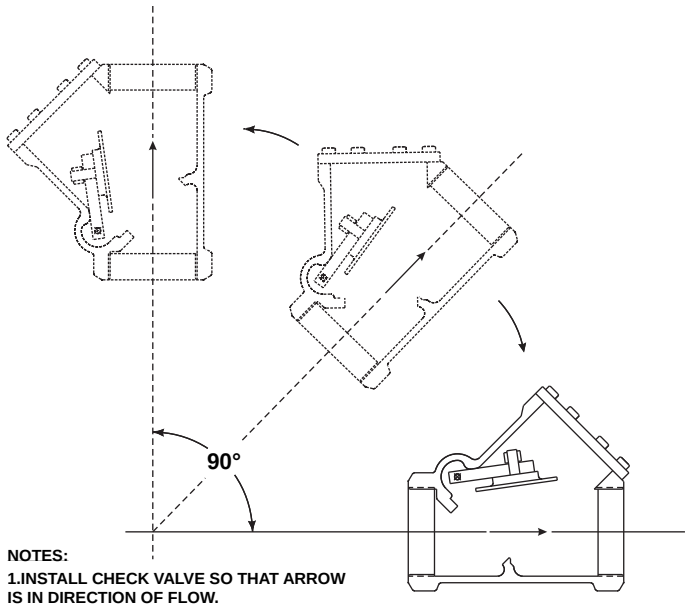


Figure 4-1. Installation Orientation of Swing Check Valves

4-2.4.1 EL-CHECK VALVES

Install El-check valves in accordance with Figure 4-2. Ensure that the check moves freely on the shaft and that it is seated before installing onto the manifold.

WARNING

The arrow cast into the El-check valve body indicates the direction of flow, and must be pointing up when installed within the limits shown in Figure 4-2. Failure to install in the correct orientation could result in unobstructed flow through the valve in the event of system actuation.

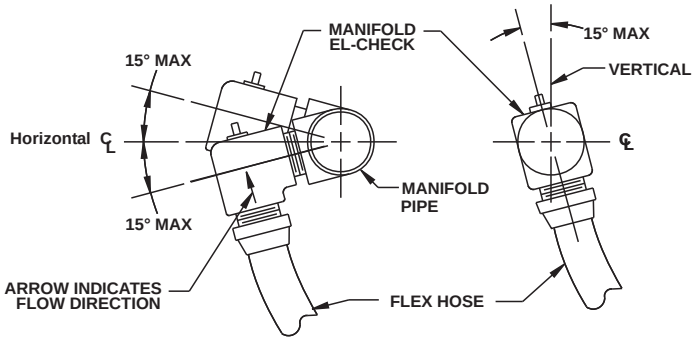


Figure 4-2. El-Check Valve

Note: Adjust El-check valve to achieve the correct radius in the flexible discharge hose. See Paragraph 4-2.9.

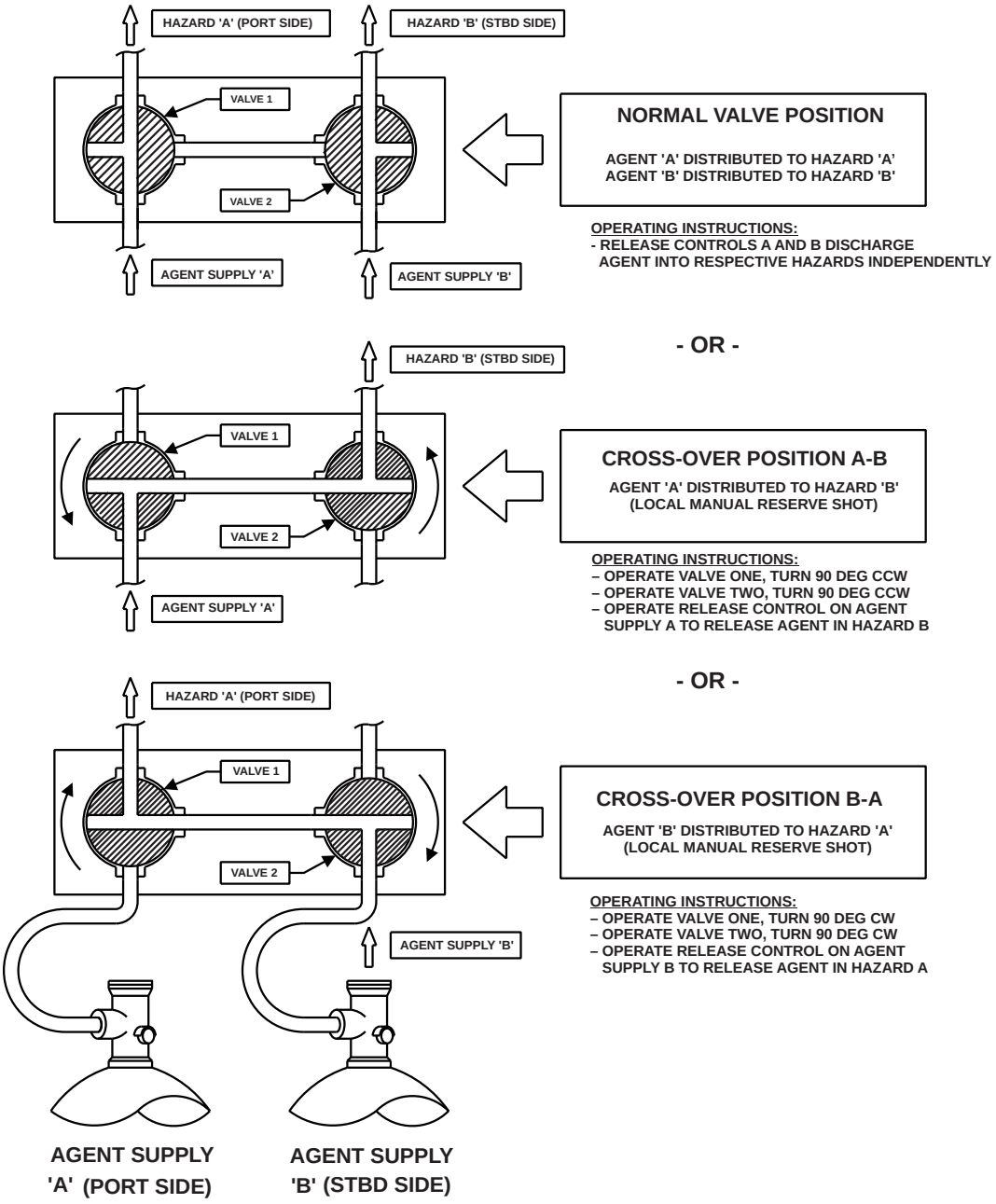
4-2.5 Installation of 3-Way Cross-Over Valves

Valves must be installed so that the hand-wheels are accessible and that the position indicators are clearly visible. Grooved pipe couplings should be used to connect to the system piping, with a minimum of 500 PSI (35 bar) pressure rating. Pipe supports should be located as close to valve as possible to support the weight of the valves. Check valves should be installed between agent cylinder and 3-Way Cross-Over Valves.

Signage must be clearly displayed indicating the correct operation procedures.

Figure 4-3 illustrates how two cross-over valves are installed and operated so that either system can protect each individual space.

Note: Design for a distribution system that contains cross-over valves must take into consideration all possible valve positions when piping length is calculated. Refer to Paragraph 2-3.10.7 for the equivalent length of these valves for each of their positions.



Note: Check valves should be installed between agent cylinder and 3-Way Cross Over Valves.

Figure 4-3. 3-Way Cross-Over Configuration

4-2.6 Installation of Discharge Nozzles

After the system piping has been blown free of debris, install the discharge nozzles in strict accordance with the system drawings. Orient the nozzles as shown on the drawings. Make certain that the correct nozzle type, part number and orifice size are installed in the proper location. See Paragraph 3-2.1.6 for correct nozzle placement and orientation.

A capped tee should be installed at the end of each pipe section to serve as a dirt trap and allow the connection of an air or nitrogen supply for cleaning and testing of the network.

4-2.7 Installation of Pressure Actuation Pipe

The pipe or tubing must be routed in the most direct manner with a minimum of fittings. Pipe and fittings must be in accordance with the requirements listed in Paragraph 3-2.1.8. Fittings can be flared, threaded (pipe only) or compression type. The pressure-temperature ratings of the fitting manufacturer must not be exceeded.

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

4-2.8 Installation of Valve Outlet Adapter

WARNING

Always connect a valve outlet adapter into system piping (union connection) before connecting to an Kidde Engineered System cylinder.

Install valve outlet adapter (P/Ns WK-283904-000, WK-283905-000 and WK-283906-000) in system piping. Tighten securely.

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

4-2.9 Installation of Flexible Discharge Hose

WARNING

Always connect the flexible discharge hose into system piping before connecting to an Kidde Engineered System cylinder.

Attach the flexible discharge hose from system piping or El-check in the discharge manifold to the cylinder valve. Tighten securely (see Figure 4-4 and Tables 4-1 and 4-2).

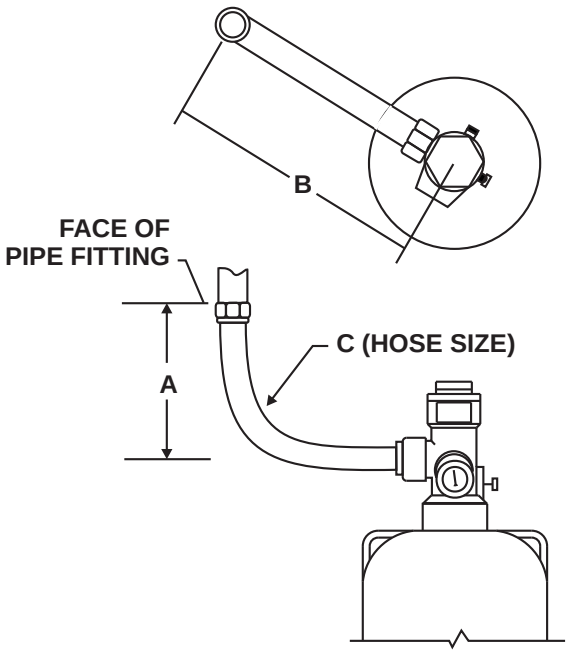


Figure 4-4. Installation of the Flexible Hose Directly into System Piping

Table 4-1. Installation of the Flexible Hose Directly into System Piping, Inches

Cylinder Capacity	Dimensions in Inches		
	A	B	C*
10 lb.	14 5/8	16 3/4	1 1/2
20 lb.	14 5/8	16 3/4	1 1/2
40 lb.	14 5/8	16 3/4	1 1/2
70 lb.	14 5/8	16 3/4	1 1/2
125 lb.	14 5/8	16 3/4	1 1/2
200 lb.	19	21 3/4	2
350 lb.	19	21 3/4	2
600 lb.	33	36	3
900 lb.	33	36	3
Note: Dimensions A and B must be maintained in order to obtain a smooth radius in flexible loop. *Hose may require an adapter to connect to system piping.			

Table 4-2. Installation of the Flexible Hose Directly into System Piping, Millimeters

Cylinder Capacity	Dimensions in Millimeters		
	A	B	C
10 lb.	371	425	38
20 lb.	371	425	38
40 lb.	371	425	38
70 lb.	371	425	38
125 lb.	371	425	38
200 lb.	483	552	51
350 lb.	483	552	51
600 lb.	838	914	76
900 lb.	838	914	76
Note: Dimensions A and B must be maintained in order to obtain a smooth radius in flexible loop. *Hose may require an adapter to connect to system piping.			

4-2.10 Installation of Master Cylinder Adapter Kit, P/N 82-844895-000

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

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

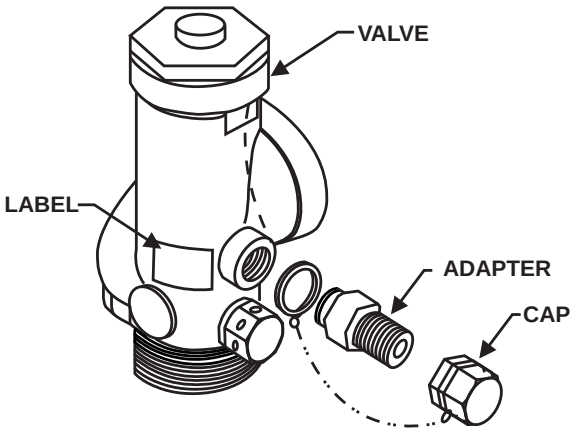


Figure 4-5. Installation of Master Cylinder Adapter Kit

4-2.11 Installation of Kidde Engineered System Cylinder/Valve Assemblies

The Kidde Engineered System cylinders should be located as close as possible to the protected hazard area. The assemblies should be located in a place which is readily accessible for manual actuation and inspection, service and maintenance. The cylinders shall be located in an environment protected from the weather, and where the ambient temperature does not exceed 130°F (54°C) or fall below 32°F (0°C). External heating or cooling may be required to maintain this temperature range. The following installation instructions must be followed in the exact sequence outlined below to prevent accidental discharge, bodily injury and property damage. Cylinders should be raised at least 2 in. (50 mm) from the deck using a suitable bracket or blocks if the area is regularly washed down or is subject to environmental wetting.

4-2.11.1 SINGLE CYLINDER SYSTEMS

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

1. Position the Kidde Engineered System cylinder in designated position, and secure in place with the cylinder mounting straps and associated hardware. For cylinders of 125 lb. capacity and above, a cradle is used to support between the cylinder and the unistrut or bulkhead. See Figure 4-6 and Tables 4-3 and 4-4 for the relevant installation dimensions. Ensure the valve outlet is correctly orientated for connection to the system pipework.

   Note: The valve pressure indicator and/or liquid level indicator should be accessible for service and inspection.

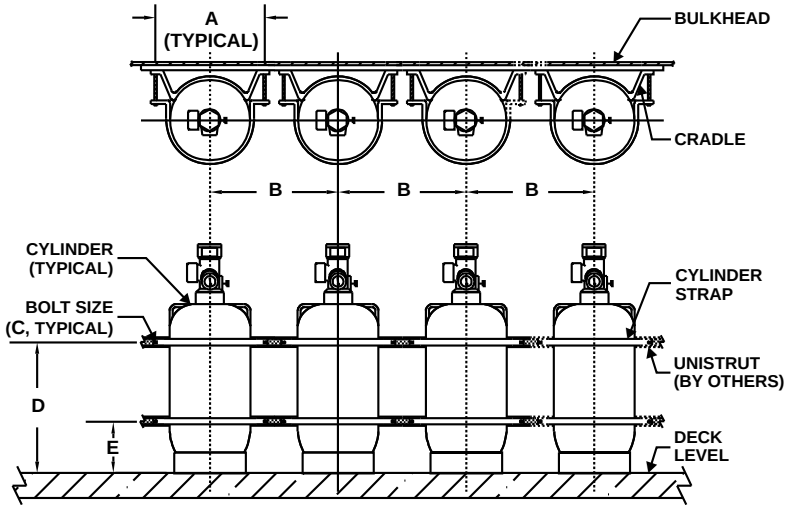


Figure 4-6. Typical Cylinder Installation, Vertical Mounting

Table 4-3. Single Cylinder Installation Dimensions, Inches

Cylinder Size	Strap Part Number	Cradle Part Number	A	B	C	D	E
10 lb.	WK-283945-000	N/A	8.8	11.0	3/8	7.4	1.4
20 lb.	WK-283945-000	N/A	8.8	11.0	3/8	12.5	1.4
40 lb.	WK-283934-000	N/A	10.8	13.0	1/2	10.4	4.1
70 lb.	WK-283934-000	WK-878760-000	10.8	13.0	1/2	21.9	8.3
125 lb.	06-235317-001	06-235431-001	15.0	18.0	3/8	20.9	8.3
200 lb.	06-292971-000	06-235431-001	15.5	18.0	3/8	29.6	12.0
350 lb.	WK-281866-000	WK-281867-000	18.0	21.0	1/2	36.0	16.0
600 lb.	WK-294651-000	WK-294652-000	24.0	27.0	1/2	36.0	16.0
900 lb.	06-236125-001	06-118300-001	26.0	29.5	1/2	48.0	16.0

Table 4-4. Single Cylinder Installation Dimensions, Millimeters

Cylinder Size	Strap Part Number	Cradle Part Number	A	B	C	D	E
10 lb.	WK-283945-000	N/A	224	280	10	188	36
20 lb.	WK-283945-000	N/A	224	280	10	318	36
40 lb.	WK-283934-000	N/A	274	330	12	264	104
70 lb.	WK-283934-000	WK-878760-000	274	330	12	556	211
125 lb.	06-235317-001	06-235431-001	381	457	10	531	211
200 lb.	06-292971-000	06-235431-001	394	457	10	752	305
350 lb.	WK-281866-000	WK-281867-000	457	533	12	914	406
600 lb.	WK-294651-000	WK-294652-000	610	686	12	914	406
900 lb.	06-236125-001	06-118300-001	660	750	12	1220	406

2. Remove the safety cap from the cylinder valve outlet port.
3. Connect a 1½-, 2-, or 3-inch flexible discharge hose or valve outlet adapter to the cylinder outlet port.

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

WARNING

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

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

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

WARNING

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

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

4-2.11.2 MULTIPLE CYLINDER SYSTEM

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

1. Position the Kidde Engineered System cylinders in the designated positions, and secure in place with cylinder mounting straps and associated hardware. For cylinders of 125 lb. capacity and above, a cradle is used to support between the cylinder and the unistrut or bulkhead. See Figure 4-6 and Tables 4-3 and 4-4 for the relevant installation dimensions. Orient the cylinders so that the valve outlets are angled towards the El-check valves in the manifold.

   Note: The valve pressure indicators and/or liquid level indicators should be accessible for service and inspection.

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

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

WARNING **Control heads must be in the SET position (that is, the actuating pin must be in the fully retracted or SET position) before attaching to Kidde Engineered System cylinders in order to prevent accidental discharge. Personal injury and/or property damage could occur.**

4-2.11.3 MAIN AND RESERVE SYSTEM

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

4-2.12 Installation of Pressure Operated Control Head, P/N 82-878737-000

1. Remove the protection cap from the cylinder actuation port (see Figure 4-7).

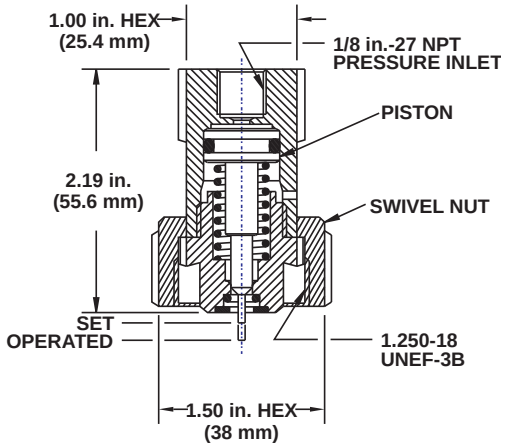


Figure 4-7. Pressure Operated Control Head

2. Install the pressure operated control head using a suitable wrench. Tighten securely. Connect the actuation line to the pressure port using the appropriate adapter.

WARNING

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

4-2.13 Installation of Lever Operated Control Head, P/N WK-870652-000

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

4-2.14 Installation of Lever/Pressure Operated Control Head, P/N 82-878851-000

1. Ensure the control head is in the SET position with the safety pull pin and seal wire intact.
2. Remove the protection cap from the cylinder valve actuation port.
3. Install the lever/pressure operated control head using a suitable wrench. Tighten securely. Connect the actuation line to the pressure port using the appropriate adapter.

WARNING

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

4-2.15 Installation of Cable Operated Control Head and Ancillaries

4-2.15.1 INSTALLATION OF CABLE OPERATED CONTROL HEAD, P/N WK-979469-000

WARNING

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

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

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

7. Insert the closure disc and replace the cover on the control head. The control head is now armed.

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

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

4-2.15.2 INSTALLATION OF DUAL-PULL MECHANISM, P/N 81-840058-000, AND DUAL-PULL EQUALIZER, P/N 81-840051-000

Install the dual-pull mechanism or equalizer on a flat surface and ensure that the cable and conduit can be routed and connected squarely to the unit. Secure using the four mounting holes with suitable fasteners. Ensure that the cables move freely into the unit and that each cable is correctly tensioned. Test the pull cable arrangement to ensure that the pull force and travel limitations referenced in Paragraph 3-2.4.2 are not exceeded.

4-2.15.3 INSTALLATION OF CORNER PULLEY, P/N 81-803808-000

Apply Teflon® tape or pipe compound to the male thread on the cable conduit. Leave the first two full threads clean. Ensure conduit connects squarely to the pulley.

4-2.16 Installation of Lever Operated Control Head, P/N WK-870652-000

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

4-2.17 Installation of Pneumatic Control and Detection

4-2.17.1 INSTALLATION OF PNEUMATIC CONTROL HEAD

The following procedures are to be performed before attaching control head to the cylinder valve (see Figure 4-8):

1. Remove pilot outlet protection cap from valve of cylinder to be equipped with control head.
2. Be sure the control head is in the "SET" position.
3. The arrow on the reset stem should line up with the "SET" arrow on the nameplate.
4. Connect the heat detector tubing securely to the diaphragm chamber of the control head.
5. If a tandem pneumatic control head is required, both control heads must be connected using 3/16 in. tubing (P/N WK-802366-000). See Figure 4-9.

   Note: If a mechanical pull box is supplied, proceed with Steps 6 through 8.

6. Connect the control cable conduit to the control head. Remove the control head nameplate, exposing the manual release chamber.
7. Loosen the screws on the cable clamp, and feed the cable through the hole. Tighten the set screws securely, allowing the cable to have approximately 3/16 in. free play. Do not pull the cable taut. Cut off any excess cable.

8. Make certain that the locking pin and seal wire have been assembled to the nameplate. The local control lever should be parallel with the nameplate. Assemble the nameplate to the control head, being sure to fit the small shaft into the cover bearing and the large pin under the trip lever.

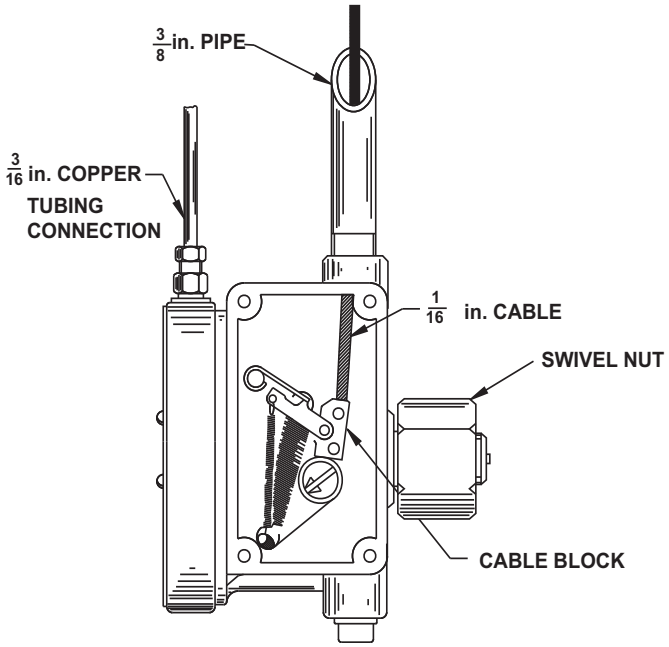


Figure 4-8. Single Pneumatic Control Head

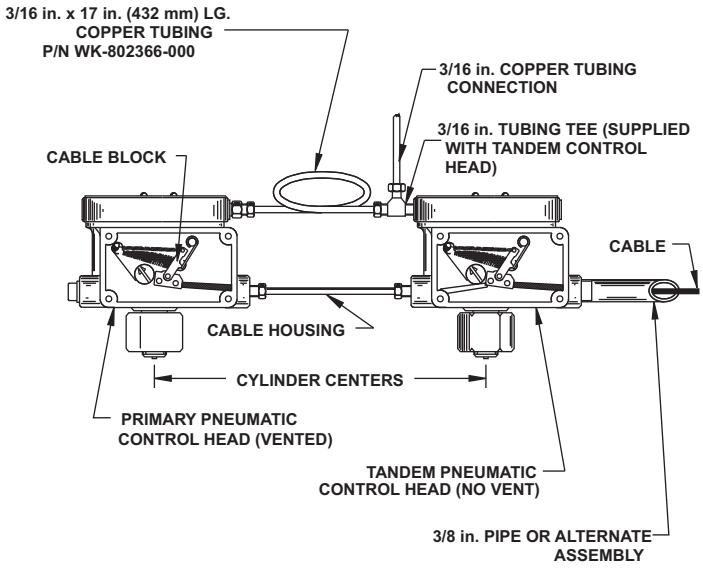


Figure 4-9. Tandem Pneumatic Control Head

WARNING

Before installing the control head on the carbon dioxide cylinder valve, ensure that the control head is in the "SET" position (the actuating pin is in the fully retracted, or "SET" position). Failure to position the control head to the "SET" position will result in accidental cylinder discharge when the control head is installed on the cylinder valve.

9. Assemble the control head to the pilot control port. Tighten the swivel coupling nut securely.

4-2.17.2 INSTALLATION OF PNEUMATIC DETECTOR

4-2.17.2.1 Positioning Heat Actuated Detector (HAD) Units

HADs are to be installed in the anticipated path of convective heat flow that would accompany fire within the protected space. Do not install detectors on the underside of beams or other projections and consider the use of a heat-collecting baffle.

The maximum center to center spacing shall not exceed 25 ft. (7.6 m) or an area of coverage of 625 sq. ft. (58 sq. m). No more than four detectors can be used in a single actuation system.

Note: Consult Kidde for applications where enclosure heights exceed 15 ft., 10 in.

4-2.17.2.2 Installing HAD and Control Head Tubing

The sensitivity and resulting response time of a pneumatic detection and control system is dependent on a number of factors, the primary factors are:

- Fire Intensity and growth profile.
- HAD spacing and location.
- Control head pressure setting and vent size.
- Volume of capillary connective tubing.

The system will actuate when the entire sensing volume (HADs, copper tubing and the diaphragm chamber) is pressurized to a level equal to the control head pressure setting (e.g., 3 in. of water). To ensure a rapid response, the overall tubing length must not exceed 100 ft. (61 m). The connection between the main pneumatic tubing material and the system devices is made using the Kidde supplied 3/16 in. tube lengths and fittings.

4-2.18 Installation of Manual Pull Station, P/N 81-871403-000

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

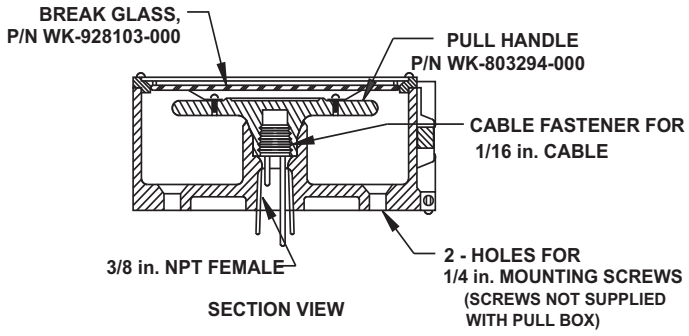


Figure 4-10. Pull Box, Break Glass

4-2.18.1 INSTALLATION OF PULL STATION, P/N 81-871403-000

Where clearance behind the manual pull station does not allow the cable/conduit and corner pulley to be installed the behind the mounting surface a "Z" bracket, P/N WK-605320-000, can be used. This bracket allows the unit to be installed 4.5 in. (114 mm) from the mounting surface.

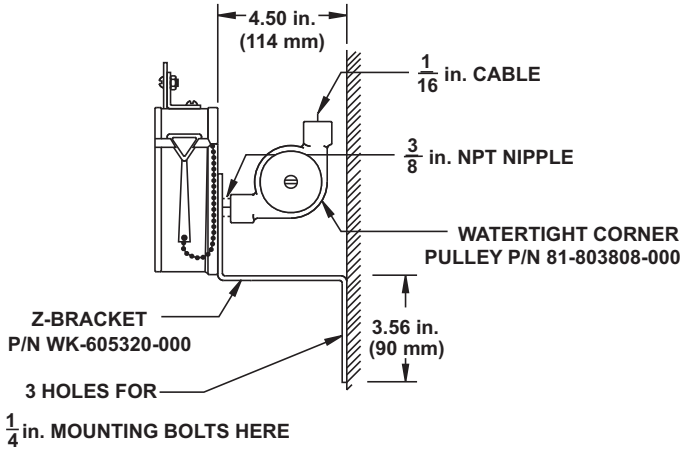


Figure 4-11. Pull Box, Break Glass used with Z-Bracket

4-2.18.2 INSTALLATION OF WATERTIGHT PULL BOX, P/N 81-870087-000

Mount the watertight pull box against a flat section of bulkhead using a suitable gasket. Ensure that all six 5/16 in. mounting holes are utilized. Allow adequate clearance around the unit, particularly below the unit where the cover must be able to fully clear the unit to allow access to the break glass. Install the unit with the cover instruction horizontal.

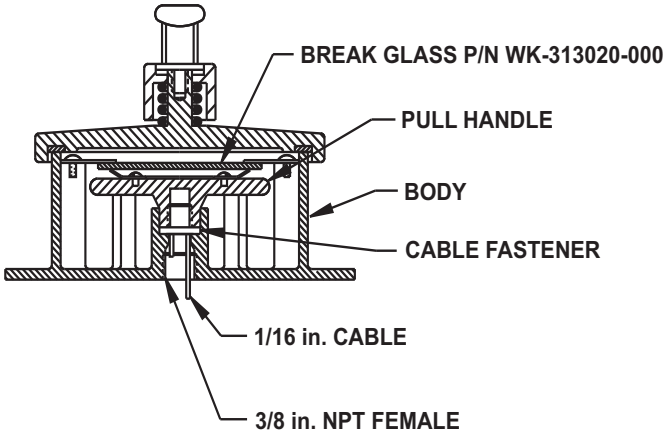
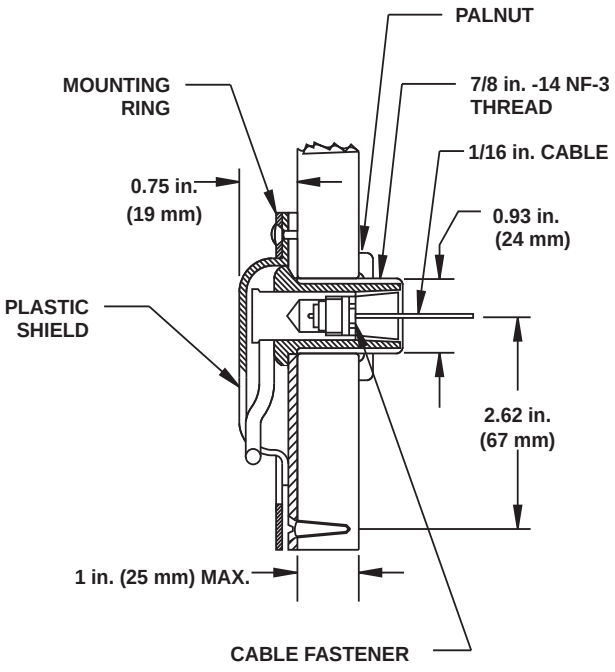


Figure 4-12. Watertight Pull Box

4-2.18.3 INSTALLATION OF FLUSH PULL BOX, P/N 81-840098-000

The flush pull box, yacht type, should only be installed on surfaces where the material thickness is 1 in. (25 mm) or less. This is so that the male 7/8 in.-14 NF-3 thread of the cable entry has sufficient engagement for the connection of the cable conduit fittings. All three mounting holes must be used to install the unit. The unit is supplied with two sets of fixing screws.



Mounting Hardware Provided:
3– 10-32 Flat Head Screws (½ in. [13 mm] long)
3– No. 10 Flat Head Wood Screws (3/4 in. [19 mm] long)

Figure 4-13. Flush Pull Box, Yacht Type

4-2.19 Nitrogen Pilot Cylinder Installation, 108 cu. in., P/N WK-877940-000

4-2.19.1 INSTALLATION OF NITROGEN CYLINDER, P/N WK-877940-000, AND MOUNTING BRACKET, P/N WK-877845-000

1. Locate the nitrogen cylinder mounting bracket in an area where the cylinder valve assembly and control head will be protected from inclement weather by a suitable total or partial enclosure, preferably adjacent to the Kidde Engineered System storage cylinders.
2. Install the mounting bracket clamps and hardware. Install the nitrogen cylinder in position in a mounting bracket; tighten sufficiently to hold the cylinder in place while allowing the cylinder enough free play to be rotated.
3. Turn the cylinder until the cylinder valve discharge outlet is in the desired position. The nitrogen cylinder must be positioned so that control head is readily accessible during manual operation.
4. Securely tighten the mounting bracket clamps and hardware.
5. If the cylinder is being used to drive a pressure operated siren, P/N 90-981574-001, then the add-on label P/N 06-231866-518 (supplied with the cylinder) should be affixed over the area at the center of the cylinder main label (bounded by a dotted line). This ensures the cylinder function is adequately indicated.

4-2.19.2 INSTALLATION OF 1/4 IN. BALL VALVE, P/N WK-283888-000, AND PILOT LINES

1. Mount the 1/4 in. ball valve on to the bulkhead using the integral mounting points.
2. Ensure the valve is in the closed position. Install the seal wire.
3. Install the upstream 1/4 in. pipe section with 1/4 in. coupling from the ball valve and secure it to the bulkhead.
4. Attach the nitrogen cylinder outlet adapter, P/N WK-699205-010.
5. Connect a flexible actuation hose, P/N WK-264986-000 or WK-264987-000 from the 1/4 in. coupling to the outlet of the nitrogen pilot cylinder.
6. Remove the protective cap from the cylinder valve actuation port.

WARNING

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

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

4-2.20 Nitrogen Pilot Cylinder Installation, 1040 cu. in. and 2300 cu. in., P/Ns 90-101040-000 and 90-102300-100 Respectively

WARNING

Nitrogen cylinders must not be moved unless the discharge and control heads have been removed and the protection caps are installed. Failure to follow these instructions could result in inadvertent discharge, serious bodily injury, death or property damage.

The nitrogen pilot cylinders must be located as close to the hazard area as possible. The storage location must be protected from the elements and maintained at a temperature between 32°F (0°C) and 130°F (54°C). External heating and/or cooling may be required to maintain this temperature range. Cylinders should be raised at least 2 in. (50 mm) from the deck using a suitable bracket or blocks if the area is regularly washed down or is subject to environmental wetting.

Single cylinders should be installed using two straps, P/N WK-270014-000, installed at the heights shown in Figure 4-14. See Table 4-5 for strap dimensions. Where two cylinders are installed, two double straps, P/N WK-241219-000 can be used. Install at the same heights defined for single cylinder straps.

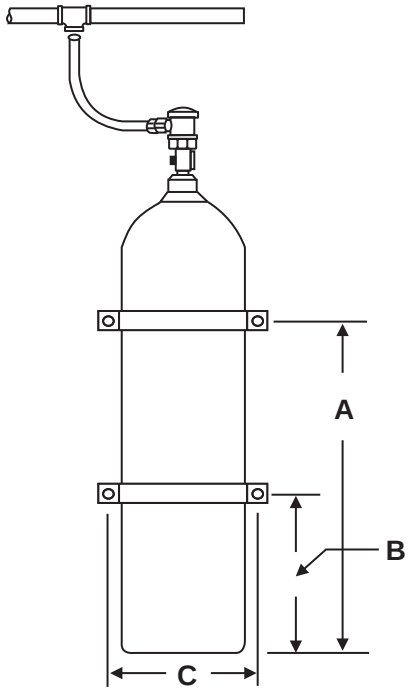


Figure 4-14. Typical 1040 and 2300 cu. in. Pilot (Driver) Cylinder Strap Installation (P/N 90-101040-000 and 90-102300-100)

Table 4-5. 1040 and 2300 cu. in. Nitrogen Pilot (Driver) Cylinder Strap Installation

Part Number	Description	A		B		C	
		in.	mm	in.	mm	in.	mm
90-101040-000	1040 cu. in.	21 to 22	533 to 559	6 to 8	152 to 203	10.4	263
90-102300-100	2300 cu. in.	42 to 44	1067 to 1118	12 to 14	305 to 356	10.4	263

Before connecting cylinders into the discharge pipework, tighten straps until there is clearance enough to allow the cylinders to be rotated in place if required. Tighten fully when all components are correctly positioned.

1040 cu. in. cylinders being installed as a pilot cylinder (in a single stage system), or as first stage pilots, do not require add-on label(s) to be affixed. However, 1040 cu. in. cylinders being installed as second-stage pilot cylinders, or as siren drivers, should have the add-on label P/N 06-231866-519 (second-stage) or P/N 06-231866-518 (siren driver) affixed to the area at the center of the cylinder label (rectangle with the dotted line) to indicate the function of the unit.

Note: Both labels are supplied with the unit.

The 2300 cu. in. cylinder is only used as a siren driver, and therefore requires no additional labeling.

4-2.20.1 INSTALLATION OF FLEXIBLE DISCHARGE HOSE, P/N 06-118207-00X

Connect the discharge hose to the piping or manifold as shown on the system drawings. Apply Teflon tape or pipe jointing compound to the male threads. Ensure that the manifold or system piping is at the correct height and the cylinder is correctly positioned such that the hose, when installed, will not be kinked or flattened when installed.

WARNING

Discharge 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 an inadvertent discharge.

4-2.20.2 INSTALLATION OF DISCHARGE HEAD, P/N WK-872450-000 AND P/N 81-872442-000

Attach the discharge head to the flexible discharge hose. The hose must be already attached to the system piping. Do not connect discharge head(s) to the cylinder valve(s) until all flex hoses and discharge heads are installed on a common manifold. Install the discharge head to the cylinder valve as follows:

1. Remove protective cap from the cylinder valve and ensure that the sealing surfaces are clean.
2. Verify that the discharge head o-rings are correctly seated in their grooves in the swivel nut. O-rings must be free of dirt and other contaminants. The o-rings are lightly lubricated at the factory and should not require further lubrication.
3. Ensure that the pilot orifice, located between the inner and outer o-ring seals, is unobstructed,
4. Install the discharge head on the cylinder valve and tighten securely.

WARNING

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

4-2.20.3 INSTALLATION OF TIME DELAY, P/N 81-871072-001, 81-871072-002, 81-871072-003 AND 81-871072-004

The discharge time delay must be installed in either the pilot line or the discharge manifold, as shown on the system drawings. The time delay must be securely mounted to a structural member by securing the attached pipework (use channel mount pipe clamp or equivalent with a load rating equal to or greater than 400 lb.) and by using bracket P/N WK-877845-000. Make certain the inlet and outlet ports are properly oriented and the arrow is in the direction of flow. Both ports have 3/4 in. NPT fittings for connection to the pipe. A lever or cable operated control head must be installed on each time delay. Operation of the control head will override the timing cycle. Make certain the control heads are installed in their “SET” or non-operated position.

Note: The time delay units are factory set to give the nominal rating minus zero, plus 20% per NFPA 2001: 2000 Edition and UL-2166. The nominal ratings are indicated in Table 4-18. Due to the wide operating temperature range of the units, the delay at 70°F is greater than the nominal value. The actual delay achieved in service is dependant on the ambient conditions.

Table 4-6. Nitrogen Discharge Delay Rating

Part Number	Cylinder	Nominal Rating (seconds)	Nominal Delay @ 70°F (seconds)
90-871072-001	108 cu. in.	34 sec.	37
90-871072-002	108 cu. in.	61 sec.	68
90-871072-003	1040 cu. in.	35 sec.	40
90-871072-004	1040 cu. in.	68 sec.	74

4-2.20.4 INSTALLATION OF PRESSURE OPERATED SIREN, P/N 81-981574-001

The siren should be installed within the protected space connected to the siren driver using the pipe specified in Table 3-9. Install a dirt trap and union as per Figure 4-15.

Each siren consumes approximately 0.5 to 0.9 lb. (0.23 to 0.5 kg) of nitrogen per minute at 70°F (21°C)

Refer to Paragraph 3-2.5.2.4 for siren driver limitations.

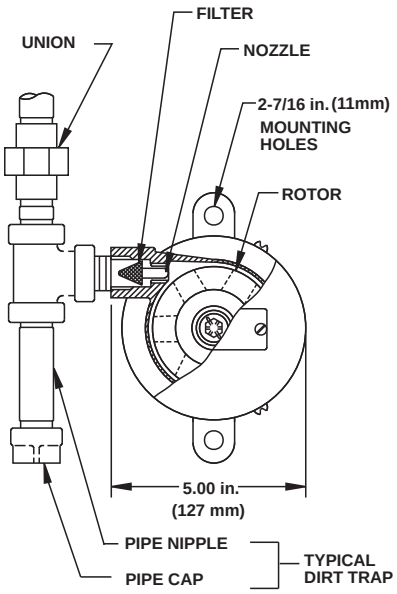


Figure 4-15. Pressure Operated Siren

4-2.21 Installation of Discharge Pressure Switches, P/N 81-486536-000 and P/N 81-981332-000

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

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

4-2.22 Installation of Pressure Trip, P/N 81-874290-000

Install the pressure trip on the discharge manifold or piping in the horizontal position as shown on the system drawings. Connect the trip to the piping with 1/2 in. Schedule 40 pipe. The minimum operating pressure required is 75 PSIG (5 bar gauge). The maximum allowable load to be attached to the retaining ring is 100 lb. (45.4 kg).

4-2.23 Installation of Discharge Indicator, P/N 81-967082-000

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

4-2.24 Installation of Supervisory Pressure Switches, P/Ns 06-118262-001 and 06-118263-001

Installation of the supervisory pressure switch can be accomplished safely on a pressurized cylinder (see Figure 4-16).

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

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

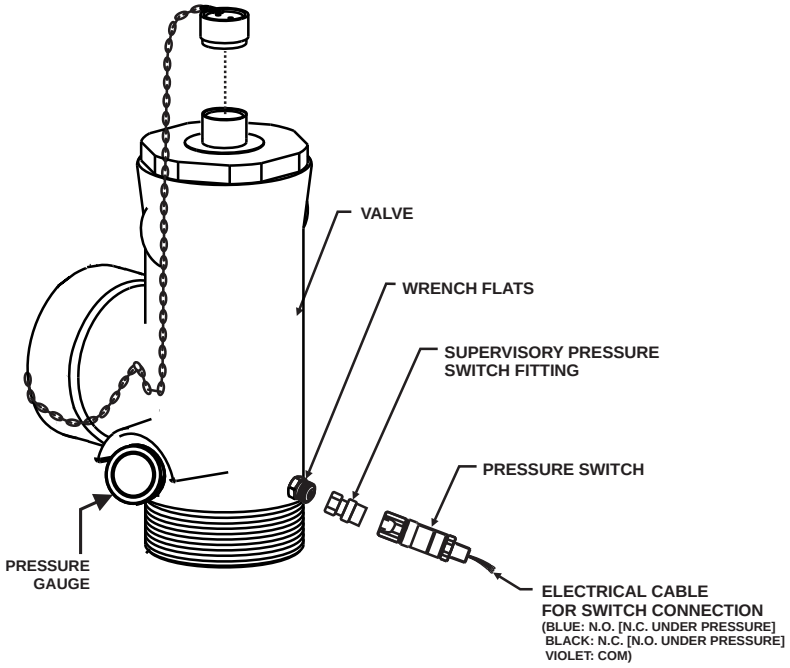


Figure 4-16. Installation of Supervisory Pressure Switch (Up to 2 in. Valve)

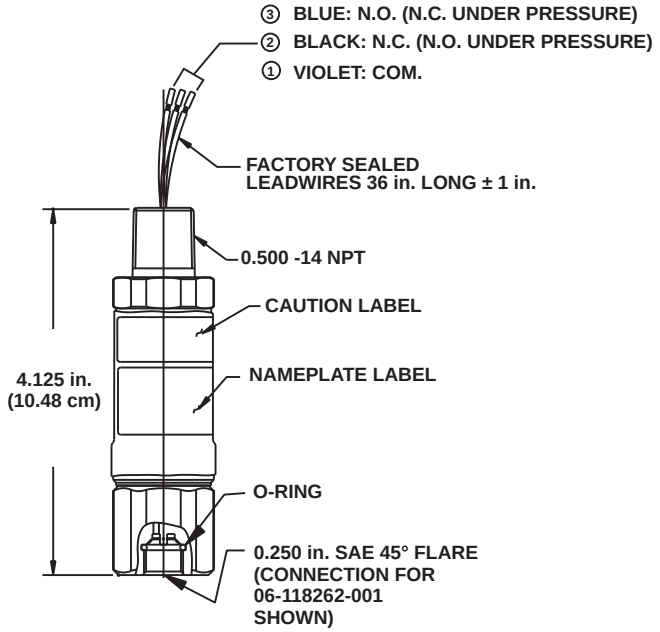
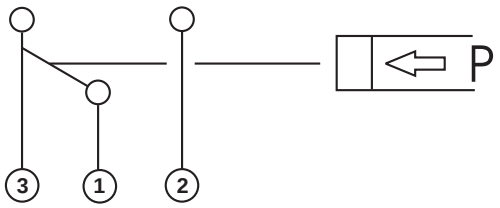


Figure 4-17. Supervisory Pressure Switch Electrical Connections



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

Figure 4-18. Supervisory Pressure Switch Connection Diagram and Electrical Rating

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

4-2.24.1 INSTALLATION OF PRESSURE SWITCH, P/N 06-118262-001

Install the pressure switch as follows:

Note: Do not use with 3 in. valves.

1. Check that the sealing surface of the flare connection of the supervisory switch is not scratched, dented, scored, etc.
2. Remove the end cap from the pressure switch port of the valve. This is a flare fitting and does not require tape dope or any type of sealant.
3. Install the pressure switch onto the pressure port of the valve. Be sure to secure the pressure port with a wrench so that you are not turning the port fitting further into the valve. Tighten the switch hand-tight and then tighten 1/4-turn further using a wrench.
4. **Important:** Leak test the pressure switch connection with a Kidde Engineered System leak detector or a bubbling solution. If the connection leaks, the switch may be tightened further until the leak is eliminated, again, be sure to have a counter wrench on the switch port.

4-2.24.2 INSTALLATION OF PRESSURE SWITCH, P/N 06-118263-001

Install the pressure switch as follows:

Note: For 3 in. valves only.

1. Hold the pressure switch fitting on the valve with a wrench and remove the 1/8 in. plug with a second wrench. Ensure that the fitting does not rotate in the valve body. The fitting contains a check valve that will prevent the escape of the cylinder contents.
2. Before fitting the switch, apply Permacel® No. 412D Teflon® tape to the male threads of the pressure switch.
3. Install the pressure switch into the port of the valve. Be sure to secure the pressure port fitting with a wrench. Tighten the switch hand-tight and then tighten 1¼-turns further using a wrench.
4. **Important:** Leak test the pressure switch connection with a Kidde Engineered System leak detector or a bubbling solution. If the connection leaks, the switch may be tightened further a 1/4 in. turn at a time until the leak is eliminated, again, be sure to have a counter wrench on the switch port. Do not exceed two turns from hand-tight. Refer to ANSI B1.20.3 for NPT thread engagement details.

4-2.25 Installation of Safety Outlets, P/N 81-803242-000 and P/N 82-844346-000

The safety outlet must be installed upstream of any closed section of piping (i.e., between the cylinder(s) and a stop valve). The connection is made using a 3/4 in. NPT fitting. Attach the unit and tighten using a wrench.

CAUTION

Do not hold the wrench on the safety disc-retaining nut during installation or removal. Use the main body hex. Apply Teflon® tape or jointing compound to the male thread.

4-2.26 Post-Installation Checkout

After a Kidde Engineered System installation has been completed, perform the following inspections and tests.

1. Verify that the cylinders of correct weight and pressure are installed in accordance with installation drawings.
2. Verify that the cylinder brackets and straps are properly installed and all fittings are tight.
3. The piping distribution system must be inspected for compliance with the system drawings, NFPA 2001, design limitations within this manual and the computerized hydraulic calculations associated with each independent piping and nozzle configuration.
4. Check that the discharge manifold, discharge piping and actuation piping are securely hung. Ensure all fittings are tight and securely fastened to prevent agent leakage and hazardous movement during discharge. The means of pipe size reduction and installation position of the tees must be checked for conformance to the design requirements.
5. The piping distribution system must be cleaned, blown free of foreign material and inspected internally to ensure that oil or particulate matter will not soil the hazard area or reduce the nozzle orifice area and affect agent distribution.
6. System piping should be pressure tested in accordance with the requirements of NFPA 2001 and USCG rules (see Paragraph 4-2.3).
7. Ensure that the check valves are installed in the proper location as indicated on the installation drawings and that the equipment is installed with the arrow pointing in the direction of flow.
8. Verify the nozzles are installed in the correct locations and have the correct part numbers and orifice sizes as indicated on installation drawings. Discharge nozzles must be oriented such that optimum agent dispersal can be achieved. Check the nozzle orifices for any obstructions.
9. The discharge nozzles, piping and mounting brackets must be installed such that they will not cause injury to personnel. The agent must not be discharged at head height or below where people in a normal work area could be injured by the discharge. The agent must not directly impinge on any loose objects or shelves, cabinet tops or similar surfaces where loose objects could be propelled by the discharge.

10. For systems with a main/reserve capability, the MAIN/RESERVE controls must be clearly identified and properly installed where it is readily accessible.
11. Manual pull stations must also be clearly identified and properly installed where they are readily accessible. All manual stations that activate Kidde Engineered Systems should be properly identified as to their purpose. Particular care should be taken where manual pull stations for more than one system are in close proximity and could be confused and the wrong system actuated. In this case, manual stations should be clearly identified as to which hazard area they affect.
12. Perform the pressure switch test outlined in Paragraph 6-4.3.1 for all pressure switches installed.

    Note: All acceptance testing shall be in accordance with NFPA 2001 current edition.

CHAPTER 5
OPERATION

5-1 INTRODUCTION

This chapter describes the basic operating principle and procedures for the Kidde Engineered Fire Suppression System designed for use with 3M™ Novec™ 1230 Fire Protection Fluid.

5-2 SYSTEM CONTROLS AND INDICATORS

5-2.1 General

Novec 1230 fluid (agent), super-pressurized with nitrogen, is stored in welded steel cylinders fitted with fast-acting discharge valves. To initiate a discharge, the valve is opened directly or indirectly by the control system, which vents the top chamber of the valve allowing the valve piston to be displaced. The agent then flows into the discharge pipes as a liquid to the nozzles in the system. The agent rapidly vaporizes at the nozzles, and is dispersed to create a homogeneous mixture of agent and enclosure air. The nozzles provide the proper flow rate and distribution of Novec 1230 fluid. The concentration of the final form of agent is at least equal to the minimum design concentration, and this concentration is maintained in the enclosure for the required hold-time to prevent re-ignition.

5-3 OPERATING PROCEDURES

5-3.1 Remote Manual Operation

Operate as follows:

1. Evacuate the hazard area as quickly and safely as possible.
2. Ensure all personnel have exited the hazard area.
3. Ensure hazard integrity; close all hatches, vents, ducts and other openings into protected space.
4. Proceed to the appropriate remote release station.
5. Operate the release controls.
6. Confirm that the system has been operated.
7. Prevent personnel from re-entering the hazard area.

Note: The above operating instructions must be posted on display in the protected area. These instructions should also indicate the cylinder storage location in the event that the system must be locally operated during an emergency condition.

5-3.2 Local Manual Operation

Operate as follows:

1. Evacuate the hazard area as quickly and safely as possible.
2. Ensure all personnel have exited the hazard area.
3. Ensure hazard integrity; close all hatches, vents, ducts and other openings into protected space.
4. Proceed to the appropriate local release station.
5. Operate the release controls.
6. Confirm that the system has been operated.
7. Prevent personnel from re-entering the hazard area.

Note: The above operating instructions must be posted at the local release station.

5-3.3 Automatic Operation

Note: Where permitted (see Paragraph 3-2.6).

When the system is operated automatically, personnel must immediately evacuate the hazard area upon hearing the pre-discharge alarm. Prevent personnel form re-entering the hazard area.

5-4 POST-FIRE OPERATION

WARNING

Do not enter a hazard area with an open flame or lighted cigarette. The possible presence of flammable vapors may cause re-ignition or explosion.

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

After an Kidde Engineered System discharge, one must observe all warnings before entering the hazard area. Integrity must be maintained to prevent the migration of products of decomposition to adjacent areas outside of the protected space. After extinguishment, a minimum agent hold time of fifteen minutes must be maintained. When ventilating the protected space of products of combustion, care should be taken to allow smoke, decomposition products, etc., to clear the vessel, away from personnel, muster stations, embarkation areas, etc. Upon arriving in port, qualified fire suppression system maintenance personnel must perform post-fire maintenance, as described in Chapter 6 of this manual.

5-5 CYLINDER RECHARGE

1. Recharge all Kidde Engineered System and nitrogen pilot cylinders immediately after use.
2. Return all cylinders to Kidde distributor or qualified refill agency.
3. Refill in accordance with procedures outlined in Paragraph 7-3 of this manual.

5-6 SPECIAL SYSTEM PRECAUTIONS

5-6.1 Resetting Non-Pressure Operated Control Heads

All control heads must be reset prior to reinstallation on Kidde Engineered System cylinder valves.

5-6.2 Resetting Pressure Operated Control Heads

Pressure operated and lever/pressure operated control heads reset themselves only after actuation pressure (either from a pilot cylinder or master Kidde Engineered System cylinder) is released.

5-6.2.1 PRESSURE OPERATED CONTROL HEADS ACTUATED BY PRESSURE FROM A MASTER KIDDE ENGINEERED SYSTEM CYLINDER

Pressure and lever/pressure operated control heads actuated by pressure from a master Kidde Engineered System cylinder will automatically reset following system actuation. The master/slave arrangement permits Kidde Engineered System pressure to back-bleed into the discharge manifold to release the pressure. As a precaution before reattaching the pressure operated control head(s) to the Kidde Engineered System cylinder control port, ensure that the actuating pin(s) is/are in the retracted (SET) position.

5-6.2.2 PRESSURE OPERATED CONTROL HEADS NOT ACTUATED BY PRESSURE FROM A MASTER KIDDE ENGINEERED SYSTEM CYLINDER

Pressure and lever/pressure operated control heads NOT actuated by pressure from a master Kidde Engineered System cylinder will not automatically reset themselves. In these arrangements, pilot pressure can remain in the pilot manifold upon system actuation, which keeps the control head actuating pin(s) in the "OPERATED" position. Therefore, before re-attaching pressure operated control heads to the recharged Kidde Engineered System cylinders, the following procedure must be performed to ensure that the pilot manifold is vented, and the control heads have returned to the "SET" position.

1. Vent any remaining pressure from the pilot line and remove the master control head from the Nitrogen pilot cylinder(s). Reset the master control head and remove the pressure operated control head(s) from the slave cylinder(s).
2. Recharge and reinstall nitrogen pilot cylinders to the correct charged pressure and reinstall master control head.
3. Before installing pressure operated control heads on the Kidde Engineered System cylinders, ensure that the actuator pin is in the retracted ("SET") position.
4. Follow all other procedures and cautions as detailed in Chapter 7 of this manual.

5-6.2.3 SYSTEMS ACTUATED WITH PILOT NITROGEN CYLINDER(S)

In systems where a pilot nitrogen cylinder actuates a pressure operated control head on a slave Kidde Engineered System cylinder, nitrogen pressure can remain in the pilot manifold when the system actuates. Therefore, before reattaching a pressure operated control head to a recharged Kidde Engineered System cylinder, the following procedure must be performed to ensure that the pilot manifold is vented and the pressure operated control heads have returned to the SET position.

1. Vent any remaining pressure from the pilot line and remove the master control head from the nitrogen pilot cylinder(s). Reset the master control head and remove the pressure operated control head(s) from the slave cylinder(s).
2. Recharge and reinstall the nitrogen pilot cylinders to the correct charged pressure and reinstall the master control head.
3. Before installing a pressure operated control head on an Kidde Engineered System cylinder, ensure that the actuator pin is in the retracted (SET) position.
4. Follow all other procedures and cautions as detailed in Chapter 7 of this manual.

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CHAPTER 6
MAINTENANCE

6-1 INTRODUCTION

This chapter contains maintenance instructions for the Kidde Engineered Fire Suppression System designed for use with 3M™ Novec™ 1230 Fire Protection Fluid. These procedures must be performed regularly in accordance with regulations. If problems arise, corrective action must be taken.

6-2 MAINTENANCE PROCEDURES

WARNING

Kidde Engineered System and nitrogen cylinder valve assemblies must be handled, installed, inspected and serviced only by qualified and trained personnel in accordance with the instructions contained in this manual and Compressed Gas Association (CGA) pamphlets C-1, C-6 and P-1. CGA pamphlets my be obtained from Compressed Gas Association, Crystal Square Two, 1725 Jefferson Davis Highway, Arlington, VA 22202-4102.

6-2.1 General

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

1. Inspection interval.
2. The inspection procedure performed.
3. Maintenance performed, if any, as a result of inspection.
4. The name of inspector performing the task.

If the inspection indicates areas of rust or corrosion, immediately clean and repaint the area. Perform cylinder hydrostatic pressure testing in accordance with Paragraph 6-5 of this manual.

6-3 PREVENTIVE MAINTENANCE

Perform preventive maintenance per Table 6-1.

Table 6-1. Preventive Maintenance Schedule

Schedule	Requirement	Paragraph
Daily	Check Kidde Engineered System cylinder pressure	6-4.1.1
	Check nitrogen pressure	6-4.1.2
Monthly	Inspect hazard area system components	6-4.2
	Check Kidde Engineered System cylinder weights and pressures	
Semi-Annually	Test pressure switches	6-4.3
Every 2 Years	Blow out distribution piping	6-4.4
Every 5 Years	Kidde Engineered System and nitrogen cylinder hydrostatic pressure test and inspection	6-5
	Flexible hose hydrostatic pressure test and inspection	
Every 12 Years	Nitrogen cylinder hydrostatic pressure test	7-4.1 and 7-5.1

6-4 INSPECTION PROCEDURES

6-4.1 Daily

6-4.1.1 CHECK KIDDE ENGINEERED SYSTEM CYLINDER PRESSURE

Check the Kidde Engineered System cylinder pressure gauges for proper operating pressure (refer to Table 2-3). If the pressure gauge indicates a pressure loss (adjusted for temperature) of more than 10%, or loss in agent quantity shown on cylinder valve of more than 5%, it shall be refilled. Remove and recharge the cylinder as instructed in Paragraph 7-3.

6-4.1.2 CHECK NITROGEN CYLINDER PRESSURE

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

6-4.2 Monthly

6-4.2.1 GENERAL INSPECTION

Make a general inspection survey of all cylinders and equipment for damaged or missing parts. If the equipment requires replacement, refer to Paragraph 6-6.3. Inspect all system component plates. If any show signs of damage or deterioration, replace immediately.

6-4.2.2 HAZARD ACCESS

Ensure access to hazard areas, manual pull stations, discharge nozzles and cylinders are unobstructed, and that nothing obstructs the operation of the equipment or distribution of Novec 1230 fluid.

6-4.2.3 INSPECT HOSES

Inspect 1/4-inch flexible actuation hoses for loose fittings, damaged threads, cracks, distortion, cuts, dirt and frayed wire-braid. Tighten loose fittings and replace hoses with stripped threads or other damage. If necessary, clean parts as directed in Paragraph 6-6.1. Inspect the adapters, couplings and tees at the Kidde Engineered System cylinder pilot outlets and tighten couplings if necessary. Replace any damaged parts.

6-4.2.4 INSPECT CONTROL HEADS

Inspect Kidde Engineered System cylinder operated control heads for physical damage, deterioration, corrosion, distortion, cracks, dirt and loose couplings. Tighten loose couplings. Replace damaged caps. Replace the control head if damaged. If necessary, clean as directed in Paragraph 6-6.1.

6-4.2.5 INSPECT PNEUMATIC DETECTION TUBING

Inspect pneumatic detection tubing and fittings for cracks, dents, distortion or corrosion. Tighten loose fittings and replace damaged sections of pipe/tubing or fittings.

6-4.2.6 INSPECT CYLINDER AND VALVE ASSEMBLY

Inspect the Kidde Engineered System cylinder and valve assembly for leakage and physical damage such as cracks, dents, distortion and worn parts. Check the safety disc and pressure gauges for damage. Replace damaged gauges or safety disc per Paragraphs 7-2.6 and 7-2.7. If the gauge pressure is not normal (360 PSIG at 70°F [25 bar gauge at 21°C]), remove and recharge the cylinder as instructed in Paragraphs 5-5 and 6-3. If damaged parts are found on the Kidde Engineered System cylinder or cylinder valve, replace the Kidde Engineered System cylinder. If necessary, clean the cylinder and associated parts as directed in Paragraph 6-6.1.

6-4.2.7 INSPECT BRACKETS, STRAPS, CRADLES AND MOUNTING HARDWARE

Inspect the Kidde Engineered System cylinder brackets, straps, cradles and mounting hardware for loose, damaged or broken parts. Check the cylinder brackets, straps and associated parts for corrosion, oil, grease and grime. Tighten any loose hardware. Replace damaged parts. If necessary, clean as directed in Paragraph 6-6.1.

6-4.2.8 INSPECT DISCHARGE HOSES

Inspect he flexible discharge hoses for loose fittings, damaged threads, cracks, rust, kinks, distortion, dirt and frayed wire-braid. Tighten loose fittings and replace hoses with stripped threads. If necessary, clean as directed in Paragraph 6-6.1.

6-4.2.9 INSPECT ACTUATION LINE

Inspect the nitrogen actuation line (if used) and support brackets for continuity, physical damage, loose fittings, distortion, cracks or cuts. Tighten loose fittings. Replace damaged parts. If necessary, clean as directed in Paragraph 6-6.1.

6-4.2.10 INSPECT DISCHARGE NOZZLES

Inspect discharge nozzles for dirt and physical damage. Replace damaged nozzles. If nozzles are dirty or clogged, refer to Paragraph 6-6.1.

Nozzles must never be painted. Paint can obstruct the holes on the nozzle, thereby causing system malfunction.

CAUTION

Nozzles must be replaced by nozzles of the same part number. (A part number is located on each nozzle.) Nozzles must never be interchanged since random interchanging of nozzles could adversely affect proper Novec 1230 fluid distribution and concentration within a hazard area.

6-4.2.11 INSPECT PULL STATIONS

Inspect all manual pull stations for cracks, broken or cracked glass plate, dirt or distortion. Inspect the station for signs of physical damage. Replace damaged glass. Replace the station if damaged. If necessary, clean as directed in Paragraph 6-6.1.

6-4.2.12 INSPECT PRESSURE SWITCHES

Inspect pressure switches for deformations, cracks, dirt or other damage. Replace the switch if damaged. If necessary, clean the switch as directed in Paragraph 6-6.1.

6-4.2.13 WEIGHING KIDDE ENGINEERED SYSTEM CYLINDERS

Weigh 10 through 900 lb. Kidde Engineered System cylinders as follows:

6-4.2.13.1 Check Kidde Engineered System Agent Quantity

WARNING

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

Install a protection cap on the Kidde Engineered System cylinder valve actuation port and safety cap on the cylinder valve outlet port.

1. Remove the cylinder as instructed in Paragraph 6-7.
2. Place the cylinder on a scale.
3. Record the weight and date on a record card and attach it to the cylinder. The gross weight and tare (empty) weight are metal stamped on the Kidde Engineered System cylinder valve label. Subtract tare weight from the gross weight to determine net weight of the original charge. Then, subtract tare weight from the scale reading to determine net weight of the Novec 1230 fluid remaining in the cylinder. If the recorded agent net weight is less than 95% of original charge net weight, replace the cylinder with a fully charged Kidde Engineered System cylinder (recharging the cylinders is explained in Paragraph 7-3).
4. Reinstall the cylinder (see Paragraph 6-8 for reinstallation instructions).

6-4.2.13.2 Cylinders Equipped with a Flexible Tape Liquid Level Indicator

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

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

CAUTION

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

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

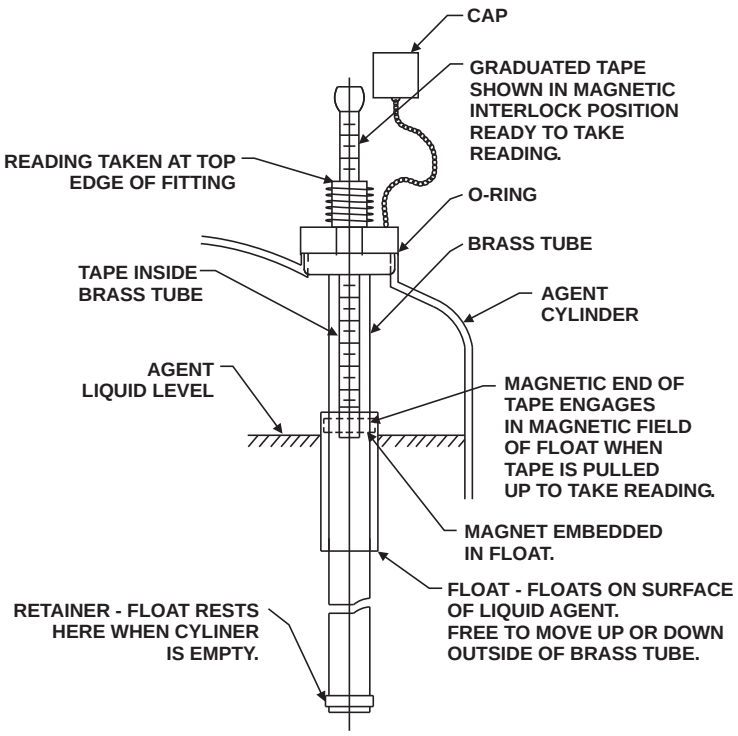

Figure 6-1. Liquid Level Indicator

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

Note: If the weight measured by the liquid level indicator indicates the cylinder should be recharged, it is recommended that the cylinder first be removed from service and the weight loss verified using a weigh scale before recharging.

All Kidde Engineered System cylinders must be filled or recharged by weight using a platform scale or equivalent. If weight loss is more than 5% of the Kidde Engineered System charge, the unit must be recharged.

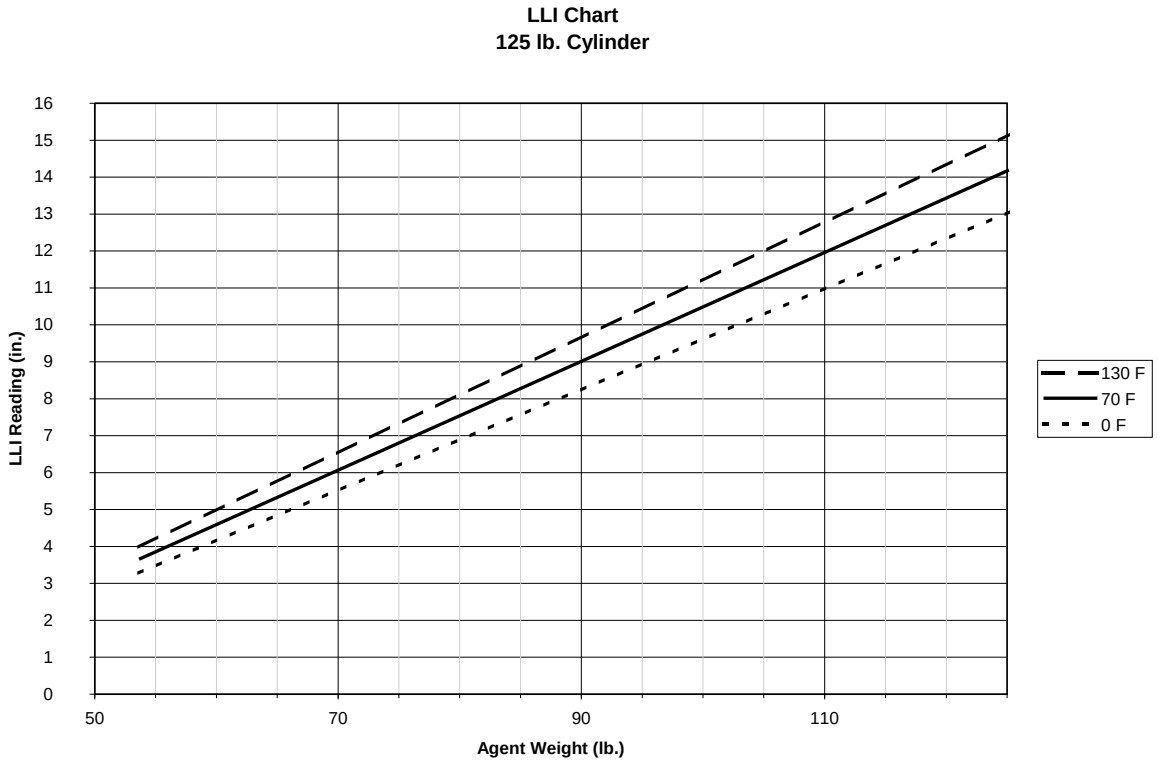

Figure 6-2. Calibration Chart 125 lb. Cylinder

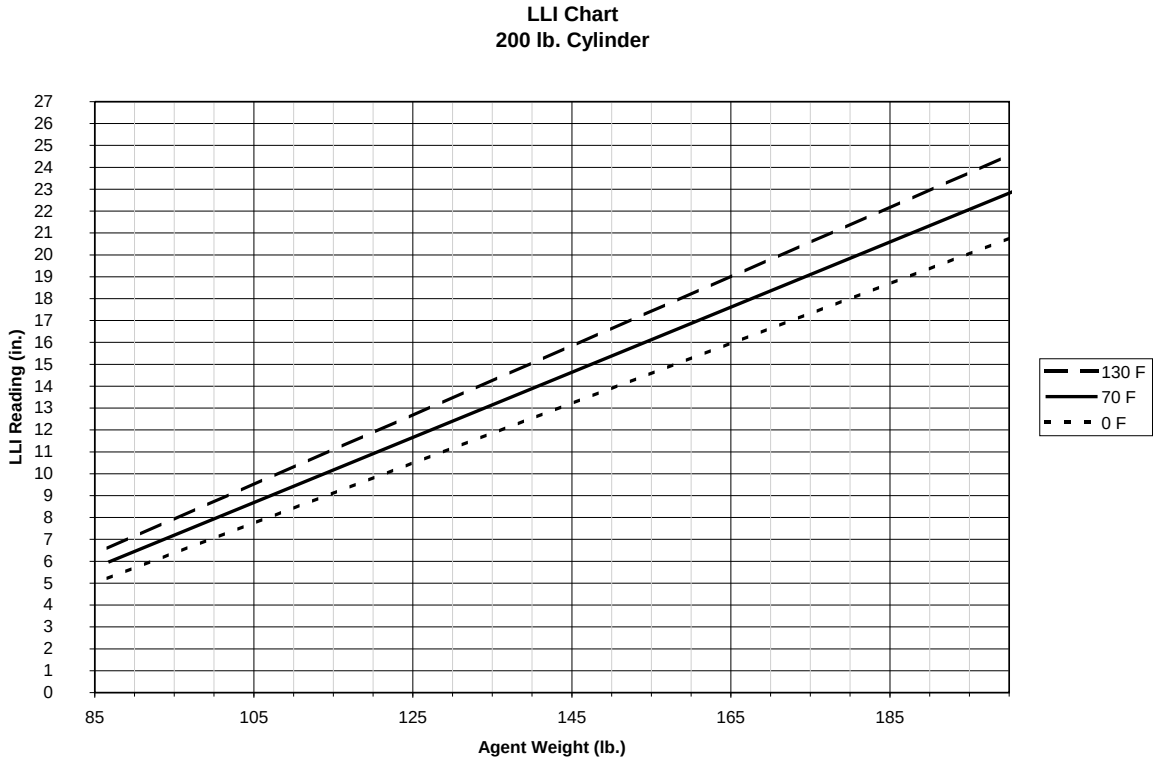

Figure 6-3. Calibration Chart for 200 lb. Cylinder

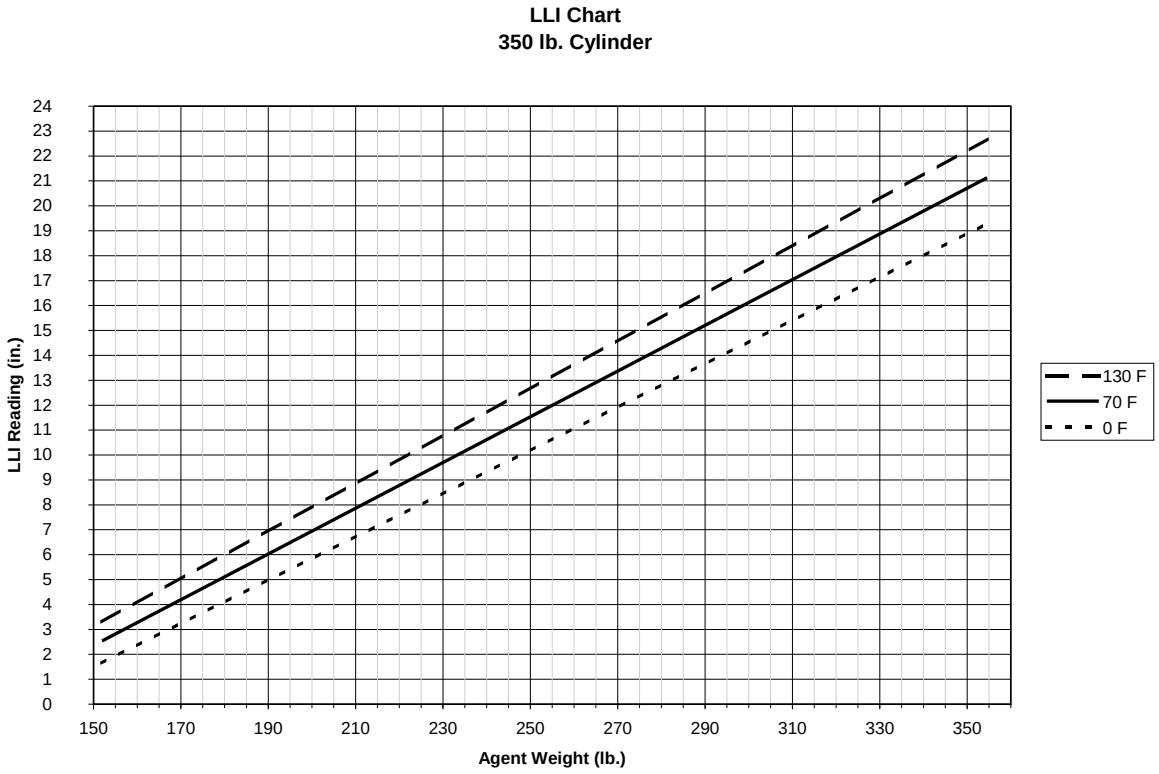

Figure 6-4. Calibration Chart for 350 lb. Cylinder

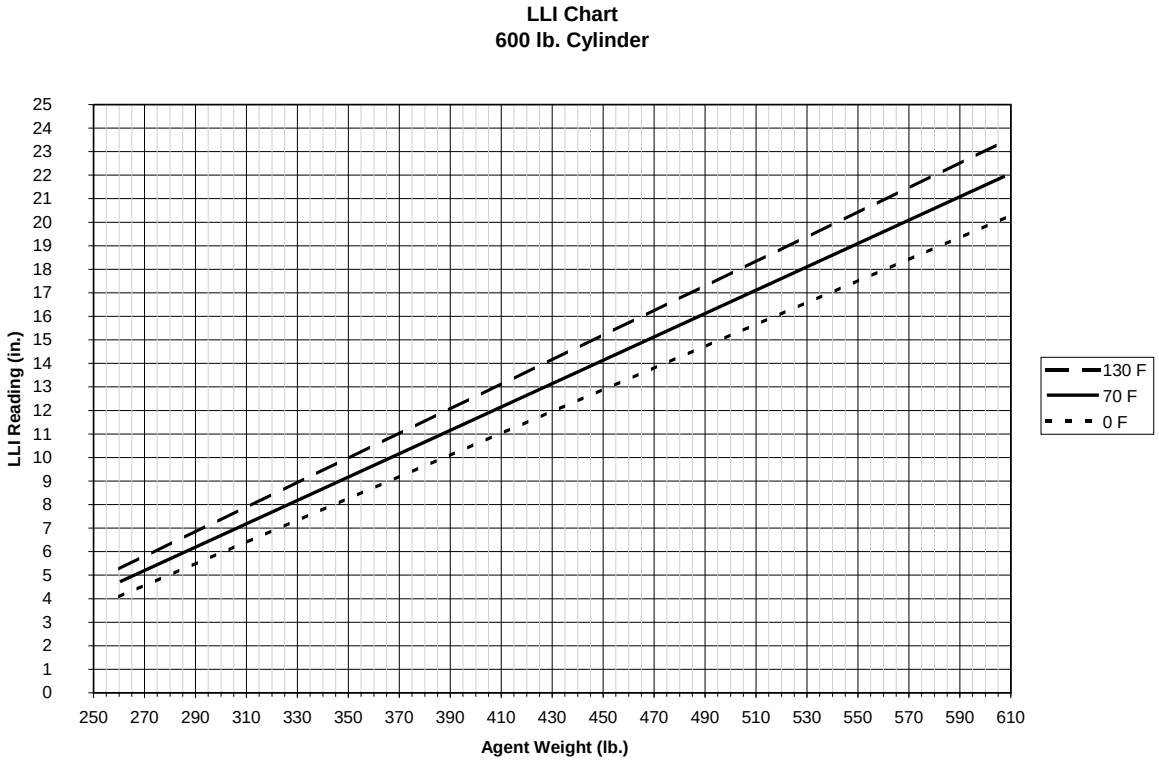

Figure 6-5. Calibration Chart for 600 lb. Cylinder

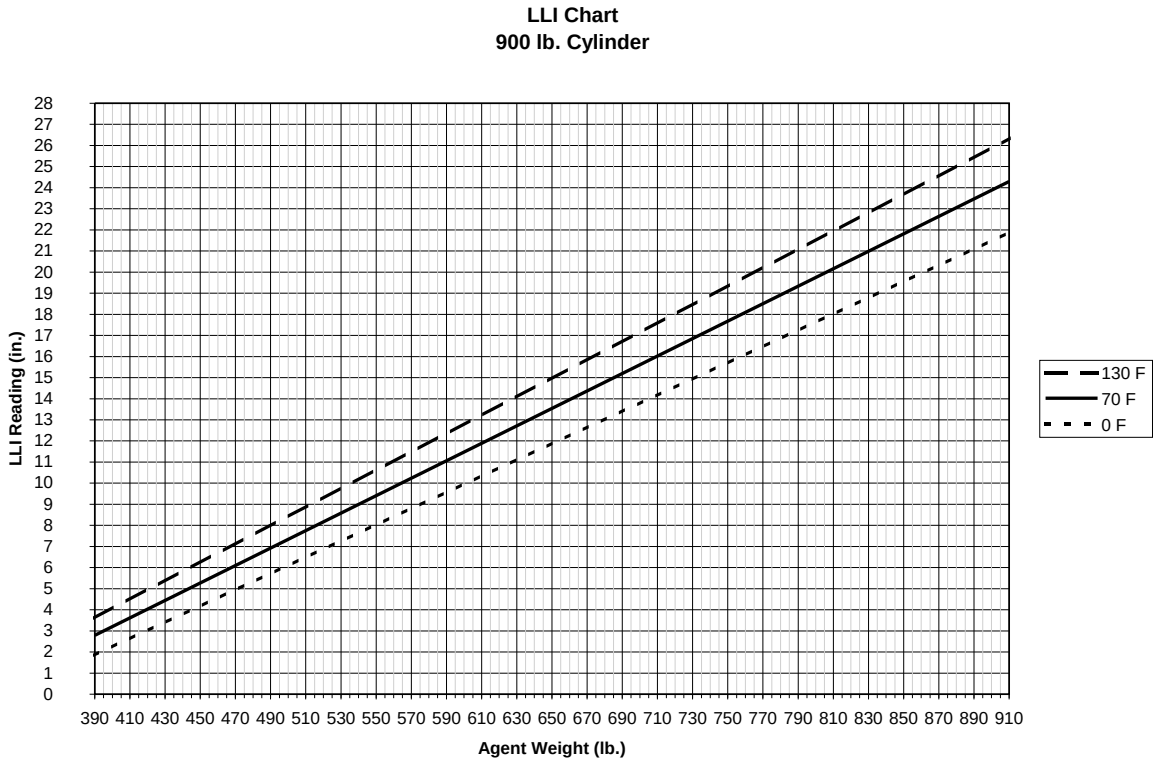

Figure 6-6. Calibration Chart for 900 lb. Cylinder

6-4.3 Inspection Procedures, Semi-Annual

6-4.3.1 PRESSURE SWITCH TEST

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

6-4.4 Inspection Procedures-2 Year

WARNING

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

1. Remove any nozzles from the piping to allow foreign matter to blow clear.
2. Remove all pressure operated control heads from the Kidde Engineered System cylinders.

WARNING

Do not disconnect the flexible actuation hose from the pressure operated control head. If Kidde Engineered System accidentally discharges, the unattached flexible actuation hose will whip around and may cause severe bodily injury and/or damage equipment.

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

6-4.4.1 TEST PNEUMATIC DETECTION SYSTEM

Before conducting any of these tests outlined in the following sections, remove the pneumatic control head(s) from the cylinder(s).

WARNING **When disconnecting control heads (tandem mounted), do not let heads turn (only possible if the interconnecting cable housing is a loose fit). This will reduce the likelihood of accidental discharge.**

6-4.4.1.1 Pneumatic Control Head Test

Pressure setting; see Figure 6-7.

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 unit so the control head will not be damaged upon operation.
3. If the control head has been operated, reset it by placing a screwdriver in the reset stem and turning clockwise until stem locks in position (with arrow on reset stem lined up with “SET” arrow on nameplate).

Note: Slight resistance will be met just before stem locks.

4. Use manometer test set (P/N WK-840041-000, Figure 6-7) and pour water into the open tube until the water level in both tubes is exactly at the zero mark. (The test set is not furnished as part of the system.)
5. Close off the rubber “A” by squeezing tightly with the fingers or use a crimp clamp, and then apply pressure by gradually squeezing the rubber bulb “C.” The control head must operate at the factory pressure setting, plus or minus the 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 (i.e., 3-inches both tubes or 1½-inches on one 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 sucked into the tubing and control head, which can cause system malfunction.**

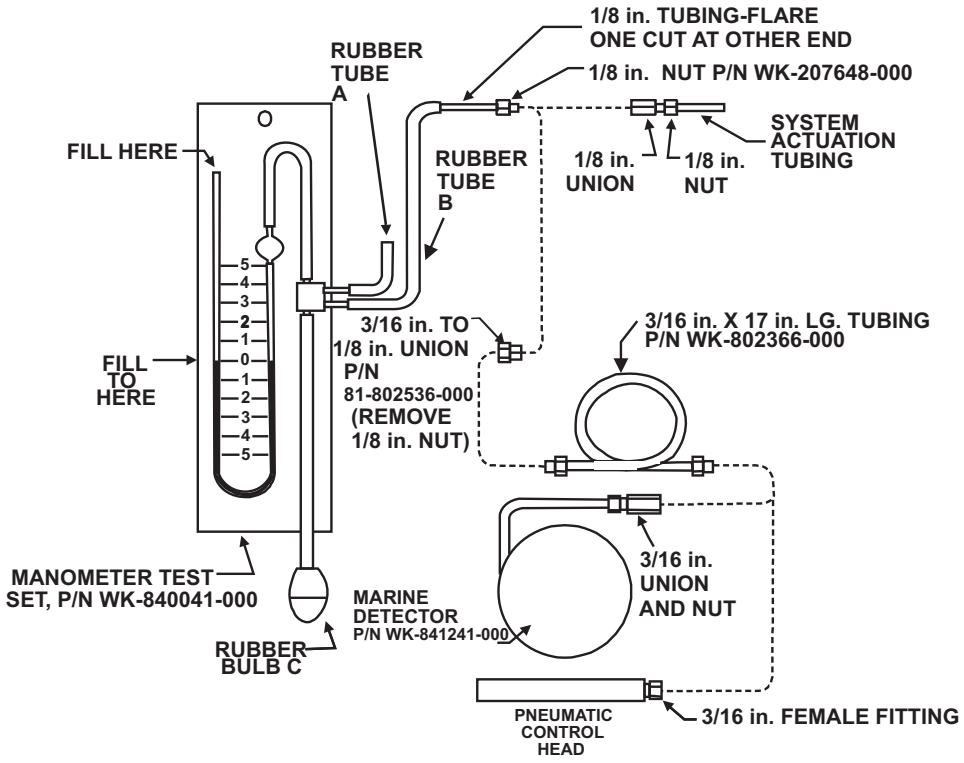

Figure 6-7. Manometer Test Set

6-4.4.1.2 Control Head Vent Test

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

1. Squeeze the 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 water level to change which indicates the inches of vacuum applied to control head (vacuum must be more than a minimum of 3 inches in order to observe drop from 3 inches to 1 inch).
3. The water column will recede to “0” level as air passes through the vent. The time required (number of seconds) for the water column to recede 2 inches reading from 3 inches to 1 inch on both legs or 1½-inch to 1/2-inch on either leg is the number of the vent (the calibrated rate of flow), i.e., if the time required to pass the above amount of water is five seconds the control head vent is “No. 5.” When vents are tested, the time will vary due to the added volume in the control head diaphragm chamber. A No. 5 vent may test at five to seven seconds, which is acceptable. If a vent time reads much higher, it will increase system sensitivity and may not be acceptable. Table 6-2 shows the acceptable times allowed when testing for vent sensitivity using manometer method with vent installed in the control head.
4. Repeat above procedure for testing tandem control head if installed. Since there is no vent in the tandem control head, the vacuum must hold (same as tubing tightness test).
5. 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 manometer test set, P/N WK-840041-000, must be used.

Table 6-2. Pneumatic Control Head Calibration Chart

Control Head Vent Setting	Allowable Time (Seconds)
40 seconds	40 to 60 seconds
20 seconds	20 to 27 seconds
10 seconds	10 to 15 seconds
5 seconds	5 to 7 seconds

6-4.4.1.3 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 and then close off open rubber tube “A.” Very gradually, release rubber bulb to its normal shape. This will cause the water level in the two tubes to change, at which time a maximum vacuum will develop. Hold a minimum 8 inch vacuum (difference between two sides of “U” tube, or 4 inches on each side of “U” tube).
3. If all connections are absolutely tight, the water level will remain in the position taken in Step 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 that 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 actuating chamber. Do not stand directly beneath the container.**

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

5. The heat test must be performed on each heat detector. Between each test, wait about five minutes for the system to return to normal and then reset the control head. To reset, insert a screwdriver in the reset stem and turn clockwise until the stem locks in position with the arrow or reset stem lining up with the “SET” arrow on the nameplate (slight resistance will be met just before the stem locks).
6. If application of heat does not cause the control head to operate within fifteen seconds, remove the container of water and investigate cause:
   a. Heat differential was inadequate.
   b. Leakage in the tubing system (tubing connections not tight).
   c. Obstruction in the tubing.

6-4.5 Troubleshooting the Pneumatic Detection System

Failure of system to operate pneumatic detection system testing when applying heat to the detectors may be caused by insufficient heat applied, obstructions in tubing or leaks in system. The manometer can be used to assist in troubleshooting the system as follows:

1. Install manometer in system tubing at pneumatic control head connection. Replace union connection with a control heat “T.” Close open tube “A” of the manometer (see Figure 6-7) with 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 buildup within the system, and will assist in determining if there is sufficient or insufficient pressure buildup during test of the system.

6-5 INSPECTION AND RETEST PROCEDURES FOR KIDDE ENGINEERED SYSTEM CYLINDERS, PILOT CYLINDERS AND FLEXIBLE HOSES

6-5.1 Inspection and Test of Kidde Engineered System Cylinders

A cylinder that is damaged or corroded should be emptied, retested and restamped in accordance with DOT CFR Title 49, Section 173.34 (retesting is explained in Paragraph 6-5.1.3).

CAUTION **These guidelines do not apply to cylinders containing a commodity other than Kidde Engineered System.**

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

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

6-5.1.1 CYLINDERS CONTINUOUSLY IN SERVICE WITHOUT DISCHARGE

These cylinders are governed by NFPA 2001 regulations. Cylinders in continuous service without discharge require a complete external visual inspection every five years in accordance with Compressed Gas Association Pamphlet C-6, Section 3, except that the cylinders need not be emptied or stamped while under pressure. Record date of inspection on record tag attached to each cylinder. Where the visual inspection shows damage or corrosion, the cylinder shall be emptied, retested and restamped in accordance with DOT CFR Title 49, Section 173.34.

6-5.1.2 DISCHARGED CYLINDERS OR CHARGED CYLINDERS THAT ARE TRANSPORTED

These cylinders may come under NFPA 2001 requirements, or in the case of shipment of charged cylinders, DOT, federal or state regulations may apply. In either case, the cylinders shall not be charged and shipped if more than five years have elapsed from the date of the last test date stamped on the cylinder. The cylinders shall be retested and restamped in accordance with the Department of Transportation (DOT) Code of Federal Regulation (CFR) Title 49, Section 173.34.

6-5.1.3 RETEST

DOT 4BA and 4BW cylinders used exclusively in Kidde Engineered System service which are commercially free from corroding components are required to be hydrostatically retested and restamped every five years in accordance with DOT CFR Title 49, Paragraph 173.34(e) prior to recharge and shipment. An alternate option is an external visual inspection performed in lieu of the hydrostatic test at the time the periodic retest becomes due in accordance with CFR 49, Paragraph 173.34(e) (13). Therefore, the retest can be performed by either of the following methods:

Table 6-3. Retest Schedule

Retest Method	First Retest Due	Subsequent Retest Due	Special Marking
Full hydrostatic test including determination of cylinder expansion	5 years	5 years	Retest Date Month/Year
External visual inspection per Paragraph 173.34(e) (13) and CGA Pamphlet C-6, Section 3	5 years	5 years	Retest Date Followed by "E"

6-5.2 Flexible Hoses

In accordance with NFPA 2001, all system hoses shall be examined annually for damage. If visual examination shows any deficiency, the hose shall be replaced or tested. In accordance with NVIC 3-95, Enclosure (1), flex hoses shall be visually examined annually for damage. If the inspection shows any deficiency, the hose shall be replaced or tested.

6-5.3 Inspection and Test of Nitrogen and CO_2 Pilot Cylinders

CAUTION **These guidelines do not apply to cylinders containing commodities other than CO2 or nitrogen.**

All Kidde CO_2 cylinders are designed, fabricated, factory tested and stamped in compliance with DOT CFR 49 Regulations 3A-2015 or 3AA-2300. All Kidde nitrogen pilot actuation cylinders are designed, fabricated, factory tested and stamped in compliance with DOT CFR 49 Regulations 3A-1800 or 3AA-1800.

CO_2 and nitrogen cylinders must be hydrostatic tested and marked in accordance with DOT CFR 49 Section 173.34 as follows:

1. All CO_2 and N_2 cylinders which have been discharged subsequent to five (5) years from the date of the last hydrostatic test, as indicated by the marking on the cylinder shoulder, must be tested and remarked. DOT requires that these cylinders shall not be recharged and transported without retest if more than five years have elapsed from the last test date.

Note: CO_2 and N_2 cylinders continuously in service without being discharged do not have to be retested every five years.

2. All CO_2 and N_2 system cylinders continuously in service without being discharge may be retained in service for a maximum of twelve years from the date of the last hydrostatic test. At the end of twelve years, these cylinders must be removed from service, discharged, retested, and remarked in accordance with DOT 49 CFR Section 173.34 before NFPA 12/10 or CFR 173.301 through 308 and 173.34, reference 147.65 returning to service.
3. A cylinder must be hydrostatic tested immediately if the cylinder shows evidence of distortion, damage, cracks, corrosion or mechanical damage. Any cylinder failing the visual inspection or hydrostatic pressure test must be destroyed.

6-5.4 Records

In accordance with NVIC 3-95, Enclosure (1), records of all inspections and tests shall be maintained on the vessel and shall be available for inspection. See NVIC 3-95 for more details.

6-6 SERVICE

6-6.1 Cleaning

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

6-6.2 Nozzle Service

Service nozzles after use as follows:

1. Clean the outside of the nozzles with a rag or soft brush.
2. Examine the discharge orifices for damage or blockage. If the nozzles appear to be obstructed, unscrew the nozzles and clean by immersing them in cleaning solvent. Dry thoroughly with lint-free cloth. Replace damaged nozzles. Nozzles must be replaced with the same part number in the same location. See Paragraph 3-2.1.6 for the correct nozzle placement and orientation.

6-6.3 Repairs

Replace all damaged parts found during inspection. Replacement procedures for Kidde Engineered System cylinders are provided below. Since replacement for other system components are similar, refer to installation drawings and Kidde Engineered System assembly drawings for guidance.

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

6-7 REMOVING A KIDDE ENGINEERED SYSTEM CYLINDER

Remove a Kidde Engineered System cylinder as follows:

WARNING

Do not disconnect flexible discharge hose or valve outlet adapter prior to removing control heads from Kidde Engineered System cylinders. Before replacing a Kidde Engineered System cylinder in a hazard area group, ensure pilot line is completely vented of all pressure.

6-7.1 Single Cylinder System

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

6-7.2 Multiple Cylinder System

WARNING

Remove all control heads from Kidde Engineered System cylinders.

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

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

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

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

7. Immediately install the safety cap on the cylinder valve outlet port.
8. Remove the attaching hardware or cylinder straps. Remove the Kidde Engineered System cylinder from the bracket. Weigh the cylinders using a platform scale.

6-8 REINSTALLING A KIDDE ENGINEERED SYSTEM CYLINDER

Install an Kidde Engineered System cylinder as follows:

6-8.1 Single Cylinder System

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

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

2. Remove the safety cap from the cylinder valve outlet port.
3. Immediately reconnect the valve outlet adapter or flexible discharge hose to the cylinder outlet port.
4. Remove the protection cap from the Kidde Engineered System cylinder actuation port.

WARNING **The control head must be in SET position (that is, the actuating pin must be in the fully retracted or SET position) before attaching it to the cylinder valve to prevent accidental discharge.**

5. Install the control head.
6. If required, install the supervisory pressure switch, as instructed in Paragraph 4-2.24.

6-8.2 Multiple Cylinder System

1. Position the Kidde Engineered System cylinders in their designated locations. Secure in place with cylinder straps or wall brackets and mounting hardware. Orient the cylinders with the valve outlets angled toward the cylinder discharge piping (refer to system installation drawings).

WARNING

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

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

WARNING

The control head must be in the SET position before attaching it to the cylinder valve. A control head in the released position will cause discharge of Kidde Engineered System when it is installed on the cylinder valve.

6. Reinstall control head(s) and tighten the swivel nut(s). Refit the flexible actuation hoses or tubing (where fitted) to the valve actuation port(s) and/or control head ports.
7. If required, install supervisory pressure switches, as explained in Paragraph 4-2.24.

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CHAPTER 7
POST-DISCHARGE MAINTENANCE

7-1 INTRODUCTION

Follow these procedures after the system has been activated and Kidde Engineered Fire Suppression System designed for use with 3M™ Novec™ 1230 Fire Protection Fluid has been discharged.

7-2 POST-DISCHARGE MAINTENANCE STANDARD CYLINDERS

7-2.1 Kidde Engineered System Valve Inspection and Service

Inspect and service the Kidde Engineered System valve as follows:

Note: Important–Because the agent tends to dissolve and wash out lubricant, certain components in the Kidde Engineered System valve assembly will have to be inspected and serviced before recharging the cylinder and valve assembly. Part numbers for items which may require replacement are listed in Table 8-1.

7-2.2 Valve Disassembly (1½ in. and 2 in.)

Refer to Figure 7-1 and Figure 7-2 and Table 7-1. All item number references are drawn from Figure 7-1.

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

1. Remove the valve with the siphon tube from the cylinder.
2. Remove the O-ring (4). Discard and replace O-ring.
3. Remove the valve cap, spring and piston assembly.

Note: All internal components of Kidde Engineered System valves are removed from the top of the assembly. However, if there is excessive piston O-ring friction, the siphon tube may have to be removed and the piston assembly pressed out from the bottom.

4. Remove the remaining O-rings and examine for cuts or nicks; replace if necessary. Examine the O-ring grooves for foreign matter. O-Ring (3) will require a spanner wrench for removal.
5. Examine the exposed surface of the O-ring for nicks and cuts. Also, ensure that the O-ring protrudes a minimum or 0.020 in. (0.5 mm) above the conical seating surface of the piston assembly. Replace this O-ring if necessary by removing the seat retainer.
6. Replace the valve core if necessary using a standard Schraeder core wrench.

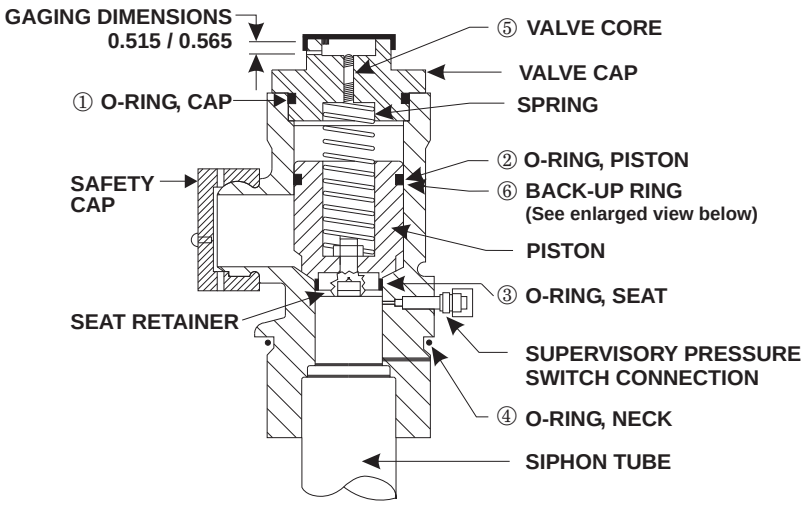

Figure 7-1. Valve Assembly (1½ in. and 2 in.)

Table 7-1. Valve Components

Figure Item Number	Description	10-125 lb. Cylinders	200-350 lb. Cylinders
1	O-ring, cap	WK-566102-250	WK-566102-300
2	O-ring, piston	WK-566103-250	WK-566103-300
3	O-ring, seat	WK-566102-150	WK-566103-260
4	O-ring, neck	WK-566109-320	WK-566103-350
5	Valve core	WK-220278-000	WK-220278-000
6	Back-up ring	WK-554003-250	WK-554003-300

Figure 7-2. Piston O-Ring

Table 7-2. Other Valve Component Materials

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

7-2.3 Valve Disassembly (3 in.)

Note: Refer to Figure 7-3 for items.

1. Remove the valve with the siphon tube from the cylinder.
2. Remove the Neck O-ring and discard.
3. Remove the valve cap, spring and piston assembly.

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

4. Remove the remaining O-rings and examine them for cuts and nicks; replace if necessary. Examine the O-ring grooves for foreign matter.
5. Examine the exposed surface of the Piston O-ring for nicks and cuts. Also, ensure that the Piston O-ring protrudes a minimum of 0.020 in. (0.5 mm) above the conical seating surface of the piston assembly. Replace this O-ring if necessary by removing the seat retainer.
6. Examine the pilot check for any evidence of bending or other damage. Depress the check and make certain it snaps back freely. Replace pilot check if necessary.

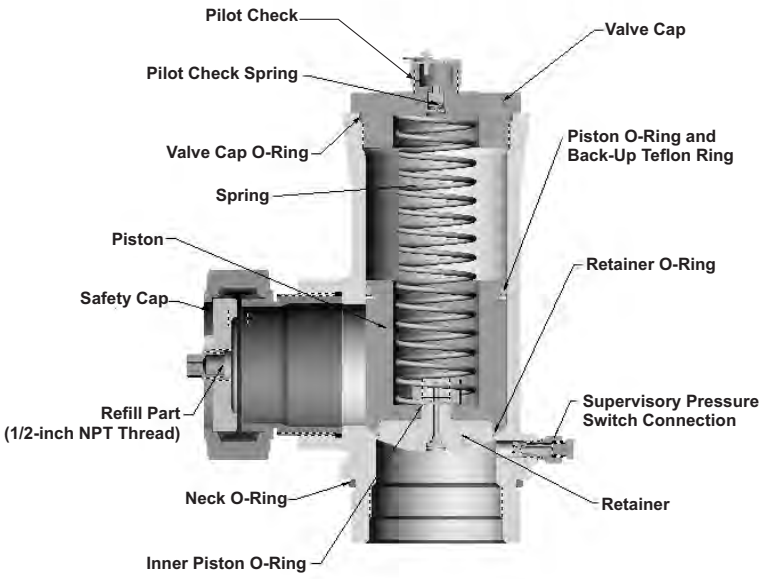

Figure 7-3. 3 in. Valve Assembly

Table 7-3. 3 in. Valve Components

Part Number	Description
WK-554003-400	O-Ring, Backup Teflon
WK-566101-170	O-Ring, Inner Piston
WK-566102-410	O-ring, Valve Cap
WK-566103-370	O-ring, Piston
WK-566103-400	O-ring, Retainer
WK-566103-470	O-ring, Neck
WK-923066-000	Pilot Check Assembly
WF-230640-000	Pilot Check Spring
06-235924-001	Retainer

7-2.4 Valve Assembly (1½ in. and 2 in.)

Note: The items refer to Figure 7-1.

CAUTION

Make certain the Teflon® back-up ring is below this O-ring as shown in Figure 7-2.

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

7-2.5 Valve Assembly (3 in.)

Note: Refer to Figure 7-3.

CAUTION

Make certain that the Teflon® back-up ring is below the O-ring as shown in Figure 7-3.

1. Install the Piston O-ring in the piston groove. Apply a lubricant to the O-Ring prior to installation.

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

7-2.6 Safety Disc Replacement (1½ in. and 2 in.)

Note: Refer to Figure 7-4.

1. Remove the safety disc retainer with safety disc and safety disc washer from the valve body. Discard the safety disc and washer.
2. Assemble the safety disc retainer with new safety disc and safety disc washer to the valve body. Torque to the appropriate value listed in Table 7-4.

WARNING

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

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

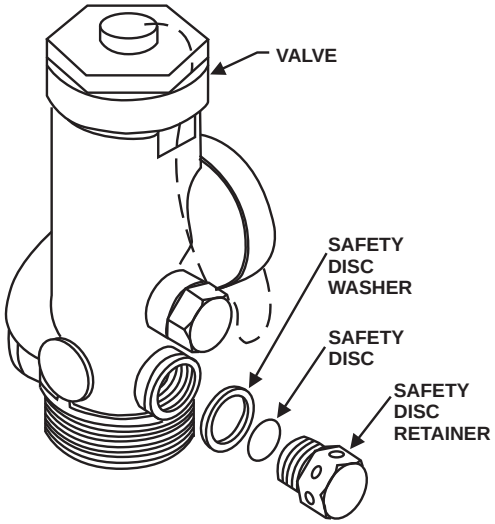

Figure 7-4. Safety Disc Replacement

Table 7-4. Safety Disc Replacement Table (1½ in. and 2 in.)

Cylinder Size	Safety Disc Part Number	Safety Disc Washer Part Number	Torque Value	PSIG @ 70°F
10-125 lb.	WK-242461-000	WK-294500-000	33 ft. lb.	750-900
200-350 lb.	WK-264925-000	WK-220360-000	38 ft. lb.	800-975

7-2.7 Safety Disc Replacement (3 in.)

The safety disc for the 3 in. valve is located on the cylinder head, not on the cylinder valve.

1. Remove the safety disc retainer (see Figure 7-5) including safety disc and safety disc washer from the cylinder body. Discard the safety disc and washer.
2. Reassemble the safety disc retainer with a new safety disc and safety disc washer to the valve body. Torque to the appropriate value listed in Table 7-5.

WARNING

Never install any type of disc other than specified in Table 7-5 for the corresponding cylinder. Installing the incorrect disc could result in a violent rupture of the cylinder and serious injury.

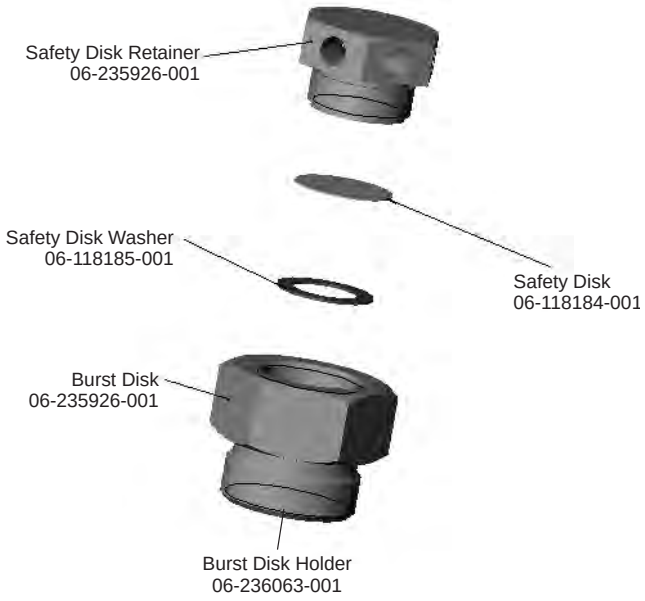

Figure 7-5. Safety Disc

Table 7-5. Safety Disc Replacement Table (3 in.)

Cylinder Size	Safety Disc P/N	Torque Value	PSIG @ 70° F
600 and 900 lb.	06-118184-001	90 ft. lb.	800-975

7-3 RECHARGING KIDDE ENGINEERED SYSTEM CYLINDERS

CAUTION

Kidde Engineered System cylinders may require retest before recharging (see Paragraph 6-5 for details on cylinder retest). FM Approval is based upon the usage of factory filled Kidde Engineered System cylinders.

WARNING

Under no circumstances while performing either cylinder recharge or leak test, should a charged cylinder be allowed to stand freely without either the charging apparatus attached or the safety cap installed. Whenever these devices are not installed, a charged cylinder must be securely clamped to a rigid structure capable of sustaining the full thrust that would result should the valve inadvertently open. The clamping device and supports must be capable of withstanding a thrust force of 1800 lb. (816.5 kg). This approximates the thrust force generated out of the Kidde Engineered System cylinder valve outlet on a full, wide-open discharge.

Kidde Engineered System charging equipment consists of an Kidde Engineered System storage cylinder, piping adapter, control valves, strainer, pressure gauge, flexible hoses, seating adapter, recharge adapter, pump, regulated nitrogen supply, scale and interconnecting plumbing. Recharge equipment must be suitable for the purpose intended and must be compatible with Kidde Engineered System. A typical Kidde Engineered System charging system schematic is shown in Figure 7-6.

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

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

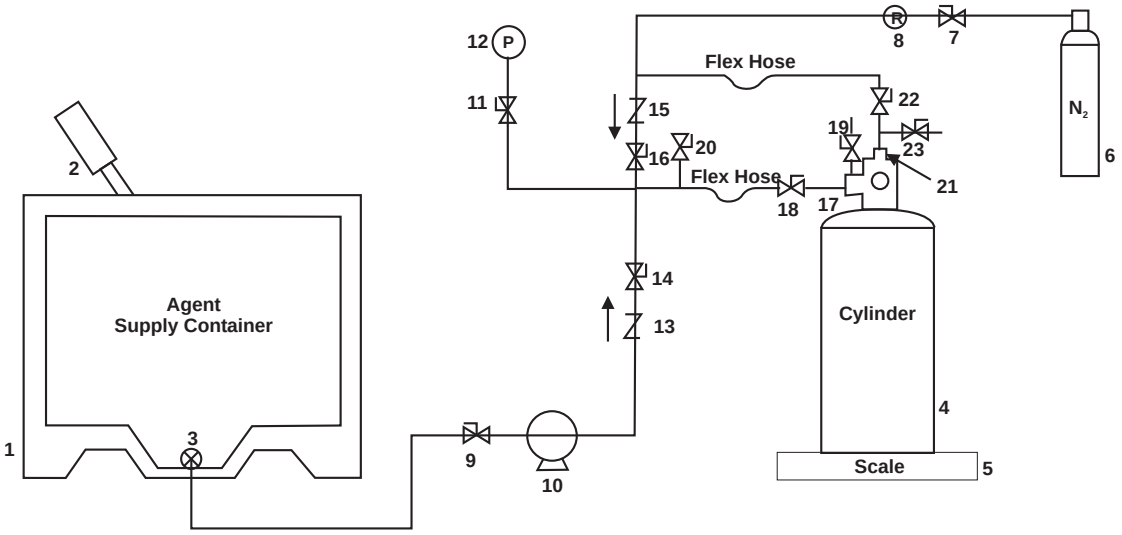

Figure 7-6. Typical Kidde Engineered System Charging System Schematic

Table 7-6. Typical Kidde Engineered System Charging System Schematic

1	Agent Supply Container	13	Check Valve
2	Drierite Filter	14	Ball Valve
3	Container Supply Valve	15	Check Valve
4	Cylinder and Valve Assembly	16	Ball Valve
5	Scale	17	Recharge Adapter
6	Nitrogen Cylinder	18	Ball Valve
7	Ball Valve	19	Ball Valve
8	Regulator	20	Ball Valve
9	Ball Valve	21	Seating Adapter
10	Pump	22	Vent Valve
11	Ball Valve	23	Vent Valve
12	Master Pressure Gauge		

7-3.1 Charging Equipment Installation

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

7-3.2 Charging Kidde Engineered System Cylinder and Valve Assembly

Recharge Kidde Engineered System cylinder and valve assembly as follows (see Figure 7-6 and Table 7-6:

WARNING

Only qualified, designated personnel should operate the charging equipment. Exercise extreme care when working with pressure equipment to prevent injury to people and damage to property, resulting from careless handling or possible equipment failure. Perform all operations in an assigned area cleared of all unauthorized personnel. Make sure all equipment is properly secured. Never attempt to adjust or disassemble pressurized equipment.

1. Check the cylinder for the last hydrostatic test date prior to charging. Perform any required DOT hydrostatic tests (see Paragraph 6-5).
2. Check the cylinder valve assembly for any unacceptable physical defects (for example, cracks of any kind, elongated pits of any length, inclusions of any size, pitting, bulging, dents, corrosion, fire damage, mechanical defects, scratches, nicks or gouges if more than superficial in nature). These defects shall be cause for rejection.
3. Weigh the cylinder and valve assembly to verify the quantity of agent in the cylinder. Ensure that no more than 10 PSIG (0.7 bar gauge) of nitrogen is in cylinder before beginning the fill procedures.

CAUTION

Novec 1230 fluid is a colorless, odorless gas, low in toxicity, and is an extremely effective fire suppression agent. Novec 1230 fluid can be liquefied by compression, and is normally shipped and stored in this condition. Being a liquefied and compressed gas, Novec 1230 fluid is stored and handled under saturated conditions (that is, the liquid and vapor coexist in equilibrium). Reducing the pressure without reducing the temperature causes the liquid to flash into vapor with accompanying refrigeration effects. By understanding the physical properties of Novec 1230 fluid and safe handling techniques, the agent may be transferred from shipping cylinders to the desired end-use cylinder safely.

Note: Drierite filter (Item 2) should be installed on agent supply container (Item 1) prior to beginning filling. Drierite filters are designed to remove moisture/humidity from the air to prevent contamination of fluid.

4. Connect the supply line to the supply cylinder valve (Item 3). Close all valves in the charging system.
5. Open the supply valves (Items 3, 9, and 14). Start the pump (Item 10), then crack the vent valve (Item 20) until Novec 1230 fluid liquid is present. Close valve (Item 20) and shut off pump (Item 10).
6. Position the Kidde Engineered System cylinder and valve assembly (Item 4) (with safety cap and pilot actuation port protection cap in place and properly connected) on a weigh scale (Item 5). Record the weight from the scale. The empty weight of the cylinder and valve assembly must be stamped on the cylinder valve nameplate.
7. Remove the safety cap and immediately connect the cylinder assembly into the charging system by assembling the recharge adapter with recharge adapter (Item 17) to the cylinder assembly outlet port.

Note: The main piston in the cylinder valve assembly will unseat, permitting flow into the assembly when a 10 PSIG (0.7 bar gauge) differential (approximate) exists at the outlet port. Initial valve assembly seating occurs with pressure equalization. Final valve assembly seating occurs with removal of pressure from valve assembly outlet port and subsequent momentary application of 450 to 600 PSIG (31 to 41 bar gauge) of nitrogen discussed below.

8. Open valve (Item 18) and start the pump (Item 10). Monitor the weigh scale (Item 5). When the scale indicates the correct charge weight, shut off the pump (Item 10) and close the supply valves (Item 18 and 14).

Note: Nitrogen charge weight for Kidde Engineered System cylinders at 70 lb./ft.^{3} (1121 kg/m^3) fill density is based on 1.88 lb. (0.85 kg) of nitrogen per 100 lb. (45.3 kg) of Kidde Engineered System.

9. Open valve (Item 18) and start the pump (Item 10). Monitor the weigh scale (Item 5). When the scale indicates a charge weight C, shut off the pump (Item 10) and close the supply valves (Item 18 and 14).

Note: The 360 PSIG (25 bar gauge) pressure applies to the filling procedure with nitrogen and Kidde Engineered System at 70°F ± 10°F (21°C ± -12°C). When the temperature is other than 70°F (21°C), refer to Table 7-5 for required total pressure. Do not fill Kidde Engineered System cylinders at temperatures below 60°F (16°C) or above 90°F (27°C).

Table 7-7. Pressure vs. Temperature

Pressure versus Temperature			
Temperature		**Pressure**	
60°F	15.6°C	340 PSIG	23.5 bar gauge
70°F	21.1°C	360 PSIG	24.8 bar gauge
80°F	26.7°C	381 PSIG	26.3 bar gauge
90°F	32.2°C	402 PSIG	27.7 bar gauge

Note: 360 PSIG + 25, - 0 PSIG, at 70°F (25 bar gauge +1.7, -0 bar gauge at 21°C) is the final pressure required after the charged cylinder has had sufficient time to stabilize. Nitrogen topping may be required to attain the 360 PSIG (25 bar gauge) after the stabilization period has elapsed.

10. If nitrogen is required, open the handwheel valve on the nitrogen supply valve (Item 7), nitrogen valve (Item 16), and valve (Item 11). Adjust the regulator (Item 8) until the master pressure gauge (Item 12) shows a pressure indication of 360 PSIG + 25, -0 PSIG (25 bar gauge + 1.7, -0 bar gauge).

11. Open the hose control valve (Item 18) and let the nitrogen flow into the cylinder until the master pressure gauge indicates 360 PSIG (25 bar gauge). Cylinder agitation will assist with the equilibrium on nitrogen and Kidde Engineered System. Additional nitrogen may be necessary as the cylinder equilibrates.

12. Close the hose control valve (Item 18). Remove the pilot actuation port protection cap and assemble the seating adapter (Item 21) with the flexible hose to the cylinder valve actuation port. Adjust the regulator to 450 to 600 PSIG. Open valve (Item 22) to momentarily apply nitrogen pressure to the actuation port to firmly seat the cylinder valve piston.

13. While momentarily maintaining pressure on the actuation port, open vent valve (Item 19) on the recharge adapter (Item 17) to rapidly vent Kidde Engineered System from the valve assembly outlet port. The sudden pressure decrease at the valve outlet will ensure the valve seat stays in the closed position.
14. Leave vent valve (Item 19) open. Close valve (Item 22) and open valve (Item 23) to vent nitrogen from the seating adapter.

CAUTION

Any hissing or discharge coming from vent valve (Item 19) indicates that the piston is not sealed properly or has opened. If this occurs, close valve (Item 19) and repeat steps 12 and 13. Verify that the cylinder valve piston remains closed.

15. Keep vent valve (Item 19) open. Close valve (Item 23), and once again open valve (Item 22) to reapply nitrogen pressure to the actuation port. While momentarily maintaining pressure on the actuation port, remove the recharge adapter (Item 17) from the cylinder valve outlet port and immediately install the safety cap. Close the vent valve (Item 19).

WARNING

Nitrogen pressure must be maintained on the actuation port while removing the charging adapter and installing the safety cap to ensure that the cylinder valve does not inadvertently actuate while the valve outlet port is wide open. Failure to follow this could result in injury and damage to property.

16. Close the nitrogen supply valve (Item 7) and open vent valve (Item 23) to vent nitrogen from the supply line.
17. Remove the seating adapter (Item 21) from the cylinder valve and reinstall the actuation port protection cap. Close valves (Items 22 and 23).
18. Weigh the fully charged cylinder. The weight must agree with the weight stamped on the cylinder valve nameplate. Record the date of recharge on the cylinder record tag.
19. Monitor the cylinder valve gauge. The gauge indicator must read 360 PSIG + 25, -0 PSIG at 70°F (25 bar +1.7, -0 bar gauge at 21°C) after the stabilization period.
20. The cylinder is now ready for the leak test (refer to Paragraph 7-3.4).

CAUTION

The Kidde Engineered System cylinders have been designed for a maximum fill density of 70 lb./cu. ft. (1121 kg/m3) and super pressurized with nitrogen to 360 PSIG + 25 PSIG at 70°F (25 bar gauge +1.7, -0 bar gauge at 21°C). It is important that these values not be exceeded.

The pressure in the agent cylinder is significantly affected by fill density and temperature. At elevated temperatures, the rate of increase in pressure is very sensitive to fill density (see Figure 1-1). If the maximum fill density is exceeded, the pressure will increase rapidly with temperature increase so as to present a hazard to personnel and property. Adherence to the limits on fill density and pressurization levels will prevent excessively high pressures from occurring if the agent cylinder is exposed to elevated temperature, minimizing the possibility of an inadvertent discharge of agent through the pressure relief device.

Note: To change the agent supply container (Item 1) close container valve (Items 3) and valve (Item 9). Disconnect filling line from agent supply container. Position new agent supply container in place. Connect filling line to the new agent supply container. Open valves (Items 3 and 9).

7-3.3 Topping off Kidde Engineered System Cylinders with Nitrogen

The procedure for adding Nitrogen to a charge Kidde Engineered System cylinder is listed below:

Note: All precautions for care and handling of pressurized vessels shall be followed.

1. Disconnect the Flexible Discharge Hose (or Valve Outlet adapter) from the valve outlet and attach the anti-recoil cap (or recharge adapter with shutoff valve) to the outlet.
2. Remove the Supervisory Pressure Switch, if present.
3. Attach an accurate pressure gauge to the supervisory pressure switch port with a refrigeration hose or fitting equipped with an insert to push to Schraeder valve down.
4. Attach Seating Adapter (P/N WK-933537-000) to the control head port on the top of the valve. Ensure that the O-ring is in place on the adapter.
5. Attach threaded end of adapter to a regulated source of nitrogen.
6. Set nitrogen regulator to approximately 500 PSIG (34.5 bar gauge).
7. Introduce nitrogen into cylinder until gauge attached to supervision pressure switch port indicates proper pressure for ambient temperature.
8. With nitrogen source closed, quickly vent pressure in section from regulator to Seating Adapter (P/N WK-933537-000).
9. Detach gauge from supervisory pressure switch port.
10. Attach supervisory pressure switch in accordance with Paragraph 4-2.24.
11. Perform leak check on valve with sniffer or soapy solution.
12. Reattach cylinder to system.

Note: This procedure is only effective if no agent has been lost from the tank. If agent has leaked, the tank should be emptied and refilled with the appropriate amount of agent as described in Paragraph 7-3.5

7-3.4 Kidde Engineered System Cylinder Leak Test

WARNING

Clamp Kidde Engineered System cylinder securely in place. The clamping device and supports must be capable of withstanding a thrust force of 1800 lb. (816.5 kg). This approximates the thrust force generated out of the Kidde Engineered System cylinder valve outlet on a full, wide open discharge.

WARNING

Kidde Engineered System cylinder leak tests must be conducted in a well-ventilated area, away from the charging station so as not to be influenced by extraneous Novec 1230 fluid vapors released during the filling operations. Kidde recommends the Yokogawa Type H25C leak detector for Kidde Engineered System, with the Yokogawa Type LS-20 leak standard for Kidde Engineered System for calibrating the leak detector.

1. Warm up the leak detector for 30 minutes before proceeding with Step 2.
2. Calibrate the detector against the LS-20 leak standard by holding the probe about 1/8 in. (3 mm) away, and noting the meter deflection for the leakage allowance of the standard. Maximum allowable leak rates are shown in Table 7-8.
3. Remove the safety cap from the discharge outlet. Blow nitrogen on the surface where the plug was removed.
4. Move the probe back and forth slowly about 1/8 in. (3 mm) away from all potential leak points (such as the discharge outlet area, pilot check, valve bonnet,

supervisory pressure switch connection, safety outlet, liquid level indicator, valve-to-cylinder connections, gauge and cylinder welds).

5. Meter deflections greater than indicated during calibration are considered excessive and will be cause for rejection.
6. Replace the safety cap immediately after the test.
7. If excess leakage is detected, salvage the Novec 1230 fluid, perform the required maintenance on the cylinder and recharge.
8. After the leak test is complete, reassemble the protection cap to the actuation port of the valve assembly. Unclamp the cylinder.

Table 7-8. Maximum Permitted Leakage Rates, Standard Cylinders

Part Number	Cylinder Size	Cylinder Fill Weight	Maximum Allowable Leakage
45-200010-001	10 lb.	6 lb. - 11 lb.	0.11 oz./yr.
45-200020-001	20 lb.	9 lb. - 23 lb.	0.20 oz./yr.
45-200021-001	20 lb.	9 lb. - 23 lb.	0.20 oz./yr.
45-200040-001	40 lb.	17 lb. - 40 lb.	0.37 oz./yr.
45-200070-001	70 lb.	30 lb. - 70 lb.	0.67 oz./yr.
45-200125-001	125 lb.	54 lb. - 125 lb.	1.20 oz./yr.
45-200200-001	200 lb.	86 lb. - 200 lb.	1.81 oz./yr.
45-200201-001*	200 lb.	86 lb. - 200 lb.	1.81 oz./yr.
45-200200-001	200 lb.	86 lb. - 200 lb.	1.81 oz./yr.
45-200201-001*	200 lb.	86 lb. - 200 lb.	1.81 oz./yr.
45-200350-001	350 lb.	150 lb. - 350 lb.	3.34 oz./yr.
45-200351-001*	350 lb.	150 lb. - 350 lb.	3.34 oz./yr.
45-200600-001	600 lb.	258 lb. - 600 lb.	5.74 oz./yr.
45-200601-001*	600 lb.	258 lb. - 600 lb.	5.74 oz./yr.
45-20090X-001	900 lb.	390 lb. - 900 lb.	8.68 oz./yr.
*__Note:__ Includes liquid level indicator			

7-3.5 Salvaging Novec 1230 Fluid from a Leaking Cylinder Assembly

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

1. Close the agent supply valve (Item 3) and close valve (Item 9). Disconnect the charging flexible hose from the supply valve (Item 3).
2. Connect the salvage discharge assembly to the flexible hose coupling. Then assemble the discharge assembly to the outlet port of the leaking cylinder assembly (not shown).
3. Position an empty cylinder assembly of suitable size for a Kidde Engineered System on the scale. Record the empty weight.
4. Connect the recharge adapter (Item 17) to the empty cylinder outlet port.
5. Assemble a manually operated control head onto the cylinder valve actuation port of the leaking cylinder assembly.
6. Check that all charging system valves are closed. Open valves (Items 9, 11 and 14). Set the manually operated control head to the OPEN position. The pressure gauge (Item 12) should indicate the supply pressure. Crack vent valve (Item 20) until Novec 1230 fluid liquid is present. Shut valve (Item 20).
7. If the cylinder assembly on the scale is of sufficient size and is being used to store Novec 1230 fluid, monitor the scale, open the valve (Item 18) and start the pump. Continue pumping until a maximum of Novec 1230 fluid is transferred from the leaking cylinder assembly as indicated by a pressure drop on the pressure gauge.
8. If the cylinder assembly on the scale is being charged, fill with the required weight of Novec 1230 fluid by adding the required pounds to the empty cylinder weight. Follow the charging procedure outlined in steps 9 through 20 of Paragraph 7-3.2. Conduct a cylinder leak test as described in Paragraph 7-3.4.
9. Continue to transfer the Novec 1230 fluid agent until the leaking cylinder assembly is empty as indicated by pressure drop as measured by the pressure gauge. Shut off the pump and close the hose control valve (Item 18) and valve (Item 9).
10. Close valve (Item 3) and open valve (Item X), then disassemble the adapter from the outlet port of the leaking cylinder assembly and from the flexible hose hookup. Reassemble the flexible hose to the agent supply valve (Item 19).
11. If the cylinder assembly being recharged, is not charged sufficiently, continue the charging procedure as indicated in Paragraph 7-3.2 using the agent supply.

7-4 NITROGEN PILOT CYLINDER, 108 CU. IN., SERVICE AND MAINTENANCE

WARNING

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

7-4.1 Nitrogen Pilot Cylinder Hydrostatic Pressure Test

A hydrostatic test must be performed in accordance with DOT regulations CFR Title 49, Section 173.34.

Nitrogen cylinders shall not be recharged and shipped without hydrostatic test if more than five years has elapsed from the date of the last test.

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

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

7-4.2 Nitrogen Cylinder Replacement

WARNING

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

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

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

7-4.3 Nitrogen Cylinder Recharge

Nitrogen cylinders must be recharged when the cylinder pressure gauge indicates pressure is below normal (1800 PSIG at 70°F [124 bar gauge at 21°C] or as adjusted for temperature) or immediately after discharge. Nitrogen used for charging must comply with Federal Specification BB-N-411C, Grade A, Type 1. Copies of this specification may be obtained from: Global Engineering Documents, 2625 S. Hickory St., Santa Ana, CA 92707.

WARNING

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

Recharge the nitrogen cylinders as follows:

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

7-4.4 Nitrogen Cylinder Installation

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

CAUTION

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

4. Securely tighten the mounting bracket clamps and hardware.
5. Remove the pipe plug, reconnect the adapter (P/N 6992-0501) and flexible actuation hose or tubing to the cylinder valve outlet port.
6. Remove the protective cap from the cylinder valve actuation port.

WARNING

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

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

7-5 NITROGEN PILOT (SIREN) CYLINDER SERVICE AND MAINTENANCE, P/NS 90-102300-100 AND 90-101040-000

WARNING

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

7-5.1 Nitrogen Cylinder Hydrostatic Pressure Test

Hydrostatic test must be performed in accordance with DOT regulations CFR Title 49, Paragraph 173.34. Nitrogen pilot cylinders must not be recharged and shipped without hydrostatic test if more than five years has elapsed from the date of the last test. Nitrogen pilot cylinders continuously in service without discharging can be retained in service for a maximum of five years from the date of the last hydrostatic test. At the end of five years, the cylinder must be visually inspected per CGA pamphlet C-6. Cylinders must also be hydrostatic pressure tested immediately if the cylinder shows evidence of distortion, cracking, corrosion, or mechanical and/or fire damage.

7-5.2 Nitrogen Cylinder Replacement

WARNING

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

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

1. Remove the control head from the nitrogen cylinder valve.
2. Immediately install the protection cap on the nitrogen pilot cylinder actuation port.
3. Remove discharge head from cylinder valve.
4. Remove clamps and hardware securing nitrogen cylinder to the mounting bracket.

7-5.3 Nitrogen Cylinder Recharge

Nitrogen cylinders must be recharged when the cylinder pressure gauge indicates pressure is 10% below normal (1800 PSIG at 70°F [124 bar gauge @ 21°C] as adjusted for temperature as shown in Figure 7-10) or immediately after discharge. Nitrogen used for charging must comply with Federal Specification BB-N-411C, Grade A, Type 1. Copies of this specification may be obtained from: Global Engineering Documents, 2625 S. Hickory St., Santa Ana, CA 92707.

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.

Recharge nitrogen cylinders as follows:

1. Remove the protection cap from the cylinder valve actuation port.
2. Install the nitrogen cylinder recharge adapter (P/N 933537) to the cylinder valve actuation port and plug valve outlet port with 1/8-inch NPT pipe plug.

Note: The pressure gauge attached to the extinguishing system is not to be used to determine when the intended charging pressure has been reached.

A pressure regulator is to be used per UL-2166.

3. Connect the nitrogen recharging supply hose to the adapter. Tighten securely.
4. Open the nitrogen recharging control valve slowly until full nitrogen flow is obtained.
5. Monitor the recharging supply pressure gauge. Close the charging control valve when the gauge indicates proper cylinder pressure (1800 PSIG @ 70°F [124 bar gauge @ 21°C]) or until the mass of nitrogen reaches the number referenced in the Table 7-9.

Table 7-9. Nitrogen Fill Weights

Part Number	Description	Fill Weight (lb.) Nominal
90-101040-000	1040 cu. in. nitrogen cylinder	5.7
90-102300-100	2300 cu. in. nitrogen cylinder	12.2

6. Allow the cylinder to cool to ambient temperature and recheck the nitrogen cylinder indicated pressure.
7. Open valve and add additional nitrogen as needed to obtain full cylinder charge at ambient temperature (1800 PSIG @ 70°F [124 bar gauge @ 21°C]).
8. Close valve and remove supply hose and charging adapter from nitrogen pilot cylinder.
9. Check the nitrogen cylinder valve for leakage using a soap solution. Bubbles appearing in the soap solution indicate leakage and shall be cause for rejection of cylinder.
10. After the leak test is completed, thoroughly clean and dry the cylinder valve.
11. Ensure the cylinder valve control head port is clean and dry.
12. Immediately install the protective cap to the actuation port of the cylinder valve.
13. Install the charged cylinder as directed in Paragraph 6-8.

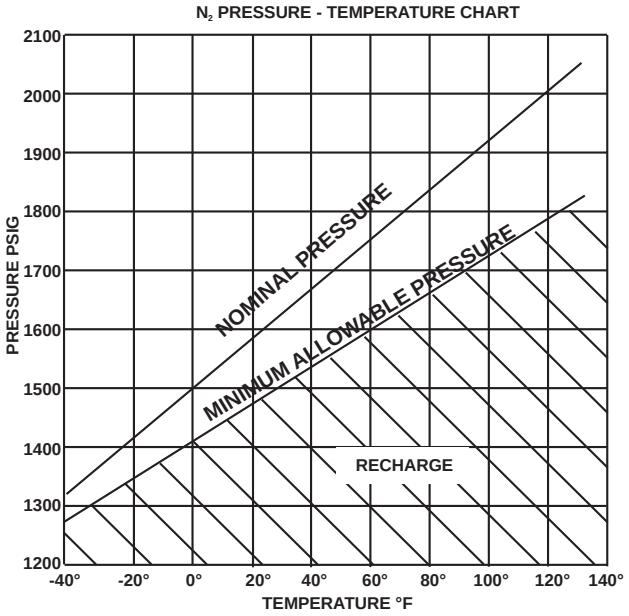

Figure 7-7. Nitrogen Temperature vs. Pressure Data

7-5.4 Nitrogen Cylinder I-Valve Inspection and Services

Inspect and service the Nitrogen I-Valve as follows:

Note: After every discharge, certain components in the Nitrogen I-Valve assembly will have to be serviced and inspected before recharging the Cylinder/Valve Assembly. Part numbers for items which may require replacement are listed in Table 7-10.

7-5.4.1 VALVE DISASSEMBLY

Note: Refer to Figure 7-8 and Table 7-10.

WARNING **Before disassembly of valve, relieve all pressure from the cylinder. Contents under pressure can cause personal injury or property damage.**

1. Remove valve seat (P/N 202490).
2. Remove copper sealing gasket (P/N 32642).
3. Remove main check assembly and spring (P/Ns 800760 and 32641).
4. Remove sleeve retainer, brass sleeve and pilot check assembly (P/Ns 202804, 202805 and 923066 respectively).
5. Examine rubber portions of main check and pilot check assemblies. If any nicks, chips or dirt is found, the checks should be replaced with new parts before the cylinder and valve assembly is recharged.

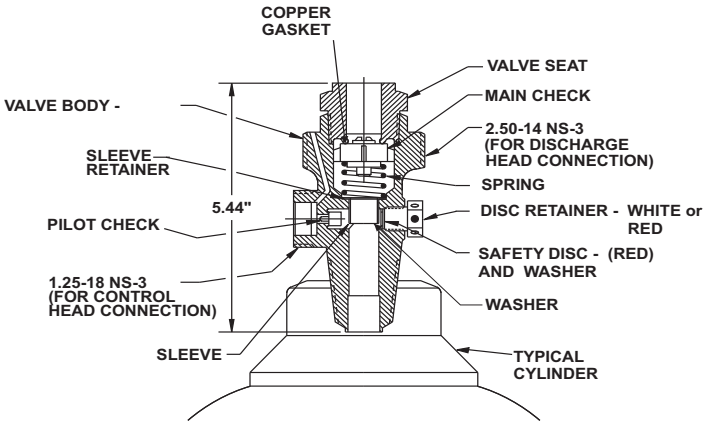

Figure 7-8. 5/8-inch I-Valve for Nitrogen Cylinder

Table 7-10. I-Valve Components

Part Number	Description	Qty.
WK-923066-000	Pilot Check Assembly	1
WK-202805-000	Brass Sleeve	1
WK-202804-000	Sleeve Retainer	1
WK-326410-000	Spring	1
WK-800760-000	Main Check Assembly–5/8 in. I-Valve	1
WK-326420-000	Copper Gasket	1
WK-202490-000	Valve Seat	1
WF-368200-000	Safety Disc (White for 2300 cu. in. driver)	1
WK-294500-000	Washer	1

7-5.4.2 NITROGEN CYLINDER I-VALVE ASSEMBLY

After each part has been thoroughly inspected, assemble the valve in the following order:

1. Pilot Check Assembly.
2. Brass Sleeve.
3. Sleeve Retainer.
4. Spring.

Note: The main check assembly is installed with the rubber seat facing up. The copper sealing gasket MUST be replaced when the valve seat is removed. Refer to Figure 7-8.

5. Main Check Assembly.
6. New Copper Gasket (rounded side up). Apply a lubricant to the gasket before replacing.
7. Valve Seat. Torque to 150 ± 15 ft. lb. (203 ± 20 N-m).

7-5.4.3 SAFETY DISC REPLACEMENT

1. Remove the safety disc retainer, along with the safety disc and safety disc washer from the valve body.
2. Assemble the safety disc retainer, the new safety disc and the new safety disc washer to the valve body. Refer to Table 7-11 for torque valves.

WARNING

Never install any type disc other than the specified compliment for the cylinder. Installing the incorrect disc could result in violent rupture of the cylinder causing serious personal injury.

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

Table 7-11. Safety Disc Replacements for the I-Valve

Nitrogen Cylinder	Safety Disc and Washer P/N	Safety Disc Retainer Nut P/N	Torque Valve	PSIG @ 70°F
90-102300-100	81-902048-000 (white)	WK-220034-000	350 ± 35 in. lb.	2900-3250
90-101040-000	81-902048-000 (white)	WK-220034-000	350 ± 35 in. lb.	2900-3250

7-5.4.4 DISCHARGE HEAD INSPECTION AND SERVICE

Note: After every discharge, certain components in the Discharge Head Assembly MUST be inspected and serviced before recommissioning the Nitrogen Cylinder. Part numbers for the items which may require replacement are listed in Table 7-12.

1. Remove top cap using a suitable wrench.
2. Inspect packing o-ring (P/N 209180). Replace if o-ring shows any sign of damage or deterioration.
3. Lubricate packing o-ring (P/N 209180) and reinstall top cap. Tighten to 25 to 50 ft. lb. (35 to 70 N-m).
4. Examine inner and outer packing o-ring (P/N 242466 and 242467 respectively) located concentrically on the bottom of the discharge head body.
5. Apply lubricant to both o-rings prior to attaching to I-valve (refer to Table 7-2 for lubricant recommendations).

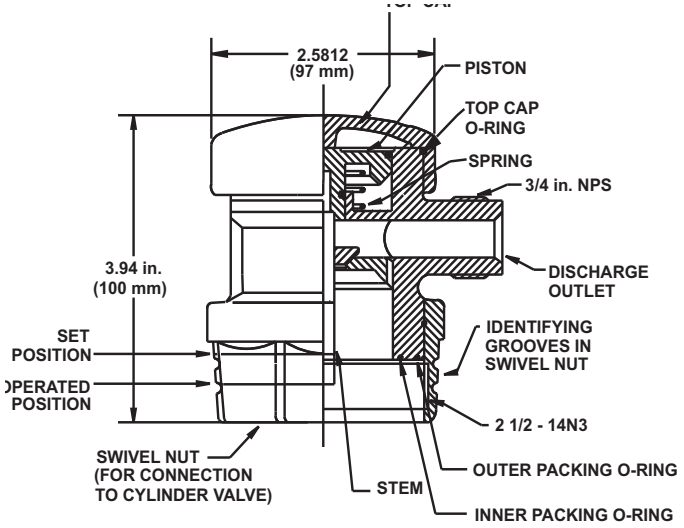

Figure 7-9. Discharge Head (Grooved Nut Shown)

Table 7-12. Discharge Head O-Ring Part Numbers

Part Number	Description	Qty.
WF-242466-000	Outer Packing O-Ring	1
WF-242467-000	Inner Packing O-Ring	1
WF-209180-000	Packing O-Ring, Top Cap	1

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CHAPTER 8
PARTS LIST

8-1 INTRODUCTION AND PARTS LIST

The table below, and on the following pages, provides a complete list of Kidde Engineered Fire Suppression System designed for use with 3M™ Novec™ 1230 Fire Protection Fluid parts and associated system equipment. Kidde Engineered System equipment can be ordered as complete assemblies or as individual items. In most situations, when ordering a system, it will be easier and more cost effective to order by assembly part numbers.

Table 8-1. Parts List

Nomenclature	Part Number
Cylinder Valve Assemblies, Vertical Mount Only	
10 lb. STD	45-200010-001
20 lb. STD	45-200020-001
40 lb. STD	45-200040-001
70 lb. STD	45-200070-001
125 lb. STD 125 lb. w/ LLI	45-200125-001 45-200121-001
200 lb. STD 200 lb. w/ LLI	45-200200-001 45-200201-001
350 lb. STD 350 lb. w/ LLI	45-200350-001 45-200351-001
600 lb. STD 600 lb. w/ LLI	45-200600-001 45-200601-001
900 lb. STD 900 lb. w/ LLI	45-200900-001 45-200901-001
Liquid Level Indicator (LLI) for 125 lb. Cylinder and Valve Assembly	06-235681-001
Liquid Level Indicator (LLI) for 200 lb., 350 lb. and 600 lb. Cylinder and Valve Assembly	WK-283894-000
Liquid Level Indicator (LLI) for 900lb. Cylinder and Valve Assembly	06-118266-001
Flexible Discharge Hoses	
10 to 125 lb. Cylinders	WK-283898-000
200 to 350 lb. Cylinders	WK-283899-000
600 to 900 lb. Cylinders	06-118225-001
Valve Outlet Adapters	
10 to 125 lb. Cylinders	WK-283904-000
200 to 350 lb. Cylinders	WK-283905-000
Cylinder Straps	
10 to 20 lb.	WK-283945-000
40 to 70 lb.	WK-283934-000

Table 8-1. Parts List (Continued)

Nomenclature	Part Number
125 and 200 lb.	06-235317-001
350 lb.	WK-281866-000
600 lb.	WK-294651-000
900 lb.	06-236125-001
Cradles	
125 lb. and 200 lb.	06-235431-001
350 lb.	WK-281867-000
600 lb.	WK-294652-000
900 lb.	06-118300-001
Control Heads	
Pneumatic 3 in. (5 sec.)	81-872335-000
Pneumatic 6 in. (5 sec.)	81-872365-000
Pneumatic 6 in. (2 sec.)	81-872362-000
Pneumatic 3 in. (Tandem)	81-872330-000
Pneumatic 6 in. (Tandem)	81-872360-000
Lever Operated	WK-870652-000
Pressure Operated	82-878737-000
Pressure Operated, Stackable	82-878750-000
Lever/Pressure Operated	82-878751-000
Cable Operated	81-979469-000
Pressure Control Equipment	
Master Cylinder Adapter Kit	82-844895-000
Male Branch Tee, 5/16 in. Flare x 1/8 in. NPT	WK-699205-050
Male Elbow, 5/16 in. Flare x 1/8 in. NPT	WK-699205-030
Male Connector, 5/16 in. Flare x 1/8 in. NPT	WK-699205-010
Actuation Hose, 22 in. (10 to 200 lb. Cylinder)	WK-264987-000
Actuation Hose, 30 in. (350 to 900 lb. Cylinder)	WK-264986-000
Nitrogen Pilot Cylinder Nitrogen Pilot Cylinder w/ Powered Supervisory Switch	WK-877940-000 WK-877940-200
Mounting Bracket, Nitrogen Pilot Cylinder	WK-877845-000
Nitrogen Pilot Cylinder (w/ NO Contact Supervisory Switch)	06-129773-001
Nitrogen Pilot Cylinder (w/ NC Contact Supervisory Switch)	06-129773-002
1040 cu. in. Nitrogen Cylinder (Pilot, Siren Driver) 1040 cu. in. Nitrogen Cylinder (Pilot, Siren Driver) w/ Supervisory Switch	90-101040-000 90-101040-200
2300 cu. in. Nitrogen Siren Driver Cylinder 2300 cu. in. Nitrogen Siren Driver Cylinder w/ Supervisory Switch	90-102300-100 90-102300-200
Pressure Operated Siren	90-981574-001
Nitrogen Time Delay for use with 108 cu. in. Pilot Cylinder (nom. 34 sec. delay)	81-871072-001
Nitrogen Time Delay for use with 108 cu. in. Pilot Cylinder (nom. 61 sec. delay)	81-871072-002
Nitrogen Time Delay for use with 1040 cu. in. Pilot Cylinder (nom. 35 sec. delay)	81-871072-003

Table 8-1. Parts List (Continued)

Nomenclature	Part Number
Nitrogen Time Delay for use with 1040 cu. in. Pilot Cylinder (nom. 68 sec. delay)	81-871072-004
Flexible Nitrogen Discharge Hose, 14.75 in. long, 3/4 in. NPT	06-118207-002
Flexible Nitrogen Discharge Hose, 18.00 in. long, 3/4 in. NPT	06-118207-001
Heavy-Duty Actuation Hose, Stainless Steel 34.00 in. Long	06-236215-001
Nitrogen Discharge Head, Plain Nut	WK-872450-000
Nitrogen Discharge Head, Grooved Nut	81-872442-000
Nitrogen Cylinder Straps, Single	WK-270014-000
Nitrogen Cylinder, Double	WK-241219-000
Nitrogen Actuation Circuit Vent	WK-284051-000
Pilot Nitrogen Ball Valve	WK-283888-000
“Y” Fitting	81-207877-000
Switch-in-Gauge	06-118238-001
Dual-Loop Fitting Kit	06-129978-001
Fitting: 1/4 in. NPT M x 1/8 in. NPT F	06-118318-001
Fitting: 4-Way 1/4 in. NPT F	06-118319-001
Fitting: 1/4 in. NPT M x 1/4 in. NPT M	06-118320-001
Fitting: 1/8 in. NPT M x 1/8 in. NPT M	06-118321-001
Fitting: 1/8 in. NPT M x 7/16 in. SAE Flare	06-118191-001
Bleed: 1/8 in. NPT M x 7/16 in. SAE Flare	WK-263303-000
Bleed Cap: 7/16 in. SAE Flare	WK-263304-000
Safety Outlet, Novec 1230 Fluid	82-844346-000
Safety Outlet, Nitrogen/Carbon Dioxide	81-803242-000
Remote Control Equipment, Cable Operated	
Corner Pulley, Watertight	81-803808-000
1/16 in. Cable, 100 ft. roll	06-118316-000
Z-Bracket	81-605320-000
Adapter, 1/2 in. EMT	WK-843837-000
Dual-Pull Equalizer	81-840051-000
Dual-Pull Mechanism	81-840058-000
Cable Pull Station, Surface Mount	81-871403-000
Cable Pull Station, Watertight	81-870087-000
Cable Pull Station, Yacht Type	81-840098-000
Pneumatic Control Equipment	
Pneumatic Heat Detector	WK-841241-000
Pneumatic Tubing, 3/16 in. (17 in.)	81-802366-000
Pneumatic Tubing, 3/16 in. (46 in.)	81-802367-000
Pneumatic Tubing, 3/16 in. (12')	WK-802486-000
Tubing Nut, 3/16 in.	WF-528103-000
3/16 in. Union, without Nuts	WK-528103-600

Table 8-1. Parts List (Continued)

Nomenclature	Part Number
3/16 in. x 1/8 in. Reducing Union	81-802536-000
3/16 in. Tee without Nuts	WK-528103-700
Ancillary Equipment	
Supervisory Pressure Switch (10 to 350 lb. Cylinders)	06-118262-001
Supervisory Pressure Switch (600 to 900 lb. Cylinders)	06-118263-001
Pressure Operated Switch, Standard	81-486536-000
Pressure Operated Switch, Explosion Proof	81-981332-000
Pressure Operated Trip	81-874290-000
Discharge Indicator, 3/4 in. (Brass)	81-967082-000
Stop Valves	
Stop Valve, 1/2 in. NPT	81-870023-000
Stop Valve, 3/4 in. NPT	81-870022-000
Stop Valve, 1 in. NPT	81-870122-000
Stop Valve, 1¼ in. NPT	81-870032-000
Stop Valve, 1½ in. NPT	81-870123-000
Stop Valve, 2'' NPT	81-870049-000
Stop Valve, 2½ and 3 in.	81-870123-000
Stop Valve, 4 in. Flanged	81-890208-000
Check Valves	
Check Valve, 1/4 in. NPT	WK-264985-000
Check Valve, 3/8 in. NPT	WK-261193-000
Check Valve, 1/2 in. NPT	81-800327-000
Check Valve, 3/4 in. NPT	81-800266-000
Check Valve, 1 in. NPT	WK-800443-000
Check Valve, 1¼ in. NPT	81-800444-000
Check Valve, 1½ in. NPT	81-870152-000
Check Valve, 2 in. NPT	81-870151-000
Check Valve, 3 in. NPT	81-870100-000
Swing Check Valve, 2 in. NPT	06-118213-001
Swing Check Valve, 3 in. NPT	06-118058-001
Manifold El-Check Valve, 2 in. NPT	WK-877690-000
Manifold El-Check Valve, 2½ in. NPT	82-878743-000
Cross-Over Valves	
Cross-Over Valve, 3 in.	90-300007-000
Cross-Over Valve, 4 in.	90-300008-000
Cylinder Recharge Adapters	
Cylinder Size: 10 to 125 lb.	82-878757-000
Cylinder Size: 200 and 350 lb.	82-878758-000
Name Plate	

Table 8-1. Parts List (Continued)

Nomenclature	Part Number
“Main”	WK-31033-000
"Reserve"	WK-31034-000
"Warning Novec 1230 Fluid"	06-231866-760
“Agent Release”	WK-218270-000

8-2 DISCHARGE NOZZLES

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

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

1/4 in. nozzles are not UL listed. All other nozzles are listed by UL.

Table 8-2. UL Listed 180 Degree Brass Nozzles

Drill	Area	1/4 in. NPT	3/8 in. NPT	1/2 in. NPT	3/4 in. NPT	1 in. NPT	1-1/4 in. NPT	1-1/2 in. NPT	2 in. NPT
53	0.0223	45-194711-100							
1/16	0.0246	45-194711-101							
52	0.0254	45-194711-102							
51	0.0283	45-194711-103							
50	0.0308	45-194711-104							
49	0.0335	45-194711-105							
48	0.0363	45-194711-106							
5/64	0.0384	45-194711-107	45-194712-107						
47	0.0388	45-194711-108	45-194712-108						
46	0.0413	45-194711-109	45-194712-109						
45	0.0423	45-194711-110	45-194712-110						
44	0.0465		45-194712-111						
43	0.0498		45-194712-112						
42	0.055		45-194712-113						
3/32	0.0553		45-194712-114						
41	0.058		45-194712-115						
40	0.0604		45-194712-116						
39	0.0623		45-194712-117	45-194713-117					
38	0.0648		45-194712-118	45-194713-118					
37	0.068		45-194712-119	45-194713-119					
36	0.0713		45-194712-120	45-194713-120					
7/64	0.0752		45-194712-121	45-194713-121					
35	0.0761		45-194712-122	45-194713-122					
34	0.0775		45-194712-123	45-194713-123					
33	0.0803		45-194712-124	45-194713-124					
32	0.0846		45-194712-125	45-194713-125					
31	0.0905		45-194712-126	45-194713-126					
1/8	0.0982		45-194712-127	45-194713-127					
30	0.1038		45-194712-128	45-194713-128					
29	0.1163		45-194712-129	45-194713-129	45-194714-129				
28	0.1241			45-194713-130	45-194714-130				
9/64	0.1243			45-194713-131	45-194714-131				
27	0.1303			45-194713-132	45-194714-132				
26	0.1358			45-194713-133	45-194714-133				

Table 8-2. UL Listed 180 Degree Brass Nozzles

Drill	Area	1/4 in. NPT	3/8 in. NPT	1/2 in. NPT	3/4 in. NPT	1 in. NPT	1-1/4 in. NPT	1-1/2 in. NPT	2 in. NPT
25	0.1405			45-194713-134	45-194714-134				
24	0.1452			45-194713-135	45-194714-135				
23	0.1491			45-194713-136	45-194714-136				
5/32	0.1534			45-194713-137	45-194714-137				
22	0.1549			45-194713-138	45-194714-138				
21	0.1589			45-194713-139	45-194714-139				
20	0.1629			45-194713-140	45-194714-140				
19	0.1732			45-194713-141	45-194714-141	45-194715-141			
18	0.1806			45-194713-142	45-194714-142	45-194715-142			
11/64	0.1857			45-194713-143	45-194714-143	45-194715-143			
17	0.1881			45-194713-144	45-194714-144	45-194715-144			
16	0.1969			45-194713-145	45-194714-145	45-194715-145			
15	0.2036			45-194713-146	45-194714-146	45-194715-146			
14	0.2082			45-194713-147	45-194714-147	45-194715-147			
13	0.2151				45-194714-148	45-194715-148			
3/16	0.2209				45-194714-149	45-194715-149			
12	0.2245				45-194714-150	45-194715-150			
11	0.2293				45-194714-151	45-194715-151			
10	0.2353				45-194714-152	45-194715-152			
9	0.2414				45-194714-153	45-194715-153			
8	0.2489				45-194714-154	45-194715-154			
7	0.2539				45-194714-155	45-194715-155			
13/64	0.2592				45-194714-156	45-194715-156			
6	0.2615				45-194714-157	45-194715-157			
5	0.2654				45-194714-158	45-194715-158			
4	0.2745				45-194714-159	45-194715-159			
3	0.2851				45-194714-160	45-194715-160			
7/32	0.3008				45-194714-161	45-194715-161	45-194716-161		
2	0.3069				45-194714-162	45-194715-162	45-194716-162		
1	0.3267				45-194714-163	45-194715-163	45-194716-163		
A	0.3441				45-194714-164	45-194715-164	45-194716-164		
15/64	0.3453				45-194714-165	45-194715-165	45-194716-165		
B	0.356				45-194714-166	45-194715-166	45-194716-166		
C	0.368				45-194714-167	45-194715-167	45-194716-167		
D	0.3803				45-194714-168	45-194715-168	45-194716-168		
E	0.3927				45-194714-169	45-194715-169	45-194716-169		
F	0.415				45-194714-170	45-194715-170	45-194716-170	45-194717-170	
G	0.4281					45-194715-171	45-194716-171	45-194717-171	
17/64	0.4433					45-194715-172	45-194716-172	45-194717-172	
H	0.4446					45-194715-173	45-194716-173	45-194717-173	
I	0.4649					45-194715-174	45-194716-174	45-194717-174	
J	0.4822					45-194715-175	45-194716-175	45-194717-175	
K	0.4962					45-194715-176	45-194716-176	45-194717-176	
9/32	0.4969					45-194715-177	45-194716-177	45-194717-177	

Table 8-2. UL Listed 180 Degree Brass Nozzles

Drill	Area	1/4 in. NPT	3/8 in. NPT	1/2 in. NPT	3/4 in. NPT	1 in. NPT	1-1/4 in. NPT	1-1/2 in. NPT	2 in. NPT
L	0.5285					45-194715-178	45-194716-178	45-194717-178	
M	0.5468					45-194715-179	45-194716-179	45-194717-179	
19/64	0.5539					45-194715-180	45-194716-180	45-194717-180	
N	0.5731					45-194715-181	45-194716-181	45-194717-181	
5/16	0.6136					45-194715-182	45-194716-182	45-194717-182	
O	0.6275					45-194715-183	45-194716-183	45-194717-183	
P	0.6556					45-194715-184	45-194716-184	45-194717-184	
21/64	0.6764					45-194715-185	45-194716-185	45-194717-185	45-194718-185
Q	0.6926					45-194715-186	45-194716-186	45-194717-186	45-194718-186
R	0.7221					45-194715-187	45-194716-187	45-194717-187	45-194718-187
11/32	0.7427						45-194716-188	45-194717-188	45-194718-188
S	0.761						45-194716-189	45-194717-189	45-194718-189
T	0.8053						45-194716-190	45-194717-190	45-194718-190
23/64	0.8116						45-194716-191	45-194717-191	45-194718-191
U	0.8509						45-194716-192	45-194717-192	45-194718-192
3/8	0.8836						45-194716-193	45-194717-193	45-194718-193
V	0.8931						45-194716-194	45-194717-194	45-194718-194
W	0.9362						45-194716-195	45-194717-195	45-194718-195
25/64	0.9587						45-194716-196	45-194717-196	45-194718-196
X	0.9903						45-194716-197	45-194717-197	45-194718-197
Y	1.0256						45-194716-198	45-194717-198	45-194718-198
13/32	1.0368						45-194716-199	45-194717-199	45-194718-199
Z	1.0718						45-194716-200	45-194717-200	45-194718-200
27/64	1.1185						45-194716-201	45-194717-201	45-194718-201
7/16	1.2027						45-194716-202	45-194717-202	45-194718-202
29/64	1.29							45-194717-203	45-194718-203
15/32	1.3809							45-194717-204	45-194718-204
31/64	1.4744							45-194717-205	45-194718-205
1/2	1.5708							45-194717-206	45-194718-206
33/64	1.6704							45-194717-207	45-194718-207
17/32	1.773								45-194718-208
35/64	1.8794								45-194718-209
9/16	1.9881								45-194718-210
37/64	2.0999								45-194718-211
19/32	2.2155								45-194718-212
39/64	2.3334								45-194718-213
5/8	2.4544								45-194718-214
41/64	2.5785								45-194718-215
21/32	2.7056								45-194718-216
43/64	2.8366								45-194718-217

Table 8-3. UL Listed 360 Degree Brass Nozzles

Drill	Area	1/4 in. NPT	3/8 in. NPT	1/2 in. NPT	3/4 in. NPT	1 in. NPT	1-1/4 in. NPT	1-1/2 in. NPT	2 in. NPT
53	0.0223	45-194721-100							
1/16	0.0246	45-194721-101							
52	0.0254	45-194721-102							
51	0.0283	45-194721-103							
50	0.0308	45-194721-104							
49	0.0335	45-194721-105							
48	0.0363	45-194721-106							
5/64	0.0384	45-194721-107	45-194722-107						
47	0.0388	45-194721-108	45-194722-108						
46	0.0413	45-194721-109	45-194722-109						
45	0.0423	45-194721-110	45-194722-110						
44	0.0465	45-194721-111	45-194722-111						
43	0.0498	45-194721-112	45-194722-112						
42	0.055	45-194721-113	45-194722-113						
3/32	0.0553	45-194721-114	45-194722-114						
41	0.058	45-194721-115	45-194722-115						
40	0.0604	45-194721-116	45-194722-116						
39	0.0623	45-194721-117	45-194722-117	45-194723-117					
38	0.0648	45-194721-118	45-194722-118	45-194723-118					
37	0.068	45-194721-119	45-194722-119	45-194723-119					
36	0.0713	45-194721-120	45-194722-120	45-194723-120					
7/64	0.0752	45-194721-121	45-194722-121	45-194723-121					
35	0.0761	45-194721-122	45-194722-122	45-194723-122					
34	0.0775	45-194721-123	45-194722-123	45-194723-123					
33	0.0803		45-194722-124	45-194723-124					
32	0.0846		45-194722-125	45-194723-125					
31	0.0905		45-194722-126	45-194723-126					
1/8	0.0982		45-194722-127	45-194723-127					
30	0.1038		45-194722-128	45-194723-128					
29	0.1163		45-194722-129	45-194723-129	45-194724-129				
28	0.1241		45-194722-130	45-194723-130	45-194724-130				
9/64	0.1243		45-194722-131	45-194723-131	45-194724-131				
27	0.1303		45-194722-132	45-194723-132	45-194724-132				
26	0.1358		45-194722-133	45-194723-133	45-194724-133				
25	0.1405		45-194722-134	45-194723-134	45-194724-134				
24	0.1452		45-194722-135	45-194723-135	45-194724-135				
23	0.1491		45-194722-136	45-194723-136	45-194724-136				
5/32	0.1534		45-194722-137	45-194723-137	45-194724-137				
22	0.1549		45-194722-138	45-194723-138	45-194724-138				
21	0.1589		45-194722-139	45-194723-139	45-194724-139				
20	0.1629		45-194722-140	45-194723-140	45-194724-140				
19	0.1732			45-194723-141	45-194724-141	45-194725-141			
18	0.1806			45-194723-142	45-194724-142	45-194725-142			

Table 8-3. UL Listed 360 Degree Brass Nozzles

Drill	Area	1/4 in. NPT	3/8 in. NPT	1/2 in. NPT	3/4 in. NPT	1 in. NPT	1-1/4 in. NPT	1-1/2 in. NPT	2 in. NPT
11/64	0.1857			45-194723-143	45-194724-143	45-194725-143			
17	0.1881			45-194723-144	45-194724-144	45-194725-144			
16	0.1969			45-194723-145	45-194724-145	45-194725-145			
15	0.2036			45-194723-146	45-194724-146	45-194725-146			
14	0.2082			45-194723-147	45-194724-147	45-194725-147			
13	0.2151			45-194723-148	45-194724-148	45-194725-148			
3/16	0.2209			45-194723-149	45-194724-149	45-194725-149			
12	0.2245			45-194723-150	45-194724-150	45-194725-150			
11	0.2293			45-194723-151	45-194724-151	45-194725-151			
10	0.2353			45-194723-152	45-194724-152	45-194725-152			
9	0.2414			45-194723-153	45-194724-153	45-194725-153			
8	0.2489			45-194723-154	45-194724-154	45-194725-154			
7	0.2539			45-194723-155	45-194724-155	45-194725-155			
13/64	0.2592			45-194723-156	45-194724-156	45-194725-156			
6	0.2615				45-194724-157	45-194725-157			
5	0.2654				45-194724-158	45-194725-158			
4	0.2745				45-194724-159	45-194725-159			
3	0.2851				45-194724-160	45-194725-160			
7/32	0.3008				45-194724-161	45-194725-161	45-194726-161		
2	0.3069				45-194724-162	45-194725-162	45-194726-162		
1	0.3267				45-194724-163	45-194725-163	45-194726-163		
A	0.3441				45-194724-164	45-194725-164	45-194726-164		
15/64	0.3453				45-194724-165	45-194725-165	45-194726-165		
B	0.356				45-194724-166	45-194725-166	45-194726-166		
C	0.368				45-194724-167	45-194725-167	45-194726-167		
D	0.3803				45-194724-168	45-194725-168	45-194726-168		
E	0.3927				45-194724-169	45-194725-169	45-194726-169		
F	0.415				45-194724-170	45-194725-170	45-194726-170	45-194727-170	
G	0.4281				45-194724-171	45-194725-171	45-194726-171	45-194727-171	
17/64	0.4433				45-194724-172	45-194725-172	45-194726-172	45-194727-172	
H	0.4446				45-194724-173	45-194725-173	45-194726-173	45-194727-173	
I	0.4649					45-194725-174	45-194726-174	45-194727-174	
J	0.4822					45-194725-175	45-194726-175	45-194727-175	
K	0.4962					45-194725-176	45-194726-176	45-194727-176	
9/32	0.4969					45-194725-177	45-194726-177	45-194727-177	
L	0.5285					45-194725-178	45-194726-178	45-194727-178	
M	0.5468					45-194725-179	45-194726-179	45-194727-179	
19/64	0.5539					45-194725-180	45-194726-180	45-194727-180	
N	0.5731					45-194725-181	45-194726-181	45-194727-181	
5/16	0.6136					45-194725-182	45-194726-182	45-194727-182	
O	0.6275					45-194725-183	45-194726-183	45-194727-183	
P	0.6556					45-194725-184	45-194726-184	45-194727-184	
21/64	0.6764					45-194725-185	45-194726-185	45-194727-185	45-194728-185
Q	0.6926					45-194725-186	45-194726-186	45-194727-186	45-194728-186

Table 8-3. UL Listed 360 Degree Brass Nozzles

Drill	Area	1/4 in. NPT	3/8 in. NPT	1/2 in. NPT	3/4 in. NPT	1 in. NPT	1-1/4 in. NPT	1-1/2 in. NPT	2 in. NPT
R	0.7221					45-194725-187	45-194726-187	45-194727-187	45-194728-187
11/32	0.7427						45-194726-188	45-194727-188	45-194728-188
S	0.761						45-194726-189	45-194727-189	45-194728-189
T	0.8053						45-194726-190	45-194727-190	45-194728-190
23/64	0.8116						45-194726-191	45-194727-191	45-194728-191
U	0.8509						45-194726-192	45-194727-192	45-194728-192
3/8	0.8836						45-194726-193	45-194727-193	45-194728-193
V	0.8931						45-194726-194	45-194727-194	45-194728-194
W	0.9362						45-194726-195	45-194727-195	45-194728-195
25/64	0.9587						45-194726-196	45-194727-196	45-194728-196
X	0.9903						45-194726-197	45-194727-197	45-194728-197
Y	1.0256						45-194726-198	45-194727-198	45-194728-198
13/32	1.0368						45-194726-199	45-194727-199	45-194728-199
Z	1.0718						45-194726-200	45-194727-200	45-194728-200
27/64	1.1185						45-194726-201	45-194727-201	45-194728-201
7/16	1.2027						45-194726-202	45-194727-202	45-194728-202
29/64	1.29							45-194727-203	45-194728-203
15/32	1.3809							45-194727-204	45-194728-204
31/64	1.4744							45-194727-205	45-194728-205
1/2	1.5708							45-194727-206	45-194728-206
33/64	1.6704							45-194727-207	45-194728-207
17/32	1.773								45-194728-208
35/64	1.8794								45-194728-209
9/16	1.9881								45-194728-210
37/64	2.0999								45-194728-211
19/32	2.2155								45-194728-212
39/64	2.3334								45-194728-213
5/8	2.4544								45-194728-214
41/64	2.5785								45-194728-215
21/32	2.7056								45-194728-216
43/64	2.8366								45-194728-217

Table 8-4. 180 Degree Stainless Steel

Drill	Area	1/4 in. NPT	3/8 in. NPT	1/2 in. NPT	3/4 in. NPT	1 in. NPT	1-1/4 in. NPT	1-1/2 in. NPT	2 in. NPT
53	0.0223	45-194611-100							
1/16	0.0246	45-194611-101							
52	0.0254	45-194611-102							
51	0.0283	45-194611-103							
50	0.0308	45-194611-104							
49	0.0335	45-194611-105							
48	0.0363	45-194611-106							
5/64	0.0384	45-194611-107	45-194612-107						
47	0.0388	45-194611-108	45-194612-108						
46	0.0413	45-194611-109	45-194612-109						
45	0.0423	45-194611-110	45-194612-110						
44	0.0465		45-194612-111						
43	0.0498		45-194612-112						
42	0.055		45-194612-113						
3/32	0.0553		45-194612-114						
41	0.058		45-194612-115						
40	0.0604		45-194612-116						
39	0.0623		45-194612-117	45-194613-117					
38	0.0648		45-194612-118	45-194613-118					
37	0.068		45-194612-119	45-194613-119					
36	0.0713		45-194612-120	45-194613-120					
7/64	0.0752		45-194612-121	45-194613-121					
35	0.0761		45-194612-122	45-194613-122					
34	0.0775		45-194612-123	45-194613-123					
33	0.0803		45-194612-124	45-194613-124					
32	0.0846		45-194612-125	45-194613-125					
31	0.0905		45-194612-126	45-194613-126					
1/8	0.0982		45-194612-127	45-194613-127					
30	0.1038		45-194612-128	45-194613-128					
29	0.1163		45-194612-129	45-194613-129	45-194614-129				
28	0.1241			45-194613-130	45-194614-130				
9/64	0.1243			45-194613-131	45-194614-131				
27	0.1303			45-194613-132	45-194614-132				
26	0.1358			45-194613-133	45-194614-133				
25	0.1405			45-194613-134	45-194614-134				
24	0.1452			45-194613-135	45-194614-135				
23	0.1491			45-194613-136	45-194614-136				
5/32	0.1534			45-194613-137	45-194614-137				
22	0.1549			45-194613-138	45-194614-138				
21	0.1589			45-194613-139	45-194614-139				
20	0.1629			45-194613-140	45-194614-140				
19	0.1732			45-194613-141	45-194614-141	45-194615-141			
18	0.1806			45-194613-142	45-194614-142	45-194615-142			

Table 8-4. 180 Degree Stainless Steel

Drill	Area	1/4 in. NPT	3/8 in. NPT	1/2 in. NPT	3/4 in. NPT	1 in. NPT	1-1/4 in. NPT	1-1/2 in. NPT	2 in. NPT
11/64	0.1857			45-194613-143	45-194614-143	45-194615-143			
17	0.1881			45-194613-144	45-194614-144	45-194615-144			
16	0.1969			45-194613-145	45-194614-145	45-194615-145			
15	0.2036			45-194613-146	45-194614-146	45-194615-146			
14	0.2082			45-194613-147	45-194614-147	45-194615-147			
13	0.2151				45-194614-148	45-194615-148			
3/16	0.2209				45-194614-149	45-194615-149			
12	0.2245				45-194614-150	45-194615-150			
11	0.2293				45-194614-151	45-194615-151			
10	0.2353				45-194614-152	45-194615-152			
9	0.2414				45-194614-153	45-194615-153			
8	0.2489				45-194614-154	45-194615-154			
7	0.2539				45-194614-155	45-194615-155			
13/64	0.2592				45-194614-156	45-194615-156			
6	0.2615				45-194614-157	45-194615-157			
5	0.2654				45-194614-158	45-194615-158			
4	0.2745				45-194614-159	45-194615-159			
3	0.2851				45-194614-160	45-194615-160			
7/32	0.3008				45-194614-161	45-194615-161	45-194616-161		
2	0.3069				45-194614-162	45-194615-162	45-194616-162		
1	0.3267				45-194614-163	45-194615-163	45-194616-163		
A	0.3441				45-194614-164	45-194615-164	45-194616-164		
15/64	0.3453				45-194614-165	45-194615-165	45-194616-165		
B	0.356				45-194614-166	45-194615-166	45-194616-166		
C	0.368				45-194614-167	45-194615-167	45-194616-167		
D	0.3803				45-194614-168	45-194615-168	45-194616-168		
E	0.3927				45-194614-169	45-194615-169	45-194616-169		
F	0.415				45-194614-170	45-194615-170	45-194616-170	45-194617-170	
G	0.4281					45-194615-171	45-194616-171	45-194617-171	
17/64	0.4433					45-194615-172	45-194616-172	45-194617-172	
H	0.4446					45-194615-173	45-194616-173	45-194617-173	
I	0.4649					45-194615-174	45-194616-174	45-194617-174	
J	0.4822					45-194615-175	45-194616-175	45-194617-175	
K	0.4962					45-194615-176	45-194616-176	45-194617-176	
9/32	0.4969					45-194615-177	45-194616-177	45-194617-177	
L	0.5285					45-194615-178	45-194616-178	45-194617-178	
M	0.5468					45-194615-179	45-194616-179	45-194617-179	
19/64	0.5539					45-194615-180	45-194616-180	45-194617-180	
N	0.5731					45-194615-181	45-194616-181	45-194617-181	
5/16	0.6136					45-194615-182	45-194616-182	45-194617-182	
O	0.6275					45-194615-183	45-194616-183	45-194617-183	
P	0.6556					45-194615-184	45-194616-184	45-194617-184	
21/64	0.6764					45-194615-185	45-194616-185	45-194617-185	45-194618-185
Q	0.6926					45-194615-186	45-194616-186	45-194617-186	45-194618-186

Table 8-4. 180 Degree Stainless Steel

Drill	Area	1/4 in. NPT	3/8 in. NPT	1/2 in. NPT	3/4 in. NPT	1 in. NPT	1-1/4 in. NPT	1-1/2 in. NPT	2 in. NPT
R	0.7221					45-194615-187	45-194616-187	45-194617-187	45-194618-187
11/32	0.7427						45-194616-188	45-194617-188	45-194618-188
S	0.761						45-194616-189	45-194617-189	45-194618-189
T	0.8053						45-194616-190	45-194617-190	45-194618-190
23/64	0.8116						45-194616-191	45-194617-191	45-194618-191
U	0.8509						45-194616-192	45-194617-192	45-194618-192
3/8	0.8836						45-194616-193	45-194617-193	45-194618-193
V	0.8931						45-194616-194	45-194617-194	45-194618-194
W	0.9362						45-194616-195	45-194617-195	45-194618-195
25/64	0.9587						45-194616-196	45-194617-196	45-194618-196
X	0.9903						45-194616-197	45-194617-197	45-194618-197
Y	1.0256						45-194616-198	45-194617-198	45-194618-198
13/32	1.0368						45-194616-199	45-194617-199	45-194618-199
Z	1.0718						45-194616-200	45-194617-200	45-194618-200
27/64	1.1185						45-194616-201	45-194617-201	45-194618-201
7/16	1.2027						45-194616-202	45-194617-202	45-194618-202
29/64	1.29							45-194617-203	45-194618-203
15/32	1.3809							45-194617-204	45-194618-204
31/64	1.4744							45-194617-205	45-194618-205
1/2	1.5708							45-194617-206	45-194618-206
33/64	1.6704							45-194617-207	45-194618-207
17/32	1.773								45-194618-208
35/64	1.8794								45-194618-209
9/16	1.9881								45-194618-210
37/64	2.0999								45-194618-211
19/32	2.2155								45-194618-212
39/64	2.3334								45-194618-213
5/8	2.4544								45-194618-214
41/64	2.5785								45-194618-215
21/32	2.7056								45-194618-216
43/64	2.8366								45-194618-217

Table 8-5. 360 Degree Stainless Steel Nozzles

Drill	Area	1/4 in. NPT	3/8 in. NPT	1/2 in. NPT	3/4 in. NPT	1 in. NPT	1-1/4 in. NPT	1-1/2 in. NPT	2 in. NPT
53	0.0223	45-194621-100							
1/16	0.0246	45-194621-101							
52	0.0254	45-194621-102							
51	0.0283	45-194621-103							
50	0.0308	45-194621-104							
49	0.0335	45-194621-105							
48	0.0363	45-194621-106							
5/64	0.0384	45-194621-107	45-194622-107						
47	0.0388	45-194621-108	45-194622-108						
46	0.0413	45-194621-109	45-194622-109						
45	0.0423	45-194621-110	45-194622-110						
44	0.0465	45-194621-111	45-194622-111						
43	0.0498	45-194621-112	45-194622-112						
42	0.055	45-194621-113	45-194622-113						
3/32	0.0553	45-194621-114	45-194622-114						
41	0.058	45-194621-115	45-194622-115						
40	0.0604	45-194621-116	45-194622-116						
39	0.0623	45-194621-117	45-194622-117	45-194623-117					
38	0.0648	45-194621-118	45-194622-118	45-194623-118					
37	0.068	45-194621-119	45-194622-119	45-194623-119					
36	0.0713	45-194621-120	45-194622-120	45-194623-120					
7/64	0.0752	45-194621-121	45-194622-121	45-194623-121					
35	0.0761	45-194621-122	45-194622-122	45-194623-122					
34	0.0775	45-194621-123	45-194622-123	45-194623-123					
33	0.0803		45-194622-124	45-194623-124					
32	0.0846		45-194622-125	45-194623-125					
31	0.0905		45-194622-126	45-194623-126					
1/8	0.0982		45-194622-127	45-194623-127					
30	0.1038		45-194622-128	45-194623-128					
29	0.1163		45-194622-129	45-194623-129	45-194624-129				
28	0.1241		45-194622-130	45-194623-130	45-194624-130				
9/64	0.1243		45-194622-131	45-194623-131	45-194624-131				
27	0.1303		45-194622-132	45-194623-132	45-194624-132				
26	0.1358		45-194622-133	45-194623-133	45-194624-133				
25	0.1405		45-194622-134	45-194623-134	45-194624-134				
24	0.1452		45-194622-135	45-194623-135	45-194624-135				
23	0.1491		45-194622-136	45-194623-136	45-194624-136				
5/32	0.1534		45-194622-137	45-194623-137	45-194624-137				
22	0.1549		45-194622-138	45-194623-138	45-194624-138				
21	0.1589		45-194622-139	45-194623-139	45-194624-139				
20	0.1629		45-194622-140	45-194623-140	45-194624-140				
19	0.1732			45-194623-141	45-194624-141	45-194625-141			
18	0.1806			45-194623-142	45-194624-142	45-194625-142			

Table 8-5. 360 Degree Stainless Steel Nozzles

Drill	Area	1/4 in. NPT	3/8 in. NPT	1/2 in. NPT	3/4 in. NPT	1 in. NPT	1-1/4 in. NPT	1-1/2 in. NPT	2 in. NPT
11/64	0.1857			45-194623-143	45-194624-143	45-194625-143			
17	0.1881			45-194623-144	45-194624-144	45-194625-144			
16	0.1969			45-194623-145	45-194624-145	45-194625-145			
15	0.2036			45-194623-146	45-194624-146	45-194625-146			
14	0.2082			45-194623-147	45-194624-147	45-194625-147			
13	0.2151			45-194623-148	45-194624-148	45-194625-148			
3/16	0.2209			45-194623-149	45-194624-149	45-194625-149			
12	0.2245			45-194623-150	45-194624-150	45-194625-150			
11	0.2293			45-194623-151	45-194624-151	45-194625-151			
10	0.2353			45-194623-152	45-194624-152	45-194625-152			
9	0.2414			45-194623-153	45-194624-153	45-194625-153			
8	0.2489			45-194623-154	45-194624-154	45-194625-154			
7	0.2539			45-194623-155	45-194624-155	45-194625-155			
13/64	0.2592			45-194623-156	45-194624-156	45-194625-156			
6	0.2615				45-194624-157	45-194625-157			
5	0.2654				45-194624-158	45-194625-158			
4	0.2745				45-194624-159	45-194625-159			
3	0.2851				45-194624-160	45-194625-160			
7/32	0.3008				45-194624-161	45-194625-161	45-194626-161		
2	0.3069				45-194624-162	45-194625-162	45-194626-162		
1	0.3267				45-194624-163	45-194625-163	45-194626-163		
A	0.3441				45-194624-164	45-194625-164	45-194626-164		
15/64	0.3453				45-194624-165	45-194625-165	45-194626-165		
B	0.356				45-194624-166	45-194625-166	45-194626-166		
C	0.368				45-194624-167	45-194625-167	45-194626-167		
D	0.3803				45-194624-168	45-194625-168	45-194626-168		
E	0.3927				45-194624-169	45-194625-169	45-194626-169		
F	0.415				45-194624-170	45-194625-170	45-194626-170	45-194627-170	
G	0.4281				45-194624-171	45-194625-171	45-194626-171	45-194627-171	
17/64	0.4433				45-194624-172	45-194625-172	45-194626-172	45-194627-172	
H	0.4446				45-194624-173	45-194625-173	45-194626-173	45-194627-173	
I	0.4649					45-194625-174	45-194626-174	45-194627-174	
J	0.4822					45-194625-175	45-194626-175	45-194627-175	
K	0.4962					45-194625-176	45-194626-176	45-194627-176	
9/32	0.4969					45-194625-177	45-194626-177	45-194627-177	
L	0.5285					45-194625-178	45-194626-178	45-194627-178	
M	0.5468					45-194625-179	45-194626-179	45-194627-179	
19/64	0.5539					45-194625-180	45-194626-180	45-194627-180	
N	0.5731					45-194625-181	45-194626-181	45-194627-181	
5/16	0.6136					45-194625-182	45-194626-182	45-194627-182	
O	0.6275					45-194625-183	45-194626-183	45-194627-183	
P	0.6556					45-194625-184	45-194626-184	45-194627-184	
21/64	0.6764					45-194625-185	45-194626-185	45-194627-185	45-194628-185
Q	0.6926					45-194625-186	45-194626-186	45-194627-186	45-194628-186

Table 8-5. 360 Degree Stainless Steel Nozzles

Drill	Area	1/4 in. NPT	3/8 in. NPT	1/2 in. NPT	3/4 in. NPT	1 in. NPT	1-1/4 in. NPT	1-1/2 in. NPT	2 in. NPT
R	0.7221					45-194625-187	45-194626-187	45-194627-187	45-194628-187
11/32	0.7427						45-194626-188	45-194627-188	45-194628-188
S	0.761						45-194626-189	45-194627-189	45-194628-189
T	0.8053						45-194626-190	45-194627-190	45-194628-190
23/64	0.8116						45-194626-191	45-194627-191	45-194628-191
U	0.8509						45-194626-192	45-194627-192	45-194628-192
3/8	0.8836						45-194626-193	45-194627-193	45-194628-193
V	0.8931						45-194626-194	45-194627-194	45-194628-194
W	0.9362						45-194626-195	45-194627-195	45-194628-195
25/64	0.9587						45-194626-196	45-194627-196	45-194628-196
X	0.9903						45-194626-197	45-194627-197	45-194628-197
Y	1.0256						45-194626-198	45-194627-198	45-194628-198
13/32	1.0368						45-194626-199	45-194627-199	45-194628-199
Z	1.0718						45-194626-200	45-194627-200	45-194628-200
27/64	1.1185						45-194626-201	45-194627-201	45-194628-201
7/16	1.2027						45-194626-202	45-194627-202	45-194628-202
29/64	1.29							45-194627-203	45-194628-203
15/32	1.3809							45-194627-204	45-194628-204
31/64	1.4744							45-194627-205	45-194628-205
1/2	1.5708							45-194627-206	45-194628-206
33/64	1.6704							45-194627-207	45-194628-207
17/32	1.773								45-194628-208
35/64	1.8794								45-194628-209
9/16	1.9881								45-194628-210
37/64	2.0999								45-194628-211
19/32	2.2155								45-194628-212
39/64	2.3334								45-194628-213
5/8	2.4544								45-194628-214
41/64	2.5785								45-194628-215
21/32	2.7056								45-194628-216
43/64	2.8366								45-194628-217

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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: 162.161/9/0 Expires: 10 August 2017

ENGINEERED HALOCARBON FIRE EXT. SYSTEM

KIDDE-FENWAL INC.
400 MAIN STREET
ASHLAND MA 01721

NOVEC 1230 total flooding clean agent fixed fire extinguishing systems.

Fixed fire extinguishing systems for the protection of machinery spaces, cargo pump rooms, and other enclosed spaces with Class B and C hazards. Complies with IMO MSC/Circ.848 as amended by MSC.1/Circ. 1267. Not acceptable for cargo hold protection.

Identifying Data: Underwriters Laboratories, Inc. Reports: Project 01NK35595, File Ex6263 dated 23 September 2002; Project 04NK23160, File 4674 dated 1 February 2005; Project 04NK1456, File 4674 dated 2 February 2005; and Project 04NK23160, File 4674 dated 3 February 2005. Kidde-Fenwal Marine Design, Installation, Operation, and Maintenance Manual P/N 45-NOVMAR-001 revised June 2012, Kidde-Fenwal Flow Calculation Software Manual 45-NOVMAR-100 dated February 2005, and USCG letters dated 16 May 2005 and 10 August 2012.

Follow-up Program: UL.

Approval valid only for products from the above location.

Supersedes and extends certificate dated 16 May 2010 to indicate conformance with MSC.1/Circ. 1267, and recognize 2012 revisions to the approved 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 10th DAY OF AUGUST 2012, AT WASHINGTON D.C.

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

APPENDIX B
TYPICAL SYSTEM LAYOUTS

B-1 CYLINDERS LOCATED OUTSIDE THE PROTECTED SPACE

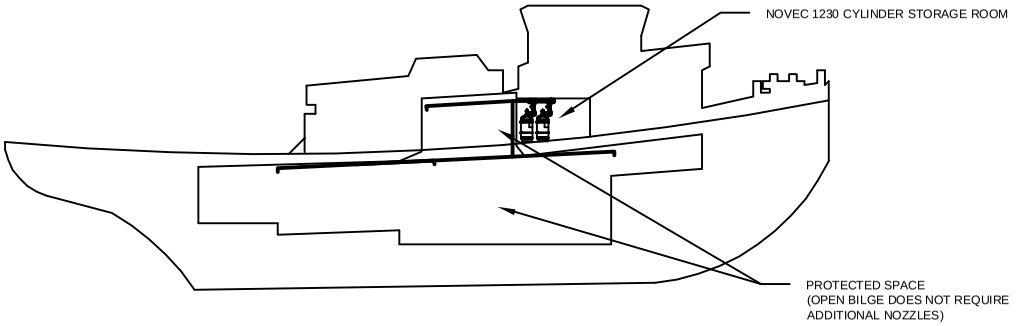
The material in this section is intended to illustrate a typical system and includes the drawings and flow calculation reports that would form part of the system documentation package.

Note: This format is a sample only and need not be followed exactly in order to comply with Approval requirements.

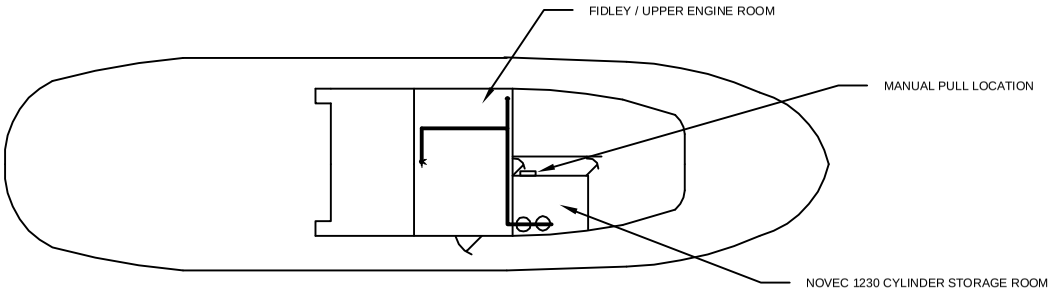
In the following example, the agent cylinders are located outside the protected space. This is typical of small to medium sized vessels.

BILL OF MATERIALS

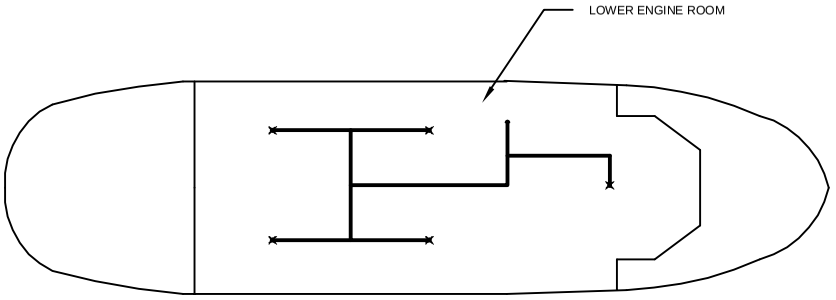
NO.	DESCRIPTION	QTY	PART NO.
1	900# NOVEC 1230 CYLINDER W/ LLI, FILLED TO 560#	2	45-200901-001
2	CYLINDER STRAP	4	236125
3	CYLINDER CRADLE	4	06-118300-001
4	3" SWING CHECK	2	06-118058-001
5	PULL BOX, SURFACE, 3/8" PIPE (BREAK GLASS)	2	871403
6	CORNER PULLEY, 3/8" PIPE (WATERTIGHT)	30	803808
7	1/16" CABLE, 100 FT ROLL	2	06-118316-100
8	CABLE OPERATED CONTROL HEAD	2	979469
9	NITROGEN PILOT CYLINDER, 108 CU.IN., NO PRESS SWITCH	2	877940
10	MOUNTING BRACKET, NITROGEN PILOT CYLINDER	2	877845
11	MALE CONNECTOR, 5/16" FLARE x 1/8" NPT	8	69920501
12	ACTUATION HOSE, 30"	5	264986
13	SAFETY OUTLET (N2 & CO2)	1	803242
14	1/2" STOP VALVE	1	870023
15	PRESSURE OPERATED SWITCH	1	486536
16	NITROGEN TIME DELAY (108 CU.IN. PILOT, 34 S DELAY)	1	81-871072-001
17	LEVER OPERATED CONTROL HEAD	1	870652
18	LEVER AND PRESSURE OPERATED CONTROL HEAD	2	878751
19	MALE ELBOW, 5/16" FLARE x 1/8" NPT	1	69920503
20	MASTER CYLINDER ADAPTER KIT	1	844895
21	PRESSURE OPERATED CONTROL HEAD	1	878737
22	180° NOVEC 1230 DISCHARGE NOZZLE, 1-1/4" NPT, 0.8509	1	45-194616-192
23	360° NOVEC 1230 DISCHARGE NOZZLE, 2" NPT, 1.3806	5	45-194628-204
24	SIREN NITROGEN PRESSURE OPERATED	1	90-981574-001



ELEVATION VIEW
NOT TO SCALE



PLAN VIEW - FIDLEY / UPPER ENGINE ROOM
NOT TO SCALE



PLAN VIEW - LOWER ENGINE ROOM
NOT TO SCALE

NOVEC 1230 SYSTEM DATA

HAZARD INFORMATION

HAZARD:	TUGBOAT
FIRE TYPE:	CLASS CLASS B - DIESEL
CONSTRUCTION:	STEEL
DESCRIPTION:	UPPER & LOWER ENGINE ROOM

SYSTEM INFORMATION

SYSTEM:	MANIFOLDED SYSTEM MAIN ONLY SYSTEM
CONTAINER:	900-LB CYLINDER W/3" VALVE AND LLI QTY: 2 P/N: 45-200901-001 FILL WEIGHT: 560 LBS.
NOZZLES:	SEE PLANS & NOZZLE CHART FOR TYPE, SIZE, LOCATION, AND PART NUMBER

ENCLOSURE INFORMATION

ENCLOSURE:	FIDLEY / UPPER ENGINE ROOM		
AREA:	N/A SQ.FT.	MIN. TEMP:	32 °F
HEIGHT:	N/A FT.	MAX. TEMP:	130 °F
VOLUME:	1,950 CU.FT.	MIN. AGENT REQ'D:	113.91 LBS.
DESIGN CONC.:	5.85 %	AGENT SUPPLIED:	115.98 LBS.

ENCLOSURE:	LOWER ENGINE ROOM		
AREA:	N/A SQ.FT.	MIN. TEMP:	32 °F
HEIGHT:	N/A FT.	MAX. TEMP:	130 °F
VOLUME:	17,100 CU.FT.	MIN. AGENT REQ'D:	998.87 LBS.
DESIGN CONC.:	5.85 %	AGENT SUPPLIED:	1004.02 LBS.

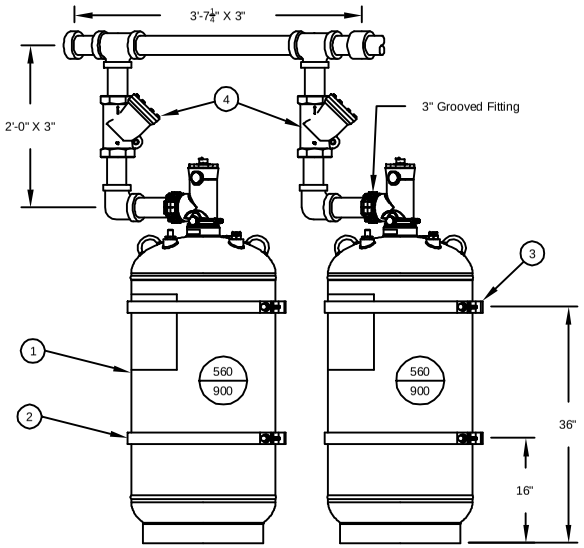
NOTE: THE SYSTEM SHOWN IN THIS DRAWING IS AN EXAMPLE ONLY AND IS NOT INTENDED TO PRECLUDE OTHER SYSTEM CONFIGURATIONS SHOWN IN THE USCG APPROVED MANUAL.

Kidde
FIRE SYSTEMS
400 MAIN STREET
ASHLAND, MA 01721

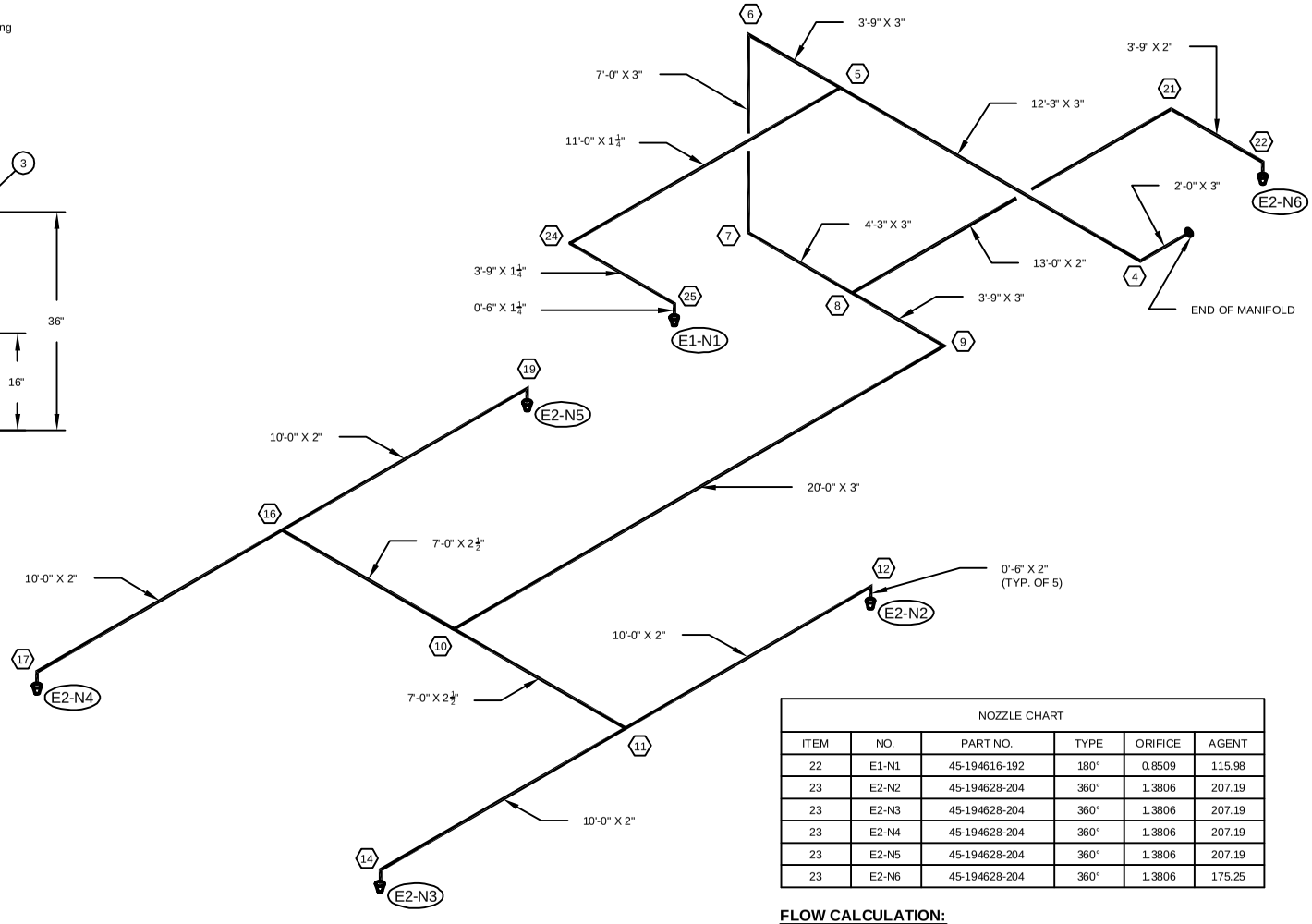
MANUAL P/N 90-NOVMAR-001

TYPICAL NOVEC 1230 SYSTEM WITH CYLINDERS OUTSIDE THE PROTECTED SPACE - FOR U.S.C.G. APPROVAL

DRN:	PJS	18JULY05	SIZE	DWG. NO.	REV
CHK'D:			A	LI-5184605-01	A
ISSUED:					
SCALE:	NOTED	UNITS:	FEET-INCHES	SHEET:	1 OF 3



CYLINDER MANIFOLD SETUP



NOVEC 1230 MECHANICAL NOTES

1. FOR INSTALLATION REQUIREMENTS, REFER TO NFPA 2001 AND THE KIDDE FIRE SYSTEMS DESIGN, INSTALLATION, OPERATION AND MAINTENANCE MANUAL.
2. GALVANIZED PIPE SHALL CONFORM TO ASTM A-53 CLASS F, ASTM A-53 ERW GRADES A OR B, OR ASTM A-106 SEAMLESS GRADES A, B OR C. ALL PIPE SHALL BE SCHEDULE 40 MINIMUM. FITTINGS SHALL BE CLASS 300 MALLEABLE OR DUCTILE IRON FOR SIZES UP TO AND INCLUDING 3" AND 1000-LB RATED DUCTILE IRON OR FORGED STEEL FITTINGS FOR ALL LARGER SIZES. ALL FLANGED JOINTS SHALL BE CLASS 300. ALL GROOVED FITTINGS AND COUPLINGS SHALL BE 500-LB RATED AND LISTED. GROOVED COUPLINGS SHALL BE VICTAULIC STYLE 07, STYLE 77, OR EQUIVALENT
3. ALL PIPE SIZE REDUCTIONS MUST BE MADE USING CONCENTRIC REDUCING COUPLINGS OR REDUCING TEES. BUSHINGS SHALL NOT BE USED.
4. ALL PIPE SHALL BE REAMED AND CLEANED PRIOR TO ASSEMBLY, AND AFTER ASSEMBLY THE ENTIRE PIPING SYSTEM SHALL BE BLOWN OUT USING NITROGEN OR COMPRESSED AIR PRIOR TO NOZZLE OR EQUIPMENT INSTALLATION.
5. PIPE SHALL BE SECURED IN ACCORDANCE WITH 46 CFR AND THESE DRAWINGS.
6. PIPE NETWORK SHALL BE PRESSURE TESTED AT 540 PSI FOR A PERIOD OF 2 MINUTES WITH MAXIMUM ALLOWABLE PRESSURE LOSS OF 150 PSI.

NOZZLE CHART

ITEM	NO.	PART NO.	TYPE	ORIFICE	AGENT
22	E1-N1	45-194616-192	180°	0.8509	115.98
23	E2-N2	45-194628-204	360°	1.3806	207.19
23	E2-N3	45-194628-204	360°	1.3806	207.19
23	E2-N4	45-194628-204	360°	1.3806	207.19
23	E2-N5	45-194628-204	360°	1.3806	207.19
23	E2-N6	45-194628-204	360°	1.3806	175.25

FLOW CALCULATION:

FILE NAME: C1-5184605-01.FLC

CALCULATION DATE/TIME: JUL 12, 2005 3:29:56 PM

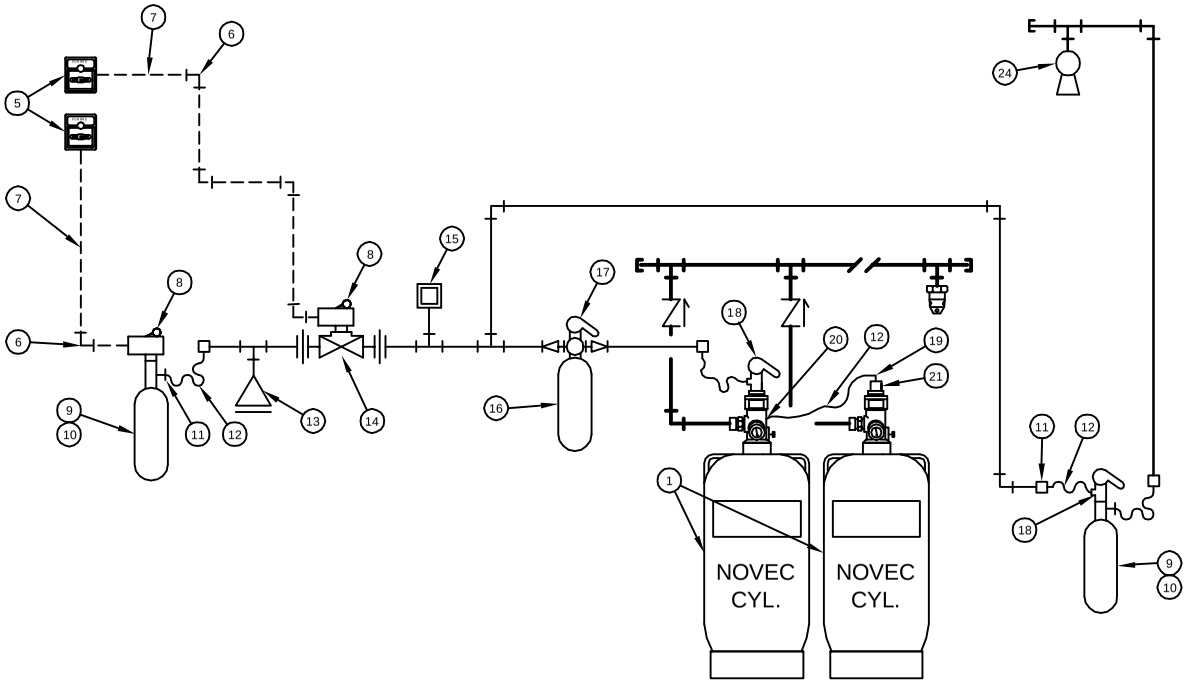
NOTE: THE SYSTEM SHOWN IN THIS DRAWING IS AN EXAMPLE ONLY AND IS NOT INTENDED TO PRECLUDE OTHER SYSTEM CONFIGURATIONS SHOWN IN THE USCG APPROVED MANUAL.

Kidde
FIRE SYSTEMS
400 MAIN STREET
ASHLAND, MA 01721

MANUAL P/N 90-NOVMAR-001

TYPICAL NOVEC 1230 SYSTEM WITH CYLINDERS OUTSIDE THE PROTECTED SPACE - FOR U.S.C.G. APPROVAL

DRN:	PJS	12JULY05	SIZE	DWG. NO.	REV
CHK'D:				LI-5184605-01	A
ISSUED:					
SCALE:	NOTED	UNITS:	FEET-INCHES	SHEET:	2 OF 3



ACTUATION SETUP
NOT TO SCALE

ACTUATION SYSTEM NOTES:

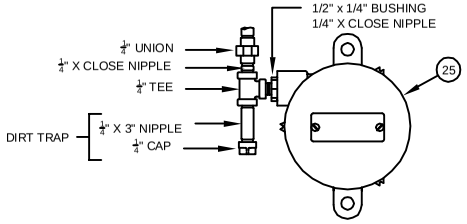
1) CYLINDERS ARE LOCATED OUTSIDE THE PROTECTED SPACE
2) ALL CABLE, ACTUATION PILOT LINES, AND SIREN DRIVER PIPE TO BE ROUTED AS REQUIRED
3) ROUTINGS AND INSTALLATION SHALL BE IN ACCORDANCE WITH THE LIMITATIONS AND RECOMMENDATIONS IN MANUAL P/N 45-NOVMAR-001

SEQUENCE OF OPERATION:

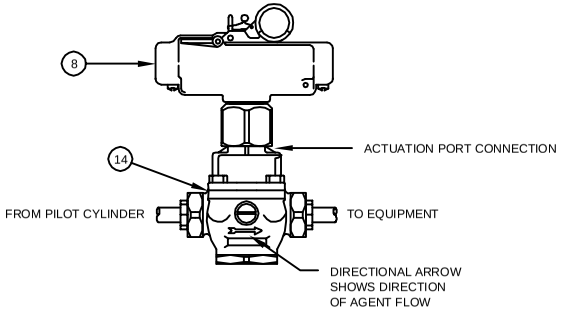
-PULL MANUAL STATION FOR NITROGEN PILOT TO RELEASE PRESSURE INTO THE PILOT LINE
-PULL MANUAL STATION FOR STOP VALVE TO ALLOW ACTUATION OF THE NITROGEN SIREN DRIVER AND OPERATION OF THE TIME DELAY
-AFTER TIME DELAY PERIOD, NOVEC 1230 CYLINDERS ARE ACTUATED

-SYSTEM MAY ALSO BE ACTUATED BY PULLING THE RESPECTIVE MANUAL RELEASE HANDLES ON THE CABLE OPERATED CONTROL HEADS

-THE NOVEC 1230 CYLINDERS MAY ALSO BE LOCALLY ACTUATED FOR IMMEDIATE RELEASE BY OPERATING THE MANUAL LEVER ON THE MASTER CYLINDER (ACTUATION BY THIS METHOD WILL PRECLUDE THE OPERATION OF THE PRESSURE OPERATED SIREN, UNLESS THE NITROGEN SIREN DRIVER IS MANUALLY ACTUATED)



PRESSURE OPERATED SIREN INSTALLATION DETAIL
NOT TO SCALE



STOP VALVE INSTALLATION DETAIL
NOT TO SCALE

NOTE: THE SYSTEM SHOWN IN THIS DRAWING IS AN EXAMPLE ONLY AND IS NOT INTENDED TO PRECLUDE OTHER SYSTEM CONFIGURATIONS SHOWN IN THE USCG APPROVED MANUAL.

Kidde Fire Systems 400 Main Street Ashland, MA 01721	TYPICAL NOVEC 1230 SYSTEM WITH CYLINDERS OUTSIDE THE PROTECTED SPACE - FOR U.S.C.G. APPROVAL			
	DRN: PJS 12JULY05	SIZE	DWG. NO.	REV
	CHK'D:		LI-5184605-01	A
	ISSUED:			
MANUAL P/N 90-NOVMAR-001	SCALE: NOTED	UNITS: FEET-INCHES	SHEET: 3 OF 3	

USCG NOVEC 1230 Manual

NOVEC™ 1230 Hydraulic Flow Calculation Program
Data
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Outside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-01
Hazard Name:	Tugboat	Revision:	A

Data File Name: C:\C1-5184605-01A.CHM
Data File Units: English

Customer Information

Customer Name:	Kidde Fire Systems
Customer Address:	Ashland MA 01721
Customer Contact:	Applications Engineering
Contact's Phone Number:	508-881-2000

Cylinder Information

Amount of NOVEC per Cylinder (lbs):	560.0	Type of Cylinder:	900lb Cylinder w/LLI
Quantity of Cylinders:	2	Cylinder Maximum Capacity (lbs):	910
Cylinder Initial Temperature(F):	70.	Altitude Relative to Sea (ft):	0
Type of Hardware:	US D.O.T	Min. Nozzle Press:	74 PSIA

Hazard Information

Hazard: Fidley / Upper Eng Rm
Concentration Required: 5.85

Hazard Type: Class B Fire
Hazard Temp. (F): 32.0

Nozzle(s): E1-N1 180° Nozzle

Dimensions (ft): 1950.0 X 1.0 X 1.0

Total Agent Required: 113.91lbs

Hazard: Lower Engine Room
Concentration Required: 5.85

Hazard Type: Class A Fire
Hazard Temp. (F): 32.0

Nozzle(s):

Dimensions (ft):

1 (Continued)

NOVEC™ 1230 Hydraulic Flow Calculation Program
Data File
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name: Cylinders Outside the Protected Space
Location: Various
Hazard Name: Tugboat

Date: 7/12/05
Project Number: C1-5184605-01
Revision: A

Hazard Information (Continued)

Nozzle(s): E2-N2 360° Nozzle
E2-N3 360° Nozzle
E2-N4 360° Nozzle
E2-N5 360° Nozzle
E2-N6 360° Nozzle

Dimensions (ft): 17100.0 X 1.0 X 1.0

Total Agent Required: 998.87lbs

Piping Model

Section Start	End	Lgth	Elev	Pipe Sch	Size	90's	Tee's	Cplng/ Union	Note 1	EQL
1	2	0.0	4.9	40T	3	0	None	0	801	22.7
2	3	5.3	2.0	40T	3	2	None	0	801	20.8
3	4	2.0	0.0	40T	3		None	0	802	0
4	5	12.3	0.0	40T	3	1	None	0	0.000	0
5	6	3.8	0.0	40T	3	1	Thru	0	0.000	0
6	7	7.0	-7.0	40T	3	1	None	0	0.000	0
7	8	4.3	0.0	40T	3	1	None	0	0.000	0
8	9	3.8	0.0	40T	3		Thru	0	0.000	0
9	10	20.0	0.0	40T	3	1	None	0	0.000	0
10	11	7.0	0.0	40T	2 1/2		Side	0	0.000	0
11	12	10.0	0.0	40T	2		Side	0	0.000	0
12	E2-N2	0.5	-0.5	40T	2	1	None	0	1.3806	0
11	14	10.0	0.0	40T	2		Side	0	0.000	0
14	E2-N3	0.5	-0.5	40T	2	1	None	0	1.3806	0
10	16	7.0	0.0	40T	2 1/2		Side	0	0.000	0
16	17	10.0	0.0	40T	2		Side	0	0.000	0
17	E2-N4	0.5	-0.5	40T	2	1	None	0	1.3806	0
16	19	10.0	0.0	40T	2		Side	0	0.000	0
19	E2-N5	0.5	-0.5	40T	2	1	None	0	1.3806	0

NOVEC™ 1230 Hydraulic Flow Calculation Program
Data File
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name: Cylinders Outside the Protected Space
Location: Various
Hazard Name: Tugboat

Date: 7/12/05
Project Number: C1-5184605-01
Revision: A

Piping Model (Continued)

Section Start	End	Lgth	Elev	Pipe Sch	Size	90's	Tee's	Cplng/ Union	Note 1	EQL
8	21	13.0	0.0	40T	2		Side	0	0.000	0
21	22	3.8	0.0	40T	2	1	None	0	0.000	0
22	E2-N6	0.5	-0.5	40T	2	1	None	0	1.3806	0
5	24	11.0	0.0	40T	1 1/4		Side	0	0.000	0
24	25	3.8	0.0	40T	1 1/4	1	None	0	0.000	0
25	E1-N1	0.5	-0.5	40T	1 1/4	1	None	0	0.8509	0

Note 1: This column is used to indicate either a manifold, fixed agent amount or fixed nozzle orifice diameter. The 800 Series numbers indicate either a single cylinder (801) or multiple cylinders (802 = 2 cylinders, 803 = 3 cylinders, etc...).
This data file has fixed nozzle diameters.

Note 2: The data input file shown here may not agree with the data used for the flow calculation. The data input file may have been changed since the calculation was performed.

System Manufacturer:

Kidde-Fenwal Inc.
Telephone: (508) 881-2000
Fax: (508) 231-2031

USCG NOVEC 1230 Manual

NOVEC™ 1230 Hydraulic Flow Calculation Program
Results
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Outside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-01
Hazard Name:	Tugboat	Revision:	A

Customer Information

Customer Name:	Kidde Fire Systems
Customer Address:	Ashland MA 01721
Customer Contact:	Applications Engineering
Contact's Phone Number:	508-881-2000

System Information

Storage Pressure (psig):	360	Average Cyl Pressure (PSIA):	210
Ave Initial Pipe Temp (F):	70	Fill Density (lbs/cu.ft.):	43.08
Ratio Agent in Pipe:	46.0	Average Discharge Time (sec):	6.3
Quantity of Cylinders:	2	Type of Cylinder:	900 lb Cylinder w/L
Amount per Cylinder (lbs):	560.0	Total Amount of Agent (lbs):	1120.0
Type of Hardware:	US D.O.T	Min. Nozzle Press:	74 PSIA

Altitude Relative to Sea (ft): 0

Piping Model Results

Section Start	Section End	Pipe Size (in)	Length (ft)	Elev (ft)	EQL (ft)	Tee	Start (PSIA)	Term (PSIA)	Flow (lbs/sec)
1	2	3 - SCH 40	0.1	4.9	22.8		210	196	99.7
2	3	3 - SCH 40	5.3	2.0	41.4		196	185	99.7
3	4	3 - SCH 40	2.0	0.0	2.0		185	171	199.5
4	5	3 - SCH 40	12.3	0.0	19.9		171	150	199.5
5	6	3 - SCH 40	3.8	0.0	16.5	THRU	150	139	178.2
6	7	3 - SCH 40	7.0	-7.0	14.7		139	132	178.2
7	8	3 - SCH 40	4.3	0.0	11.9		132	122	178.2
8	9	3 - SCH 40	3.8	0.0	8.9	THRU	122	122	146.7
9	10	3 - SCH 40	20.0	0.0	27.7		122	106	146.7

Kidde Marine

NOVEC™ 1230 Hydraulic Flow Calculation Program
Results
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Outside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-01
Hazard Name:	Tugboat	Revision:	A

Piping Model Results (Continued)

Section Start	Section End	Pipe Size (in)	Length (ft)	Elev (ft)	EQL (ft)	Tee	Start (PSIA)	Term (PSIA)	Flow (lbs/sec)
10	11	2 1/2 - SCH 40	7.0	0.0	21.4	BULL	106	97	73.4
11	12	2 - SCH 40	10.0	0.0	22.1	BULL	97	91	36.7
12	E2-N2	2 - SCH 40	0.5	-0.5	5.7		91	90	36.7
11	14	2 - SCH 40	10.0	0.0	22.1	BULL	97	91	36.7
14	E2-N3	2 - SCH 40	0.5	-0.5	5.7		91	90	36.7
10	16	2 1/2 - SCH 40	7.0	0.0	21.4	BULL	106	97	73.4
16	17	2 - SCH 40	10.0	0.0	22.1	BULL	97	91	36.7
17	E2-N4	2 - SCH 40	0.5	-0.5	5.7		91	90	36.7
16	19	2 - SCH 40	10.0	0.0	22.1	BULL	97	91	36.7
19	E2-N5	2 - SCH 40	0.5	-0.5	5.7		91	90	36.7
8	21	2 - SCH 40	13.0	0.0	25.9	SIDE	122	115	31.5
21	22	2 - SCH 40	3.8	0.0	8.9		115	113	31.5
22	E2-N6	2 - SCH 40	0.5	-0.5	5.7		113	112	31.5
5	24	1 1/4 - SCH 40	11.0	0.0	20.8	SIDE	150	131	21.3
24	25	1 1/4 - SCH 40	3.8	0.0	7.2		131	124	21.3
25	E1-N1	1 1/4 - SCH 40	0.5	-0.5	4.0		124	121	21.3

Concentration Results

Enclosure Area	Enclosure Volume (cu.ft)	Agent Required (lbs)	Agent Discharged (lbs)	Concentration Requested / Achieved	
Fidley / Upper Eng Rm	1950.0	113.9	116.0	5.85	5.95
Lower Engine Room	17100.0	998.9	1004.0	5.85	5.87

NOVEC™ 1230 Hydraulic Flow Calculation Program
Results
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name: Cylinders Outside the Protected Space
Location: Various
Hazard Name: Tugboat

Date: 7/12/05
Project Number: C1-5184605-01
Revision: A

Nozzle Information

Nozzle ID	Size (inches)	Nozzle Part Number	Style	Nozzle Material	Total Orifice Area (sq.in.)	Discharged (lbs)
E2-N2	2 -SCH 40	45-194628- 204	360°	Stainless	1.3806	207.19
E2-N3	2 -SCH 40	45-194628- 204	360°	Stainless	1.3806	207.19
E2-N4	2 -SCH 40	45-194628- 204	360°	Stainless	1.3806	207.19
E2-N5	2 -SCH 40	45-194628- 204	360°	Stainless	1.3806	207.19
E2-N6	2 -SCH 40	45-194628- 204	360°	Stainless	1.3806	175.25
E1-N1	1 1/4-SCH 40	45-194616- 192	180°	Stainless	0.8509	115.98

Error Messages

NOVEC Flow Calculation Module Version 1.1.0
Orifice diameters and pipe sizes are fixed in input data.
No Errors
Time and date of calculation 15:29:56 07-12-2005

Calculation performed with Version 1.0.2

System Manufacturer:

Kidde-Fenwal Inc.
Telephone: (508) 881-2000
Fax: (508) 231-2031

NOVEC™ 1230 Hydraulic Flow Calculation Program
Results
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Outside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-01
Hazard Name:	Tugboat	Revision:	A

Error Messages

Calculation by Kidde Fire Systems
Applications Engineering
400 Main St.
Ashland MA 1721 USA
Telephone: 508-881-2000
Fax: 508-231-2119

TIME AND DATE OF PRINTOUT 3:30:25 PM 7/12/05

USCG NOVEC 1230 Manual

NOVEC™ 1230 Hydraulic Flow Calculation Program
Bill of Material
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Outside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-01
Hazard Name:	Tugboat	Revision:	A

Nozzle Bill of Material

Item No	Qty	Nozzle Size	Nozzle Description	Orifice Area	Nozzle Part Number
2	5	2	360°Nozzle, SST	1.3806	45-194628- 204

Pipe and Fitting Summary

Item	Type	Size (in)	Qty
Pipe	40 T	1-1/4	15.3 (ft)
Pipe	40 T	2	59.3 (ft)
Pipe	40 T	2-1/2	14.0 (ft)
Pipe	40 T	3	58.5 (ft)
Elbow (90)	CL 300 (B16.3)	1-1/4	2 (Ea)
Elbow (90)	CL 300 (B16.3)	2	6 (Ea)
Elbow (90)	CL 300 (B16.3)	3	7 (Ea)
Tee, Straight	CL 300 (B16.3)	2-1/2	2 (Ea)
Tee, Straight	CL 300 (B16.3)	3	3 (Ea)
Concen. Reducer	CL 300 (B16.3)	3 x 2	1 (Ea)
Concen. Reducer	CL 300 (B16.3)	3 x 1-1/4	1 (Ea)
Concen. Reducer	CL 300 (B16.3)	3 x 2-1/2	2 (Ea)
Concen. Reducer	CL 300 (B16.3)	2-1/2 x 2	4 (Ea)

The above list of pipe and fittings are based on the calculation input data. Any additional equivalent length, inputted as elbows, will appear as elbows in this list. This list is approximate for field conditions and is not intended necessarily for a buy list.

NOVEC 1230 SYSTEM DATA

HAZARD INFORMATION

HAZARD:	TUGBOAT
FIRE TYPE:	CLASS CLASS B - DIESEL
CONSTRUCTION:	STEEL
DESCRIPTION:	FIDLEY / UPPER ENGINE ROOM

SYSTEM INFORMATION

SYSTEM:	MODULAR SYSTEM
	MAIN ONLY SYSTEM
CONTAINER:	125-LB CYLINDER W/ 1.5" VALVE AND LLI
	QTY: 1 P/N: 45-200121-001 FILL WEIGHT: 114 LBS.
NOZZLES:	SEE PLANS & NOZZLE CHART FOR TYPE, SIZE, LOCATION, AND PART NUMBER

ENCLOSURE INFORMATION

ENCLOSURE:	FIDLEY / UPPER ENGINE ROOM		
AREA:	N/A SQ.FT.	MIN. TEMP:	32 °F
HEIGHT:	N/A FT.	MAX. TEMP:	130 °F
VOLUME:	1,950 CU.FT.	MIN. AGENT REQ'D:	113.91 LBS.
DESIGN CONC.:	5.85 %	AGENT SUPPLIED:	114 LBS.

NOVEC 1230 SYSTEM DATA

HAZARD INFORMATION

HAZARD:	TUGBOAT
FIRE TYPE:	CLASS CLASS B - DIESEL
CONSTRUCTION:	STEEL
DESCRIPTION:	AFT LOWER ENGINE ROOM

SYSTEM INFORMATION

SYSTEM:	MODULAR SYSTEM
	MAIN ONLY SYSTEM
CONTAINER:	600-LB CYLINDER W/ 3" VALVE AND LLI
	QTY: 1 P/N: 45-200601-100 FILL WEIGHT: 500 LBS.
NOZZLES:	SEE PLANS & NOZZLE CHART FOR TYPE, SIZE, LOCATION, AND PART NUMBER

ENCLOSURE:	AFT LOWER ENGINE ROOM		
AREA:	N/A SQ.FT.	MIN. TEMP:	32 °F
HEIGHT:	N/A FT.	MAX. TEMP:	130 °F
VOLUME:	8,550 CU.FT.	MIN. AGENT REQ'D:	499.43 LBS.
DESIGN CONC.:	5.85 %	AGENT SUPPLIED:	500 LBS.

NOVEC 1230 SYSTEM DATA

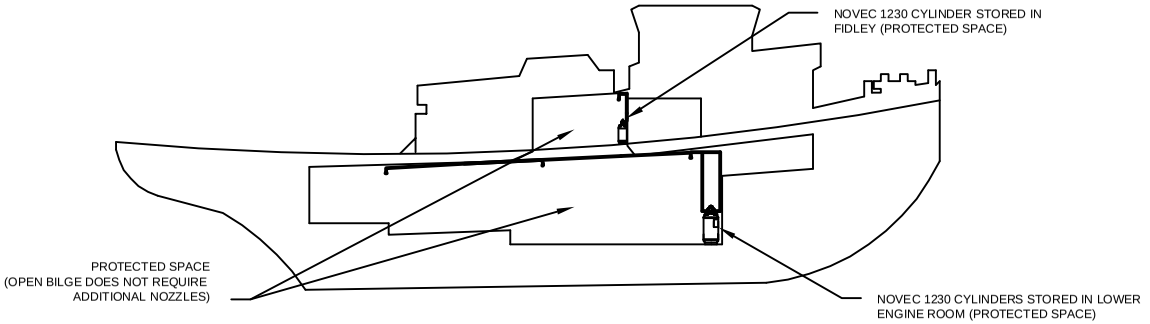
HAZARD INFORMATION

HAZARD:	TUGBOAT
FIRE TYPE:	CLASS CLASS B - DIESEL
CONSTRUCTION:	STEEL
DESCRIPTION:	FWD LOWER ENGINE ROOM

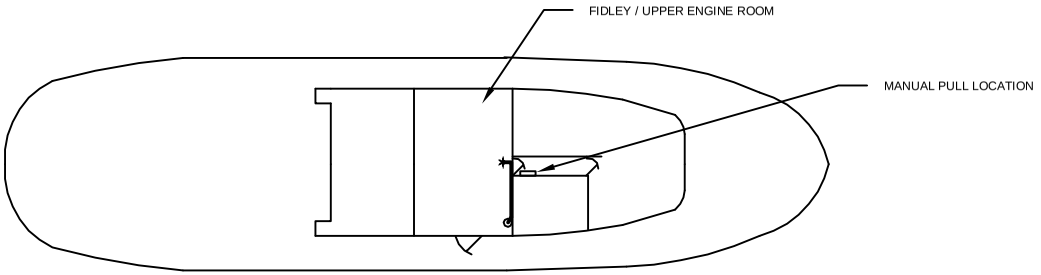
SYSTEM INFORMATION

SYSTEM:	MODULAR SYSTEM
	MAIN ONLY SYSTEM
CONTAINER:	600-LB CYLINDER W/ 3" VALVE AND LLI
	QTY: 1 P/N: 45-200601-100 FILL WEIGHT: 500 LBS.
NOZZLES:	SEE PLANS & NOZZLE CHART FOR TYPE, SIZE, LOCATION, AND PART NUMBER

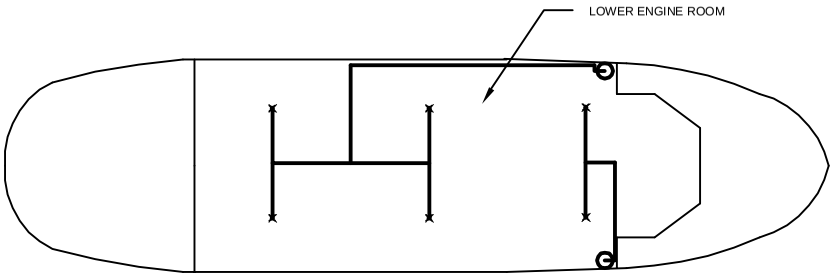
ENCLOSURE:	FWD LOWER ENGINE ROOM		
AREA:	N/A SQ.FT.	MIN. TEMP:	32 °F
HEIGHT:	N/A FT.	MAX. TEMP:	130 °F
VOLUME:	8,550 CU.FT.	MIN. AGENT REQ'D:	499.43 LBS.
DESIGN CONC.:	5.85 %	AGENT SUPPLIED:	500 LBS.



ELEVATION VIEW
NOT TO SCALE



PLAN VIEW - FIDLEY / UPPER ENGINE ROOM
NOT TO SCALE



PLAN VIEW - LOWER ENGINE ROOM
NOT TO SCALE

NOTE: THE SYSTEM SHOWN IN THIS DRAWING IS AN EXAMPLE ONLY AND IS NOT INTENDED TO PRECLUDE OTHER SYSTEM CONFIGURATIONS SHOWN IN THE USCG APPROVED MANUAL.

Kidde
FIRE SYSTEMS
400 MAIN STREET
ASHLAND, MA 01721

MANUAL P/N 90-NOVMAR-001

TYPICAL NOVEC 1230 SYSTEM WITH CYLINDERS INSIDE THE PROTECTED SPACE - FOR U.S.C.G. APPROVAL

DRN: PJS 18JULY05	SIZE	DWG. NO.	REV
CHK'D:	A	LI-5184605-02	A
ISSUED:			
SCALE: NOTED	UNITS: FEET-INCHES	SHEET: 1 OF 3	

BILL OF MATERIALS

NO.	DESCRIPTION	QTY	PART NO.
1	600# NOVEC 1230 CYLINDER W/ LLI, FILLED TO 500#	2	45-200601-100
2	CYLINDER STRAP, 600-LB CYLINDER	4	294651
3	CYLINDER CRADLE, 600-LB CYLINDER	4	294652
4	125# NOVEC 1230 CYLINDER W/ LLI, FILLED TO 114#	1	45-200121-001
5	CYLINDER STRAP, 125-LB CYLINDER	2	235317
6	CYLINDER CRADLE, 125-LB CYLINDER	2	235431
7	1-1/2" FLEXIBLE DISCHARGE HOSE	1	283898
8	PULL BOX, SURFACE, 3/8" PIPE (BREAK GLASS)	2	871403
9	CORNER PULLEY, 3/8" PIPE (WATERTIGHT)	30	803808
10	1/16" CABLE, 100 FT ROLL	2	06-118316-100
11	CABLE OPERATED CONTROL HEAD	2	979469
12	NITROGEN PILOT CYLINDER, 108 CU.IN., NO PRESS SWITCH	5	877940
13	MOUNTING BRACKET, NITROGEN PILOT CYLINDER	5	877845
14	MALE CONNECTOR, 5/16" FLARE x 1/8" NPT	8	69920501
15	ACTUATION HOSE, 30"	6	264986
16	SAFETY OUTLET (N2 & CO2)	2	803242
17	1/2" STOP VALVE	2	870023
18	PRESSURE OPERATED SWITCH	2	486536
19	NITROGEN TIME DELAY (108 CU.IN. PILOT, 34 S DELAY)	1	81-871072-001
20	LEVER OPERATED CONTROL HEAD	5	870652
21	PRESSURE OPERATED CONTROL HEAD	4	878737
22	SIREN NITROGEN PRESSURE OPERATED	1	90-981574-001
23	DUAL-LOOP BLEED KIT	4	06-129978-001
24	MALE ELBOW, 5/16" FLARE X 1/8" NPT	1	69920503
25	180° NOVEC 1230 DISCHARGE NOZZLE, 1-1/4" NPT, 0.4280	1	45-194616-171
26	360° NOVEC 1230 DISCHARGE NOZZLE, 1-1/4" NPT, 0.5731	4	45-194626-181
27	360° NOVEC 1230 DISCHARGE NOZZLE, 1-1/2" NPT, 1.0717	2	45-194627-200

NOZZLE CHART

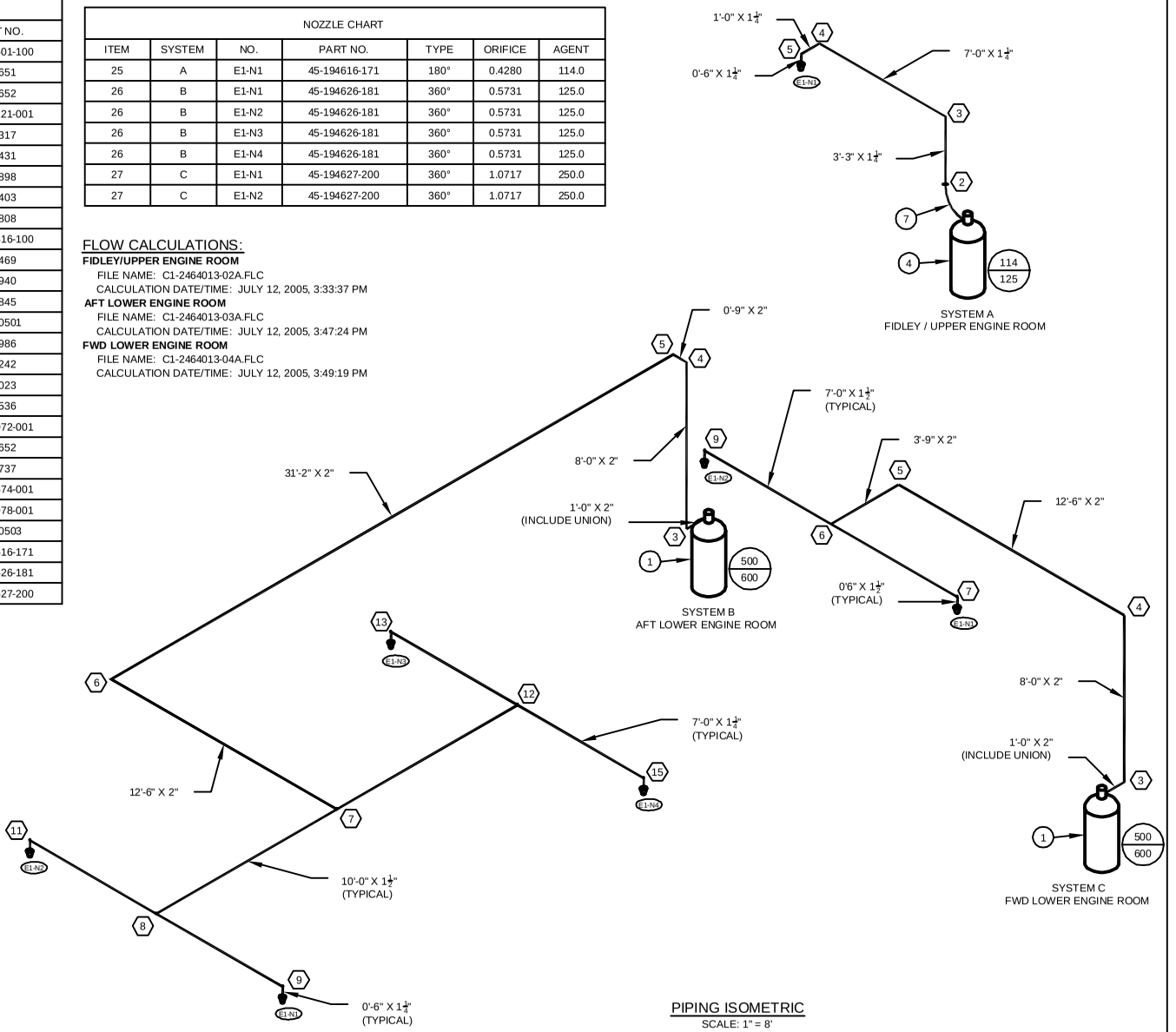
ITEM	SYSTEM	NO.	PART NO.	TYPE	ORIFICE	AGENT
25	A	E1-N1	45-194616-171	180°	0.4280	114.0
26	B	E1-N1	45-194626-181	360°	0.5731	125.0
26	B	E1-N2	45-194626-181	360°	0.5731	125.0
26	B	E1-N3	45-194626-181	360°	0.5731	125.0
26	B	E1-N4	45-194626-181	360°	0.5731	125.0
27	C	E1-N1	45-194627-200	360°	1.0717	250.0
27	C	E1-N2	45-194627-200	360°	1.0717	250.0

FLOW CALCULATIONS:

FIDLEY/UPPER ENGINE ROOM
FILE NAME: C1-2464013-02A.FLC
CALCULATION DATE/TIME: JULY 12, 2005, 3:33:37 PM

AFT LOWER ENGINE ROOM
FILE NAME: C1-2464013-03A.FLC
CALCULATION DATE/TIME: JULY 12, 2005, 3:47:24 PM

FWD LOWER ENGINE ROOM
FILE NAME: C1-2464013-04A.FLC
CALCULATION DATE/TIME: JULY 12, 2005, 3:49:19 PM



NOVEC 1230 MECHANICAL NOTES

1. FOR INSTALLATION REQUIREMENTS, REFER TO NFPA 2001 AND THE KIDDE FIRE SYSTEMS DESIGN, INSTALLATION, OPERATION AND MAINTENANCE MANUAL.
2. GALVANIZED PIPE SHALL CONFORM TO ASTM A-53 CLASS F, ASTM A-53 ERW GRADES A OR B, OR ASTM A-106 SEAMLESS GRADES A, B OR C. ALL PIPE SHALL BE SCHEDULE 40 MINIMUM. FITTINGS SHALL BE CLASS 300 MALLEABLE OR DUCTILE IRON FOR SIZES UP TO AND INCLUDING 3" AND 1000-LB RATED DUCTILE IRON OR FORGED STEEL FITTINGS FOR ALL LARGER SIZES. ALL FLANGED JOINTS SHALL BE CLASS 300. ALL GROOVED FITTINGS AND COUPLINGS SHALL BE 500-LB RATED AND LISTED. GROOVED COUPLINGS SHALL BE VICTAULIC STYLE 07, STYLE 77, OR EQUIVALENT
3. ALL PIPE SIZE REDUCTIONS MUST BE MADE USING CONCENTRIC REDUCING COUPLINGS OR REDUCING TEES. BUSHINGS SHALL NOT BE USED.
4. ALL PIPE SHALL BE REAMED AND CLEANED PRIOR TO ASSEMBLY, AND AFTER ASSEMBLY THE ENTIRE PIPING SYSTEM SHALL BE BLOWN OUT USING NITROGEN OR COMPRESSED AIR PRIOR TO NOZZLE OR EQUIPMENT INSTALLATION.
5. PIPE SHALL BE SECURED IN ACCORDANCE WITH 46 CFR AND THESE DRAWINGS.
6. PIPE NETWORK SHALL BE PRESSURE TESTED AT 540 PSI FOR A PERIOD OF 2 MINUTES WITH MAXIMUM ALLOWABLE PRESSURE LOSS OF 150 PSI.

PIPING ISOMETRIC

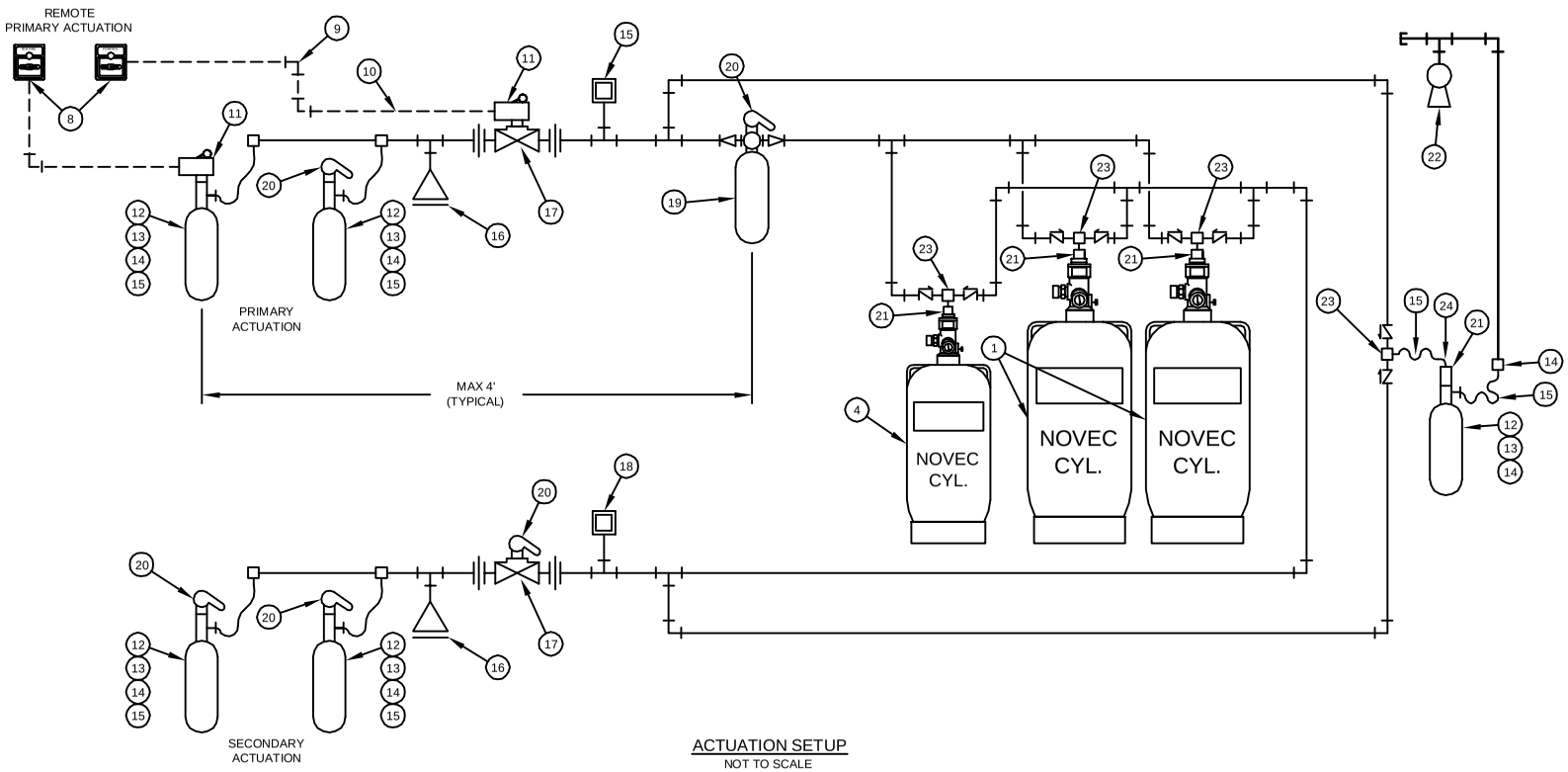
SCALE: 1" = 8'

NOTE: THE SYSTEM SHOWN IN THIS DRAWING IS AN EXAMPLE ONLY AND IS NOT INTENDED TO PRECLUDE OTHER SYSTEM CONFIGURATIONS SHOWN IN THE USCG APPROVED MANUAL.

Kidde
FIRE SYSTEMS
400 MAIN STREET
ASHLAND, MA 01721

TYPICAL NOVEC 1230 SYSTEM WITH CYLINDERS INSIDE THE PROTECTED SPACE - FOR U.S.C.G. APPROVAL

DRN: PJS 12JULY05	SIZE	DWG. NO.	REV
CHK'D:		LI-5184605-02	A
ISSUED:			
MANUAL P/N 90-NOVMAR-001	SCALE: NOTED	UNITS: FEET-INCHES	SHEET: 2 OF 3



ACTUATION SETUP
NOT TO SCALE

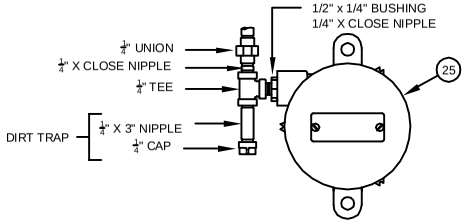
ACTUATION SYSTEM NOTES:

1) CYLINDERS ARE LOCATED INSIDE THE PROTECTED SPACE
2) ALL CABLE, ACTUATION PILOT LINES, AND SIREN DRIVER PIPE TO BE ROUTED AS REQUIRED
3) ROUTINGS AND INSTALLATION SHALL BE IN ACCORDANCE WITH THE LIMITATIONS AND RECOMMENDATIONS IN MANUAL P/N 45-NOVMAR-001 (MOST RECENT REVISION)
4) NITROGEN ACTUATION LINES SHALL BE $\frac{1}{4}$" SCHEDULE 80 STAINLESS STEEL

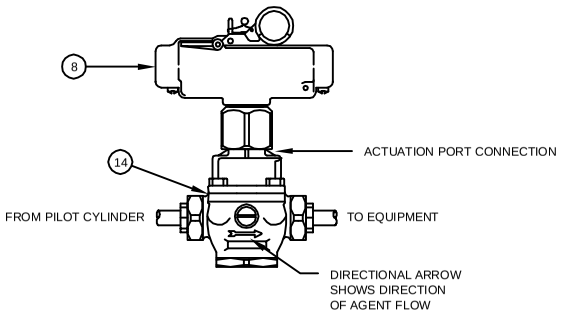
SEQUENCE OF OPERATION:

-PULL MANUAL STATION FOR NITROGEN PILOT TO RELEASE PRESSURE INTO THE PILOT LINE
-PULL MANUAL STATION FOR STOP VALVE TO ALLOW ACTUATION OF THE NITROGEN SIREN DRIVER AND OPERATION OF THE TIME DELAY
-AFTER TIME DELAY PERIOD, NOVEC 1230 CYLINDERS ARE ACTUATED
-IF ACTUATION DOES NOT OCCUR, OPERATE SECONDARY MANUAL CONTROLS TO EFFECT IMMEDIATE ACTUATION

-PRIMARY ACTUATION MAY ALSO BE OPERATED BY PULLING THE RESPECTIVE MANUAL RELEASE HANDLES ON THE CABLE OPERATED CONTROL HEADS



PRESSURE OPERATED SIREN
INSTALLATION DETAIL
NOT TO SCALE



STOP VALVE INSTALLATION DETAIL
NOT TO SCALE

NOTE: THE SYSTEM SHOWN IN THIS DRAWING IS AN EXAMPLE ONLY AND IS NOT INTENDED TO PRECLUDE OTHER SYSTEM CONFIGURATIONS SHOWN IN THE USCG APPROVED MANUAL.

Kidde Fire Systems 400 Main Street Ashland, MA 01721	TYPICAL NOVEC 1230 SYSTEM WITH CYLINDERS INSIDE THE PROTECTED SPACE - FOR U.S.C.G. APPROVAL				
	DRN: PJS 12JULY05	SIZE	DWG. NO.	REV
	CHK'D:		LI-5184605-02	A
MANUAL P/N 90-NOVMAR-001	ISSUED:			
	SCALE: NOTED	UNITS: FEET-INCHES	SHEET: 3 OF 3	

USCG NOVEC 1230 Manual

NOVEC™ 1230 Hydraulic Flow Calculation Program
Data
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-02
Hazard Name:	Tugboat	Revision:	A

Data File Name: C:\C1-5184605-02A.CHM
Data File Units: English

Customer Information

Customer Name:	Kidde Fire Systems
Customer Address:	Ashland MA 01721
Customer Contact:	Applications Engineering
Contact's Phone Number:	508-881-2000

Cylinder Information

Amount of NOVEC per Cylinder (lbs):	114.0	Type of Cylinder:	125lb Cylinder w/LLI
Quantity of Cylinders:	1	Cylinder Maximum Capacity (lbs):	125
Cylinder Initial Temperature(F):	70.	Altitude Relative to Sea (ft):	0
Type of Hardware:	US D.O.T	Min. Nozzle Press:	74 PSIA

Hazard Information

Hazard: Fidley / Upper Eng Rm
Concentration Required: 5.85

Hazard Type: Class A Fire
Hazard Temp. (F): 32.0

Nozzle(s): E1-N1 180° Nozzle

Dimensions (ft): 1950.0 X 1.0 X 1.0

Total Agent Required: 113.91lbs

Piping Model

Section Start	End	Lgth	Elev	Pipe Sch	Size	90's	Tee's	Cplng/ Union	Note 1	EQL
1	2	0.0	3.0	40T	1 1/2	0	None	0	801	45.2

1 (Continued)

NOVEC™ 1230 Hydraulic Flow Calculation Program
Data File
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-02
Hazard Name:	Tugboat	Revision:	A

Piping Model (Continued)

Section Start	End	Lgth	Elev	Pipe Sch	Size	90's	Tee's	Cplng/ Union	Note 1	EQL
2	3	3.3	3.3	40T	1 1/4	0	None	0	0.000	0
3	4	7.0	0.0	40T	1 1/4	1	None	0	0.000	0
4	5	1.0	0.0	40T	1 1/4	1	None	0	0.000	0
5	E1-N1	0.5	-0.5	40T	1 1/4	1	None	0	113.910	0

Note 1: This column is used to indicate either a manifold, fixed agent amount or fixed nozzle orifice diameter. The 800 Series numbers indicate either a single cylinder (801) or multiple cylinders (802 = 2 cylinders, 803 = 3 cylinders, etc...).
This data file has fixed agent amount specified for the nozzle.

Note 2: The data input file shown here may not agree with the data used for the flow calculation. The data input file may have been changed since the calculation was performed.

System Manufacturer:

Kidde-Fenwal Inc.
Telephone: (508) 881-2000
Fax: (508) 231-2031

USCG NOVEC 1230 Manual

NOVEC™ 1230 Hydraulic Flow Calculation Program
Results
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-02
Hazard Name:	Tugboat	Revision:	A

Customer Information

Customer Name:	Kidde Fire Systems
Customer Address:	Ashland MA 01721
Customer Contact:	Applications Engineering
Contact's Phone Number:	508-881-2000

System Information

Storage Pressure (psig):	360	Average Cyl Pressure (PSIA):	164
Ave Initial Pipe Temp (F):	70	Fill Density (lbs/cu.ft.):	63.84
Ratio Agent in Pipe:	11.1	Average Discharge Time (sec):	9.8
Quantity of Cylinders:	1	Type of Cylinder:	125 lb Cylinder w/L
Amount per Cylinder (lbs):	114.0	Total Amount of Agent (lbs):	114.0
Type of Hardware:	US D.O.T	Min. Nozzle Press:	74 PSIA
Altitude Relative to Sea (ft):	0		

Piping Model Results

Section Start	Section End	Pipe Size (in)	Length (ft)	Elev (ft)	EQL (ft)	Tee	Start (PSIA)	Term (PSIA)	Flow (lbs/sec)
1	2	1 1/2 - SCH 40	0.1	3.0	45.3		164	154	14.4
2	3	1 1/4 - SCH 40	3.3	3.3	4.4		154	149	14.4
3	4	1 1/4 - SCH 40	7.0	0.0	10.5		149	146	14.4
4	5	1 1/4 - SCH 40	1.0	0.0	4.5		146	145	14.4
5	E1-N1	1 1/4 - SCH 40	0.5	-0.5	4.0		145	144	14.4

1 (Continued)

Kidde Marine

NOVEC™ 1230 Hydraulic Flow Calculation Program
Results
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-02
Hazard Name:	Tugboat	Revision:	A

Concentration Results

Enclosure Area	Enclosure Volume (cu.ft)	Agent Required (lbs)	Agent Discharged (lbs)	Concentration Requested / Achieved	
Fidley / Upper Eng Rm	1950.0	113.9	114.0	5.85	5.85

Nozzle Information

Nozzle ID	Size (inches)	Nozzle Part Number	Style	Nozzle Material	Total Orifice Area (sq.in.)	Discharged (lbs)
E1-N1	1 1/4-SCH 40	45-194616- 171	180°	Stainless	0.428	114.00

Error Messages

NOVEC Flow Calculation Module Version 1.1.0
No Errors
Time and date of calculation 15:33:37 07-12-2005

Calculation performed with Version 1.0.2

System Manufacturer:

Kidde-Fenwal Inc.
Telephone: (508) 881-2000
Fax: (508) 231-2031

NOVEC™ 1230 Hydraulic Flow Calculation Program
Results
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-02
Hazard Name:	Tugboat	Revision:	A

Error Messages

Calculation by Kidde Fire Systems
Applications Engineering
400 Main St.
Ashland MA 1721 USA
Telephone: 508-881-2000
Fax: 508-231-2119

TIME AND DATE OF PRINTOUT 3:33:57 PM 7/12/05

USCG NOVEC 1230 Manual

NOVEC™ 1230 Hydraulic Flow Calculation Program
Bill of Material
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-02
Hazard Name:	Tugboat	Revision:	A

Nozzle Bill of Material

Item No	Qty	Nozzle Size	Nozzle Description	Orifice Area	Nozzle Part Number
1	1	1 1/4	180°Nozzle, SST	0.428	45-194616- 171

Pipe and Fitting Summary

Item	Type	Size (in)	Qty
Pipe	40 T	1-1/4	11.8 (ft)
Elbow (90)	CL 300 (B16.3)	1-1/4	3 (Ea)

The above list of pipe and fittings are based on the calculation input data. Any additional equivalent length, inputted as elbows, will appear as elbows in this list. This list is approximate for field conditions and is not intended necessarily for a buy list.

USCG Marine NOVEC 1230 Manual

NOVEC™ 1230 Hydraulic Flow Calculation Program
Data
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-03
Hazard Name:	Tugboat	Revision:	A

Data File Name: C:\C1-5184605-03A.CHM
Data File Units: English

Customer Information

Customer Name:	Kidde Fire Systems
Customer Address:	Ashland MA 01721
Customer Contact:	Applications Engineering
Contact's Phone Number:	508-881-2000

Cylinder Information

Amount of NOVEC per Cylinder (lbs):	500.0	Type of Cylinder:	600lb Cylinder w/LLI
Quantity of Cylinders:	1	Cylinder Maximum Capacity (lbs):	600
Cylinder Initial Temperature(F):	70.	Altitude Relative to Sea (ft):	0
Type of Hardware:	US D.O.T	Min. Nozzle Press:	74 PSIA

Hazard Information

Hazard: Aft Lower Engine Room
Concentration Required: 5.85

Hazard Type: Class A Fire
Hazard Temp. (F): 32.0

Nozzle(s): E1-N1 360° Nozzle
E1-N2 360° Nozzle
E1-N3 360° Nozzle
E1-N4 360° Nozzle

Dimensions (ft): 8550.0 X 1.0 X 1.0

Total Agent Required: 499.43lbs

Piping Model

Section Start	End	Lgth	Elev	Pipe Sch	Size	90's	Tee's	Cplng/ Union	Note 1	EQL
1	2	0.0	4.0	40T	3	0	None	0	801	22.7

1 (Continued)

NOVEC™ 1230 Hydraulic Flow Calculation Program
Data File
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name: Cylinders Inside the Protected Space
Location: Various
Hazard Name: Tugboat
Date: 7/12/05
Project Number: C1-5184605-03
Revision: A

Piping Model (Continued)

Section Start	End	Lgth	Elev	Pipe Sch	Size	90's	Tee's	Cplng/ Union	Note 1	EQL
2	3	1.0	0.0	40T	2	0	None	0	0.000	0
3	4	8.0	8.0	40T	2	1	None	0	0.000	0
4	5	0.8	0.0	40T	2	1	None	0	0.000	0
5	6	31.1	0.0	40T	2	1	None	0	0.000	0
6	7	12.5	0.0	40T	2	1	None	0	0.000	0
7	8	10.0	0.0	40T	1 1/2	0	Side	0	0.000	0
8	9	7.0	0.0	40T	1 1/4	0	Side	0	0.000	0
9	E1-N1	0.5	-0.5	40T	1 1/4	1	None	0	0.5731	0
8	10	7.0	0.0	40T	1 1/4	0	Side	0	0.000	0
10	E1-N2	0.5	-0.5	40T	1 1/4	1	None	0	0.5731	0
7	11	10.0	0.0	40T	1 1/2	0	Side	0	0.000	0
11	12	7.0	0.0	40T	1 1/4	0	Side	0	0.000	0
12	E1-N3	0.5	-0.5	40T	1 1/4	1	None	0	0.5731	0
11	14	7.0	0.0	40T	1 1/4	0	Side	0	0.000	0
14	E1-N4	0.5	-0.5	40T	1 1/4	1	None	0	0.5731	0

Note 1: This column is used to indicate either a manifold, fixed agent amount or fixed nozzle orifice diameter. The 800 Series numbers indicate either a single cylinder (801) or multiple cylinders (802 = 2 cylinders, 803 = 3 cylinders, etc...).
This data file has fixed nozzle diameters.

Note 2: The data input file shown here may not agree with the data used for the flow calculation. The data input file may have been changed since the calculation was performed.

System Manufacturer:

Kidde-Fenwal Inc.
Telephone: (508) 881-2000
Fax: (508) 231-2031

Kidde Marine

NOVEC™ 1230 Hydraulic Flow Calculation Program
Results
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-03
Hazard Name:	Tugboat	Revision:	A

Customer Information

Customer Name:	Kidde Fire Systems
Customer Address:	Ashland MA 01721
Customer Contact:	Applications Engineering
Contact's Phone Number:	508-881-2000

System Information

Storage Pressure (psig):	360	Average Cyl Pressure (PSIA):	155
Ave Initial Pipe Temp (F):	70	Fill Density (lbs/cu.ft.):	58.33
Ratio Agent in Pipe:	37.7	Average Discharge Time (sec):	9.7
Quantity of Cylinders:	1	Type of Cylinder:	600 lb Cylinder w/L
Amount per Cylinder (lbs):	500.0	Total Amount of Agent (lbs):	500.0
Type of Hardware:	US D.O.T	Min. Nozzle Press:	74 PSIA

Altitude Relative to Sea (ft): 0

Piping Model Results

Section Start	Section End	Pipe Size (in)	Length (ft)	Elev (ft)	EQL (ft)	Tee	Start (PSIA)	Term (PSIA)	Flow (lbs/sec)
1	2	3 - SCH 40	0.1	4.0	22.8		155	150	52.4
2	3	2 - SCH 40	1.0	0.0	3.6		150	143	52.4
3	4	2 - SCH 40	8.0	8.0	13.2		143	129	52.4
4	5	2 - SCH 40	0.8	0.0	5.9		129	126	52.4
5	6	2 - SCH 40	31.1	0.0	36.3		126	104	52.4
6	7	2 - SCH 40	12.5	0.0	17.7		104	93	52.4
7	8	1 1/2 - SCH 40	10.0	0.0	19.4	BULL	93	82	26.2
8	9	1 1/4 - SCH 40	7.0	0.0	15.1	BULL	82	77	13.1
9	E1-N1	1 1/4 - SCH 40	0.5	-0.5	4.0		77	76	13.1

1 (Continued)

Kidde Marine

NOVEC™ 1230 Hydraulic Flow Calculation Program
Results
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-03
Hazard Name:	Tugboat	Revision:	A

Piping Model Results (Continued)

Section Start	Section End	Pipe Size (in)	Length (ft)	Elev (ft)	EQL (ft)	Tee	Start (PSIA)	Term (PSIA)	Flow (lbs/sec)
8	10	1 1/4 - SCH 40	7.0	0.0	15.1	BULL	82	77	13.1
10	E1-N2	1 1/4 - SCH 40	0.5	-0.5	4.0		77	76	13.1
7	11	1 1/2 - SCH 40	10.0	0.0	19.4	BULL	93	82	26.2
11	12	1 1/4 - SCH 40	7.0	0.0	15.1	BULL	82	77	13.1
12	E1-N3	1 1/4 - SCH 40	0.5	-0.5	4.0		77	76	13.1
11	14	1 1/4 - SCH 40	7.0	0.0	15.1	BULL	82	77	13.1
14	E1-N4	1 1/4 - SCH 40	0.5	-0.5	4.0		77	76	13.1

Concentration Results

Enclosure Area	Enclosure Volume (cu.ft)	Agent Required (lbs)	Agent Discharged (lbs)	Concentration Requested	Concentration Achieved
Aft Lower Engine Room	8550.0	499.4	500.0	5.85	5.85

Nozzle Information

Nozzle ID	Size (inches)	Nozzle Part Number	Style	Nozzle Material	Total Orifice Area (sq.in.)	Discharged (lbs)
E1-N1	1 1/4-SCH 40	45-194626- 181	360°	Stainless	0.5731	125.00
E1-N2	1 1/4-SCH 40	45-194626- 181	360°	Stainless	0.5731	125.00
E1-N3	1 1/4-SCH 40	45-194626- 181	360°	Stainless	0.5731	125.00
E1-N4	1 1/4-SCH 40	45-194626- 181	360°	Stainless	0.5731	125.00

NOVEC™ 1230 Hydraulic Flow Calculation Program
Results
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-03
Hazard Name:	Tugboat	Revision:	A

Error Messages

NOVEC Flow Calculation Module Version 1.1.0
Orifice diameters and pipe sizes are fixed in input data.
No Errors
Time and date of calculation 15:47:24 07-12-2005

Calculation performed with Version 1.0.2

System Manufacturer:

Kidde-Fenwal Inc.
Telephone: (508) 881-2000
Fax: (508) 231-2031

Calculation by Kidde Fire Systems
Applications Engineering
400 Main St.
Ashland MA 1721 USA
Telephone: 508-881-2000
Fax: 508-231-2119

TIME AND DATE OF PRINTOUT 3:47:49 PM 7/12/05

USCG Marine NOVEC 1230 Manual

NOVEC™ 1230 Hydraulic Flow Calculation Program
Bill of Material
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinders Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-03
Hazard Name:	Tugboat	Revision:	A

Nozzle Bill of Material

Item No	Qty	Nozzle Size	Nozzle Description	Orifice Area	Nozzle Part Number
1	4	1 1/4	360°Nozzle, SST	0.5731	45-194626- 181

Pipe and Fitting Summary

Item	Type	Size (in)	Qty
Pipe	40 T	1-1/4	30.0 (ft)
Pipe	40 T	1-1/2	20.0 (ft)
Pipe	40 T	2	53.4 (ft)
Elbow (90)	CL 300 (B16.3)	1-1/4	4 (Ea)
Elbow (90)	CL 300 (B16.3)	2	4 (Ea)
Tee, Straight	CL 300 (B16.3)	1-1/2	2 (Ea)
Tee, Straight	CL 300 (B16.3)	2	1 (Ea)
Concen. Reducer	CL 300 (B16.3)	2 x 1-1/2	2 (Ea)
Concen. Reducer	CL 300 (B16.3)	1-1/2 x 1-1/4	4 (Ea)

The above list of pipe and fittings are based on the calculation input data. Any additional equivalent length, inputted as elbows, will appear as elbows in this list. This list is approximate for field conditions and is not intended necessarily for a buy list.

USCG NOVEC 1230 Manual

NOVEC™ 1230 Hydraulic Flow Calculation Program
Data
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinder Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-04
Hazard Name:	Tugboat	Revision:	A

Data File Name: C:\C1-5184605-04A.CHM
Data File Units: English

Customer Information

Customer Name:	Kidde Fire Systems
Customer Address:	Ashland MA 01721
Customer Contact:	Applications Engineering
Contact's Phone Number:	508-881-2000

Cylinder Information

Amount of NOVEC per Cylinder (lbs):	500.0	Type of Cylinder:	600lb Cylinder w/LLI
Quantity of Cylinders:	1	Cylinder Maximum Capacity (lbs):	600
Cylinder Initial Temperature(F):	70.	Altitude Relative to Sea (ft):	0
Type of Hardware:	US D.O.T	Min. Nozzle Press:	74 PSIA

Hazard Information

Hazard: Fwd Lower Engine Room
Concentration Required: 5.85

Hazard Type: Class A Fire
Hazard Temp. (F): 32.0

Nozzle(s): E1-N1 360° Nozzle
E1-N2 360° Nozzle

Dimensions (ft): 8550.0 X 1.0 X 1.0

Total Agent Required: 499.43lbs

Piping Model

Section Start	End	Lgth	Elev	Pipe Sch	Size	90's	Tee's	Cplng/ Union	Note 1	EQL
1	2	0.0	4.0	40T	3	0	None	0	801	22.7

1 (Continued)

NOVEC™ 1230 Hydraulic Flow Calculation Program
Data File
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name: Cylinder Inside the Protected Space
Location: Various
Hazard Name: Tugboat

Date: 7/12/05
Project Number: C1-5184605-04
Revision: A

Piping Model (Continued)

Section Start	End	Lgth	Elev	Pipe Sch	Size	90's	Tee's	Cplng/ Union	Note 1	EQL
2	3	1.0	0.0	40T	2	0	None	0	0.000	0
3	4	8.0	8.0	40T	2	1	None	0	0.000	0
4	5	12.5	0.0	40T	2	1	None	0	0.000	0
5	6	3.8	0.0	40T	2	1	None	0	0.000	0
6	7	7.0	0.0	40T	1 1/2	0	Side	0	0.000	0
7	E1-N1	0.5	-0.5	40T	1 1/2	1	None	0	1.0717	0
6	9	7.0	0.0	40T	1 1/2	0	Side	0	0.000	0
9	E1-N2	0.5	-0.5	40T	1 1/2	1	None	0	1.0717	0

Note 1: This column is used to indicate either a manifold, fixed agent amount or fixed nozzle orifice diameter. The 800 Series numbers indicate either a single cylinder (801) or multiple cylinders (802 = 2 cylinders, 803 = 3 cylinders, etc...).
This data file has fixed nozzle diameters.

Note 2: The data input file shown here may not agree with the data used for the flow calculation. The data input file may have been changed since the calculation was performed.

System Manufacturer:

Kidde-Fenwal Inc.
Telephone: (508) 881-2000
Fax: (508) 231-2031

USCG NOVEC 1230 Manual

NOVEC™ 1230 Hydraulic Flow Calculation Program
Results
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinder Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-04
Hazard Name:	Tugboat	Revision:	A

Customer Information

Customer Name:	Kidde Fire Systems
Customer Address:	Ashland MA 01721
Customer Contact:	Applications Engineering
Contact's Phone Number:	508-881-2000

System Information

Storage Pressure (psig):	360	Average Cyl Pressure (PSIA):	157
Ave Initial Pipe Temp (F):	70	Fill Density (lbs/cu.ft.):	58.33
Ratio Agent in Pipe:	16.5	Average Discharge Time (sec):	9.5
Quantity of Cylinders:	1	Type of Cylinder:	600 lb Cylinder w/L
Amount per Cylinder (lbs):	500.0	Total Amount of Agent (lbs):	500.0
Type of Hardware:	US D.O.T	Min. Nozzle Press:	74 PSIA
Altitude Relative to Sea (ft):	0		

Piping Model Results

Section Start	Section End	Pipe Size (in)	Length (ft)	Elev (ft)	EQL (ft)	Tee	Start (PSIA)	Term (PSIA)	Flow (lbs/sec)
1	2	3 - SCH 40	0.1	4.0	22.8		157	152	55.9
2	3	2 - SCH 40	1.0	0.0	3.6		152	144	55.9
3	4	2 - SCH 40	8.0	8.0	13.2		144	129	55.9
4	5	2 - SCH 40	12.5	0.0	17.7		129	117	55.9
5	6	2 - SCH 40	3.8	0.0	8.9		117	111	55.9
6	7	1 1/2 - SCH 40	7.0	0.0	16.4	BULL	111	101	28.0
7	E1-N1	1 1/2 - SCH 40	0.5	-0.5	4.5		101	98	28.0
6	9	1 1/2 - SCH 40	7.0	0.0	16.4	BULL	111	101	28.0
9	E1-N2	1 1/2 - SCH 40	0.5	-0.5	4.5		101	98	28.0

1 (Continued)

USCG NOVEC 1230 Manual

NOVEC™ 1230 Hydraulic Flow Calculation Program
Results
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinder Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-04
Hazard Name:	Tugboat	Revision:	A

Concentration Results

Enclosure Area	Enclosure Volume (cu.ft)	Agent Required (lbs)	Agent Discharged (lbs)	Concentration Requested / Achieved	
Fwd Lower Engine Room	8550.0	499.4	500.0	5.85	5.85

Nozzle Information

Nozzle ID	Size (inches)	Nozzle Part Number	Style	Nozzle Material	Total Orifice Area (sq.in.)	Discharged (lbs)
E1-N1	1 1/2-SCH 40	45-194627- 200	360°	Stainless	1.0717	250.00
E1-N2	1 1/2-SCH 40	45-194627- 200	360°	Stainless	1.0717	250.00

Error Messages

NOVEC Flow Calculation Module Version 1.1.0
Orifice diameters and pipe sizes are fixed in input data.
No Errors
Time and date of calculation 15:49:19 07-12-2005

Calculation performed with Version 1.0.2

System Manufacturer:

Kidde-Fenwal Inc.
Telephone: (508) 881-2000
Fax: (508) 231-2031

NOVEC™ 1230 Hydraulic Flow Calculation Program
Results
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinder Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-04
Hazard Name:	Tugboat	Revision:	A

Error Messages

Calculation by Kidde Fire Systems
Applications Engineering
400 Main St.
Ashland MA 1721 USA
Telephone: 508-881-2000
Fax: 508-231-2119

TIME AND DATE OF PRINTOUT 3:49:34 PM 7/12/05

USCG NOVEC 1230 Manual

NOVEC™ 1230 Hydraulic Flow Calculation Program
Bill of Material
NOVEC 1230 Version 1.0.2
Agency Listing: USCG, ULC, Factory Mutual

Project Name:	Cylinder Inside the Protected Space	Date:	7/12/05
Location:	Various	Project Number:	C1-5184605-04
Hazard Name:	Tugboat	Revision:	A

Nozzle Bill of Material

Item No	Qty	Nozzle Size	Nozzle Description	Orifice Area	Nozzle Part Number
1	2	1 1/2	360°Nozzle, SST	1.0717	45-194627- 200

Pipe and Fitting Summary

Item	Type	Size (in)	Qty
Pipe	40 T	1-1/2	15.0 (ft)
Pipe	40 T	2	25.3 (ft)
Elbow (90)	CL 300 (B16.3)	1-1/2	2 (Ea)
Elbow (90)	CL 300 (B16.3)	2	3 (Ea)
Tee, Straight	CL 300 (B16.3)	2	1 (Ea)
Concen. Reducer	CL 300 (B16.3)	2 x 1-1/2	2 (Ea)

The above list of pipe and fittings are based on the calculation input data. Any additional equivalent length, inputted as elbows, will appear as elbows in this list. This list is approximate for field conditions and is not intended necessarily for a buy list.

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APPENDIX C
ACTUATION CIRCUIT CONFIGURATION

C-1 CYLINDER STORAGE LOCATION - USCG REQUIREMENTS

United States Coast Guard (USCG) has discontinued the approval of cylinders inside protected spaces of greater than 6,000 ft.^{3}. USCG had previously issued a certificate of approval to Kidde (Approval Number: 162.161/9/0) which allowed Novec 1230 fluid cylinders to be located inside protected spaces of greater than 6,000 ft.^{3}. The period of the approval was from 2005 to 2007, including projects contracted, but not completed prior to 2008. USCG will still consider requests for systems with agent cylinders inside protected spaces of greater than 6,000 ft.^{3} on a vessel-by-vessel basis.

In order to maintain USCG approval, the material in the following sections has been deleted:

- 3-2.1.5.5
- 3-2.5.2.2
- 3-2.5.2.3
- 4-2.21

Refer to Novec 1230 fluid Marine Series Engineered Fire Suppression System Design, Installation, Operation, and Maintenance Manual, P/N 45-NOVMAR-001, dated February 2005, for this information. Please contact USCG for further information on this subject.

C-2 CYLINDER STORAGE LOCATION - SOLAS REQUIREMENTS

For applications where Coast Guard approval is not required and only SOLAS regulations are applicable, the agent cylinders can be located inside of the protected space provided the following requirements of IMO MSC/Circ. 848 and MSC. 1/Circ. 1267 are met:

- Agent Cylinders should be evenly distributed throughout the space.
- Manual initiated power release with duplicate sources of power should be provided and available for immediate use outside the protected space.
- Electric power circuits connecting cylinders should be monitored for faults and power loss with audible and visible alarm indicators.
- Pneumatic, electric, or hydraulic power circuits connecting cylinders should be duplicated and widely separated sources of pneumatic/hydraulic pressure should be monitored with audible and visible alarms.
- Essential electrical circuits should be fire resistant according to IEC 60331 or equivalent standard.
- Essential piping systems should be of steel or equivalent heat-resistant material.
- System arrangement should allow for minimum extinguishing concentration to still be discharged in the event that one power release line or valve fails due to damage.
- Cylinders should be monitored for decrease in pressure due to leakage or discharge. Visual and audible indicators should be present in the protected area as well as on the navigation bridge or fire control station.

Reference vessel class approval for specific requirements.

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

A UTC Fire & Security Company

400 Main Street
Ashland, MA 01721
Ph: 508.881.2000
Fax: 508.881.8920
www.kiddefiresystems.com

These instructions do not purport to cover all the details or variations in the equipment described, nor do they provide for every possible contingency to be met in connection with installation, operation and maintenance. All specifications are subject to change without notice. Should further information be desired or should particular questions arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to KIDDE-FENWAL INC., Ashland, Masssachusetts

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