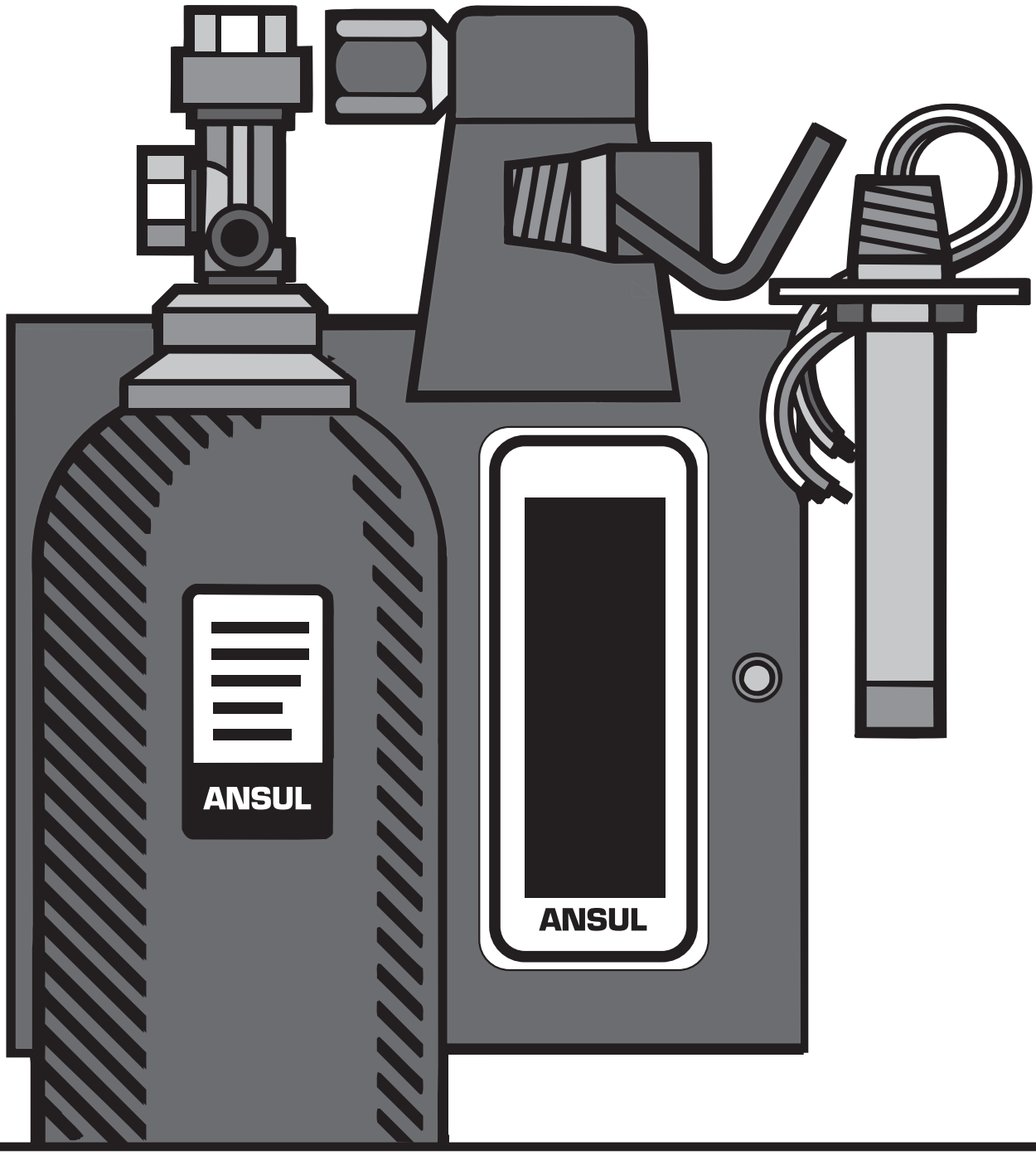
HIGH PRESSURE CARBON DIOXIDE SYSTEMS

ANSUL®

DESIGN, INSTALLATION, RECHARGE, AND MAINTENANCE MANUAL



tyco Fire Protection Products

One Stanton Street / Marinette, WI 54143-2542, USA / +1-715-735-7411 / www.ansul.com
 / Part No. 427604-05

ANSUL®
HIGH PRESSURE CARBON DIOXIDE SYSTEMS
DESIGN, INSTALLATION, RECHARGE AND MAINTENANCE MANUAL
PART NO. 427604-05

DECEMBER 15, 2017
UL EX-2968

This manual is intended for use with the ANSUL® High Pressure Carbon Dioxide ($HPCO_2$) System. This system is specifically engineered for monitoring and release of Carbon Dioxide agent into a protected area(s). Design, installation, recharge, and maintenance of the system must conform to the limitations detailed in this manual. Installation and maintenance shall be performed by an individual holding a current ANSUL $HPCO_2$ Systems Training Program with training to design, install, recharge, and maintain the $HPCO_2$ System(s).

Those who design, install, operate, recharge, inspect, or maintain these systems should read this entire manual. Specific sections will be of particular interest depending upon one's responsibilities.

As with all electro-mechanical-pneumatic equipment, the system needs periodic care to help provide maximum assurance it will operate effectively and safely. Inspection frequency shall be performed consistently, depending on operating and/or environmental conditions. Maintenance shall be performed semi-annually, or sooner, depending on operating and/or environmental conditions.

The application and use of the $HPCO_2$ System is limited to the application and uses described in this manual. For other applications, contact your Authorized ANSUL Distributor, Territory Manager, or Tyco Fire Protection – Technical Services Department, Marinette, Wisconsin 54143-2542, USA.

Note: The converted metric values in this manual are provided for dimensional reference only and do not reflect an actual measurement.

Part Number: 427604-05

Date: 2017-DEC-15

⚠ DANGER

Indicates a hazardous situation in which a person ***will*** **experience serious personal injury or death** if the situation is not avoided.

⚠ WARNING

Indicates a hazardous situation in which a person ***could*** **experience serious personal injury or death** if the situation is not avoided.

⚠ CAUTION

Indicates a hazardous situation in which a person **could experience minor or moderate personal injury** if the situation is not avoided.

CAUTION

Addresses practices not related to personal injury, such as a system part malfunctioning, property damage, or system failure.

NOTICE

Addresses general practices or observations related to system function that are not related to personal injury.

DATE	PAGE	REV. NO.
2010-SEP-01	Complete manual has been reformatted and reorganized, plus technical changes have been made. For clarity, all pages (except for Components section) have been changed to Revision 3 regardless of previous revision number, and all revision indicators (►) previously used to indicate technical information changes have been removed.	03
2010-SEP-01	1-20a	01
2010-SEP-01	1-21a	01
2010-SEP-01	1-24a	01
2010-SEP-01	1-25.1a	New
2010-SEP-01	1-27a	01
2010-SEP-01	1-28a	01
2010-SEP-01	1-28b	01
2010-SEP-01	1-29a	01
2010-SEP-01	1-29b	01
2010-SEP-01	1-29.1a	01
2010-SEP-01	1-29.1b	01
2010-SEP-01	1-30a	01
2010-SEP-01	1-30b	01
2010-SEP-01	1-33a	02
2010-SEP-01	1-34a	01
2010-SEP-01	1-37a	01
2010-SEP-01	1-44a	New
2011-JUL-19	6-8	04

DATE	PAGE	REV. NO.
2017-DEC-15	Unmarked changes: *Cylinder* to *container* *ANSUL AUTOMAN* to *AUTOMAN* *extinguish* to *suppress*.	04
2017-DEC-15	Section 1 - All component sheets transferred from individual component sheets with form numbers to manual pages. New "**NOTES:**" pages added for spacing purposes, not listed. Previously revised component sheets listed above.	-
2017-DEC-15	1-1a	03
2017-DEC-15	1-1b	03
2017-DEC-15	1-1.1a	01
2017-DEC-15	1-1.1b	01
2017-DEC-15	1-1.2a	New
2017-DEC-15	1-1.2b	New
2017-DEC-15	1-2a	03
2017-DEC-15	1-3a	03
2017-DEC-15	1-4a	03
2017-DEC-15	1-4.1a	New
2017-DEC-15	1-5a	Replaced/ New
2017-DEC-15	1-6a	02
2017-DEC-15	1-6.1a	New
2017-DEC-15	1-7a	02
2017-DEC-15	1-7b	02
2017-DEC-15	1-7.1a	New
2017-DEC-15	1-7.1b	New

LEGEND FOR PAGES WITH REVISION INDICATORS:	► Indicates revised technical information. ■ Indicates change in page sequence (located at top of page, left of header).

DATE	PAGE	REV. NO.
2017-DEC-15	1-8a	01
2017-DEC-15	1-9a	03
2017-DEC-15	1-9b	03
2017-DEC-15	1-9.1a	New
2017-DEC-15	1-9.1b	New
2017-DEC-15	1-10a	02
2017-DEC-15	1-11a	03
2017-DEC-15	1-12a	03
2017-DEC-15	1-12b	03
2017-DEC-15	1-13a	03
2017-DEC-15	1-13.1a	New
2017-DEC-15	1-14a	04
2017-DEC-15	1-14b	04
2017-DEC-15	1-14.1a	New
2017-DEC-15	1-15a	03
2017-DEC-15	1-15b	03
2017-DEC-15	1-16a	02
2017-DEC-15	1-17a	03
2017-DEC-15	1-17b	03
2017-DEC-15	1-17.1a	New
2017-DEC-15	1-17.1b	New
2017-DEC-15	1-18a	04
2017-DEC-15	1-18b	04
2017-DEC-15	1-18.1a	New
2017-DEC-15	1-18.1b	New
2017-DEC-15	1-19a	03

DATE	PAGE	REV. NO.
2017-DEC-15	1-19b	03
2017-DEC-15	1-19c	New
2017-DEC-15	1-22a	03
2017-DEC-15	1-23a	01
2017-DEC-15	1-23b	01
2017-DEC-15	1-25a	02
2017-DEC-15	1-25b	02
2017-DEC-15	1-26a	02
2017-DEC-15	1-26b	02
2017-DEC-15	1-26.1a	New
2017-DEC-15	1-26.1b	New
2017-DEC-15	1-27.1a	02
2017-DEC-15	1-31a	02
2017-DEC-15	1-31b	02
2017-DEC-15	1-32a	02
2017-DEC-15	1-32b	02
2017-DEC-15	1-32c	02
2017-DEC-15	1-33.1a	03
2017-DEC-15	1-33.1b	03
2017-DEC-15	1-34.1a	New
2017-DEC-15	1-35a	02
2017-DEC-15	1-35.1a	New
2017-DEC-15	1-36a	02
2017-DEC-15	1-38a	03
2017-DEC-15	1-39a	02
2017-DEC-15	1-40	Removed/ Blank page

DATE	PAGE	REV. NO.
2017-DEC-15	1-41	Removed/ Blank page
2017-DEC-15	1-42a	Replaced/ New
2017-DEC-15	1-42.1a	New
2017-DEC-15	1-43a	03
2017-DEC-15	1-43.1a	New
2017-DEC-15	1-45a	03
2017-DEC-15	2-1 thru 2-6	04
2017-DEC-15	2-7	New
2017-DEC-15	2-8	New
2017-DEC-15	4-1	04
2017-DEC-15	5-16	04
2017-DEC-15	5-17	04
2017-DEC-15	6-11	04
2017-DEC-15	6-19	04
2017-DEC-15	10-4	04

DATE	PAGE	REV. NO.

NOTES:

* Material included in the manual may be revised after the manual revision date. Confirm documents with Part No. and Form No. identifiers are the latest available revision.

NOTES:

High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

CV-98 Valve/Container Shipping Assembly

Description

The container is factory filled with carbon dioxide. A single container may be used or multiple containers can be manifolded together to obtain the required quantity of agent for total flooding or local application methods. The CV-98 valve can be actuated electrically, pneumatically, and/or manually with approved valve actuation components. All valves are equipped with an anti-recoil feature.

Note: Operational temperature range of 0 °F to 130 °F (–17.8 °C to 54.4 °C).

The containers are shipped with a maintenance record card and protective shipping cap attached to the threaded neck of each container. This cap entirely encloses and protects the valve while in shipment.

The 35 lb and 50 lb (15.9 kg and 22.7 kg) containers are manufactured with a bent siphon tube which allows for either horizontal or vertical mounting. When mounting the containers in any position other than vertical, the safety relief of the valve must face upwards so the bottom opening of the siphon tube is directly downward, at the lowest point in the container.

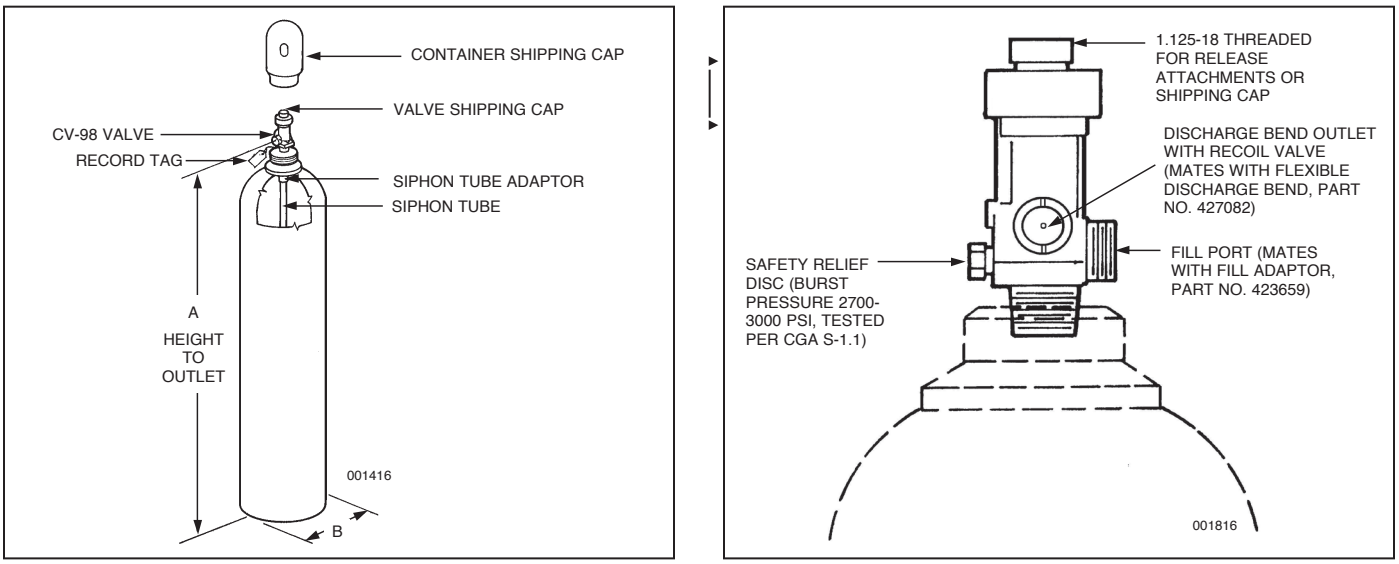
The equivalent length of the valve and flexible discharge bend is equal to 38 ft (11.6 m) of 1/2 in. Sch. 40 pipe.

Component	Material	Thread Size/Type	Approvals and Standards
Container DOT Specification	Steel	1-11 1/2 NPT, Female	Meets DOT 3A1800, 3AA1800, or 3AA2300; Also meets TC3AM138, TC3AAM138, TC3AM176, or TC3AAM176.
UN Certification	Steel	1-11 1/2 NPT, Female	UN/DOT USA: Type Approved ISC 9809-1 TC Equivalency Certification SO11150
CV-98 Valve	Brass	1-11 1/2 NPT, Male x 1 5/16-12UN-3A Outlet Thread – Male	
Valve/Container Assembly			UL; ULC (EX-2968) and listed for use with FM Approved Systems
Protective Shipping Cap	Steel	3.125-11 NS1, Female	

Shipping Assembly Part No.	Weight of CO_2 lb	(kg)	Approximate Weight lb	(kg)	Dimension A in.	(mm)	Dimension B in.	(mm)
Finish: Red Enamel Paint								
426246	75	(34.0)	200	(91)	57 3/4	(1467)	9 1/4	(235)
426612 (LC)*	100	(45.4)	300	(136)	60 1/4	(1530)	10 1/2	(268)
441675 (UN)	100	(45.4)	300	(136)	60 1/4	(1530)	10 1/2	(266)
428421*	120	(54.4)	390	(177)	66 5/8	(1692)	11	(279)
441673 (UN)	120	(54.4)	390	(177)	66 5/8	(1692)	11	(279)
Finish: Red Epoxy Paint								
426243	35	(15.9)	121	(55)	35 3/4	(908)	8 1/2	(216)
426245	50	(22.7)	165	(75)	52 3/4	(1340)	8 1/2	(216)
426247	75	(34.0)	200	(91)	57 3/4	(1467)	9 1/4	(235)
426613 (LC)*	100	(45.4)	300	(136)	60 1/4	(1530)	10 1/2	(268)
426249	100	(45.4)	300	(136)	60 1/4	(1530)	10 3/4	(273)
441671 (UN)	100	(45.4)	300	(136)	60 1/4	(1530)	10 3/4	(273)
428422*	120	(54.4)	390	(177)	66 5/8	(1692)	11	(279)
441669 (UN)	120	(54.4)	390	(177)	66 5/8	(1692)	11	(279)

*These containers are special order: minimum order quantities apply, please call for delivery time.

CV-98 VALVE/CONTAINER SHIPPING ASSEMBLY (Continued)



Note: Use Flexible Discharge Bend (Part No. 427082) when attaching valve to supply pipe or manifold.

CV-98 CO_2 Valve

The valve is sealed closed and must never be disassembled. If there is ever a malfunction of the CV-98 valve, the complete valve must be returned to Tyco Fire Protection Products.

High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

CV-98 Valve/Container Shipping Assembly – Bureau of Indian Standards (BIS) Approvals

Description

The CV-98 container is factory filled with carbon dioxide. A single container may be used or multiple containers can be manifolded together to obtain the required quantity of agent for total flooding or local application methods. The CV-98 valve can be actuated electrically, pneumatically, and/or manually with approved valve actuation components. All valves are equipped with an anti-recoil feature.

Note: Operational temperature range of 0 °F to 130 °F (–18 °C to 54 °C).

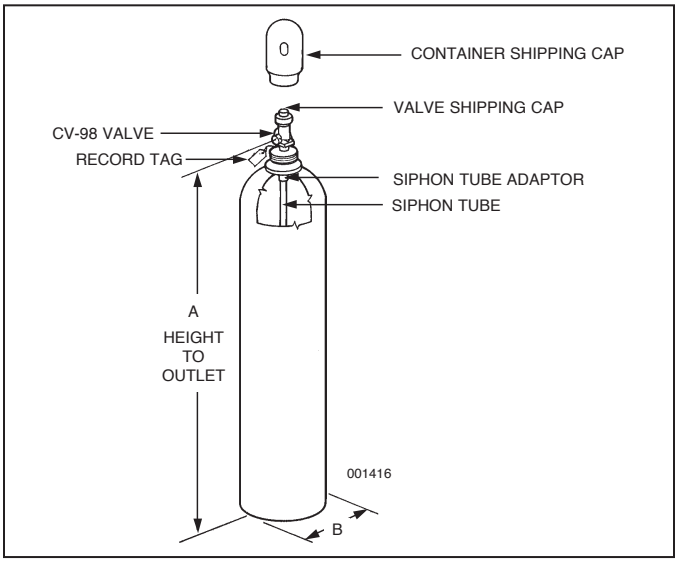
The containers are shipped with a maintenance record card and protective shipping cap attached to the threaded neck of each container. This cap entirely encloses and protects the valve while in shipment.

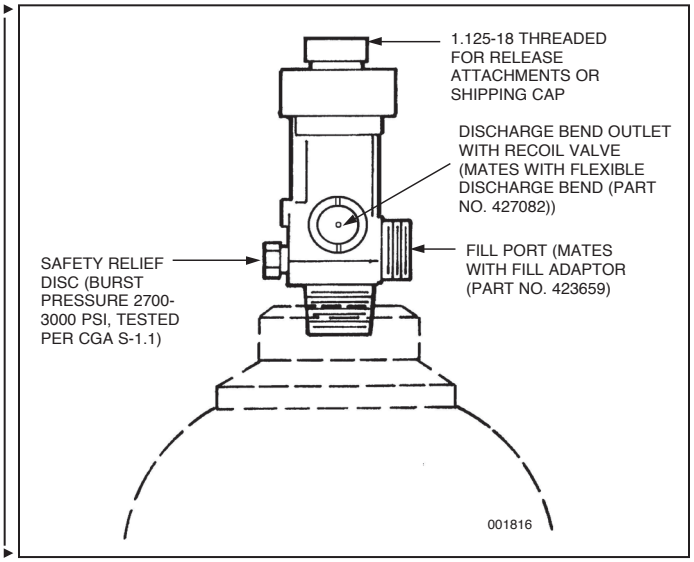
The equivalent length of the valve and flexible discharge bend is equal to 38 ft (11.6 m) of 1/2 in. Sch. 40 pipe.

Component	Material	Thread Size/Type	Approvals
Container	Steel, Red Epoxy CR Paint	1-11 1/2 NPT, Female	IS 7285
CV-98 Valve	Brass	1-11 1/2 NPT, Male x 1 5/16-12UN-3A Outlet Thread – Male	
Safety Relief Valve	Brass	0.6250-18UNF-3B, Male	In Accordance with Bureau of Explosives
Valve/Container Assembly			UL (EX-2968); Listed for use with FM Approved systems
Protective Shipping Cap	Steel, Red Epoxy CR Paint	3.125-11 NS1, Female	

Shipping Assembly Part No.	Weight of CO_2 lb	(kg)	Approximate Weight lb	(kg)	Dimension A in.	(mm)	Dimension B in.	(mm)
438810	100	(45.4)	300	(136.1)	59 3/4	(1518)	10 3/4	(273)

CV-98 VALVE/CONTAINER SHIPPING ASSEMBLY – BUREAU OF INDIAN STANDARDS (BIS) APPROVALS (Continued)





Note: Use Flexible Discharge Bend (Part No. 427082) when attaching valve to supply pipe or manifold.

CV-98 CO_2 Valve

The valve is sealed closed and must never be disassembled. If there is ever a malfunction of the CV-98 valve, the complete valve must be returned to Tyco Fire Protection Products.

China CCCF CV-98 Valve/Container Shipping Assembly

Description

The container is factory filled with carbon dioxide. A single container may be used or multiple containers can be manifolded together to obtain the required quantity of agent for total flooding or local application methods. The CV-98 valve can be actuated electrically, pneumatically, and/or manually with approved valve actuation components. All valves are equipped with an anti-recoil feature.

Note: Operational temperature range of 0 °F to 130 °F (–17.8 °C to 54.4 °C).

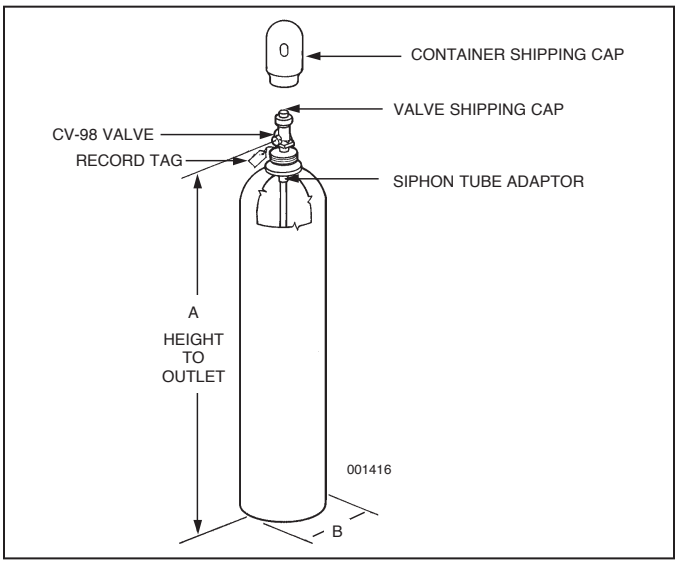
The containers are shipped with a maintenance record card and protective shipping cap attached to the threaded neck of each Container. This cap entirely encloses and protects the valve while in shipment.

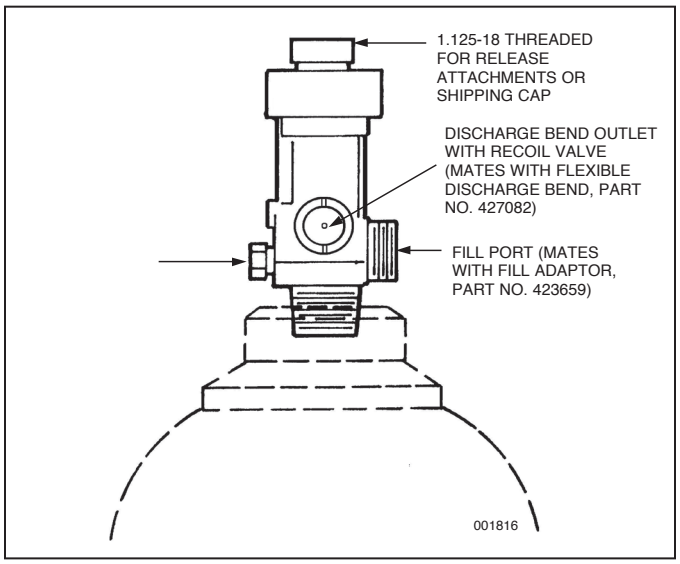
The equivalent length of the valve and flexible discharge bend is equal to 38 ft (11.6 m) of 1/2 in. Sch. 40 pipe.

Component	Material	Thread Size/Type	Approvals and Standards
Container DOT Specification	Steel	1-11 1/2 NPT, Female	Meets DOT 3AA2300; Also meets GB5099.
CV-98 Valve	Brass	1-11 1/2 NPT, Male x 1 5/16-12UN-3A Outlet Thread – Male	
Valve/Tank			UL; ULC (EX-2968) and listed for use with Assembly
Protective Shipping Cap	Steel	3.125-11 NS1, Female	

Shipping Assembly Part No.	Weight of CO_2 lb (kg)	Approximate Weight lb (kg)	Dimension A in. (mm)	Dimension B in. (mm)
Finish: Red Epoxy Paint				
445042 (Marinette)	107.5 (48.8)	329.5 (149.5)	66 5/8 (1692)	11 (279)
446249 (Shanghai)	107.5 (48.8)	329.5 (149.5)	66 5/8 (1692)	11 (279)

CHINA CCCF CV-98 VALVE/CONTAINER SHIPPING ASSEMBLY (Continued)





Note: Use Flexible Discharge Bend (Part No. 427082) when attaching valve to supply pipe or manifold.

CV-98 CO_2 Valve

The valve is sealed closed and must never be disassembled. If there is ever a malfunction of the CV-98 valve, the complete valve must be returned to Tyco Fire Protection Products.

CV-98 Valve Flexible Discharge Bend

Description

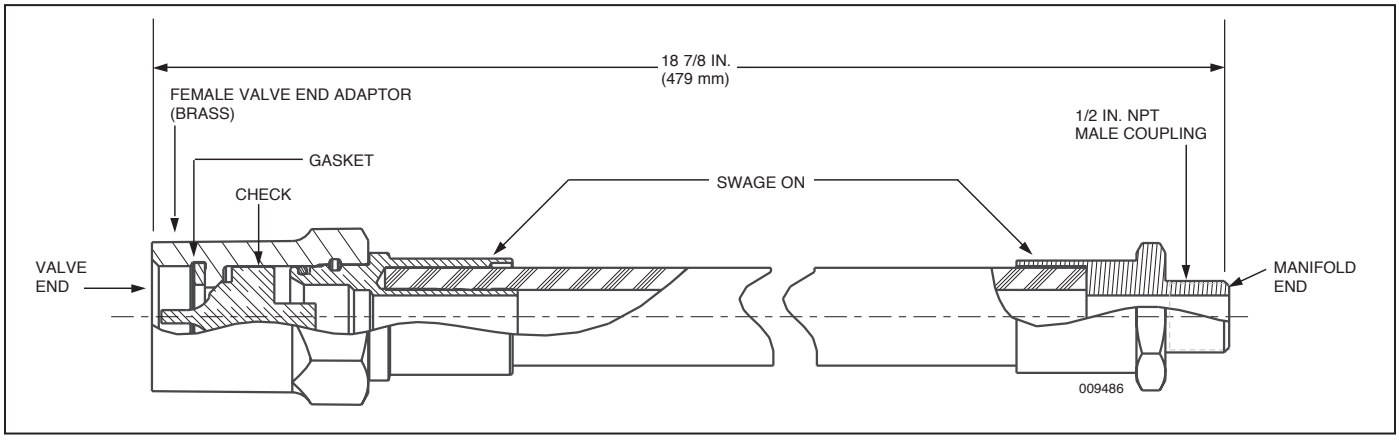
The CV-98 valve Flexible Discharge Bend (Part No. 427082) is a 5/8 in. (15.9 mm) I.D. extra-heavy flexible hose which connects the valve discharge outlet to the fixed piping or header manifold. The discharge bend has a female 1 5/16-12-UN-3B thread for connecting to the valve outlet and a male 1/2 in. NPT thread for connecting to the fixed piping or manifold. The discharge bend will withstand a pressure of 9000 psi (621 bar). Its flexible connection allows for easy alignment of multiple container banks to fixed piping. Each bend has a built-in check valve that prevents loss of agent should the system discharge while any container is removed.

The equivalent length of this hose is equal to 18 ft (5.5 m) of 1/2 in. Sch. 40 pipe.

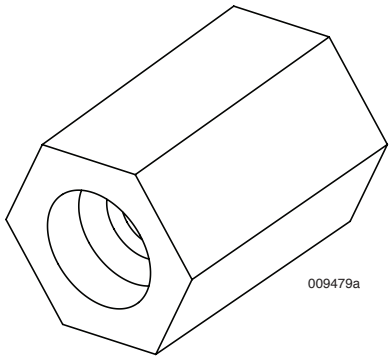
- The female adaptor should only be hand tight plus a half turn with a wrench
- The minimum bend radius is 7.5 in. (190 mm)

Shipping Assembly Part No.	Description
427082	Flexible discharge bend
42430	Washer (for previous adaptor design)
437919	Gasket
422509	Hydrostatic Test Adaptor

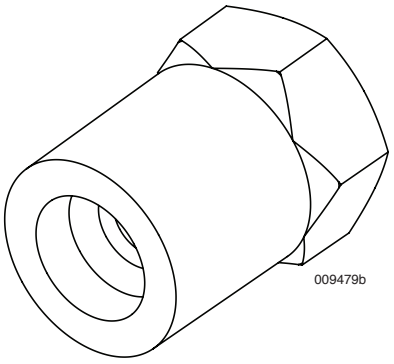
Component	Material	Thread Size/Type		Approvals
		Valve End	Manifold End	
5/8 in. Flexible Discharge Bend	SAE 100 R2 Type AT	1 5/16-12-UN-3B Female	1/2 NPT Male	UL (EX-2968); Listed for use with FM Approved systems



Valve End Adaptor Comparison



PREVIOUS ADAPTOR DESIGN
(REQUIRED WASHER – PART NO. 42430)



NEW ADAPTOR DESIGN
(REQUIRED GASKET – PART NO. 437919)

NOTES:

High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

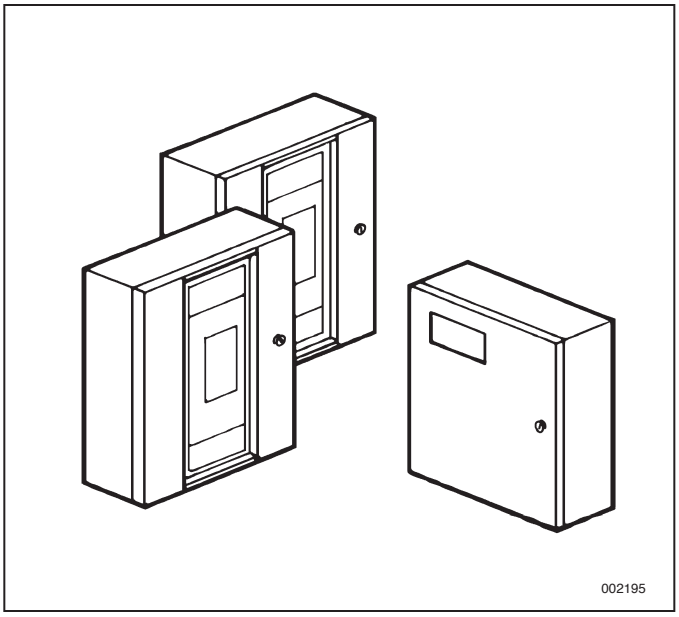
AUTOPULSE Control System

Description

The AUTOPULSE Control System provides a range of features and benefits, ranging from simple detection through counting circuits.

Several models of the AUTOPULSE Control System are available depending on the type of hazard being protected.

Refer to the AUTOPULSE Detection and Control Systems Manual (Part No. 430261, latest revision) for detailed information concerning all AUTOPULSE Control Systems.



NOTES:

HF Electric Actuator

Description

Electrical actuation of an agent container is accomplished by an HF electric actuator interfaced through an AUTOPULSE Control System. This actuator can be used in hazardous environments where the ambient temperature range is between –0 °F to 130 °F (–18 °C to 54 °C). The HF electric actuator meets the requirements of N.E.C. Class I, Div. 1, Groups B, C, D and Class II, Div. 1, Groups E, F, G. A maximum of two HF electric actuators connected in series can be used on a single 24 VDC AUTOPULSE release circuit. When utilizing only one HF electric actuator, an in-line resistor (Part No. 73886) must be used in place of the second actuator in the series connected circuit.

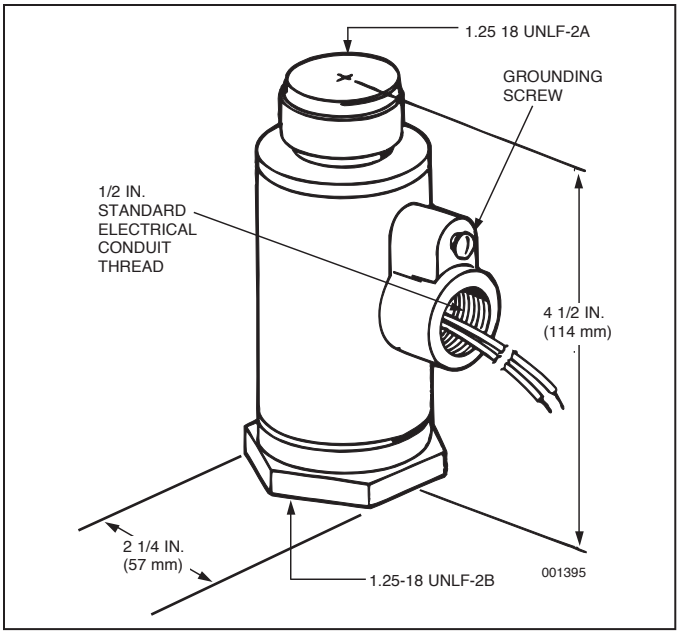
The actuator specifications (single actuator) are:

Nominal Voltage	Rated Voltage Minimum	Rated Voltage Maximum
12 VDC @ 0.57 amps	10.4 VDC*	14.0 VDC

In auxiliary or override applications, a lever release valve actuator (Part No. 70846) can be installed on top of the HF electric actuator by removing the safety cap.

The actuator contains a standard 1/2 in. threaded female straight connector for electrical conduit hookup. A reset tool is required to reset the actuator after operation.

Shipping Assembly Part No.	Description
73327	HF Electric Actuator
75433	Arming Tool
73886	In-Line Resistor



Component	Material	Thread Size/Type	Approvals
HF Electric Actuator	Body: Brass Plunger: Stainless Steel	1/2 in. Straight Female	UL (EX-2968); Listed for use with FM Approved systems

*Minimum operating voltage is 9.0 VDC.

NOTES:

China CCCF HF Electric Actuator

Description

Electrical actuation of an agent container is accomplished by an HF electric actuator interfaced through an AUTOPULSE Control System. This actuator can be used in hazardous environments where the ambient temperature range is between –0 °F to 130 °F (–18 °C to 54 °C). The HF electric actuator meets the requirements of N.E.C. Class I, Div. 1, Groups B, C, D and Class II, Div. 1, Groups E, F, G. A maximum of two HF electric actuators connected in series can be used on a single 24 VDC AUTOPULSE release circuit. When utilizing only one HF electric actuator, an in-line resistor (Part No. 73886) must be used in place of the second actuator in the series connected circuit.

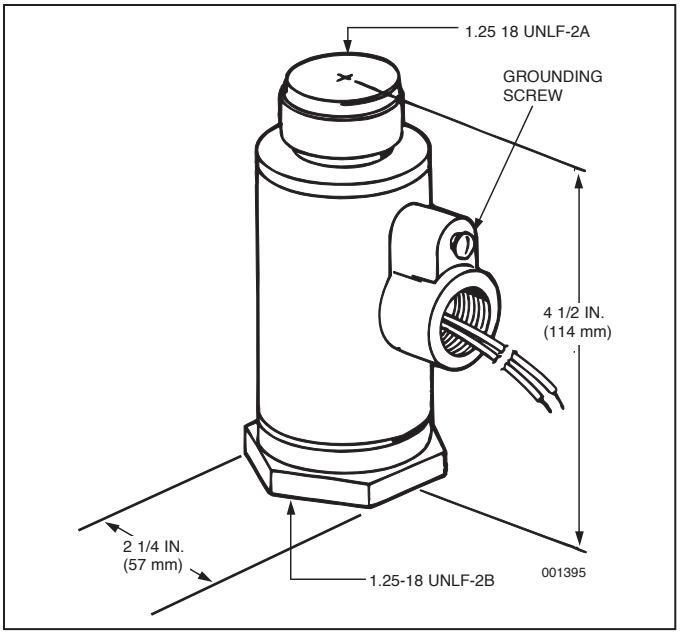
The actuator specifications (single actuator) are:

Nominal Voltage	Rated Voltage Minimum	Rated Voltage Maximum
12 VDC @ 0.57 amps	10.4 VDC*	14.0 VDC

In auxiliary or override applications, a lever release valve actuator (Part No. 70846) can be installed on top of the HF electric actuator by removing the safety cap.

The actuator contains a standard 1/2 in. threaded female straight connector for electrical conduit hookup. A reset tool is required to reset the actuator after operation.

Shipping Assembly Part No. (Marinette)	Shipping Assembly Part No. (Shanghai)	Description
442991	445138	HF Electric Actuator
75433	75433	Arming Tool
73886	73886	In-Line Resistor



Component	Material	Thread Size/Type	Approvals
HF Electric Actuator	Body: Brass Plunger: Stainless Steel	1/2 in. Straight Female	UL (EX-2968); Listed for use with FM Approved systems

*Minimum operating voltage is 9.0 VDC.

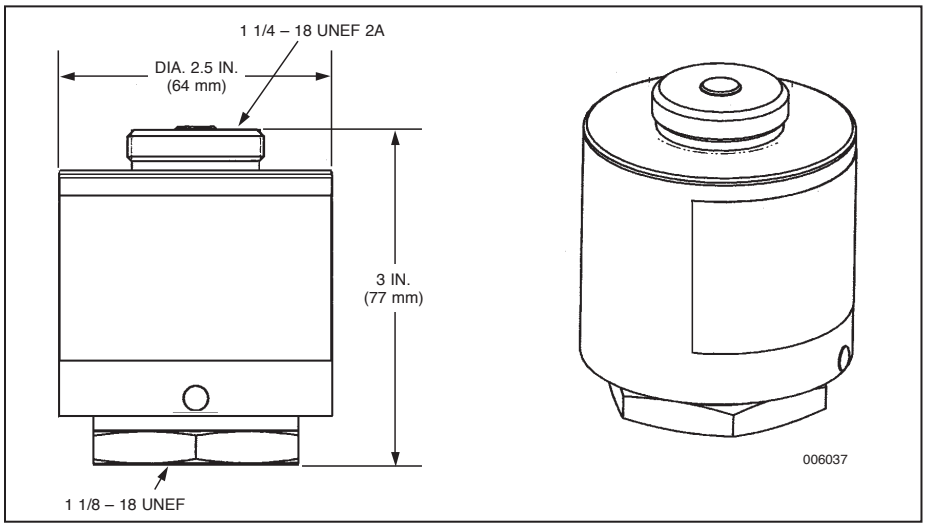
NOTES:

Booster Actuator

Description

The Booster Actuator (Part No. 428949) is used when electric actuation is required on the selector valve or the CV-98 container valve. The actuator mounts directly to the CV-98 valve or selector valve and then a HF electric actuator mounts to the top of the booster actuator.

The Booster Actuator requires resetting after actuation. A Reset Tool (Part No. 429847) is required for this use, the actuator cannot be reset without it.



NOTES:

Pressure Operated Stackable Actuator

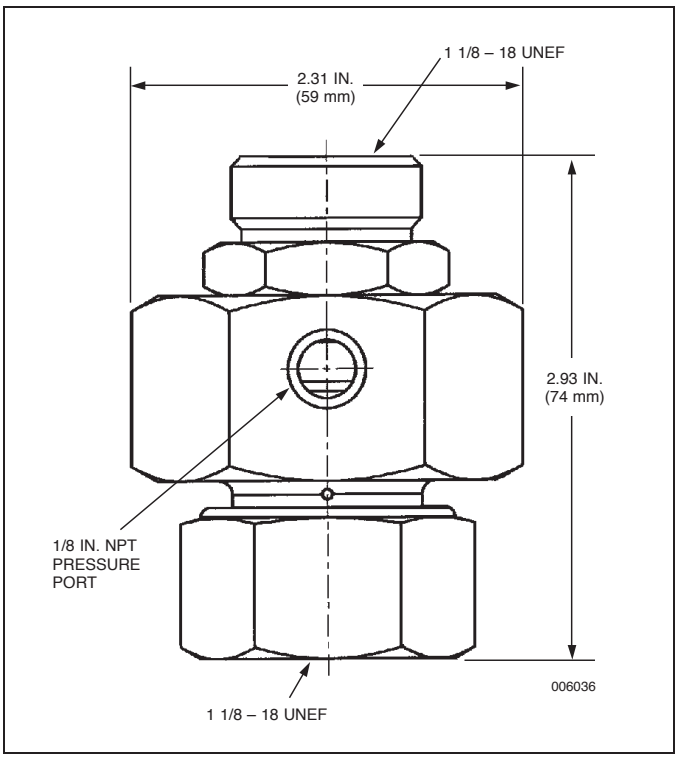
Description

The pressure operated stackable actuator (Part No. 428566) is necessary when pneumatic actuation is required on any selector valve. This actuator is installed on top of the selector valve, a lever release (Part No. 427207) must be installed on top of the actuator, and a 1/4 in. pressure line must be attached to the 1/8 in. pressure port on the side of the actuator. The actuator must be manually reset after use by pushing the stem back up into the actuator body. The actuator is constructed of brass.

When installed in actuation line, Selector Valve Pneumatic Actuation Line Kit (Part No. 436127) must also be utilized.

Component	Material	Approvals
Pressure Operated Stackable Actuator	Brass	Listed for use with FM Approved systems; UL Listed (EX-2968)

Shipping Assembly Part No.	Description
428566	Pressure operated stackable actuator
427207	Lever release



NOTES:

High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

Selector Valve Pneumatic Actuation Line Kit

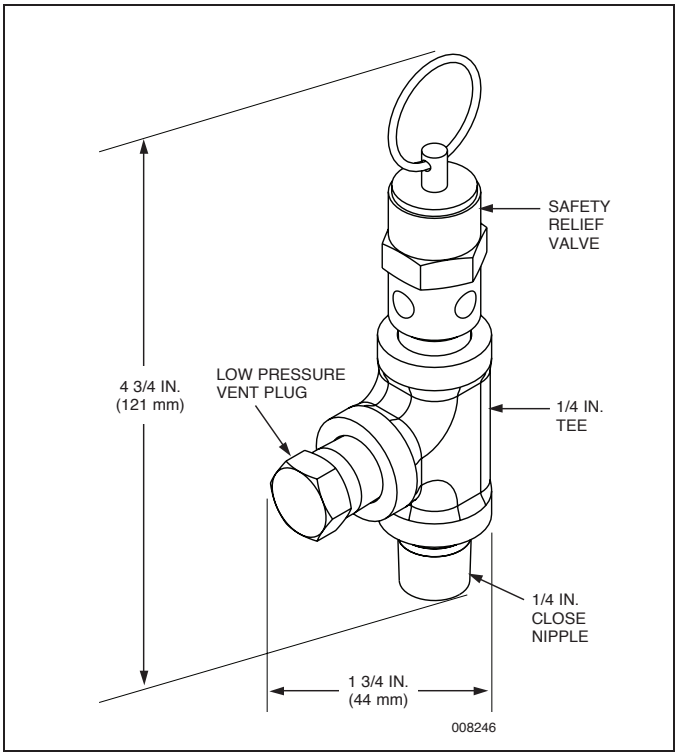
Description

The Selector Valve Pneumatic Actuation Line Kit (Part No. 436127) is used to control the pressure in the actuation lines of the selector valves. One selector valve pneumatic actuation line kit is required for each Pneumatic Actuator (Part No. 428566) and must be installed within 1 ft (0.3 m) of the actuator/isolation valve.

The Low Pressure Vent Plug (Part No. 436085) and Safety Relief Valve (Part No. 15677) are to be installed with a torque of 125 in.-lb (14 N•m).

After system discharge, all pressure in the actuation line must be relieved by pulling the ring on the safety relief valve.

Component	Material	Approvals
Low-Pressure Vent Plug	Brass	UL Listed (EX-2968); Listed for use with FM Approved systems
Safety Relief Valve	Brass	UL Listed (EX-2968); Listed for use with FM Approved systems
1/4 in. Close Nipple	Galvanized Steel	UL Listed (EX-2968); Listed for use with FM Approved systems
1/4 in. Tee	Galvanized Steel	UL Listed (EX-2968); Listed for use with FM Approved systems



Shipping Assembly Part No.	Description
436127	Selector Valve Pneumatic Actuation Line Kit
436085	Low Pressure Vent Plug
15677	Safety Relief Valve
28484	1/4 in. Close Nipple
27350	1/4 in. Tee

Note: The low pressure vent plug cannot be ordered separately.

NOTES:

Selector Valves

Description

Selector valves are used to direct the flow of CO_2 into a single hazard of a multiple hazard system.

When pneumatic actuation is required for any selector valve, the following must be ordered separately: a Stackable Actuator Assembly (Part No. 428566) and Selector Valve Pneumatic Actuation Line Kit (Part No. 436127).

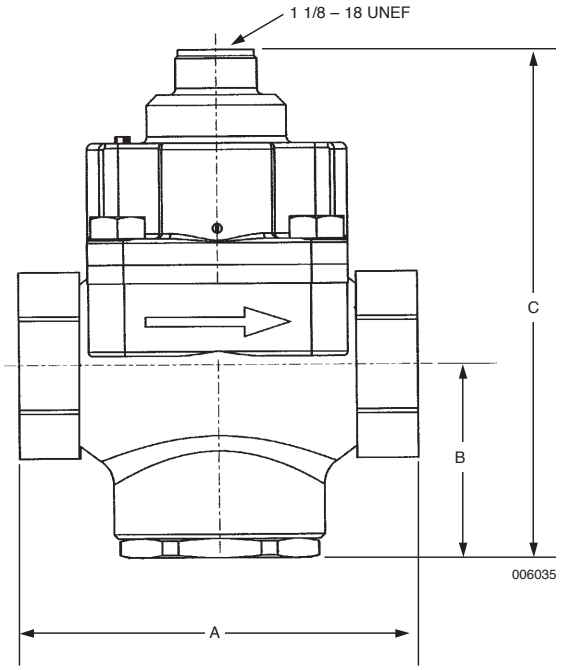
When electric actuation is required for any selector valve, a Booster Actuator (Part No. 428949) and HF electric actuator (Part No. 73327) must be ordered separately.

Selector valves can be manually operated by mounting a lever actuator either directly onto the valve, onto the top of the pressure operated stackable actuator, or onto the top of the electric actuator. See Lever Release Actuator (page 1-8a) for correct actuator.

Note: The Selector Valve Adaptor (Part No. 430832) can also be used to retrofit older model 1/2 in. through 2 1/2 in. selector valves (Part No. 57428-57433) when used in conjunction with Lever Release (Part No. 427207) and the Pressure-Operated Stackable Actuator (Part No. 428566).

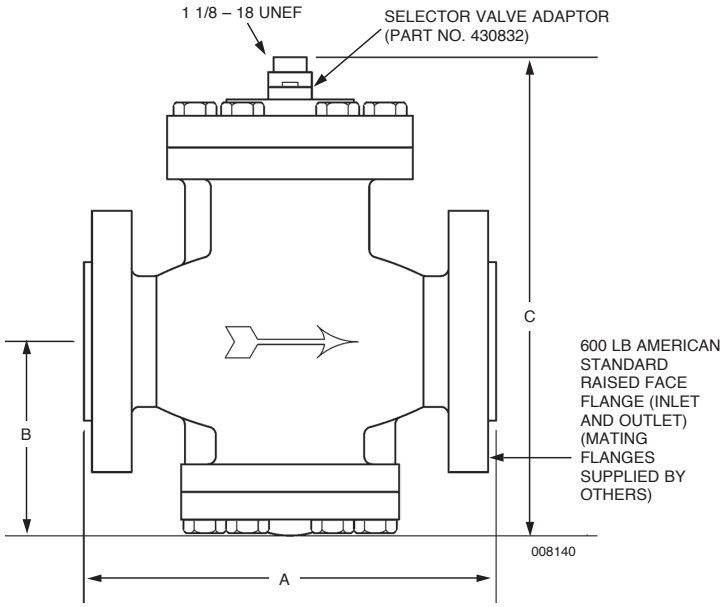
Component	Material	Thread Size/Type	Approvals
1 in. Selector Valve (Used for 1/2 in., 3/4 in. and 1 in. pipe sizes)	Bronze	1 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems
2 in. Selector Valve (Used for 1 1/4 in., 1 1/2 in. and 2 in. pipe sizes)	Bronze	2 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems
2 in., 2 1/2 in., 3 in. Selector Valve	Ductile Iron	3 in. Flange American Standard Raised Face	UL (EX-2968); Listed for use with FM Approved systems
4 in. Selector Valve	Ductile Iron	4 in. Flange American Standard Raised Face	UL (EX-2968); Listed for use with FM Approved systems

Shipping Assembly Part No.	Description
427185	1 in. Selector valve – threaded
427150	2 in. Selector valve – threaded
57433	2, 2 1/2, 3 in. Selector valve – flanged
57445	4 in. Selector valve – flanged
428566	Pressure-operated stackable actuator
428949	Booster actuator



1 IN. AND 2 IN. THREADED VALVE

FIGURE 1



NOTE: FOR 2 IN. AND 2 1/2 IN. FLANGE SELECTOR VALVES, USE A 3 IN. FLANGE VALVE.

3 IN. AND 4 IN. FLANGED VALVE

FIGURE 2

Shipping Selector Valve Sizes	Shipping Assembly Part No.	Body	A in.	A (mm)	B in.	B (mm)	C in.	C (mm)	Shipping Weight lb	Shipping Weight (kg)
1 in. (Fig. 1)	427185	Threaded – 1 in. NPT female	5 1/2	(140)	2 9/16	(67)	7	(178)	16	(7.3)
2 in. (Fig. 1)	427150	Threaded – 2 in. NPT female	7 1/2	(191)	3 1/2	(89)	8 9/16	(218)	33	(15.0)
2 in., 2 1/2 in., 3 in. (Fig. 2)	57433	Flanged – 3 in.	13	(330)	6 1/8	(156)	14 1/2	(368)	117	(53.0)
4 in. (Fig. 2)	57445	Flanged – 4 in.	16	(406)	8 3/4	(222)	18 1/8	(460)	262	(118.8)

China CCCF Selector Valves

Description

Selector valves are used to direct the flow of CO_2 into a single hazard of a multiple hazard system.

When pneumatic actuation is required for any selector valve, the following must be ordered separately: a Stackable Actuator Assembly (Part No. 428566) and Selector Valve Pneumatic Actuation Line Kit (Part No. 436127).

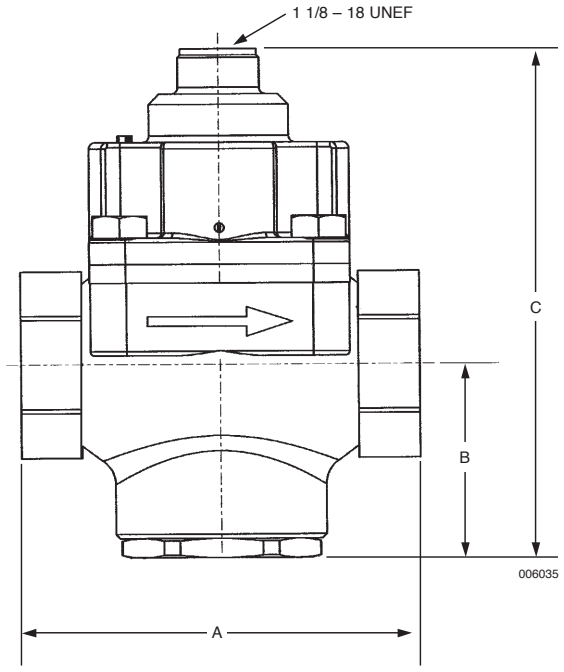
When electric actuation is required for any selector valve, a Booster Actuator (Part No. 428949) and HF electric actuator (Part No. 73327) must be ordered separately.

Selector valves can be manually operated by mounting a lever actuator either directly onto the valve, onto the top of the pressure operated stackable actuator, or onto the top of the electric actuator. See Lever Release Actuator (page 1-8a) for correct actuator.

Component	Material	Thread Size/Type	Approvals
1 in. Selector Valve (Used for 1/2 in., 3/4 in. and 1 in. pipe sizes)	Bronze	1 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems
2 in. Selector Valve (Used for 1 1/4 in., 1 1/2 in. and 2 in. pipe sizes)	Bronze	2 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems
2 in., 2 1/2 in., 3 in. Selector Valve	Ductile Iron	3 in. Flange American Standard Raised Face	UL (EX-2968); Listed for use with FM Approved systems
4 in. Selector Valve	Ductile Iron	4 in. Flange American Standard Raised Face	UL (EX-2968); Listed for use with FM Approved systems

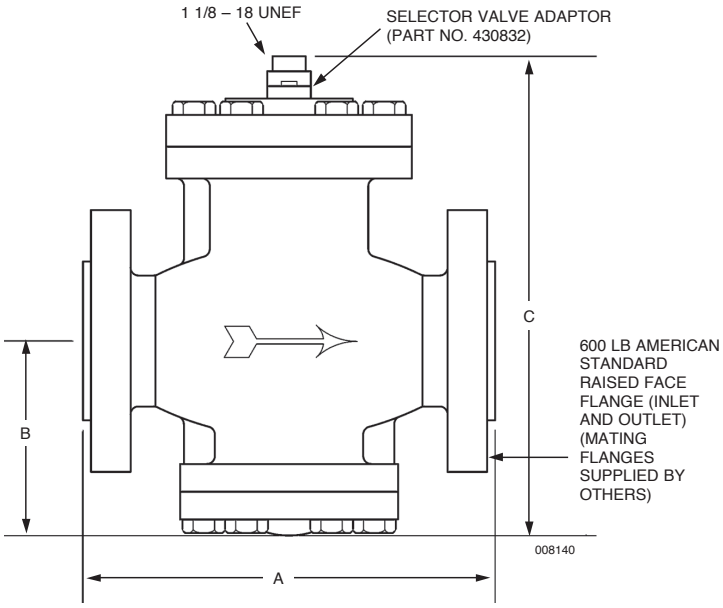
CHINA CCCF SELECTOR VALVES (Continued)

Shipping Assembly Part No.		
Marinette Factory	**Shanghai Factory**	**Description**
442995	445176	1 in. Selector valve – threaded
442996	445177	2 in. Selector valve – threaded
442997	445178	2, 2 1/2, 3 in. Selector valve – flanged
442998	445179	4 in. Selector valve – flanged
428566		Pressure-operated stackable actuator
428949		Booster actuator



1 IN. AND 2 IN. THREADED VALVE

FIGURE 1



NOTE: FOR 2 IN. AND 2 1/2 IN. FLANGE SELECTOR VALVES, USE A 3 IN. FLANGE VALVE.

3 IN. AND 4 IN. FLANGED VALVE

FIGURE 2

Shipping Selector Valve Sizes	Shipping Assembly Part No.	Body	A in.	A (mm)	B in.	B (mm)	C in.	C (mm)	Shipping Weight lb	Shipping Weight (kg)
1 in. (Fig. 1)	442995 445176	Threaded – 1 in. NPT female	5 1/2	(140)	2 9/16	(67)	7	(178)	16	(7.3)
2 in. (Fig. 1)	442996 445177	Threaded – 2 in. NPT female	7 1/2	(191)	3 1/2	(89)	8 9/16	(218)	33	(15.0)
2 in., 2 1/2 in., 3 in. (Fig. 2)	442997 445178	Flanged – 3 in.	13	(330)	6 1/8	(156)	14 1/2	(368)	117	(53.0)
4 in. (Fig. 2)	442998 445179	Flanged – 4 in.	16	(406)	8 3/4	(222)	18 1/8	(460)	262	(118.8)

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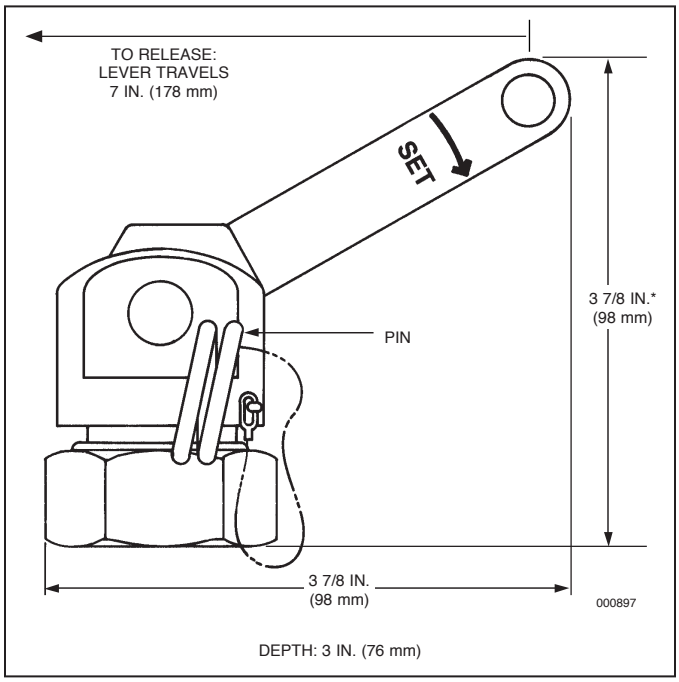
Lever Release Actuator

Description

The manual lever release actuator provides a manual means of actuating container valves and selector valves. This can be accomplished by direct manual actuation of its pull lever or cable actuation when used in conjunction with a remote manual pull station. When used with a remote manual pull station, the pull station must contain the components necessary to meet the actuator lever traveling requirements of 7 in. (178 mm) and not exceed 40 lb (18 kg) to operate.

The actuator is shipped with ring pin and chain attached. If the ring pin is not required, it must be removed. Failure to remove the ring pin/chain assembly will prevent system actuation if a remote cable pull actuation system is employed and the ring pin is accidentally installed in the actuator.

Three actuators are available. Each is designed for a specific component.



* Add 1 9/16 in. (39 mm) to height when lever is in the straight up position.

Note: The lever actuator used on a CV-90 valve must not be used on a CV-98 valve.

Component	Material	Approvals
All Manual Cable-pull Actuators	Brass with Stainless Steel Pin	Listed for use with FM Approved systems; UL Listed (EX-2968)

Shipping Assembly Part No.	Description
423309	Lever Release (1 1/8-18 mounting thread) – Mounts directly to a CV-98 container valve.
70846	Lever Release (1 1/4-18 mounting thread) – Mounts directly to an HF electric actuator.
427207	Lever Release (1 1/8-18 mounting thread) – Mounts directly to the 1 in., 2 in., 3 in., and 4 in. selector valves. Mounts directly to pressure operated stackable actuator (Part No. 428566). Actuator has the handle painted red.

NOTES:

Discharge Nozzle – Type "D"

Description

The type "D" nozzle is used primarily for local application and is also listed and approved for use as a total flooding nozzle. The nozzle shell is drawn mild or stainless sheet steel and the insert is brass or stainless steel. The "D" type nozzle is available in orifice sizes ranging from 1 through 7. The discharge rate of the nozzle depends on the orifice size and nozzle pressure.

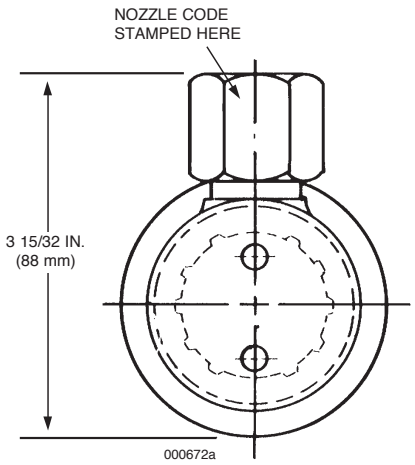
The area covered in local application is dependent upon the discharge rate and the height of the nozzle above the surface being protected. Height range: 15 in. to 91 1/2 in. (381 mm to 2324 mm). Discharge rate: 11 lb to 48.5 lb per minute (5 kg to 22 kg per minute). See Section 5 – Design for UL and FM listed area coverage and required flow rates.

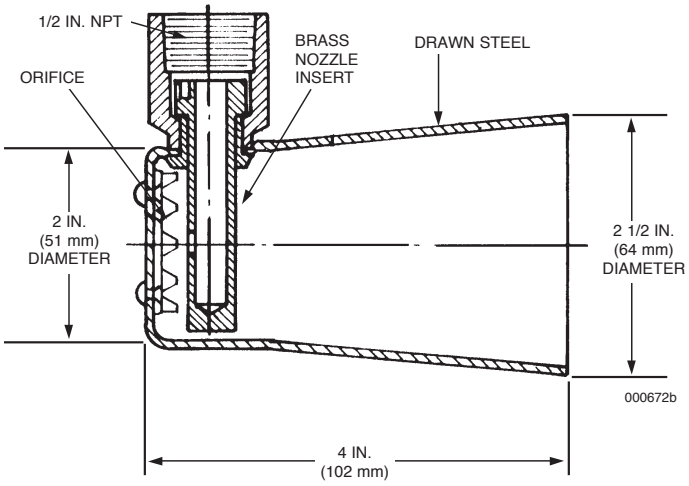
Component	Material	Shell Finish	Thread Size/Type	Orifice Size	Approvals
Type "D" nozzle	Shell: Steel Insert: Brass Strainer: Monel	Red Enamel	1/2 in. NPT Female	1 through 7	UL (EX-2968); Listed for use with FM Approved systems (non-stainless steel only)

Shipping Assembly Part No.	Description	Orifice Code
426100	Type "D" nozzle with strainer	1 – 3
426101	Type "D" nozzle	3.5 – 7
428103	Stainless steel type "D" nozzle with strainer	1 – 3
428104	Stainless steel type "D" nozzle	3.5 – 7

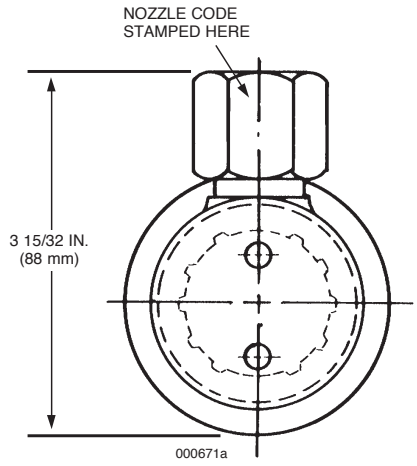
Note: When ordering, specify orifice code required: Example – Part No. 426100 – 2.5.

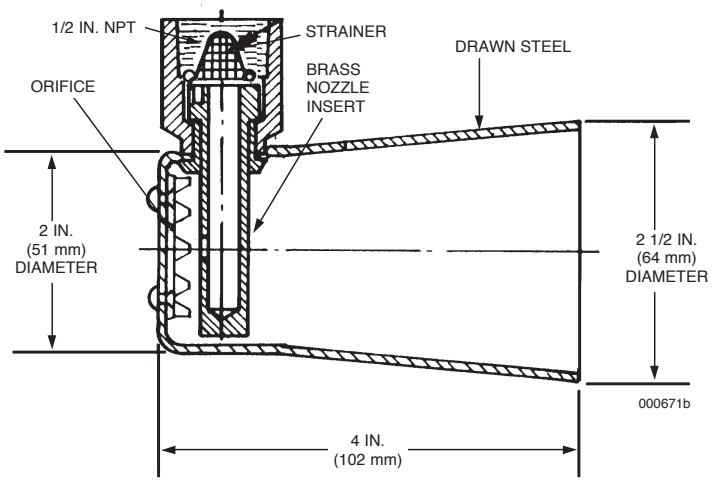
Carbon Dioxide Type ‘‘D’’ Discharge Nozzle





Carbon Dioxide Type ‘‘D’’ Discharge Nozzle with Strainer





China CCCF Discharge Nozzle – Type "D"

Description

The type "D" nozzle is used primarily for local application and is also listed and approved for use as a total flooding nozzle. The nozzle shell is drawn mild or stainless sheet steel and the insert is brass or stainless steel. The "D" type nozzle is available in orifice sizes ranging from 3.5 through 7. The discharge rate of the nozzle depends on the orifice size and nozzle pressure.

The area covered in local application is dependent upon the discharge rate and the height of the nozzle above the surface being protected. Height range: 15 in. to 91 1/2 in. (381 mm to 2324 mm). Discharge rate: 11 lb to 48.5 lb per minute (5 kg to 22 kg per minute). See Section 5 – Design for UL and FM listed area coverage and required flow rates.

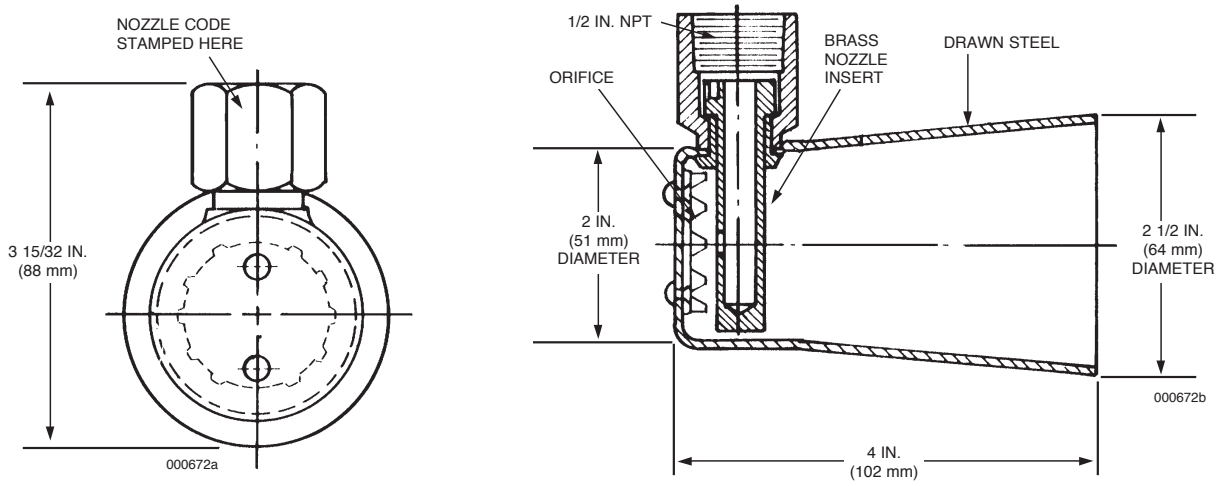
Component	Material	Shell Finish	Thread Size/Type	Orifice Size	Approvals
Type "D" nozzle	Shell: Steel Insert: Brass Strainer: Monel	Red Enamel	1/2 in. NPT Female	3.5 through 7	UL (EX-2968); Listed for use with FM Approved systems (non-stainless steel only)

Shipping Assembly Part No. (Shanghai)	Description	Orifice Code
445267	Type "D" nozzle	3.5 – 7

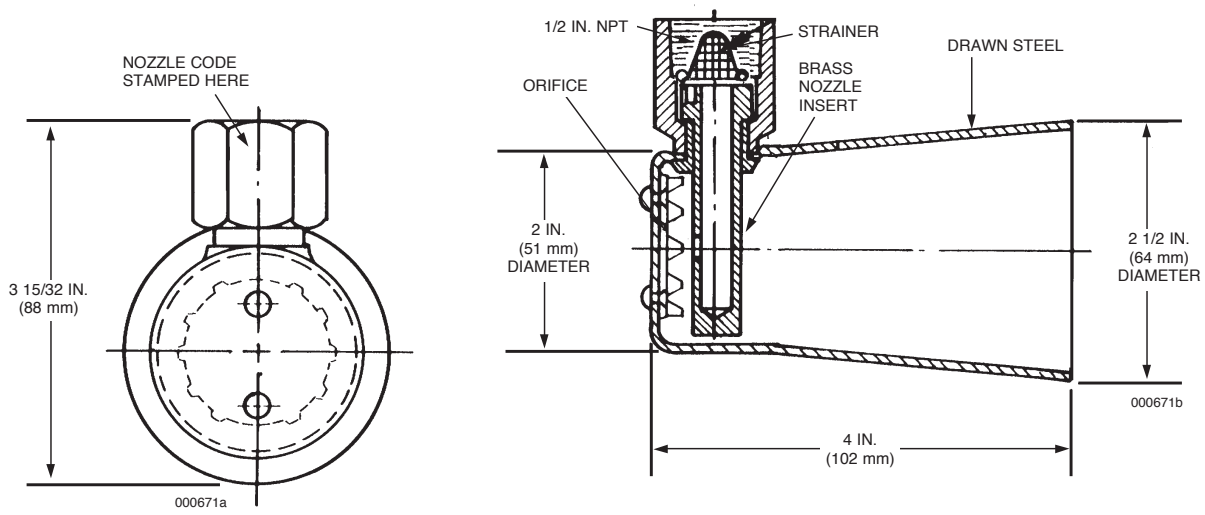
Note: When ordering, specify orifice code required: Example – Part No. 445267 – 3.5.

CHINA CCCF DISCHARGE NOZZLE – TYPE "D" (Continued)

Carbon Dioxide Type ''D'' Discharge Nozzle



Carbon Dioxide Type ''D'' Discharge Nozzle with Strainer



Discharge Nozzle - Type “D” (Corrosion-Resistant)

Description

The corrosion-resistant (CR) type “D” nozzle is used primarily for local application wet bench protection but is also approved for use as a total flooding nozzle. The nozzle shell is drawn sheet steel and the insert is stainless steel. The shell is coated with a corrosion-resistant material which is not effected by the acid type environment of a typical wet bench hazard. The CR “D” type nozzle is available in orifice sizes ranging from 1 through 7. A blow off cap is used to seal the uncoated tip.

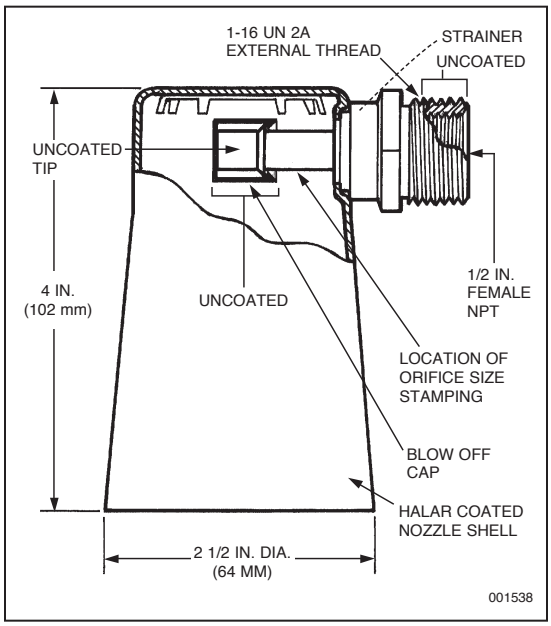
A plastic pipe seal adaptor is also available which can be threaded on the external nozzle threads so plastic tubing can be attached to this to cover the discharge piping within the corrosive environment.

The last 3/8 in. of the 1-16 UN2A external threads are not coated to allow the use of stainless steel tubing or installation of the pipe seal adaptor. If an adaptor is not used, the exposed thread must be wrapped with a CR material to seal the exposed threads.

The discharge rate of the nozzle depends on the orifice size and nozzle pressure. The area covered in local application is dependent upon the discharge rate and the height of the nozzle above the surface being protected. Height range: 15 in. to 91 1/2 in. (381 mm to 2324 mm). Discharge rate: 11 lb to 48.5 lb per minute (5 kg to 22 kg per minute). See Section 5 – Design for FM listed area coverage and required flow rates.

Component	Material	Thread Size/Type	Orifice Size	Approvals
Type “D” nozzle	Shell: Steel External Thread: Steel Insert: Stainless Steel Strainer: Monel (internal) Shell coated with acid resistant material (Halar* ECTFE)	1/2 in. NPT Female	1 through 7	Listed for use with FM Approved systems
Blow Off Cap	Teflon* (TFE)			

Shipping Assembly Part No.	Description	Orifice Code
422647	Type “D” nozzle with strainer	1
422648	Type “D” nozzle with strainer	1+
422649	Type “D” nozzle with strainer	2
422650	Type “D” nozzle with strainer	2+
422651	Type “D” nozzle with strainer	3
422652	Type “D” nozzle	3+
422653	Type “D” nozzle	4
422654	Type “D” nozzle	4+
422655	Type “D” nozzle	5
422656	Type “D” nozzle	5+
422657	Type “D” nozzle	6
422658	Type “D” nozzle	6+
422659	Type “D” nozzle	7
422888	Pipe Seal Adaptor	
422890	Spare Blow Off Cap (1)	



Note: For non-typical wet bench environments, contact Technical Services.

* Halar is a registered trademark of Ausimont, Teflon is a registered trademark of DuPont.

NOTES:

High Pressure Carbon Dioxide Systems Manual
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Sealed Nozzle With Strainer

Description

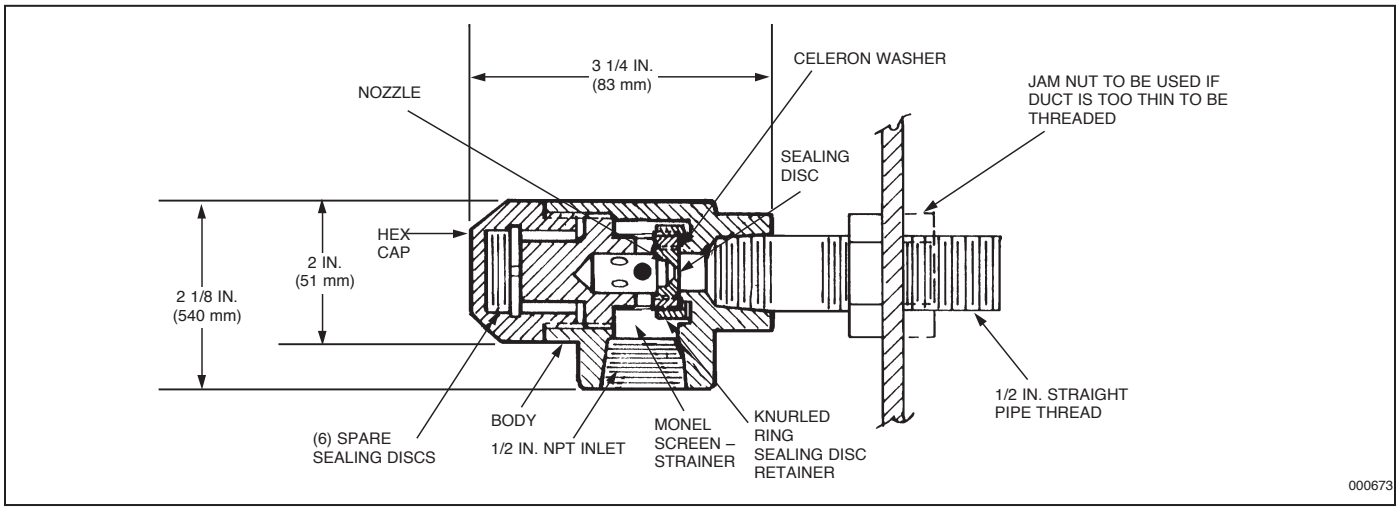
The sealed nozzle is used primarily in ducts and enclosed machinery spaces. The seal portion of the nozzle is a combination line seal and strainer unit. It is used to prevent dirt or vapors from entering the system piping and also to function as a strainer for the system piping. On operation of the carbon dioxide system, the high pressure of the gas released from the containers ruptures the thin sealing disc, allowing an unobstructed flow of gas to the internal discharge nozzle.

The advantage of the sealed nozzle is that it does not require disassembly of the system piping to clean the strainer or replace a ruptured sealing disc. This is accomplished by removing the hex cap on the nozzle.

Component	Material	Thread Size/Type	Orifice Size	Approvals
Sealed Nozzle	Body: Brass Strainer: Monel	1/2 in. NPT Female (inlet and outlet)	2 through 7	UL (EX-2968); Listed for use with FM Approved systems

Shipping Assembly Part No.	Description	Orifice Code
426102 45699	Sealed nozzle with strainer Replacement Seal (Package of 10)	2 – 7

Note: When ordering, specify orifice code required: Example – Part No. 426102 – 2.5.



NOTES:

Discharge Nozzle – Type "A"

Description

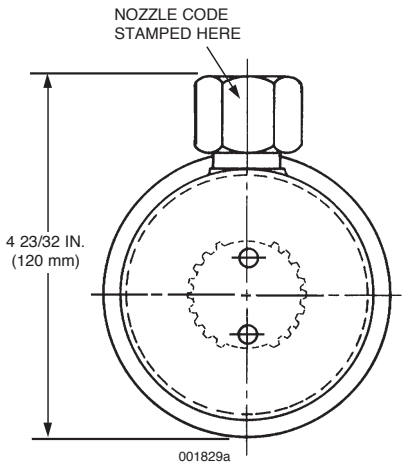
The type "A" nozzle is used primarily for local application and is also listed and approved for use as a total flooding nozzle. The nozzle shell is drawn sheet steel and the insert is brass; the nozzle is painted red. The "A" type nozzle is available in orifice sizes ranging from 1 through 7. The discharge rate of the nozzle depends on the orifice size and nozzle pressure. The area covered in local application is dependent on the discharge rate of the height of the nozzle above the surface being protected. Height range: 18 in. to 72 in. (457 mm to 1829 mm). Discharge rate: 14 lb to 48.5 lb per minute (6 kg to ▸ 22 kg per minute). See Section 5 – Design for area coverage and required flow rates.

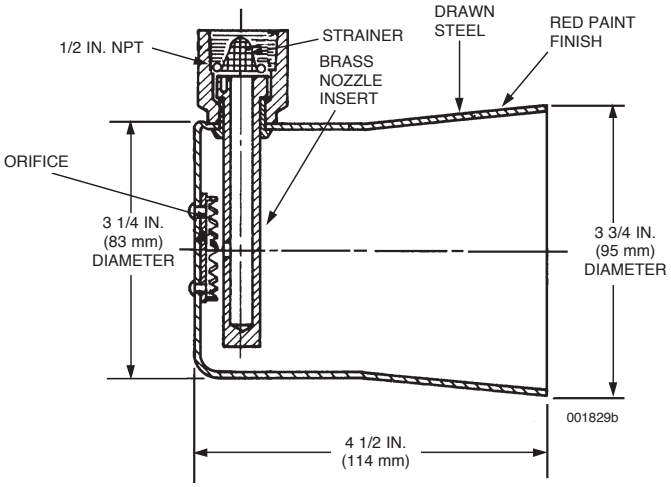
Component	Material	Shell Finish	Thread Size/Type	Orifice Size	Approvals
Type "A" Nozzle	Shell: Steel Insert: Brass Strainer: Monel	Red Enamel	1/2 in. NPT Female	1 through 7	UL (EX-2968); Listed for use with FM Approved systems

Shipping Assembly Part No.	Description	Orifice Code
426103	Type "A" nozzle with strainer	1 – 3
426104	Type "A" nozzle	3.5 – 7

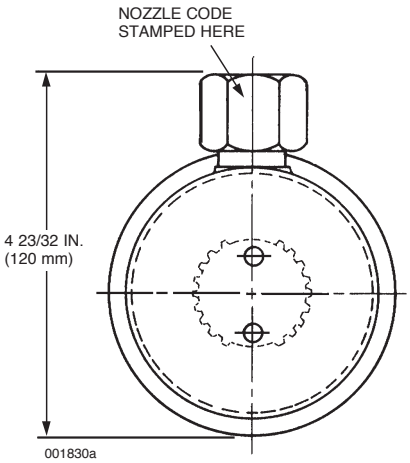
Note: When ordering, specify orifice code required: Example – Part No. 426103 – 2.5.

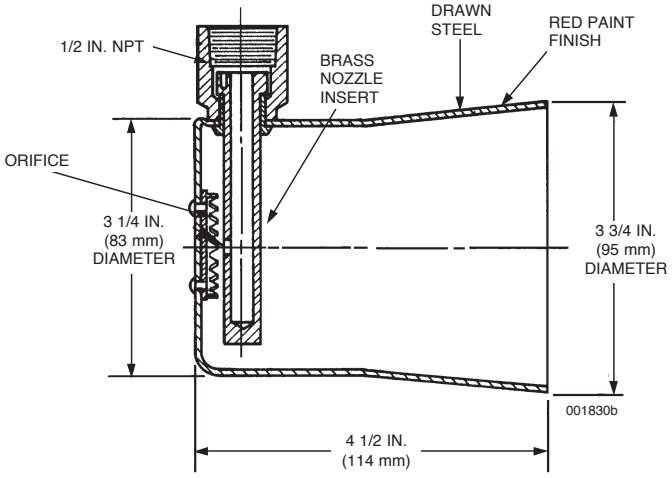
Carbon Dioxide Type ‘‘A’’ Discharge Nozzle with Strainer





Carbon Dioxide Type ‘‘A’’ Discharge Nozzle





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(Part No. 427604)

Discharge Nozzle – Cone Type

Description

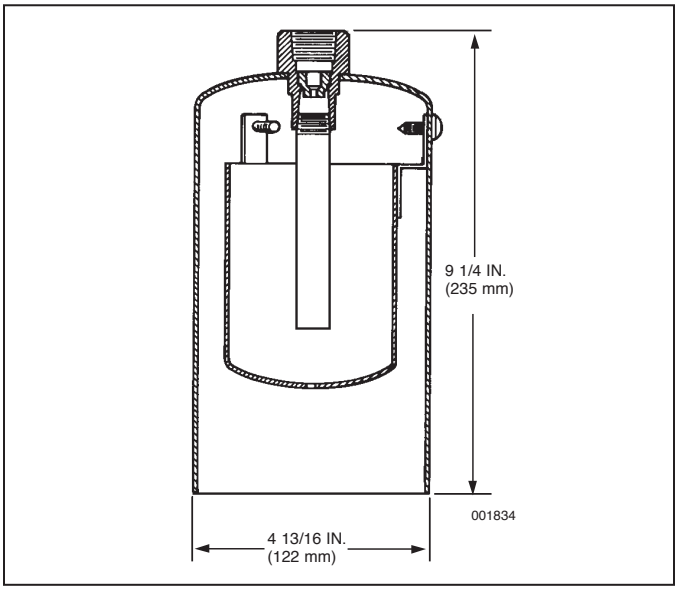
The cone nozzle is used primarily for local application and also listed and approved for use as a total flooding nozzle. The nozzle insert is stainless steel and the body is sheet steel; the nozzle is painted red. The nozzle is available in orifice sizes ranging from 3 through 11. The discharge rate of the nozzle depends on the orifice size and nozzle pressure. The area covered in local application is dependent upon the discharge rate and the height above the surface being protected.

Height range: 42 in. to 108 in. (1067 mm to 2743 mm). Discharge rate: 21 lb to 132 lb per minute (10 kg to 60 kg ▸ per minute). See Section 5 – Design for area coverage and required flow rates.

Component	Material	Shell Finish	Thread Size/Type	Orifice Size	Approvals
Cone nozzle	Shell: Steel Insert: Stainless Steel	Red Enamel	1/2 in. NPT Female	3 through 11	UL (EX-2968); Listed for use with FM Approved systems

Shipping Assembly Part No.	Description	Orifice Code
426105	Cone nozzle	3 – 11

Note: When ordering, specify orifice code required:
Example – Part No. 426105 – 3.5.



NOTES:

China CCCF Discharge Nozzle – Cone Type

Description

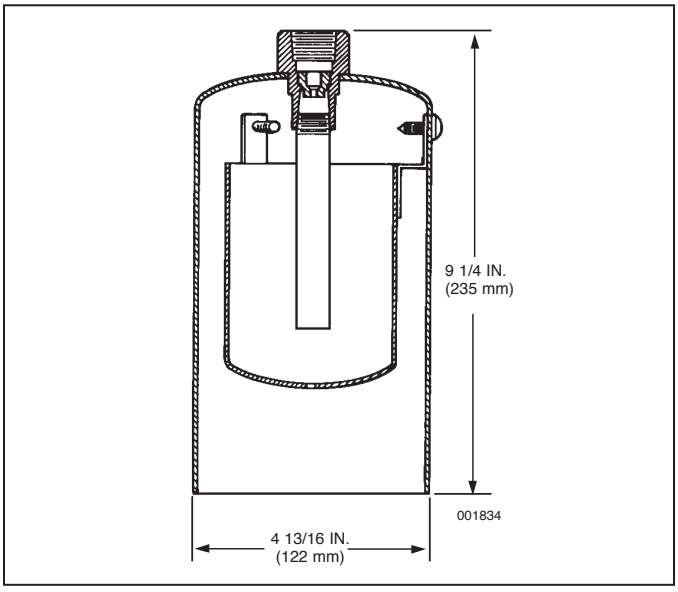
The cone nozzle is used primarily for local application and also listed and approved for use as a total flooding nozzle. The nozzle insert is stainless steel and the body is sheet steel; the nozzle is painted red. The nozzle is available in orifice sizes ranging from 3 through 11. The discharge rate of the nozzle depends on the orifice size and nozzle pressure. The area covered in local application is dependent upon the discharge rate and the height above the surface being protected.

Height range: 42 in. to 108 in. (1067 mm to 2743 mm). Discharge rate: 21 lb to 132 lb per minute (10 kg to 60 kg per minute). See Section 5 – Design for area coverage and required flow rates.

Component	Material	Shell Finish	Thread Size/Type	Orifice Size	Approvals
Cone nozzle	Shell: Steel Insert: Stainless Steel	Red Enamel	1/2 in. NPT Female	3 through 11	UL (EX-2968); Listed for use with FM Approved systems

Shipping Assembly Part No. (Shanghai)	Description	Orifice Code
445272	Cone nozzle	3 – 11

Note: When ordering, specify orifice code required:
Example – Part No. 445272 – 3.5.



NOTES:

High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

Discharge Nozzle – 4 in. Multi-Discharge Type

Description

The 4 in. multi-discharge nozzle is used only for total flooding applications. The nozzle insert is brass and the remainder of the nozzle is steel; the nozzle is painted red.

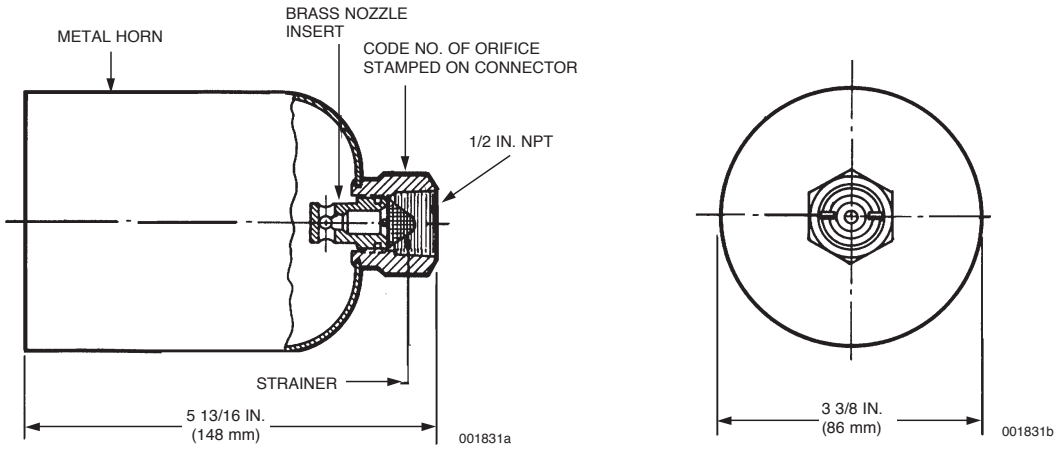
The nozzle is available in orifice sizes ranging from 2 through 18. The discharge rate of the nozzle depends on the orifice size and the nozzle pressure.

Component	Material	Shell Finish	Thread Size/Type	Orifice Size	Approvals
4 in. MD Nozzle w/Strainer	Nozzle: Steel Insert: Brass	Red Enamel	1/2 in. NPT Female	2 through 4.5	UL (EX-2968); Listed for use with FM Approved systems
4 in. MD Nozzle	Nozzle: Steel Insert: Brass	Red Enamel	1/2 in. NPT Female	5 through 10	UL (EX-2968); Listed for use with FM Approved systems
4 in. MDL Nozzle	Nozzle: Steel Insert: Brass	Red Enamel	3/4 in. NPT Female	8 through 18	UL (EX-2968); Listed for use with FM Approved systems

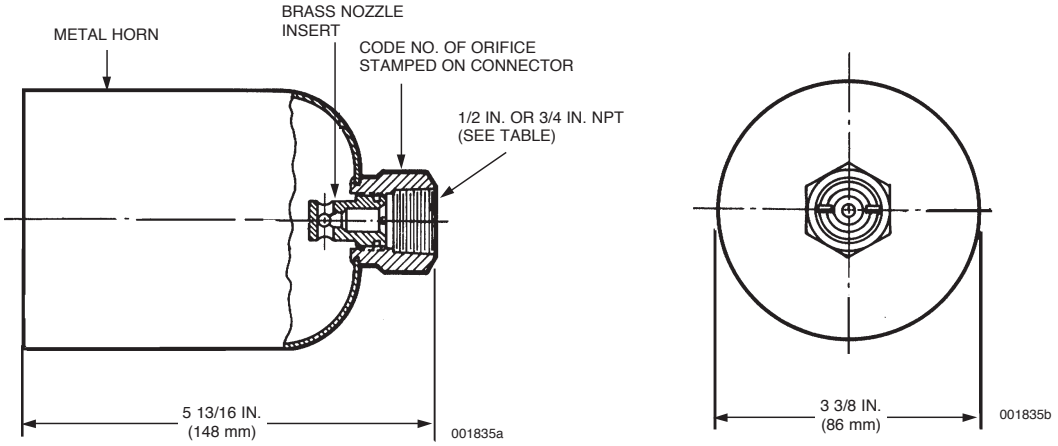
Shipping Assembly Part No.	Description	Orifice Code
426106	4 in. MD nozzle with strainer	2 – 4.5
426107	4 in. MD nozzle	5 – 10
▸ 426108	4 in. MDL nozzle	8 – 18

Note: When ordering, specify orifice code required: Example – Part No. 426107 – 6.5.

Multi-Discharge Nozzle – 4 MD with Strainer



Multi-Discharge Nozzle – 4 MD and 4 MDL



High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

China CCCF Discharge Nozzle – 4 in. Multi-Discharge Type

Description

The 4 in. multi-discharge nozzle is used only for total flooding applications. The nozzle insert is brass and the remainder of the nozzle is steel; the nozzle is painted red.

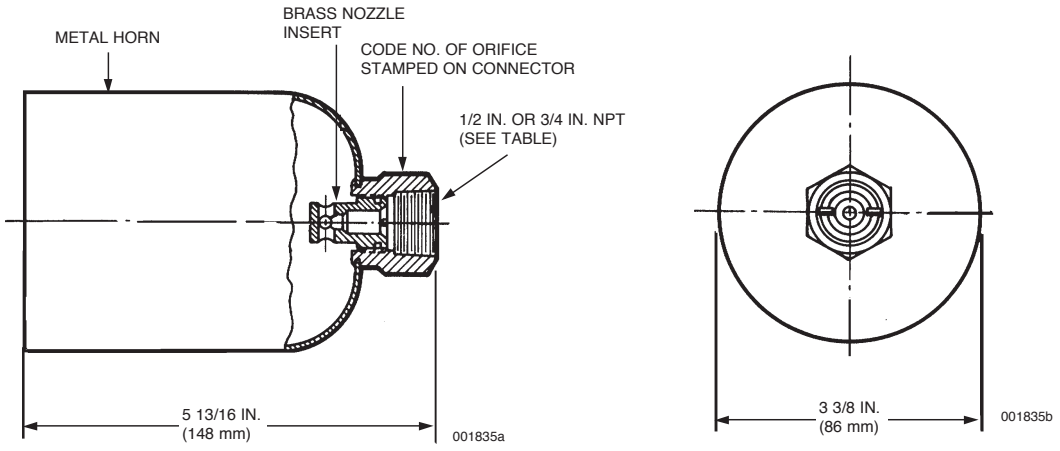
The nozzle is available in orifice sizes ranging from 8 through 18. The discharge rate of the nozzle depends on the orifice size and the nozzle pressure.

Component	Material	Shell Finish	Thread Size/Type	Orifice Size	Approvals
4 in. MDL Nozzle	Nozzle: Steel Insert: Brass	Red Enamel	3/4 in. NPT Female	8 through 18	UL (EX-2968); Listed for use with FM Approved systems

Shipping Assembly Part No. (Marinette)	Description	Orifice Code
446049	4 in. MDL nozzle	8 – 18

Note: When ordering, specify orifice code required: Example – Part No. 446049 – 10.5.

Multi-Discharge Nozzle – 4 MDL



NOTES:

High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

Discharge Nozzle – 6 in. Multi-Discharge Type

Description

The 6 in. multi-discharge nozzle is used primarily for local application and it is also listed and approved for use as a total flooding nozzle. The nozzle insert is brass and the remainder of the nozzle is steel; the nozzle is painted red. The nozzle is available in orifice sizes ranging from 2 through 18.

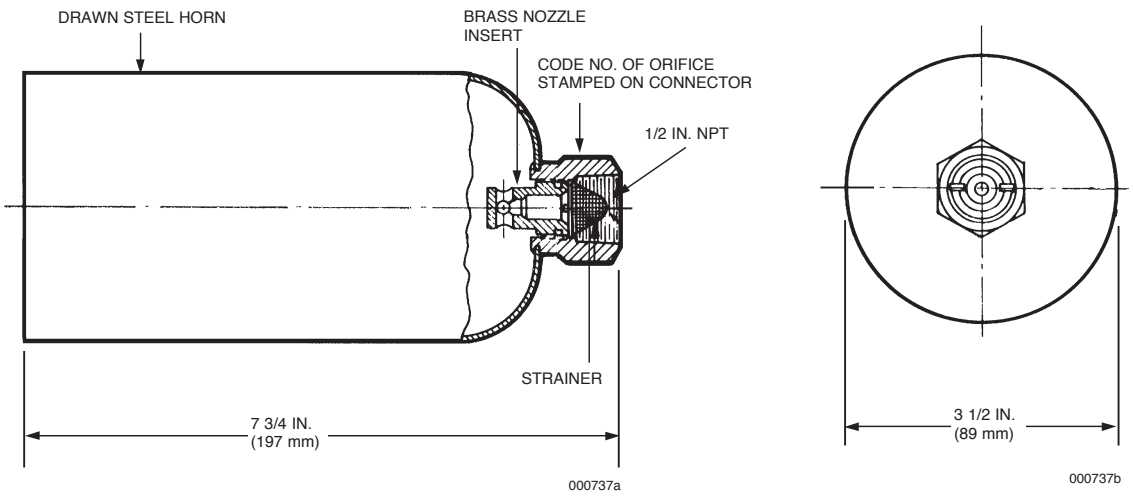
The discharge rate of the nozzle depends on the orifice size and the nozzle pressure. The area covered in local application is dependent upon the discharge rate and the height above the surface being protected. Height range: 36 in. to 144 in. (914 mm to 3658 mm). Discharge rate: 28.5 lb to 108 lb per ▸ minute (13 kg to 49 kg per minute). See Section 5 – Design for area coverage and required flow rates.

Component	Material	Shell Finish	Thread Size/Type	Orifice Size	Approvals
6 in. MD Nozzle w/Strainer	Nozzle: Steel Insert: Brass	Red Enamel	1/2 in. NPT Female	2 through 4.5	UL (EX-2968); Listed for use with FM Approved systems
6 in. MD Nozzle	Nozzle: Steel Insert: Brass	Red Enamel	1/2 in. NPT Female	5 through 10	UL (EX-2968); Listed for use with FM Approved systems
6 in. MDL Nozzle	Nozzle: Steel Insert: Brass	Red Enamel	3/4 in. NPT Female	8 through 18	UL (EX-2968); Listed for use with FM Approved systems

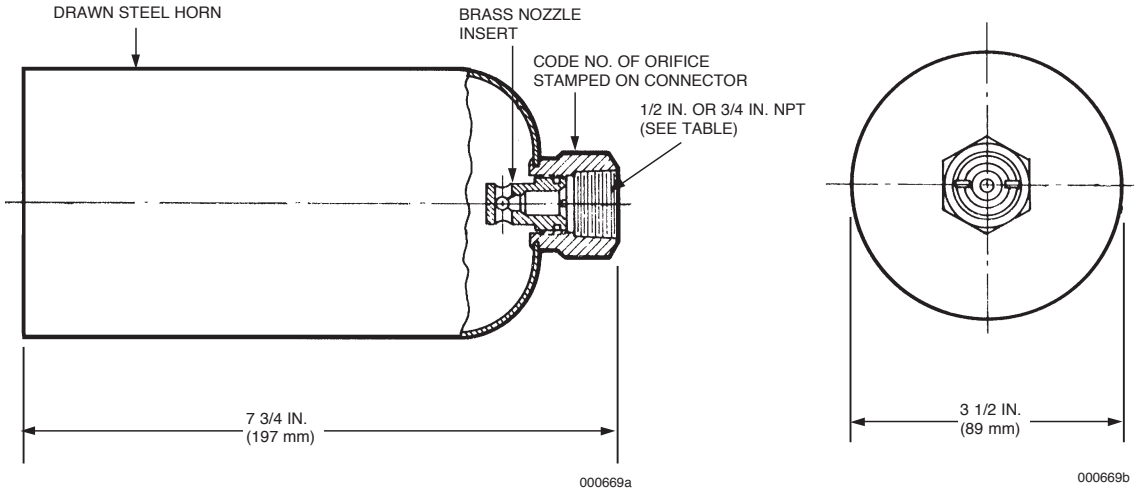
Shipping Assembly Part No.	Description	Orifice Code
426109	6 in MD nozzle with strainer	2 – 4.5
426110	6 in MD nozzle	5 – 10
426111	6 in MDL nozzle	8 – 18

Note: When ordering, specify orifice code required: Example – Part No. 426111 – 17.5.

Multi-Discharge Nozzle – 6 MD with Strainer



Multi-Discharge Nozzle – 6 MD and 6 MDL



High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

Bulkhead Mounting Flange

Description

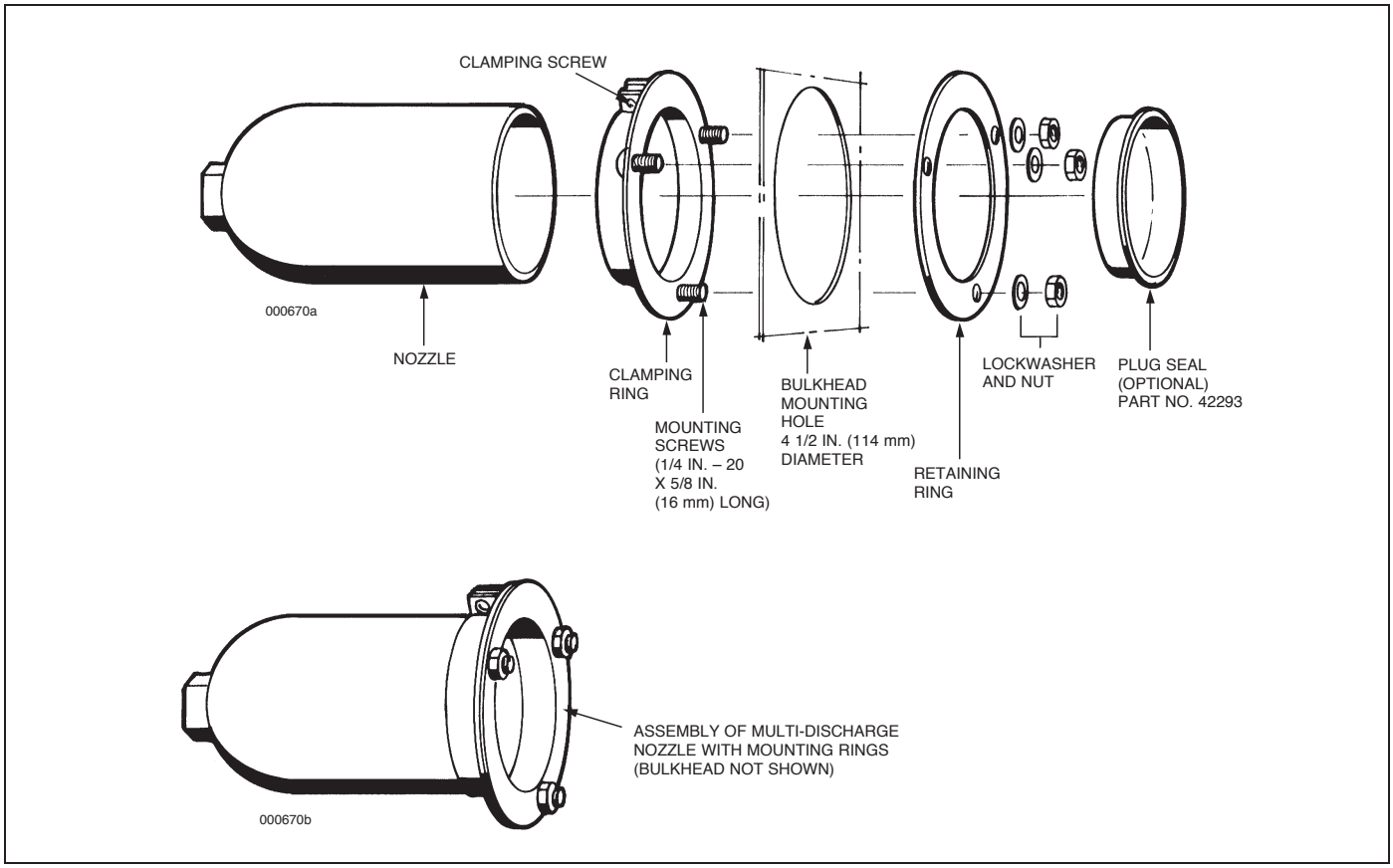
The bulkhead mounting flange (Part No. 42806) is used on the 6 in. multi-discharge nozzle. The flange allows the nozzle to be rigidly fastened against a wall or bulkhead of a hazard area, keeping the nozzle outside of the area. This is an advantage on hazard areas where the nozzle cannot be mounted inside the area because of space limitations or interference with moving parts. A typical application is a large exhaust duct where access into the duct is limited.

Also available is a sealing plug (Part No. 42293) which is ordered and shipped as a separate unit.

Component	Material	Approvals
Mounting Flange	Steel	UL (EX-2968); Listed for use with FM Approved systems

- 5 in. (127 mm) outside diameter
- 4.125 in. (105 mm) bolt hole diameter
- 3.5 in. (90 mm) inside diameter

Shipping Assembly Part No.	Description
42806	Bulkhead Mounting Flange
42293	Plug Seal



NOTES:

Discharge Nozzle – Regular Type

Description

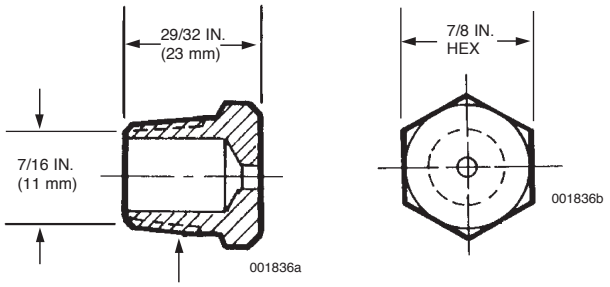
The regular type nozzle is used for total flooding applications only. The nozzle is available in seven different configurations: regular (1/2 in.), regular RL (3/4 in.), regular sealed with strainer, regular sealed, regular sealed with flange and strainer, regular sealed with flange, and regular RSFL sealed with flange. The sealed type has a sealing disc retaining ring and a frangible seal to prevent foreign matter from entering and plugging the nozzle orifice. The discharge rate of the regular nozzle depends on nozzle pressure and orifice size. The regular type nozzle provides orifice sizes of 1 through 18. The nozzle is available with 1/2 in. NPT threads for orifice sizes 1 through 12 and 3/4 in. NPT threads for orifice sized 8 through 18. Nozzles with orifices of 1 through 2+ are supplied with a strainer.

- The nozzle is supplied in brass. Stainless steel nozzles are also available. All nozzles are UL (EX-2968) approved and listed for use with FM Approved systems.

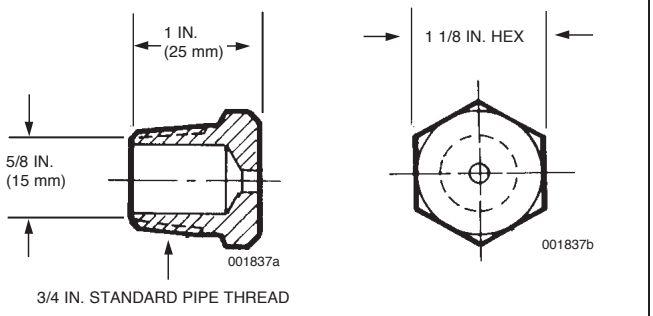
Shipping Assembly Part No. Brass	Shipping Assembly Part No. Stainless Steel	Description	Orifice Code
426112		Regular type nozzle	3 – 12
426113		Regular RL type nozzle	8 – 18
426114	437230	Regular sealed with strainer nozzle	1 – 2.5
426115	437231	Regular sealed nozzle	3 – 12
426116		Regular sealed with flange and strainer nozzle	1 – 2.5
426117		Regular sealed with flange nozzle	3 – 12
426118		Regular RSFL sealed with flange nozzle	8 – 18
426299		Regular sealed with flange and strainer nozzle 3 oz (stainless steel)	1 – 2.5
426300		Regular sealed with flange nozzle 3 oz (stainless steel)	3 – 12
45699		Spare Seal Kit (10 disks and 2 washers)	

Note: When ordering, specify orifice code required: Example – Part No. 426118 – 9.5.

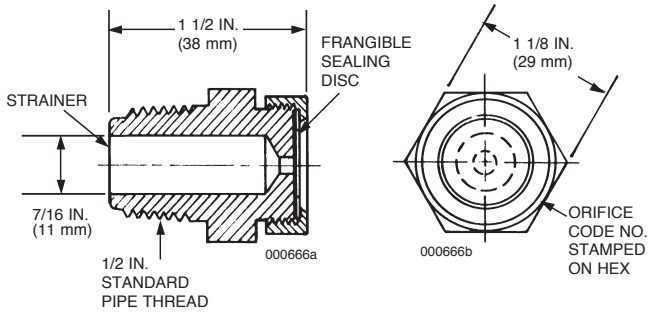
Regular Type Nozzle – Brass



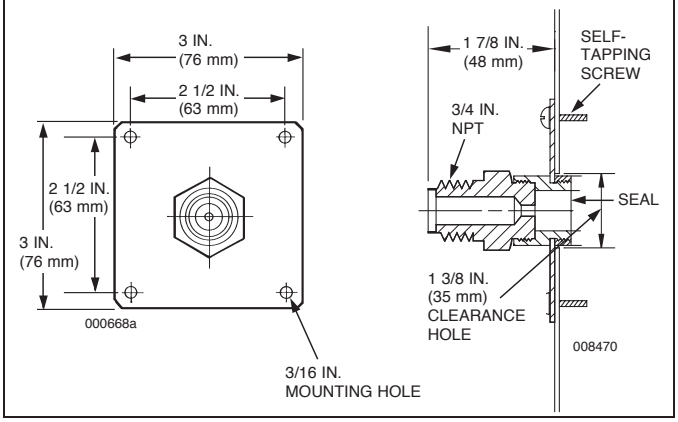
Regular Nozzle – Type RL



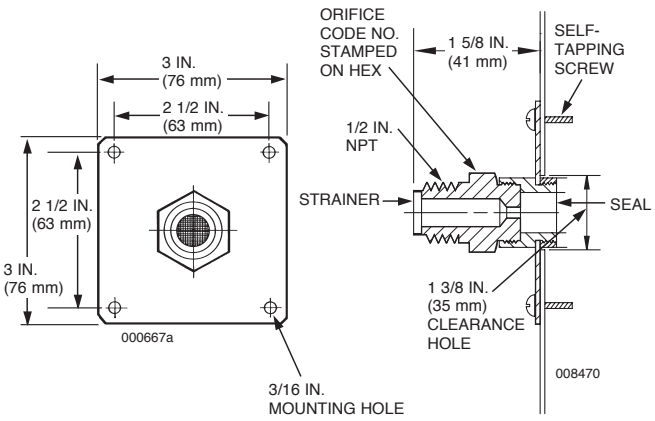
Regular Type Sealed Nozzle With Strainer
Regular Type Sealed Nozzle Without Strainer



Regular Sealed Flanged Type Nozzle – Type RSFL



Regular Sealed Flanged Type Nozzle With Strainer
Regular Sealed Flanged Type Nozzle Without Strainer



China CCCF Discharge Nozzle – Regular Type

Description

The regular type nozzle is used for total flooding applications only. The nozzle is available in three different configurations: regular (1/2 in.), regular RL (3/4 in.), and regular sealed with flange. The sealed type has a sealing disc retaining ring and a frangible seal to prevent foreign matter from entering and plugging the nozzle orifice. The discharge rate of the regular nozzle depends on nozzle pressure and orifice size. The regular type nozzle provides orifice sizes of 3 through 18.

The nozzle is available with 1/2 in. NPT threads for orifice sizes 3 through 12 and 3/4 in. NPT threads for orifice sized 8 through 18.

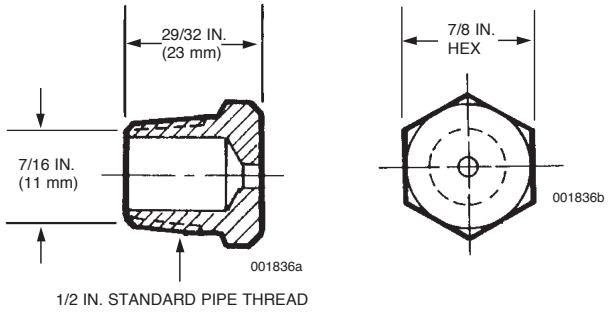
The nozzle is supplied in brass. All nozzles are UL (EX-2968) approved and listed for use with FM Approved systems.

Shipping Assembly Part No. (Shanghai)	Description	Orifice Code
445270	Regular type nozzle	3 – 12
445271	Regular RL type nozzle	8 – 18
445269	Regular sealed with flange nozzle	3 – 12

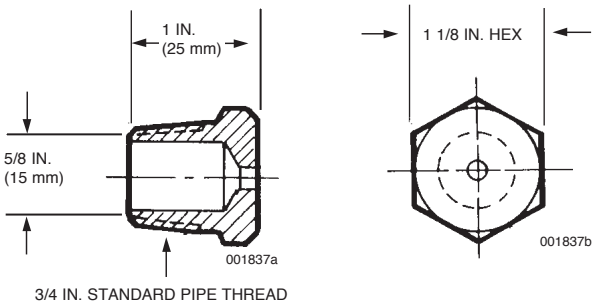
Note: When ordering, specify orifice code required: Example – Part No. 445270 – 9.5.

CHINA CCCF DISCHARGE NOZZLE – REGULAR TYPE (Continued)

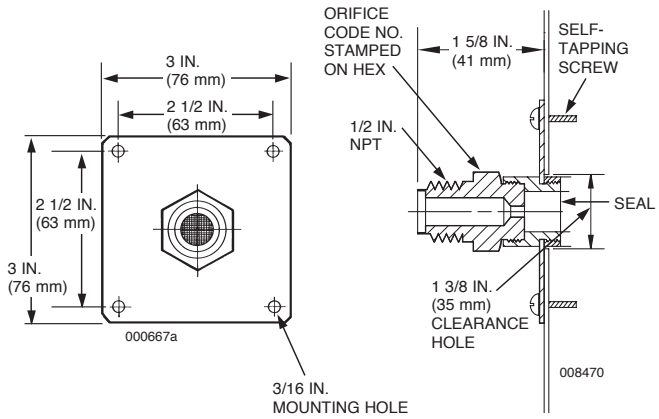
Regular Type Nozzle – Brass



Regular Nozzle – Type RL



Regular Sealed Flanged Type Nozzle Without Strainer



Discharge Nozzle – Baffle Type

Description

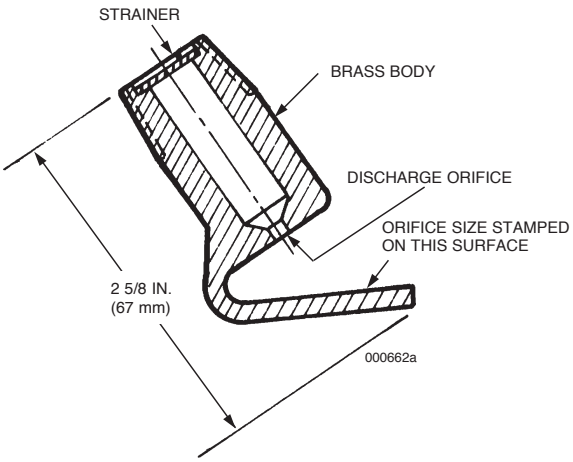
The baffle type nozzle is used in total flood applications only. Placed around the outside edge or placed near the ceiling approximately 15 to 20 ft (4.6 to 6.1 m) on centers in a room or any enclosed space, each nozzle provides a 180° fan spray ▸ of CO_2, spreading the suppressing gas quickly and efficiently throughout the protected space.

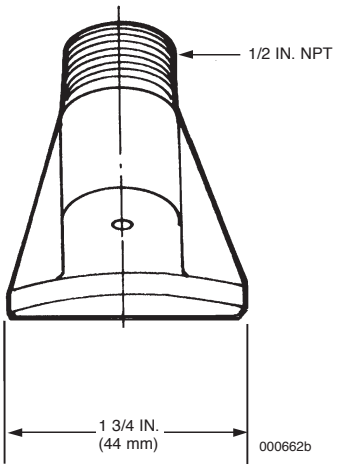
Discharge rate depends upon nozzle pressure and orifice size. Baffle type nozzles are available in orifice sizes 1 through 16. ▸ The nozzle is supplied in brass.

Note: When ordering, specify orifice code required:
Example – Part No. 426121 – 10.5

Component	Material	Thread Size/Type	Orifice Size	Approvals
Baffle Type with Strainer	Nozzle: Brass Strainer: Monel	1/2 in. NPT Male	1 through 3	UL (EX-2968); Listed for use with FM Approved systems
Baffle Type	Brass	1/2 in. NPT Male	3.5 through 14	UL (EX-2968); Listed for use with FM Approved systems
Baffle Type BL	Brass	3/4 in. NPT Male	9 through 16	UL (EX-2968); Listed for use with FM Approved systems

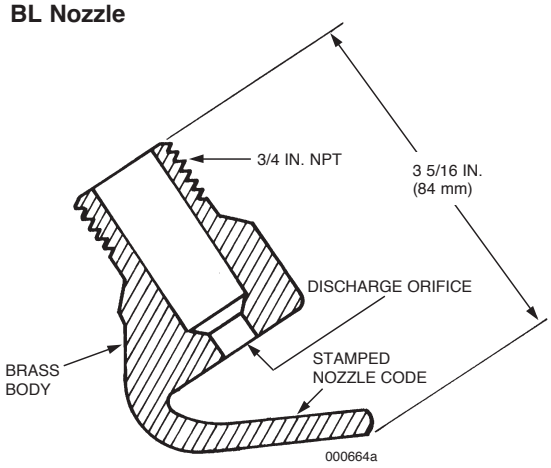
Baffle Type Nozzle With or Without Strainer (Baffle Type with Strainer)

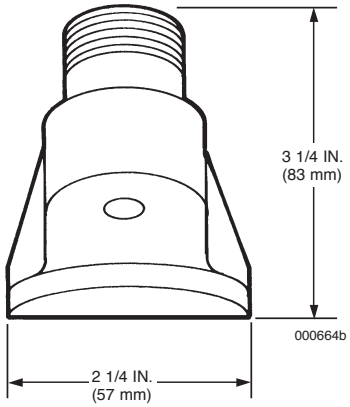




Shipping Assembly Part No.	Description	Orifice Code
426119	Baffle type with strainer nozzle	1 – 3
426120	Baffle type without strainer	3.5 – 14

Baffle Type BL Nozzle





Shipping Assembly Part No.	Description	Orifice Code
426121	Baffle type BL nozzle	9 – 16

China CCCF Discharge Nozzle – Baffle Type

Description

The baffle type nozzle is used in total flood applications only. Placed around the outside edge or placed near the ceiling approximately 15 to 20 ft (4.6 to 6.1 m) on centers in a room or any enclosed space, each nozzle provides a 180° fan spray of CO_2, spreading the suppressing gas quickly and efficiently throughout the protected space.

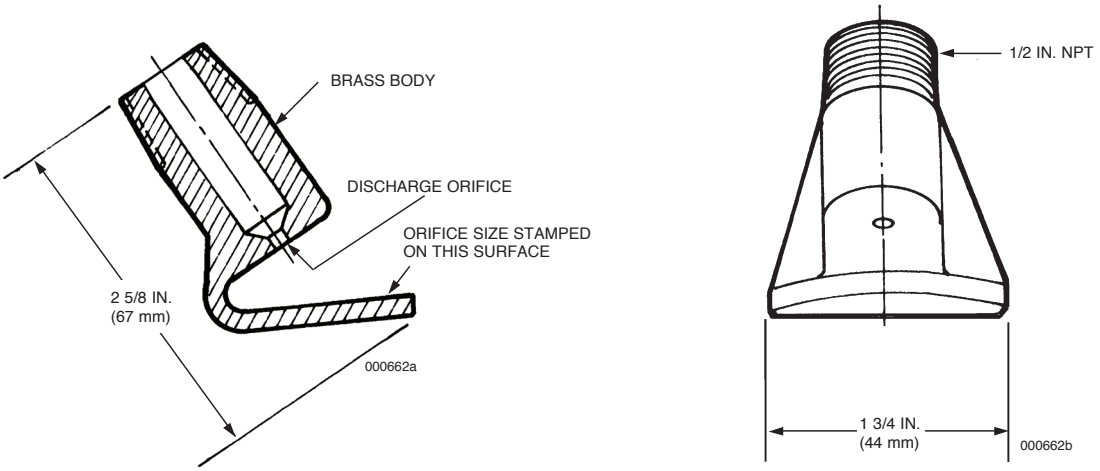
Discharge rate depends upon nozzle pressure and orifice size. Baffle type nozzles are available in orifice sizes 3.5 through 16. The nozzle is supplied in brass.

Note: When ordering, specify orifice code required:
Example – Part No. 445274 – 10.5

Component	Material	Thread Size/Type	Orifice Size	Approvals
Baffle Type	Brass	1/2 in. NPT Male	3.5 through 14	UL (EX-2968); Listed for use with FM Approved systems
Baffle Type BL	Brass	3/4 in. NPT Male	9 through 16	UL (EX-2968); Listed for use with FM Approved systems

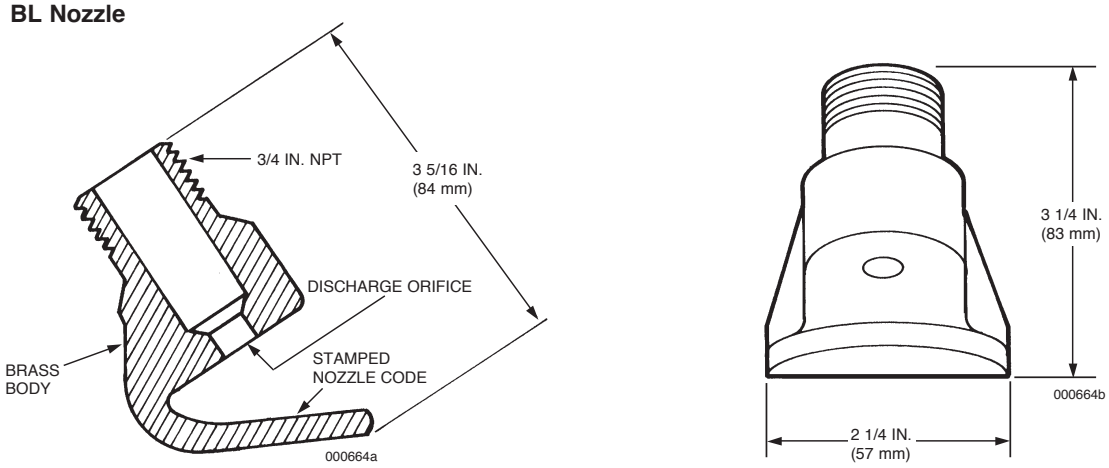
CHINA CCCF DISCHARGE NOZZLE – BAFFLE TYPE (Continued)

Baffle Type Nozzle Without Strainer



Shipping Assembly Part No. (Shanghai)	Description	Orifice Code
445274	Baffle type without strainer	3.5 – 14

Baffle Type BL Nozzle



Shipping Assembly Part No. (Shanghai)	Description	Orifice Code
445273	Baffle type BL nozzle	9 – 16

High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

Container Bracketing

Description

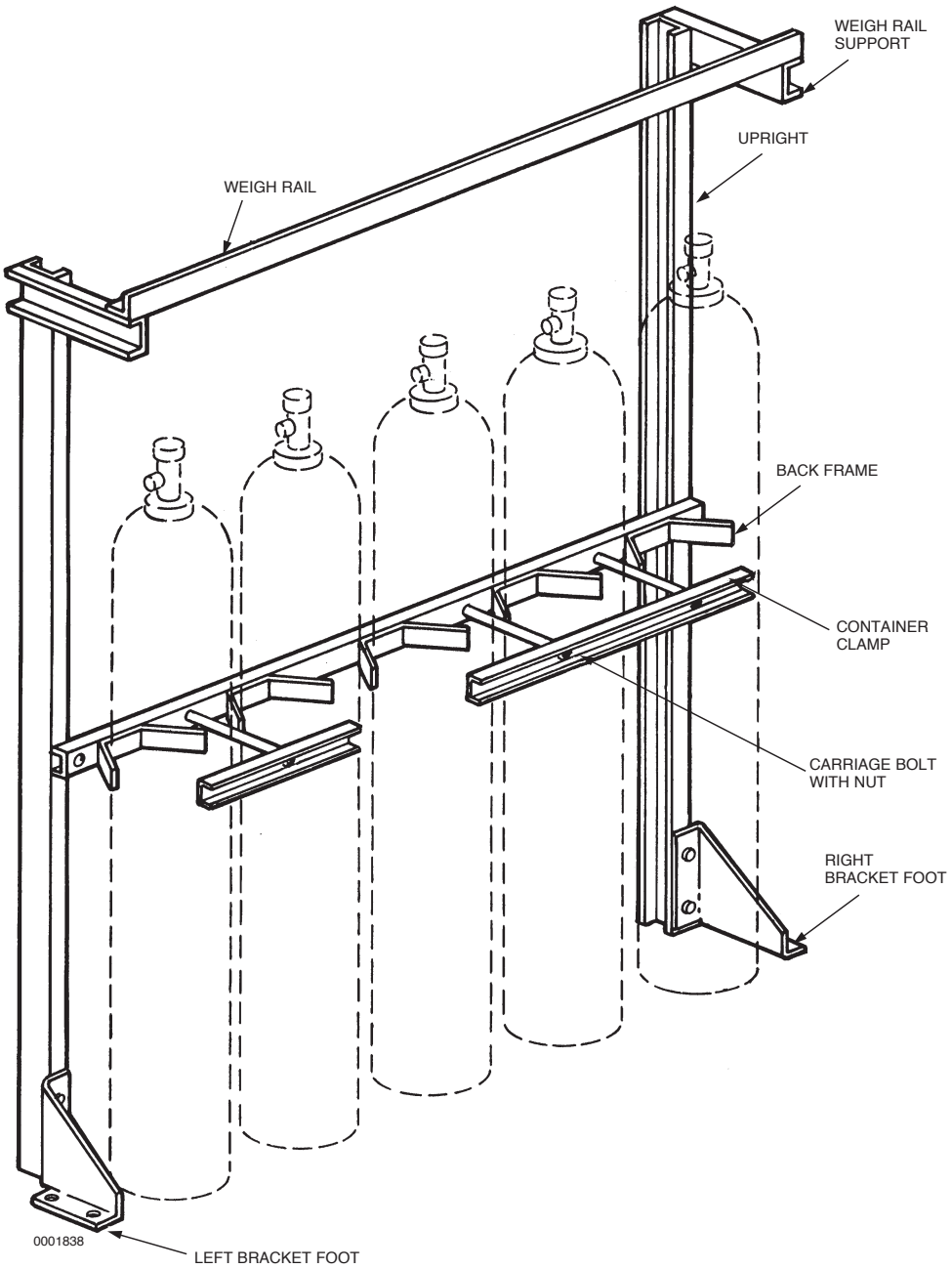
The container bracketing is designed to rigidly support the installed carbon dioxide containers. The bracketing components are constructed of heavy structural steel. Bracket assemblies are available in modules for two to six containers and can also be connected together for any combination over six. Bracketing can be assembled to support single row, double row or back-to-back rows of containers. Bracketing uprights and weigh rail supports are also available for weighing containers in place. Bracketing components are painted with a red enamel coating. Uprights and back frame assemblies can be bolted (fasteners are not included) or welded together, which ever makes the installation more convenient. For weighing containers, a scale and lifting yoke is also available.

▸ Refer to the Section 6 – Installation for further details.

Component	Material	Finish	Approvals
Bracketing	Steel	Red Paint	UL (EX-2968); Listed for use with FM Approved systems

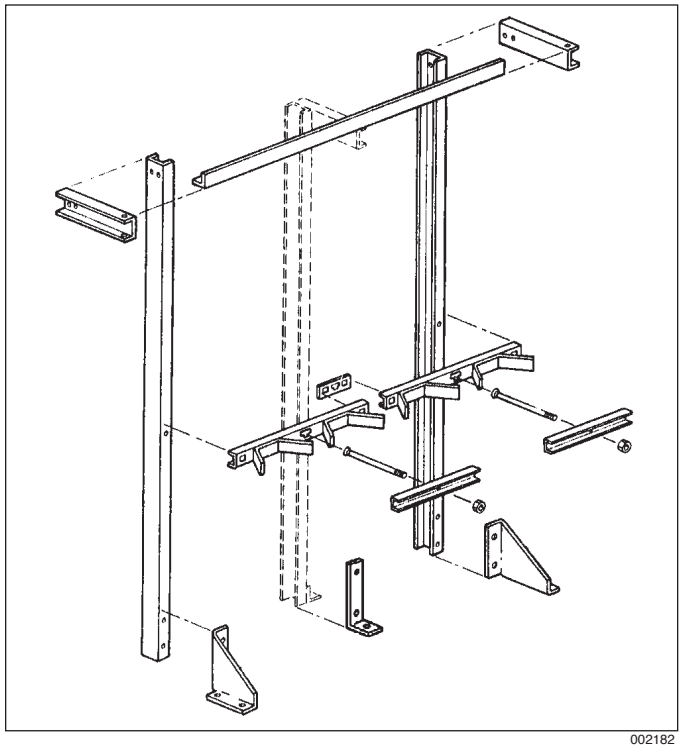
Shipping Assembly Part No.	Description
45120	35 lb (15.9 kg) and 50 lb (22.7 kg) container strap (single container)
45244	35 lb (15.9 kg) and 50 lb (22.7 kg) container channel with nuts and bolts (single container)
45121	75 lb (34 kg) container strap (single container)
45261	75 lb (34 kg) container channel with nuts and bolts (single container)
45122	100 lb (45.4 kg) container strap (single container)
45245	100 lb (45.4 kg) container channel with nuts and bolts (single container)
427704	120 lb (54.4 kg) container strap (single container)
427705	120 lb (54.4 kg) container channel with nuts and bolts (single container)
79638	Back frame assembly (2 container)
79639	Back frame assembly (3 container)
79640	Back frame assembly (4 container)
79641	Back frame assembly (5 container)
79642	Back frame assembly (6 container)
73257	Upright (used either for right or left side)
426592	120 lb (54.4 kg) upright (used either for right or left side)
73553	Single row or back-to-back row bracket foot (left side)
73554	Single row or back-to-back row bracket foot (right side)
73555	Double row bracket foot (left side)
73556	Double row bracket foot (right side)
73256	Center upright (required when weighing seven or more containers in a row)
79413	Connector (required to hook together back frames for seven or more containers)
73250	10.5 in. (267 mm) carriage bolt with nut (for single row 50 lb (22.7 kg) containers)
73251	11 in. (279 mm) carriage bolt with nut (for single row 75 lb (34 kg) containers)
73252	12.5 in. (318 mm) carriage bolt with nut (for single row 100 lb (45.4 kg) containers)
418502	13 in. (330 mm) carriage bolt with nut (for single row 120 lb (54.4 kg) containers)
73253	21 in. (533 mm) carriage bolt with nut (for double row 50 lb (22.7 kg) containers)
73254	22 in. (559 mm) carriage bolt with nut (for double row 75 lb (34 kg) containers)
73255	26 in. (660 mm) carriage bolt with nut (for double row 100 lb (45.4 kg) containers)
418503	27 in. (686 mm) carriage bolt with nut (for double row 120 lb (54.4 kg) containers)
73266	Weigh rail (two container)
73267	Weigh rail (three container)
73268	Weigh rail (four container)
73269	Weigh rail (five container)
73270	Weigh rail (six container)

Shipping Assembly Part No.	Description
73091	Container clamp (2 containers)
73092	Container clamp (3 containers)
71683	Weigh rail support (single row)
71682	Weigh rail support (double row)
71684	Weigh rail support (back-to-back)
74241	Scale
69877	Lifting yoke



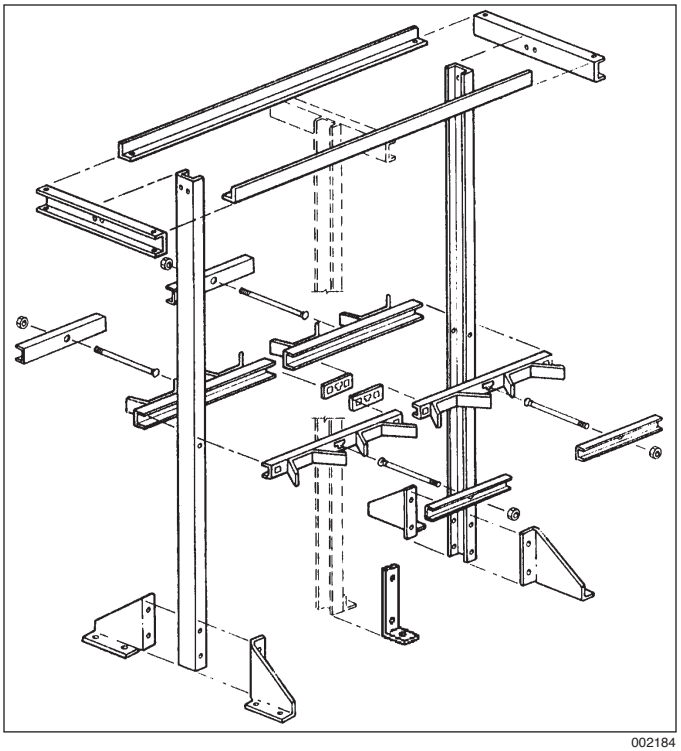
CONTAINER BRACKTING (Continued)

Single Row Bracketing with Weigh Rail



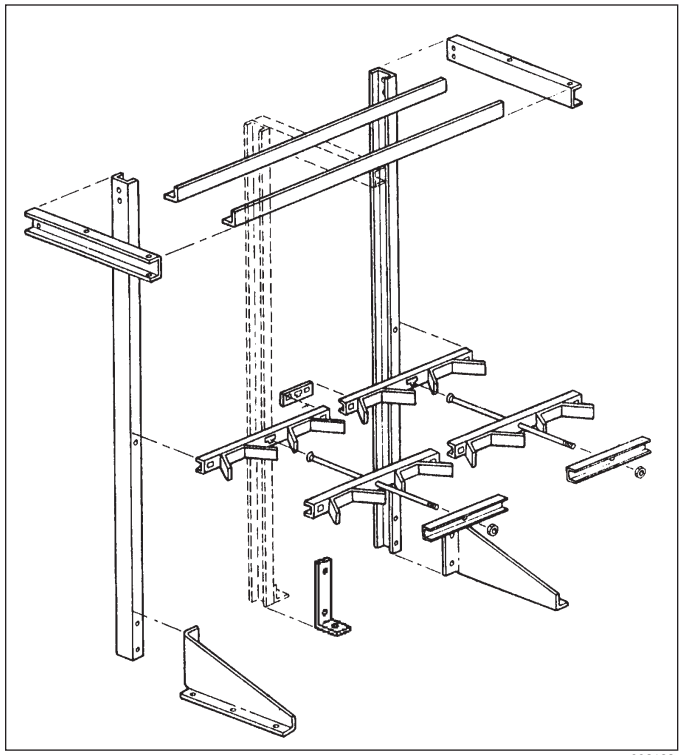
002182

Back-toBack Bracketing with Weigh Rail



002184

Double Row Bracketing with Weigh Rail



002183

Note:

- Some drilling required for assembly of feet, backframes, and weigh rails.
- When bolting components together, use the following size bolts, nuts, flatwashers, and lock washers:
  - Backframe to Upright - one 2 1/2 in. (6.4 cm) x 1/2 in. diameter bolt, nut, flatwasher, and lock washer (9/16 in. (1.4 cm) clearance hole required).
  - Weigh Rail to Weigh Rail Support - one 1 1/2 in. (3.8 cm) x 7/16 in. diameter bolt, nut, flatwasher, and lock washer (15/32 in. (1.2 cm) clearance hole required).
  - Weigh Rail Support to Upright - two 1 1/2 in. (3.8 cm) x 7/16 in. diameter bolt, nut, flatwasher, and lock washers (15/32 in. (1.2 cm) clearance hole required).
  - Bracket Foot to Upright - two 1 1/2 in. (3.8 cm) x 7/16 in. diameter bolts, nuts. flatwashers, and lock washers (15/32 in. (1.2 cm) clearance hole required).
  - Backframe Connector to Backframe - two 1 1/2 in. (3.8 cm) x 7/16 in. diameter bolts, nuts. flatwashers, and lock washers.

NOTES:

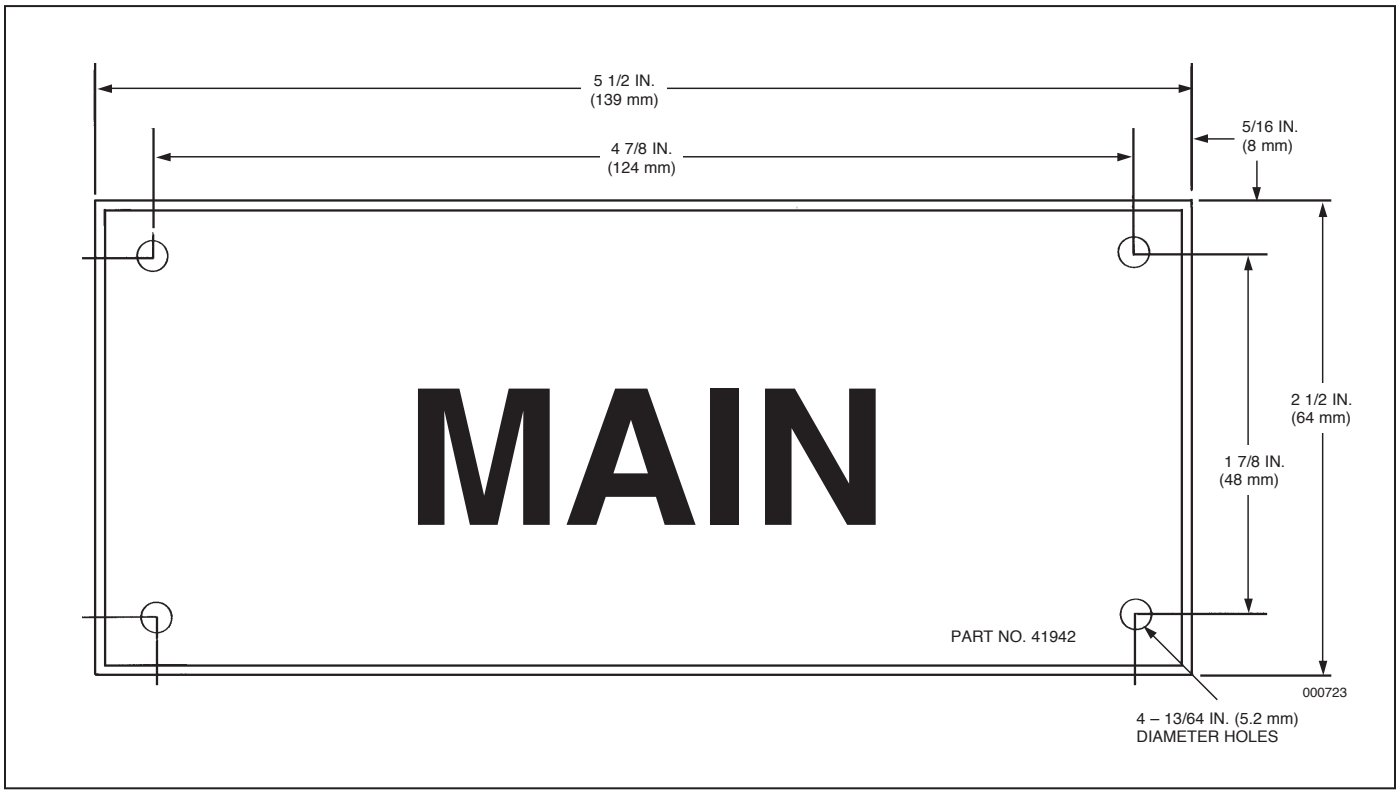
Nameplate – MAIN

Description

The "MAIN" nameplate is available for labeling components and/or remote pull stations to distinguish them from reserve system components. The nameplate is furnished with four mounting holes for ease of installation.

Shipping Assembly Part No.	Description
41942	Nameplate – MAIN

Component	Material	Mounting Hole Size	Approvals
Nameplate	Aluminum	13/64 in. (5.2 mm)	UL (EX-2968); Listed for use with FM Approved systems



NOTES:

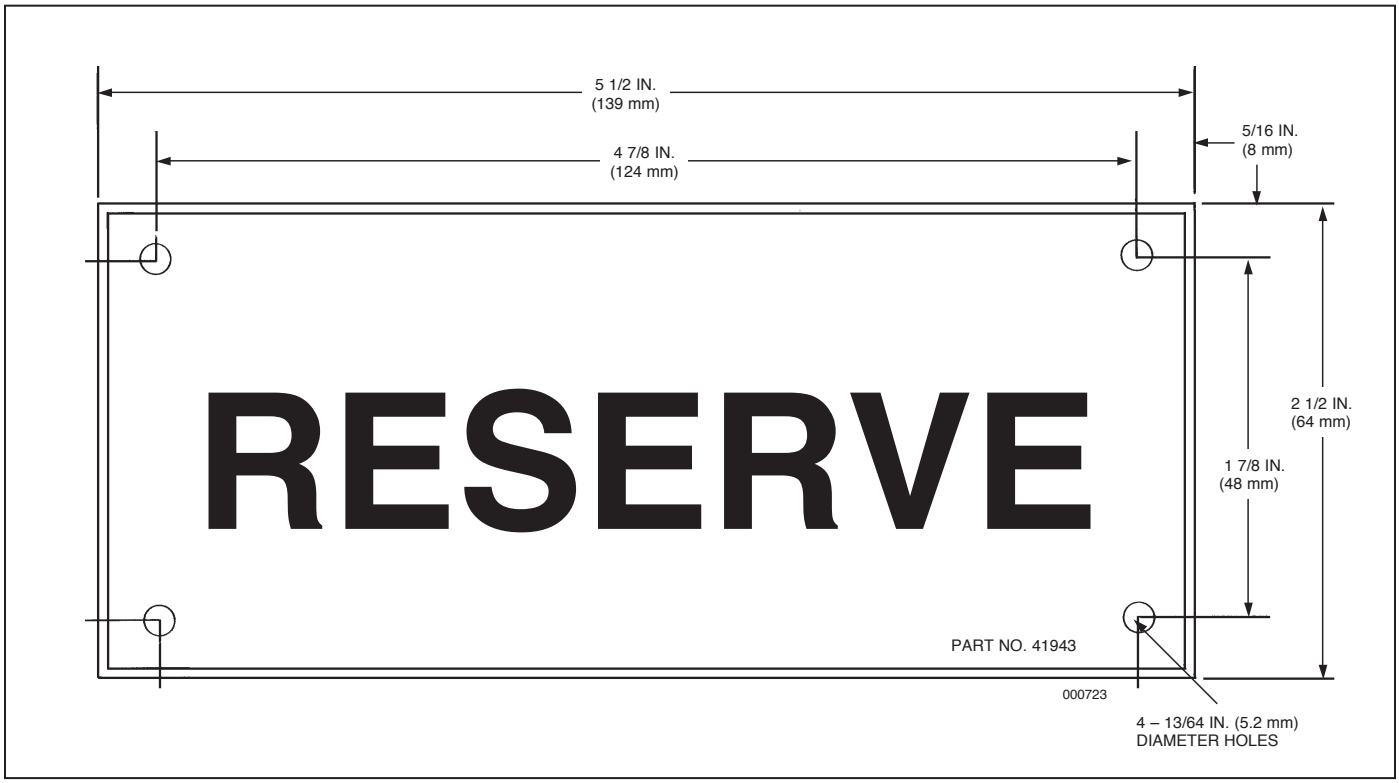
Nameplate – RESERVE

Description

The "RESERVE'' nameplate is available for labeling components and/or remote pull stations to distinguish them from main system components. The nameplate is furnished with four mounting holes for ease of installation.

Shipping Assembly Part No.	Description
41943	Nameplate – RESERVE

Component	Material	Mounting Hole Size	Approvals
Nameplate	Aluminum	13/64 in. (5.2 mm)	UL (EX-2968); Listed for use with FM Approved systems



NOTES:

High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

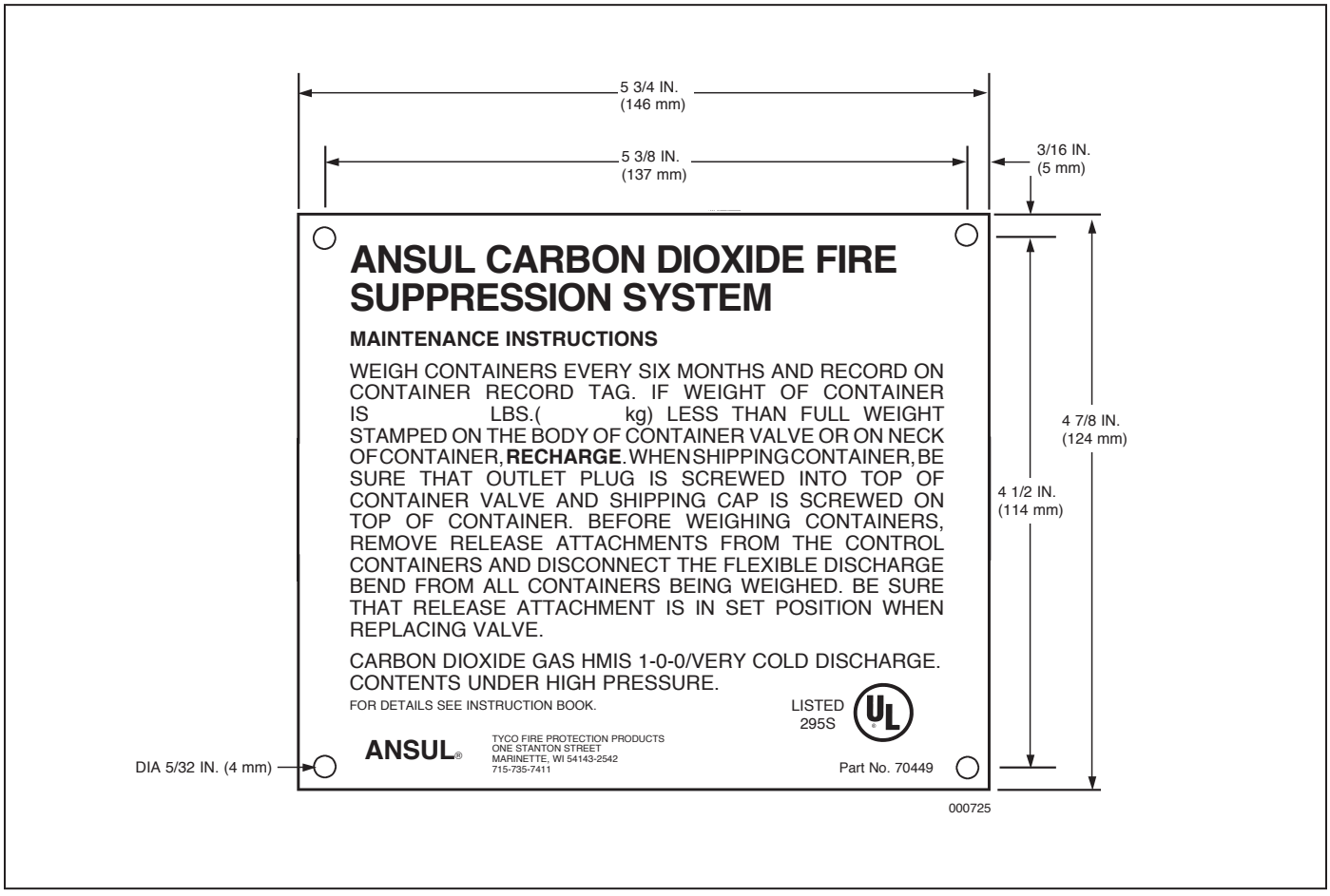
Nameplate – Maintenance

Description

The maintenance nameplate is available for mounting near the system containers. This plate gives instructions for performing the semi-annual container weighing requirements. The nameplate is furnished with four mounting holes for ease of installation.

Shipping Assembly Part No.	Description
70449	Nameplate – maintenance

Component	Material	Mounting Hole Size	Approvals
Nameplate	Aluminum	5/32 in. (4 mm)	UL (EX-2968); Listed for use with FM Approved systems



NOTES:

Warning Signs

Description

The following warning plates are required either inside or outside the hazard area to warn personnel that the space is protected by a carbon dioxide system and no one should enter after a discharge without being properly protected. The warning plates are furnished with four mounting holes for ease of installation.

Mounting Hole Size: 7/32 in. (56 mm)

Approvals: UL (EX-2968), listed for use with FM Approved systems

Material: Aluminum

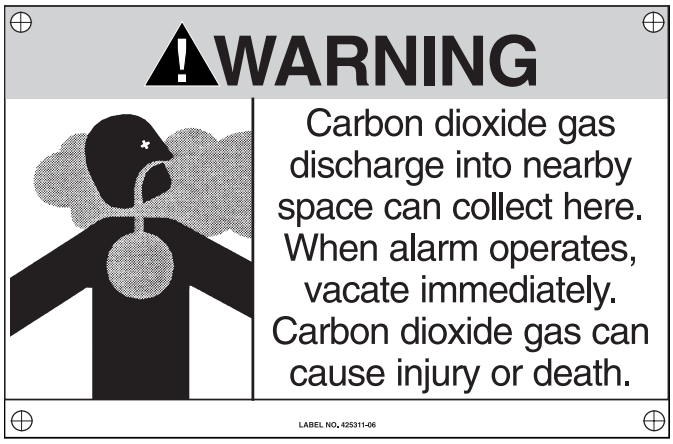
Part No. 425309 Sign in Every Protected Area

10 IN. (254 mm) X 10 IN. (254 mm)

Part No. 425310 Sign at Every Entrance to Protected Space

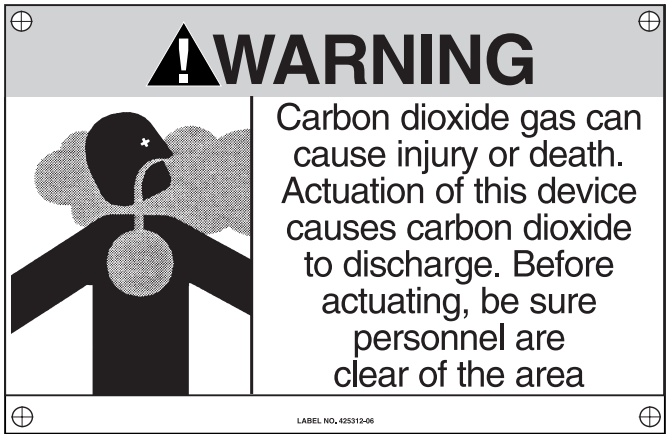
10 IN. (254 mm) X 10 IN. (254 mm)

Part No. 425311 Sign in Every Nearby Space Where CO_2 Can Accumulate to Hazardous Levels



10 IN. (254 mm) X 6.5 IN. (165 mm)

Part No. 425312 Sign at Each Manual Actuation Station

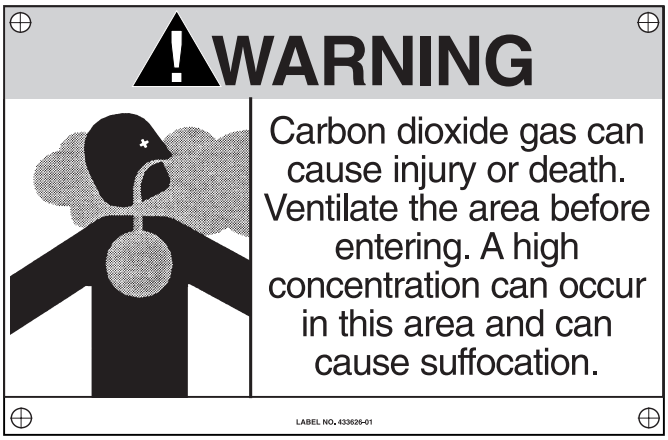


10 IN. (254 mm) X 6.5 IN. (165 mm)

Part No. 433625 Sign at Every Entrance to Protected Space for Systems Provided with Wintergreen Odorizer

10 IN. (254 mm) X 10 IN. (254 mm)

Part No. 433626 Sign Outside Each Entrance to Carbon Dioxide Storage Room



10 IN. (254 mm) X 6.5 IN. (165 mm)

Connecting Link

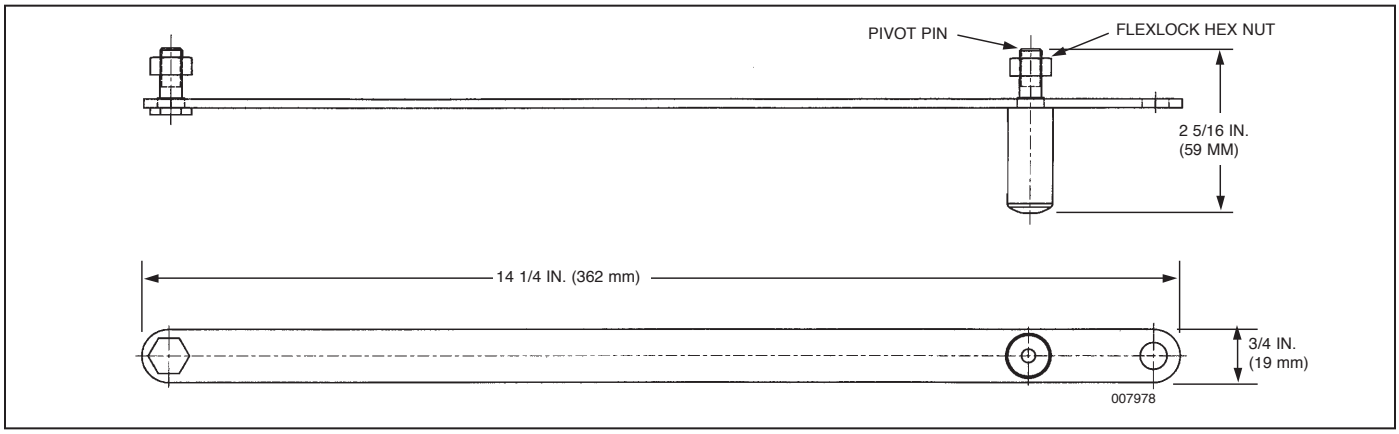
Description

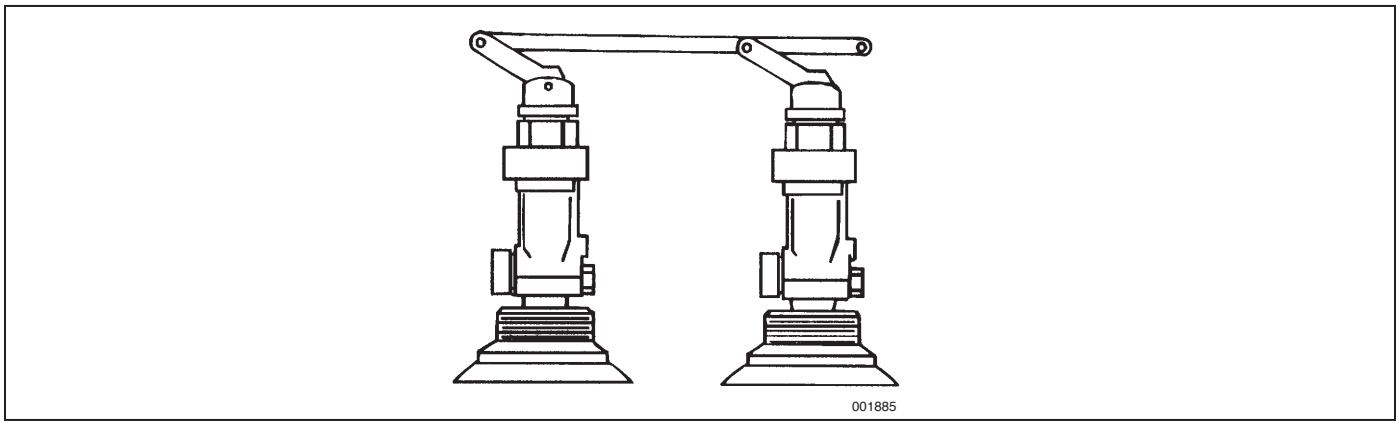
The connecting link is used to connect two lever releases together when two pilot containers are required for actuation. The connecting link can be used on lever releases installed on CV-98 ANSUL carbon dioxide valves.

One size connecting link is available for all size containers.

Shipping Assembly Part No.	Description
42514	Connecting link

Component	Material	Paint	Approvals
Connecting Link (EX-2968)	Steel	Red Enamel	UL





NOTES:

Lock Handle Stop Valve

Description

The lock handle stop valve is a manually operated ball valve installed in various locations of the piping system. The valve is used to inhibit the discharge of CO_2 into an entire system or a specific area of a system when maintenance of the system or entry into the protected space is required. The valve is equipped with a slide locking device to padlock the valve in the open or closed position. Each valve is equipped with two monitoring switches to provide constant supervision of the valve at the control panel with contacts for the open and closed positions. Install warning sign (Part No. 428974) in easily visible location near valve.

APPROVALS

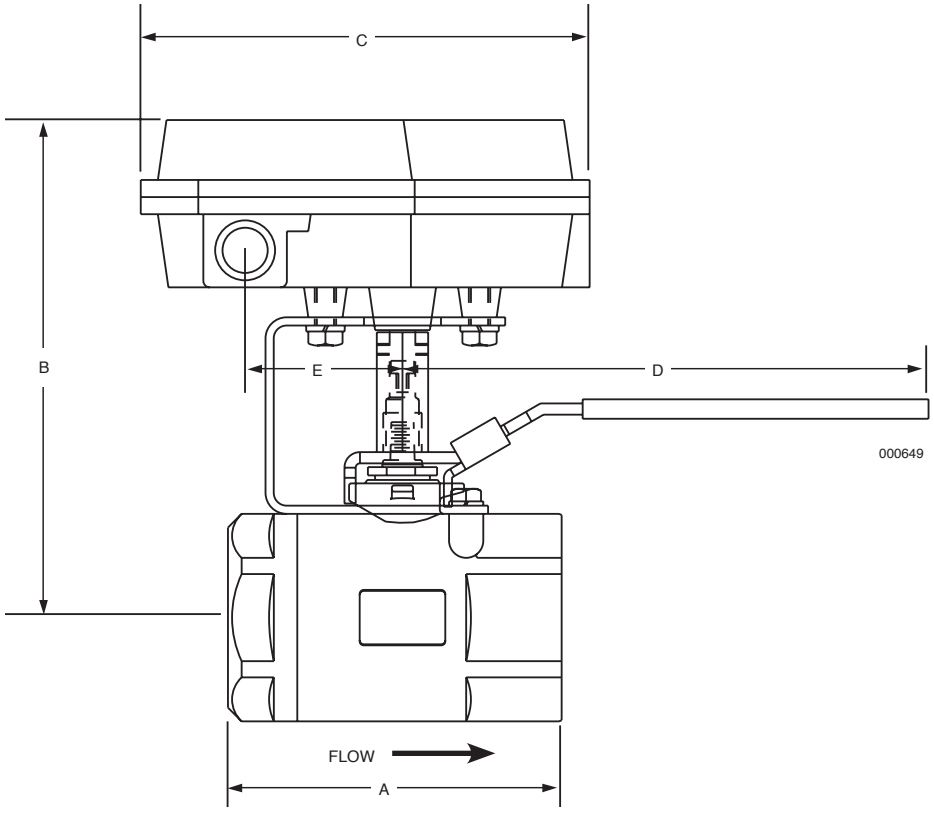
UL (EX2968)

Listed for use with FM Approved systems

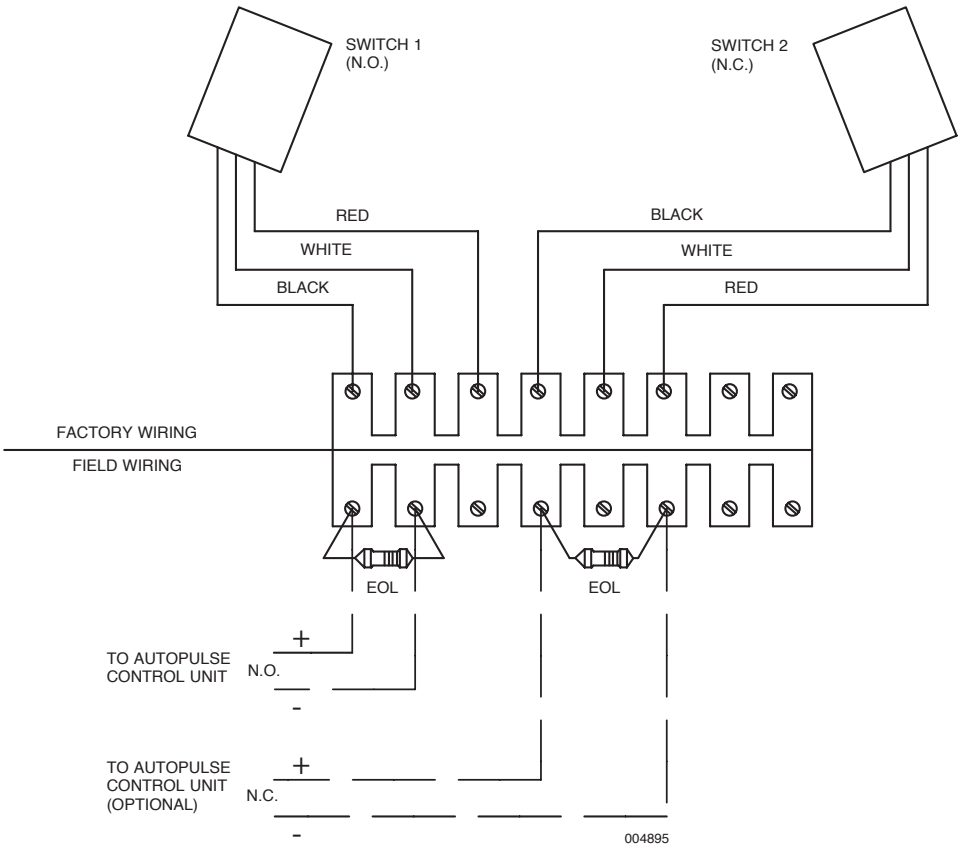
VALVE MATERIAL

316 SS Body, ball, and stem reinforced Teflon seats and seals

Tamper-proof latch locking SS handle



	Dimensions												
		A		B		C		D		E		Weight	
Size	Part No.	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)	lb	(kg)
1/2 in.	428153	2.36	(60)	7.07	(179)	6.56	(167)	4.19	(106)	2.3	(58)	6	(2.7)
3/4 in.	428154	2.80	(71)	7.25	(184)	6.56	(167)	5.75	(146)	2.3	(58)	7	(3.2)
1 in.	428155	3.23	(82)	7.41	(188)	6.56	(167)	5.75	(146)	2.3	(58)	7	(3.2)
1 1/4 in.	428156	3.62	(92)	7.55	(192)	6.56	(167)	7.63	(194)	2.3	(58)	8	(3.6)
1 1/2 in.	428157	4.06	(103)	7.75	(197)	6.56	(167)	7.63	(194)	2.3	(58)	9	(4.1)
2 in.	428158	4.65	(118)	8.02	(204)	6.56	(167)	7.63	(194)	2.3	(58)	11	(5.0)



CARBON DIOXIDE SYSTEM LOCK-OUT VALVE

VALVE MUST BE CLOSED AND LOCKED PRIOR TO ENTRY OF PROTECTED SPACE

NOTIFY PROPER PERSONNEL PRIOR TO CLOSING VALVE (TROUBLE ALARM WILL SOUND)

ALTERNATE FIRE PROTECTION MUST BE PROVIDED WHILE THIS VALVE IS CLOSED

VALVE MUST BE RESET AFTER EXIT FROM PROTECTED SPACE TO RETURN PROTECTION AND ALARM SYSTEMS TO STAND-BY STATUS

⚠ WARNING

CARBON DIOXIDE DOES NOT SUPPORT LIFE. FAILURE TO LOCK-OUT THE CARBON DIOXIDE SYSTEM BY CLOSING AND LOCKING THIS VALVE BEFORE ENTRY INTO THE PROTECTED SPACE MAY CAUSE INJURY OR DEATH IF THE SYSTEM ACTUATES.

TYCO FIRE PROTECTION PRODUCTS, MARINETTE, WI 54143-2542 LABEL NO. 428974

High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

3 in. – 4 in. Lock-Out Valve

Description

The lock-out valve is a manually operated ball valve installed in various locations of the piping system. The valve is used to inhibit the discharge of CO_2 into an entire system or a specific area of a system when maintenance of the system or entry into the protected space is required. The valve is equipped with a locking device to padlock the valve in the open or closed position. Each valve is equipped with a monitoring switch to provide constant supervision of the valve at the control panel with contacts for the open and closed positions. Install warning sign, Part No. 428974, in an easily visible location near valve.

Approvals

UL (EX2968)

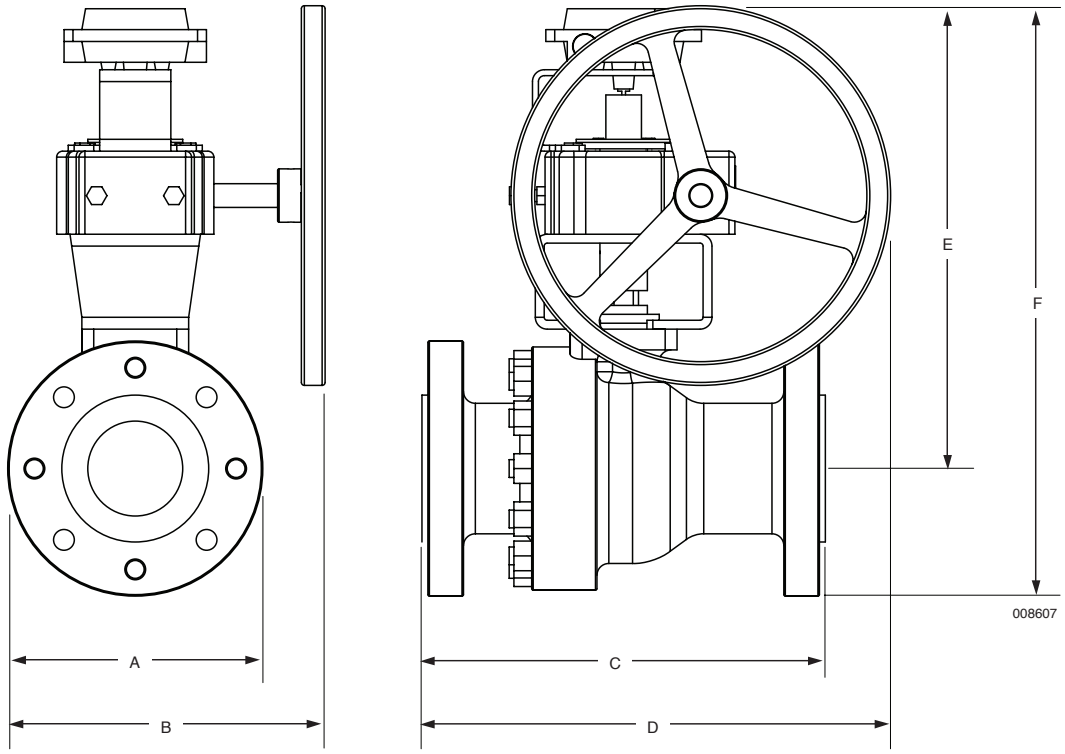
Listed for use with FM Approved systems

Valve Material

Corrosion-Resistant Painted Steel Body

316 SS Ball, Stem, and Hardware

Reinforced Teflon Seats



Dimensions								
Size	**Part No.**	**A in. (mm)**	**B in. (mm)**	**C in. (mm)**	**D in. (mm)**	**E in. (mm)**	**F in. (mm)**	**Weight lb (kg)**
3 in.	437216	8.25 (210)	12.43 (316)	14 (356)	16.13 (410)	17.03 (433)	21.15 (537)	137 (62.1)
4 in.	437217	10.75 (273)	13.38 (340)	17 (432)	19.75 (502)	19.51 (496)	24.88 (632)	247 (112.0)

NOTES:

Check Valves

Description

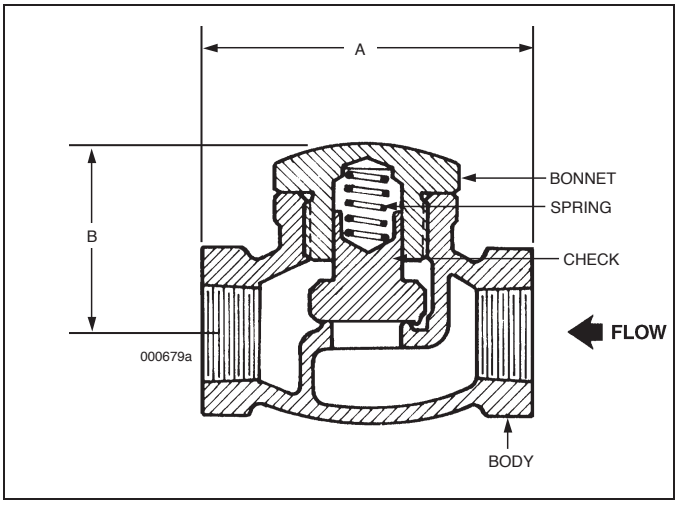
Check valves are used in main/reserve systems and on systems protecting multiple hazards of different volumes using selector valves to control the direction of agent flow. On main/reserve systems the check valve prevents pressurization of the reserve system manifold by blocking the flow of carbon dioxide from the main system. The check valve allows gas flow from the reserve (if actuated) to pass through into the distribution piping.

On selector valve systems, the check valve prevents the containers from the selected hazard from pressurizing the manifold of the containers required for protecting a larger hazard. Only the containers needed for the particular hazard are actuated.

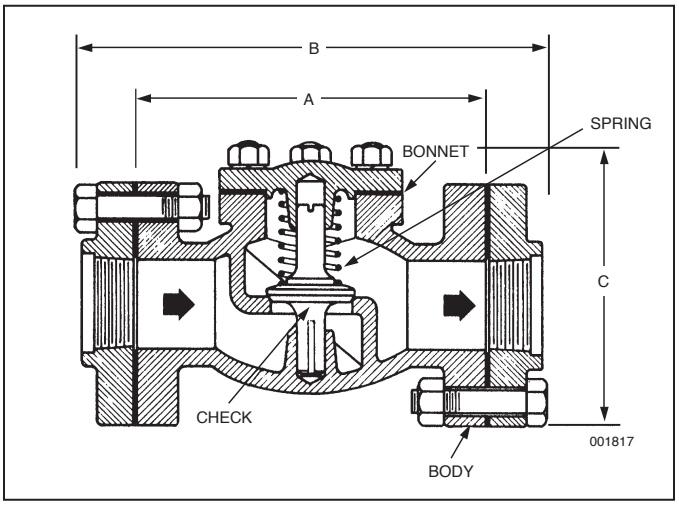
The check valves are available in sizes from 1/2 in. through ▸ 3 in. Two body styles are available: weld neck flange and threaded flange.

Part No.	Component	Material	Thread Size/Type	Body Type	Approvals
40860	Check Valve	Bronze	1/2 in. NPT Female	Threaded	UL (EX-2968) (See Note)
40852	Check Valve	Bronze	3/4 in. NPT Female	Threaded	UL (EX-2968) (See Note)
41470	Check Valve	Bronze	1 in. NPT Female	Threaded	UL (EX-2968) (See Note)
41549	Check Valve	Bronze	1 1/4 in. NPT Female	Threaded	UL (EX-2968 (See Note)
41463	Check Valve	Bronze	1 1/2 in. NPT Female	Threaded	UL (EX-2968 (See Note)
40649	Check Valve	Bronze	2 in. NPT Female	Threaded	UL (EX-2968) (See Note)
40656	Check Valve	Bronze	2 1/2 in. NPT Female	Threaded	UL (EX-2968 (See Note)
40665	Check Valve	Check Valve: Bronze Flange: Steel	3 in. NPT Female	Threaded	UL (EX-2968) (See Note)
▸ 40672	Check Valve	Check Valve: Bronze Flange: Steel	3 in. NPT Female	Weld Neck Flanged	UL (EX-2968) (See Note)

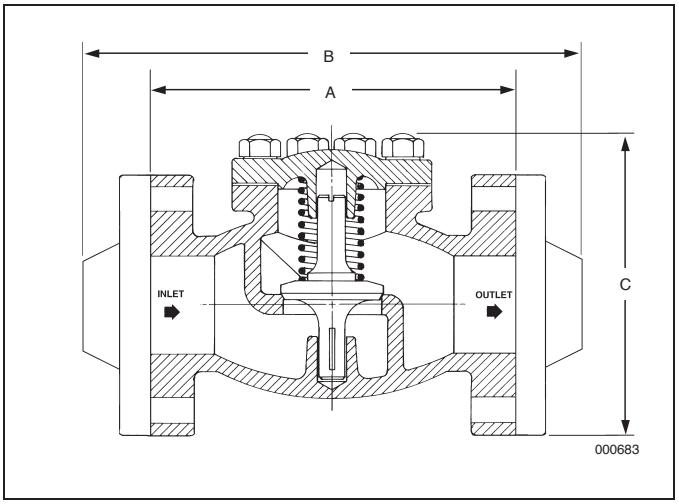
NOTE: All check valves shown are listed for use with FM Approved systems



Check Valve – Threaded				
Valve Size	Dimension A in.	(mm)	Dimension B in.	(mm)
1/2 in.	3	(76)	1 3/4	(44.5)
3/4 in.	3 5/8	(92)	2 1/16	(52.4)
1 in.	4 1/8	(104)	2 5/16	(58.7)
1 1/4 in.	5	(127)	2 13/16	(71.4)
1 1/2 in.	5 1/2	(139)	3 1/4	(82.6)
2 in.	6 1/2	(165)	3 1/2	(89)
2 1/2 in.	8	(203)	4 1/16	(103.2)



Check Valve – Threaded Flange						
Valve Size	Dimension A in.	(mm)	Dimension B in.	(mm)	Dimension C in.	(mm)
3 in.	11 1/2	(292)	15	(381)	9 1/2	(241)



Check Valve – Weld Neck Flange						
Valve Size	Dimension A in.	(mm)	Dimension B in.	(mm)	Dimension C in.	(mm)
3 in.	11 1/2	(292)	18	(457)	9 1/2	(241)

China CCCF Check Valves

Description

Check valves are used in main/reserve systems and on systems protecting multiple hazards of different volumes using selector valves to control the direction of agent flow. On main/reserve systems the check valve prevents pressurization of the reserve system manifold by blocking the flow of carbon dioxide from the main system. The check valve allows gas flow from the reserve (if actuated) to pass through into the distribution piping.

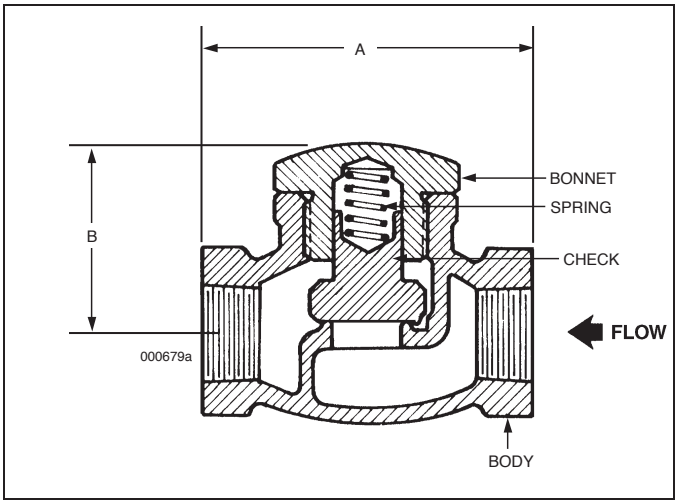
On selector valve systems, the check valve prevents the containers from the selected hazard from pressurizing the manifold of the containers required for protecting a larger hazard. Only the containers needed for the particular hazard are actuated.

The check valves are available in sizes from 1/2 in. through 3 in. Two body styles are available: weld neck flange and threaded flange.

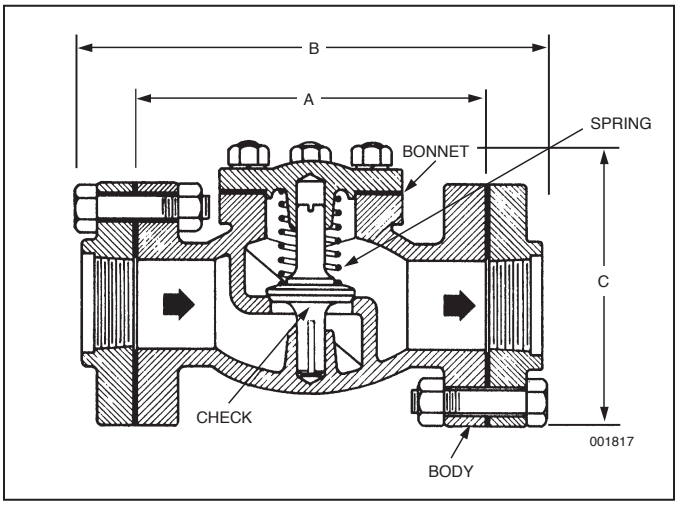
Part No.	Material	Thread Size/Type	Body Type	Approvals
445180 (Shanghai)	Bronze	1/2 in. NPT Female	Threaded	UL (EX-2968) (See Note)
445181 (Shanghai) 442999 (Marinette)	Bronze	1 in. NPT Female	Threaded	UL (EX-2968) (See Note)
445182 (Shanghai)	Bronze	1 1/2 in. NPT Female	Threaded	UL (EX-2968 (See Note)
445183 (Shanghai) 443000 (Marinette)	Bronze	2 in. NPT Female	Threaded	UL (EX-2968) (See Note)
445184 (Shanghai) 443001 (Marinette)	Check Valve: Bronze Flange: Steel	3 in. NPT Female	Threaded	UL (EX-2968) (See Note)

NOTE: All check valves shown are listed for use with FM Approved systems

CHINA CCCF CHECK VALVES (Continued)



Check Valve – Threaded				
	Dimension A		Dimension B	
Valve Size	in.	(mm)	in.	(mm)
1/2 in.	3	(76)	1 3/4	(44.5)
1 in.	4 1/8	(104)	2 5/16	(58.7)
1 1/2 in.	5 1/2	(139)	3 1/4	(82.6)
2 in.	6 1/2	(165)	3 1/2	(89)



Check Valve – Threaded Flange						
Valve Size	Dimension A		Dimension B		Dimension C	
	in.	(mm)	in.	(mm)	in.	(mm)
3 in.	11 1/2	(292)	15	(381)	9 1/2	(241)

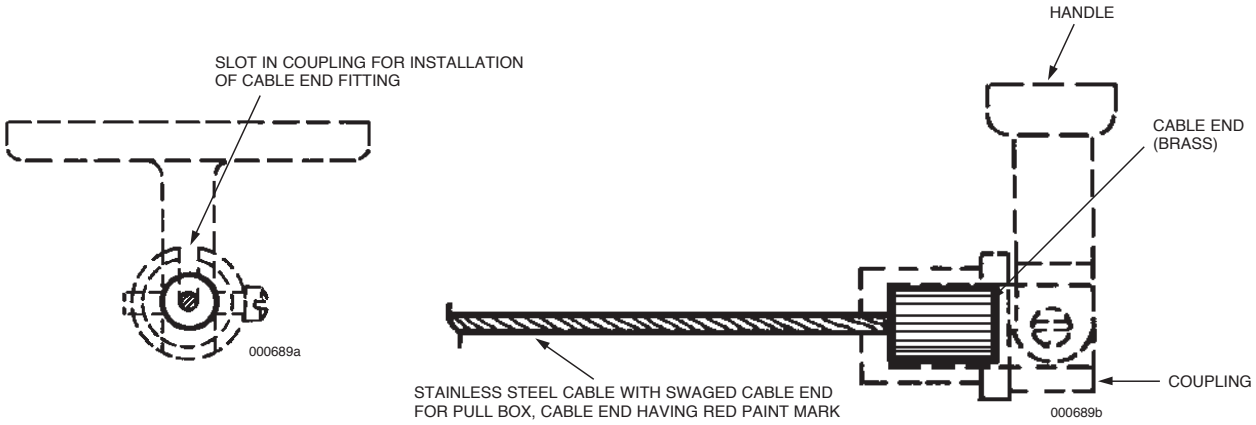
Cable With Swaged End Fitting

Description

The 1/16 in. diameter cable is used to attach remote manual pull boxes to container valves, pull equalizers, control boxes and selector valves. The cable is constructed of stranded, stainless steel wire. The cable is available in lengths of 50 ft, 100 ft, 150 ft, and 200 ft (15.2 m, 30.5 m, 45.7 m, and 60.9 m). The cable assemblies include a brass swaged end fitting for attaching to the remote pull box.

Component	Material	Approvals
Cable Assembly	Cable: Stainless Steel Swaged Fitting: Brass	UL (EX-2968); Listed for use with FM Approved systems

Shipping Assembly Part No.	Description
42104	50 ft (15.2 m) 1/16 in. (1.6 mm) cable with swaged end fitting
42109	100 ft (30.5 m) 1/16 in. (1.6 mm) cable with swaged end fitting
42113	150 ft (45.7 m) 1/16 in. (1.6 mm) cable with swaged end fitting
42128	200 ft (60.9 m) 1/16 in. (1.6 mm) cable with swaged end fitting



Note: The strength of the end fitting exceeds the breaking point of the cable.

NOTES:

Corner Pulley

Description

The corner pulley is required on a carbon dioxide system whenever a mechanical release pull cable run involves a change in direction. Corner pulleys are installed as part of the cable housing (pipe or conduit) and provide 90° direction changes with minimal force loss and no induced kinking.

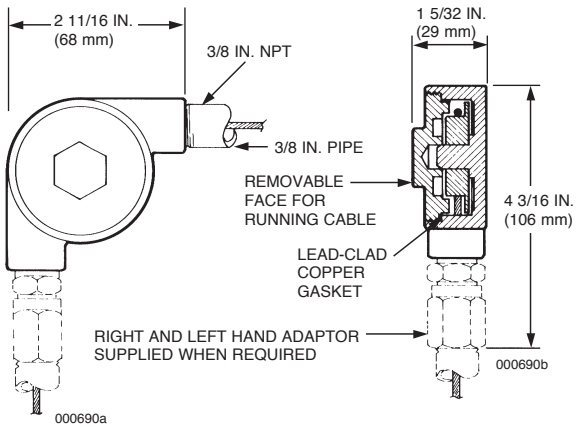
Two types of corner pulleys are available. One is made of die cast aluminum, has a ball bearing roller, and uses compression fittings for 1/2 in. EMT connections.

▸ The second type is made of brass and is threaded for 3/8 in.
▸ NPT pipe. Two styles of brass corner pulleys are available: one with a brass wheel and one with a nylon wheel. Both styles of brass pulleys are watertight. The brass wheel corner pulley is designed for location inside or outside the protected space. The nylon wheel corner pulley is designed for location only outside the hazard space. Thread adaptors are available to simplify the installation.

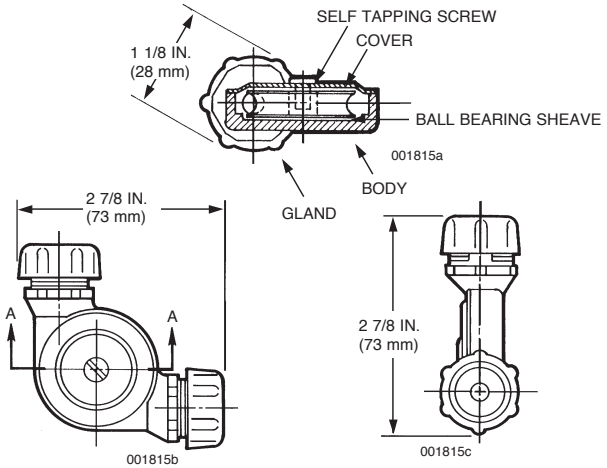
Component	Material	Thread Size/Type	Approvals
Corner Pulley	Body: Aluminum Roller: Stainless Steel	1/2 in. EMT	UL (EX-2968); Listed for use with FM Approved systems
Corner Pulley	Body: Brass Wheel: Brass	3/8 in. NPT	UL (EX-2968); Listed for use with FM Approved systems
Corner Pulley	Body: Brass Wheel: Nylon	3/8 in. NPT	UL (EX-2968); Listed for use with FM Approved systems

Shipping Assembly Part No.	Description
423250	Aluminum corner pulley
45515	Brass corner pulley (brass wheel) – water-tight
40696	Thread adaptor – Right/left hand (brass pulley only)
42678	Brass corner pulley (nylon wheel) – water-tight

▸ **Brass Watertight Corner Pulley, Sheave Type, Part No. 45515 (Brass Wheel) or Part No. 42678 (Nylon Wheel)**



Corner Pulley for 1/2 in. EMT, Part No. 423250



NOTES:

High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

Dual/Triple Control Boxes

Description

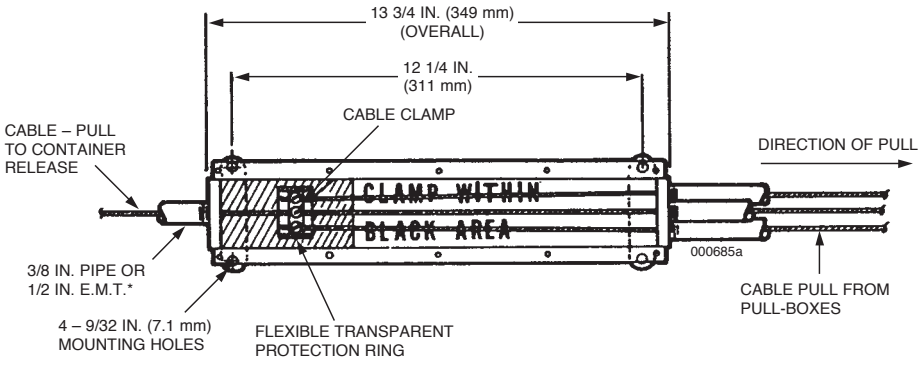
The dual/triple control boxes allow manual actuation of a container valve or a sector valve from two or three remote pull boxes. Two styles of control boxes are available. Part No. 42784 is 13 3/4 in. (349 mm) and Part No. 43166 is 20 3/4 in. (527 mm) long. Both styles can be used for container valve actuation but only Part No. 43166 can be used for sector valve operation. The sector valve operation requires a longer cable travel which can only be accomplished by the longer control box. The inlet and outlet connections are threaded for 3/8 in. pipe. If 1/2 in. EMT conduit connections are required, adaptor Part No. 45780 is available.

▸ All operated components must use the same travel distance
▸ when the dual triple control boxes are employed.

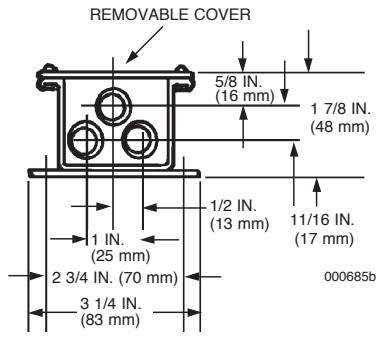
Shipping Assembly Part No.	Description
42784	Dual/triple control box (short)
43166	Dual/triple control box (long)

Component	Material	Thread Size/Type	Approvals
▸ Control Box (short)	Steel	3/8 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems
▸ Control Box (long)	Steel	3/8 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems

Part No. 42784



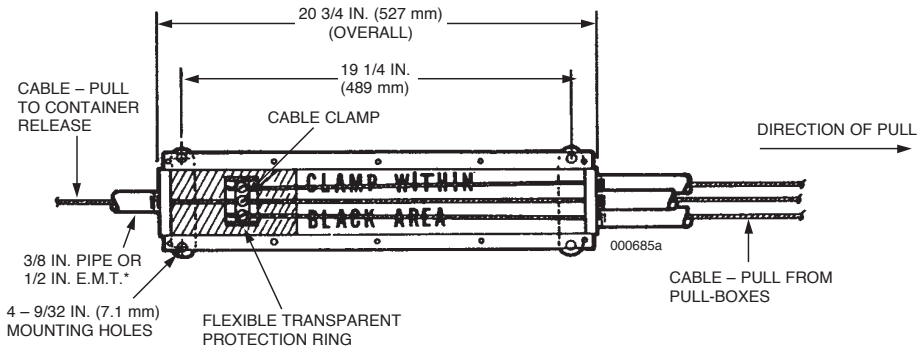
Part No. 42784 Junction Box (Shown Without Cover)



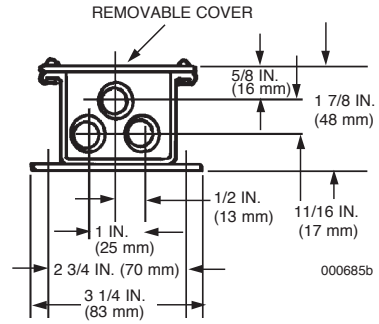
End View

* Adaptors furnished for use with 1/2 in. EMT – Part No. 45780

Part No. 43166



Part No. 43166 Junction Box (Shown Without Cover)



End View

* Adaptors furnished for use with 1/2 in. EMT – Part No. 45780

Remote Cable Pull Equalizer

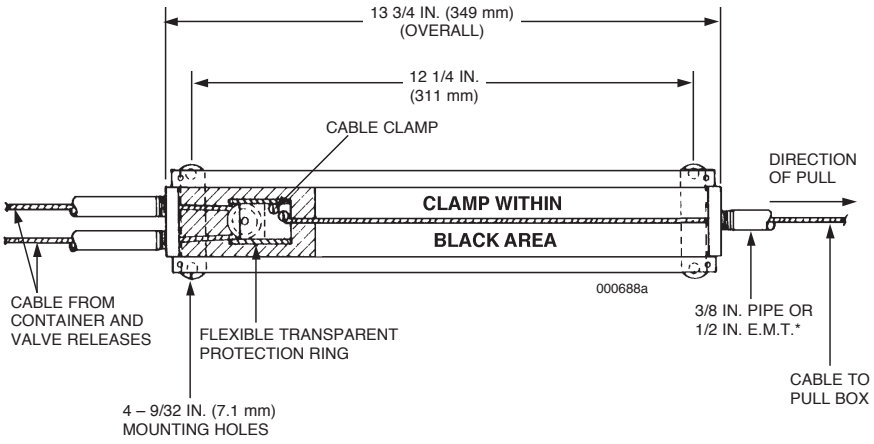
Description

The remote cable pull equalizer is used in systems where manual actuation of the container valve and operation of a selector valve must be accomplished at the same time. The pull equalizer is mounted in the remote pull station cable line. By pulling the remote pull box, the cable attached to the pull equalizer will pull the internal cable clamp in the pull equalizer which in turn will pull the cables attached to the container valve and selector valve, causing them to operate. Two styles of pull equalizers are available. Part No. 42791 is 13 3/4 in. (349 mm) long and Part No. 43168 is 20 3/4 in. (527 mm). Only the longest equalizer, Part No. 43168, can be used for valves utilizing sectors. The inlet and outlet connections are threaded for 3/8 in. pipe. If 1/2 in. EMT conduit connections are required, adaptor Part No. 45780 is available.

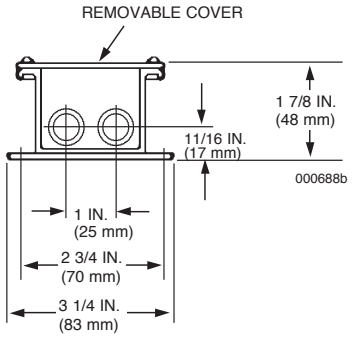
Shipping Assembly Part No.	Description
42791	Remote cable pull equalizer (short)
43168	Remote cable pull equalizer (long)

Component	Material	Thread Size/Type	Approvals
Pull Equalizer (short)	Steel	3/8 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems
Pull Equalizer (long)	Steel	3/8 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems

Part No. 42791



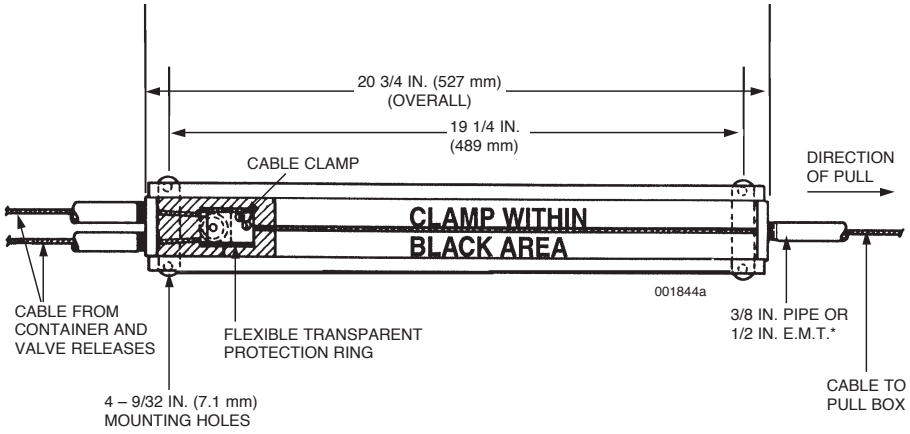
Part No. 42791
Equalizer Box



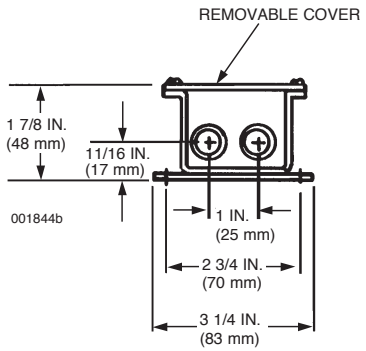
End View

* Adaptors furnished for use with 1/2 in. E.M.T. – Part No. 45780

Part No. 43168



Part No. 43168 Equalizer Box



End View

* Adaptors furnished for use with 1/2 in. E.M.T. – Part No. 45780

High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

Manual Pull Box

Description

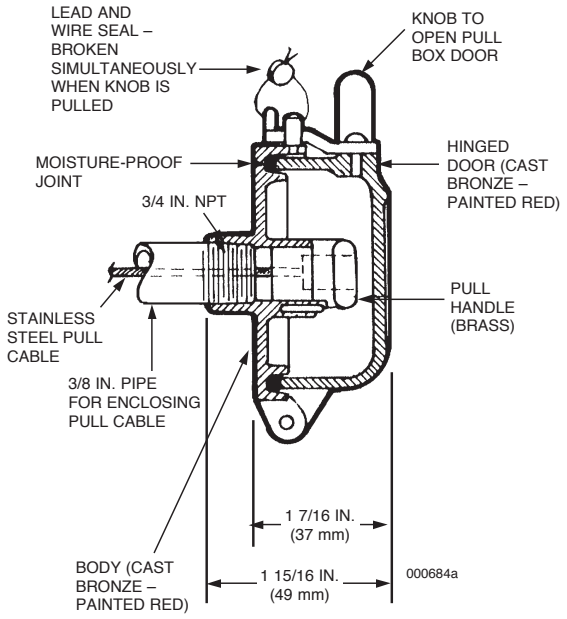
The pull box on a carbon dioxide system is used to provide mechanical release of the system or directional valve from a manually operated remote station. Two types of pull boxes are available. The latched door type has a solid cast brass door which must be opened to reach the pull handle. The second type has a break glass window and a spring mounted handle which rotates forward for use when the glass is broken. A 3/8 in. female NPT opening is provided at the back of each enclosure for connection of the cable housing. Both types are painted red.

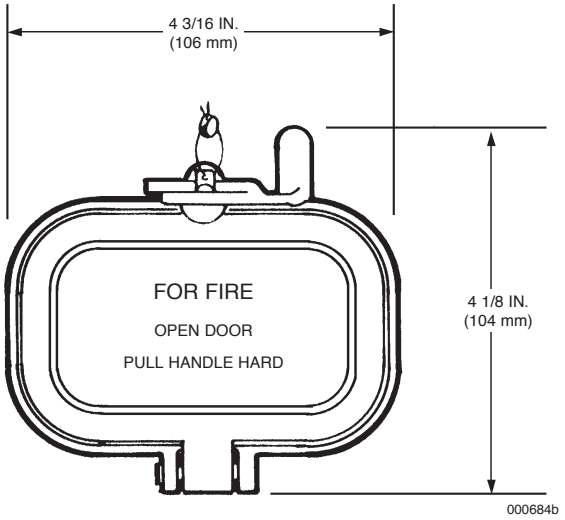
A pulley elbow may be attached directly to the back of the pull box, if necessary, to provide immediate changes in pull cable direction. With this option, the pull box can be extended an additional 3 1/2 in. (89 mm) from the mounting surface by using support legs attached to the back of the pull box (one set for latched door type, two sets for break-glass type).

Component	Material	Approvals
Latch door pull box	Brass	UL (EX-2968); Listed for use with FM Approved systems
Break glass window pull box	Brass	UL (EX-2968); Listed for use with FM Approved systems

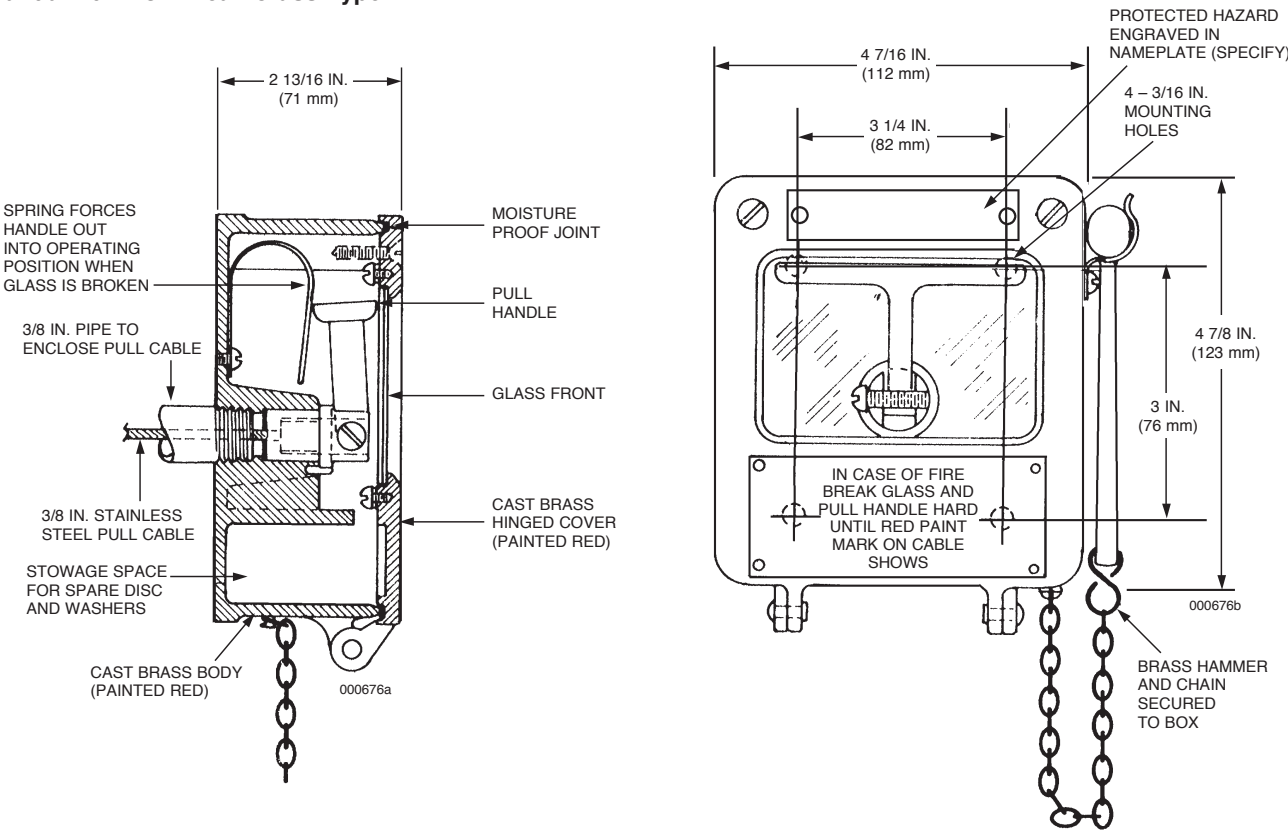
Shipping Assembly Part No.	Description
45062	Latch door type pull box
41527	Break-glass window pull box
41542	Support legs
40209	Glass Window (Type A)

Manual Pull Box Latched Door Type





Manual Pull Box Break Glass Type "A"



Quartzoid Bulb Actuator

Description

The Quartzoid Bulb Actuator (QBA-5) is a self-contained, automatic actuating device designed to be mounted directly in the hazard area.

It actuates the system pilot container valves by supplying actuation pressure when the hazard temperature reaches the fixed rating of the quartzoid bulb and causes it to break, releasing the pressure in the actuator. The pressure is routed to the carbon dioxide containers through a maximum of 100 ft (30.5 m) of 1/8 in. pipe. The QBA-5 is available temperature ratings of 135, 175, and 250 °F (57, 79, and 121 °C).

The QBA-5 is a rugged, completely self-contained actuating device, well suited for rough environments.

The QBA-5 is available with or without a mounting bracket.

The mounting bracket and cylinder are painted red.

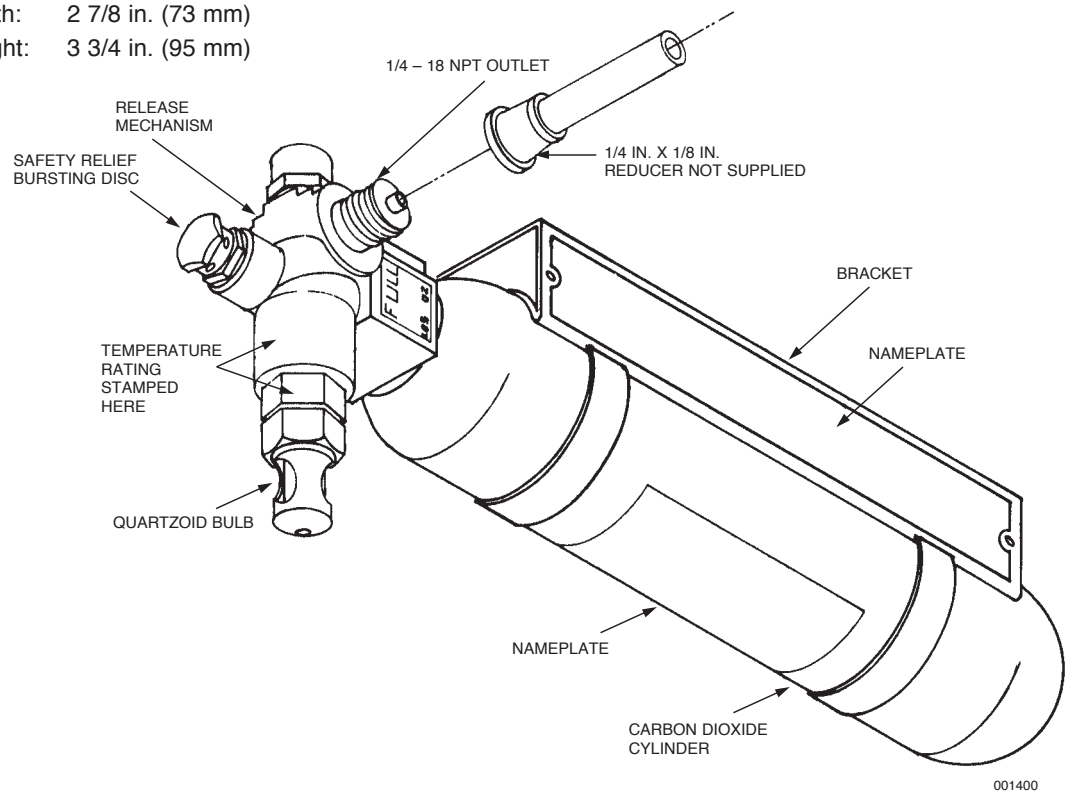
Note: The Quartzoid Bulb Actuator is not part of the FM Approved system.

Component	Material	Thread Size/Type	Approvals
QBA-5 135 °F (57 °C)	Cylinder: Steel Valve: Brass	1/4 in. NPT Male	UL (EX-2968)
QBA-5 175 °F (79 °C)	Cylinder: Steel Valve: Brass	1/4 in. NPT Male	UL (EX-2968)
QBA-5 250° F (121 °C)	Cylinder: Steel Valve: Brass	1/4 in. NPT Male	UL (EX-2968)

Shipping Assembly Part No.	Description
42267	QBA-5 – 135 °F (57 °C) with bracket
42274	QBA-5 – 175 °F (79 °C) with bracket
42276	QBA-5 – 250 °F (121 °C) with bracket
41893	QBA-5 – 135 °F (57 °C) without bracket
41894	QBA-5 – 175 °F (79 °C) without bracket
41895	QBA-5 – 250 °F (121 °C) without bracket
41651	Replacement Bulb – 135 °F (57 °C)
41657	Replacement Bulb – 175 °F (79 °C)
41659	Replacement Bulb – 250 °F (121 °C)

Component Dimensions

Length: 10 in. (254 mm)
Width: 2 7/8 in. (73 mm)
Height: 3 3/4 in. (95 mm)



Pneumatic Time Delay

Description

To meet the requirements of NFPA 12, a mechanical time delay is required for all carbon dioxide systems that protect "Normally Occupied" or "Occupiable" spaces protected with total flooding systems, or local application systems where the discharge exposes personnel to concentrations of carbon dioxide in excess of 7.5 percent. These are areas where it is necessary to evacuate personnel prior to the discharge of a carbon dioxide system. For improved accuracy, the time delay uses nitrogen from an LT-10 cartridge (Part No. 423423) to power the factory set delay mechanism. The time delay is installed in the discharge piping, either directly after the control (pilot) container, or further along the piping.

The time delay is activated by pressure from the pilot containers when they are released. After discharge is completed, the time delay can be returned to service ▸ by following the procedure in Section 8 – Resetting and Recharge. The length of time is factory set and is not adjustable. A manual release is incorporated on the time delay valve to allow instant override of the time delay. The time delay is available in delay settings of 10, 30, 68, and 88 seconds.

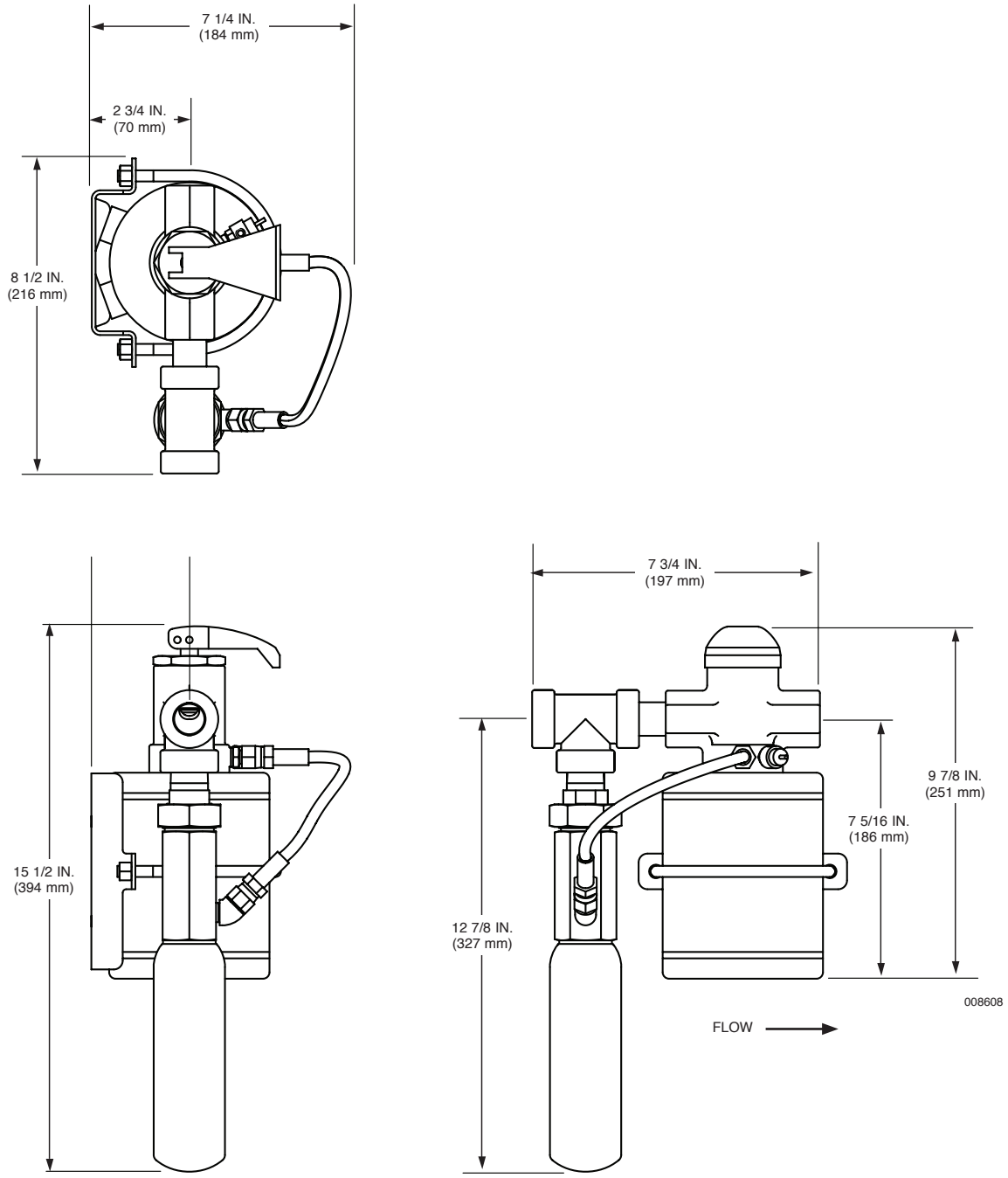
CAUTION: Use only approved LT-10-R nitrogen cartridges (Part No. 423423). Use of unapproved cartridges will result in improper system operation.

▸ LT-10-R cartridge (Part No. 423423) needs to be ordered ▸ separately.

Shipping Assembly Part No.	Description
437715	10 second pneumatic time delay
437716	30 second pneumatic time delay
437717	68 second pneumatic time delay
437718	88 second pneumatic time delay
423423	LT-10-R cartridge shipping assembly

Component	Material	Thread Size/Type	Approvals
Time Delay (10, 30, 68, and 88 second)	Valve: Brass Accumulator: Steel Booster: Brass	3/4 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems

PNEUMATIC TIME DELAY (Continued)



Hose Reels

Description

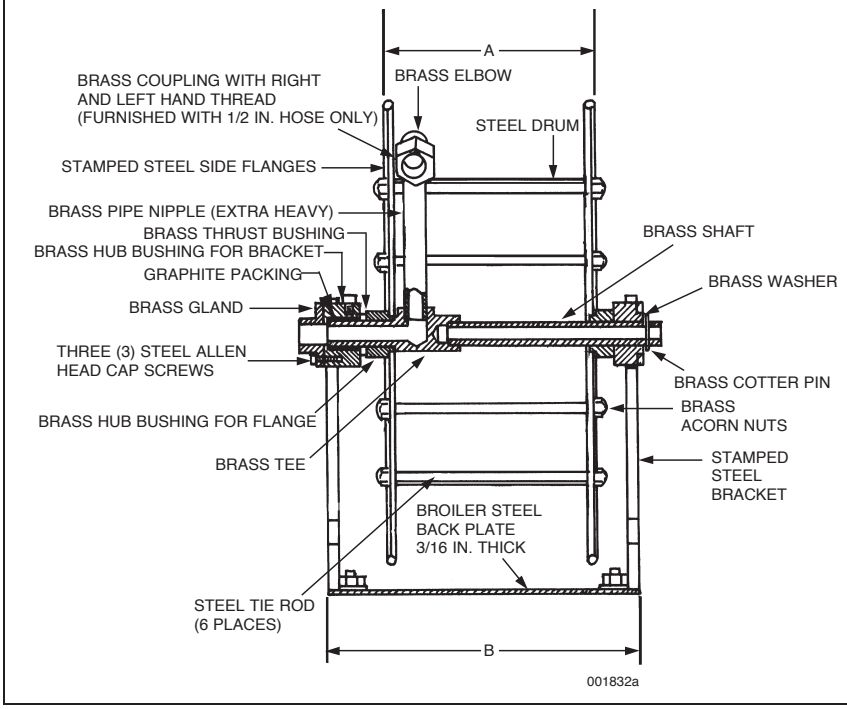
The carbon dioxide hose reel can be used in areas that normally do not require fixed pipe systems, or as a back up to a fixed pipe system. When used as a back up, provisions must be made to have self-contained breathing apparatus available for anyone entering the hazard area immediately after the fixed system discharge. Hose reels are available with hose lengths ranging from 50 ft to 100 ft (15.2 m to 30.5 m).

The complete hose reel is finished in red enamel.

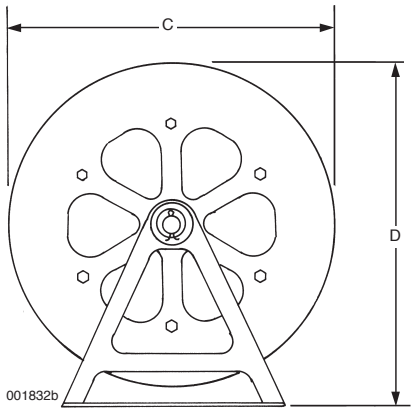
Component	Material	Thread	Approvals
Hose Reel	Steel With Brass Fittings	3/4 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems

Shipping Assembly Part No.	Description
41519	Hose reel with 50 ft (15.2 m) of 1/2 in. (13 mm) hose
41520	Hose reel with 75 ft (22.9 m) of 1/2 in. (13 mm) hose
41524	Hose reel with 50 ft (15.2 m) of 3/4 in. (19 mm) hose
44967	Hose reel with 100 ft (30.5 m) of 3/4 in. (19 mm) hose
42303	Volume discharge horn for 1/2 in. hose – 75 lb (34 kg) systems and larger
40237	Upper bracket (one required)
41807	Lower bracket (Use two per projector horn and one per volume discharge horn)
41924	Operating instructions – for systems less than 100 lb (45.4 kg)
41923	Operating instructions – for systems 100 lb (45.4 kg) or larger
42227	1/2 in. hose assembly – 25 ft (7.6 m) (replacement)
42228	1/2 in. hose assembly – 50 ft (15.2 m) (replacement)
42224	1/2 in. hose assembly – 75 ft (22.9 m) (replacement)
42222	3/4 in. hose assembly – 50 ft (15.2 m) (replacement)
46604	3/4 in. hose assembly – 100 ft (30.5 m) (replacement)

Hose Reel – Sectional View

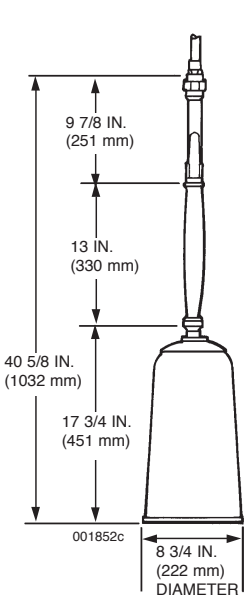


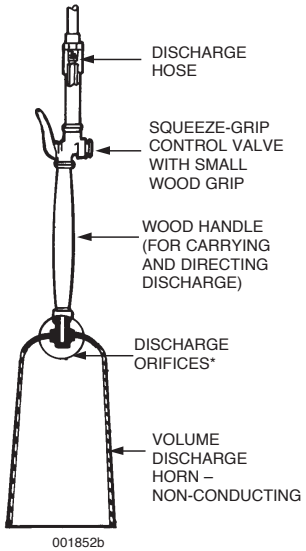
Hose Reel – Side View



	Hose Reel Dimensions							
	A		B		C		D	
Hose Capacity	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)
Up to 75 ft (22.9 m) of 1/2 in. (13 mm) hose	8	(203)	12 3/8	(314)	20	(508)	21 1/2	(546)
Up to 50 ft (15.2 m) of 3/4 in. (19 mm) hose	8	(203)	12 3/8	(314)	20	(508)	21 1/2	(546)
75 to 100 ft (22.8 to 30.4 m) of 1/2 in. (13 mm) hose	12	(305)	16 3/8	(416)	20	(508)	21 1/2	(546)
50 to 75 ft (15.2 to 22.8 m) of 3/4 in. (19 mm) hose	12	(305)	16 3/8	(416)	20	(508)	21 1/2	(546)
75 to 100 ft (22.8 to 30.4 m) of 3/4 in. (19 mm) hose	14	(356)	20 1/4	(514)	23 1/2	(597)	25 3/4	(654)

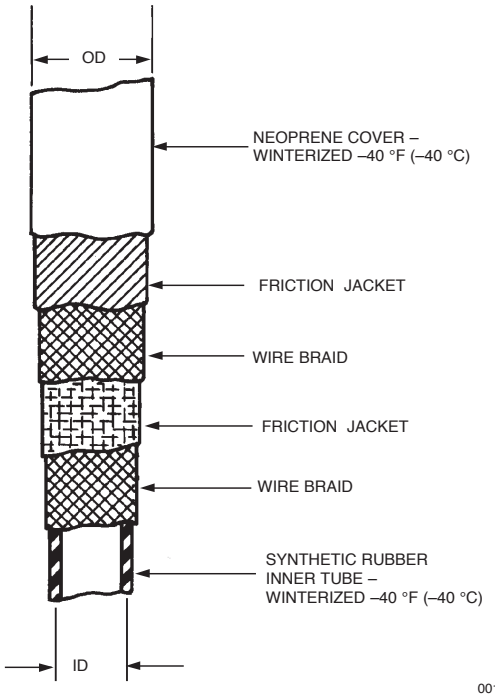
Volume Discharge Horn – Part No. 42303 for 1/2 in. Hose





*FOR HOSE LENGTHS OF 50 FT OR 75 FT (15.2 m OR 22.9 m), ORDER ORIFICE CODE 6.5.
FOR HOSE LENGTHS OF 100 FT (30.5 m), ORDER ORIFICE CODE 12.0.

Extra Heavy Flexible Hose – Wire Reinforced High Pressure Type



Flexible Hose	OD in.	OD (mm)	ID in.	ID (mm)
1/2 in. Hose	1	(25)	1/2	(13)
3/4 in. Hose	1 1/4	(32)	3/4	(19)

NOTES:

Pressure Trip

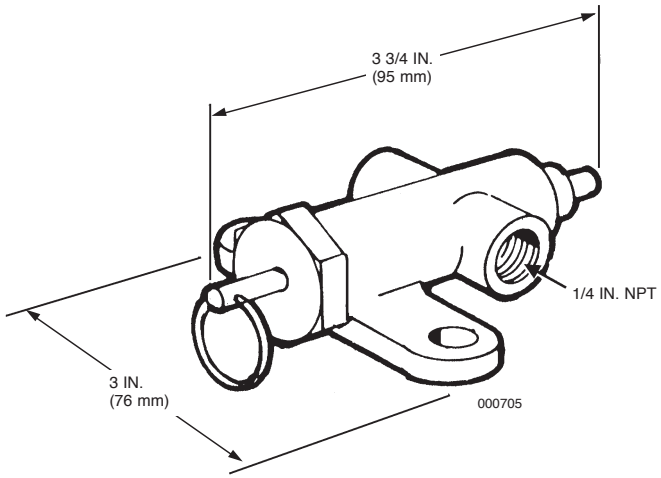
Description

The pressure trip is connected to the actuation or discharge line of a carbon dioxide system. By either pneumatic or manual actuation, the pressure trip can release spring or weight powered devices to close doors and windows, open fuel dump valves, close fire dampers or close fuel supply valves. The pressure trip is constructed of brass with two 1/4 in. NPT fittings for connection to discharge or actuation lines. The link on the pressure switch is released either pneumatically, by agent discharge pressure; or manually, by use of the pull ring. The link then releases the device which performs the auxiliary functions.

Note: Operating pressure must be a minimum of 75 psi (5.2 bar) with a maximum load of 70 lb (31.8 kg).

Shipping Assembly Part No.	Description
5156	Pressure trip

Component	Material	Thread Size/Type	Approvals
Pressure Trip	Brass	1/4 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems



NOTES:

Direction/Stop Valve

Description

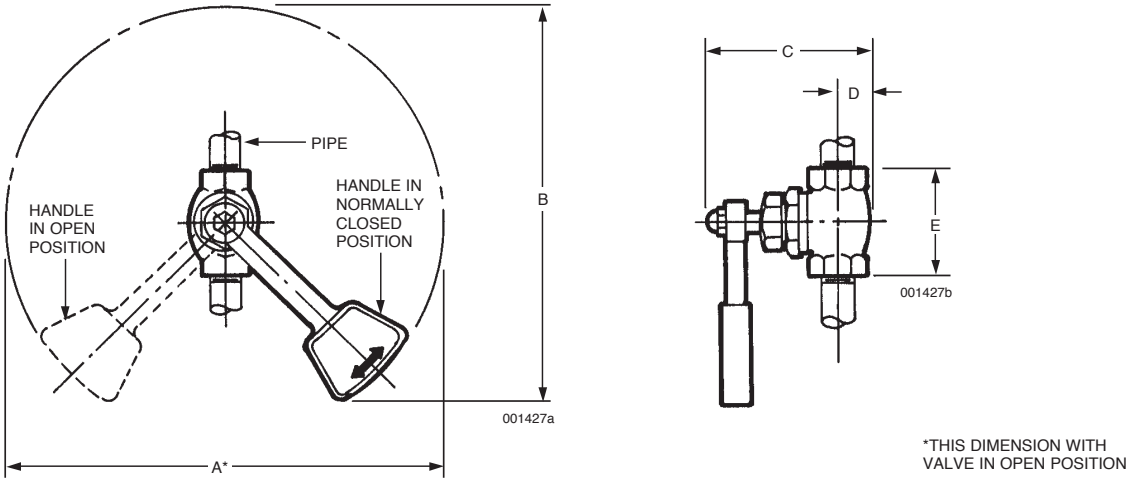
Direction/stop valves are used to either manually control the flow of carbon dioxide into a hazard area or to manually control the flow into one of several hazards being protected by a common bank of carbon dioxide containers. The valves are operated manually, either by the use of a hand lever attached directly to the valve or by means of a remote manual pull box which will operate a sector attached to the valve.

The valves are available in sizes ranging from 1/2 in. to 1 1/2 in. Each size can be used with a hand lever or a sector.

Component	Material	Thread Size/Type	Approvals
Direction/Stop Valve	Forged Brass	1/2 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems
Direction/Stop Valve	Forged Brass	3/4 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems
Direction/Stop Valve	Forged Brass	1 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems
Direction/Stop Valve	Forged Brass	1 1/4 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems
Direction/Stop Valve	Forged Brass	1 1/2 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems

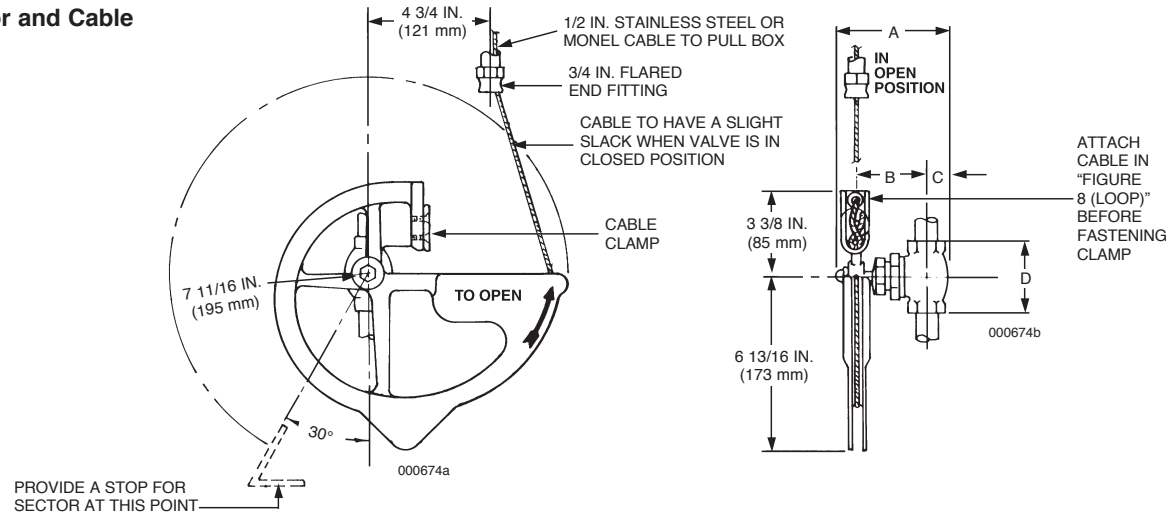
Shipping Assembly Part No.	Description
41451	1/2 in. direction/stop valve (valve only)
41102	3/4 in. direction/stop valve (valve only)
41354	1 in. direction/stop valve (valve only)
41338	1 1/4 in. direction/stop valve (valve only)
41424	1 1/2 in. direction/stop valve (valve only)
40248	Handle – normally open (for use with 1/2 in. valve)
40267	Handle – normally open (for use with 3/4 in. and 1 in. valves)
46393	Handle – normally open (for use with 1 1/4 in. and 1 1/2 in. valves)
40238	Handle – normally closed (for use with 1/2 in. valve)
40239	Handle – normally closed (for use with 3/4 in. and 1 in. valves)
40259	Handle – normally closed (for use with 1 1/4 in. and 1 1/2 in. valves)
40276	Sector (for use with 1/2 in. valve)
40279	Sector (for use with 3/4 in. and 1 in. valves)
40281	Sector (For use with 1 1/4 in. and 1 1/2 in. valves)

Hand Lever



Valve Size	A in.	A (mm)	B in.	B (mm)	C in.	C (mm)	D in.	D (mm)	E in.	E (mm)
1/2 in.	10	(254)	9 3/8	(238)	4 3/4	(122)	7/8	(22)	2 15/16	(74)
3/4 in.	14	(355)	12 3/4	(323)	5 5/8	(142)	1 1/8	(28)	3 5/8	(92)
1 in.	14	(355)	12 3/4	(323)	6 3/8	(161)	1 7/16	(36)	4 1/8	(104)
1 1/4 in.	17	(431)	15 5/8	(396)	7 7/8	(200)	1 11/16	(42)	5	(127)
1 1/2 in.	17	(431)	15 5/8	(396)	8 1/4	(209)	1 7/8	(47)	5 1/2	(139)

Sector and Cable

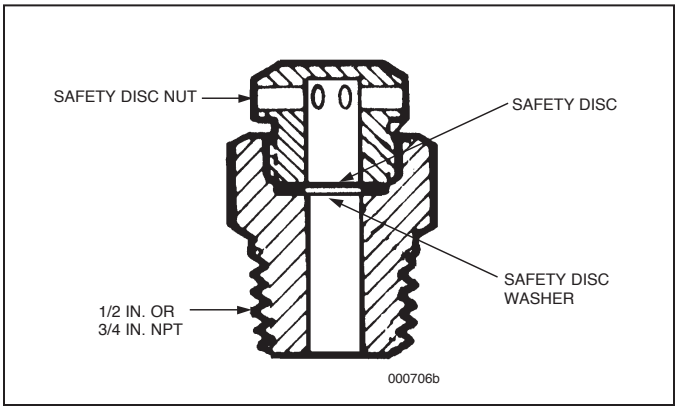


Valve Size	A in.	A (mm)	B in.	B (mm)	C in.	C (mm)	D in.	D (mm)
1/2 in.	4 3/4	(121)	3	(76)	7/8	(22)	2 15/16	(74)
3/4 in.	5 5/8	(143)	3 5/8	(93)	1 1/8	(28)	3 5/8	(92)
1 in.	6 5/16	(160)	4 1/8	(104)	1 7/16	(36)	4 1/8	(104)
1 1/4 in.	8 1/8	(206)	5 1/4	(133)	1 11/16	(42)	5	(127)
1 1/2 in.	8 1/4	(209)	5 3/8	(136)	1 7/8	(47)	5 1/2	(139)

Header Safety

Description

The header safety is a device used to relieve high pressure build-up in a closed section of piping. If actuation pressure should get inadvertently trapped and should an increase in temperature cause the pressure to rise to a dangerous level, the burst disc in the header safety will rupture, allowing the pressure to escape. The header safety is available with 1/2 in. or 3/4 in. NPT threads.



Shipping Assembly Part No.	Description
40094	1/2 in. Header Safety
40076	3/4 in. Header Safety
78756	Replacement burst disc, rupture at 2400 psi to 2800 psi (165.5 bar to 193 bar)

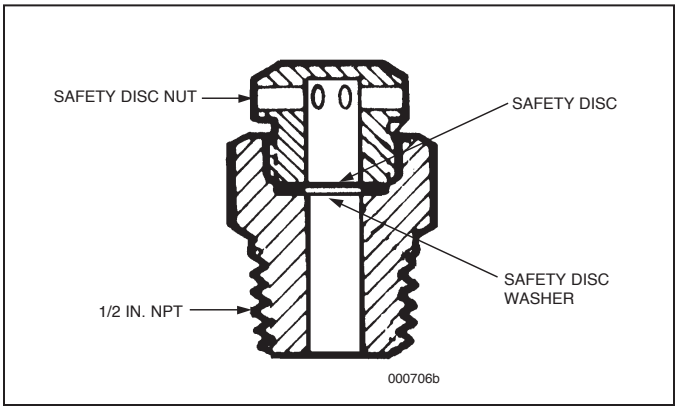
Component	Material	Thread Size/Type	Approvals
Header Safety	Brass	1/2 or 3/4 in. NPT Male	UL (EX-2968); Listed for use with FM Approved systems

NOTES:

China CCCF Header Safety

Description

The header safety is a device used to relieve high pressure build-up in a closed section of piping. If actuation pressure should get inadvertently trapped and should an increase in temperature cause the pressure to rise to a dangerous level, the burst disc in the header safety will rupture, allowing the pressure to escape. The header safety is available with 1/2 in. NPT threads.



Shipping Assembly Part No.		
Marinette Factory	**Shanghai Factory**	**Description**
446055	446056	1/2 in. Header Safety

Component	Material	Thread Size/Type	Approvals
Header Safety	Brass	1/2 in. NPT Male	UL (EX-2968); Listed for use with FM Approved systems

NOTES:

High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

Header Vent Plug

Description

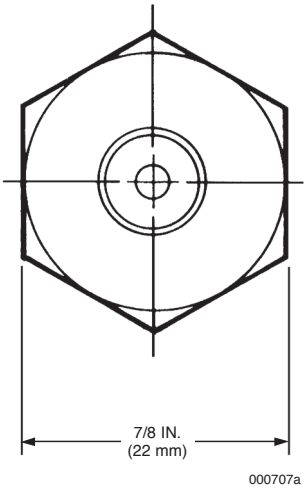
The header vent plug is used to release low pressure build up that may occur in a closed system utilizing time delays, selector valves, or check valves. The header vent plug functions by releasing small amounts of pressure caused by a leaking valve that would otherwise cause back-pressure actuation of the system. When high pressures are encountered, as in a system discharge, the seal contacts the seat, stopping the flow of agent from the header vent plug. The header vent plug should also be installed on the container sides of the check valves on both main and reserve systems to relieve any pressure that may leak past the check valve and accidentally actuate the reserve system while the main system is discharging.

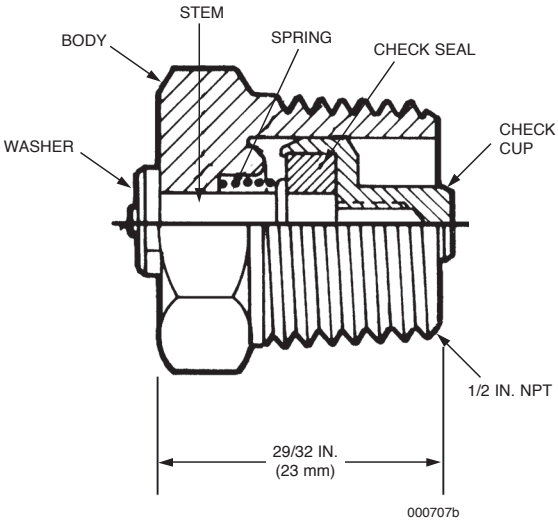
CAUTION

A header vent plug must be installed in all closed sections of the system manifold(s). The omission of a header vent plug may cause the manifold to build pressure. This could result in the actuation of a system container, which would then cause all containers in that specific system to actuate.

Shipping Assembly Part No.	Description
40309	Header vent plug

Component	Material	Thread Size/Type	Approvals
Vent Plug	Body: Brass Spring: Bronze Seal: Neoprene	1/2 in. NPT Male	UL Listed (EX-2968); Listed for use with FM Approved systems





NOTES:

High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

China CCCF Approved Header Vent Plug

Description

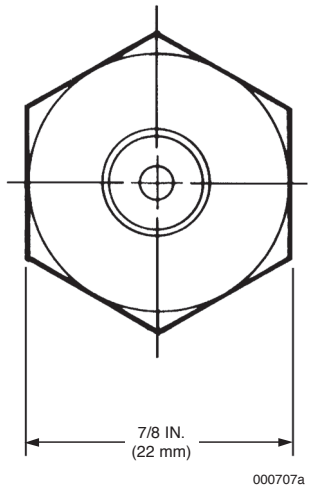
The header vent plug is used to release low pressure build up that may occur in a closed system utilizing time delays, selector valves, or check valves. The header vent plug functions by releasing small amounts of pressure caused by a leaking valve that would otherwise cause back-pressure actuation of the system. When high pressures are encountered, as in a system discharge, the seal contacts the seat, stopping the flow of agent from the header vent plug. The header vent plug should also be installed on the container sides of the check valves on both main and reserve systems to relieve any pressure that may leak past the check valve and accidentally actuate the reserve system while the main system is discharging.

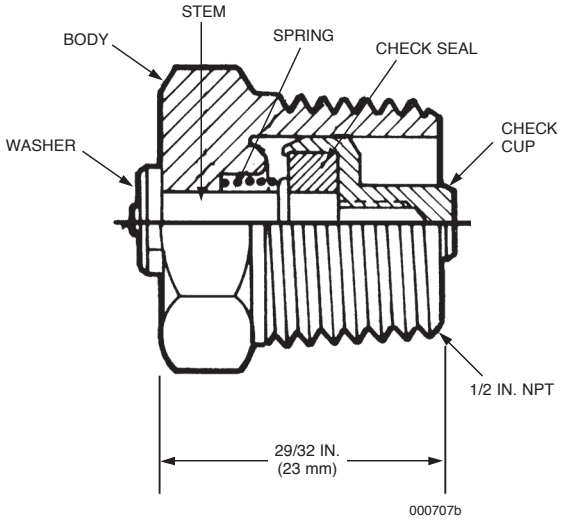
CAUTION

A header vent plug must be installed in all closed sections of the system manifold(s). The omission of a header vent plug may cause the manifold to build pressure. This could result in the actuation of a system container, which would then cause all containers in that specific system to actuate.

Shipping Assembly Part No.		
Marinette Factory	**Shanghai Factory**	**Description**
446052	445137	Header Vent Plug

Component	Material	Thread Size/Type	Approvals
Vent Plug	Body: Brass Spring: Bronze Seal: Neoprene	1/2 in. NPT Male	UL Listed (EX-2968); Listed for use with FM Approved systems





NOTES:

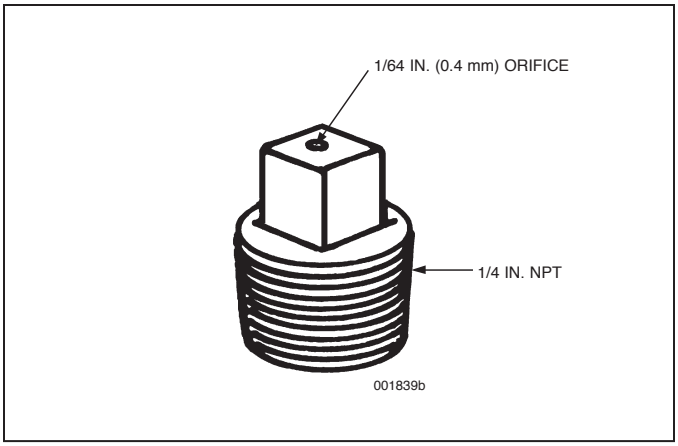
Pressure Bleeder Plug – 1/4 in.

Description

The pressure bleeder plug can be used to relieve the pressure in closed actuation lines. The plug relieves the pressure through a small 1/64 in. (0.4 mm) orifice. This slow relief of pressure does not affect the function of the actuation line.

CAUTION

Pressure Bleeder Plug (Part No. 42175) **must not** be installed anywhere in the directional/selector valve actuation line as the directional/selector valve may not remain open during a complete system discharge, potentially interfering with the ability of the system to suppress a fire.



Shipping Assembly Part No.	Description
42175	Pressure Bleeder Plug

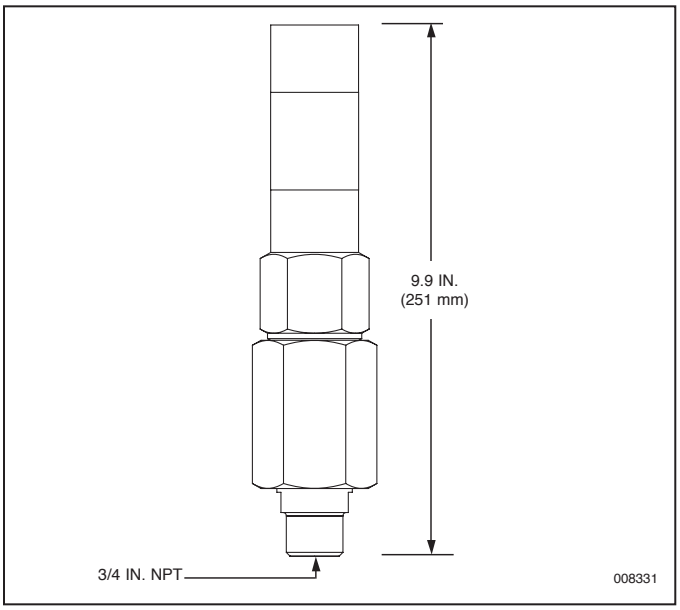
Component	Material	Thread Size/Type	Approvals
Bleeder Plug	Brass	1/4 in. NPT Male	UL Listed (EX-2968); Listed for use with FM Approved systems

NOTES:

Odorizer

Description

The odorizer is used to inject a small amount of wintergreen scent into the carbon dioxide while flowing through the piping network. When the carbon dioxide discharges into the hazard area, it will carry a scent of wintergreen with it. This wintergreen scent is a warning to personnel entering the hazard area that the area contains a concentration of carbon dioxide and precautions must be taken, either leave the area immediately or secure proper breathing apparatus. The internal ampoule containing the oil of wintergreen in the odorizer must be replaced after each system discharge.



Shipping Assembly Part No.	Description
42278	Odorizer
42284	Replacement ampoule (includes burst disc)
428271	Replacement burst disc assembly (included with Part No. 42284)

Component	Material	Thread Size/Type	Approvals
Odorizer	Steel	3/4 in. NPT Male	UL Listed (EX-2968); Listed for use with FM Approved systems

ODORIZING UNIT
Part No. 42278
INSTALL UNIT UPRIGHT

AFTER USE, REMOVE ASSEMBLY AND UNSCREW RUPTURED BURST DISC. REMOVE CAP AND CLEAN OUT BROKEN AMPOULE. USING REPLACEMENT KIT PART NO. 42284 REPLACE AMPOULE AND BURST DISC. SCREW CAP DOWN TIGHT AND REINSTALL ASSEMBLY.

TYCO FS&BP
MARINETTE, WI 54143-2542
715-735-7411

LABEL NO. 42280-05

NOTES:

Pressure-Operated Siren

Description

The pressure-operated siren is used to warn personnel of a system discharge. The siren operates upon pilot container activation and continues to sound through most of the discharge time.

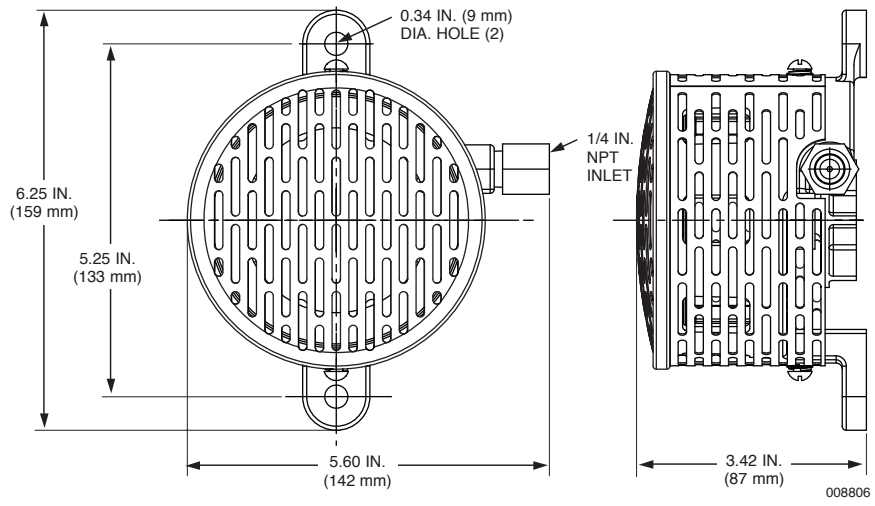
A pipe hanger or bracket must be installed within 1 ft (0.3 m) of the siren.

Component	Material	Approvals
Siren	Body: Brass Grille: Steel Screen: Stainless Steel	UL Listed (EX-2968); Listed for use with FM Approved systems

Shipping Assembly Part No.	Description
437616	Pressure-operated siren

The design requirements are as follows:

- Maximum Pipe Length:
  - 240 ft (73.2 m) of 3/4 in. Schedule 40 pipe
  - 430 ft (131.1 m) of 1/2 in. Schedule 40 pipe
  - 675 ft (205.7 m) of 3/8 in. Schedule 40 pipe
- Maximum Sirens: 5
- Maximum Elbows: 30
- Flow Rate: 14.4 lb/min (65 kg/min)
- If siren is not located in hazard area, include agent flow and quantity through siren in system design



NOTES:

High Pressure Carbon Dioxide Systems Manual
(Part No. 427604)

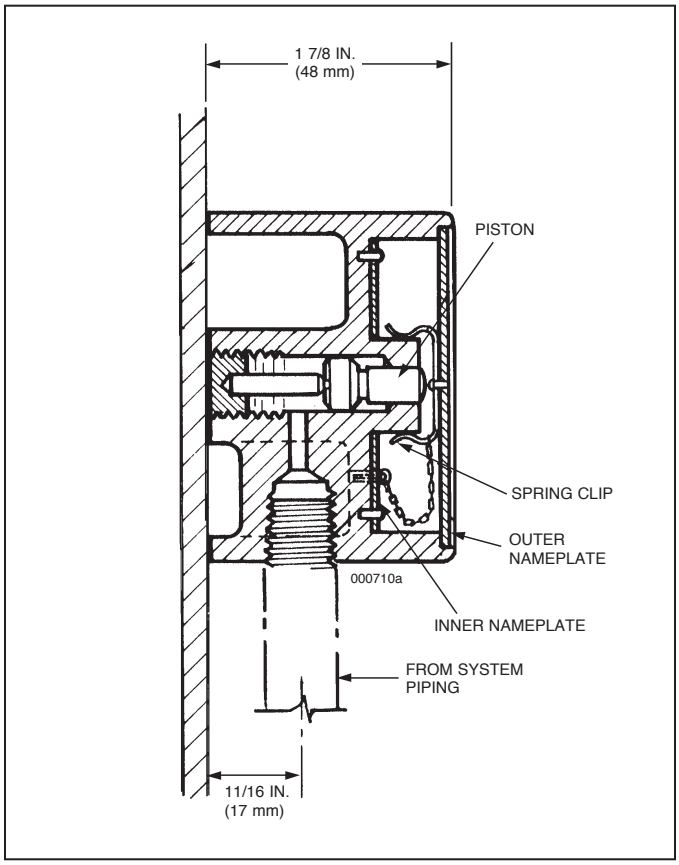
Discharge Indicator

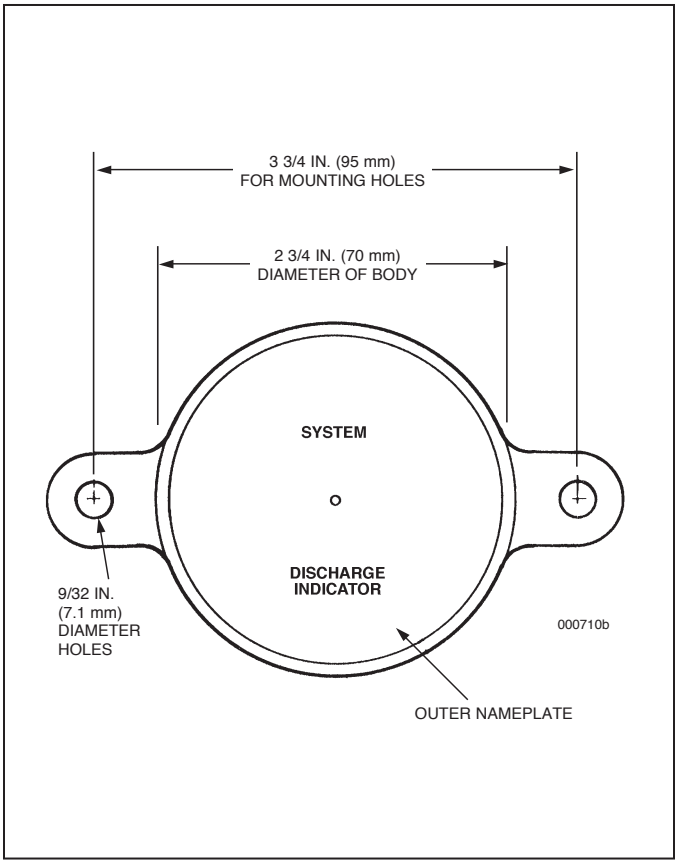
Description

The system discharge indicator is used to visually indicate, at a remote location, when the carbon dioxide system has discharged. Pressure from the system is piped to the discharge indicator with 1/4 in. piping. When the system discharges, pressure operates a piston in the indicator which pushes off a cover plate and exposes the wording ‘‘System Discharged.’’

Shipping Assembly Part No.	Description
40765	Discharge Indicator

Component	Material	Thread Size/Type	Approvals
Discharge Indicator	Housing: Bronze Piston: Stainless Steel	1/4 in. NPT Female	UL (EX-2968); Listed for use with FM Approved systems





NOTES:

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Pressure Switch – 3PDT

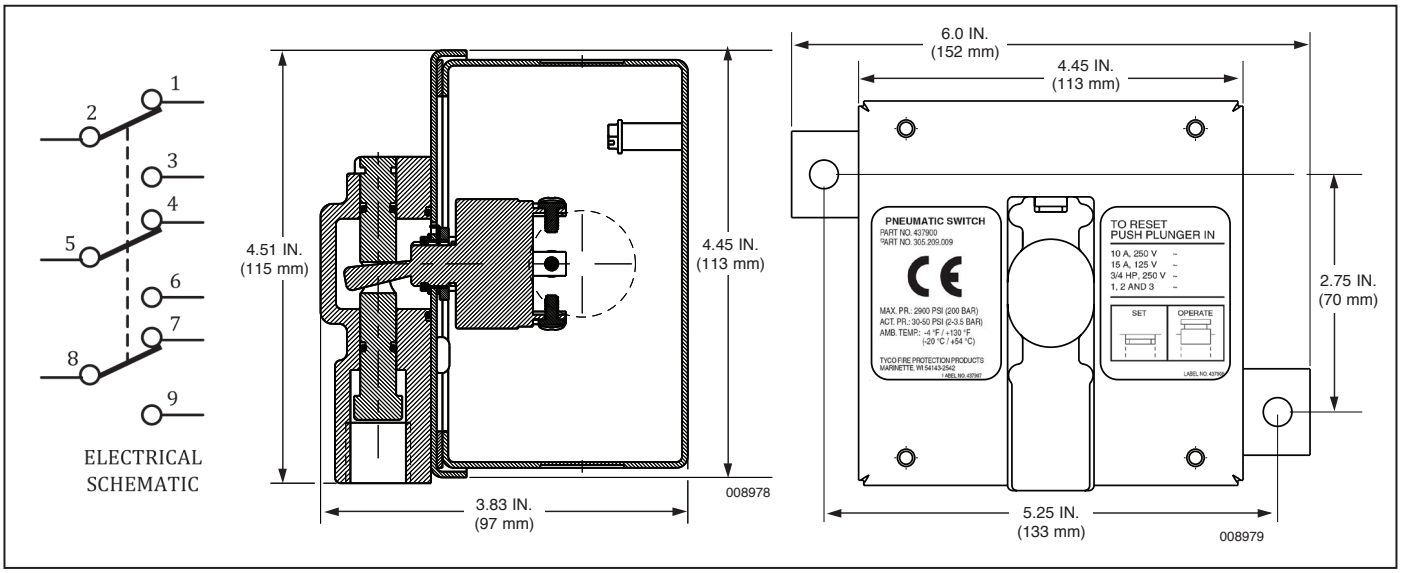
Description

The pressure switch is operated by carbon dioxide agent pressure when the system is discharged. The pressure switch can be used to open or close electrical circuits to shut down equipment (single or 3-phase) or turn on lights or alarms. The housing is constructed of 16 ga. steel, painted red, and is rated IP65 for dust and water ingress. The 3/8 in. NPT brass pressure inlet is used to connect the pressure switch to the suppression system.

Minimum operating pressure is 50 psi (3.5 bar).

Shipping Assembly Part No.	Description
437900	Pressure switch – 3PDT

Component	Material	Thread Size/Type	Electrical Rating	Approvals
Pressure Switch – 3PDT	Switch: Nickel-plated Brass Housing/Cover: C.R. 16 ga. steel Plunger: Stainless Steel Pressure Port: C37700 Brass	Conduit Inlets: 3/4 in. and 1/2 in. Pressure Inlet: 3/8 in. NPT Female	10A, 250 VAC 15A, 125 VAC 3/4 HP, 250 VAC 1-, 2-, and 3-phase	UL Listed (EX-2968); Listed for use with FM Approved systems



NOTES:

China CCCF Pressure Switch – 3PDT

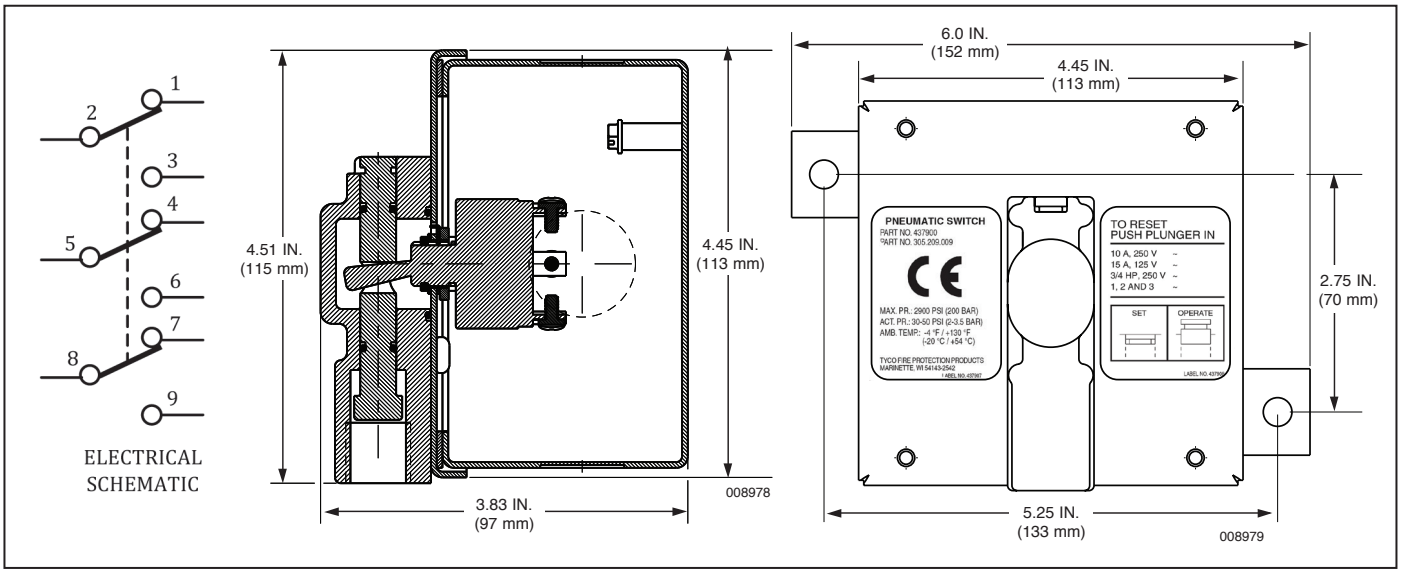
Description

The pressure switch is operated by carbon dioxide agent pressure when the system is discharged. The pressure switch can be used to open or close electrical circuits to shut down equipment (single or 3-phase) or turn on lights or alarms. The housing is constructed of 16 ga. steel, painted red, and is rated IP65 for dust and water ingress. The 3/8 in. NPT brass pressure inlet is used to connect the pressure switch to the suppression system.

Minimum operating pressure is 50 psi (3.5 bar).

Shipping Assembly Part No.		
Marinette Factory	**Shanghai Factory**	**Description**
442988	445135	Pressure Switch – 3PDT

Component	Material	Thread Size/Type	Electrical Rating	Approvals
Pressure Switch – 3PDT	Switch: Nickel-plated Brass Housing/Cover: C.R. 16 ga. steel Plunger: Stainless Steel Pressure Port: C37700 Brass	Conduit Inlets: 3/4 in. and 1/2 in. Pressure Inlet: 3/8 in. NPT Female	10A, 250 VAC 15A, 125 VAC 3/4 HP, 250 VAC 1-, 2-, and 3-phase	UL Listed (EX-2968); Listed for use with FM Approved systems



NOTES:

Pressure Switch DPDT – Explosion-Proof

Description

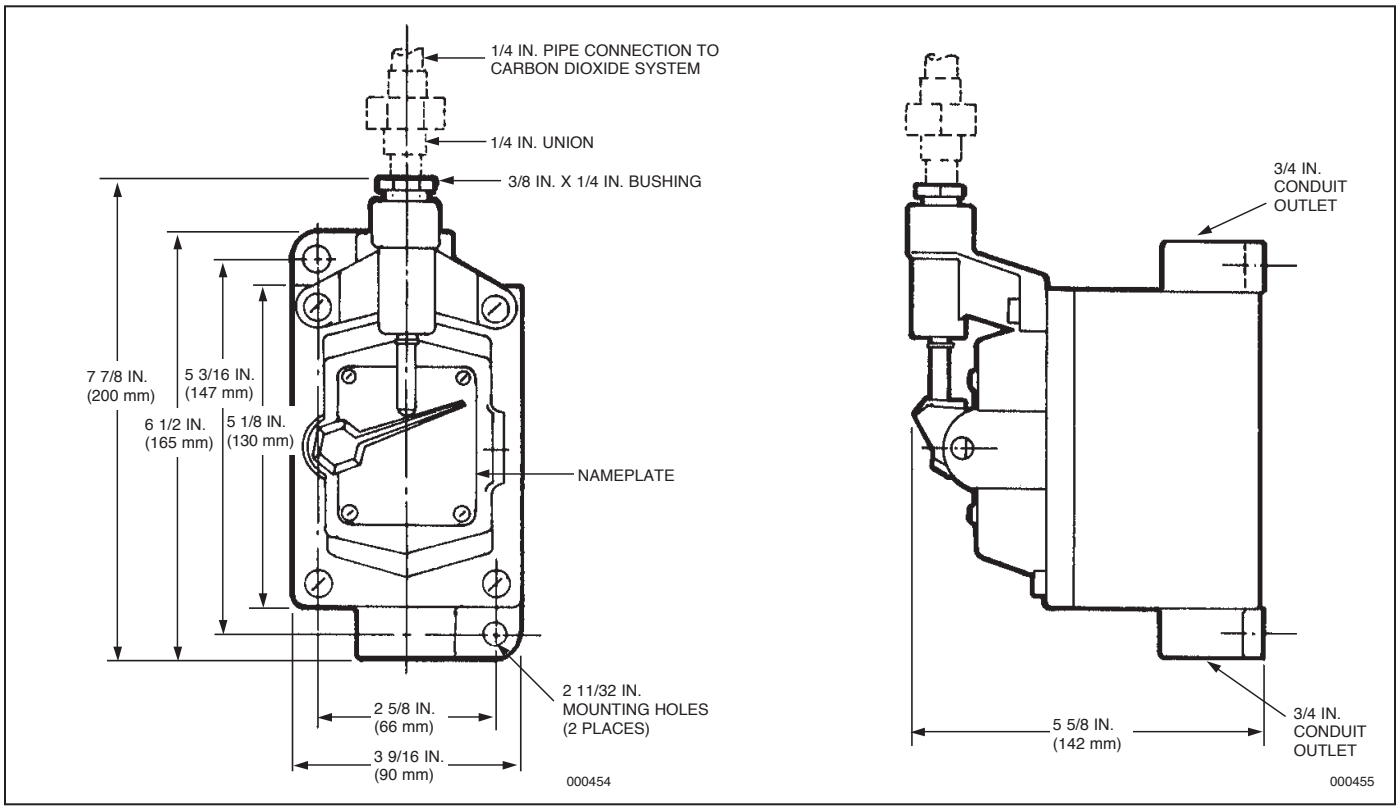
The pressure switch is operated by the carbon dioxide agent pressure when the system is discharged. The pressure switch can be used to open or close electrical circuits to either shut down equipment or turn on lights or alarms. The double pole, double throw (DPDT) pressure switch is constructed with an explosion-proof housing suitable for hazardous environments. A 1/4 in. NPT pressure inlet is used to connect the 1/4 in. pipe from the carbon dioxide system.

The pressure switch can be installed either before or after the pressure reducer in the distribution piping.

Minimum operating pressure is 50 psi (3.5 bar)

Shipping Assembly Part No.	Description
43241	Pressure switch – DPDT

Component	Material	Thread Size/Type	Electrical Rating	Approvals
Pressure Switch DPDT	Housing: Malleable Iron	Conduit Inlet: 3/4 in. NPT Female Pressure Inlet: 1/4 in. NPT Female	10A - 125 VAC 5A - 250 VAC	UL Listed (EX-2968); Listed for use with FM Approved systems



Note: Suitable for hazardous locations, Class I, Division I, Groups C, D, and Class II, Division I, Groups E, F, G.

NOTES:

China CCCF Pressure Switch DPDT – Explosion-Proof

Description

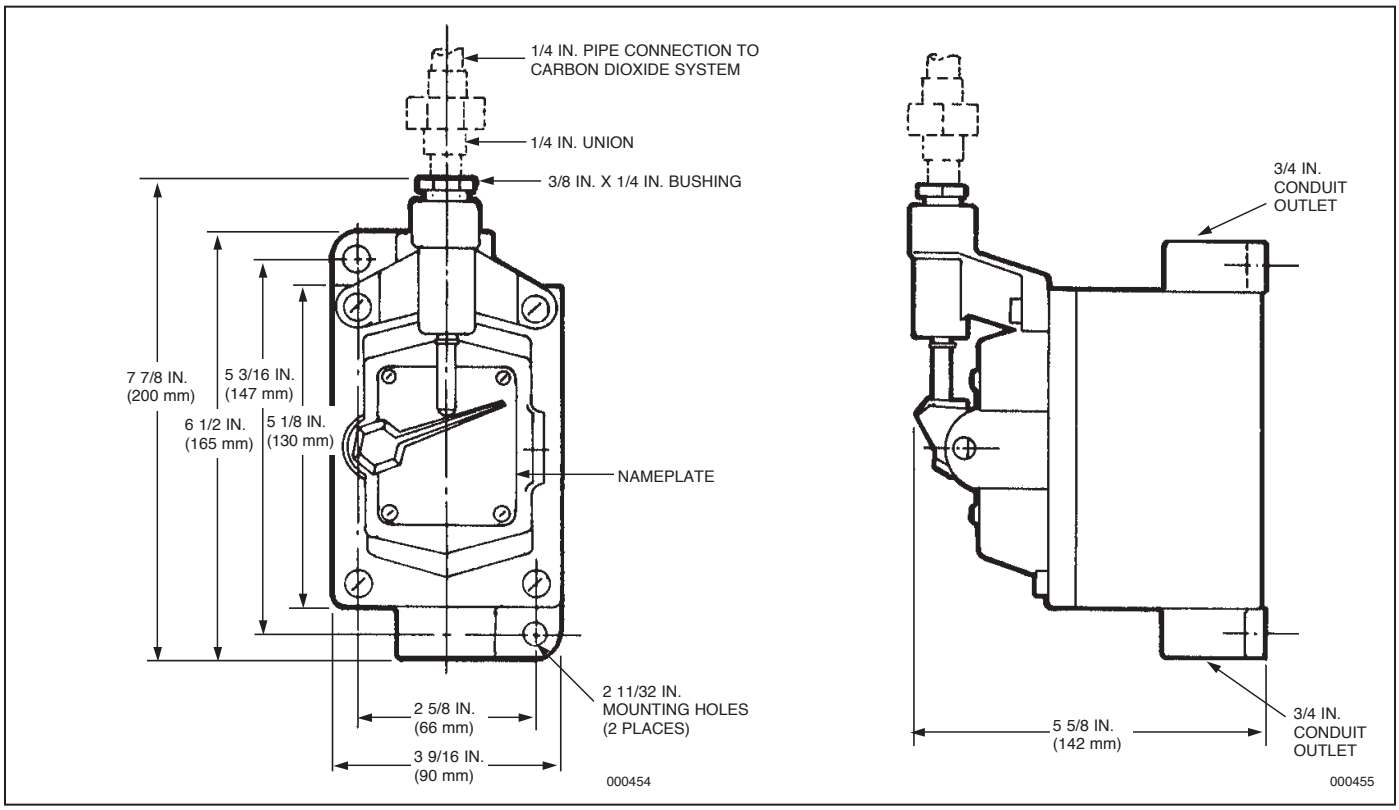
The pressure switch is operated by the carbon dioxide agent pressure when the system is discharged. The pressure switch can be used to open or close electrical circuits to either shut down equipment or turn on lights or alarms. The double pole, double throw (DPDT) pressure switch s constructed with an explosion-proof housing suitable for hazardous environments. A 1/4 in. NPT pressure inlet is used to connect the 1/4 in. pipe from the carbon dioxide system.

The pressure switch can be installed either before or after the pressure reducer in the distribution piping.

Minimum operating pressure is 50 psi (3.5 bar).

Shipping Assembly Part No.		
Marinette Factory	**Shanghai Factory**	**Description**
442989	445136	Pressure Switch – DPDT

Component	Material	Thread Size/Type	Electrical Rating	Approvals
Pressure Switch DPDT	Housing: Malleable Iron	Conduit Inlet: 3/4 in. NPT Female Pressure Inlet: 1/4 in. NPT Female	10A - 125 VAC 5A - 250 VAC	UL Listed (EX-2968); Listed for use with FM Approved systems



Note: Suitable for hazardous locations, Class I, Division I, Groups C, D, and Class II, Division I, Groups E, F, G.

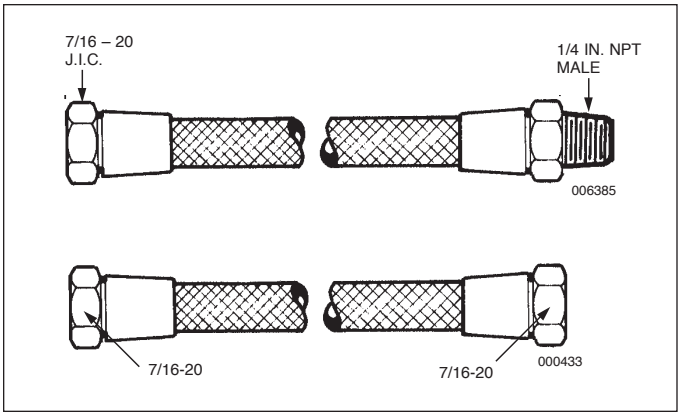
NOTES:

Actuation Components

Description

The Stainless Steel Actuation Hose is used to connect the actuation line flared tees between each agent tank. The hose has the same thread, 7/16-20, as the flared tees. The actuation hose allows flexibility between the rigid actuation piping and the tank valve.

Minimum Bend Radius: 27/32 in. (21 mm)



Shipping Assembly Part No.	Description
31809	Stainless Steel Braided Hose, 16 in. (406 mm) Female-to-Female
32335	Stainless Steel Braided Hose, 20 in. (508 mm) Female-to-Female
32336	Stainless Steel Braided Hose, 24 in. (609 mm) Female-to-Female
73596	Stainless Steel Braided Hose, 12 in. (305 mm) Male-to-Female
73597	Stainless Steel Braided Hose, 16 in. (406 mm) Male-to-Female
73598	Stainless Steel Braided Hose, 20 in. (609 mm) Male-to-Female
415142	Stainless Steel Braided Hose, 32 in. (813 mm) Male-to-Female
430815	Stainless Steel Braided Hose, 42 in. (1067 mm) Male-to-Female

Additional Actuation Fittings

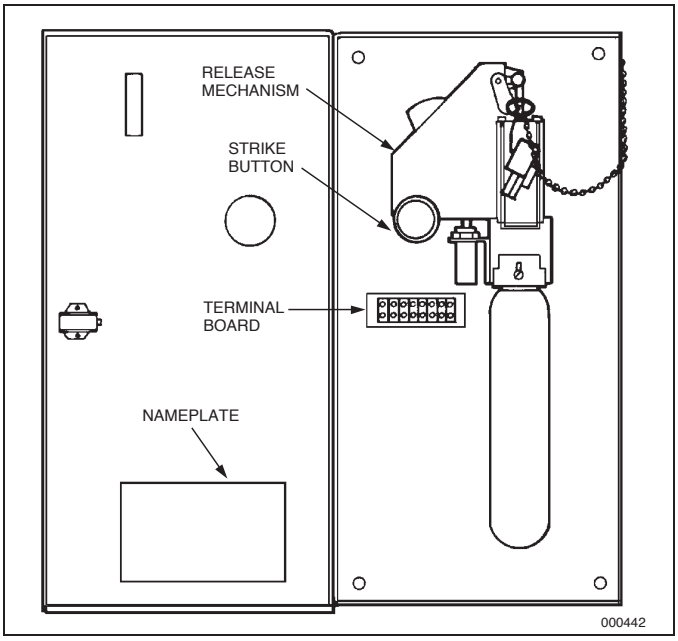
Part No.	Description
73236	CV-98 Actuation Adapter
32338	Male Straight Connector (7/16-20 JIC x 1/4 in. NPT)
32334	Male Elbow (7/16-20 JIC x 1/8 in. NPT)
31810	Male Elbow (7/16-20 JIC x 1/4 in. NPT)
418359	Male Branch Tee (7/16-20 JIC x 1/8 in. NPT)
31811	Male Branch Tee (7/16-20 JIC x 1/4 in. NPT)

NOTES:

AUTOMAN II-C Releasing Device

Description

The AUTOMAN II-C Releasing Device consists of a metal enclosure which contains a spring-loaded puncture pin release mechanism, an actuation cartridge, electrical circuitry, and an input/output terminal strip for making electrical connections. The AUTOMAN II-C releasing device provides automatic pneumatic actuation of the system. When wired to an AUTOPULSE Control System, it will provide supervised electric detection and release. It also provides manual actuation using the strike button on the release enclosure and with the optional remote manual cable pull station. When an AUTOPULSE Control System is used, manual actuation is accomplished using an electric manual pull station.



Component	Approvals
AUTOMAN II-C Releasing Device AUTOMAN II-C Releasing Device (Explosion-Proof)	UL Listed (R5998); FM Approved

Shipping Assembly Part No.	Description
17728	AUTOMAN II-C Releasing Device, 24 VDC
31492	AUTOMAN II-C Releasing Device, Explosion-Proof, 24 VDC
32525	AUTOMAN II-C Releasing Device, Explosion-Proof, 120 VAC
▸ 35623	AUTOMAN II-C Releasing Device, Weather-Proof, 24 VDC
5373	LT-30-R Nitrogen Cartridge

▸

NOTES:

SDS (Safety Data Sheets)

Safety Data Sheets (SDS) available at www.ansul.com

The SDS document in this section is a sample reference only. Technically, SDS information is country and language specific. Refer to the link below for the most recent and applicable version.

http://tycosds.thewercs.com/external/private/search.aspx

SAMPLE SDS FOR REFERENCE ONLY (PAGE 1):

ANSUL

Safety Data Sheet

This safety data sheet complies with the requirements of: 2012 OSHA Hazard Communication Standard (29CFR 1910.1200)

Product name Carbon Dioxide

1. Identification

1.1. Product Identifier

Product name	Carbon Dioxide

1.2. Other means of identification

Product code	426246
UN/ID no	UN1013
Synonyms	None
Chemical Family	No information available

1.3. Recommended use of the chemical and restrictions on use

Recommended use	No information available.
Uses advised against	Consumer use.

1.4. Details of the Supplier of the Safety Data Sheet

Company Name	Tyco Fire Protection Products One Stanton Street Marinette, WI 54143-2542 Telephone: 715-735-7411
Contact point	Product Stewardship at 1-715-735-7411
E-mail address	psra@tycofp.com

1.5. Emergency Telephone Number

Emergency telephone	CHEMTREC 800-424-9300 or 703-527-3887

2. Hazards Identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Gases Under Pressure - Compressed Gas
Simple asphyxiants - Yes

2.2. Label Elements

Signal Word
WARNING

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

Revision date 22-Feb-2017 **Version** 30

SDS (Continued)

Safety Data Sheets (SDS) available at www.ansul.com

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http://tycosds.thewercs.com/external/private/search.aspx

SAMPLE SDS FOR REFERENCE ONLY (PAGE 2):

Precautionary Statements

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

2.3. Hazards Not Otherwise Classified (HNOC)
Simple asphyxiants.

2.4. Other Information
Unknown Acute Toxicity 100% of the mixture consists of ingredient(s) of unknown toxicity

3. Composition/information on Ingredients

3.1. Mixture
The following component(s) in this product are considered hazardous under applicable OSHA(USA)

Chemical name	CAS No.	weight-%
Carbon Dioxide	124-38-9	60 - 100

4. First aid measures

4.1. Description of first aid measures

Eye Contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin contact Wash skin with soap and water. Get medical attention if irritation develops and persists.

Inhalation Remove to fresh air. If breathing is difficult, give oxygen. (Get medical attention immediately if symptoms occur.).

Ingestion Rinse mouth. Do not induce vomiting without medical advice. If swallowed, call a poison control center or physician immediately.

4.2. Most Important Symptoms and Effects, Both Acute and Delayed
Symptoms Unconsciousness.

4.3. Indication of Any Immediate Medical Attention and Special Treatment Needed
Note to physicians Treat symptomatically.

5. Fire-fighting measures

5.1. Suitable Extinguishing Media
Product is extinguishing agent. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.2. Unsuitable Extinguishing Media
None.

SDS (Continued)

Safety Data Sheets (SDS) available at www.ansul.com

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http://tycosds.thewercs.com/external/private/search.aspx

SAMPLE SDS FOR REFERENCE ONLY (PAGE 3):

Product code 426246 / **Product name** Carbon Dioxide / **PAGE** 3 / 8

5.3. Specific Hazards Arising from the Chemical
None known.

Hazardous Combustion Products Carbon oxides, Fluorinated oxides, Nitrogen oxides (NOx), Oxides of sulfur

5.4. Explosion Data
Sensitivity to Mechanical Impact None.
Sensitivity to Static Discharge None.

5.5. Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Personal Precautions Ensure adequate ventilation, especially in confined areas.

For emergency responders Use personal protection recommended in Section 8.

6.2. Environmental Precautions

Environmental Precautions Prevent further leakage or spillage if safe to do so. Prevent entry into waterways, sewers, basements or confined areas. See Section 12 for additional Ecological Information.

6.3. Methods and material for containment and cleaning up

Methods for Containment Prevent further leakage or spillage if safe to do so.

Methods for Cleaning Up Pick up and transfer to properly labeled containers.

7. Handling and Storage

7.1. Precautions for Safe Handling

Advice on safe handling Avoid contact with skin and eyes. Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place.

Incompatible Materials Strong oxidizing agents. Strong acids. Strong bases.

8. Exposure Controls/Personal Protection

8.1. Control Parameters

Exposure guidelines

Chemical name	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL
Carbon Dioxide 124-38-9	STEL: 30000 ppm TWA: 5000 ppm	-	IDLH: 40000 ppm TWA: 5000 ppm	TWA 5000 ppm (VLE-PPT) TWA 9000 mg/m^3

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SDS (Continued)

Safety Data Sheets (SDS) available at www.ansul.com

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http://tycosds.thewercs.com/external/private/search.aspx

SAMPLE SDS FOR REFERENCE ONLY (PAGE 4):

Product code 426246 / **Product name** Carbon Dioxide / **PAGE** 4 / 8

			TWA: 9000 mg/m³ STEL: 30000 ppm STEL: 54000 mg/m³	(VLE-PPT) STEL 15000 ppm(PPT-CT) STEL 27000 mg/m³(PPT-CT)

ACGIH (American Conference of Governmental Industrial Hygienists) OSHA (Occupational Safety and Health Administration of the US Department of Labor) NIOSH IDLH Immediately Dangerous to Life or Health

8.2. Appropriate Engineering Controls

Engineering controls Showers
Eyewash stations
Ventilation systems.

8.3. Individual protection measures, such as personal protective equipment

Eye/Face Protection Avoid contact with eyes. Tight sealing safety goggles.

Skin and Body Protection Wear protective gloves and protective clothing.

Respiratory Protection If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.

Ventilation Use local exhaust or general dilution ventilation to control exposure with applicable limits

8.4. General hygiene considerations
Do not eat, drink or smoke when using this product. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical State	Compressed Gas		
Odor	None	**Color**	Colorless
Odor Threshold	No data available		

Property	**Values**	**Remarks • Method**
pH	No data available	
Melting point/freezing point	No data available	
Boiling point / boiling range	-1.4 °C / 28 °F	
Flash Point	No data available	
Evaporation Rate	No data available	
Flammability (solid, gas)	No data available	
Flammability limit in air		
Upper flammability limit:	No data available	
Lower flammability limit:	No data available	
Vapor Pressure	No data available	
Vapor Density	No data available	
Specific gravity	No data available	
Water Solubility	No data available	
Solubility in Other Solvents	No data available	
Partition coefficient	No data available	
Autoignition Temperature	No data available	
Decomposition Temperature	No data available	

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SDS (Continued)

Safety Data Sheets (SDS) available at www.ansul.com

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http://tycosds.thewercs.com/external/private/search.aspx

SAMPLE SDS FOR REFERENCE ONLY (PAGE 5):

Kinematic viscosity	No data available

10. Stability and Reactivity

10.1. Chemical Stability

Stable under recommended storage conditions.

10.2. Reactivity
No data available

10.3. Possibility of hazardous reactions

None under normal processing.

Hazardous Polymerization	Hazardous polymerization does not occur.

10.4. Conditions to Avoid

Extremes of temperature and direct sunlight.

10.5. Incompatible Materials

Strong oxidizing agents. Strong acids. Strong bases.

10.6. Hazardous decomposition products

Carbon oxides. Nitrogen oxides (NOx). Oxides of sulfur. Fluorinated oxides.

11. Toxicological Information

11.1. Information on Likely Routes of Exposure

Product information

Inhalation	In high concentration the gas may cause a suffocation. Victim may not be aware of asphyxiation. In confined or poorly ventilated areas, vapors can readily accumulate and can cause unconsciousness and death.
Eye Contact	None known.
Skin contact	None known.
Ingestion	Not an expected route of exposure.

Acute Toxicity

11.2. Information on Toxicological Effects

Symptoms	Unconsciousness.

11.3. Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin Corrosion/Irritation	No information available.
Serious eye damage/eye irritation	No information available.
Sensitization	No information available.

SDS (Continued)

Safety Data Sheets (SDS) available at www.ansul.com

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http://tycosds.thewercs.com/external/private/search.aspx

SAMPLE SDS FOR REFERENCE ONLY (PAGE 6):

Product code 426246 / **Product name** Carbon Dioxide / **PAGE** 6 / 8

Germ Cell Mutagenicity	No information available.
Carcinogenicity	No information available.
Reproductive Toxicity	Lack of oxygen during pregnancy has produced developmental abnormalities in humans and experimental animals.
STOT - Single Exposure	No information available.
STOT - Repeated Exposure	No information available.
Target organ effects	Respiratory System, Central Vascular System (CVS).
Aspiration Hazard	No information available.

11.4. Numerical Measures of Toxicity - Product information

The following values are calculated based on chapter 3.1 of the GHS document

12. Ecological Information

12.1. Ecotoxicity

The environmental impact of this product has not been fully investigated.

100% of the mixture consists of components(s) of unknown hazards to the aquatic environment

12.2. Persistence and Degradability
No information available.

12.3. Bioaccumulation
No information available.

12.4. Other Adverse Effects
No information available

13. Disposal Considerations

13.1. Waste Treatment Methods

Disposal of wastes	Disposal should be in accordance with applicable regional, national and local laws and regulations.
Contaminated Packaging	Do not reuse container.

14. Transport Information

DOT

UN/ID no	UN1013
Description	UN1013, Carbon dioxide, 2.2
Proper Shipping Name	Carbon dioxide
Hazard class	2.2
Emergency Response Guide Number	120

TDG

UN/ID no	UN1013
Description	UN1013, Carbon dioxide, 2.2

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SDS (Continued)

Safety Data Sheets (SDS) available at www.ansul.com

The SDS document in this section is a sample reference only. Technically, SDS information is country and language specific. Refer to the link below for the most recent and applicable version.

http://tycosds.thewercs.com/external/private/search.aspx

SAMPLE SDS FOR REFERENCE ONLY (PAGE 7):

Product code 426246 / **Product name** Carbon Dioxide / **PAGE** 7 / 8

Proper Shipping Name	Carbon dioxide
Hazard class	2.2

MEX

UN/ID no	UN1013
Description	UN1013, Carbon dioxide, 2.2
Proper Shipping Name	Carbon dioxide
Hazard class	2.2

ICAO (air)

UN/ID no	UN1013
Description	UN1013, Carbon dioxide, 2.2
Proper Shipping Name	Carbon dioxide
Hazard class	2.2

IATA

UN/ID no	UN1013
Description	UN1013, Carbon dioxide, 2.2
Proper Shipping Name	Carbon dioxide
Hazard class	2.2
ERG Code	2L

IMDG

UN/ID no	UN1013
Description	UN1013, Carbon dioxide, 2.2
Proper Shipping Name	Carbon dioxide
Hazard class	2.2
EmS-No	F-C, S-V

15. Regulatory Information

15.1. International Inventories

TSCA	Complies
DSL/NDSL	Complies
ENCS	Complies
IECSC	Complies
KECL	Complies
PICCS	Complies
AICS	Complies

Legend:

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

15.2. US Federal Regulations

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

SARA 311/312 Hazard Categories

Acute Health Hazard	No

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SDS (Continued)

Safety Data Sheets (SDS) available at www.ansul.com

The SDS document in this section is a sample reference only. Technically, SDS information is country and language specific. Refer to the link below for the most recent and applicable version.

http://tycosds.thewercs.com/external/private/search.aspx

SAMPLE SDS FOR REFERENCE ONLY (PAGE 8):

Product code 426246 / **Product name** Carbon Dioxide / **PAGE** 8 / 8

Chronic health hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	Yes
Reactive Hazard	No

CWA (Clean Water Act)
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

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

15.3. US State Regulations

U.S. State Right-to-Know Regulations

Chemical name	New Jersey	Massachusetts	Pennsylvania
Carbon Dioxide 124-38-9	X	X	X

16. Other information, including date of preparation of the last revision

NFPA	**Health Hazards** 1	**Flammability** 0	**Instability** 0	**Physical and chemical properties** Simple asphyxiants
HMIS	**Health Hazards** 1	**Flammability** 0	**Physical Hazards** 3	**Personal Protection** X

Revision date 22-Feb-2017
Revision note No information available.
Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

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CARBON DIOXIDE

Carbon dioxide, as a suppressing agent, has many desirable properties. It will not damage equipment and leaves no residue to be cleaned up. Since it is a gas, carbon dioxide will penetrate and spread to all parts of the protected hazard. It does not conduct electricity and, therefore, can be used on live electrical equipment. It can be effectively used on most combustible material.

Carbon dioxide suppresses fire by reducing the oxygen concentration to a point where the atmosphere will no longer support combustion. The carbon dioxide concentration must be maintained for a sufficient period to allow the maximum temperature to be reduced below the auto-ignition temperature of the burning material. Carbon dioxide is most effective against flammable liquid fires. For most flammable liquids, reduction of the oxygen concentration to 15% (from the normal 21%) will be sufficient to suppress the fire. For Class A (wood, and paper) combustibles, a reduction to 15% will control the fire. Some materials, such as acetylene and ethylene oxide, require a greater reduction of oxygen concentration for suppression. Still other materials, such as cellulose nitrate and metal hydrides, which do not require oxygen as they burn, cannot be suppressed by use of carbon dioxide.

PERSONNEL SAFETY

⚠ CAUTION

The discharge of carbon dioxide into an enclosed space can create an asphyxiant as well as toxic environment. It can also reduce visibility to a point where exits are difficult to locate by persons attempting to evacuate the area.

Any use of carbon dioxide in an occupied space should provide for the prompt evacuation of personnel and resuscitation of anyone trapped in the hazard area. Time delays, training, signs, alarms, and breathing apparatus should be provided to the personnel involved.

TYPES OF SYSTEMS

There are two basic types of systems: total flooding and local application.

Total Flooding

A total flooding system normally consists of a fixed supply of carbon dioxide connected to fixed piping with nozzles to direct the agent into an enclosed space about the hazard. In a total flooding system, the space around the hazard must be tight enough to hold the required percentage of carbon dioxide concentration long enough to suppress the fire.

Local Application

A local application system consists of a fixed supply of carbon dioxide, piping, and nozzles to direct the agent at the hazard independent of any enclosure that may exist. The nozzles are arranged to discharge the carbon dioxide directly onto the burning material.

TYPES OF ACTUATION

There are three basic types of actuation for carbon dioxide systems: pneumatic, mechanical, and electrical.

Pneumatic

Pneumatic actuation utilizes gas pressure from either a remote cartridge actuator or from a cartridge located in a control panel such as an AUTOMAN II-C release.

On a CV-98 valve, a 1/4 in. actuation line is attached to the pilot port on the side of the valve. Pneumatic pressure from the AUTOMAN II-C or pilot container opens the valve through this port.

Mechanical

Mechanical actuation is accomplished by a lever actuator mounted on top of the container valve. By manually rotating the lever, the container valve can be opened, allowing the carbon dioxide to discharge through the piping and nozzles.

Electrical

Electrical automatic actuation of the CV-98 container valve can be accomplished by using an HF and booster actuator. The actuators are energized by an electric signal from the detection control panel.

TYPES OF DETECTION

There is one type of automatic detection available for carbon dioxide systems, electric (control panel).

Electric

Electric operation of the carbon dioxide system is obtained through the use of electronic control systems which monitor and control various system functions. Detection devices available are: ionization smoke detectors, photoelectric smoke detectors, fixed temperature detectors, rate-of-rise heat detectors, flame detectors, or combustible vapor detectors. When a detector senses a fire, a signal is sent to the control panel. The panel in turn sends an electric signal to the actuator located on the container valve. The actuator opens the container valve causing the carbon dioxide to be released into the piping network and discharged out the nozzles.

PLANNING

One of the key elements for fire protection is to correctly define the hazard and choose the best application method. This section is divided into two sub-sections: Application Methods and Hazard Analysis.

APPLICATION METHODS

Two types of approved application methods are available with the carbon dioxide system: total flooding and local application.

Total Flooding

Total flooding is defined as a system consisting of a fixed supply of carbon dioxide permanently connected to fixed piping, with fixed nozzles arranged to discharge carbon dioxide into an enclosed space or enclosure about the hazard. The enclosure must be adequate to contain the discharge of agent to achieve the required carbon dioxide concentration. Examples of this type of enclosure include unoccupied rooms, vaults, and machine enclosures.

Local Application

Local application is defined as a system consisting of a fixed supply of carbon dioxide permanently connected to a system of fixed piping with nozzles arranged so as to discharge the agent directly into the fire. Local application systems are used for the suppression of surface fires in flammable liquids, gases, and shallow solids where the hazard is not enclosed or where the enclosure does not conform to the requirements for total flooding. Examples of hazards that may be successfully protected by local application systems include dip tanks, quench tanks, oil-filled electric transformer, etc. Local application systems are divided into two types: rate-by-area and rate-by-volume. Rate-by-area method of system design is used where the fire hazard consists primarily of flat surfaces or low-level objects associated with horizontal surfaces. The rate-by-volume method of system design is used where the fire hazard consists of three-dimensional irregular objects that cannot be easily reduced to equivalent surface areas.

HAZARD ANALYSIS

A thorough hazard analysis is required to determine the type and quantity of protection required. It is important to cover each element and accurately record the information. This information will be used to determine the size and type of carbon dioxide system required and also to determine at a later date if any changes were made to the hazard after the system was installed. Record size of hazard, any obstructions, unclosable openings, and anything else that would concern system performance. Review each of the following criteria:

Hazard Type

Briefly describe the types of hazards being protected. If protecting prefabricated booths or machines, record the manufacturer model number and anything unique about the hazard.

Hazard Dimensions

Sketch hazard and record all pertinent dimensions including all interior walls, location of doors and windows, and any permanent structures which may interfere with piping or discharge pattern.

Unclosable Openings

For enclosures that have unclosable openings, the guidelines from NFPA 12, the “Standard on Carbon Dioxide Extinguishing Systems,” must be observed when the application is total flooding.

HAZARD ANALYSIS (Continued)

Unclosable Openings (Continued)

Openings leading to adjacent areas containing hazards can be protected in several ways. The opening may be equipped with automatic closures operated by pressure trip devices which close the openings upon system actuation. Or, screening nozzles may be installed at the opening areas to prevent fire from spreading through the opening to adjacent areas. Any additional carbon dioxide required for screening the opening must be adjusted if the temperatures are outside the normal design range.

Types of Fires

Types of fires which can be suppressed by total flooding may be divided into two categories: surface fires involving flammable liquids, gases and solids, and deep-seated fires involving solids subject to smoldering. Local application systems can be used only for surface fire protection.

Surface Fires – Are the most common hazards particularly adaptable to suppression by total flooding systems. They are subject to prompt suppression when carbon dioxide is quickly introduced into the enclosure in sufficient quantity to overcome leakage and provide a suppressing concentration for the particular materials involved. Cooking oils and grease will require longer discharge.

Deep-Seated – For deep-seated fires, the required suppressing concentration shall be maintained for a sufficient period of time to allow the smoldering to be suppressed and the material to cool to a point at which reignition will not occur. The hazard should be inspected immediately after to make certain suppression is complete.

Hazard Atmosphere

The carbon dioxide system can be used in most industrial environments. If the hazard is designed as explosion-proof, the control system, releasing devices and electric valve actuators (if not approved for hazardous environments) must be located away from the hazard area and the system must be remotely piped to the area. Only the detectors, distribution piping, nozzles, or other nonelectrical parts may be located in the hazard.

Hazardous Material

Carbon dioxide is an effective agent to suppress the following types of fires:

Class A – Surface Fires: These fires involve ordinary combustible materials such as cloth, paper, rubber, and many plastics.

Class B – Flammable Liquid and Gas Fires – These fires involve such materials as oils, greases, tars, oil-based paints, lacquers, and gasoline. **Note:** Specific fuel must be identified as it will determine total flood concentration requirements.

Class C – Energized Electrical Equipment Fires – Common Class C devices include control rooms, transformers, oil switches, circuit breakers, rotating equipment, pumps, and motors.

Carbon dioxide is NOT effective on the following types of fires:

- Class D combustible metals such as sodium, potassium, magnesium, titanium, and zirconium.
- Chemicals containing their own oxygen supply, such as cellulose nitrate.
- Metal hydrides

Ventilation Considerations

The hazard ventilation system is very important when considering total flooding application, but should also be considered for local application. If possible, the ventilation system should be shut down and/or dampered before or simultaneously with the start of the carbon dioxide discharge. If the ventilation system cannot be shut down, the volume of air moved by the system during the discharge period must be added to the enclosure volume if a total flooding designed system is required.

Consider installing dampers wherever possible to restrict the fire to the protected area and enhance the fire protection.

Electrical Considerations

It is recommended that all electrical power sources associated with the protected hazard be shut down before system discharge. This eliminates the potential of a fire being electrically-reignited.

In addition to the above, review the following statements:

Live Uninsulated High Voltage Wire – For minimum clearances of live uninsulated high voltage wire, refer to NFPA 12 “Electrical Clearances.’’ Reduced clearance can result in line spikes being fed into the control system, releasing devices, or field wiring circuits.

120 VAC Primary Power Source – Determine if a 120 VAC primary power source is available for the control system or releasing device operation. The control system or releasing device requires an independent 120 VAC 50/60 Hz circuit. System wiring must comply with all local codes and applicable NFPA Standards.

HAZARD ANALYSIS (Continued)

Temperature Range

The following temperature ranges must be determined and noted to ensure proper placement and operation of the carbon dioxide and detection control components:

Hazard Area – Determine the minimum and maximum temperature of the hazard to be protected. This temperature may be any temperature that the distribution piping and detectors can withstand only if the agent tank, control system, or accessories are located outside of the hazard area.

For extreme temperature conditions, the following compensations must be made:

- If the enclosure temperature is above 200 °F (93 °C), the quantity of agent must be increased by 1% for each five degrees above 200° F (93 °C).
- If the temperature is below 0 °F (–18 °C), the agent quantity must be increased by 1% for each one degree below 0 °F (–18 °C).

Agent Container – Carbon dioxide container for total flooding systems must be located in an area with a temperature range from 0 °F to 130 °F (–18 °C to 54 °C). Ambient storage temperatures for local application systems must not exceed 120 °F (49 °C) nor be less than 32 °F (0 °C).

Detection/Control System – The detection/control system must be located in an area with a temperature range from 32 °F to 120 °F (0 °C to 49 °C).

Other Factors That Influence System Planning

The following additional factors require consideration to perform a thorough hazard analysis:

Physically Disabled Personnel – Care should be taken that proper signs and visual devices are placed so all personnel are aware that the system has been activated.

Response Time of Firefighting Service – Establish the maximum time required for firefighting service to respond to an alarm. This information can be used to determine if a reserve system is required. The reserve system can provide a second discharge in the event of a fire reflash.

Reserve System – If a reserve carbon dioxide system is required, determine if it should be permanently connected, or unconnected and located on the premises. The addition of a connected or unconnected reserve system will add to your job cost estimate.

Container and Accessory Location – Establish a location that is acceptable with the end-user and verify the following:

- Temperature range is acceptable
- Piping limitations are not exceeded
- Components are not subject to damage or vandalism

Discharge Test – Determine if a discharge test is required. A discharge test will require proper preparation and will affect your total cost estimate.

Authority Having Jurisdiction – Contact the end-user or authority having jurisdiction to establish the requirements for:

- Minimum/maximum detector spacing
- Type of detection and control system that is acceptable
- Final inspection or discharge test required
- If reserve system is required
- What audible and/or visual alarm devices may be required

NOTES:

DESIGN

After completing the hazard analysis sub-section in Section 4 – Planning, proceed with the following elements to work up a complete design and bill of materials.

APPLICATION METHOD

Choose one of the following approved application methods. Depending on the hazard, it may be necessary to combine different application methods on the total system.

LOCAL APPLICATION (Continued on page 5-6)

Local application is defined as a system consisting of a fixed supply of carbon dioxide permanently connected to a system of fixed piping with nozzles arranged so as to discharge the agent directly into the fire. Local application systems are used for the suppression of surface fires in flammable liquids, gases, and shallow solids where the hazards not enclosed or where the enclosure does not conform to the requirements for total flooding. Examples of hazards that may be successfully protected by local application systems include dip tanks, quench tanks, oil-filled electric transformers, etc. Local application systems are divided in to two types: rate-by-area and rate-by-volume. Rate-by-area method of system design is used where the fire hazard consist primarily of flat surfaces or low-level objects associated with horizontal surfaces. The rate-by-volume method of design is used where the fire hazard consists of three-dimensional irregular objects that cannot be easily reduced to equivalent surface areas.

TOTAL FLOODING

Total flooding is defined as a system consisting of a fixed supply of carbon dioxide permanently connected to fixed piping, with fixed nozzles arranged to discharge carbon dioxide into an enclosed space or enclosure about the hazard. The enclosure must be adequate to contain the discharge of agent to achieve the required carbon dioxide concentration. Examples of this type of enclosure include unoccupied rooms, vaults, and machine enclosures.

Total Flooding

The following steps must be followed, in the order they are presented, to properly design a High Pressure Carbon Dioxide total flooding system. A simple design example will be used throughout the steps to help understand each step.

STEP NO. 1 Determine hazard volume(s)

The first step in the design of a High Pressure Carbon Dioxide system is to calculate the volume of each area to be protected. Multiply the length times the width to determine the area, and then multiply the area times the height to determine the volume for each hazard area. If any area is an odd shape, the designer may need to divide it up into regular shapes that will allow volume calculations, and then total all of the volumes together to determine the actual volume of that area. If the irregular shape will affect distribution of agent, it may be best to calculate sections of the hazard as separate areas and include nozzles for each of these areas.

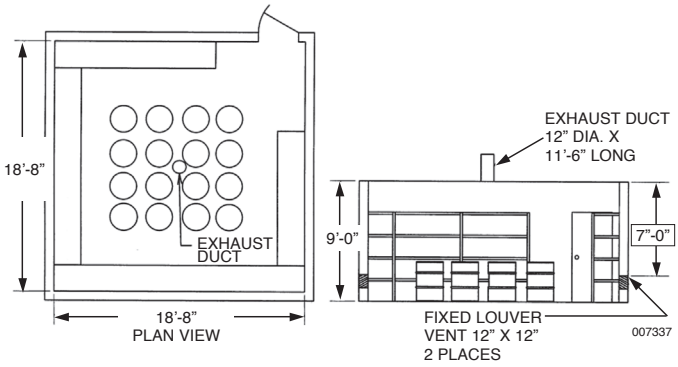

FIGURE 5-1

Complete this step for each area protected by the system.

Total Flood Example:

Flammable Liquid Storage Room = 18 ft 8 in. x 18 ft 8 in. x 9 ft = 3133.76 ft^3

STEP NO. 2 Determine volume of solid, permanent structures, or equipment

The volume of solid objects in each hazard area that are not removable can be deducted from the volume of the hazard. This volume may include columns, beams, cut-out room sections, closets that will always be closed, ducts that pass completely through the area without any openings, and any other large, permanently fixed objects that cannot be removed from the hazard enclosure.

Calculate the volume of all such objects and add them together to determine the amount of space to be deducted from the volume.

Complete this step for each enclosure protected by the system.

Example:

There are no solid, permanent structures or equipment to deduct from hazard areas.

APPLICATION METHOD (Continued)

Total Flooding (Continued)

STEP NO. 3 Determination of unclosable openings

Any opening that cannot be closed at the time of discharge shall be compensated for by the addition of carbon dioxide agent equal to the anticipated loss at the design concentration during discharge.

Example:

There are two unclosable openings of 1 foot x 1 foot (fixed louver vents) which are located 7 feet below the hazard height.

(1 ft x 1 ft) x 2 vents = 2 ft^2

STEP NO. 4 Calculating agent quantity

The quantity of agent required for suppression is dependent upon whether the fire is a surface-type or deep-seated.

Surface Fires – It is assumed that suppression will occur as soon as the necessary concentration is achieved. Minimum design concentration for many common flammable liquids are given in Figure 5-2. For materials not listed in this table, values must be obtained from a recognized source or obtained by testing. The minimum design concentration used for any hazard must not be less than 34%.

Minimum Carbon Dioxide Concentrations For Suppression

Material	Theoretical Min. CO_2 Concentration (%)	Minimum Design CO_2 Concentration (%)
Acetylene	55	66
Acetone	27*	34
Aviation Gas Grades 115/145	30	36
Benzol, Benzene	31	37
Butadiene	34	41
Butane	28	34
Butane-1	31	37
Carbon Disulfide	60	72
Carbon Monoxide	53	64
Coal or Natural Gas	31*	37
Cyclopropane	31	37
Diethyl Ether	33	40
Dimethyl Ether	33	40
Dowtherm	38*	46
Ethane	33	40
Ethyl Alcohol	36	43
Ethyl Ether	38*	46
Ethylene	41	49
Ethylene Dichloride	21	34
Ethylene Oxide	44	53
Gasoline	28	34
Hexane	29	35
Higher Paraffin Hydrocarbons Cn H2m + 2m - 5	28	34
Hydrogen	62	75
Hydrogen Sulfide	30	36
Isobutane	30*	36
Isobutylene	26	34
Isobutyl Formate	26	34
JP-4	30	36
Kerosene	28	34
Methane	25	34
Methyl Acetate	29	35
Methyl Alcohol	33	40
Methyl Butene I	30	36
Methyl Ethyl Ketone	33	40
Methyl Formate	32	39
Pentane	29	35
Propane	30	36
Propylene	30	36
Quench Lube Oils	28	34

Note: The theoretical minimum suppressing concentrations in air for the above materials were obtained from a compilation of Bureau of Mines Limits of Flammability of Gases and Vapors (Bulletins 503 and 627). Those marked with * were calculated from accepted residual oxygen values.

FIGURE 5-2

APPLICATION METHOD (Continued)

Total Flooding (Continued)

Because some carbon dioxide escapes from the enclosure with the displaced air, the actual amount of agent required is greater than the theoretical amount. For example, to achieve a carbon dioxide concentration of 34% would ideally require about one pound of carbon dioxide per 26 cubic feet of space. However, in actual practice, one pound of carbon dioxide is required per 22 cubic feet of space to achieve 34% concentration.

For enclosures of less than 50,000 cubic feet, the minimum quantities of agent and volume factors given in Figure 5-3 must be adhered to.

Volume Factors

Volume of Space (ft^3 inclusive)	Volume Factor (ft^3 / lb CO_2)	(lb CO_2 / ft^3)	Calculated Quantity (lb) Not Less Than
Up to 140	14	0.072	–
141 – 500	15	0.067	10
501 – 1600	16	0.063	35
1601 – 4500	18	0.056	100
4501 – 50000	20	0.050	250
Over 50000	22	0.046	2500

FIGURE 5-3

Total Flood Example:

The Flammable Liquid Storage Room is 3133.76 ft^3, therefore:

3133.76 ft^3 x 0.056 lb CO_2/ ft^3 = 175.49 lb of CO_2

The higher concentration achieved from using this table is based on the assumption that the leakage from a small enclosure will be greater on a volumetric basis, than from a large enclosure. If the minimum design concentration is greater than 34% for the hazard, the volume factor must be multiplied by the material conversion factor listed in Figure 5-4 to achieve the required greater concentration.

Material Conversion Factors

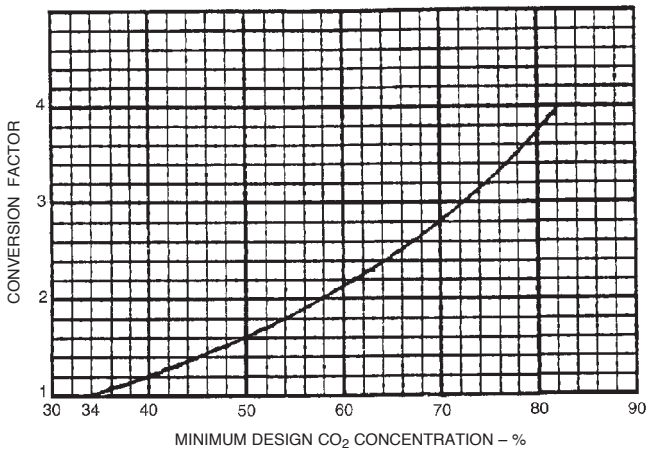

FIGURE 5-4
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Total Flood Example:

The Flammable Liquid Storage Room contains the following liquids:

- Kerosene
- Acetone
- Benzene
- Hexane
- Methyl Alcohol
- Propylene

The application would be based upon the fire hazard as a surface fire. For surface fires, the design concentration shall be achieved within 1 minute.

Methyl Alcohol requires the highest design concentration, therefore the minimum design concentration for this hazard is 40%.

Therefore; 175.49 lb of CO_2 x 1.2 (Material Conversion Factor) = 210.59 lb of CO_2

Deep-Seated Fires – For deep-seated fires, the concentration of agent must be maintained for a substantial period of time, but not less than 20 minutes, to assure suppression. This consideration demands that the enclosure be relatively leak proof. Any leakage must be given careful consideration. The agent concentration is dependent upon the type of combustible material present. See Figure 5-5 to determine the correct flooding factors for deep-seated fires.

APPLICATION METHOD (Continued)

Total Flooding (Continued)

Flooding Factors For Specific Hazards (Deep Seated)

Design Concentrations %	Flooding Factor $ft^3/lb\ CO_2$ ($m^3/kg\ CO_2$)	Flooding Factor $lb\ CO_2/ft^3$ ($kg\ CO_2/m^3$)	Specific Hazard
50	10 (0.62)	0.100 (1.60)	Dry electric,wiring insulation hazards in general. Spaces 0-2000 ft^3
50	12 (0.75)	0.083 (1.33)	Spaces greater than 2000 ft^3
65	8 (0.50)	0.125 (2.00)	Record (bulk paper) storage, ducts, and covered trenches
75	6 (0.38)	0.166 (2.66)	Fur storage vaults, dust collectors

FIGURE 5-5

For deep-seated fires, the design concentration shall be achieved within 7 minutes, but the rate shall be not less than that required to develop a concentration of 30% in 2 minutes.

The flooding factor for 30% design concentration is 0.043.

As an example for a hazard area of 7000 ft^3 containing dry electrical, wiring and insulation, the quantity of CO_2 required is calculated as follows:

7000 ft^3 x 0.043 (30% factor) = 301 lb of CO_2 ÷ 2 minute = 150.5 lb CO_2 per minute flow

then,

7000 ft^3 x 0.083 = 581 lb CO_2 ÷ 150.5 lb CO_2 per minute flow = 3.86 minutes

Therefore, the time to reach 100% of the require design concentration is less than 7 minutes, this is within the design requirements for a deep seated fire.

Special conditions that may occur must be compensated for as follows:

- For ventilating systems that cannot be shut down, additional carbon dioxide shall be added to the space through the regular distribution system in an amount computed by dividing the volume moved during the liquid discharge period by the flooding factor. This shall be multiplied by the material conversion factor when the design concentration is greater than 34%.

Total Flood Example:

The Flammable Liquid Storage Room has a ventilation system of 360 cfm, but is designed to be shut down and dampered upon discharge of the carbon dioxide system.

For extreme temperature conditions, the following compensations must be made:

- If the enclosure temperature is above 200 °F (93 °C), the quantity of agent must be increased by 1% for each five degrees above 200 °F (93 °C).
- If the temperature is below 0 °F (17 °C), the agent quantity must be increased by 1% for each one degree below 0 °F (17 °C).

Total Flood Example:

The Flammable Liquid Storage Room temperature range is between 50 °F (10 °C) and 85 °F (29.4 °C), therefore no increase in agent is required.

STEP NO. 5 Calculation loss through openings

After calculating the minimum amount of carbon dioxide required, add to it any additional carbon dioxide needed to compensate for loss through openings, extreme temperature ranges, etc., as stated in the beginning of this section.

To determine the additional amount of CO_2 required to compensate for the loss through the unclosable openings, refer to Figure 5-6. Determine the height from the top of the hazard down to the center of the unclosable opening.

Find this dimension on the bottom line of the chart. Read up the chart to the diagonal line representing the % of CO_2 being designed for. At that intersect point, read to the left to determine the leakage rate in lbs. of CO_2 per minute per ft^2 of opening.

APPLICATION METHOD (Continued)

Total Flooding (Continued)

Finally, multiply this number by 1/2 of the ft^2 area of the unclosable opening. This will now give the additional amount of CO_2 required which must be added to the previous total. Remember, use only 1/2 of the total opening area since it is presumed that fresh air will enter through one-half of the opening and the protective gas will exit through the other half.

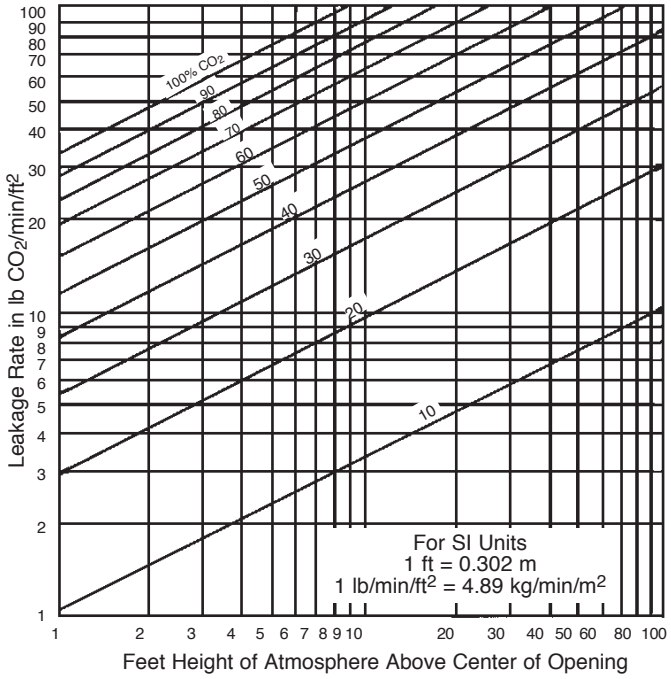

FIGURE 5-6
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Total Flood Example:

The hazard has two unclosable opening of 1 ft x 1 ft each. This is an area of 2 ft^2. The center of the opening is 7.5 ft down from the ceiling of the hazard. The Methyl Alcohol requires a carbon dioxide concentration of 40%. Referring to the chart in Figure 5-6, find 7.5 ft on the bottom line. Follow up the line until it intersects approximately 40% on the diagonal line. Reading over to the left gives a leakage rate of approximately 23 lb per min per ft^2 of opening. Now multiply 23 lb x 1 ft^2 (1/2 the total opening area) = 23 lb. 23 lb of additional CO_2 must now be added to the original amount of 210.6 lb for a new total of 233.6 lb.

Special situations must be given the same considerations previously mentioned under special conditions, page 5-2. If the agent concentration must be maintained for an extended period of time, the agent discharge time must be increased accordingly to maintain the minimum concentration required.

For unusually tight enclosures, venting may be required to prevent a dangerous buildup of pressure within the enclosure. Small leaks in normal enclosures have been found to provide adequate venting in most cases.

STEP NO. 6 Numbers of Nozzles Required

There is no exact science when it comes to placing discharge nozzles in a hazard area. Some of the rules that should be followed are:

- 20 ft maximum spacing between nozzles total flooding only
- Not more than 10 ft from a wall or major obstruction total flooding only
- Try not to locate the nozzle near an unclosable opening unless using for screening
- Make certain nothing interferes with the discharge pattern of the nozzle
- Make certain the nozzle is not located so that it causes unduly splash of flammable liquids or creates dust clouds that might extend the fire, create an explosion, or otherwise adversely affect the contents of the enclosure.

When locating the nozzles, draw a sketch of the hazard and place the location of the nozzles on it. Dimension the location of the nozzles from the walls or major components in the hazard area. These locations and dimensions will be used later to determine piping lengths and number of fittings.

STEP NO. 7 Choosing Nozzle Type

Again, there is no exact science when choosing a nozzle for total flooding. Some style nozzles are better suited for certain type of hazards than others. Listed below are the styles of available total flooding nozzles and a short description of their discharge characteristics and possible usage:

- A or D Type Nozzle – Produces a soft discharge. Generally used in sub-floor areas where a too strong of discharge would drive the carbon dioxide out of the area.
- Sealed Type Nozzle – Sealed to prevent dirt or vapors from getting into the piping network. Generally used in ducts, hoods, or enclosed machinery spaces.
- Regular Type Nozzle – Produces a high velocity spray type pattern. Generally used in ducts and small enclosed hazards.
- Baffle Type Nozzle – Fan shape pattern. Spreads agent rapidly. Most commonly used nozzle for rooms and enclosed spaces. Usually mounted near ceiling.

APPLICATION METHOD (Continued)

Total Flooding (Continued)

EXTENDED RATE OF APPLICATION – Where leakage is appreciable and the design concentration must be obtained quickly and maintained for an extended period of time, carbon dioxide provided for leakage compensation may be applied at a reduced rate using small orifice nozzles.

This type of system is particularly applicable to enclosed rotating electrical apparatus, such as generators, motors, and convertors, but it may also be used on ordinary total flooding applications where suitable.

The minimum design concentration shall be obtained within the limits specified below:

- For surface fires, the design concentration shall be achieved within 1 minute.
- If a part of the hazard is to be protected by total flooding, the discharge rate for the total flooding portion shall be computed by dividing the quantity required for total flooding by the factor 1.4 and by the time of the local application discharge in minutes.
- For deep-seated fires, the design concentration shall be achieved within 7 minutes, but the rate shall be not less than that required to develop a concentration of 30% in 2 minutes.
- The extended rate of discharge shall be sufficient to maintain the minimum concentration.
- For enclosed rotating electrical equipment, a minimum concentration of 30% shall be maintained for the deceleration period, but not less than 20 minutes.

STEP NO. 8 Hydraulic Calculations

For estimating purposes, see Figure 5-20 to approximately determine the size of piping required for carbon dioxide discharge. Consult your piping sketch and determine flow rate and approximate pipe sizes. These pipe sizes are not to be used for final hydraulic system design. The designer must have knowledge of and access to the most recent version of the ANSUL HP CO_2 FLOW CALCULATION HYDRAULIC CALCULATION PROGRAM.

Local Application

Local application systems are divided in to two types: rate-by-area and rate-by-volume. Rate-by-area method of system design is used where the fire hazard consist primarily of flat surfaces or low-level objects associated with horizontal surfaces. The rate-by-volume method of design is used where the fire hazard consists of three-dimensional irregular objects that cannot be easily reduced to equivalent surface areas.

The discharge time for local application systems is a minimum of 30 seconds. This applies to normal fuels such as quench oil. When protecting fuels with an auto-ignition point below its boiling point, such as paraffin wax or cooking oils, the effective discharge time is increased to 3 minutes. This increase is to permit cooling of the fuel to prevent re-ignition.

Nozzle discharge rates shall be determined by either the area method or the volume method:

- The area method of system design is used where the fire hazard consists of flat surfaces or low level objects associated with horizontal surfaces.
- The volume method of system design is used where the fire hazard consists of three-dimensional irregular objects that cannot be easily reduced to equivalent surface areas.

The agent quantity formula is as follows:

Amount of Agent Required = Number of Nozzles x Flow Rate Per Nozzle x 1.4 x Discharge Time Required

The number of containers required is obtained by dividing the total pounds of agent required by the size of the agent storage container to be used and then rounding the result up to the next whole number.

The following steps must be followed, in the order they are presented, to properly design a High Pressure Carbon Dioxide Local Application Rate by Area system. A simple design example will be used throughout the steps to help understand each step. Use the Design Calculations Worksheet in this section.

Local Application (Rate by Area)

The following two sample problems, rate by area, and rate by volume, are structured to lead you, step by step, through each of the required areas for designing a local application system.

APPLICATION METHOD (Continued)

Local Application (Continued)

STEP NO. 1 Determine hazard area(s)

The first step is to determine what area(s) and if the area(s) being protected is a liquid surface or a wetted surface.

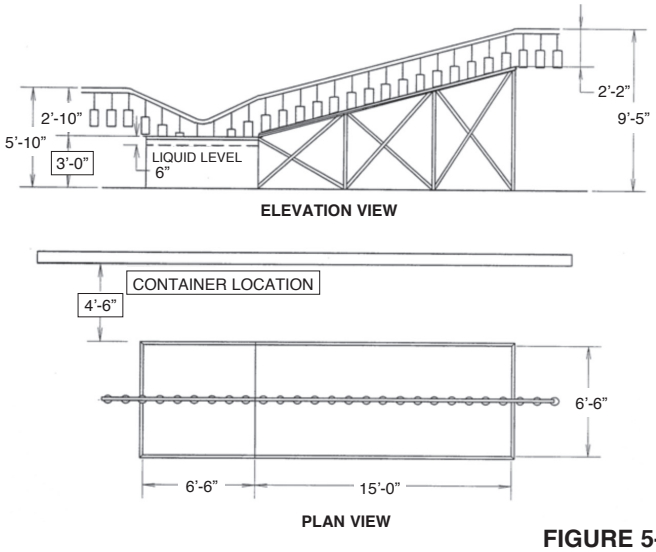

FIGURE 5-7
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Local Application (R x A) Example:

A paint dip tank (6 ft 6 in. long x 6 ft 6 in. wide) and drainboard (15 ft long x 6 ft 6 in. wide) is to be protected by means of a local application carbon dioxide system. The parts to be dipped are fed into the dip tank by means of an overhead conveyor system. Attached to the dip tank is a drainboard to reclaim any excess from the dripping operation. The ceiling height in the area is 14 ft. The area temperatures around the operation range between 50 °F to 85 °F.

STEP NO. 2 Determine location of nozzles

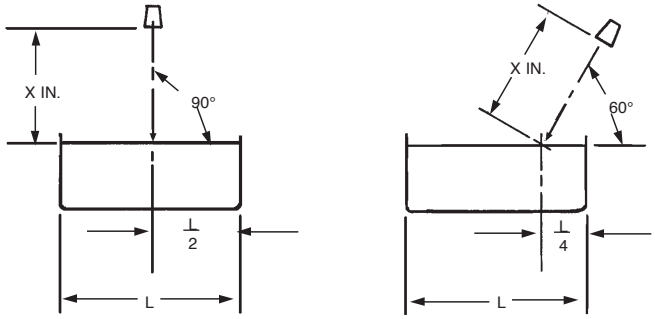
Local application carbon dioxide fire suppression systems employ overhead type nozzles. Each nozzle is rated for a specific flow rate at a given height over the protected surface. The nozzle is also rated to protect a specific square area based on a side-of-square dimension at a given height and flow rate. The overhead nozzles are not restricted to placement exactly perpendicular to the surface they are protecting. These nozzles may be installed at angles between 45 and 90 (perpendicular) from the plane of the hazard surface. See Figure 5-8 and 5-9. The following chart lists the aiming factors for angular placement of nozzles, based on a 6-inch freeboard.

Discharge Angle (1)	Aiming Factor (2)
45 – 59	1/4
60 – 74	1/4 - 3/8
75 – 89	3/8 - 1/2
90 (Perpendicular)	1/2 (Center)

(1) Degrees from plane of hazard surface

(2) Fractional amount of nozzle coverage side-of-square

Local Application Nozzle Ranges



NOTE: Distance "X" and the flow rate are the same in both cases; only the aiming point for the nozzle changes.

FIGURE 5-8
001860

Local Application Nozzle Ranges

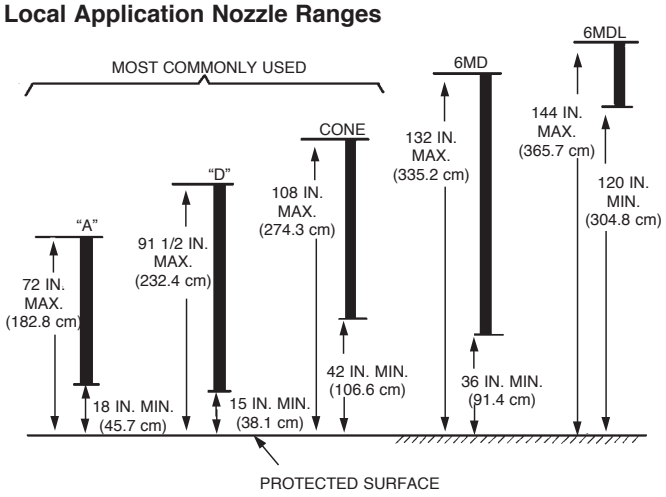


FIGURE 5-9
001861

The nozzle height above the hazard will determine flow rate and number of nozzles required, therefore, based on what the hazard configuration will allow, place the nozzles as close to the hazard as possible. This will then allow for the least number of nozzles and the least total amount of agent.

APPLICATION METHOD (Continued)

Local Application (Continued)

Figure 5-10 through Figure 5-14 show the overhead nozzle ratings for flow rate and side-of-square for specific heights above the surface being protected. For liquid or wetted surfaces, (rate by area) 6 in. Multi-Discharge, Type "A," Type "D," or Cone nozzles are normally used. For rate by volume, the 6 in. Multi-Discharge is normally used. Be sure to compare all nozzles and choose the most efficient one.

"A" Nozzle

	UL			FM		
Height (in.)	Flow Rate (lb/min)	Side of Square Liquid (ft)	Wetted (ft)	Flow Rate (lb/min)	Side of Square Liquid (ft)	Wetted (ft)
18	14.0	1.58	1.87	13.7	1.58	1.87
21	16.0	1.70	2.00	15.5	1.73	2.05
24	18.0	1.82	2.15	17.2	1.88	2.21
27	19.9	1.91	2.27	19.0	2.03	2.39
30	21.7	2.02	2.40	20.7	2.07	2.45
33	23.6	2.13	2.51	22.5	2.12	2.51
36	26.0	2.24	2.65	24.3	2.16	2.57
39	27.5	2.32	2.74	26.0	2.21	2.63
42	29.5	2.40	2.85	28.3	2.25	2.66
45	31.4	2.48	2.95	33.7	2.25	2.66
48	33.0	2.57	3.03	38.0	2.25	2.66
51	35.1	2.64	3.13	39.4	2.25	2.66
54	37.0	2.72	3.23	40.9	2.25	2.66
57	38.9	2.80	3.30	42.3	2.44	2.90
60	41.0	2.88	3.41	43.8	2.63	3.11
63	42.8	2.96	3.51	45.2	2.81	3.33
64 1/2	44.0	3.00	3.55	45.9	2.90	3.44
66	44.8	3.00	3.55	46.6	3.00	3.55
69	46.6	3.00	3.55	48.1	3.00	3.55
72	48.5	3.00	3.55	49.5	3.00	3.55

Note: These tables shall not be extrapolated beyond the upper or lower limits shown.

FIGURE 5-10

"D" Nozzle

	UL	FM	Side of Square		
Height (in.)	Flow Rate (lb/min)		Liquid (ft)	Wetted (ft)	
15	11.0	11.0	1.58	1.87	18
12.5	12.8	1.71	2.00		
21	14.3	14.6	1.85	2.17	
24	16.0	16.4	1.97	2.32	
27	17.5	18.2	2.11	2.51	
30	19.0	20.0	2.24	2.65	
33	20.5	21.8	2.24	2.65	
36	22.0	23.6	2.24	2.65	
39	23.3	25.4	2.24	2.65	
42	24.7	26.0	2.24	2.65	
45	26.0	26.6	2.24	2.65	
48	27.5	27.2	2.24	2.65	
51	29.0	27.8	2.24	2.65	
54	30.5	28.4	2.24	2.65	
57	32.0	29.0	2.24	2.65	
60	33.5	30.7	2.24	2.65	
63	35.0	32.4	2.24	2.65	
66	36.5	34.1	2.24	2.65	
69	38.0	35.8	2.24	2.65	
72	39.5	37.5	2.24	2.65	
75	40.8	39.2	2.24	2.65	
78	42.2	40.9	2.24	2.65	
81	43.6	42.6	2.24	2.65	
84	45.0	44.3	2.24	2.65	
87	46.4	46.0	2.24	2.65	
90	47.8	47.7	2.24	2.65	
91 1/2	48.5	48.5	2.24	2.65	

Note: These tables shall not be extrapolated beyond the upper or lower limits shower.

FIGURE 5-11

APPLICATION METHOD (Continued)

Local Application (Continued)

Cone Nozzle

Height (in.)	UL/FM Flow Rate (lb/min)	Side of Square Liquid (ft)	Wetted (ft)
42	21.0	2.47	2.91
45	26.5	2.67	3.16
48	31.5	2.86	3.39
51	37.0	3.03	3.59
54	41.5	3.20	3.78
57	46.5	3.36	3.97
60	51.5	3.51	4.14
63	57.0	3.65	4.31
66	62.0	3.80	4.48
69	67.0	3.92	4.63
72	72.0	4.05	4.78
75	77.0	4.17	4.94
78	82.0	4.29	5.08
81	87.0	4.41	5.23
84	92.0	4.53	5.36
87	97.0	4.64	5.49
90	102.0	4.75	5.61
93	107.0	4.85	5.75
96	112.5	4.96	5.86
99	117.0	4.98	5.89
102	122.0	5.00	5.91
105	127.0	5.00	5.91
108	132.0	5.00	5.91

Note: These tables shall not be extrapolated beyond the upper or lower limits shown.

FIGURE 5-12

6MD Nozzle

Height (in.)	UL/FM Flow Rate (lb/min)	Side of Square Liquid (ft)	Wetted (ft)
36	28.5	2.26	2.66
39	31.0	2.32	2.74
42	33.0	2.38	2.81
45	35.5	2.43	2.88
48	38.0	2.49	2.95
51	40.0	2.55	3.02
54	42.5	2.61	3.08
57	45.0	2.66	3.15
60	47.0	2.72	3.21
63	49.5	2.77	3.28
66	52.0	2.83	3.35
69	54.0	2.88	3.41
72	56.5	2.93	3.46
75	58.5	2.98	3.52
78	61.0	3.03	3.59
81	63.5	3.08	3.65
84	66.0	3.13	3.70
87	68.0	3.18	3.76
90	70.5	3.23	3.81
93	73.0	3.27	3.87
96	75.5	3.32	3.92
99	77.0	3.36	3.97
102	79.5	3.40	4.02
105	82.0	3.43	4.06
108	84.5	3.47	4.11
111	86.5	3.53	4.18
114	89.0	3.53	4.18
117	91.5	3.53	4.18
120	94.0	3.53	4.18
123	96.0	3.53	4.18
126	98.0	3.53	4.18
129	100.5	3.53	4.18
132	103.0	3.53	4.18

Note: These tables shall not be extrapolated beyond the upper or lower limits shown.

FIGURE 5-13

6MDL Nozzle

Height (in.)	UL/FM Flow Rate (lb/min)	Side of Square Liquid (ft)	Wetted (ft)
120	86.0	3.39	4.01
123	89.0	3.48	4.11
126	91.5	3.56	4.22
129	94.0	3.64	4.31
132	97.0	3.71	4.39
135	100.0	3.80	4.48
138	102.5	3.88	4.58
141	105.0	3.95	4.67
144	108.0	4.02	4.76

Note: These tables shall not be extrapolated beyond the upper or lower limits shown.

FIGURE 5-14

APPLICATION METHOD (Continued)

Local Application (Continued)

The number of nozzles required is based on the length and width of the hazard area. After the type of nozzle has been chosen and the height above the hazard has been determined, refer to the appropriate figure (Figures 5-10 to 5-14) for that nozzle and record the listed side-of-square. Then, use the following formula to determine total number of nozzles required:

$$\text{Number of Nozzles Required} = \frac{\text{Linear Length}}{\text{Side-of-Square}} \times \frac{\text{Linear Width}}{\text{Side-of-Square}}$$

In the case of local application type carbon dioxide fire suppression systems, only the liquid portion of the discharge is considered effective. The calculated quantity of agent, then, shall always be increased by 40%. This is done through the use of a multiplier with a value of 1.4 (140%).

Local Application (R x A) Example:

To prevent the nozzles from interfering with the operation and to allow for maintenance to the conveyor, tank, or drain, the overhead nozzles are requested to be no closer than 50 inches from the surface being protected.

Once the placement of the nozzles have been determined, the nozzle type and number is required.

Referring to the Nozzle Range Table, Figure 5-12, it is noted that the Cone Type nozzle will permit placement in a range that is acceptable for the sample problem.

It should be noted that even though other overhead nozzles meet the criteria of the example problem, the further the nozzle is from the hazard surface, the higher the flow rate must be; and, therefore, more agent is required.

The following table compares the Cone Type nozzles at same height for the liquid surface protection of the dip tank:

Nozzle Type	Height (in.)	Flow Rate (lb/min)	Side-of Square (ft)	Number Required*	Total Flow (lb/min)
A	57	38.9	2.80	9	350.1
D	57	32.0	2.24	9	288
Cone	57	46.5	3.36	4	186.0

$$\text{*Number Required} = \frac{\text{Linear Length}}{\text{Side-of-Square}} \times \frac{\text{Linear Width}}{\text{Side-of-Square}}$$

With this comparison, it can easily be seen that of the three types of nozzles, the Cone type nozzle will provide the protection required with the fewest number of nozzles and the least amount of agent.

For the liquid surface of the dip tank, the Cone type nozzle at a height of 57 in. will protect an area having a side-of-square of 3.36 feet. The number required to protect the dip tank is:

$$\text{Number Required} = \frac{\text{Linear Length}}{\text{Side-of-Square}} \times \frac{\text{Linear Width}}{\text{Side-of-Square}}$$

$$= \frac{6.5 \text{ ft}}{3.36 \text{ ft}} \times \frac{6.5 \text{ ft}}{3.36 \text{ ft}}$$

$$= 1.93 \times 1.93$$

$$= 2 \times 2$$

$$= 4 \text{ “Cone” Nozzles at 57 in. and 46.5 lb/min flow rate each}$$

For the wetted surface of the drainboard, the Cone type nozzle at a height of 54 in. will protect an area having a side-of-square (wetted) of 3.78 feet. The number required to protect the drainboard is:

$$\text{Number Required} = \frac{\text{Linear Length}}{\text{Side-of-Square}} \times \frac{\text{Linear Width}}{\text{Side-of-Square}}$$

$$= \frac{15.0 \text{ ft}}{3.78 \text{ ft}} \times \frac{6.5 \text{ ft}}{3.78 \text{ ft}}$$

$$= 3.97 \times 1.72$$

$$= 4 \times 2$$

$$= 8 \text{ “Cone” Nozzles at 54 in. and 41.5 lb/min flow rate each.}$$

Now that the type, number and flow rate of each nozzle has been determined, the quantity of agent may now be calculated.

It should again be noted that only the liquid portion of the discharge is considered effective. The quantity of agent must, therefore, be increased by 40%. To do this, the calculation includes a multiplier of 1.4 (140%).

Also, the discharge time for local application systems protecting hazards containing normal fuels shall be a minimum of 30 second (0.5 minutes).

Given the above parameters, the following calculations for agent quantity can be made:

Quantity of Agent = Number of Nozzles x Flow Rate per Nozzle x 1.4 x Discharge Time

Liquid Surface = 4 Cone Nozzles x 46.5 lb/min/nozzle x 1.4 x 0.5 minutes = 130.2 lb of carbon dioxide required

Wetted Surfaces = 8 Cone Nozzles x 41.5 lb/min/nozzle x 1.4 x 0.5 minutes = 232.4 lb of carbon dioxide required

Total Agent Rq’d = 130.2 lb + 232.4 lb = 362.6 lb of carbon dioxide required using 100 lb containers.

$$\text{Number of Containers} = \frac{\text{Agent Required}}{\text{Container Size}} = \frac{362.6 \text{ lb}}{100 \text{ lb/cyl}} = 4\text{-}100 \text{ lb Containers}$$

APPLICATION METHOD (Continued)

Local Application (Continued)

Since the agent supply is larger than required, the discharge time will be somewhat greater than 30 seconds.

NOTICE

Do not increase flow rate as this may cause splashing of fuel.

Local Application (Rate by Volume)

Another type of local application system is the rate by volume method. This type should be considered when the fire hazard consists of three-dimensional irregular objects that cannot be easily reduced to equivalent surface areas.

Rate by volume (assumed enclosure): When attempting to design a system using this approach, several factors must be considered:

- The total discharge rate of the system shall be based on the volume of an assumed enclosure entirely surrounding the hazard.
- The assumed enclosure shall be based on an actual closed floor unless special provisions are made to take care of bottom conditions, such as local application or rate by area design applied from underneath.
- The assumed walls and ceiling of the enclosure shall be at least 2 ft from the main hazard unless actual walls are involved and shall enclose all areas of possible leakage, splashing, or spillage.
- No reduction shall be made for solid objects within the volume.
- A minimum dimension of 4 ft shall be used in calculating the volume of the assumed enclosure.
- If the hazard may be subject to winds or forced drafts, the assumed volume shall be increased to compensate for losses on the windward sides.
- The total discharge rate for the basic system shall be equal to 1 lb/min/ft^{3}of assumed volume.
- If the assumed enclosure has a closed floor and is partly defined by permanent continuous walls extending at least 2 ft above the hazard (where the walls are not normally a part of the hazard), the discharge rate may be proportionately reduced to not less than 0.25 lb/min/ft^3 actual walls completely surrounding the enclosure.

Rate by volume is normally a less cost efficient way to protect a hazard but this approach should be considered if no other appropriate means of protection is available.

The first approach to look at in designing a rate by volume system is to design the system assuming there are no walls around or near the hazard. This approach requires increasing the hazard size by 2 ft all around (assume volume) and designing the system for this increased size.

The following example will take you through the necessary steps.

Rate by Volume Example 1

The hazard in question is a back-up generator located in a corner of a warehouse. The generator itself is 6 ft long x 3 ft wide x 4 ft high. When utilizing the first approach to designing a rate by volume system, add 2 ft completely around the hazard. This then gives a total hazard size of 10 ft long x 7 ft wide x 6 ft high. This increase in size now gives an assumed volume of 420 ft^3. See Figure 5-15.

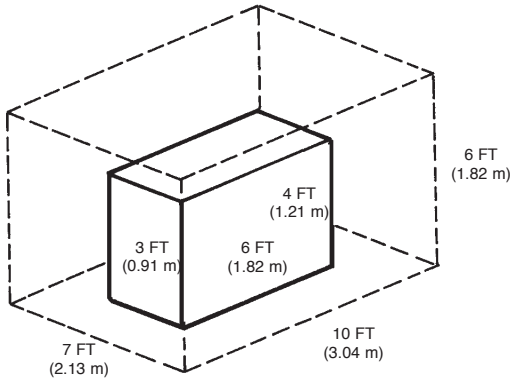


FIGURE 5-15
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The next step is to determine the system flow rate. This is done by multiplying the assumed volume x the system discharge rate. In this example the total assumed volume is 420 ft^3, the system discharge rate is 1 lb per minute per ft^3 when no reduction is figured in for walls, therefore, the formula is:

420 (volume in ft^3) x 1 (system discharge rate of 1 lb/min/ft^3 = 420 lb/min system flow rate.

The next step is to determine the total amount of carbon dioxide required. This is accomplished by multiplying the total assumed volume x the system discharge rate x the liquid carbon dioxide factor of 1.4 x the minimum discharge time of 30 seconds.

420 (volume in ft^3) x 1 (system discharge rate of 1 lb/min/ft^3) x 1.4 (liquid factor) x 0.5 (minimum discharge time) = 294 lb of carbon dioxide required.

294 (total carbon dioxide) divided by 100 (size of container chosen) = 2.94 or 3 containers required (rounded up).

APPLICATION METHOD (Continued)

Local Application (Continued)

Now, review the hazard to determine where to locate the nozzles and how many nozzles will be required. There is no exact science for locating local application nozzles. Choose as many nozzles as you feel it may take to adequately cover the assumed volume. The nozzles should be mounted around the perimeter of the assumed volume and pointed at the hazard. The number of nozzles required for a rate by volume system to protect a hazard in an open area is based on the distance the nozzle is located from the hazard, the listed nozzle flow rate for the nozzle at that distance, (the flow rate should be equal to or greater than that used for rate by area applications), and the configuration of the hazard being protected. In this example, four nozzles have been chosen. Nozzles should be placed to keep agent in assumed enclosure.

NOTICE

If the hazard contains liquids in depth, nozzles directed at such liquids shall have flow rates not greater than those for which the nozzle is listed at the given distance from the liquid surface. Higher flow rates could produce splashing of the liquid and possibly spread the fire outside the protected volume.

Next step is to determine flow rate per nozzle by dividing the system flow rate by the number of nozzles:

420 lb/min (system flow rate) divided by 4 (total number of nozzles) = 105 lb/min flow rate.

NOTICE

To establish nozzle flow requirements the distance used is from the nozzle to the closest point of the hazard being protected. In this example the nozzle must have a minimum listed flow rate of 105 lb/min at the chosen mounted height of the nozzle.

If no other rate by volume designs were to be looked at, then the next step would be to sketch the piping configuration and proceed to the hydraulic calculation program to determine pipe sizes. In this example though, we will continue on and look at additional types of rate by volume designs for this same hazard.

Rate by Volume Example 2

The next approach to this hazard would be to consider what the system requirements would be by designing the system utilizing the actual walls which are on two sides of the hazard.

The following steps detail this type of local application, rate by volume, approach:

The first step is to determine the new assumed volume. This is done by adding two ft to the sides of the hazard which are not enclosed by actual walls and using the actual distance that the hazard is from the actual walls. Again, in determining volume, two ft. must also be added to the height of the actual hazard. Determine the assumed volume by multiplying the length, width, and height together. See Figure 5-16.

14 ft long x 11 ft wide x 6 ft high = 924 ft^3

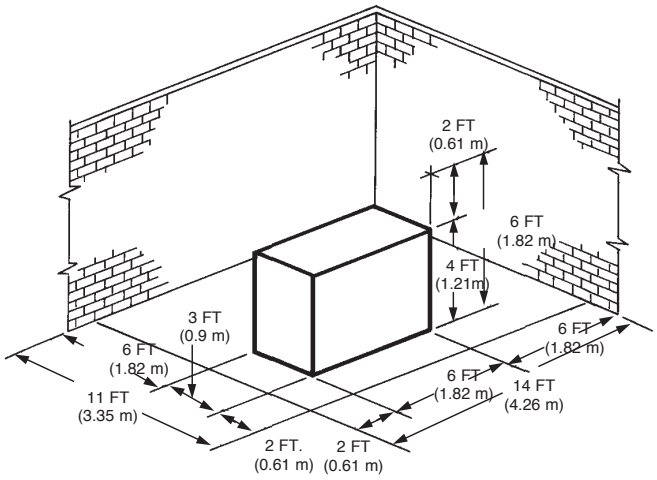


FIGURE 5-16
001863

APPLICATION METHOD (Continued)

Local Application (Continued)

Next, determine the % of closed perimeter (actual walls) compared to the total perimeter (total of assumed walls and actual walls). This is done by adding the actual wall lengths and dividing that number by the total of all walls (both actual and assumed). In this example, the actual walls total 25 ft (14 + 11) and the total perimeter totals 50 ft (14 + 14 + 11 + 11). See Figure 5-17.

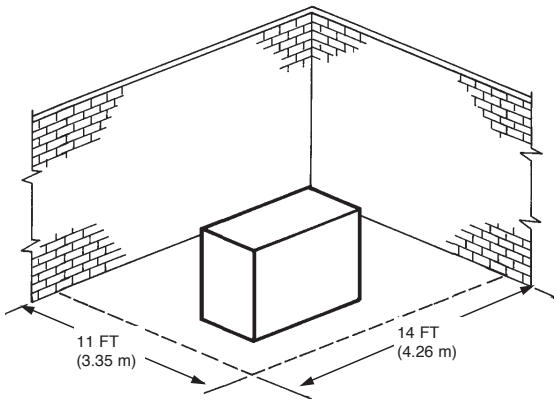


FIGURE 5-17
001864

% of enclosure = 25 ft divided by 50 ft = 0.5
0.5 x 100 = 50% perimeter closed

Now, knowing that 50% of the perimeter is closed, refer to the Rate By Volume Assumed Enclosure Chart, Figure 5-18, to determine the required nozzle discharge rate.

Rate By Volume (Assumed Enclosure)

Perimeter Closed	Discharge Rate
0%	1 lb/min/CF
10%	0.925 lb/min/CF
15%	0.8875 lb/min/CF
20%	0.85 lb/min/CF
25%	0.8125 lb/min/CF
30%	0.775 lb/min/CF
35%	0.7375 lb/min/CF
40%	0.70 lb/min/CF
45%	0.6625 lb/min/CF
50%	0.625 lb/min/CF
55%	0.5875 lb/min/CF
60%	0.55 lb/min/CF
65%	0.512 lb/min/CF
70%	0.475 lb/min/CF
75%	0.4375 lb/min/CF
80%	0.40 lb/min/CF
85%	0.3625 lb/min/CF
90%	0.325 lb/min/CF
93%	0.310 lb/min/CF
95%	0.290 lb/min/CF
100%	0.25 lb/min/CF

FIGURE 5-18

Referring to the chart, 50% closed perimeter allows a discharge rate of 0.625 lb/min/ft^3. Knowing this, the total amount of carbon dioxide required can now be calculated by the following formula:

Total agent required = Volume x Flow Rate per minute per ft^3 x 1.4 (liquid factor) x 0.5 (minimum discharge time).

924 ft^3 x 0.625 lb/min/ft^3 x 1.4 x 0.5 = 404 lb of carbon dioxide required.

At this point, it appears that this approach is not as cost effective as Example No. 1 using the assumed volume method with no walls. But, if the closed perimeter approach is looked at by having the customer install some inexpensive, non-combustible concrete block walls around the open side of the hazard, the results may be considerably different.

Assume that the customer will install 6 ft high walls around the open sides of the hazard, calculate the amount of agent required by following the steps in Example 3.

APPLICATION METHOD (Continued)

Local Application (Continued)

Rate by Volume Example 3

Once again, we are dealing with the same volume as Example 2 (924 ft^3) but this time the hazard has been enclosed on the two open sides by the addition of a concrete block wall. See Figure 5-19. The only wall opening that exists now is a 3.5 ft opening for access to the generator. Remember, the additional wall must only be 2 ft higher than the actual hazard.

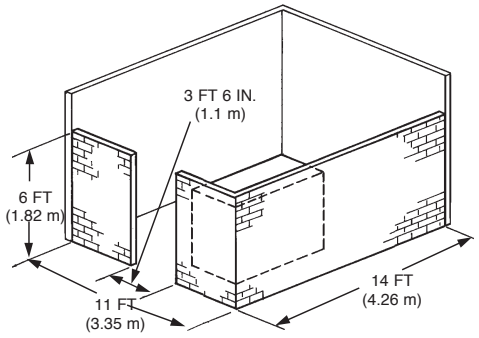


FIGURE 5-19
001865

Now, determine the % of closed perimeter (actual walls) compared to the total perimeter (total of assumed walls and actual walls). This is accomplished by adding the actual wall lengths and dividing that number by the total of all walls (both actual and assumed). In this example, the actual walls total 46.5 ft (14 + 11 + 14 + 7.5) and the total perimeter totals 50 ft (14 + 14 + 11 + 11).

% of enclosure = 46.5 ft divided by 50 ft = 0.93
0.93 x 100 = 93% perimeter closed

Referring to the Rate By Volume Assumed Enclosure Chart, Figure 5-18, 93% closed perimeter allows a discharge rate of 0.31 lb/min/ft^3. Knowing this, the total amount of carbon dioxide required can now be calculated by the following formula:

Total agent required = Volume x Flow Rate per Minute per Ft^3 x 1.4 (liquid factor) x 0.5 (minimum discharge time)

924 ft^3 x 0.31 lb/min/ft^3 x 1.4 x 0.5 = 200 lb of carbon dioxide required.

As you can see, by having the customer install a fairly inexpensive wall, the hazard can be protected by 2-100 lb containers instead of the next least amount of three as calculated in Example 1.

HYDRAULIC CALCULATIONS

For estimating purposes, the following Figure 5-20 can be used to approximately determine the size of piping required for carbon dioxide discharge. Consult your piping sketch and determine flow rate and approximate pipe sizes. These pipe sizes are not to be used for final hydraulic system design.

Pipe Size (in.)	Schedule	Nominal Flow With Average Conditions (lb/min)	Maximum Flow With Short Runs (lb/min)
1/2	40	60	100
3/4	40	150	200
1	80	250	300
1 1/4	80	500	600
1 1/2	80	800	900
2	80	1300	1600
2 1/2	80	2300	2500
3	80	3500	4000

Note: This table is for estimating purposes only. Flow calculations are required for all system installations.

Check valves or selector valves may be chosen through the use of this table.

FIGURE 5-20

The designer must have knowledge of and access to the most recent version of the ANSUL HP CO_2 FLOW CALCULATION HYDRAULIC CALCULATION PROGRAM.

Hand Hose Lines

Hand hose line systems may be used to supplement fixed fire protection systems or to supplement first aid fire extinguishers for the protection of specific hazards for which carbon dioxide is a suitable suppressing agent. These systems shall not be used as a substitute for other fixed carbon dioxide fire suppressing systems equipped with fixed nozzles, except where the hazard cannot adequately or economically be provided with fixed protection. The decision as to whether hose lines are applicable to the particular hazard shall rest with the authority having jurisdiction.

Hand hose lines stations shall be placed such that they are easily accessible and within reach of the most distant hazard which they are expected to protect. In general, they shall not be located such that they are exposed to the hazard nor shall they be located inside any hazard area protected by a total flooding system.

The rate and duration of discharge and consequently the amount of carbon dioxide shall be determined by the type and potential size of the hazard. A hand hose line shall have a sufficient quantity of carbon dioxide to permit its use for at least one minute.

HYDRAULIC CALCULATIONS (Continued)

Hand Hose Lines (Continued)

The carbon dioxide supply shall be located as close to the hose reel as possible so that liquid carbon dioxide will be supplied to the hose line with a minimum of delay after actuation.

Refer to UL Fire Protection Equipment Directory, under section titled Carbon Dioxide System Units, Hand Hose Line (FYWZ) for equivalent lengths of hose line components.

DETECTION SYSTEM REQUIREMENTS

Refer to AUTOPULSE Detection and Control Installation, Programming, and Maintenance Manual.

ACTUATION REQUIREMENTS

Three types of actuation are available for the Carbon Dioxide system: manual, pneumatic, and electric.

Manual Actuation

Manual actuation can be used with or without automatic detection. When no detection is required, the lever actuator can be mounted on top of the carbon dioxide container valve. The manual lever release actuator provides a manual means of agent container actuation by direct manual actuation of its pull lever or cable actuation when used in conjunction with a remote manual pull station. In a two container system, the remaining container is actuated by the pressure generated within the distribution manifold. In three or more container systems, two lever actuators are required, and a connecting link is used to provide simultaneous actuation of both manual cable-pull actuators. The maximum length of actuator cable which may be used in the remote line is 125 ft. The maximum number of corner pulley elbows is 18.

Pneumatic Actuation

Pneumatic actuation is used with the pilot port on the side of the CV98 valve. The pressure is supplied from an LT-30-R nitrogen cartridge located in the AUTOMAN II-C release. The pressure pneumatically opens the container valves. One pneumatic pilot container is required in single or two container systems and two pilot containers are required in systems with three or more containers. The maximum length of 1/4 inch Schedule 40 pipe is 150 ft. If it is necessary to have an actuation pipe run which exceeds the maximum allowable 1/4 in. pipe requirements, 1/4 in. stainless steel tubing with a wall thickness of 0.065 can be used for the actuation line. When this size tubing is used, a maximum of 300 ft, with no reductions for elbows or tees, is allowed.

Electric Actuation

Electric actuation is used with the HF electric actuator and booster actuator mounted on the carbon dioxide container valve and an AUTOPULSE control system. See appropriate AUTOPULSE manual for detailed wiring information. The AUTOPULSE control system also provides a supervised method of tank actuation without limits on the tank location. In auxiliary or override applications, a lever actuator can be installed on top of the HF actuator.

A means of electric actuation of a selector valve is by the use of an HF electric actuator and booster actuator. See appropriate AUTOPULSE manual for detailed wiring information.

ACCESSORIES

Specific selection and placement of accessories that may be used with the carbon dioxide are:

Electric or Mechanical Manual Pull

The electric or mechanical manual pull station allows the carbon dioxide system to be manually operated at some point distant from the control system or containers. The pull station should be installed at a minimum height of 42 in. to a maximum height of 48 in. and located in the path of exit.

The total length of wire rope used for each mechanical manual pull station within a system must not exceed 125 ft.

The maximum number of pulley elbows that may be used per pull station is 18.

Selector Valves

Selector valves are used to direct the flow of carbon dioxide into a single hazard of a multiple hazard system.

Selector valves can be operated by either pneumatic pressure, an electric signal to operate an HF electric actuator attachment, remote cable pull, or manually at the valve. Selector valves range in size from 1/2 in. to 4 in. When installing cable operated selector valves, the maximum length of 1/16 in. cable that may be run to operate the selector valve is 125 ft with a maximum of 18 pulley elbows.

All style of selector valves can be actuated manually or by remote cable when adding a lever actuator to the top of the valve.

ACCESSORIES (Continued)

Lock-out or Direction/Stop Valves

Direction/stop valves are used to either manually control the flow of carbon dioxide into a hazard area or to manually control the flow into one of several hazards being protected by a common bank of carbon dioxide containers. These valves are operated manually, either by the use of a handle attached directly to the valve or by means of a remote pull box which operates a sector attached to the valve. Lock-out valves can be used as a safety feature, keeping the flow of carbon dioxide from entering a hazard area, either because of a false discharge or to allow the occupants enough time to exit the area prior to the valve being manually opened.

When installing a remote pull station to operate the sector on a direction/stop valve, the maximum allowable length of 1/16 in. cable is 125 ft and the maximum allowable number of pulley elbows is 18.

Pressure Operated Siren

The pressure operated siren is used to warn personnel prior to a system discharge. The siren is operated with the carbon dioxide pressure from the system. The piping to the siren is normally run from the system distribution manifold and located before the time delay. The minimum decibel level at 10 ft is 90 dB. The design requirements are as follows:

Required Pipe:	1/4 in., Schedule 40
Flow Rate:	13.6 lb per minute
Maximum Sirens:	4
Maximum Pipe Length:	200 ft (61 m) minus 1 ft (0.3 m) for every elbow used

NOTICE

Design of system must include agent used through siren if siren is not located in the hazard area.

Pressure Switch

The pressure switch is operated by the carbon dioxide pressure when the system is discharged. The piping to the pressure switch is normally run from the distribution manifold. The pressure switch can be used to open or close electrical circuits to either shut down equipment or turn on lights or alarms.

The piping required to connect from the system manifold to the pressure switch is 1/4 inch Schedule 40. There is no maximum length requirement for this piping as the carbon dioxide will be drawn back through the distribution piping and out the nozzles.

Pressure Trip

The pressure trip is connected to the actuation or discharge line of a carbon dioxide system. By either pneumatic or manual actuation, the pressure trip can release spring or weight powered devices to close doors and windows, open fuel dump valves, close fire dampers or close fuel supply valves.

The piping required to connect from the system manifold to the pressure trip is 1/4 inch Schedule 40. This is no maximum length requirement for this piping as the carbon dioxide will be drawn back through the distribution piping and out the nozzles.

High Pressure Time Delay

▸ To meet the requirements of NFPA 12, a mechanical time delay is required for all carbon dioxide systems that protect “Normally Occupied” or “Occupiable” spaces protected by total flooding systems, or local application systems where the discharge exposes personnel to concentrations of carbon dioxide in cess of 7.5 percent. These are areas where it is necessary to evacuate personnel prior to the discharge of a carbon dioxide system. The time delay uses nitrogen from an LT-10 cartridge (P/N 423423) to power the factory set delay mechanism. The time delay is activated by pressure from the pilot containers when they are released. The time delay is installed in the discharge piping, either directly after the control (pilot) container, or further along the piping. A manual release is incorporated on the time delay valve to allow instant override of the time delay. After discharge is completed, the time delay can be returned to service by following the procedure in the “Resetting and Recharge” section of the “ANSUL Carbon Dioxide, Design, Installation, Recharge and Maintenance Manual.” The length of time is factory set and is not adjustable. The time delay is available in delay settings of 10, 30, 68, and 88 seconds.

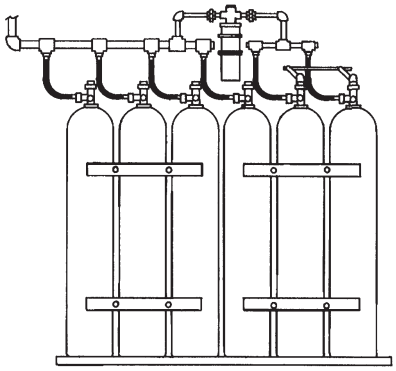


FIGURE 5-21
001867

ACCESSORIES (Continued)

Alarms

Several types of electric alarms are available. Each operate on 24 VDC and must be used on the alarm circuit of an AUTOPULSE Control System. Refer to appropriate AUTOPULSE installation, maintenance, and recharge manual for detailed design information.

RESERVE SYSTEM

Normally the authority having jurisdiction will determine whether a hazard requires a back up reserve set of carbon dioxide containers, either connected or spares.

IRI (Industrial Risk Insurers) requires the following:

- In high pressure systems an extra full complement of charged containers (connected reserve) manifolded and piped to feed into the automatic system should be provided on all installations. The reserve supply is actuated by manual operation of the main/reserve switch on either electrically operated or pneumatically operated systems.
- A connected reserve is desirable for four reasons:
- Protection should reflash occur.
- Reliability should the main bank malfunction.
- Protection during impairment when main tanks are being replaced.
- Protection of other hazards if selector valves are involved and multiple hazards are protected by the same set of containers.
- If a full complement of charged containers cannot be obtained or the empty containers recharged, delivered and reinstalled within 24 hours, a third complement of fully charged spare containers should be maintained on premises for emergency use. The need for spare containers may depend upon whether or not the hazard is under protection of automatic sprinklers.
- The current edition of NFPA 12, Standard on Carbon Dioxide Extinguishing Systems.

When designing a system, always determine if, and what kind of, reserve system is required.

Develop Bill of Materials

After completing the subsections of the design section, finalize the system design by completing a bill of material for each hazard area being protected. The bill of material, hazard sketches, hydraulic calculations, and any notes, should be kept on file for future reference.

Sample Problem

Refer to Section 12 for examples of typical applications. By reviewing these examples, it may help answer some questions concerning the total design process.

NOTES:

INSTALLATION

All installations are to be performed in accordance with the parameters of this manual and all appropriate codes and standards from the local, state, and federal authority having jurisdiction.

Before the carbon dioxide system is installed, the qualified installer should develop installation drawings in order to locate the equipment, to determine an actuation and distribution piping routing, and to develop a bill of material.

For successful system performance, the carbon dioxide system components must be located within their approved temperature ranges. The ambient temperature ranges are 0 °F to 130 °F (–18 °C to 54 °C) for total flooding and 32 °F to 120 °F (0 °C to 49 °C) for local applications. All AUTOPULSE Control Systems are designed for indoor applications and for temperature ranges between 32 °F to 120 °F (0 °C to 49 °C).

MOUNTING COMPONENTS

Container/Bracket Assembly

Carbon dioxide containers may be located inside or outside the protected space, although it is preferable to locate them outside of the space. They must not be located where they will be exposed to a fire or explosion in the hazard. When they are installed within the space they protect, a remote manual control must be installed to release the system safely from outside the hazard area.

The containers should be installed so that they can be easily removed after use or for weighing and inspection. Do not install the containers where they are exposed to direct sun rays.

See Figures 6-1 thru 6-7a for detailed mounting height information for all container bracketing.

Clamp Installation – CV-98 Container Assembly

Container Size lb	(kg)	Dim. A in.	(cm)	Dim. B in.	(cm)	Dim. C in.	(cm)	Dim. D in.	(cm)
35	(15.9)	9	(23)	18	(46)	9 3/4	(25)	12 3/4	(32)
50	(22.7)	12	(31)	26	(66)	9 3/4	(25)	12 3/4	(32)
75	(34.0)	12	(31)	29	(74)	10 1/2	(27)	13 1/2	(34)
100	(45.4)	12	(31)	31	(79)	12	(31)	15 1/8	(38)
120	(54.4)	14	(36)	38	(97)	12 7/16	(32)	15 9/16	(40)

Bracketing Without Uprights – Single Container

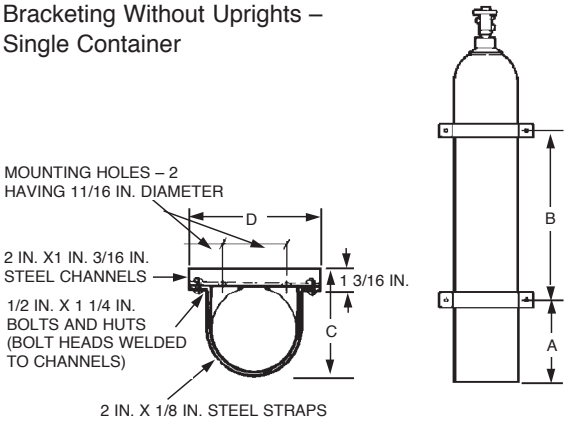


FIGURE 6-1
001868a/001868b

Bracketing Installation – CV-98 Container Assembly

Container Size lb	(kg)	Dimension A in.	(cm)	Dimension B in.	(cm)
35	(15.9)	21	(53)	11	(28)
50	(22.7)	31	(79)	11	(28)
75	(34.0)	34	(86)	11 1/2	(29)
100	(45.4)	36	(91)	13	(33)
120	(54.4)	38 1/2	(98)	13 7/16	(34.5)

BRACKETING WITHOUT UPRIGHTS – SINGLE ROW

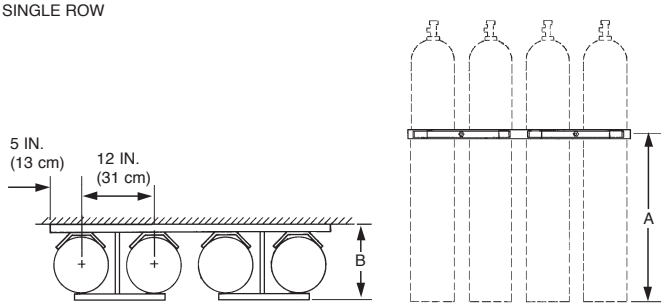


FIGURE 6-2
002260a/002260b

MOUNTING COMPONENTS (Continued)

Container/Bracket Assembly (Continued)

Bracketing Installation – CV-98 Container Assembly

Container Size		Dimension A		Dimension B	
lb	(kg)	in.	(cm)	in.	(cm)
35	(15.9)	21	(53)	21	(53)
50	(22.7)	31	(79)	21	(53)
75	(34.0)	34	(86)	22 1/2	(57)
100	(45.4)	36	(91)	26	(66)
120	(54.4)	38 1/2	(98)	26 7/8	(68)

Bracketing Without Uprights – Double Row

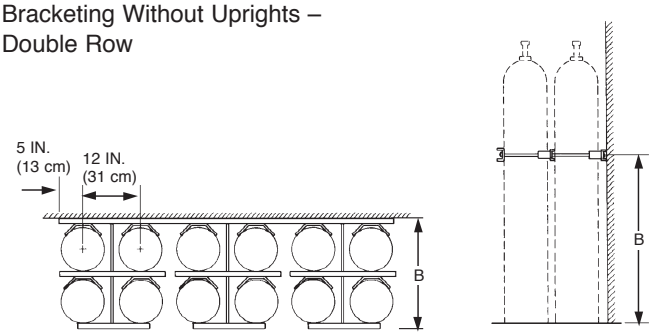


FIGURE 6-3
001869a/001869b

Bracketing Installation – CV-98 Container Assembly

Container Size		Dimension A		Dimension B		Dimension C	
lb	(kg)	in.	(cm)	in.	(cm)	in.	(cm)
35	(15.9)	21	(53)	25	(64)	80	(203)
50	(22.7)	31	(79)	25	(64)	80	(203)
75	(34.0)	34	(86)	26	(66)	80	(203)
100	(45.4)	36	(91)	29	(74)	80	(203)
120	(54.4)	38 1/2	(98)	30	(76)	85	(216)

Bracketing Without Uprights – Back To Back

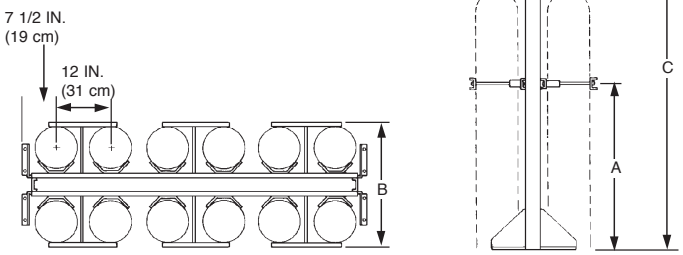
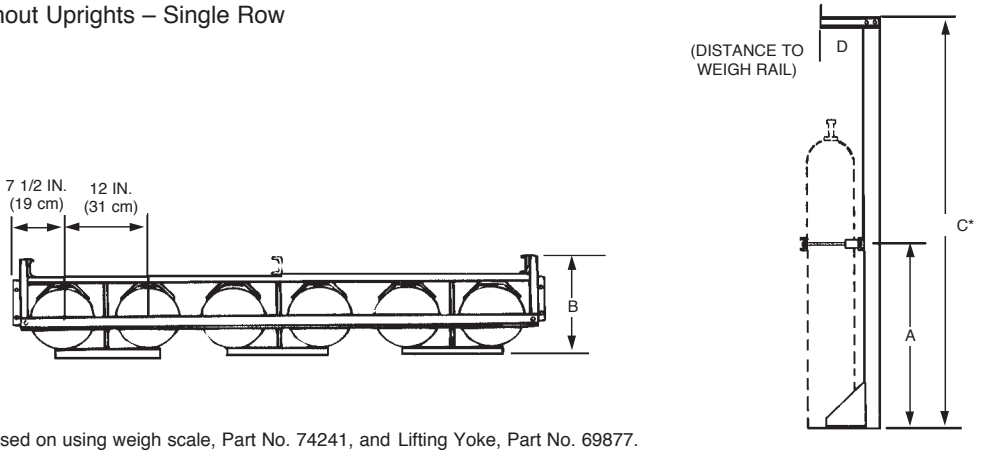


FIGURE 6-4
001870

Bracketing Installation – CV-98 Container Assembly

Container Size		Dimension A		Dimension B		Dimension C		Dimension D	
lb	(kg)	in.	(cm)	in.	(cm)	in.	(cm)	in.	(cm)
35	(15.9)	21	(53)	14	(36)	61 3/4	(156.8)	8	(20)
50	(22.7)	31	(79)	14	(36)	78 3/4	(200)	8	(20)
75	(34.0)	34	(86)	14 1/2	(37)	83 3/4	(212.7)	8	(20)
100	(45.4)	36	(91)	16	(41)	86 1/4	(219.1)	8	(20)
120	(54.4)	38 1/2	(98)	16	(41)	93	(236.2)	8	(20)

Bracketing Without Uprights – Single Row



*Dimensions are based on using weigh scale, Part No. 74241, and Lifting Yoke, Part No. 69877.

FIGURE 6-5
002253

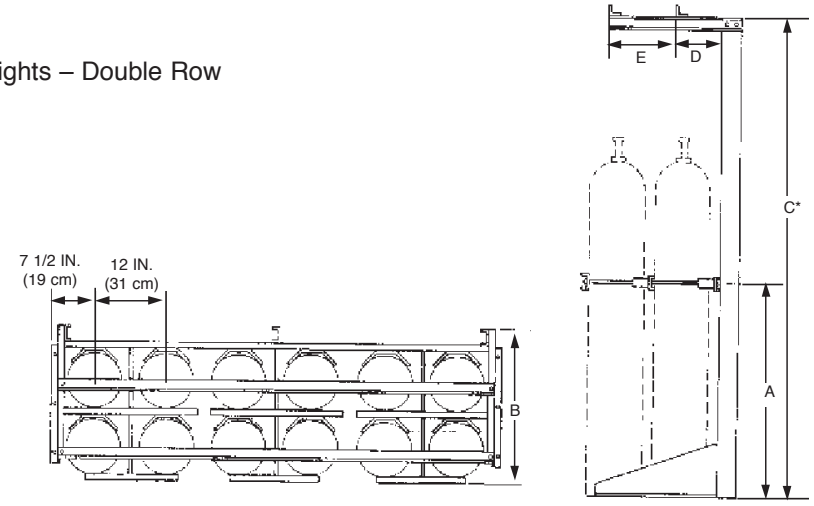
MOUNTING COMPONENTS (CONTINUED)

Container/Bracket Assembly (Continued)

Bracketing Installation – CV-98 Container Assembly

Container Size lb	(kg)	Dimension A in.	(cm)	Dimension B in.	(cm)	Dimension C in.	(cm)	Dimension D in.	(cm)	Dimension E in.	(cm)
35	(15.9)	21	(53)	24	(61)	61 3/4	(156.8)	8	(20)	11	(28)
50	(22.7)	31	(79)	24	(61)	78 3/4	(200)	8	(20)	11	(28)
75	(34.0)	34	(86)	25 1/2	(65)	83 3/4	(212.7)	8	(20)	11	(28)
100	(45.4)	36	(91)	29	(74)	86 1/4	(219.1)	8	(20)	11	(28)
120	(54.4)	38 1/2	(98)	30	(76)	93	(236.2)	8	(20)	11	(28)

Bracketing With Uprights – Double Row



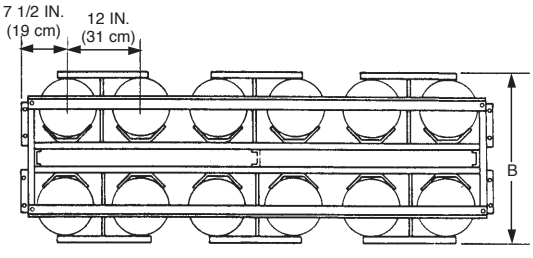
*Dimensions are based on using weigh scale, Part No. 74241, and Lifting Yoke, Part No. 69877.

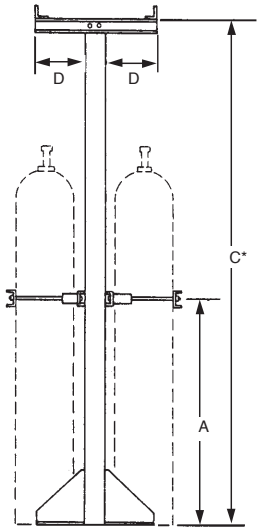
FIGURE 6-6
002271

Bracketing Installation – CV-98 Container Assembly

Container Size lb	(kg)	Dimension A in.	(cm)	Dimension B in.	(cm)	Dimension C in.	(cm)	Dimension D in.	(cm)
35	(15.9)	21	(53)	25	(64)	61 3/4	(156.8)	8	(20)
50	(22.7)	31	(79)	25	(64)	78 3/4	(200)	8	(20)
75	(34.0)	34	(86)	26	(66)	83 3/4	(212.7)	8	(20)
100	(45.4)	36	(91)	29	(74)	86 1/4	(219.1)	8	(20)
120	(54.4)	38 1/2	(98)	30	(76)	93	(236.2)	8	(20)

Bracketing With Uprights – Single Row Back To Back





*Dimensions are based on using weigh scale, Part No. 74241, and Lifting Yoke, Part No. 69877.

FIGURE 6-7
001873

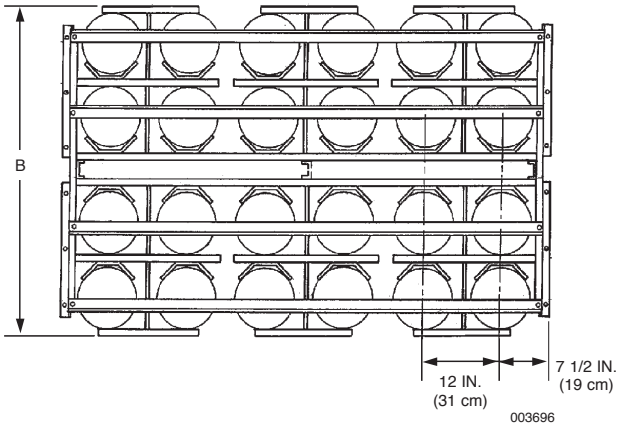
MOUNTING COMPONENTS (CONTINUED)

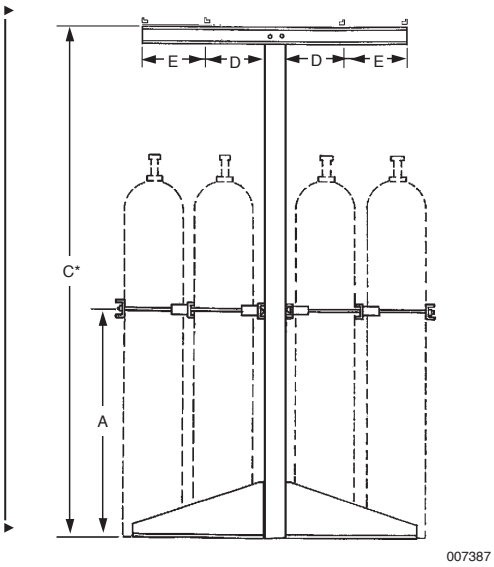
Container/Bracket Assembly (Continued)

Bracketing Installation – Container Assembly

Container Size lb.	(kg)	Dimension A in.	(cm)	Dimension B in.	(cm)	Dimension C in.	(cm)	Dimension D in.	(cm)	Dimension E in.	(cm)
35	(15.9)	21	(53)	45	(114)	61 3/4	(156.8)	8	(20)	11	(28)
50	(22.7)	31	(79)	45	(114)	78 3/4	(200)	8	(20)	11	(28)
75	(34.0)	34	(86)	48	(122)	83 3/4	(212.7)	8	(20)	11	(28)
100	(45.4)	36	(91)	48	(122)	86 1/4	(219.1)	8	(20)	11	(28)
120	(54.4)	38 1/2	(98)	55	(140)	93	(236.2)	8	(20)	11	(28)

Bracketing With Uprights – Double Row Back To Back





*Dimensions are based on using weigh scale, Part No. 74241, and Lifting Yoke, Part No. 69877.

FIGURE 6-7a

MOUNTING COMPONENTS (Continued)

Container/Bracket Assembly (Continued)

1. Mount each carbon dioxide container by completing the following:

⚠ CAUTION

Do not remove the safety shipping caps at this time. They are provided to prevent accidental actuation and discharge during shipping and handling. If valve assembly is accidentally operated, velocity of unrestricted escaping gas is forceful enough to cause injury, especially about the face and head.

   a. Assemble bracket components. See Bracketing Parts List, located in the Appendix Section, for details of container bracketing and component assembly.
   b. If a reserve system is being installed, mount the reserve container(s) directly next to the main system container(s).

⚠ CAUTION

Proper fasteners must be used when mounting container bracketing to wall or support. Failure to mount properly could cause container movement upon discharge.

   c. Securely mount bracketing to rigid wall or support.
   d. Fasten container(s) securely in bracketing.
   e. The actuated pilot valves must be located in the distribution manifold as far from the manifold outlet as possible.

Releasing Devices

Different types of Releasing/Detection systems are available with the carbon dioxide system:

– AUTOPULSE Control System using electric detection with electric actuation.

For detailed information on detection systems, refer to the following:

– ANSUL Detection and Control Application Manual
– NFPA 12 Standard for Carbon Dioxide Extinguishing Systems
– NFPA 72 National Fire Alarm Code

INSTALLING ACTUATION PIPING

Before installing any actuation piping, the piping design must be determined. This will confirm that the lengths of actuation piping does not exceed the maximum allowable.

General Piping Requirements

1. Use only 1/4 in. Schedule 40 black iron, hot-dipped galvanized, chrome-plated, or stainless steel pipe/braided hose and fittings conforming to ASTM A120, A53, or A106.
2. Before assembling the pipe and fittings, make certain all ends are carefully reamed and blown clear of chips and scale. Inside of pipe and fittings must be free of oil and dirt.
3. The piping and fitting connections must be sealed with pipe tape. When applying pipe tape, start at the second male thread and wrap the tape (two turns maximum) clockwise around the threads, away from the pipe opening.

NOTICE

Do not allow tape to overlap the pipe opening, as this could cause possible blockage of the gas pressure. Thread sealant or compound must not be used.

4. Cast iron pipe and fittings are not acceptable.
5. Actuation piping must be rigidly supported by UL listed hangers as described on Page 6-6 and 6-7.

INSTALLING ACTUATION PIPING (Continued)

Actuation Piping Installation

1. Install 1/4 in. Schedule 40 pipe from gas outlet port on the AUTOMAN II-C release to container location. Use one of the 1/2 in. (1.3 cm) knockouts provided in the top, bottom, or side of the enclosure to exit the piping.
2. Maximum length of all 1/4 in. actuation piping cannot exceed 150 ft (45.7 m).
3. If pneumatic operated accessories are required to be operated from the actuation pressure, branch off the 1/4 in. actuation piping and run to each accessory.
4. Install 1/4 in. tee in the actuation piping approximately 24 in. (61 cm) before first carbon dioxide container and install vent plug, Part No. 42175. See Figure 6-8.
5. Install actuation hose, Part No. 31809, 32335, or 32336 (depending on length required) between actuation piping and either the pneumatic actuator or the CO_2 valve. A 1/4 in. male adaptor, Part No. 32338, 31810, or 32334, is required on each end of the actuation hose. See Figure 6-8.

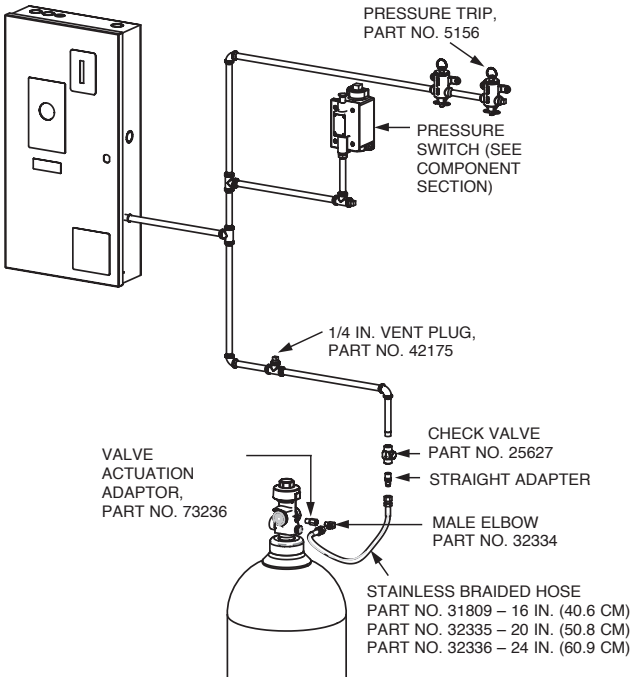


FIGURE 6-8
008609

INSTALLING DISTRIBUTION PIPING

Hanger Applications

Install the pipe hangers in accordance with good piping practice as well as the following:

1. The maximum spacing between hangers must not exceed those listed below.

Pipe Size in. NPT	Maximum Spacing Between Hangers ft	(m)
1/4	4	(1.2)
1/2	6	(1.8)
3/4	8	(2.4)
1	12	(3.7)
11/4	12	(3.7)
1 1/2 and larger	15	(4.6)

2. A hanger should be installed between fittings when the fittings are more than 2 ft (0.6 m) apart.
3. A hanger should be installed at a maximum of 1 ft (0.3 m) from the nozzle.

INSTALLING DISTRIBUTION PIPING (Continued)

Hanger Applications (Continued)

4. The hangers must be UL listed and rigidly supported. The Hanger Application Table and Figure 6-9 list some typical hangers used for different mounting surfaces.

Hanger Application Table

Hanger Type	Application
No. 1	For attaching to wood beams
No. 2	On level ceilings of sufficient thickness to permit proper fastening
No. 3	For 2 in. and smaller pipe under sloping ceilings and roofs
No. 4	For special cases where punching is more economical than using clamps
No. 5	For sheathed ceilings of wood construction with sufficient thickness
No. 6	For most cases except where plastering is done after installation
No. 7	For attaching to concrete beams
No. 8	For attaching to lower flange of beam or truss
No. 9	To keep piping closer to beam than is possible with clamp and ring
No. 10	Suitable for 3/4 to 2 in. pipe where necessary to hang pipe at a distance from wall
No. 11	For attaching to channel iron
No. 12	For attaching to bottom of steel beams

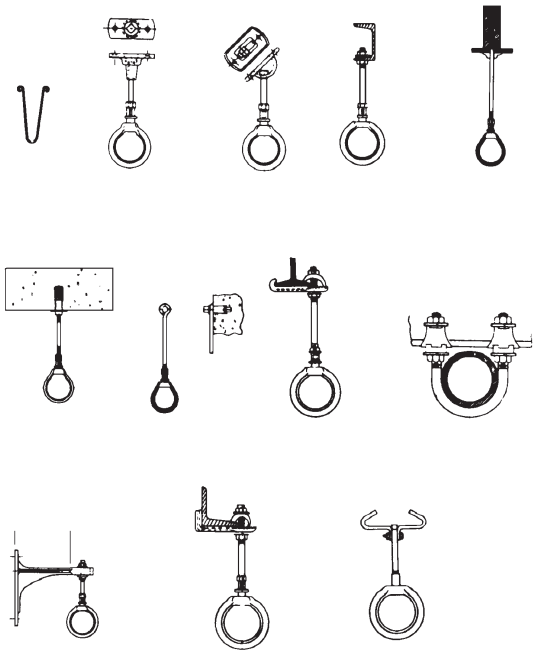


FIGURE 6-9
001875/3 rows

General Piping Requirements

1. Pipe shall conform to ASTM specifications A53 or A106; stainless steel to be TP304 or TP316 for threaded connections or TP304, TP316, TP304L, or TP316L for welded connections.
2. A120 pipe SHALL NOT BE USED.
3. All pipe up to and including 3/4 in. size to be standard weight black, stainless, or galvanized steel (Schedule 40).
4. All pipe over 3/4 in. size to be extra heavy black, stainless, or galvanized steel (Schedule 80); stainless steel to be TP304 or TP316 for threaded connections or TP304, TP316, TP304L, or TP316L for welded connections.
5. Class 300 galvanized malleable iron or ductile iron fittings should be used through 2 in. size; and galvanized forged steel fittings in all larger sizes.
6. Refer to NFPA 12, “Carbon Dioxide Extinguishing Systems” for detailed piping requirements.
7. Container and piping to be securely bracketed especially at the fittings and nozzles.
8. Ream, clean, and blow out all pipe before installing.
9. All dead end pipe lines to be provided with a 1/2 in. capped nipple, 2 in. long. See Figure 6-10.

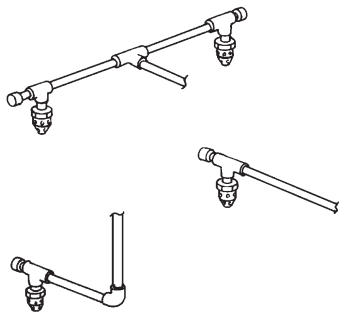


FIGURE 6-10
001876

10. After assembly, blow out entire pipe system before installing discharge nozzles.

INSTALLING DISTRIBUTION PIPING (Continued)

Distribution Manifold And Piping

1. Starting with the container manifold, securely mount the manifold at the appropriate height as shown in Figure 6-11. Make certain that if accessories piping is to be done later that the end of the manifold contains a tee instead of an elbow. The outlet of the tee will later be reduced down to 1/4 in. for piping to the accessories.
2. Continue piping remainder of the distribution piping, following piping sketch and computer design completed in System Design Section.

NOTICE

All piping shall be laid out to reduce friction losses to a reasonable minimum and care shall be taken to avoid possible restrictions due to foreign matter or faulty fabrication.

3. Before installing nozzles, blow air through complete piping system to determine there is no blockage.
4. Install discharge nozzles as specified on the computer design piping output sheet.
5. Install male end of flexible discharge bend (Part No. 427082) into each manifold inlet. Wrench tighten.
6. With containers securely mounted in bracket, attach female end of flexible discharge bend to container valve outlet. Wrench tighten.

⚠ CAUTION

Make certain flexible discharge bend is attached to valve outlet and NOT the fill port inlet. The valve outlet port is the higher of the two threaded ports.

7. If accessory piping is required, see Installing Accessories, for detailed piping information.

MAIN/RESERVE SYSTEM

NFPA 12, Standard on Carbon Dioxide Extinguishing Systems, Edition, states, “Both main and reserve supplies for fixed storage systems shall be permanently connected to the piping and arranged for easy changeover, except where the authority having jurisdiction permits an unconnected reserve.”

When piping a connected reserve system, the reserve containers must be segregated from the pressure of the main system. This is accomplished by adding check valves in the distribution manifold. It is also necessary to install a header vent plug on each side of the manifold. This is required because of the addition of the check valves in the manifold. See Figure 6-12.

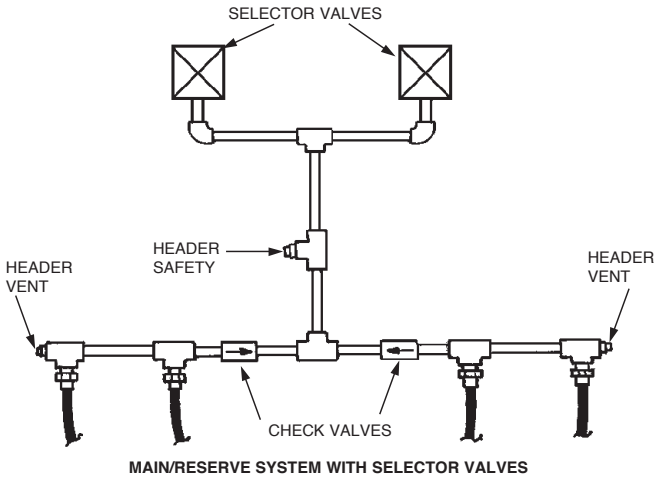


FIGURE 6-12
004306

Header Installation – Container Assembly

Container Size		Dimension A		Dimension B		Dimension C	
lb	(kg)	in.	(mm)	in.	(mm)	in.	(mm)
35	(15.9)	48 1/2	(1232)	12	(305)	12	(305)
50	(22.7)	64 1/2	(1638)	12	(305)	12	(305)
75	(34.0)	69 1/2	(1765)	12	(305)	12	(305)
100	(45.4)	72	(1829)	12	(305)	12	(305)
100 (LC)	(45.4)	72 1/2	(1842)	12	(305)	12	(305)
120	(54.4)	79	(2007)	12	(305)	12	(305)

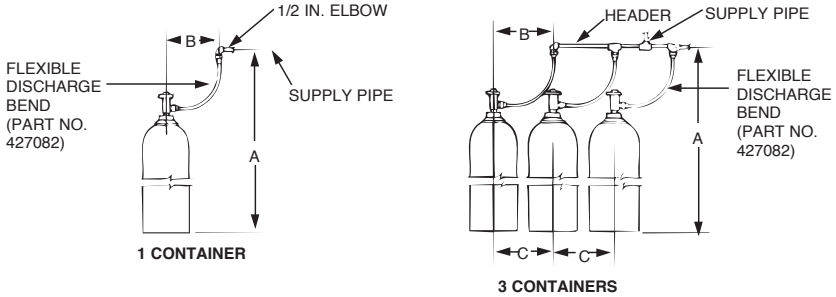


FIGURE 6-11
007459

INSTALLING DETECTION/ACTUATION SYSTEM

Several types of detection systems are available for use with the ANSUL carbon dioxide suppressing system. Some detection systems offer supervised input and output circuits and battery back-up while other types offer unsupervised mechanical, electrical, or pneumatic detection. The type of hazard or the authority having jurisdiction will determine the detection system requirements.

Supervision of automatic systems and manual lockout valves must be provided unless specifically waived by the authority having jurisdiction. Interconnections between the components that are necessary for the control of the system and life safety, such as detection, actuation, alarms, power sources, etc., must be supervised. An open circuit, ground fault condition, or loss of integrity in the pneumatic control lines that would impair full system operation shall result in a trouble signal. The alarm and trouble signals must be transmitted by one of the methods described in NFPA 72 National Fire Alarm Code.

High pressure pneumatic operated slave container connections immediately adjacent to pilot container need not be supervised.

AUTOPULSE Control System With HF Electric Actuator

The AUTOPULSE Control System is an electronic device incorporating an internal power supply, “on-line” emergency batteries, and solid-state electronics. The system can incorporate either ionization, photoelectric, heat, flame, or combustible vapor detectors.

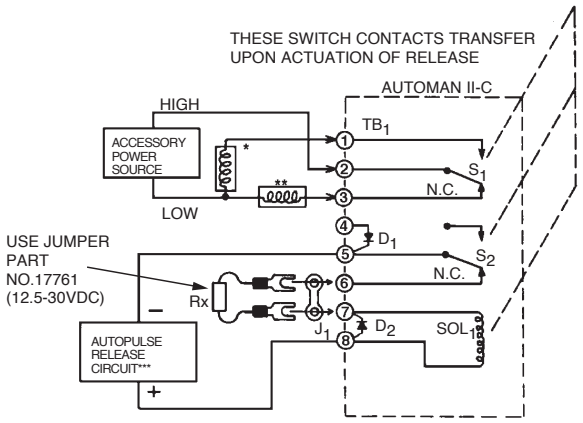
The AUTOPULSE Control system offers electric valve actuation by the use of the ANSUL HF Actuator, Part No. 73327 for the CV-98 valve container.

For detailed installation instructions, refer to the appropriate AUTOPULSE Control Systems Manual and the HF Electric Actuator Application and Installation Sheet, Part No. 73330.

AUTOPULSE Control System With AUTOMAN II-C With Pneumatic Actuation

In some cases it is advisable to have electric supervised detection with pneumatic valve actuation. This can be accomplished by incorporating an AUTOPULSE Control system for the detection and an AUTOMAN II-C release for the pneumatic actuation.

1. See the appropriate AUTOPULSE Control manual for detailed installation instructions.
2. Once the electrical portion of the detection system is completed, mount the AUTOMAN II-C release in a convenient location to both the AUTOPULSE panel and the carbon dioxide containers.
3. Complete wiring required between the AUTOPULSE control panel and the AUTOMAN II-C release, Part No. 17728 or 31492. See Figure 6-13.



* AUXILIARY ALARMING DEVICES, SEE S_1 RATINGS
** FUEL SHUT-OFF VALVE, BLOWER MOTOR, DOOR CLOSER, ETC., SEE S_1 RATINGS
*** POLARITY SHOWN IN THE ALARM CONDITIONS

FIGURE 6-13
001879

4. See Actuation Piping Requirements listed on Page 6-5.

NOTICE

It is only required to actuate two pilot containers in the total system (systems with a supply of less than three containers require only one pilot container). The remainder of the containers will be actuated by back-pressure from the pilot containers. In a connected reserve system, two pilot containers are required on the main and two on the reserve.

INSTALLING THE DETECTION SYSTEM (Continued)

Quartzoid Bulb Actuator (QBA-5)

The Quartzoid Bulb Actuator (QBA-5) release actuates the carbon dioxide system pilot container by releasing the carbon dioxide in its container through 1/8 in. pipe. The QBA-5 is available in three temperature ratings. The unit should be mounted directly above the hazard. The unit is equipped with a mounting bracket. See Figure 6-14.

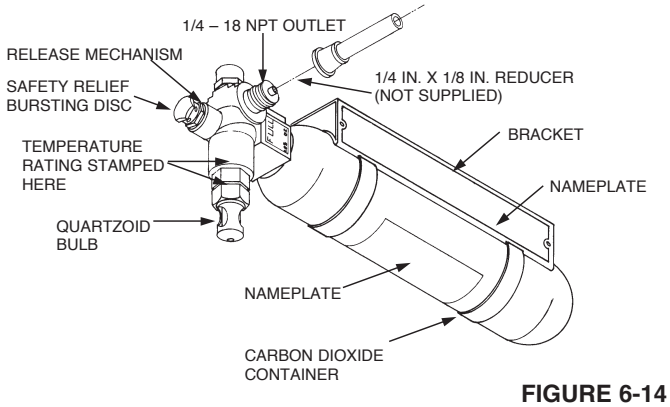


FIGURE 6-14
001400

The maximum length of 1/8 in. pipe between the Quartzoid Bulb Actuator and the carbon dioxide pilot containers is 100 ft (30.5 m).

In order to determine the normal operating temperature at the QBA-5 location, utilize a maximum registering thermometer, Part No. 15240.

Part No.	Description	
42267	QBA-5	Assembly with bracket 135 °F (57 °C)
42274	QBA-5	Assembly with bracket 175 °F (79 °C)
42276	QBA-5	Assembly with bracket 250 °F (121 °C)
41893	QBA-5	Assembly without bracket 135 °F (57 °C)
41894	QBA-5	Assembly without bracket 175 °F (79 °C)
41895	QBA-5	Assembly without bracket 250 °F (121 °C)

INSTALLING ACTUATORS

When installing actuators on the carbon dioxide valve, different styles are available depending on the requirements of the system design or type of valve. Actuators can be stacked to get the options of manual, pneumatic, and electric actuation.

Manual

Two styles of lever actuators are available which offer manual actuation at the container and can be connected to a remote manual pull station. Manual actuation is accomplished by pulling the valve hand lever. The lever design contains a forged mechanical detent which secures the lever in the open position when actuated.

⚠ CAUTION

Before mounting the lever actuator(s) on the container valves, make certain the lever actuator is in the “SET” position. If the lever actuator is not in the “SET” position, container will discharge when lever actuator is installed.

See Figure 6-15 for installation details.

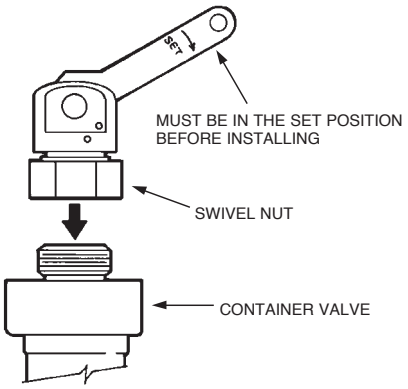


FIGURE 6-15
001849

If the system requires two lever actuators, use connecting link, Part No. 42514, to tie the two together. See Figure 6-16.

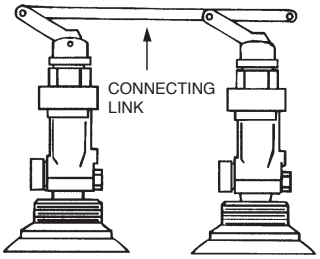


FIGURE 6-16
001885

INSTALLING ACTUATORS (Continued)

Electric – CV-98 Valve

Refer to appropriate AUTOPULSE Manual and HF electric actuator application and installation sheet (Part No. 73330) for detailed information.

- A maximum of two HF electric actuators can be installed on a single AUTOPULSE release circuit.

⚠ CAUTION

Before installing electric actuator to top of CV-98 valve, make certain piston in bottom of actuator is free to move up and down. If piston is in the down position, DO NOT INSTALL.

⚠ CAUTION

Make certain all electric power from the panel to the actuator has been disconnected. Failure to disconnect power may cause system to accidentally discharge.

Installing the Booster Actuator

1. Make certain the booster actuator is in the set (armed) position. This can be confirmed by visually checking the position of the top and bottom pins. When in the set position, the top pin will be approximately flush with the top of the actuator. The bottom pin will be flush with the inside surface of the actuator. If the actuator requires setting, use the arming tooling, Part No. 429847, and follow the instructions listed in “Resetting the Booster Actuator.”
2. Hand tighten the actuator unto the container valve or the selector valve.

⚠ CAUTION

Make certain all electric power from the panel to the actuator has been disconnected. Failure to disconnect power may cause system to accidentally discharge.

Installing the HF Actuator

1. Make certain the HF actuator is set (armed) position. When in the set position, the top pin will be flush with the top of the actuator. If the actuator requires setting, use the arming tool, Part No. 75433, and follow the instructions listed in “Resetting the HF Actuator.”
2. Hand tighten the HF actuator onto the booster actuator.
3. Refer to HF Electric Actuator Instruction Sheet, Part No. 73330, for detailed wiring information.

Stacking Actuators

Some system designs require more than one type of actuation means. Actuators can be stacked, one on top of the other, to accomplish this. Figure 6-17 shows the different ways the actuators can be arranged.

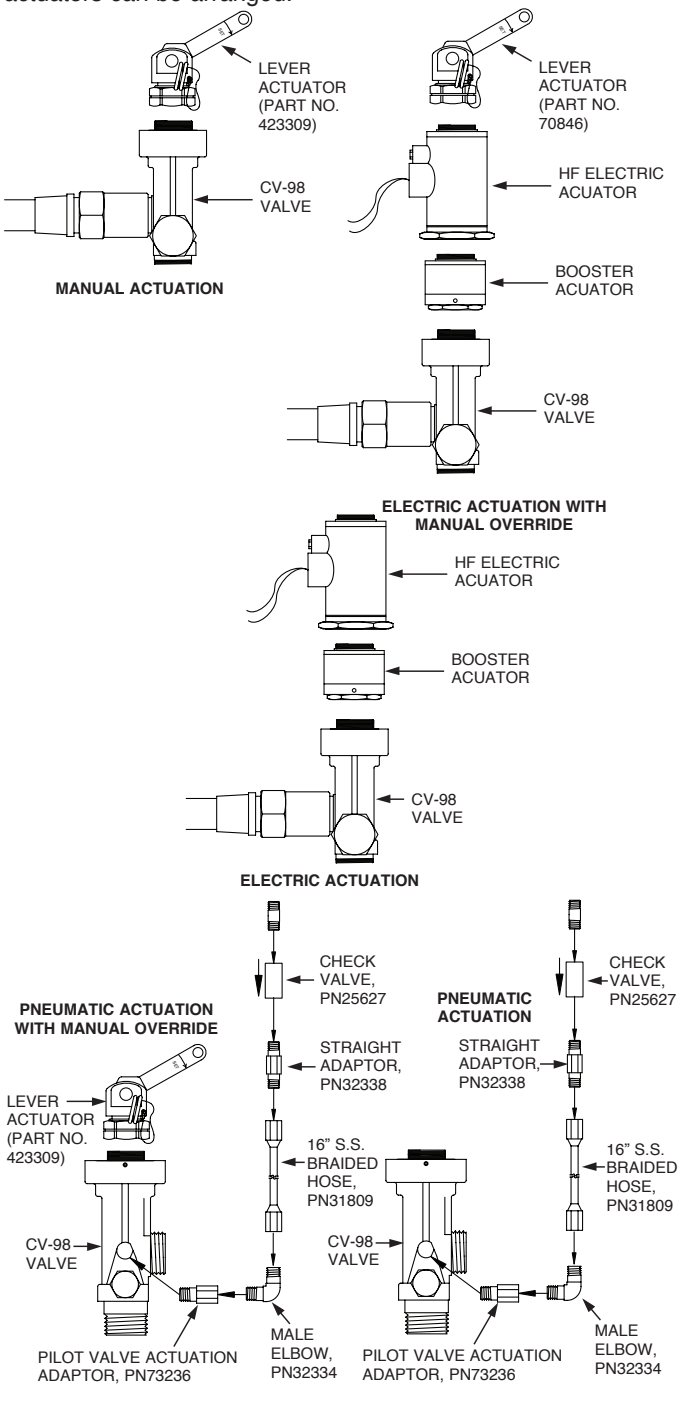


FIGURE 6-17
007427

INSTALLING ACCESSORIES

Manual Pull Station

MECHANICAL PULL STATION TO AUTOMAN II-C RELEASE – To install a mechanical pull station complete the following steps:

1. Insert ring pin in AUTOMAN II-C release. See Figure 6-18.

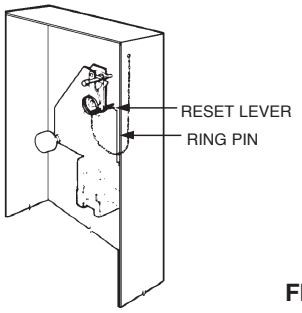


FIGURE 6-18
001894

2. If necessary, remove cartridge and install safety shipping cap on cartridge.
3. Select a convenient location in the path of exit for mounting the pull station(s) to the wall. Height and location of pull station should be determined in accordance with authority having jurisdiction.

   The total length of the wire rope used for each manual pull station within a system must not exceed 125 ft (38 m).

   The maximum number of pulley elbows that may be used per system is 18.
4. If junction box(es) is used, fasten a 4 in. (10 cm) junction box to wall or in wall where pull station is to be mounted, with mounting screws positioned so that when pull station cover is positioned in place, the printing will appear right side up and readable.

   ALTERNATE METHOD OF CONNECTION:

   a. Thread 3/4 x 1/2 in. reducing coupling to bushing on back of each cover assembly.

   b. Mount pull station cover(s) directly to wall at selected location so that printing is right side up and readable.
5. Install and secure 1/2 in. conduit, pulley tee (if required), and pulley elbows from each pull station to release assembly as necessary.

   If a pulley tee is used, it must be installed between the release assembly and first pulley elbow. The ambient temperature range of the pulley tee is between 32 °F to 130 °F (0 °C to 54 °C).
6. Feed wire rope from each pull station through conduit and each pulley elbow to cable lever located at release assembly.

> ***NOTICE***
>
> Make certain that wire rope rides on top and in center of pulley sheave. If the wire rope has been spliced to accommodate a longer run, do not allow the spliced ends to be within 12 in. (30 cm) of any pulley elbow or conduit adaptor.

7. Fasten pull station assembly to each junction box (if junction box is used).
8. Thread wire rope through rear guide hole in manual trip lever on release.
9. Pull all slack out of wire rope and thread end through sleeve, Part No. 4596.
10. Loop the wire rope back up around and through top of sleeve.
11. Position sleeve approximately 1/2 in. (1.3 cm) and crimp to secure wire rope. (Use the National Telephone Supply Company Nicopress Sleeve tool Stock No. 51-C-887 or equal to properly crimp stop sleeve.) See Figure 6-19.

MECHANICAL PULL STATION TO LEVER RELEASE – To install a mechanical pull station complete the following steps:

1. Select a convenient location in the path of exit for mounting the pull station(s) to the wall. Height and location of pull station should be determined in accordance with authority having jurisdiction.

   The total length of the wire rope used for each manual pull station within a system must not exceed 125 ft (38 m).

   The maximum number of pulley elbows that may be used per system is 18.

INSTALLING ACCESSORIES (Continued)

Manual Pull Station (Continued)

MECHANICAL PULL STATION TO LEVER RELEASE – (Continued)

2. If junction box(es) is used, fasten a 4 in. (10 cm) junction box to wall or in wall where pull station is to be mounted, with mounting screws positioned so that when pull station cover is positioned in place, the printing will appear right side up and readable.

   ALTERNATE METHOD OF CONNECTION:

   a. Thread 3/4 x 1/2 in. reducing coupling to bushing on back of each cover assembly.

   b. Mount pull station cover(s) directly to wall at selected location so that printing is right side up and readable.

3. Install and secure 1/2 in. conduit, dual/triple junction box, and pulley elbows from each pull station to release assembly as necessary.

4. Feed wire rope from pull station through conduit and each pulley elbow to cable lever located at release assembly.

   NOTICE

   Make certain that wire rope rides on top and in center of pulley sheave. If the wire rope has been spliced to accommodate a longer run, do not allow the spliced ends to be within 12 in. (30 cm) of any pulley elbow or conduit adaptor.

5. Fasten pull station assembly to each junction box (if junction box is used).

   ⚠ CAUTION

   Wire or pin the actuator lever in the "SET" position before connecting the cable to the lever. Failure to comply could result in accidental agent discharge.

6. Wire or pin the actuator lever in the "SET" position to prevent accidental discharge when installing the cable. See Figure 6-19.

7. Feed cable through hole in actuator lever and fasten with cable clamp. See Figure 6-19.

8. When installing, make certain there is at least 7 in. (17.8 cm) of free cable between the cable clamp and the flared end fitting for proper operation of lever. See Figure 6-19.

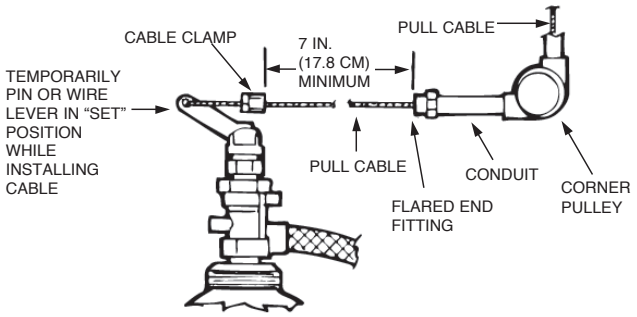


FIGURE 6-19
001895

9. Remove wire or pin that was used to hold the lever in place during cable installation.

ELECTRIC PULL STATION TO AUTOPULSE CONTROL PANEL – The electric pull station must be mounted in an area where it will not be exposed to physical abuse or a corrosive environment. The pull station should be mounted no higher than 60 in. (153 cm) from the floor, or what the authority having jurisdiction requires. See AUTOPULSE Installation, Operation, and Maintenance Manuals for detailed wiring instructions.

PNEUMATIC STATION TO PNEUMATIC CONTAINER VALVE – To install a manual pneumatic actuator complete the following steps:

1. Select a convenient location in the path of exit for mounting the pneumatic station to the wall. Height and location of pull station should be determined in accordance with authority having jurisdiction.

   The total length of 1/4 in. piping used for each pneumatic station within a system must not exceed 125 ft (38 m).

INSTALLING ACCESSORIES (Continued)

Manual Pull Station (Continued)

2. Weld or bolt mounting bracket to the selected surface. See Figure 6-20.

> ***NOTICE***
>
> Where bolting the mounting bracket is preferred, use 3/8 in. (corrosion-resistant) bolts of appropriate length, with lockwashers and nuts.

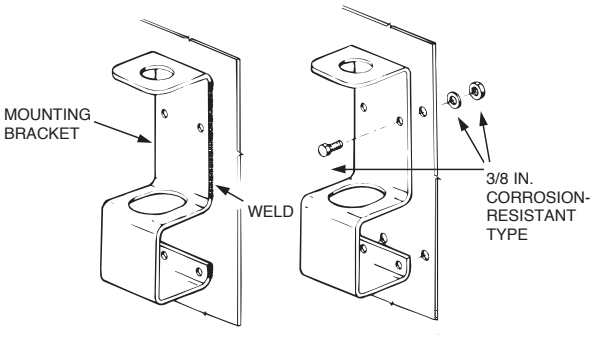


FIGURE 6-20
001898

3. Unscrew the RED actuator button from the actuator stem and slide actuator body through mounting hole on bracket. See Figure 6-21.
4. Rotate actuator body for desired location of actuation piping outlet connection. Screw locknut firmly onto actuator body and insert ring pin. Reassemble button onto the stem. See Figure 6-21.

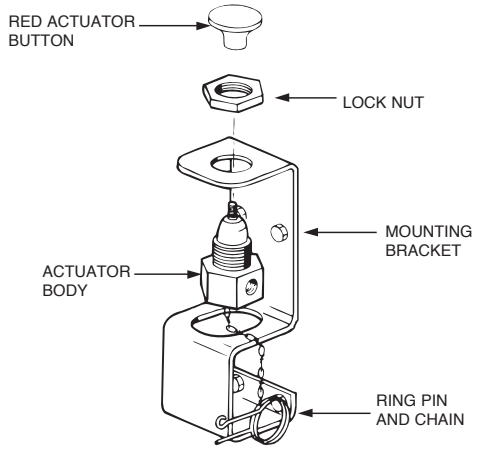


FIGURE 6-21
001899

5. Affix the appropriate operating nameplate adjacent to the manual actuator so that it is visible to attending personnel. See Figure 6-22.
6. Make certain ring pin is inserted through the RED actuator button to ensure safe cartridge installation. See Figure 6-22.

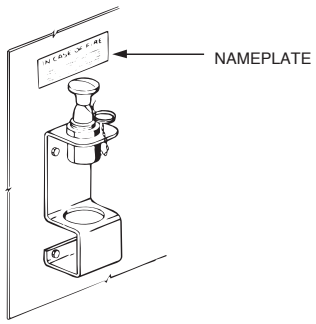


FIGURE 6-22
001900

7. Seal ring pin to actuator stem with visual inspection seal, Part No. 197. Make certain visual inspection seal is looped through ring pin and around actuator stem. Do not wrap seal around the boot cover. See Figure 6-23.

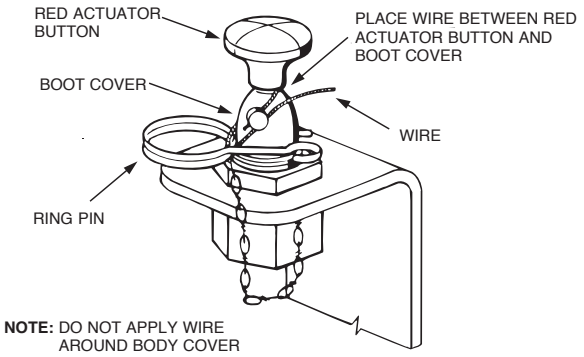


FIGURE 6-23
001901

8. Install 1/4 in. actuation piping from manual actuator to pneumatic actuator(s) on container valve(s). Make certain safety vent plug, Part No. 42175, is installed in actuation line.
9. Install nitrogen cartridge in actuator body.

INSTALLING ACCESSORIES (Continued)

Alarms

Several types of alarms are available for use with the carbon dioxide system. Some require 24 VDC power and others require 120 VAC. Make certain that the alarm chosen is compatible with the detection system control panel used.

24 VDC ALARMS – All alarms used with the AUTOPULSE Control System require 24 VDC power. See the Component Index in the appropriate AUTOPULSE Installation, Operation, and Maintenance Manual for description of available alarms.

120 VAC ALARMS – This type of alarm bell can only be utilized with an AUTOMAN II-C Release. It can not be used on an AUTOPULSE Control System.

To properly install the 120 VAC alarm, complete the following:

NOTICE

All wiring installations must comply with local, state, and federal codes and must be completed by a licensed electrician.

1. Install the alarm by first selecting a mounting location and installing a 4 in. octagon or 4 in. square junction box.
2. Run 1/2 in. conduit from the releasing device to the junction box.
3. Feed lead-in wires from release and power supply junction box.
4. Refer to appropriate wiring diagrams and connect wires in release junction box.
5. Disassemble alarm by removing bolt from face of bell housing.
6. Connect lead-in wires to leads from rear of alarm plunger mechanism.
7. Secure alarm plunger mechanism mounting plate to junction box.
8. Reassemble bell housing to alarm mechanism.

Selector Valves

Before installing the selector valves it is necessary to determine the required size of the valve. This is calculated by following the Design Section of the manual and by using the ANSUL High Pressure Carbon Dioxide Flow Calculation Program. The location of the selector valve should have been determined on the piping sketch and approved by the authority having jurisdiction.

Selector valves are available in the following sizes: 1 in., 2 in., 3 in., and 4 in. 1 in. selector valves are threaded and are used for 1/2 in., 3/4 in, and 1 in. pipe sizes. 2 in. selector valves are threaded and are used for 1 1/4 in., 1 1/2 in., and 2 in. pipe sizes. Reducing bushings are not supplied by Tyco Fire Protection Products. The 3 in. and 4 in. selector valves have an American Standard Raised Face flange. The 3 in. selector valve flange is a standard 8 hole pattern requiring a 7/8 in. bolt. The 4 in. selector valve flange is a standard 8 hole pattern requiring 1 in. bolts.

There are three basic types of operation for the selector valves: electrical, pneumatic and mechanical. The following general rules apply to all selector valve installations.

At the location where the valve(s) are to be mounted make certain they will not be subject to damage or corrosion.

⚠ CAUTION

Make certain directional arrow on valve body points in the direction of agent flow. If valve is incorrectly installed, system will not discharge.

Install valve(s) in the distribution piping making certain there is enough room above the valve to install the required actuation components. Also, make certain the flow direction arrow on the valve body is in the correct orientation.

NOTICE

If valve is very heavy, precautions must be taken to properly support the weight of the valve in the distribution piping network.

ELECTRICAL INSTALLATIONS:

Installing the Booster Actuator

Electrical installations require the use of a booster actuator, Part No. 428949 and an HF actuator, Part No. 73327. Refer to “HF Electric Actuator Application and Installation” Instruction, Part. No. 73330. The booster actuator is first installed directly to the actuation port of the selector valve. Make certain the booster actuator is in the set (armed) position. This can be confirmed by visually checking the position of the top and bottom pins.

When in the set position the top pin will be approximately flush with the top of the actuator. The bottom pin will be flush with the inside surface of the actuator. If the booster actuator requires setting use the arming tool, Part No. 429847, and follow the instructions listed in “Resetting the Booster Actuator.”

Hand tighten the booster actuator onto the selector valve.

INSTALLING ACCESSORIES (Continued)

Selector Valves (Continued)

ELECTRICAL INSTALLATIONS (Continued)

Installing the HF Actuator

Make certain the HF actuator is in the set (armed) position. When in the set position the top pin will be flush with the top of the actuator. If the actuator requires setting use the arming tool, Part No. 75433, and follow the instructions listed in "Resetting the HF Actuator."

Hand tighten the HF actuator onto the booster actuator.

If all other installations are complete connect electrical power to the HF actuator.

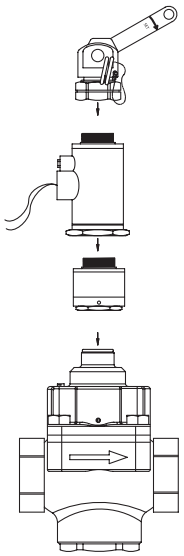


FIGURE 6-24
007384

PNEUMATIC INSTALLATIONS

The pressure operated stackable actuator, Part No. 428566, is necessary when pneumatic actuation is required for the selector valves. Pressure is typically supplied through the use of an AUTOMAN II-C Releasing Device. Make certain the pin in the pressure operated stackable actuator is in the set position. This can be confirmed by visually checking to make sure the pin is flush with the inside surface of the actuator. If the actuator requires setting use the arming tool, Part No. 75433. This actuator must be manually reset after each use. The actuator is installed by wrench tightening the swivel nut on top of the selector valve. A 1/4 in. pressure actuation line must then be attached to the 1/8 in. pressure port on the side of the actuator. Selector Valve Pneumatic Actuation Line Kit, Part No. 436127, must be used in the actuation line for the pressure operated stackable actuator.

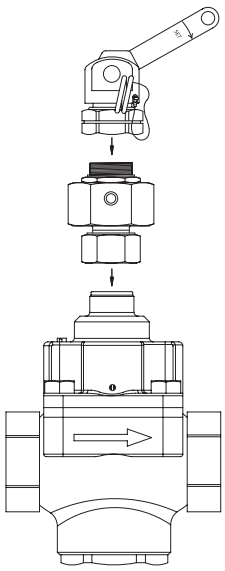


FIGURE 6-25
007385

INSTALLING ACCESSORIES (Continued)

Selector Valves (Continued)

MECHANICAL INSTALLATIONS

The manual lever release actuator provides a manual means of actuating the selector valve. Make certain the lever is in the set position and the pin is pushed up before installing the actuator. The manual lever release can be installed directly on top of the selector valve using Part No. 427207, on top of the pressure operated stackable actuator using Part No. 427207, or on top of the HF electric actuator using Part No. 70846.

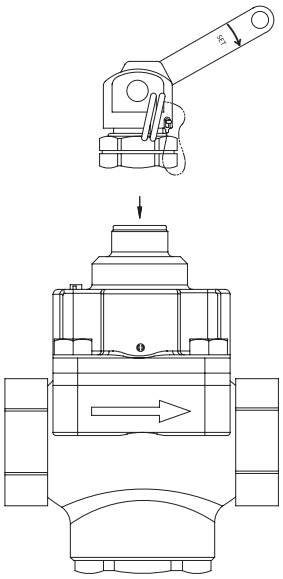


FIGURE 6-26
007386

Lock Handle Stop Valves

The 1/2 in. through 2 in. lock handle stop valves are threaded ball valves and the 3 in. and 4 in. lock handle stop valves are flanged ball valves. The valve must be installed in the direction of the flow label. When installing the valve, make certain the threads on the mating pipe are free from grit, dirt, or burrs. Care must be taken to assure that any pipe sealants used are not so excessively applied to the pipe threads that the valve cavity becomes obstructed. The valves are equipped with a monitoring switch to provide constant supervision of the valve at the control panel. Each valve shipping assembly includes detailed wiring instructions.

Direction/Stop Valves

Directional valves can be manually actuated in two ways; either at the valve with the hand lever or remotely with a manual cable pull station attached to a sector located on the directional valve.

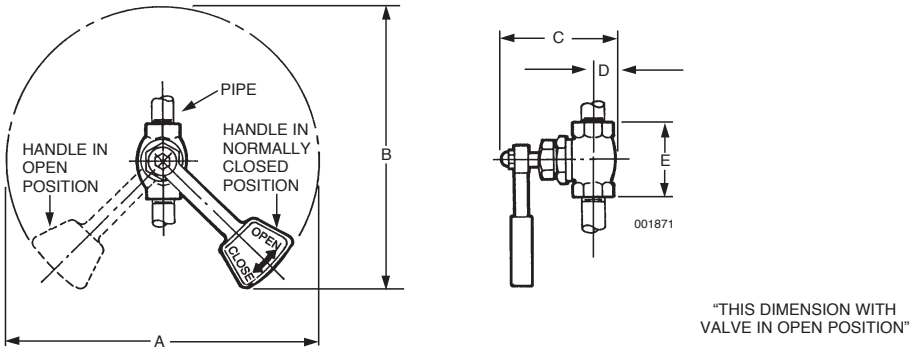
Before installing the valve in the carbon dioxide discharge piping, make certain there is enough clearance for either the hand lever to swing freely or the sector to rotate properly. See Figure 6-28 for dimension information.

NOTICE

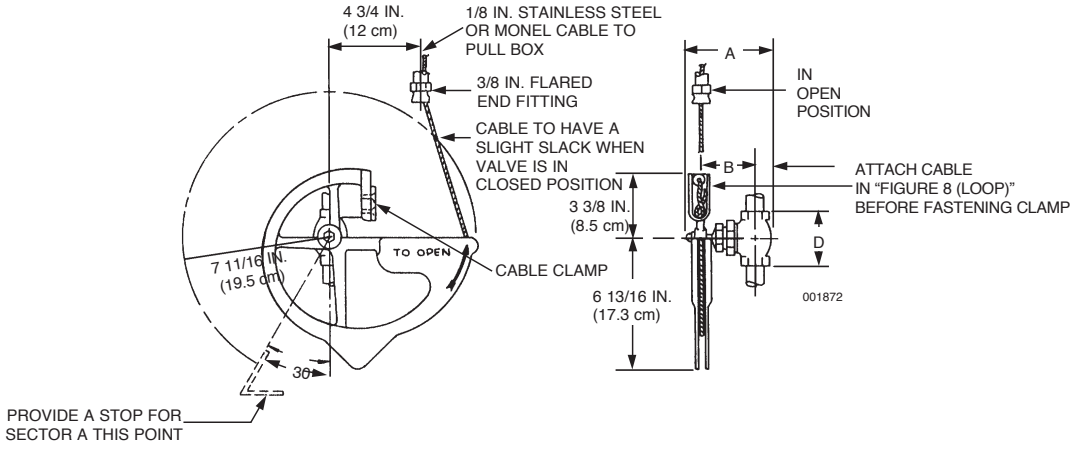
Maximum distance a manual cable pull station can be located from the sector on the directional valve is 125 ft (38.1 m). Operating force must be a maximum of 40 lb and require no more than 14 in. (35 cm) of travel to open valve.

INSTALLING ACCESSORIES (Continued)

Direction/Stop Valves (Continued)



Valve Size	A in.	(cm)	B in.	(cm)	C in.	(cm)	D in.	(cm)	E in.	(cm)
1/2 in.	10	(25.4)	9 3/8	(23.8)	4 3/4	(12)	7/8	(2.2)	215/16	(7.4)
3/4 in.	14	(35.5)	12 3/4	(32.3)	5 5/8	(14.2)	1 1/8	(2.8)	3 5/8	(9.2)
1 in.	14	(35.5)	12 3/4	(32.3)	6 3/8	(16.1)	1 7/16	(3.6)	41/8	(10.4)
1 1/4 in.	17	(43.1)	15 5/8	(39.6)	7 7/8	(20)	1 11/16	(4.2)	5	(12.7)
1 1/2 in.	17	(43.1)	15 5/8	(39.6)	8 1/4	(20.9)	1 7/8	(4.7)	5 1/2	(13.9)



Valve Size	A in.	(cm)	B in.	(cm)	C in.	(cm)	D in.	(cm)
1/2 in.	4 3/4	(12)	3	(7.6)	7/8	(2.2)	2 15/16	(7.4)
3/4 in.	5 5/8	(14.2)	3 5/8	(9.3)	1 1/8	(2.8)	3 5/8	(9.2)
1 in.	6 5/16	(16)	4 1/8	(10.4)	1 7/16	(3.6)	4 1/8	(10.4)
1 1/4 in.	8 1/8	(20.6)	5 1/4	(13.3)	1 11/16	(4.2)	5	(12.7)
1 1/2 in.	8 1/4	(20.9)	5 3/8	(13.6)	1 7/8	(4.7)	5 1/2	(13.9)

FIGURE 6-28

INSTALLING ACCESSORIES (Continued)

Pressure Trip

Pressure trips are used to actuate spring loaded or weighted mechanisms generally used to close doors or windows. The pressure trip should be securely mounted in the appropriate location and piped with 1/4 in. actuation piping back to the release device.

Pressure trips can be piped off the carbon dioxide discharge piping, which is the preferred method, or if the system is utilizing a mechanical release device, the pressure trip can be piped off the actuation line. See Figure 6-29.

Pressure trips can be piped in series and the last pressure trip must contain a 1/4 in. plug in the outlet port. See Figure 6-29. Maximum of two pressure trips in a single actuation line. Operating pressure must be a minimum of 75 psi (517 kPa) with a maximum load of 70 lb (31.8 kg).

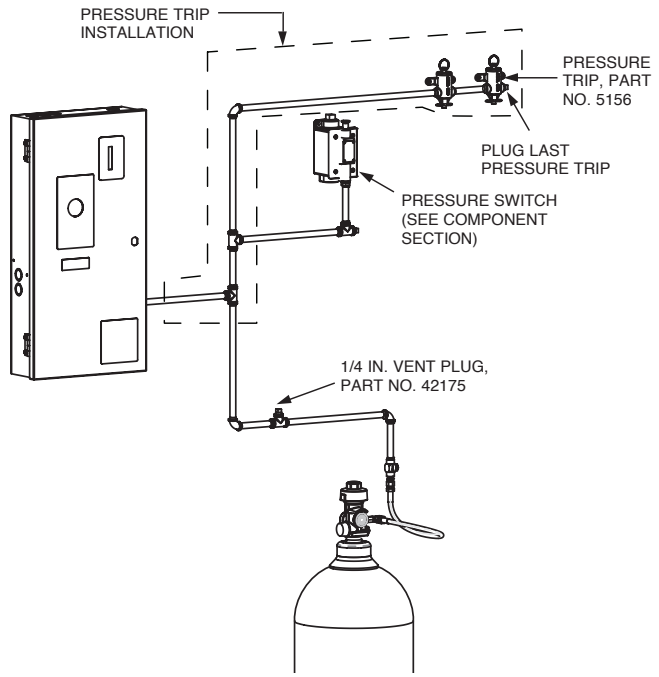


FIGURE 6-29
008610

Pressure Switch

Pressure switches are used to pneumatically operate electrical circuits which, in turn, will operate alarms, lights, or turn on or turn off equipment.

Pressure switches can be piped off the carbon dioxide discharge manifold, which is the preferred method, or if the system is utilizing an AUTOMAN II-C release device, the pressure switch can be piped off the actuation line. See Figure 6-29.

1. Mount pressure switch(es) in desired location(s) with appropriate fasteners.
2. Install piping from main actuation line or from the carbon dioxide distribution manifold to pressure switch fitting. Piping to be 1/4 in. Schedule 40, black or galvanized steel pipe.

Wire each pressure switch to other compatible components in accordance with manufacturer's instructions. A QUALIFIED ELECTRICIAN should connect all electrical components in accordance with the authority having jurisdiction.

Time Delay

The time delay is available in settings of 10, 30, 68, and 88 second delays. The time delay should be installed in the carbon dioxide distribution piping. On one and two container systems, the time delay should be mounted as close to the container as possible. On multiple container systems, the time delay should be mounted in the discharge manifold, between the pilot containers and the slave containers. The time delay can be mounted in any position: vertical, horizontal, or any angle in between. For ease of resetting, Tyco recommends installing the LT-10-R cartridge so it can be easily removed and replaced. Flow through the time delay is indicated by an ▸ arrow on the valve body. Confirm direction of flow matches ▸ direction of arrow. The time delay has 3/4 in. NPT inlet and outlet threads which will require reducing couplings if the manifold piping is less than 3/4 in. pipe. To prevent accidental activation of the time delay the LT-10-R cartridge should not be installed until the system is ready to be placed into service.

⚠ CAUTION

Use only approved LT-10-R nitrogen cartridges (Part No. 423423). Use of unapproved cartridges will result in improper system operation.

Pressure Operated Siren

The pressure operated siren operates off the carbon dioxide of the system. The siren should be piped with 1/4 in. Schedule 40 piping coming off the system discharge manifold and located before the time delay.

A maximum of four sirens are allowed on a single system.

The maximum pipe length is 200 ft (61 m) minus 1 ft (0.3 m) for every elbow used.

Sirens and piping should be securely mounted with the proper fasteners.

INSTALLING ACCESSORIES (Continued)

Odorizer

An Odorizer is an optional component added to a system that will emit a wintergreen scent when carbon dioxide has been discharged from a system. It includes a housing pressurized by carbon dioxide from the system, a burst disc, and a glass ampoule filled with oil of wintergreen.

Connection to the discharge piping system is through a 3/4 in. NPT male thread on the Odorizer.

Note: Use joint compound sparingly

The Odorizer must be installed as the last component (except the discharge nozzles) in the piping network.

Note: Oil of wintergreen liquid can be corrosive and can also damage seals and gaskets.

Note: The Odorizer must be installed so that the oil of wintergreen cannot migrate back to the containers, where damage to the internal pressure vessel could occur.

The Odorizer must be installed upright, with the threaded connection to the discharge piping at the bottom.

If oil of wintergreen is not to be discharged for testing, the Odorizer must be removed.

Note: The owner may wish to discharge the oil of wintergreen to train personnel what to expect after a discharge.

Note: If the Odorizer is removed, replace with a pipe plug before a discharge test to prevent leakage of carbon dioxide.

Note: Be sure to reinstall the Odorizer or replace the ampoule and burst disc after all testing has been completed. Care must be observed when replacing a spent ampoule due to broken glass.

TESTING ELECTRIC DETECTION/ACTUATION SYSTEM – AUTOPULSE CONTROL SYSTEM – CV-98 VALVE / HF ACTUATOR / BOOSTER ACTUATOR

⚠ CAUTION

Electric HF actuators, Part No. 73327 and Booster Actuator, Part No.428949, must not be installed on carbon dioxide CV-98 container valve during test. If installed, testing of the electric detection system will cause actuation and discharge of the fire suppression system.

In order to properly test the electric detection and actuation system, refer to the appropriate AUTOPULSE Control System Installation, Operation, and Maintenance Manual, and the HF Electric Actuator Application and Installation Sheet, Part No. 73330.

When HF Electric Actuator/Booster Actuator is actuated correctly, the piston in the bottom of the actuators will be locked in the down position. It will need to be reset using the correct reset tools (HF Actuator Arming Tool, Part No. 75433 and Booster Actuator Reset Tool, Part No. 429847). See HF Electric Actuator Application and Installation Sheet, Part No. 73330 for resetting instructions.

TESTING ELECTRIC DETECTION SYSTEM – AUTOMAN II-C RELEASE

When utilizing an AUTOMAN II-C release for electric detection or in combination with an AUTOPULSE Control System, refer to AUTOMAN II-C Releasing Device Installation, Operation, and Maintenance Manual, Part No. 17788, or for explosion-proof version, Part No. 31496, for detailed information.

TESTING TIME DELAY

To determine if the time delay is functioning properly, test in accordance with the following steps:

⚠ CAUTION

Disconnect all system containers from actuation and distribution piping before running time delay test. Failure to disconnect system containers could cause container actuation during time delay test..

1. Fill the test container and allow it to stabilize for a minimum of 48 hours for containers of 50 lb (22.7 kg) capacity and 72 hours for larger containers. The test container must be equipped with a siphon tube.

NOTICE

The test container should be adequately sized to allow for a minimum of 50 lb (22.7 kg) plus an additional 13.6 lb/min (6.17 kg/min) for each siren in the system.

2. Install a pressure gauge between the test container and the time delay device. The gauge should be calibrated with a capability of at least 1500 psi (103 bar) with increments of 10 psi (0.7 bar).

   Disconnect the piping from the outlet of the time delay and install another pressure gauge. See Figure 7-1.

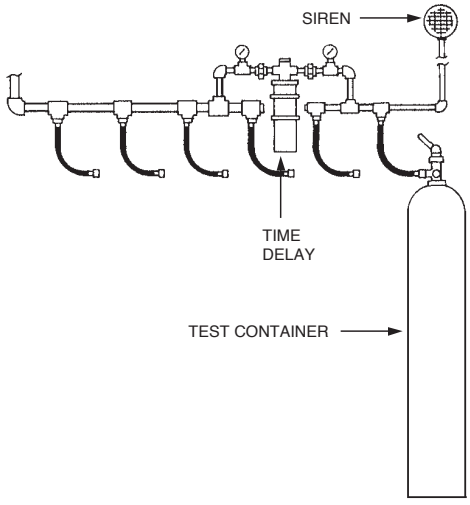


FIGURE 7-1
000927

NOTICE

The timing cycle should begin when carbon dioxide is introduced into the time delay device inlet and should end when the pressure gauge in the outlet of the time delay reads 50 psi (3.5 bar).

TESTING TIME DELAY (Continued)

3. Install new LT-10-R cartridge as follows:
   a. Remove safety shipping cap from nitrogen cartridge (LT-10-R), Part No. 423423, and weigh. **Note**: Fill weight must be +/– 1/4 oz. (7.1 g) of weight stamped on cartridge.
   b. Before installing cartridge, verify that the puncture pin in the cartridge actuator is fully retracted.
   c. Install cartridge. Hand tighten.
4. Open the test container to allow flow into the inlet of the time delay and simultaneously begin timing.
5. Observe the pressure gauge approximately 2-3 seconds after opening the test container and record the pressure reading.
6. Observe the pressure gauge on the outlet of the time delay. When the gauge reads 50 psi (3.5 bar), stop timing. Record the time delay period measured.
7. The time delay should operate at the set time of -0 seconds to +20% of the set time. **Example**: A 30 second time delay should operate at 30 to 36 seconds regardless of the ambient temperature.
8. To allow excess pressure to be released from the LT-10-R cartridge, depress the button on the purge valve located on the time delay control head.
9. Once pressure has been relieved, remove the spent LT-10-R cartridge.
10. Allow the remaining pressure in the time delay to vent through the actuator head for fifteen minutes.
11. Install new LT-10-R cartridge as follows:
    a. Remove safety shipping cap from nitrogen cartridge (LT-10-R), Part No. 423423, and weigh. **Note**: Fill weight must be +/– 1/4 oz. (7.1 g) of weight stamped on cartridge.
    b. Before installing cartridge, verify that the puncture pin in the cartridge actuator is fully retracted.
    c. Install cartridge. Hand tighten.

CLEAR ELECTRICAL EQUIPMENT

Refer to AUTOPULSE installation, operation, and maintenance manuals for detailed instructions on resetting the electric detection system.

NOTICE

If AUTOPULSE Control System is utilizing an AUTOMAN II-C releasing device for pneumatic actuation, AUTOPULSE panel will remain in trouble condition until AUTOMAN II-C is re-cocked.

If utilizing an AUTOMAN II-C release with thermal detectors, detectors must be cooled down, below their set point, before release can be reset.

Refer to AUTOMAN II-C Installation, Operation, and Maintenance Manuals, Part No. 17788 and 31496, for detailed instructions.

CHECK ELECTRICAL AND MECHANICAL EQUIPMENT

Piping and Nozzles

A fire condition could cause damage to the piping, nozzles, and possibly support members. Check all rigid pipe supports and all fitting connections. Take the nozzles off the piping, inspect them for damage, corrosion, or obstructions, then clean and reinstall, making certain they are aimed correctly.

Electric Detection System

AUTOMAN II-C RELEASING DEVICE – For complete resetting instructions, refer to Installation, Operation, and Maintenance Manuals, Part No. 17788 and 31496.

AUTOPULSE CONTROL SYSTEM – For complete resetting instructions, refer to the appropriate installation, operation, and maintenance manual, as well as the HF Electric Actuator Application and Installation Sheet, Part No. 73330.

H.A.D. Detection System

To properly reset the H.A.D. system, complete the following:

1. Check the condition of all H.A.D. heads and all tubing runs in the hazard area. Make certain no damage has been caused to them from the fire.
2. Remove the control head from the discharged carbon dioxide container.
3. The carbon dioxide container can now be removed for recharge.
4. Reset the control head by moving the control head indicator to the “SET” position. Indicator arrow on reset control must point to “SET.”
5. If H.A.D. control head was actuated manually, reset manual release lever, insert ring pin, and secure with visual inspection seal.

Pressure Switch

Reset the pressure switch by completing the following steps:

1. Make certain all pressure in the line to the switch has been properly relieved.
2. Push in red knob on end of pressure switch plunger.
3. Make certain electrical function has been correctly reset.

PLACE SYSTEM BACK IN SERVICE

Recharge CO_2 Container

Because of the number of different style valves existing in older systems, this manual will address recharging for the current CV-98 valve and also two other styles, the CV-90 and the AP8 valve.

CV-98 and CV-90 VALVE

The following steps must be followed when removing discharged CV-98 and CV-90 containers from the system:

1. Disconnect the flex bend from the container(s) outlet.
2. Remove all actuators from the container valves.
3. If necessary, remove 1/4 in. actuation hose from pneumatic actuation port.
4. If necessary, install plug, Part No. 42410, into pneumatic actuation port and wrench tighten.
5. With container secured in bracket, relieve any remaining pressure in the container by completing the following:
   a. Make certain discharge cap IS NOT on valve outlet. See Figure 8-1.

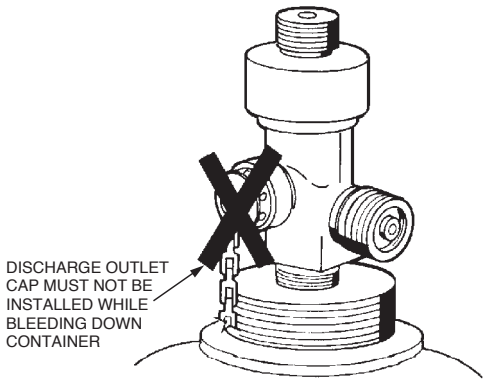


FIGURE 8-1
001515

PLACE SYSTEM BACK IN SERVICE (Continued)

Recharge CO_2 Container (Continued)

CV-98 and CV-90 VALVE (Continued)

⚠ CAUTION

Attach bleed down device, Part No. 426028 for the CV-98 or Part No. 416656 for CV-90, to fill inlet of discharged containers only. Never attach this device to fully charged containers as this will cause high pressure to discharge out of the fill inlet. Also, install device hand tight only. Do not wrench tighten. Note: Bleed-down device, Part No. 416656, CANNOT be used on CV-98 valve and Bleed-down device, Part. No. 426028, CANNOT be used on CV-90 valve.

b. Attach bleed down device, Part No. 426028 for the CV-98 or Part No. 416656 for CV-90, to valve fill inlet. See Figure 8-2.

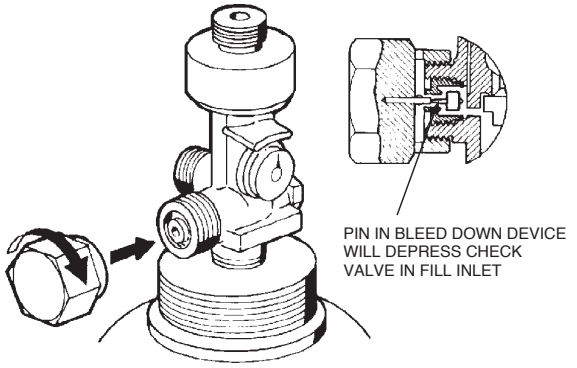


FIGURE 8-2
001853

c. Bleed residue pressure from container. Make certain container is completely empty before removing bleed down device.

d. With container completely empty, remove bleed down device and install safety shipping cap.

e. Complete Steps A through D on all discharged containers, both pilot and slave.

Refilling CV-98 or CV-90 Valve Containers

NOTICE

If maintenance is performed on the CV-90 valve before recharging, use Mobil 1 oil on all O-Rings. Mobil 1 oil is the ONLY approved lubricant for the CV-90 valve.

The following steps must be followed when recharging the CV-98 and CV-90 valve:

1. Remove shipping cap and weigh container. Compare actual container weight with weight stamped on container shoulder. Also check the last date stamped on the container. Refer to NFPA 12 (Standard on Carbon Dioxide Extinguishing Systems) for hydrostatic test guidelines.
2. If pressure and/or weight must be relieved, perform the following:
   a. Secure container.
   b. Make certain discharge outlet cap IS NOT in place on valve outlet. See Figure 8-3.

NOTICE

When depressing the actuation plunger, the anti-recoil will close on the valve outlet, but a small amount of CO_2 will discharge out of the outlet, around the anti-recoil device.

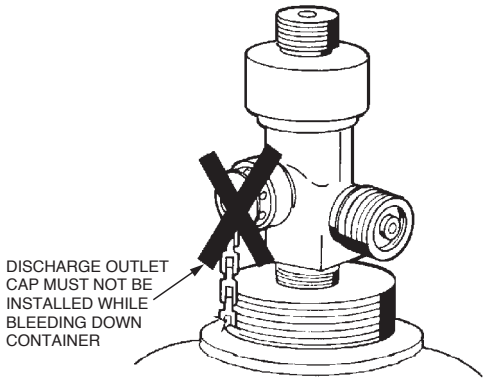


FIGURE 8-3
001515

c. Depress actuation plunger stem, located on top of valve, and relieve all container pressure. See Figure 8-4. It may be necessary to repeat this step a number of times until all pressure is relieved.

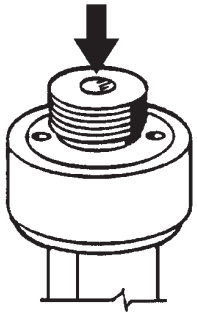


FIGURE 8-4
001516

PLACE SYSTEM BACK IN SERVICE (Continued)

Refilling CV-98 or CV-90 Valve Containers (Continued)

3. With container completely empty, once again, depress actuation plunger down until it bottoms out (approximately 3/8 in. (0.9 cm)) and quickly release. This will cause the plunger stem to pop up flush or within 0.010 in. (0.2 mm) below the top of the actuation attachment port. This is the correct position for proper seating.

⚠ CAUTION

Failure to use proper fill adaptor may cause the valve to actuate due to back pressure build-up.

NOTICE

For recharging the CV 98 and CV-90 container valve, it is necessary to have a special fill adaptor assembly. The assembly, Part No. 45389 for the CV-90 and Part No. 423659 for CV-98, consists of a fill adaptor, having a 1/2-14 straight male thread for hose attachment and a discharge outlet cap.

4. Attach the fill adaptor to the side filling inlet of the valve. See Figure 8-5. The side filling inlet is the lower of the two large threaded ports. Make certain the washer is in place in the fill adaptor. Screw the adaptor on the valve filling inlet, wrench tighten.
5. Screw the knurled discharge outlet cap on the discharge outlet, the highest large threaded port on the side of the valve. See Figure 8-5. This should be hand tight only as the pin inside the cap acts to open the anti-recoil. By holding the anti-recoil open, the residual pressure under the main valve seat is relieved, allowing the valve to properly close.

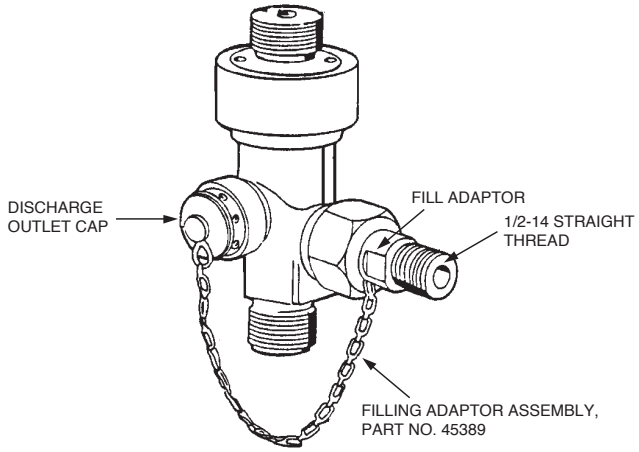


FIGURE 8-5
001517

6. Place the container on scale and secure with bracket or chain to prevent movement during filling.

⚠ CAUTION

To prevent injury or damage, take proper safety precautions when filling carbon dioxide containers.

7. Attach filling hose to fill adaptor and begin filling by slowly opening the fill valve. Gradually open the fill valve until it is completely open.

NOTICE

If the top actuation plunger on the CV-90 drops during recharge, the valve has opened. Stop filling and refer to instructions in CV-90 O-Ring Reconditioning Kit, Part No. 415250.

You may see a slight amount of residual CO_2 coming out the discharge outlet during recharging. This is acceptable and will stop when the container pressure increases high enough to completely seat the valve main seal.

8. Fill to container capacity.

NOTICE

If CO_2 continues to discharge out the CV-90 valve outlet after recharge is complete, the main seal is leaking. Reclaim CO_2 and replace the valve with a new CV-98 valve. Refer to Valve Consolidation Bulletin located in the appendix.

9. Check container valve for leaks.

NOTICE

When filling the CV-98 container, dry ice may occasionally form on the seat of the fill check. The best method is to warm the fill port to melt the dry ice. A heat gun is the recommended method to melt the dry ice. DO NOT use a torch or other direct flame device for this purpose as it could damage the valve and cause it to fail, potentially injuring the filler.

10. Mark the date and weight on the record card attached to the neck of the container. Replace valve shipping cap to prevent damage during shipping and handling.

FILLING ADAPTORS

The CV-98 valve utilizes filling adaptors different from those used for the CV-90 valve. When filling the CV-98 container assemblies, use the following components:

CV-98 Fill Adaptor for CO_2 Containers	Part No. 423659
CV-98 Conversion Adaptor (Converts CV-90 Fill Adaptor for use on CV-98 valves)	Part No. 423657

AP-8 VALVE

For recharging the AP-8 container valve, it is necessary to have a special filling adaptor assembly. The assembly, Part No. 45389, is composed of a hose adaptor, having a 1/2-14 male thread for hose attachment and a discharge outlet cap.

The hose adaptor is attached to the side filling inlet, normally covered with a knurled cap with four holes in it. See Figure 8-6. Be sure that the O-Ring is in place around the charging hole in the adaptor before attaching adaptor. Install adaptor wrench tight.

The knurled discharge outlet cap should be attached onto the discharge outlet, the lowest outlet on the side of the valve. See Figure 8-6. This should be attached hand tight only as the pin inside the cap acts to hold open the outlet check. By holding the outlet check open, the residual pressure under the main valve seat is relieved, allowing the valve to close properly.

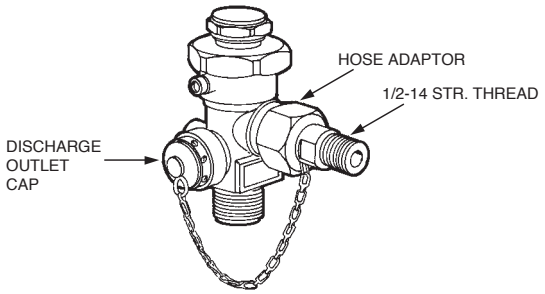


FIGURE 8-6
001921

⚠ CAUTION

To prevent injury or damage, take proper safety precautions when filling carbon dioxide containers.

To recharge container, place container on scale and secure with bracket or chain to prevent movement during filling. Attach filling adaptor as described above. Attach filling hose to adaptor and fill with dry CO_2 to proper weight. The total full weight of the container and valve is stamped on the side of the valve.

When the charging hose and adaptor are detached, the check in the filling inlet will seat under pressure and no further sealing is necessary. The knurled cap should be replaced on the filling inlet for protection.

Check valve for possible leaks. Should a leak be discovered, the following information may help in determining what the cause is.

Note: Repair parts for the AP-8 valve are no longer available. If cleaning and lubrication does not solve the problem, refer to the Valve Consolidation bulletin located.

Any leak at the valve outlet indicates leakage past the main check. This could be caused by:

a. Nick on the main seat.

b. Foreign material on or damage to the main seal of the main check.

c. The main check is not seating properly due to distortion of the valve bore. Such distortion is usually evident in the area of the safety disc due to over-torquing of the safety disc nut. A maximum torque of 23 ft-lb (31.2 N·m) is to be used when installing the safety disc nut.

Leakage out of the top of the valve (with the bonnet cap removed), usually also indicates leakage past the main check.

Leakage out the vent may be due to a number of reasons:

a. Leakage past the pressure release check, Part No. 42394, due to foreign material on the seat, damage to its seal, or a scored release check seat, Part No. 42413.

b. Leakage past the copper washer, Part No. 42255, below the release check seat.

⚠ CAUTION

When removing the piston assembly, Part No. 42416, make certain piston is not forced down before taking it from the valve body. If piston is forced down, either by hand or by the tool used to remove it, it could cause the valve to open and the container to discharge.

Whether leakage is due to a. or b. above, it can be determined by removing the bonnet cap and the piston assembly, Part No. 42416, and observing whether the leak is at the periphery of the release check seat (indicating leakage past the copper washer) or past the check stem (indicating leakage past the check).

c. Leakage out of the vent may also be caused by leakage past the copper washer, Part No. 42387, under the valve bonnet.

AP-8 VALVE (Continued)

Leakage at the filling inlet can be caused by:

a. Ice forming in the inlet or attachments

b. Leakage past the filling check due to foreign material on the seat, damage to its seal, or scoring of the seat.

Be sure to mark the date and weight on the record card attached to the neck of the container. Replace valve shipping cap to prevent damage during handling and shipping.

RESETTING ACTUATORS

Pneumatic Valve Actuator – CV-90/MAX Valve

Reinstall each pneumatic valve actuator by completing the following steps:

1. Ensure that pneumatic valve actuator internal piston is in the full "UP" position by forcing the piston up, by hand or with a short length of 1/8 in. to 1/4 in. pipe. See Figure 8-7.

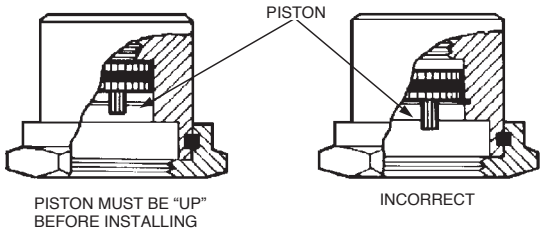


FIGURE 8-7
001883

2. Remove the actuation safety shipping cap from the top of the valve and wrench-tighten the pneumatic actuator to the slave assembly.
3. Repeat Steps 1 and 2 for each additional pneumatic valve actuator.

CV-98 Electric Actuator – Replace Metron Protractor

To replace the METRON PROTRACTOR in the electric actuator, complete the following steps:

1. Remove power from electric actuator circuit.
2. If equipped, remove manual actuator.
3. Remove electric actuator from container valve.
4. Unscrew actuator cap. See Figure 8-8.

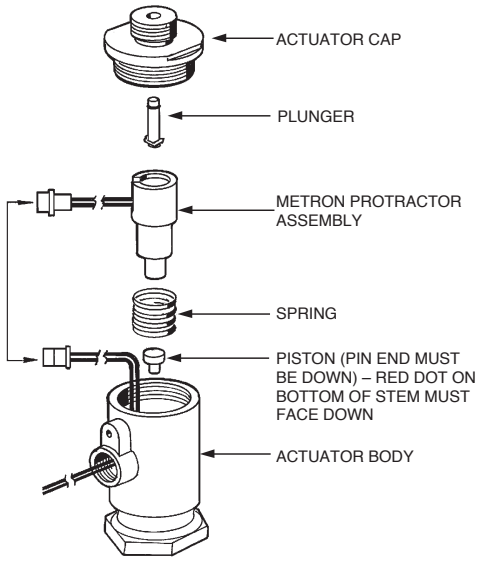


FIGURE 8-8
001854

5. Lift actuated METRON PROTRACTOR assembly housing out of actuator body and disconnect wire plug. See Figure 8-8.
6. Discard used METRON PROTRACTOR assembly. A discharged METRON PROTRACTOR will have the stainless steel pin extending approximately 1/8 – 3/16 in. out of the bottom. On a new METRON PROTRACTOR, the pin will not be visible. See Figure 8-9.

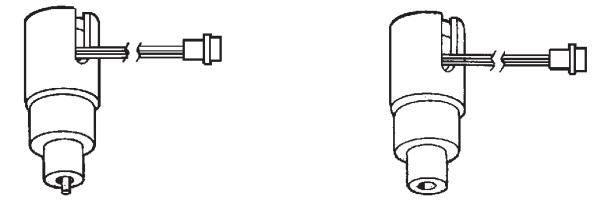


FIGURE 8-9
001855

RESETTING ACTUATORS (Continued)

CV-98 Electric Actuator – Replace Metron Protractor (Continued)

7. Before positioning new METRON PROTRACTOR housing assembly, Part No. 423958, into electric actuator body, remove the piston. Thoroughly clean piston and inside bottom surface of actuator body of any dirt or foreign material. As the pin is emitted from a METRON PROTRACTOR when it operates, a small metal disc is ejected. This metal disc may be found resting on the piston inside the actuator body. Before replacing the actuated METRON PROTRACTOR assembly with a new one, make certain this metal disc is removed from the piston area. Replace piston back into body. When replacing piston, make certain pin end is facing down. Red dot on bottom of stem must be facing down. See Figure 8-10.
8. Position METRON PROTRACTOR housing assembly back into electric actuator body, making certain METRON PROTRACTOR housing assembly and spring are properly seated in bottom of actuator body. See Figure 8-10.

⚠ CAUTION

Before completing Step No. 8, make certain the control panel is reset and the release circuit is not in an actuated mode.

9. Plug wire connector together. See Figure 8-8.
10. Carefully tuck wire connector at an approximately 45° angle down along the inside of METRON PROTRACTOR housing assembly between the spring and the inside of the actuator body. **Note:** Make certain wires are not located over top of housing.
11. Make certain plunger moves freely up and down. See Figure 8-10.
12. Screw actuator cap back on actuator body. Securely tighten.
13. Make certain piston on bottom of actuator is free to move up and down. See Figure 8-10. **Note:** If pin is not visible in bottom hole of actuator, the piston has been re-installed incorrectly. Red dot on bottom of piston stem must be visible from bottom of actuator. Disassemble and correct.

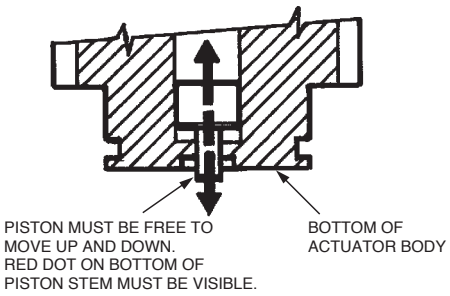


FIGURE 8-10
001857

After the container(s) has been secured back in the bracket and discharge hose(s) have been reconnected, attach the actuator(s) by completing the following:

⚠ CAUTION

Make certain all electric power from the panel to the actuator has been disconnected. Failure to disconnect power may cause system to accidentally discharge.

1. Make certain CV-98 actuator has been recharged with a new METRON PROTRACTOR assembly.

⚠ CAUTION

Before installing electric actuator to top of CV-98 valve, make certain piston in bottom of actuator is free to move up and down. Refer to Figure 8-10.

2. Attach CV-98 actuator to top thread of CV-98 valve. Securely tighten.
3. If the manual actuator was used, apply a small amount of lubricant, such as WD-40, to the pin between the handle and the body.
4. Attach manual actuator to CV-98 electric actuator.

RESETTING ACTUATORS (Continued)

HF Electric Valve Actuator

Note: HF Electric Actuator cannot be used to actuate an AP-8 valve.

⚠ CAUTION

The carbon dioxide system will actuate if the HF electric actuator pin is down, in the fired position. Before each installation, make certain all actuators are in the armed condition.

Before reinstalling HF electric actuator, check to see if the actuator is armed or fired.

1. Check to see if the actuator is armed or fired by referring to steps a. and b. respectively.
   a. The actuator is armed if the following conditions exist: See Figure 8-11.
   – When the plunger is pushed, the actuator pin will move freely up and down approximately 1/8 in. (3.2 mm).
   – When the actuator is held upright, the plunger will be approximately flush with the top surface of the actuator.
   – The pin is retracted 0.010 to 0.015 in. (0.25 to 0.38 mm) inside the reference surface at the bottom of the actuator.

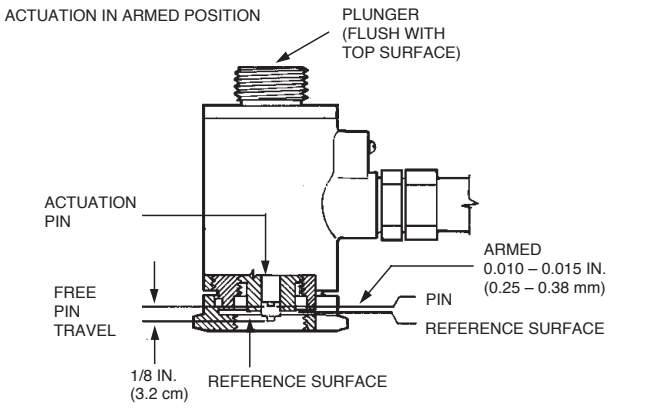


FIGURE 8-11
001922

b. The actuator is in the fired position if the following conditions exist: See Figure 8-12.

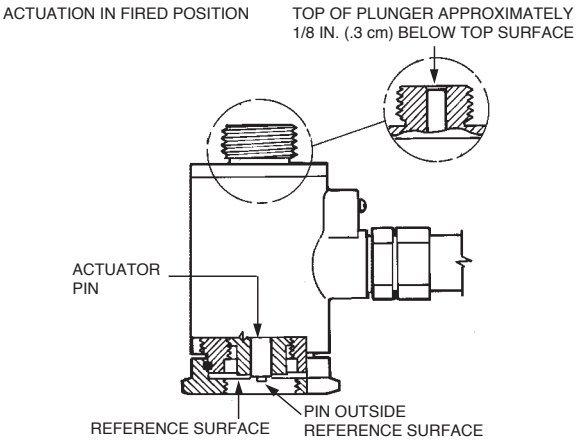


FIGURE 8-12
001923

– When pushed, the actuator pin will have no movement.
– When the actuator is held upright, the plunger will be below the top surface of the actuator.

2. To arm the actuator, use arming tool, Part No. 75433, to force the pin inside the reference surface until a distinct “click” is heard. See Figure 8-13. To verify that the actuator is properly armed, repeat Step 1.

NOTICE

Considerable force, 45-50 lb (13-23 kg) is required to arm the HF electric actuator.

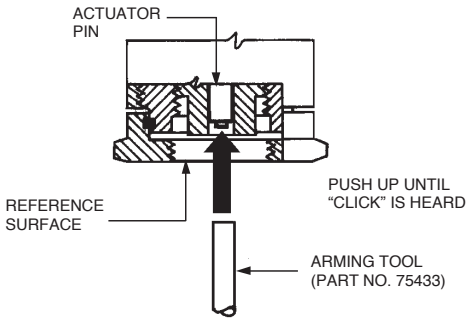


FIGURE 8-13
001924

RESETTING ACTUATORS (Continued)

HF Electric Valve Actuator (Continued)

3. If no other actuators are to be installed on top of the HF electric actuator, reinstall black safety cap after arming.
4. To install HF actuator to container valve, remove actuation shipping cap from top threads of CV-90 container valve. **Note:** When installing to a CV-98 container valve or selector valve, first install the booster actuator. See booster actuator resetting instructions below.
5. Make certain HF electric actuator is properly armed. See Step 2.
6. Thread the HF electric actuator onto top threads of container valve or booster actuator as appropriate. Do not exceed 10 ft lb torque. See Figure 8-14.
7. Feed lead and wire seal, Part No. 75568, through hole in actuator swivel hex. Wrap around actuator body, over conduit connection, and back to swivel hex. Then, crimp seal to wire.

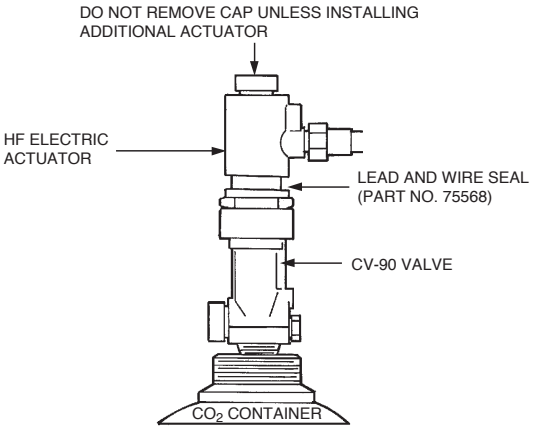


FIGURE 8-14
001851

Resetting the Booster Actuator

The booster actuator must be reset after each use. A reset tool, Part No. 429847, is required. To reset, complete the following steps:

1. Remove the booster actuator from the CV-98 valve or the selector valve.
2. Make certain the internal threaded plug in the reset tool, Part No. 429847, is backed out approximately half way.
3. Hand tighten the reset tool into the bottom of the booster actuator.
4. Turn the internal threaded plug of the reset tool clockwise (into the booster actuator) until a “snap” is heard.
5. Back out the internal threaded plug one to two turns.
6. Unscrew the reset tool from the booster actuator.
7. Check to confirm that it is reset properly: the top pin of the booster actuator will be approximately flush with the top of the actuator. The bottom pin will be flush with the inside surface of the actuator.

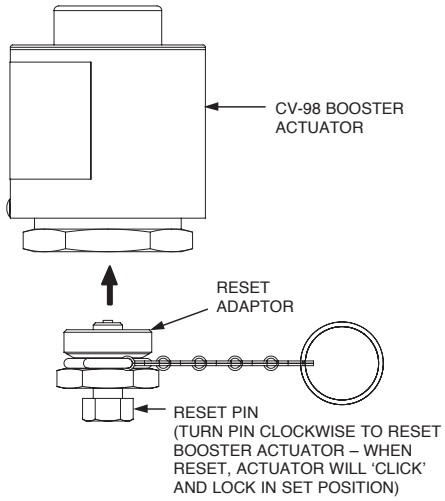


FIGURE 8-15
007025

Once both the HF actuator and the booster actuator are reset, install both and restore electrical power to the system if all other recharge steps have been completed.

Manual Lever Actuator

Before installing manual actuator back unto container valve or electric actuator, make certain manual actuator is in the “SET” position. On manual actuator with ring pins, make certain ring pin is in position and secured with a visual inspection seal.

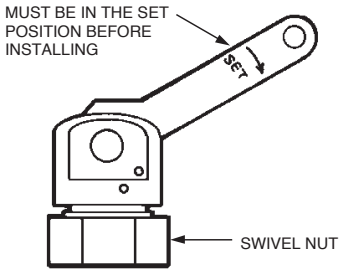


FIGURE 8-16
001850

RESETTING ACTUATORS (Continued)

Manual Pull Station

Reset remote manual pull station by using the appropriate means for the specific device:

1. If necessary, remove set screw that is retaining the break glass rod.
2. If necessary, carefully remove any remaining broken glass from station.
3. Press and position handle in proper location against cover and slide the replacement glass break rod, Part No. 4834, through stud and handle.
4. Tighten set screw into stud.

Replace AUTOMAN II-C Cartridge

Install new cartridge by completing the following steps:

1. Remove shipping cap and weigh replacement cartridge. Replace if weight is 1/2 ounce (14.2 g), or more, below weight stamped on cartridge.
2. Make certain release mechanism is cocked and lock bar is installed. Then, install replacement cartridge into release assembly and hand tighten.
3. Remove lock bar.
4. Secure cover on AUTOMAN and seal with visual inspection seal.
5. Record recharge date on tag attached to unit and/or in a permanent file.

Time Delay

Once the time delay has been activated it may be reset and returned to service.

1. To allow excess pressure to be released from the LT-10-R cartridge, depress the button on the purge valve located on the time delay control head.
2. Once pressure has been relieved remove the spent LT-10-R cartridge.
3. Allow the remaining pressure in the time delay to vent through the actuator head for fifteen minutes.
4. Install new LT-10-R cartridge as follows.
   a. Remove safety shipping cap from nitrogen cartridge (LT-10-R), Part No. 423423, and weigh. **Note:** Fill weight must be +/– 1/4 oz (7.1 g) of weight stamped on cartridge.
   b. Before installing cartridge, verify that the puncture pin in the cartridge actuator is fully retracted.
   c. Install cartridge. Hand tighten.

⚠ CAUTION

Use only approved LT-10-R nitrogen cartridges (Part No. 423423). Use of unapproved cartridges will result in improper system operation.

$HPCO_2$ Odorizer

Replace ampoule and burst disc assembly by completing the following steps:

1. Remove Odorizer Assembly from piping.
2. Remove ruptured burst disc assembly and Odorizer cap.
3. Remove broken ampoule from Odorizer and clean all parts. Care must be observed when removing a spent ampoule due to broken glass.
4. Using Recharge Kit, Part No. 42284, carefully install new burst disc and ampoule.
5. Thread cap on Odorizer and re-install onto piping. Ensure all parts are wrench tightened to prevent CO_2 from leaking during discharge.

NOTES:

INSPECTION

Inspection is a “quick check” that a system is operable. It is intended to give reasonable assurance that the system is fully charged and will operate. This is done by seeing that the system has not been tampered with and there is no obvious physical damage, or condition, to prevent operation. The value of an inspection lies in the frequency, and thoroughness, with which it is conducted. Systems should be inspected at regular monthly intervals, or at more frequent intervals when circumstances require.

The following visual checks should be performed during a CO_2 system inspection:

MANUAL PULL STATION

Check that it has not been tampered with and is ready for operation. Lead and wire seal or break rod must be in place.

DETECTORS

Check that they are in place, not damaged or coated with dirt, grease, paint, or any contaminating substance.

CONTROL SYSTEM

Make certain the panel has not been tampered with and that the green “power on” light is illuminated. No other system lights should be on.

AUTOMAN II-C RELEASING DEVICE

Make certain the releasing device has not been tampered with, and that the visual inspection seal is not broken or missing.

CONTAINER

Check that the mounting brackets are secure. Visually check container for any dents or signs of corrosion.

CONTAINER ACTUATOR

Make certain the electric, pneumatic, or manual actuator(s) are in place. Check that the actuation piping and/or wiring has not been tampered with or disconnected.

DISTRIBUTION PIPING AND NOZZLES

Check that the piping is secure and nozzles are in place. Make certain the nozzles are not covered with dirt, grease, or paint. Make certain nozzles are aimed in the proper direction.

ALARMS AND SIRENS

Check that they are in place and are not damaged.

MISCELLANEOUS

Make a check list of details that are important to the system which are not discussed above, i.e., has the hazard size or configuration been changed? Are dampers or doors jarred open where they shouldn’t be? Are special signs in place? Are nozzles obstructed by equipment moved in the area? Are there any conditions that would hinder the operation of the system?

NOTES:

SEMI-ANNUAL MAINTENANCE EXAMINATION

Systems shall be maintained at regular intervals, not more than six-months apart, or when specifically indicated by an inspection. Maintenance is a "thorough check" of the system. It is intended to give maximum assurance that a system will operate effectively and safely. It includes a thorough examination and any necessary repair, recharge, or replacement. It will reveal if there is a need for hydrostatic testing of the container.

NOTICE

Before proceeding with semi-annual maintenance examination, insert lock bar in AUTOMAN II-C release and remove nitrogen cartridge. Install safety shipping cap on cartridge.

1. Note appearance of the system and component parts, checking for mechanical damage or corrosion.
2. Remove HF, CV-90, or CV-98 electric valve actuator or H.A.D. actuator (if provided) from each container and reinstall actuation safety shipping cap on the valve.
3. Remove pneumatic valve actuator or lever actuator (if provided) from each tank and reinstall safety shipping cap on the valve assembly.
4. Remove container(s) from distribution piping by disconnecting flexible hose at the valve outlet. Install safety shipping cap on container valve.
5. Check nameplate(s) for readability, corrosion, or looseness.
6. Check distribution piping for mechanical damage or corrosion. Make certain piping connections are tight and hangers are secured to prevent excessive pipe movement during a discharge.
7. Examine each discharge nozzle for mechanical damage, corrosion, or obstructions. Make certain discharge nozzle orifices are clear and aimed correctly at the hazard.
8. Check actuation piping for mechanical damage or corrosion. Make certain the piping connections are tight and hangers are secure.
9. Check each pull station for mechanical damage. Make certain each pull station is unobstructed, that operating instructions are visible and (if provided), break glass rod is in place.
10. If provided, make certain each electric or pneumatic detector is unobstructed and not damaged. Inspect each detector for dirt and dust accumulation.
11. Weigh each container by completing the following:
    a. Loosen the mounting bracket on the container.
    b. Attach the weigh scale, Part No. 74241, to the weigh rail above the container. Thread lifting yoke, Part No. 69877, on container collar threads and lift container from floor. Record weight while container is suspended. See Figure 10-1.

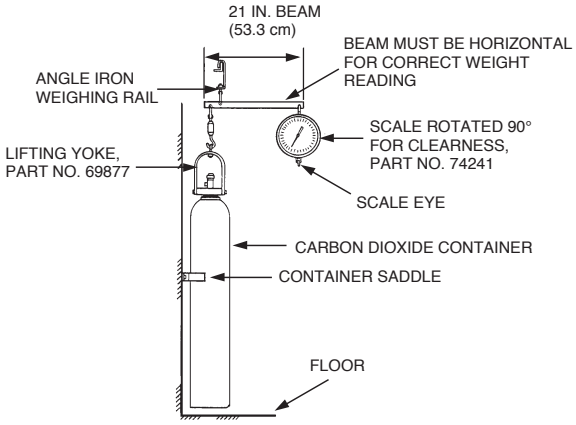


FIGURE 10-1
001925

    c. Compare actual weight with weight stamped on the container collar. If container weight loss exceeds 10 percent of weight stamped on container collar, container must be recharged or replaced.
    d. Check hydrostatic date stamped on container collar. Container may require hydrostatic testing. Refer to NFPA 12, Standard on Carbon Dioxide Extinguishing Systems, for detailed instructions concerning hydrostatic test requirements.

⚠ CAUTION

DO NOT reinstall any actuator to container valve at this time. Actuators must remain off valve until they have been tested. If actuators are mounted on container valve at this time, accidental actuation and discharge will result when actuators are tested.

12. Re-attach flex bend to container valve outlet and reclamp container in bracket.

SEMI-ANNUAL MAINTENANCE EXAMINATION (Continued)

Thermal Detection/Electric AUTOMAN II-C Release

1. Make certain ring pin is in place in AUTOMAN II-C release mechanism. See Figure 10-2.

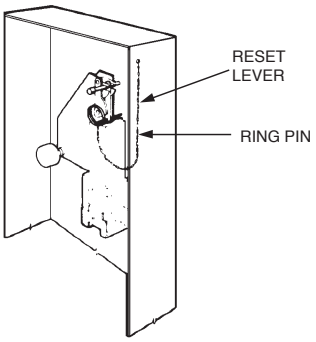


FIGURE 10-2
001894

2. Make certain no pneumatic actuator(s) are installed on any container valves.

⚠ CAUTION

During this maintenance test, if any pneumatic actuators are installed to container valves, the testing of the system will cause container discharge.

3. If necessary, install LT-30-R cartridge in AUTOMAN II-C release. Hand tighten.
4. Remove ring pin and manually test system by operating the remote manual pull station or push “STRIKE” button on AUTOMAN II-C release.
5. After operating manually, check that all functions have been accomplished and the pneumatic container actuator(s) have actuated.
6. Cock AUTOMAN II-C release mechanism using cocking lever, Part No. 26310, and install ring pin.
7. Remove empty nitrogen cartridge and reset all auxiliary devices.
8. Remove gasket from cartridge receiver in AUTOMAN II-C release mechanism. Check gasket for elasticity or cuts and replace if necessary. Clean and coat gasket lightly with a good grade of extreme temperature grease. Reinstall gasket into cartridge receiver.

⚠ CAUTION

Pneumatic container actuator must be reset prior to installing on container valve or system will actuate.

9. Reset pneumatic container actuator(s). See Figure 10-3.

NOTICE

Piston should move up and down with little resistance. If not, a small amount of Dow Corning 4 Silicone grease should be placed into the piston bore when the piston is up. Operate the piston up and down 2 or 3 times. If the piston is still hard to move, the actuator should be replaced. Make certain actuator is left in the reset (piston up) position.

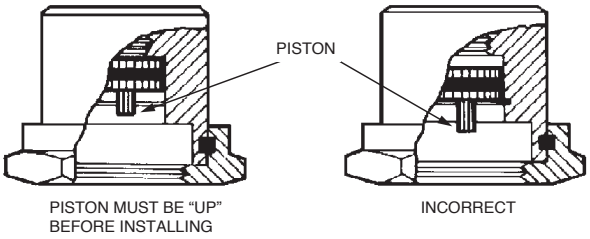


FIGURE 10-3
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10. Make certain the release mechanism is cocked and ring pin is removed.

SEMI-ANNUAL MAINTENANCE EXAMINATION (Continued)

Thermal Detection/Electric AUTOMAN II-C Release (Continued)

11. Test each thermal detector by submerging in a pan of hot or boiling water or by using an approved heat lamp. Test each detector individually and recock release mechanism after each test.

NOTICE

If system does not fire, check the integrity of the solenoid by using an ohmmeter and measure the resistance of the solenoid coil. If it is not within the resistance range, replace solenoid. There are two different solenoids used in the AUTOMAN II-C release and their resistance is as follows:

Number Stamped on Solenoid	Resistance Measurement
P4-2025	12-18 ohms
TBX16-C-12 VDC	21-32 ohms

12. With release mechanism cocked, install ring pin. See Figure 10-2.
13. Before installing cartridge, reset all additional equipment by referring to appropriate section of Resetting and Recharge, Section 9.
14. Remove shipping cap and weigh each nitrogen cartridge. Replace if weight is 1/2 ounce (14.2 g), or more, below weight stamped on cartridge.
15. Make certain release mechanism is cocked and ring pin is installed, screw replacement cartridge into release mechanism and hand tighten.
16. Remove ring pin.
17. Install cover on enclosure, install ring pin through "STRIKE" button, and secure with visual seal, Part No. 197.
18. Reinstall pneumatic actuator(s) on container valves. Make certain actuator(s) have been reset before installing on container valve.
19. Record semi-annual maintenance date on tag attached to unit and/or in a permanent file.

H.A.D. Detection/Mechanical Control Head

⚠ CAUTION

For systems with dual control heads, remove both heads before testing.

1. With mechanical control head disconnected from container, remove locking pin and operate local manual control to test proper operation of head.
2. Replace locking pin and reset control head. DO NOT attach control head to container valve.
3. Inspect H.A.D. detectors and clean off all foreign substances. Failure to clean detecting device will seriously impair the efficiency of the automatic feature of the system which may result in a failure to detect the fire.
4. To test the H.A.D. detector, make certain the control head is not mounted on the container valve. Submerge H.A.D. detector in container of hot water, 180 °F to 200 °F (82 °C to 93 °C). It is not advisable to use torch on detectors since they are very sensitive to heat. Check control heads to see that they have operated.

⚠ CAUTION

Be sure head is reset. Indicator arrow must be in "SET" position. Failure to reset will cause accidental discharge of the system. Allow detectors to cool for at least five minutes before resetting control heads.

5. Reset control head, reinstall on container valve, and wrench tighten swivel nut. Do not exceed 10 ft-lb (13.6 N·m) torque.
6. Install new seal wire on control head(s).
7. Record semi-annual maintenance date on tag attached to unit and/or in a permanent file.

General Annual System Verification

1. Check and test the carbon dioxide system for operation.
2. Check that there have been no changes to the size, type, and configuration of the hazard and system.
3. Check and test all time delay for operation.
4. Check and test all audible alarm for operation.
5. Check and test all visual signal for operation.
6. Check that all warning signs are installed.

SEMI-ANNUAL MAINTENANCE EXAMINATION (Continued)

Electric Detection/AUTOPULSE Control System

⚠ CAUTION

Remove the electric valve actuator and any additional actuators from the container valve prior to testing the AUTOPULSE Control System. Failure to do so will cause accidental system discharge.

Perform system semi-annual maintenance by following the instructions listed in the appropriate AUTOPULSE Control System Installation, Operation, and Maintenance Manual and the following:

- HF Electric Actuator Application and Installation Sheet, Part No. 73330

►

TYPICAL APPLICATIONS

In order to help understand the design process, four example hazards are covered in this section. There may be different design approaches that can be taken for each hazard. The examples are only intended to show what has to be done to complete the design and hydraulic calculations.

An outline of each of the example hazards is provided and each item is listed in the numerical order in which it should be performed.

EXAMPLE NO.1 – DIP TANKS – RATE BY AREA APPLICATION

A dip tank operation may consist of a simple hand-held basket of parts or may be a more complex operation with material being conveyed to the tank by an overhead monorail conveyor, or parts dipped by an overhead hoist.

The tank may or may not be enclosed by a hinged lid and often has a drain board or drip area which may or may not be enclosed.

The hazard to be protected would be the liquid surface of the tank, any hanging material above the drip area, the drain board/drip area, and any associated pumps within the area.

If an exhaust system is utilized, this must also be protected.

It is essential that all pumps, motorized conveyor, heaters, and ventilation fans be stopped. The exhaust duct, if any, must be dampered to close upon system actuation.

If paint and varnish operations are present, it is common practice for the dipped parts to be dried in a bake oven. The authority having jurisdiction may require that the oven also be protected.

Hazard:

The dip tank is 8 ft 6 in. x 4 ft 3 in. with a 6 in. free board.

The drainboard is 7 ft x 4 ft 3 in.

Nozzles are not to be closer than 30 in. from the surface.

Hanging parts are within 1 ft 6 in. from the surface.

Factory Mutual is the insurance authority.

Step No. 1: Determine the Hazard Area(s)

The first step is to determine what areas are to be protected and if the areas are a liquid surface or a wetted surface. In this example the dip tank measuring 8 ft 6 in. long by 4 ft 3 in. wide is considered a fuel in depth or liquid surface hazard. The drainboard measuring 7 ft long by 4 ft 3 in. wide would be considered a wetted surface hazard.

Step No. 2: Determine the Location, Number, and Type of Nozzles Required

Nozzles should be located where they will not interfere with the work process or any maintenance requirements of the equipment. When choosing the type of nozzle to use it will be advantageous to pick a nozzle which provides the greatest area of coverage using the lowest possible flow rate. In this case it has been determined the nozzles will be mounted 30 in. above the hazard and a Type “D” nozzle would be the most efficient based on the coverage and flow rate of the nozzle.

For the liquid surface of the dip tank, the D type nozzle at a height of 30 in. will protect an area having a side-of-square of 2.24 feet. The number of nozzles required to protect the dip tank is calculated as follows:

$$\text{Nozzles Required} = \frac{\text{Linear Length}}{\text{Side of Square}} \times \frac{\text{Linear Width}}{\text{Side of Square}}$$

$$= \frac{8.5 \text{ ft}}{2.24 \text{ ft}} \times \frac{4.25 \text{ ft}}{2.24 \text{ ft}}$$

$$= 3.8 \times 1.9$$

$$= 4 \times 2$$

= 8 D type nozzles at 30 in. with a flow rate of 20 lb/min

For the wetted surface of the drainboard, the D type nozzle at a height of 30 in. will protect an area having a side-of-square (wetted) of 2.65 feet. The number of nozzles required to protect the drainboard is calculated as follows:

$$\text{Nozzles Required} = \frac{\text{Linear Length}}{\text{Side of Square}} \times \frac{\text{Linear Width}}{\text{Side of Square}}$$

$$= \frac{7.0 \text{ ft}}{2.65 \text{ ft}} \times \frac{4.25 \text{ ft}}{2.65 \text{ ft}}$$

$$= 2.6 \times 1.6$$

$$= 3 \times 2$$

= 6 D type nozzles at 30 in. with a flow rate of 20 lb/min

Step No. 3: Determine the Quantity of Agent Required

Now that the type, number, and flow rate of each nozzle has been determined, the quantity of agent can now be calculated. For local applications only, the liquid portion of the discharge is effective therefore the quantity of agent must be increased by 40%.

The liquid discharge times for local applications must be a minimum of 30 seconds (0.5 minutes). Total agent requirements are then calculated as follows:

Agent Quantity = Number of Nozzles x Flow Rate per Nozzle x 1.4 x Discharge Time

= 14 D type Nozzles x 20 lb/min/nozzle x 1.4 x 0.5 minutes

= 196 lb of CO_2

EXAMPLE NO.1 – DIP TANKS – RATE BY AREA APPLICATION (Continued)

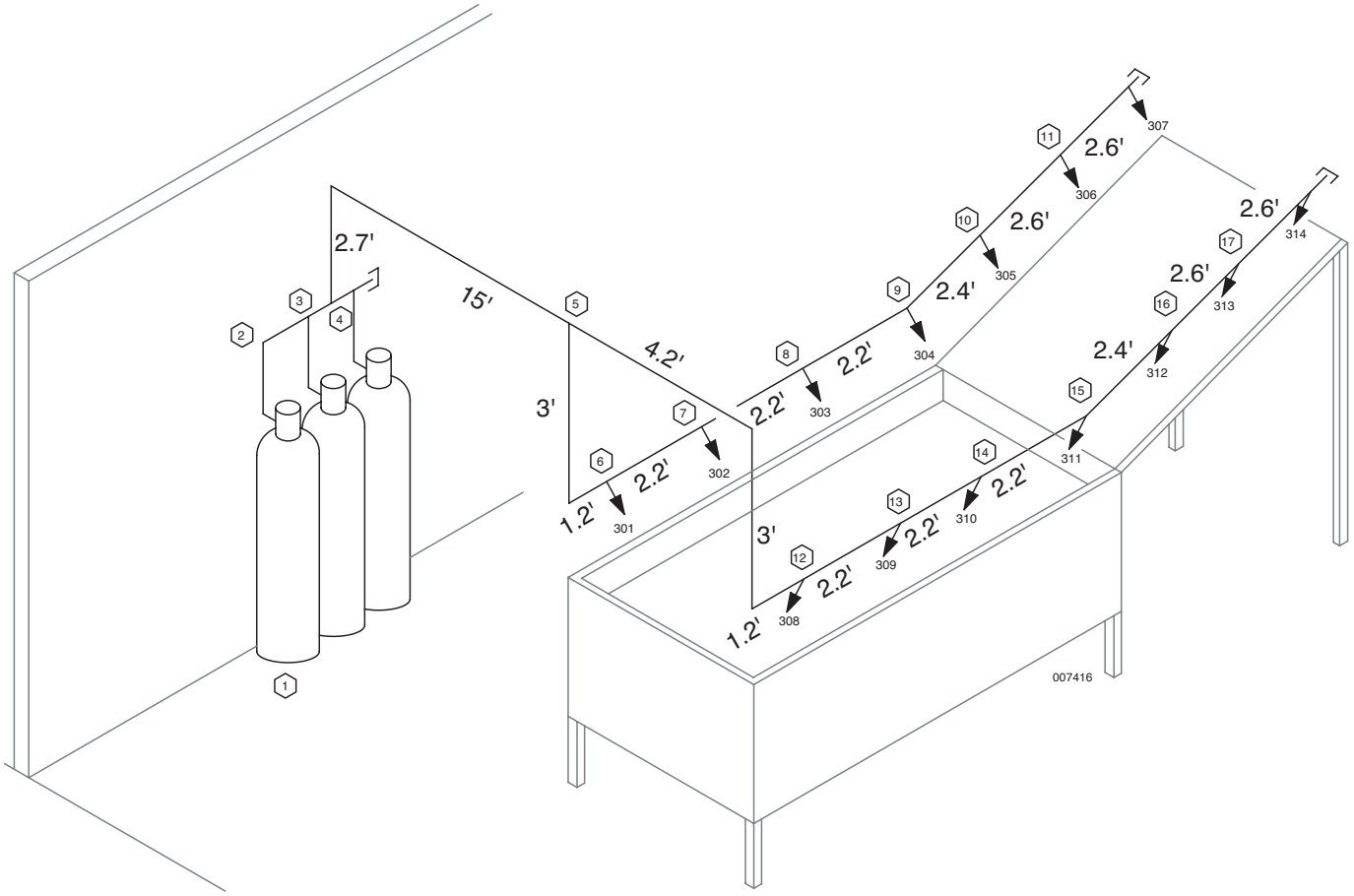
Step No. 4: Isometric Drawing

Complete a drawing or sketch of the pipe layout from the agent containers to all the nozzles. The pipe isometric should be as accurate as possible and include all pipe lengths from the most remote agent container out to all of the 14 nozzles.

Step No. 5: Flow Calculations

Node points for entering information into the HP CO_2 hydraulic flow calculation can be inserted on the pipe isometric drawing completed in Step No. 4. These node points are then entered into the High Pressure Carbon Dioxide Flow Calculation Program to verify the design meets the 30 second minimum discharge time and the flow rate requirements at the nozzles.

Note: In this example it was necessary to use 225 lb of agent to confirm the design hydraulically.



EXAMPLE NO.1 – DIP TANKS – RATE BY AREA APPLICATION (Continued)

ANSUL HP CO_2 FLOW CALCULATION PROGRAM

System Conditions

Number of containers: 3 each containing 75 lb CO_2. Total agent 225 lb
Engineering units (ft, lbs, psia) are specified
Local Application system
Flow rate is specified for each nozzle
Calculation based on 70 degree Fahrenheit pre-discharge Pipeline Temperature

Pipe Data Input

Sec Start	Sec End	Nominal Pipe Size	Length (ft)	Elev (ft)	90's Tee	Side Tee	Thru Cplg	Union/ CO_2	Qty (ft)	Eql
1	2	1/2 - 40T	0.10	0.00	0	0	0	0	0.00	38.0
2	3	0 - DFT	0.50	0.00	1	0	0	0	0.00	0.0
3	4	0 - DFT	0.50	0.00	0	1	0	0	0.00	0.0
4	5	0 - DFT	17.70	2.70	1	1	0	0	0.00	0.0
5	6	0 - DFT	4.20	-3.00	1	1	0	0	0.00	0.0
6	301	0 - DFT	0.10	0.00	0	1	0	0	20.00	0.0
6	7	0 - DFT	2.20	0.00	0	0	1	0	0.00	0.0
7	302	0 - DFT	0.10	0.00	0	1	0	0	20.00	0.0
7	8	0 - DFT	2.20	0.00	0	0	1	0	0.00	0.0
8	303	0 - DFT	0.10	0.00	0	1	0	0	20.00	0.0
8	9	0 - DFT	2.20	0.00	0	0	1	0	0.00	0.0
9	304	0 - DFT	0.10	0.00	0	1	0	0	20.00	0.0
9	10	0 - DFT	2.40	0.00	0	0	1	0	0.00	0.0
10	305	0 - DFT	0.10	0.00	0	1	0	0	20.00	0.0
10	11	0 - DFT	2.60	0.00	0	0	1	0	0.00	0.0
11	306	0 - DFT	0.10	0.00	0	1	0	0	20.00	0.0
11	307	0 - DFT	2.70	0.00	0	1*	1	0	20.00	0.0
5	12	0 - DFT	8.40	-3.00	2	0	1	0	0.00	0.0
12	308	0 - DFT	0.10	0.00	0	1	0	0	20.00	0.0
12	13	0 - DFT	2.20	0.00	0	0	1	0	0.00	0.0
13	309	0 - DFT	0.10	0.00	0	1	0	0	20.00	0.0
13	14	0 - DFT	2.20	0.00	0	0	1	0	0.00	0.0
14	310	0 - DFT	0.10	0.00	0	1	0	0	20.00	0.0
14	15	0 - DFT	2.20	0.00	0	0	1	0	0.00	0.0
15	311	0 - DFT	0.10	0.00	0	1	0	0	20.00	0.0
15	16	0 - DFT	2.40	0.00	0	0	1	0	0.00	0.0
16	312	0 - DFT	0.10	0.00	0	1	0	0	20.00	0.0
16	17	0 - DFT	2.60	0.00	0	0	1	0	0.00	0.0
17	313	0 - DFT	0.10	0.00	0	1	0	0	20.00	0.0
17	314	0 - DFT	2.70	0.00	0	1*	1	0	20.00	0.0

* Section contains one or more side tees configured as dirt traps.

EXAMPLE NO.1 – DIP TANKS – RATE BY AREA APPLICATION (Continued)

ANSUL HP CO_2 FLOW CALCULATIONS

Agent Storage Conditions

Nominal Storage Pressure is 750 psi at 70 degrees Fahrenheit
75 lb of carbon dioxide is stored in each of 3 containers.
Total carbon dioxide discharged is 225 lb

Pressure Drop Results

Sec Start	Sec End	Nominal Pipe Size	Length (ft)	Equiv Length (ft)	Elev (ft)	Tee/ Mfld	Start psi	Term psi	Flow (lb/min)
1	2	1/2 40 T	0.1	38.1	0.0	CV-98	750	727	93.7
2	3	1/2 40 T	0.5	2.1	0.0	1 cyl	727	725	93.7
3	4	1/2 40 T	0.5	3.6	0.0	2 cyl	725	712	187.4
4	5	1/2 40 T	17.7	22.4	2.7	3 cyl	712	484	281.1
5	6	1/2 40 T	4.2	8.9	-3.0	Side	484	458	140.5
6	301	1/2 40 T	0.1	3.2	0.0	Side	458	458	20.39
6	7	1/2 40 T	2.2	3.2	0.0	Thru	458	452	120.11
7	302	1/2 40 T	0.1	3.2	0.0	Side	452	452	20.11
7	8	1/2 40 T	2.2	3.2	0.0	Thru	452	446	100.0
8	303	1/2 40 T	0.1	3.2	0.0	Side	446	446	20.0
8	9	1/2 40 T	2.2	3.2	0.0	Thru	446	445	80.0
9	304	1/2 40 T	0.1	3.2	0.0	Side	445	445	20.0
9	10	1/2 40 T	2.4	3.4	0.0	Thru	445	443	60.0
10	305	1/2 40 T	0.1	3.2	0.0	Side	443	443	20.0
10	11	1/2 40 T	2.6	3.6	0.0	Thru	443	441	40.0
11	306	1/2 40 T	0.1	3.2	0.0	Side	441	441	20.0
11	307	1/2 40 T	2.7	6.8	0.0	Thru	441	441	20.0
5	12	1/2 40 T	8.4	12.5	-3.0	Thru	484	461	140.6
12	308	1/2 40 T	0.1	3.2	0.0	Side	461	461	20.42
12	13	1/2 40 T	2.2	3.2	0.0	Thru	461	455	120.18
13	309	1/2 40 T	0.1	3.2	0.0	Side	455	455	20.18
13	14	1/2 40 T	2.2	3.2	0.0	Thru	455	449	100.0
14	310	1/2 40 T	0.1	3.2	0.0	Side	449	449	20.0
14	15	1/2 40 T	2.2	3.2	0.0	Thru	449	448	80.0
15	311	1/2 40 T	0.1	3.2	0.0	Side	448	448	20.0

EXAMPLE NO.1 – DIP TANKS – RATE BY AREA APPLICATION (Continued)

ANSUL HP CO_2 FLOW CALCULATIONS Version

Pressure Drop Results

Sec Start	Sec End	Nominal Pipe Size	Length (ft)	Equiv Length (ft)	Elev (ft)	Tee/ Mfld	Start psi	Term psi	Flow (lb/min)
15	16	1/2 40 T	2.4	3.4	0.0	Thru	448	446	60.0
16	312	1/2 40 T	0.1	3.2	0.0	Side	446	446	20.0
16	17	1/2 40 T	2.6	3.6	0.0	Thru	446	444	40.0
17	313	1/2 40 T	0.1	3.2	0.0	Side	444	444	20.0
17	314	1/2 40 T	2.7	6.8	0.0	Thru	444	444	20.0

Calculation based on 70 degree Fahrenheit pre-discharge Pipeline Temperature

Nozzle Performance Summary

Nozzle Number	Nominal Pipe Size	Nozzle Code	Weight (lb) Discharged	Initial Vapor Time (sec)	Liquid Time (sec)	End of Discharge Time (sec)
301	1/2 40 T	4.00	16.4	0.2	34.3	34.5
302	1/2 40 T	4.00	16.1	0.2	34.3	34.5
303	1/2 40 T	4.00	16.0	0.3	34.3	34.5
304	1/2 40 T	4.00	16.0	0.3	34.2	34.5
305	1/2 40 T	4.00	16.0	0.4	34.1	34.5
306	1/2 40 T	4.00	16.0	0.6	33.9	34.5
307	1/2 40 T	4.00	15.9	0.8	33.7	34.5
308	1/2 40 T	4.00	16.4	0.2	34.3	34.5
309	1/2 40 T	4.00	16.2	0.3	34.2	34.5
310	1/2 40 T	4.00	16.0	0.3	34.2	34.5
311	1/2 40 T	4.00	16.0	0.4	34.2	34.5
312	1/2 40 T	4.00	16.0	0.5	34.1	34.5
313	1/2 40 T	4.00	16.0	0.7	33.9	34.5
314	1/2 40 T	4.00	15.9	0.9	33.6	34.5

Total carbon dioxide discharged is 225 lb

Messages

Hydraulic calculation was successful.

Shortest liquid discharge time for Local Application Nozzle is 33.6 sec

The system is calculated using nozzle codes rounded and fixed at nearest 1/2 code. Convergence of nozzle flow rate and pressure to ± 2.5%

EXAMPLE NO. 2 – TRANSFORMERS – TOTAL FLOOD APPLICATION

Transformers may either be set in the open or enclosed in vaults. Transformers in vaults are treated as surface type total flood hazards. If there is a possibility that a heated transformer core could produce a deep seated fire in the insulation, then treating the hazard as a deep seated application could be justified. This should be determined by consulting with the owner and the authority having jurisdiction. In this example the transformer is classified as a surface type fire with a minimum design concentration of 34%. Electrical equipment should be shut down at the time of discharge.

Hazard:
A transformer vault has the dimensions of 10 ft x 12 ft x 15 ft high. The vault has one unclosable opening measuring 2 ft x 1 ft with its center line 3 ft from the ceiling.

Step No. 1: Determine the Hazard Volume
The first step is to calculate the volume of the enclosure being protected. Multiply the length times the width to determine the area and then multiply the area times the height to determine the volume.

Transformer Vault = 10 ft x 12 ft x 15 ft = 1,800 cu ft

Step No. 2: Determine Volume of Structural Deductions
The volume of solid objects in the hazard area that are not removable can be deducted from the volume being protected. Volume reductions may be taken for such structures as beams, columns, cut out room sections, ducts which pass completely through the area without any openings, and any other large, permanently fixed objects that cannot be removed from the hazard.

In this example there are no solid, permanent structures or equipment to deduct from the hazard.

Step No. 3: Determine the Area of Unclosable Openings
Any opening that cannot be closed at the time of discharge shall be compensated for by the addition of carbon dioxide agent equal to the anticipated loss of agent during discharge.

The vault has one unclosable opening measuring 2 ft x 1 ft with its center line 3 ft from the ceiling. Unclosable opening = 2 ft x 1 ft = 2 sq ft

Step No. 4: Calculate the Agent Quantity
The quantity of agent required to protect this hazard is determined by multiplying the hazard volume by a flooding factor found in the chart in Figure 5-3 of the design section of the manual.

Agent Quantity = 1,800 cu ft x 0.056 lb CO_2/cu ft
= 100.8 lb of CO_2

Step No. 4: Calculate the Agent Quantity for Unclosable Opening
After calculating the minimum amount of carbon dioxide required for the hazard volume, an agent amount must be determined for the loss through the unclosable opening. To determine the amount of additional agent required refer to Figure 5-6 in the design section of the manual.

In this example the center of the unclosable opening is located 3 ft. down from the top of the hazard. Find this dimension on the bottom of the chart in Figure 5-6. Read up the chart to the diagonal line representing a 34% design concentration. At that intersect point read to the left to determine the leakage rate in lbs. of CO_2/min/sq ft of opening.

Finally, multiply this number by 1/2 of the sq ft area of the unclosable opening. This is the amount of agent which must be added to the initial agent quantity determined in Step No. 4.

Agent Quantity for Unclosable Opening = 12 lb (from the chart in Figure 5-6) x 1 sq ft (1/2 the total opening area)
= 12 lb of CO_2.

Step No. 4: Calculate the Total Agent Quantity Required for the Hazard
The total agent required to protect the hazard is the sum of our hazard volume agent requirements and our agent requirements for the unclosable opening.

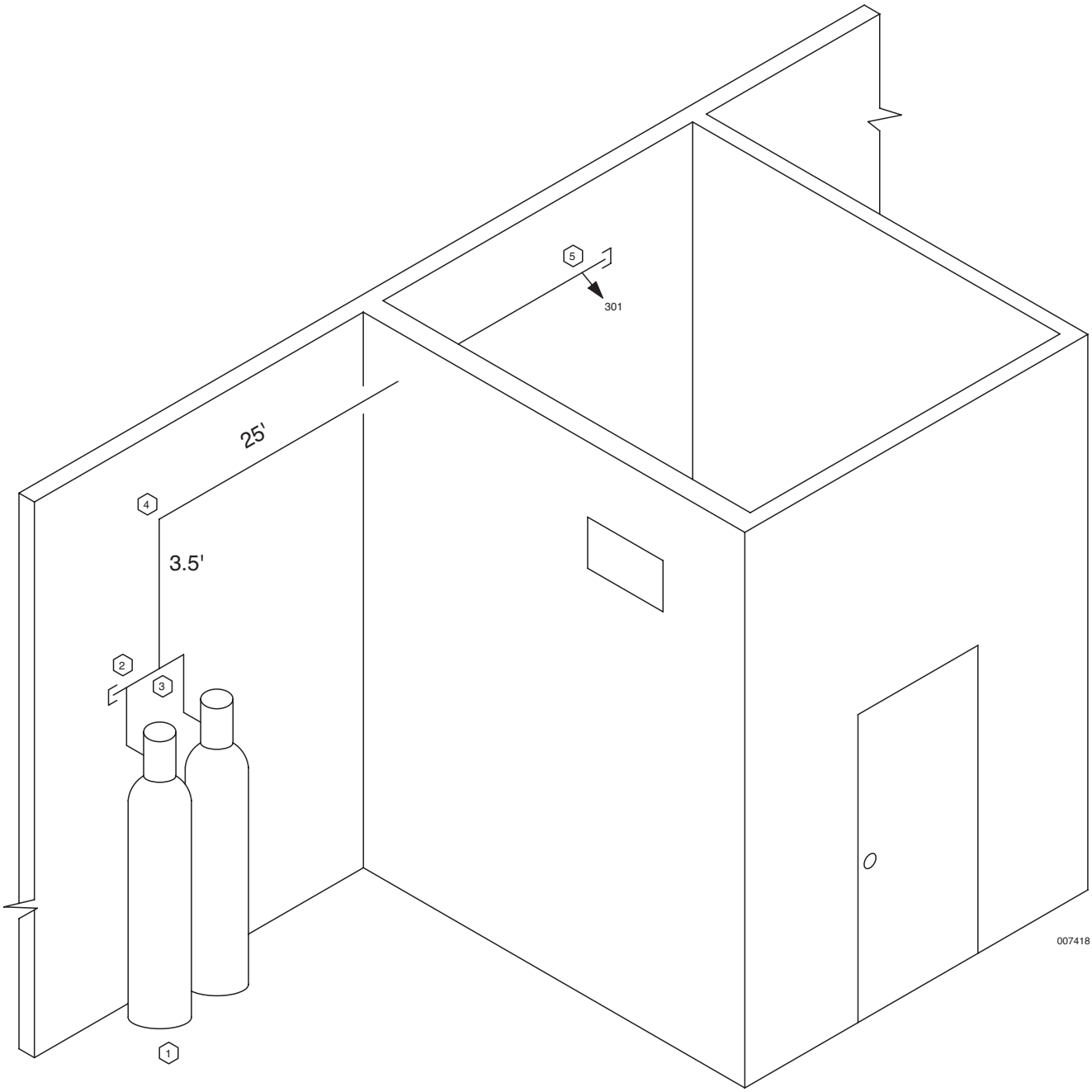
Total Agent Required = 100.8 lb + 12 lb
= 112.8 lb or 113 lb of CO_2

For this design we will use two 75 lb CO_2 containers.

Step No. 5: Isometric Drawing
Complete a drawing or sketch of the pipe layout from the agent containers to all the nozzles. Refer to Step No. 6 in the design section of the manual on page 5-5 for the general requirements of nozzle placement. The pipe isometric should be as accurate as possible and include all pipe lengths from the most remote agent container out to the nozzle.

Step No. 6: Flow Calculations
Node points for entering information into the CO_2 hydraulic flow calculation can be inserted on the pipe isometric drawing completed in Step No. 5. These node points are then entered into the High Pressure Carbon Dioxide Flow Calculation Program to confirm the design hydraulically.

EXAMPLE NO. 2 – TRANSFORMERS – TOTAL FLOOD APPLICATION (Continued)



EXAMPLE NO. 2 – TRANSFORMERS – TOTAL FLOOD APPLICATION (Continued)

ANSUL HP CO_2 FLOW CALCULATION PROGRAM

System Conditions

Number of containers: 2 each containing 75 lb CO_2. Total agent 150 lb
Engineering units (ft, lbs, psia) are specified
Total flooding system
Quantity of carbon dioxide is specified for each nozzle
Calculation based on 70 degree Fahrenheit pre-discharge Pipeline Temperature

Pipe Data Input

Sec Start	Sec End	Nominal Pipe Size	Length (ft)	Elev (ft)	90's Tee	Side Tee	Thru Cplg	Union/ CO_2	Qty (ft)	Eql
1	2	1/2 – 40T	0.10	0.00	0	0	0	0	0.00	38.0
2	3	0 – DFT	0.50	0.00	1	0	0	0	0.00	0.0
3	4	0 – DFT	3.50	3.50	0	1	0	0	0.00	0.0
4	5	0 – DFT	25.00	0.00	1	0	0	0	0.00	0.0
5	301	0 – DFT	0.10	-0.10	0	1*	0	0	150.00	0.0

* Section contains one or more side tees configured as dirt traps.

EXAMPLE NO. 2 – TRANSFORMERS – TOTAL FLOOD APPLICATION (Continued)

ANSUL HP CO_2 FLOW CALCULATIONS

Agent Storage Conditions

Nominal Storage Pressure is 750 psi at 70 degrees Fahrenheit
75 lb of carbon dioxide is stored in each of 2 containers
Total carbon dioxide discharged is 150 lb

Pressure Drop Results

Sec Start	Sec End	Nominal Pipe Size	Length (ft)	Equiv Length (ft)	Elev (ft)	Tee/ Mfld	Start psi	Term psi	Flow (lb/min)
1	2	1/2 40 T	0.1	38.1	0.0	CV-98	750	734	74.02
2	3	1/2 40 T	0.5	2.1	0.0	1 cyl	734	734	74.02
3	4	1/2 40 T	3.5	6.6	3.5	2 cyl	734	720	148.04
4	5	1/2 40 T	25.0	26.6	0.0	720	673	148.04	
5	301	1/2 40 T	0.1	3.2	-0.1	673	666	148.04	

Calculation based on 70 degree Fahrenheit pre-discharge Pipeline Temperature

Nozzle Performance Summary

Nozzle Number	Nominal Pipe Size	Nozzle Code	Weight (lb) Discharged	Initial Vapor Time (sec)	Liquid Time (sec)	End of Discharge Time (sec)
301	1/2 40 T	8.00	150.0	0.4	43.2	43.6

Total carbon dioxide discharged is 150 lb

Messages

Hydraulic calculation was successful.

The system is calculated using nozzle codes rounded and fixed at nearest 1/2 code. Convergence of nozzle flow rate and pressure to ± 2.5%

EXAMPLE NO. 3 – TRANSFORMERS – RATE BY VOLUME LOCAL APPLICATION

Transformers which are not enclosed in a vault can be protected using a rate by volume local application. This method should be used when the hazard in not enclosed and consists of three dimensional irregular objects that cannot be easily reduced to equivalent surface areas.

Electrical equipment should be shut down at the time of discharge.

Hazard:

A free standing transformer with dimensions of 4 ft x 4 ft x 5 ft high.

Step No. 1: Determine the Assumed Hazard Volume

The first step is to calculate the assumed volume of the area around the transformer. The assumed volume is determined by adding 2 ft. all around the transformer and then multiplying the assumed length x width x height to arrive at the volume.

Assumed Transformer Volume = (4 + 2 + 2) x (4 + 2 + 2) x (5 + 2)

= 8 x 8 x 7

= 448 cu ft

Step No. 2: Determine System Flow Rate

Calculating the system flow rate is done by multiplying the assumed volume by the system discharge rate. In this example the system discharge rate is 1 lb per minute per cubic foot of protected volume. If the object being protected is partially enclosed a reduction in the discharge rate is available based on the percentage of closed perimeter around the hazard. Figure 5-18 in the design section of the manual can be consulted to determine the appropriate system flow rate.

System Flow Rate = 448 cu ft x 1 lb/min/cu ft

= 448 lb per minute

Step No. 3: Calculate the Agent Quantity

Determining the total amount of carbon dioxide required is accomplished by multiplying the total assumed volume x the system discharge rate x the liquid carbon dioxide factor of 1.4 x the minimum discharge time of 30 seconds.

Agent Quantity = 448 cu ft (assumed volume) x 1 lb/min/cu ft (system discharge rate) x 1.4 (liquid factor) x 0.5 (30 second discharge time)

= 313.6 lb of CO_2

For this design we will use three 120 lb CO_2 containers.

Step No. 4: Determine Nozzle Location

Review the hazard to determine where to locate the nozzles and how many nozzles will be required. Since this is a local application you will need to use nozzles which are listed for local applications, not total flood. The nozzles should be positioned around the perimeter of the assumed volume. In general the number of nozzles required for a rate by volume system to protect a hazard in an open area is based on the distance the nozzle is located from the hazard, the listed flow rate for the nozzle at that distance, and the configuration of the hazard being protected.

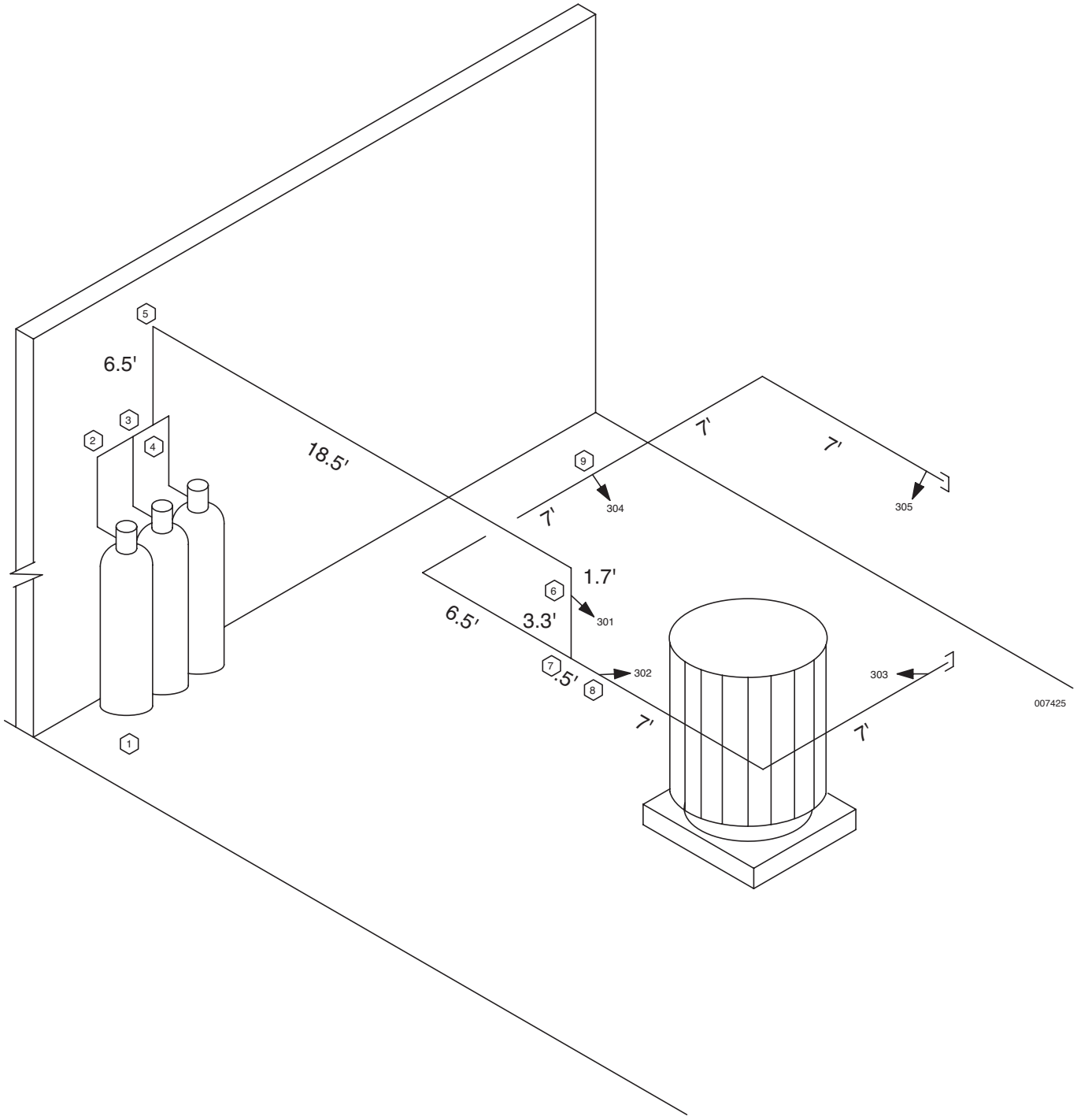
Step No. 5: Isometric Drawing

Complete a drawing or sketch of the pipe layout from the agent containers to all the nozzles. Refer to Step No. 6 in the design section of the manual on page 5-5 for the general requirements of nozzle placement. The pipe isometric should be as accurate as possible and include all pipe lengths from the most remote agent container out to the nozzles.

Step No. 6: Flow Calculations

Node points for entering information into the CO_2 hydraulic flow calculation can be inserted on the pipe isometric drawing completed in Step No. 5. These node points are then entered into the High Pressure Carbon Dioxide Flow Calculation Program to confirm the design hydraulically.

EXAMPLE NO. 3 – TRANSFORMERS – RATE BY VOLUME LOCAL APPLICATION (Continued)



EXAMPLE NO. 3 – TRANSFORMERS – RATE BY VOLUME LOCAL APPLICATION (Continued)

ANSUL HP CO_2 FLOW CALCULATION PROGRAM

System Conditions

Number of containers: 3 each containing 120 lb CO_2. Total agent 360 lb
Engineering units (ft, lbs, psia) are specified
Local Application system
Flow rate is specified for each nozzle
Calculation based on 70 degree Fahrenheit pre-discharge Pipeline Temperature

Pipe Data Input

Sec Start	Sec End	Nominal Pipe Size	Length (ft)	Elev (ft)	90's Tee	Side Tee	Thru Cplg	Union/ CO_2	Qty (ft)	Eql
1	2	1/2 – 40T	0.10	0.00	0	0	0	0	0.00	38.0
2	3	0 – DFT	1.00	0.00	1	0	0	0	0.00	0.0
3	4	0 – DFT	0.50	0.00	0	1	0	0	0.00	0.0
4	5	0 – DFT	6.50	6.50	0	1	0	0	0.00	0.0
5	6	0 – DFT	20.20	-1.70	2	0	0	0	0.00	0.0
6	301	0 – DFT	0.10	0.00	0	1	0	0	95.00	0.0
6	7	0 – DFT	3.30	-3.30	0	0	1	0	0.00	0.0
7	8	0 – DFT	0.50	0.00	0	1	0	0	0.00	0.0
8	302	0 – DFT	0.10	0.00	0	1	0	0	95.00	0.0
8	303	0 – DFT	14.00	0.00	1	1*	1	0	95.00	0.0
7	9	0 – DFT	13.50	0.00	1	1	0	0	0.00	0.0
9	304	0 – DFT	0.10	0.00	0	1	0	0	95.00	0.0
9	305	0 – DFT	14.00	0.00	1	1*	1	0	95.00	0.0

* Section contains one or more side tees configured as dirt traps.

EXAMPLE NO. 3 – TRANSFORMERS – RATE BY VOLUME LOCAL APPLICATION (Continued)

ANSUL HP CO_2 FLOW CALCULATIONS

Agent Storage Conditions

Nominal Storage Pressure is 750 psi at 70 degrees Fahrenheit
120 lb of carbon dioxide is stored in each of 3 containers
Total carbon dioxide discharged is 360 lb

Pressure Drop Results

Sec Start	Sec End	Nominal Pipe Size	Length (ft)	Equiv Length (ft)	Elev (ft)	Tee/ Mfld	Start psi	Term psi	Flow (lb/min)
1	2	1/2 40 T	0.1	38.1	0.0	CV-98	750	675	158.27
2	3	1/2 40 T	1.0	2.6	0.0	1 cyl	675	670	158.27
3	4	3/4 40 T	0.5	4.6	0.0	2 cyl	670	657	316.54
4	5	1 80 T	6.5	11.3	6.5	3 cyl	657	625	474.81
5	6	1 80 T	20.2	25.0	-1.7		625	554	474.81
6	301	1/2 40 T	0.1	3.2	0.0	Side	554	554	93.54
6	7	3/4 40 T	3.3	4.7	-3.3	Thru	554	524	381.27
7	8	1/2 40 T	0.5	3.6	0.0	BHT	524	501	189.54
8	302	1/2 40 T	0.1	3.2	0.0	Side	501	498	93.18
8	303	1/2 40 T	14.0	19.7	0.0	Thru	501	479	96.36
7	9	1/2 40 T	13.5	18.2	0.0	BHT	524	383	191.73
9	304	1/2 40 T	0.1	3.2	0.0	Side	383	380	96.07
9	305	1/2 40 T	14.0	19.7	0.0	Thru	383	350	95.66

Calculation based on 70 degree Fahrenheit pre-discharge Pipeline Temperature

Nozzle Performance Summary

Nozzle Number	Nominal Pipe Size	Nozzle Code	Weight (lb) Discharged	Initial Vapor Time (sec)	Liquid Time (sec)	End of Discharge Time (sec)
301	1/2 40 T	7.50	71.1	0.3	32.4	32.7
302	1/2 40 T	8.00	70.8	0.3	32.4	32.7
303	1/2 40 T	8.50	73.0	0.6	32.2	32.7
304	1/2 40 T	10.00	72.9	0.4	32.3	32.7
305	1/2 40 T	10.50	72.3	0.7	32.0	32.7

Total carbon dioxide discharged is 360 lb

EXAMPLE NO. 3 – TRANSFORMERS – RATE BY VOLUME LOCAL APPLICATION (Continued)

ANSUL HP CO_2 FLOW CALCULATIONS

Messages

Hydraulic calculation was successful.

Shortest liquid discharge time for Local Application Nozzle is 32. sec

The system is calculated using nozzle codes rounded and fixed at nearest 1/2 code. Convergence of nozzle flow rate and pressure to ± 2.5%

EXAMPLE NO. 4 – WAVE SOLDER MACHINE – TOTAL FLOOD/LOCAL APPLICATION SYSTEM

A typical wave solder machine consists of an enclosure and fume exhaust system. The machine usually employs a motorized conveyor for moving parts from flux tubs to a preheater and then to the solder pots.

In this example, we will assume the access doors are left open and the surface will be treated as a local application, calculated using rate x area. The exhaust duct will be treated as a total flood application.

All the heat sources, pumps, conveyor and exhaust systems must be shut down prior to the system discharge. It is also essential that the duct be dampered with the damper to close upon system actuation.

Hazard:

The surface area of the wave solder machine to be protected measures 15 ft x 4 ft. The nozzles will be mounted 3 ft above the protected surface. The exhaust duct has a 12 in. diameter and is 18 ft long.

The design and agent requirements for the local application portion of the hazard will be determined first and then the protection of the duct will be considered.

Step No. 1: Determine the Hazard Area(s)

The first step is to determine the surface area of the inside the wave solder machine to be protected.

Surface Area = 15 ft x 4 ft

Step No. 2: Determine the Location, Number and Type of Nozzle Required

Nozzles should be located where they will not interfere with the work process or any maintenance requirements of the equipment. When choosing the type of nozzle to use it will be advantageous to pick a nozzle which provides the greatest area of coverage using the lowest possible flow rate. (Refer to the nozzle charts in the design section of the manual). In this case it has been determined the nozzles will be mounted 36 in. above the hazard and a Type “D” nozzle would be the most efficient based on the coverage and flow rate of the nozzle. This would be considered a liquid surface.

The D type nozzle at a height of 36 in. will protect an area having a side-of-square of 2.24 ft. The number of nozzles required to protect the dip tank is calculated as follows:

$$\text{Nozzles Required} = \frac{\text{Linear Length}}{\text{Side of Square}} \times \frac{\text{Linear Width}}{\text{Side of Square}}$$

$$= \frac{15 \text{ ft}}{2.24 \text{ ft}} \times \frac{4 \text{ ft}}{2.24 \text{ ft}}$$

$$= 6.7 \times 1.8$$

$$= 7 \times 2$$

= 14 D type nozzles at 36 in. with a flow rate of 22 lb/min

Step No. 3: Calculate the Agent Quantity for the Local Application

When number and flow rate of each nozzle has been determined the quantity of agent can be calculated. For local applications only the liquid portion of the discharge is effective therefore the quantity of agent must be increased by 40%.

The liquid discharge times for local applications must be a minimum of 30 seconds (0.5 minutes). Total agent requirements are then calculated as follows:

Agent Quantity = Number of Nozzles x Flow Rate per Nozzle x 1.4 x Discharge Time

= 14 D Nozzles x 22 lb/min/nozzle x 1.4 x 0.5 minutes

= 215.6 lb of CO_2

Step No. 4: Calculate the Agent Quantity for the Duct

The duct would be considered a deep seated, total flood application. To determine the required agent for the duct we first need to calculate the duct volume and then multiply this volume by a flooding factor of 0.125 which will provide a 65% design concentration for the duct.

Agent Quantity = 15 cu ft (duct volume) x 0.125 (flooding factor for 65% concentration

= 1.9 lb of CO_2

Step No. 5: Calculate the Total Agent Quantity for the System

The total carbon dioxide required to protect the hazard will be the sum of the agent required for the local application and the total flood application.

Total Agent Required = 215.6 + 1.9 = 217.5 lb of CO_2

EXAMPLE NO. 4 – WAVE SOLDER MACHINE – TOTAL FLOOD/LOCAL APPLICATION SYSTEM (Continued)

Step No. 6: Determine the Minimum Flow Rate for the Duct

When part of a hazard is protected by a total flooding system, the discharge rate for the total flooding part is determined by dividing the quantity of agent required for total flooding by the factor 1.4 and by the time of the local discharge time in minutes.

$$\text{Flow Rate} = \frac{1.9 \text{ lb}}{(1.4)(0.5)}$$

$$= 2.8 \text{ lb/minute}$$

In this example the total flood application in the duct must have a system flow rate of at least 2.8 lb of CO_2 per minute.

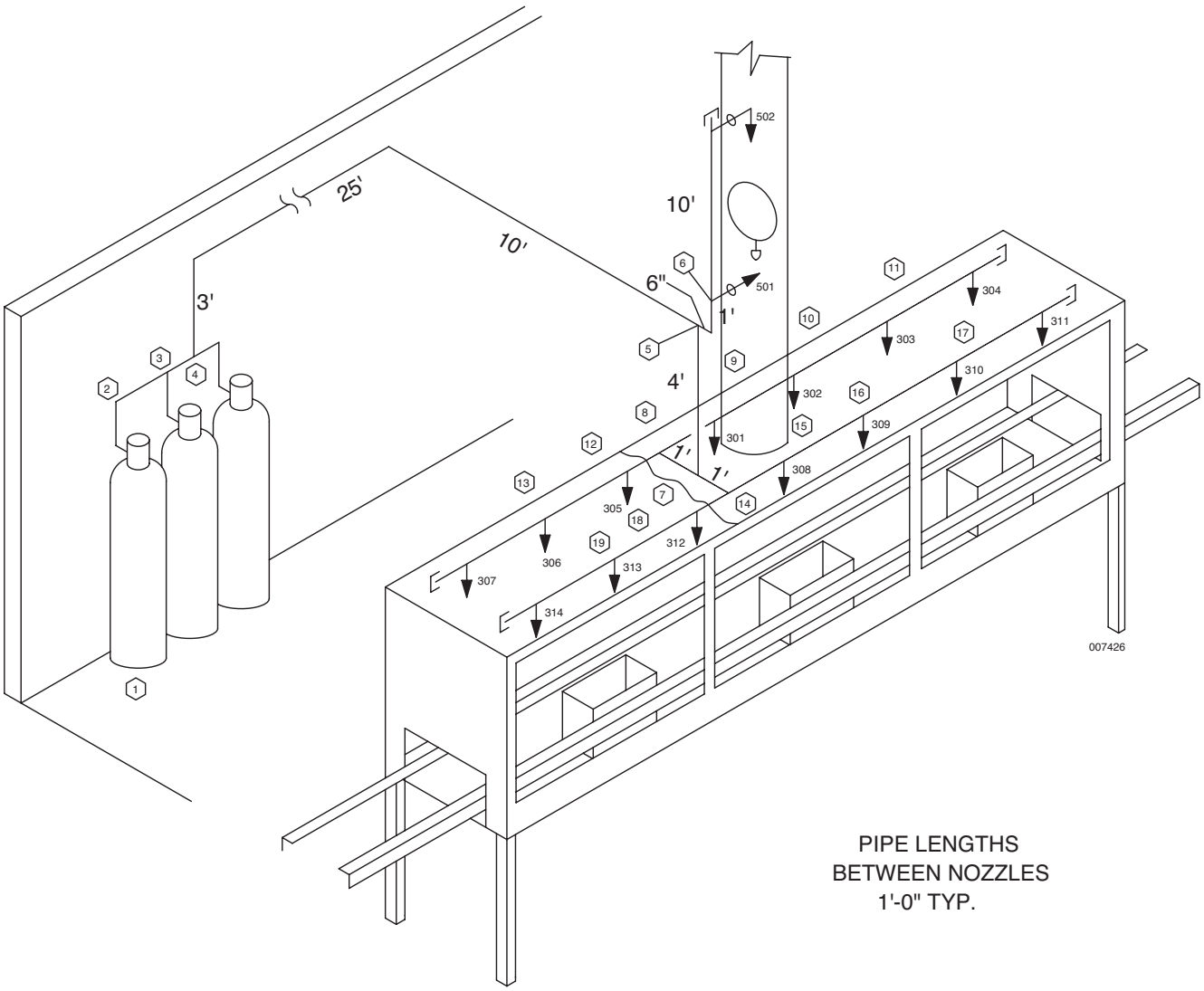
Step No. 7: Isometric Drawing

Complete a drawing or sketch of the pipe layout from the agent containers to all the nozzles. The pipe isometric should be as accurate as possible and include all pipe lengths from the most remote agent container out to all of the nozzles. It is important to remember that when assigning node points to the nozzles on combination systems, the local application nozzles are numbered 301-499 and the total flood nozzles are numbered 501-599.

Step No. 8: Flow Calculations

Node points for entering information into the CO_2 hydraulic flow calculation can be inserted on the pipe isometric drawing completed in Step No. 7. These node points are then entered into the High Pressure Carbon Dioxide Flow Calculation Program to verify the design meets the 30 second minimum discharge time and the flow rate requirements at the nozzles.

EXAMPLE NO. 4 – WAVE SOLDER MACHINE – TOTAL FLOOD/LOCAL APPLICATION SYSTEM (Continued)



PIPE LENGTHS
BETWEEN NOZZLES
1'-0" TYP.

EXAMPLE NO. 4 – WAVE SOLDER MACHINE – TOTAL FLOOD/LOCAL APPLICATION SYSTEM (Continued)

ANSUL HP CO_2 FLOW CALCULATION PROGRAM

System Conditions

Number of containers: 3 each containing 100 lb CO_2. Total agent 300 lb
Engineering units (ft, lbs, psia) are specified
Combination Local Application/Total flooding system
Flow rate is specified for each local application nozzle – Quantity of CO_2 specified for total flood nozzles
Calculation based on 70 degree Fahrenheit pre-discharge Pipeline Temperature

Pipe Data Input

Sec Start	Sec End	Nominal Pipe Size	Length (ft)	Elev (ft)	90's Tee	Side Tee	Thru Cplg	Union/ CO_2	Qty (ft)	Eql
1	2	1/2 – 40T	0.10	0.00	0	0	0	0	0.00	38.0
2	3	0 – DFT	1.00	0.00	1	0	0	0	0.00	0.0
3	4	0 – DFT	0.50	0.00	0	0	1	0	0.00	0.0
4	5	0 – DFT	38.00	3.00	2	1	0	0	0.00	0.0
5	6	0 – DFT	1.50	1.00	1	0	1	0	0.00	0.0
6	501	0 – DFT	0.10	0.00	0	1	0	0	3.00	0.0
6	502	0 – DFT	10.10	10.00	1	1*	1	0	3.00	0.0
5	7	0 – DFT	4.00	-4.00	0	1	0	0	0.00	0.0
7	8	0 – DFT	1.00	0.00	0	1	0	0	0.00	0.0
8	9	0 – DFT	1.00	0.00	0	1	0	0	0.00	0.0
9	301	0 – DFT	0.10	0.00	0	1	0	0	25.00	0.0
9	10	0 – DFT	1.00	0.00	0	0	1	0	0.00	0.0
10	302	0 – DFT	0.10	0.00	0	1	0	0	25.00	0.0
10	11	0 – DFT	1.00	0.00	0	0	1	0	0.00	0.0
11	303	0 – DFT	0.10	0.00	0	1	0	0	25.00	0.0
11	304	0 – DFT	1.10	0.00	0	1*	1	0	25.00	0.0
8	12	0 – DFT	1.00	0.00	0	1	0	0	0.00	0.0
12	305	0 – DFT	0.10	0.00	0	1	0	0	25.00	0.0
12	13	0 – DFT	1.00	0.00	0	0	1	0	0.00	0.0
13	306	0 – DFT	0.10	0.00	0	1	0	0	25.00	0.0
13	307	0 – DFT	1.10	0.00	0	1*	1	0	25.00	0.0
7	14	0 – DFT	1.00	0.00	0	1	0	0	0.00	0.0
14	15	0 – DFT	1.00	0.00	0	1	0	0	0.00	0.0
15	308	0 – DFT	0.10	0.00	0	1	0	0	25.00	0.0
15	16	0 – DFT	1.00	0.00	0	0	1	0	0.00	0.0

EXAMPLE NO. 4 – WAVE SOLDER MACHINE – TOTAL FLOOD/LOCAL APPLICATION SYSTEM (Continued)

ANSUL HP CO_2 FLOW CALCULATION PROGRAM

Pipe Data Input (Continued)

Sec Start	Sec End	Nominal Pipe Size	Length (ft)	Elev (ft)	90's Tee	Side Tee	Thru Cplg	Union/ CO_2	Qty (ft)	Eql
16	309	0 – DFT	0.10	0.00	0	1	0	0	25.00	0.0
16	17	0 – DFT	1.00	0.00	0	0	1	0	0.00	0.0
17	310	0 – DFT	0.10	0.00	0	1	0	0	25.00	0.0
17	311	0 – DFT	1.10	0.00	0	1*	1	0	25.00	0.0
14	18	0 – DFT	1.00	0.00	0	1	0	0	0.00	0.0
18	312	0 – DFT	0.10	0.00	0	1	0	0	25.00	0.0
18	19	0 – DFT	1.00	0.00	0	0	1	0	0.00	0.0
19	313	0 – DFT	0.10	0.00	0	1	0	0	25.00	0.0
19	314	0 – DFT	1.10	0.00	0	1*	1	0	25.00	0.0

* Section contains one or more side tees configured as dirt traps.

EXAMPLE NO. 4 – WAVE SOLDER MACHINE – TOTAL FLOOD/LOCAL APPLICATION SYSTEM (Continued)

ANSUL HP CO_2 FLOW CALCULATIONS

Agent Storage Conditions

Nominal Storage Pressure is 750 psi at 70 degrees Fahrenheit
100 lb of carbon dioxide is stored in each of 3 containers
Total carbon dioxide discharged is 300 lb

Pressure Drop Results

Sec Start	Sec End	Nominal Pipe Size	Length (ft)	Equiv Length (ft)	Elev (ft)	Tee/ Mfld	Start psi	Term psi	Flow (lb/min)
1	2	1/2 40 T	0.1	38.1	0.0	CV-98	750	707	121.51
2	3	1/2 40 T	1.0	2.6	0.0	1 cyl	707	705	121.51
3	4	1/2 40 T	0.5	1.5	0.0	2 cyl	705	691	243.02
4	5	3/4 40 T	38.0	46.2	3.0	3 cyl	691	532	364.54
5	6	1/2 40 T	1.5	4.1	1.0	Thru	532	532	7.14
6	501	1/2 40 T	0.1	3.2	0.0	Side	532	532	3.57
6	502	1/2 40 T	10.1	15.8	10.0	Thru	532	530	3.56
5	7	3/4 40 T	4.0	8.1	-4.0	Side	532	487	357.4
7	8	1/2 40 T	1.0	4.1	0.0	BHT	487	459	178.7
8	9	1/2 40 T	1.0	4.1	0.0	BHT	459	454	101.73
9	301	1/2 40 T	0.1	3.2	0.0	Side	454	454	25.38
9	10	1/2 40 T	1.0	2.0	0.0	Thru	454	453	76.34
10	302	1/2 40 T	0.1	3.2	0.0	Side	453	453	25.45
10	11	1/2 40 T	1.0	2.0	0.0	Thru	453	453	50.9
11	303	1/2 40 T	0.1	3.2	0.0	Side	453	453	25.45
11	304	1/2 40 T	1.1	5.2	0.0	Thru	453	453	25.45
8	12	1/2 40 T	1.0	4.1	0.0	BHT	459	458	76.97
12	305	1/2 40 T	0.1	3.2	0.0	Side	458	458	25.66
12	13	1/2 40 T	1.0	2.0	0.0	Thru	458	458	51.31
13	306	1/2 40 T	0.1	3.2	0.0	Side	458	458	25.66
13	307	1/2 40 T	1.1	5.2	0.0	Thru	458	458	25.66
7	14	1/2 40 T	1.0	4.1	0.0	BHT	487	459	178.7
14	15	1/2 40 T	1.0	4.1	0.0	BHT	459	454	101.73
15	308	1/2 40 T	0.1	3.2	0.0	Side	454	454	25.38
15	16	1/2 40 T	1.0	2.0	0.0	Thru	454	453	76.34
16	309	1/2 40 T	0.1	3.2	0.0	Side	453	453	25.45
16	17	1/2 40 T	1.0	2.0	0.0	Thru	453	453	50.9
17	310	1/2 40 T	0.1	3.2	0.0	Side	453	453	25.45
17	311	1/2 40 T	1.1	5.2	0.0	Thru	453	453	25.45

EXAMPLE NO. 4 – WAVE SOLDER MACHINE – TOTAL FLOOD/LOCAL APPLICATION SYSTEM (Continued)

ANSUL HP CO_2 FLOW CALCULATIONS

Pressure Drop Results

Sec Start	Sec End	Nominal Pipe Size	Length (ft)	Equiv Length (ft)	Elev (ft)	Tee/ Mfld	Start psi	Term psi	Flow (lb/min)
14	18	1/2 40 T	1.0	4.1	0.0	BHT	459	458	76.97
18	312	1/2 40 T	0.1	3.2	0.0	Side	458	458	25.66
18	19	1/2 40 T	1.0	2.0	0.0	Thru	458	458	51.31
19	313	1/2 40 T	0.1	3.2	0.0	Side	458	458	25.66
19	314	1/2 40 T	1.1	5.2	0.0	Thru	458	458	25.66

Calculation based on 70 degree Fahrenheit pre-discharge Pipeline Temperature

Nozzle Performance Summary

Nozzle Number	Nominal Pipe Size	Nozzle Code	Weight (lb) Discharged	Initial Vapor Time (sec)	Liquid Time (sec)	End of Discharge Time (sec)
501	1/2 40 T	1.50	2.9	0.7	34.8	35.5
502	1/2 40 T	1.50	2.8	5.6	29.9	35.5
301	1/2 40 T	4.50	20.9	0.3	35.2	35.5
302	1/2 40 T	4.50	21.0	0.4	35.1	35.5
303	1/2 40 T	4.50	21.0	0.4	35.1	35.5
304	1/2 40 T	4.50	20.9	0.5	35.0	35.5
305	1/2 40 T	4.50	21.1	0.3	35.2	35.5
306	1/2 40 T	4.50	21.1	0.4	35.1	35.5
307	1/2 40 T	4.50	21.1	0.4	35.1	35.5
308	1/2 40 T	4.50	20.9	0.3	35.2	35.5
309	1/2 40 T	4.50	21.0	0.4	35.1	35.5
310	1/2 40 T	4.50	21.0	0.4	35.1	35.5
311	1/2 40 T	4.50	20.9	0.5	35.0	35.5
312	1/2 40 T	4.50	21.1	0.3	35.2	35.5
313	1/2 40 T	4.50	21.1	0.4	35.1	35.5
314	1/2 40 T	4.50	21.1	0.4	35.1	35.5

Total carbon dioxide discharged is 300 lb

Messages

Hydraulic calculation was successful.

Shortest liquid discharge time for Local Application Nozzle is 35. sec

Combination Total Flood/Local Application System

Local Application Nozzle Numbers are 301 to 499

Total Flood Nozzle Numbers are 501 to 600

The system is calculated using nozzle codes rounded and fixed at nearest 1/2 code. Convergence of nozzle flow rate and pressure to ± 2.5%

CO_2 VALVE CONSOLIDATION

CV-98 MANIFOLD INSTRUCTIONS

In response to concerns about the various high pressure CO_2 container valves we have produced in the past, Tyco Fire Protection Products has standardized on the CV-98 valve with the goal of having it as the only available CO_2 container valve in the field; replacement parts for all valves made prior to the CV-98 will be phased out in the near future. Tyco Fire Protection Products has created a listed and approved process for combining multiple types of container valves on a common manifold; existing ANSUL valves can be replaced on a one-to-one basis with the CV-98 valve.

If a pilot valve needs to be replaced, consideration should be given to upgrading to currently available releasing and actuation components. If a new actuation system will not be utilized, or the CV-98 system actuation parameters are not met, Tyco Fire Protection Products recommends moving a slave container of the original valve type into the pilot position. The new CV-98 valve container should be placed into the slave position; this will prevent the need to replace the existing actuation system.

Note: In any system where the CV-98 valve container must be used as a pilot container, the actuation system must adhere to the following requirements:

Pneumatic – AUTOMAN Release

- Maximum length of 150 ft (45.7 m) of 1/4 in., Schedule 40 pipe

Pneumatic – QBA-5 Actuator

- Maximum length of 100 ft (30.5 m) of 1/8 in., Schedule 40 pipe

Pneumatic – Manual Actuator

- Maximum length of 125 ft (38.1 m) of 1/4 in., Schedule 40 pipe

Electric – HF Electric Actuator

- 24 VDC circuit with a minimum current of 0.57 amps

Manual – Cable Pull

- Maximum length of 125 ft (38.1 m) of wire rope.
- Maximum of 18 Pulley Elbows (Part No. 415670 or 423250)

The subsequent instructions should be followed once it has been determined that an existing valve needs to be replaced:

1. Identify the type of valve currently in the system (see matrix on Page 12-3 to 12-6 for reference).
2. Refer to matrix for required replacement parts. Order replacement valves and other components necessary to convert the valve and system.
3. If container is not empty, safely remove remaining CO_2 from container.

⚠ WARNING

Container(s) must be properly secured and all personnel in immediate area must be evacuated prior to a system discharge. Failure to comply may result in death, injury, or property damage as CO_2 displaces oxygen and creates a hazardous environment.

4. Remove the valve and siphon tube from the container.
5. Re-certify the container per 49 CFR 173 requirements.
6. Attach the siphon tube to the new container valve. **Exception:** Valve assemblies for the 25, 35, and 50 lb containers are shipped with a factory installed siphon tube; do not remove factory installed siphon tube.
7. Install the new valve and siphon tube to re-certified container.
8. Torque the valve/siphon tube assembly into the container at 160 ft-lb (217 Newton meters) (a minimum of two threads should be visible).
9. Re-charge the container per Section 8 “Resetting and Recharge” section of the ANSUL Carbon Dioxide Systems Components, Design, Installation, and Recharge Manual.
10. Disable and lock-out the system if not already done.
11. Attach the “CV-98 Reconditioned Label” (Part No. 434449) to the container in a readily visible location (label is packaged with valve assembly).

THIS CYLINDER HAS BEEN RECONDITIONED WITH A CV-98 VALVE. SERVICE TO THIS CYLINDER SHALL BE BASED UPON THE CV-98 VALVE.

LABEL NO. 434449

CO_2 VALVE CONSOLIDATION (Continued)

CV-98 MANIFOLD INSTRUCTIONS (Continued)

12. Install the container in its bracket. If the original system consists of a MAX valve, refer to Figure 12-1 for guidance to convert the manifold to accept a CV-98 container valve.

MAX VALVE TO CV-98 VALVE MANIFOLD CONVERSION

Note: Install components as identified in the following figure.

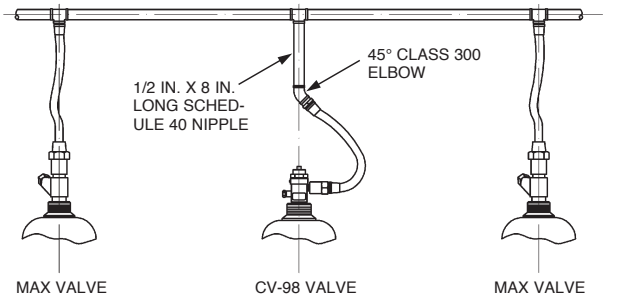


FIGURE 12-1
007477

13. Modify the actuation system if necessary.
14. Place the system back in service.
15. Notify appropriate personnel that the system is back on-line.

REPLACEMENT PARTS MATRIX

The following matrixes can be used to identify the components required to convert an older style container valve or any of its related components to the equivalent CV-98 component. In many cases not only will the container valve require replacement but any related components like the siphon tube, flexible bend, and actuators will also need replacement.

Notes

1. 25 lb containers are no longer available. If a container valve on a 25 lb container requires replacement the entire container must be replaced with a 35 lb CV-98 container. Associated components may also require replacement.
2. Replacement of VFN and AP-8 Container Valves will also require replacement of the actuator if an actuator is included on the valve, and the container can not be relocated to a slave container position.
3. The CV-98 container valve does not require a pnuematic actuator. Pnuematic actuation is performed through a port on the side of the valve. Refer to the Installation Section of the “Carbon Dioxide Systems” Design, Installation, Recharge and Maintenance manual for component selection and installation instructions.
4. Pneumatic actuators for the MAX and CV-90 valves remain available as replacement parts (Pneumatic Actuator – 32096, Pneumatic Actuator with Manual Override – 32094).

Instructions

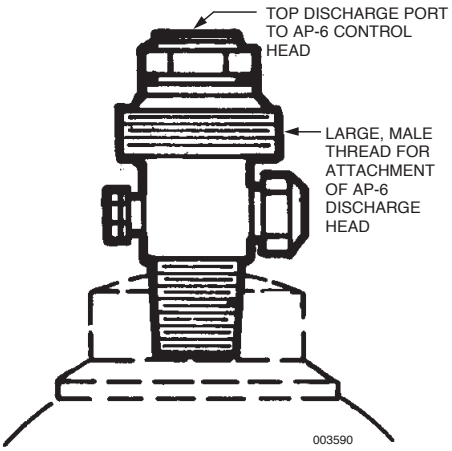
To determine the CV-98 Components required to replace an older style component:

1. Determine which valve your system is using and find the corresponding chart.
2. Locate the component to be replaced for the appropriate container size on the left side of the matrix.
3. An X in that row indicates a required CV-98 Component to replace an older style component.
4. All of the indicated components in that row must be ordered and replaced in order to maintain system functionality.
5. The appropriate replacement components and their associated part numbers are shown in the columns above the Xs.

CO_2 VALVE CONSOLIDATION (Continued)

REPLACEMENT PARTS MATRIX (Continued)

VF/VFN

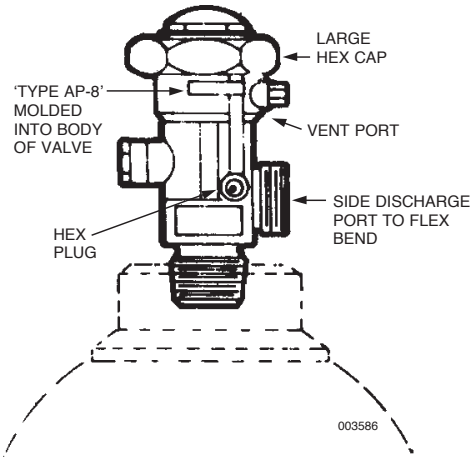


		Replacement Components												
		35 lb CV-98 Container – 426242	CV-98 Valve w/35 lb Container Siphon Tube – 426045	CV-98 Valve w/50 lb Container Siphon Tube – 426046	CV-98 Container Valve – 426009	75 lb CV-98 Container Siphon Tube – 79812	100 lb CV-98 Container Siphon Tube – 79813	CV-98 Flexible Discharge Bend – 427082	CV-98 Lever Release for Manual Actuation – 423309	See Note 3 on Page 12-2	HF Electric Actuator – 73327	Booster Actuator – 428949	Lever Release for HF Actuator – 70846	AP-8/ Sel. Viv. Lever Release – 42484
Components To Be Replaced														
25 lb Container	Container Valve	X						X						
	Siphon Tube	X						X						
	Flexible Discharge Bend	X						X						
	Lever Release	X						X	X					
	Pneumatic Actuation	X						X		X				
	Manual and Pneumatic	X						X	X	X				
	Electric Actuator	X						X			X	X		
	Electric Actuator w/ Lever Release	X						X			X	X	X	
35 lb Container	Container Valve		X					X						
	Siphon Tube		X					X						
	Flexible Discharge Bend		X					X						
	Lever Release		X					X	X					
	Pneumatic Actuation		X					X		X				
	Manual and Pneumatic		X					X	X	X				
	Electric Actuator		X					X			X	X		
	Electric Actuator w/ Lever Release		X					X			X	X	X	
50 lb Container	Container Valve			X				X						
	Siphon Tube			X				X						
	Flexible Discharge Bend			X				X						
	Lever Release			X				X	X					
	Pneumatic Actuation			X				X		X				
	Manual and Pneumatic			X				X	X	X				
	Electric Actuator			X				X			X	X		
	Electric Actuator w/ Lever Release			X				X			X	X	X	
75 lb Container	Container Valve				X	X		X						
	Siphon Tube				X	X		X						
	Flexible Discharge Bend				X	X		X						
	Lever Release				X	X		X	X					
	Pneumatic Actuation				X	X		X		X				
	Manual and Pneumatic				X	X		X	X	X				
	Electric Actuator				X	X		X			X	X		
	Electric Actuator w/ Lever Release				X	X		X			X	X	X	
100 lb Container	Container Valve				X		X	X						
	Siphon Tube				X		X	X						
	Flexible Discharge Bend				X		X	X						
	Lever Release				X		X	X	X					
	Pneumatic Actuation				X		X	X		X				
	Manual and Pneumatic				X		X	X	X	X				
	Electric Actuator				X		X	X			X	X		
	Electric Actuator w/ Lever Release				X		X	X			X	X	X	

CO_2 VALVE CONSOLIDATION (Continued)

REPLACEMENT PARTS MATRIX (Continued)

AP-8

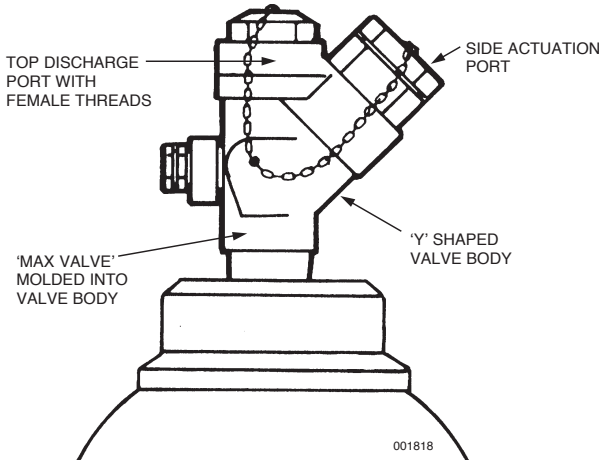


		Replacement Components												
		35 lb CV-98 Container – 426242	CV-98 Valve w/35 lb Container Siphon Tube – 426045	CV-98 Valve w/50 lb Container Siphon Tube – 426046	CV-98 Container Valve – 426009	75 lb CV-98 Container Siphon Tube – 79812	100 lb CV-98 Container Siphon Tube – 79813	CV-98 Flexible Discharge Bend – 427082	CV-98 Lever Release for Manual Actuation – 423309	See Note 3 on Page 12-2	HF Electric Actuator – 73327	Booster Actuator – 428949	Lever Release for HF Actuator – 70846	AP-8/ Sel. Vlv. Lever Release – 42484
Components To Be Replaced														
25 lb Container	Container Valve	X												
	Siphon Tube	X												
	Flexible Discharge Bend							X						
	Lever Release													X
	Pneumatic Actuation	X								X				
	Manual and Pneumatic Actuation	X							X	X				
	Electric Actuator	X									X	X		
	Electric Actuator w/ Lever Release	X									X	X	X	
35 lb Container	Container Valve		X											
	Siphon Tube		X											
	Flexible Discharge Bend							X						
	Lever Release													X
	Pneumatic Actuation		X							X				
	Manual and Pneumatic Actuation		X						X	X				
	Electric Actuator		X								X	X		
	Electric Actuator w/ Lever Release		X								X	X	X	
50 lb Container	Container Valve			X										
	Siphon Tube			X										
	Flexible Discharge Bend							X						
	Lever Release													X
	Pneumatic Actuation			X						X				
	Manual and Pneumatic Actuation			X					X	X				
	Electric Actuator			X							X	X		
	Electric Actuator w/ Lever Release			X							X	X	X	
75 lb Container	Container Valve				X	X								
	Siphon Tube				X	X								
	Flexible Discharge Bend							X						
	Lever Release													X
	Pneumatic Actuation				X	X				X				
	Manual and Pneumatic Actuation				X	X			X	X				
	Electric Actuator				X	X					X	X		
	Electric Actuator w/ Lever Release				X	X					X	X	X	
100 lb Container	Container Valve				X		X							
	Siphon Tube				X		X							
	Flexible Discharge Bend							X						
	Lever Release													X
	Pneumatic Actuation				X		X			X				
	Manual and Pneumatic Actuation				X		X		X	X				
	Electric Actuator				X		X				X	X		
	Electric Actuator w/ Lever Release				X		X				X	X	X	

CO_2 VALVE CONSOLIDATION (Continued)

REPLACEMENT PARTS MATRIX (Continued)

MAX

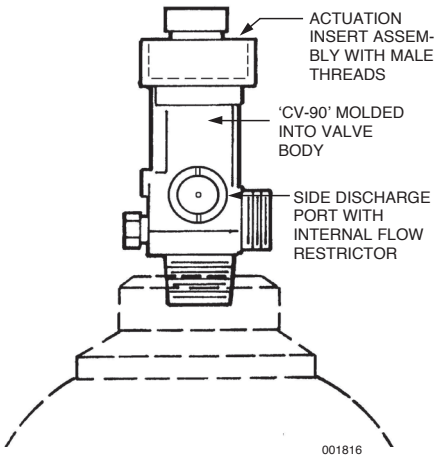


		Replacement Components												
		35 lb CV-98 Container – 426242	CV-98 Valve w/35 lb Container Siphon Tube – 426045	CV-98 Valve w/50 lb Container Siphon Tube – 426046	CV-98 Container Valve – 426009	75 lb CV-98 Container Siphon Tube – 79812	100 lb CV-98 Container Siphon Tube – 79813	CV-98 Flexible Discharge Bend – 427082	CV-98 Lever Release for Manual Actuation – 423309	See Note 4 on Page 12-2	HF Electric Actuator – 73327	Booster Actuator – 428949	Lever Release for HF Actuator – 70846	AP-8/ Sel. Vlv. Lever Release – 42484
Components To Be Replaced														
50 lb Container	Container Valve			X				X						
	Siphon Tube			X				X						
	Flexible Discharge Bend			X				X						
	Lever Release												X	
	Pneumatic Actuation									X				
	Manual and Pneumatic Actuation									X				
	Electric Actuator										X	X		
75 lb Container	Container Valve				X	X		X						
	Siphon Tube				X	X		X						
	Flexible Discharge Bend				X	X		X						
	Lever Release												X	
	Pneumatic Actuation									X				
	Manual and Pneumatic Actuation									X				
	Electric Actuator										X	X		
100 lb Container	Container Valve				X		X	X						
	Siphon Tube				X		X	X						
	Flexible Discharge Bend				X		X	X						
	Lever Release												X	
	Pneumatic Actuation									X				
	Manual and Pneumatic Actuation									X				
	Electric Actuator										X	X		

CO_2 VALVE CONSOLIDATION (Continued)

REPLACEMENT PARTS MATRIX (Continued)

CV-90



		Replacement Components												
		35 lb CV-98 Container – 426242	CV-98 Valve w/35 lb Container Siphon Tube – 426045	CV-98 Valve w/50 lb Container Siphon Tube – 426046	CV-98 Container Valve – 426009	75 lb CV-98 Container Siphon Tube – 79812	100 lb CV-98 Container Siphon Tube – 79813	CV-98 Flexible Discharge Bend – 427082	CV-98 Lever Release for Manual Actuation – 423309	See Note 4 on Page 12-2	HF Electric Actuator – 73327	Booster Actuator – 428949	Lever Release for HF Actuator – 70846	AP-8/ Sel. Vlv. Lever Release – 42484
Components To Be Replaced														
25 lb Container	Container Valve *	X												
	Siphon Tube *	X												
	Flexible Discharge Bend							X						
	Lever Release												X	
	Pneumatic Actuation									X				
	Manual and Pneumatic Actuation									X				
	Electric Actuator										X	X		
35 lb Container	Container Valve *		X											
	Siphon Tube *		X											
	Flexible Discharge Bend							X						
	Lever Release												X	
	Pneumatic Actuation									X				
	Manual and Pneumatic Actuation									X				
	Electric Actuator										X	X		
50 lb Container	Container Valve *			X										
	Siphon Tube *			X										
	Flexible Discharge Bend							X						
	Lever Release												X	
	Pneumatic Actuation									X				
	Manual and Pneumatic Actuation									X				
	Electric Actuator										X	X		
75 lb Container	Container Valve *				X									
	Siphon Tube *					X								
	Flexible Discharge Bend							X						
	Lever Release												X	
	Pneumatic Actuation									X				
	Manual and Pneumatic Actuation									X				
	Electric Actuator										X	X		
100 lb Container	Container Valve *				X									
	Siphon Tube *						X							
	Flexible Discharge Bend							X						
	Lever Release												X	
	Pneumatic Actuation									X				
	Manual and Pneumatic Actuation									X				
	Electric Actuator										X	X		

* Early CV-90 container valves (those manufactured prior to mid-1992) utilized coarse threads for the joint between the container valve and the siphon tube. CV-90 valves and siphon tubes with coarse (1.00-12UNF-2A) threads will require replacement of both the container valve and the siphon tube when either requires replacement. CV-90 container valve and siphon tubes manufactured after mid-1992 include the current threads specifications (.9375-32UN-2) as the current version of those components.