



## **PERSONNEL SAFETY AND RELIABILITY UPGRADE PROGRAM PER NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) STANDARD #12 - CARBON DIOXIDE EXTINGUISHING SYSTEMS, 2005 EDITION**

**Preface:** In the interests of reducing risks to personnel and at the same time maintaining the reliability of carbon dioxide (CO<sub>2</sub>) fire extinguishing systems, the NFPA has rewritten, revised and updated Standard #12 in the 2005 Edition.

The CO<sub>2</sub> fire system industry has always been cognizant of the potential risks involved in using CO<sub>2</sub>, which extinguishes fire by oxygen deprivation. Since an adequate amount of oxygen is necessary for sustaining human life, protected spaces must be evacuated before the system is used. It is important to mitigate this risk in order to be able to utilize the unique fire extinguishing characteristics of CO<sub>2</sub> that have made it the ideal agent to use in many fire suppression applications.

A rare action by the NFPA in the revised standard is a requirement that **existing systems** be upgraded to be in compliance by August 7, 2006. So even if you only service CO<sub>2</sub> systems, these changes offer you the opportunity to increase the safety and reliability of those systems.

The purpose of the bulletin is to bring to the reader's attention the more significant new or enhanced requirements so that planning to accommodate these changes can proceed as smoothly as possible.

Individual paragraph numbers and related text have been detailed to assist in identifying/locating the major changes to the standard. In some situations the paragraphs noted may not follow in numerical order in an attempt to logically present the intent or to emphasize the extent of the requirements. In addition, annex (appendix) material has been brought forward to avoid the confusion of relating code requirements to pertinent information shown in the annex. The new NFPA 12, 2005 edition should be consulted in regards to the specific details of all the noted changes and the many other alterations included in the revamping of NFPA 12, but not presented herein.

***This bulletin is not intended to take the place of a complete review of the 2005 edition of NFPA Standard #12.***

### **NEW INSTALLATIONS**

**4.1.1** Carbon dioxide total flooding fire extinguishing systems shall not be installed in normally occupied enclosures except as permitted in 4.1.2 through 4.1.4.

**4.1.2 New Installations.** Total flooding carbon dioxide systems shall be permitted to be installed in normally occupied enclosures where there are no suitable fire-extinguishing agents that can be used to provide an equivalent level of fire protection to that of carbon dioxide.

**4.1.2.1** If it is determined that carbon dioxide is to be used for a given application, the designer/installer shall provide supporting documentation to the authority having jurisdiction to verify that carbon dioxide is the most appropriate fire suppression agent for the application.

**4.1.3 Marine Applications.** Manually operated total flooding marine systems shall be permitted in normally occupied enclosures equipped with the following:

- (1) System lock-out valves specified in 4.5.5.
- (2) Pneumatic predischARGE alarms and pneumatic time delays specified in 9.3.3.5.
- (3) Two independent, manually operated system discharge control valves to actuate the carbon dioxide system as specified in 9.3.3.

## DEFINITIONS

**3.3.5 Normally Occupied.** An enclosure where, under normal circumstances, persons are present.

**3.3.7 Occupiable.** See 3.3.5, Normally Occupied.

**3.3.6 Normally Unoccupied.** An area or space not normally occupied by people but could be entered occasionally for brief periods.

**A.3.3.6 Normally Unoccupied.** A normally unoccupied enclosure is one that is occasionally visited by personnel. Examples of areas considered normally unoccupied are transfer bays, switch-houses, pump rooms, vaults, engine test stands, cable vaults, cable spreading rooms, utility tunnels, microwave relay stations, flammable liquid storage areas, enclosed energy systems, shipboard cargo holds, robotic paint spray areas, and computer room subfloors.

**3.3.11 Unoccupiable.** An enclosure that cannot be occupied due to dimensional or other physical constraints.

## EXISTING INSTALLATIONS

The current NFPA 12 does **not** allow the use of Class 150 malleable iron fittings. NFPA 12, 1977 edition and prior editions allowed the use of Class 150 iron fittings for 3/4" and smaller pipe sizes. All system upgrades should include the use of Class 300 fittings for the modified portion of the systems.

**1.3.4** Existing systems shall be upgraded to meet the requirements for safety signs in 4.3.2, lock-out valves in 4.3.3.6 and 4.3.3.6.1, and pneumatic time delays and pneumatic predischARGE alarms in 4.5.6.1.

**1.3.5** These upgrades shall be completed by August 7, 2006.

**A1.3.5** Exposure to carbon dioxide discharge poses a hazard to personnel; therefore, additional safety features for all new installations and for retrofitting of existing systems are provided in Section 4.3

Safety to personnel is of paramount importance, therefore, these additional safety features should be installed as soon as possible but no later than August 7, 2006.

The installation of the safety signs per 4.3.2 does not require any modifications to the installation and should be accomplished immediately.

The addition of supervised lock-out valves, per 4.3.3.6 and 4.3.3.6.1, and pneumatic predischarge alarms and pneumatic time delays, per 4.5.5.7, require that the system flow calculations be verified and be in accordance with this standard. That is, the addition of piping equipment (valve and time delays) adds equivalent pipe length to the system. The pneumatic predischarge alarm requires carbon dioxide flow to sound. The revised design should be in accordance with the agent quantity requirements of this standard.

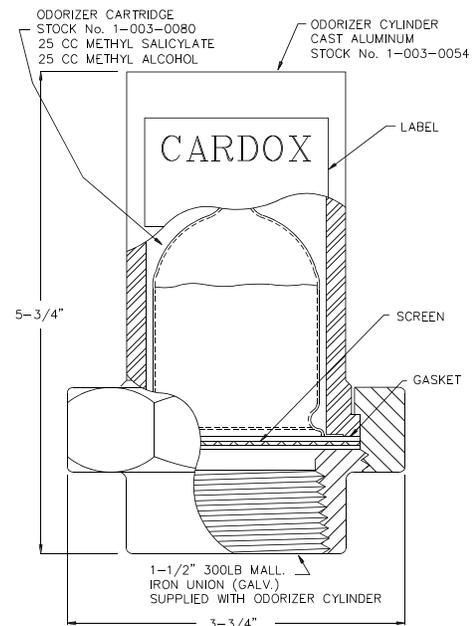
These modifications could necessitate revisions to, upgrading of, or replacement of system components, including control units.

As part of the process of implementing these modifications, the authority having jurisdiction should be consulted for additional recommendations or requirements.

**4.3.3.1.1** Visual and audible devices shall be located at the entrance to each occupiable space protected by a carbon dioxide system and at the entrance to each space where carbon dioxide could migrate, creating a hazard to personnel. Provisions shall be made to prohibit entry of unprotected personnel to spaces made unsafe by a carbon dioxide discharge until the space is ventilated and appropriate tests of the atmosphere have verified that it is safe for unprotected persons to enter. Persons who are not properly trained in the use of and equipped with self-contained breathing apparatus (SCBA) shall not remain in spaces where the concentration exceeds 4 percent. Such provisions shall include one or more of the following:

- (1) Addition of a distinctive odor to the discharging carbon dioxide, the detection of which serves as an indication to persons that carbon dioxide gas is present. (Personnel shall be trained to recognize the odor and evacuate spaces wherein the odor is detected.)
- (2) Provision of automatic alarms at the entry to and within such spaces, which alarms are activated by carbon dioxide detectors or oxygen detectors.
- (3) Establishment and enforcement of confined space entry procedures for such areas.

**A4.3.3.1.1** All total flood hazards will be made unsafe for entry of unprotected personnel until such spaces are ventilated of carbon dioxide. Spaces containing equipment protected by local application systems could become unsafe, particularly if the protected equipment occupies a sizable portion of the volume of the room containing the equipment. Pits, cellars, and rooms adjacent to the protected hazard, especially those at lower elevations, can be made unsafe by migration of the discharged carbon dioxide.



*Odorizer Cylinder*

Oil of wintergreen is a common and recommended odorizer added to the discharging carbon dioxide to produce a distinctive odor that warns of the presence of carbon dioxide gas. Other odorizers that are specially appropriate for specific locations can also be used, but, if there is no specific reason to use an odorizer other than oil of wintergreen, oil of wintergreen should be used.

Olfactory indicators could be inappropriate for applications such as clean rooms, food processing, aluminum rolling mills, and telecommunications facilities since they could adversely affect the process or equipment.

**4.3.3.1.2** The visual alarms required by 4.3.3.1.1 shall be permitted to serve this purpose if they are left operating until the space is ventilated and the safety of the atmosphere for entry by unprotected persons has been verified.

**4.3.3.1.3** The operation of electrically operated warning devices shall be continued after agent discharge until positive action has been taken regarding the alarm and prevention of exposure of personnel to hazardous concentrations.

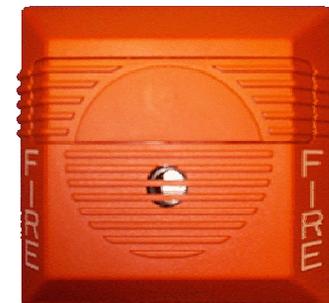


Visual Alarm - Strobe

#### **4.5.6 Predischarge Alarms.**

**4.5.6.1** A pneumatic predischarge alarm and pneumatic time delay shall be provided for the following:

- (1) All total flooding systems protecting normally occupied and occupiable enclosures.
- (2) Local application systems protecting normally occupied and occupiable enclosures where the discharge will expose personnel to hazardous concentrations of carbon dioxide. (See 4.5.4.5.3.)



Audible Alarm

**Exception:** For occupiable hazard areas where the provision of a time delay could result in unacceptable risk to personnel or unacceptable damage to critical pieces of equipment, time delays need not be provided. Provision shall be made to ensure that the carbon dioxide system is locked out at any time that personnel are present in the protected area or space.

**A4.5.6.1** Examples of hazard areas where the provision of a time delay could result in unacceptable risk to personnel or unacceptable damage to critical pieces of equipment are combustion gas turbines and engine test cells. Fires in such equipment tend to be fast growth, and delay in the discharge of the fire extinguishing agent can result in destruction of essential equipment or unacceptable risk to personnel. These are normally unoccupied spaces. When such spaces are occupied by personnel, the systems must be locked out to prevent discharge of carbon dioxide without the benefit of a predischarge alarm and time delay.

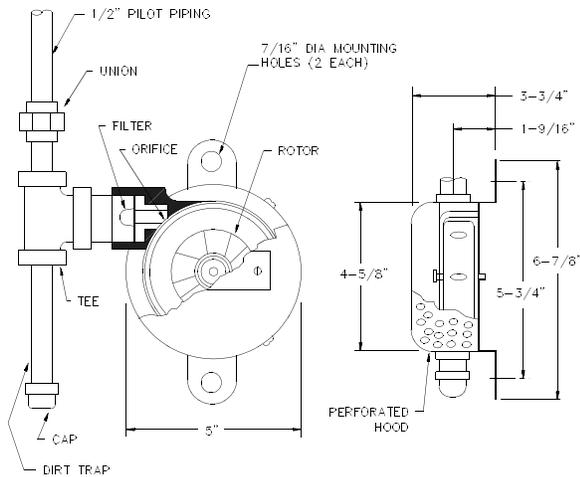
**4.5.6.2** Predischarge alarms shall be provided to give positive warning of a discharge where hazards to personnel could exist.

**4.5.6.2.1** Such alarms shall function to warn personnel against entry into hazardous areas as long as such hazards exist or until such hazards are properly recognized. (See Section 4.4.)

**4.5.6.2.2** Audible predischarge alarms shall be at least 15 dB above ambient noise level or 5 dB above maximum sound level, whichever is greater, measured 5 ft (1.5 m) above the floor of the occupiable area.

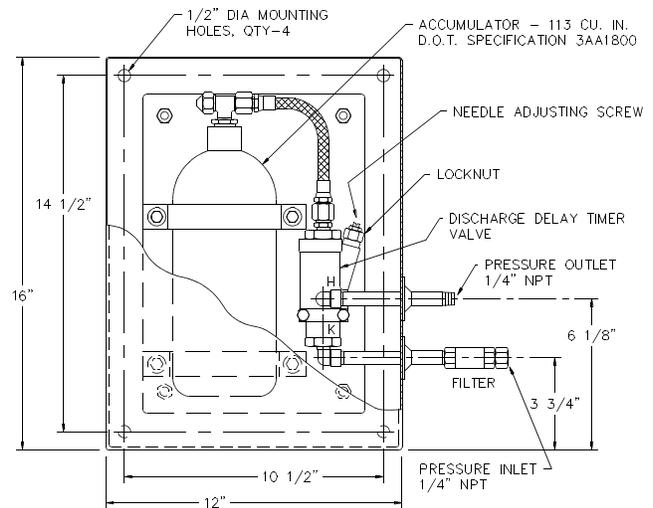
**4.5.6.2.3** Audible signal appliances shall have a sound level not more than 120 dB at the minimum hearing distance from the audible appliance.

**4.5.6.2.4** The predischarge alarm shall have a minimum decibel rating of 90 dBA at 10 ft (3 m).



*Pneumatic Predischarge Alarm*

In excess of 90 db at 10 ft distance, with CO<sub>2</sub> vapor discharges at approximately 3 lbs of CO<sub>2</sub> vapor per minute at 280 psig.



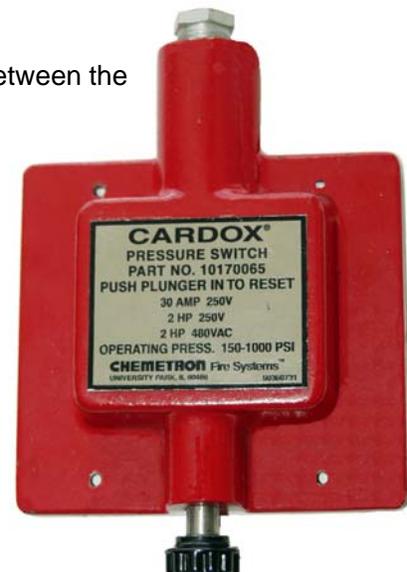
*Automatic Mechanical Timer S/N 10100947*

Stock units are factory set for 22 seconds delay.  
Limit of adjustment is 5 seconds minimum to 90 seconds maximum

**4.5.4.11 Discharge Pressure Switch.**

**4.5.4.11.1** A discharge pressure switch shall be installed between the carbon dioxide supply and the lock-out valve.

**4.5.4.11.2** The discharge pressure switch shall provide an alarm initiating signal to the releasing panel to operate electric/electronic alarm appliances.



**4.4.2.14** The system owner shall maintain an instruction and maintenance manual that includes a full sequence of operation, and a full set of system drawings and calculations shall be maintained in a protective enclosure.

**4.3.3.6** A lock-out shall be provided on all systems except where dimensional constraints prevent personnel from entering the protected space.

**4.3.3.6.1** Lock-out valves shall be installed on all systems where carbon dioxide could migrate, creating a hazard to personnel.

**4.3.3.6.2** Systems shall be locked out under the following conditions:

- (1) When persons not familiar with the systems and their operation are present in a protected space.
- (2) When persons are present in locations where discharge of the system will endanger them, and they will be unable to proceed to a safe location within the time-delay period for the system.

**4.3.3.6.3** When maintenance or testing is being conducted on the system, it shall be locked out or the protected space and affected spaces (migration) shall be evacuated.

**4.3.3.6.4** When protection is to be maintained during the lock-out period, a person(s) shall be assigned as a "fire watch" with suitable portable or semiportable fire-fighting equipment or means to restore protection.

**4.3.3.6.4.1** The fire watch shall have a communication link to a constantly monitored location.

**4.3.3.6.4.2** Authorities responsible for continuity of fire protection shall be notified of lock-out and subsequent restoration of the system.

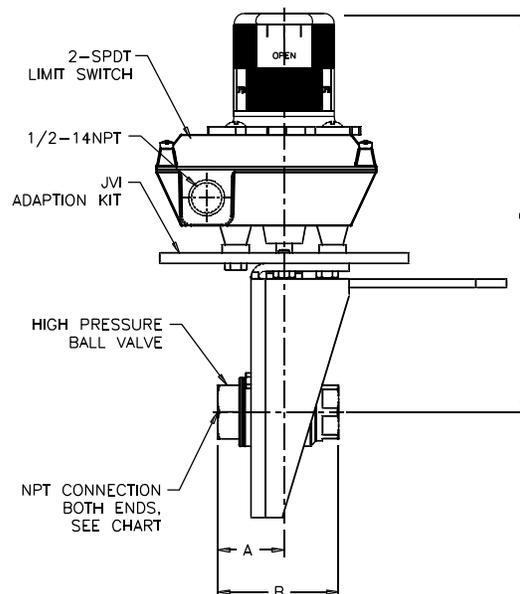
**4.5.5 Supervision and Lock-Out Valves.**

**4.5.5.1** Supervision of automatic systems and manual lock-out valves shall be provided unless specifically waived by the authority having jurisdiction.

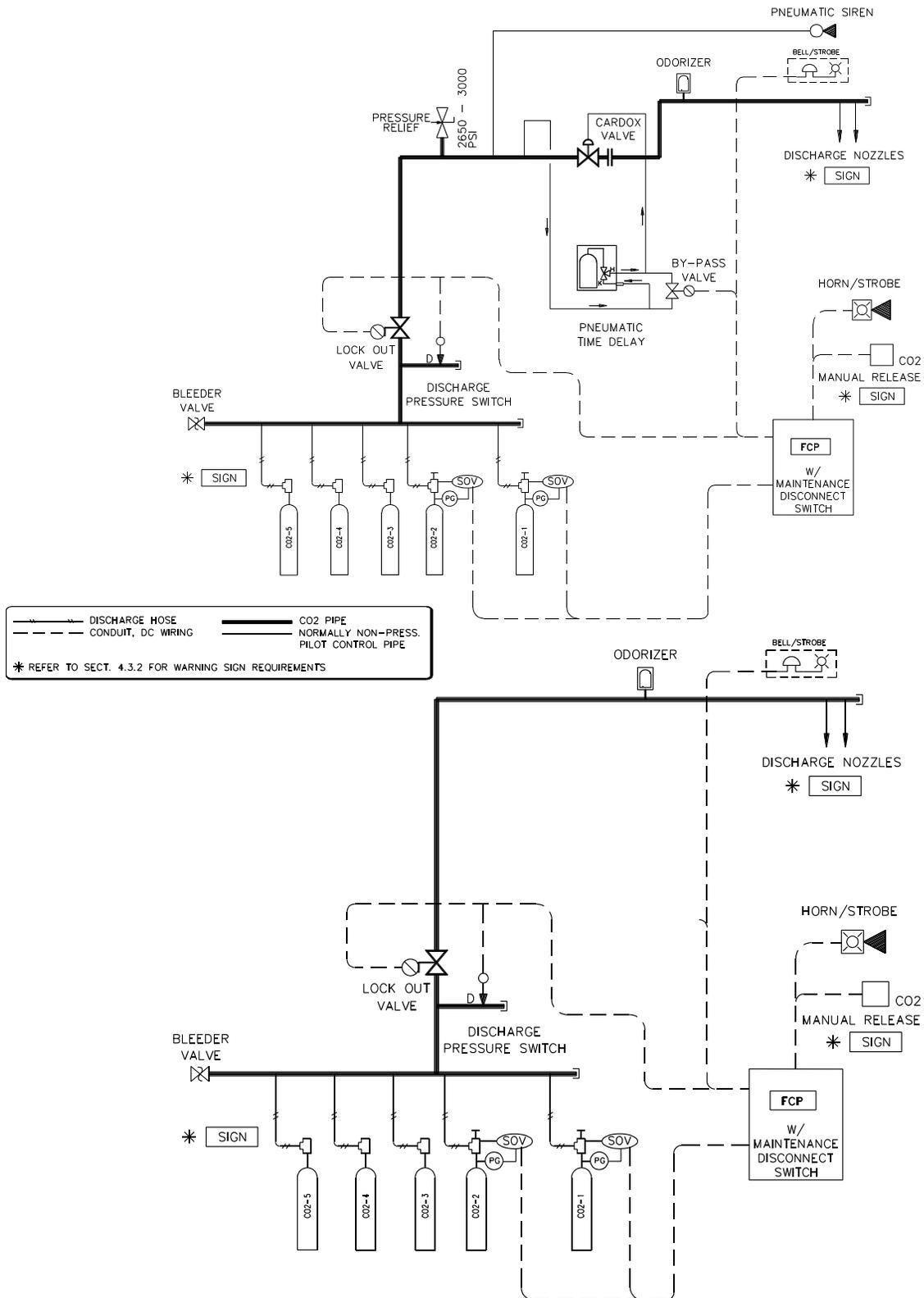
**4.5.5.2** Supervision of automatic systems shall be provided, and the lock-out required by 4.3.3.6 shall be supervised for both automatic and manual systems unless specifically waived by the authority having jurisdiction.

**4.5.5.3** Interconnections between the components that are necessary for the control of the system and life safety shall be supervised.

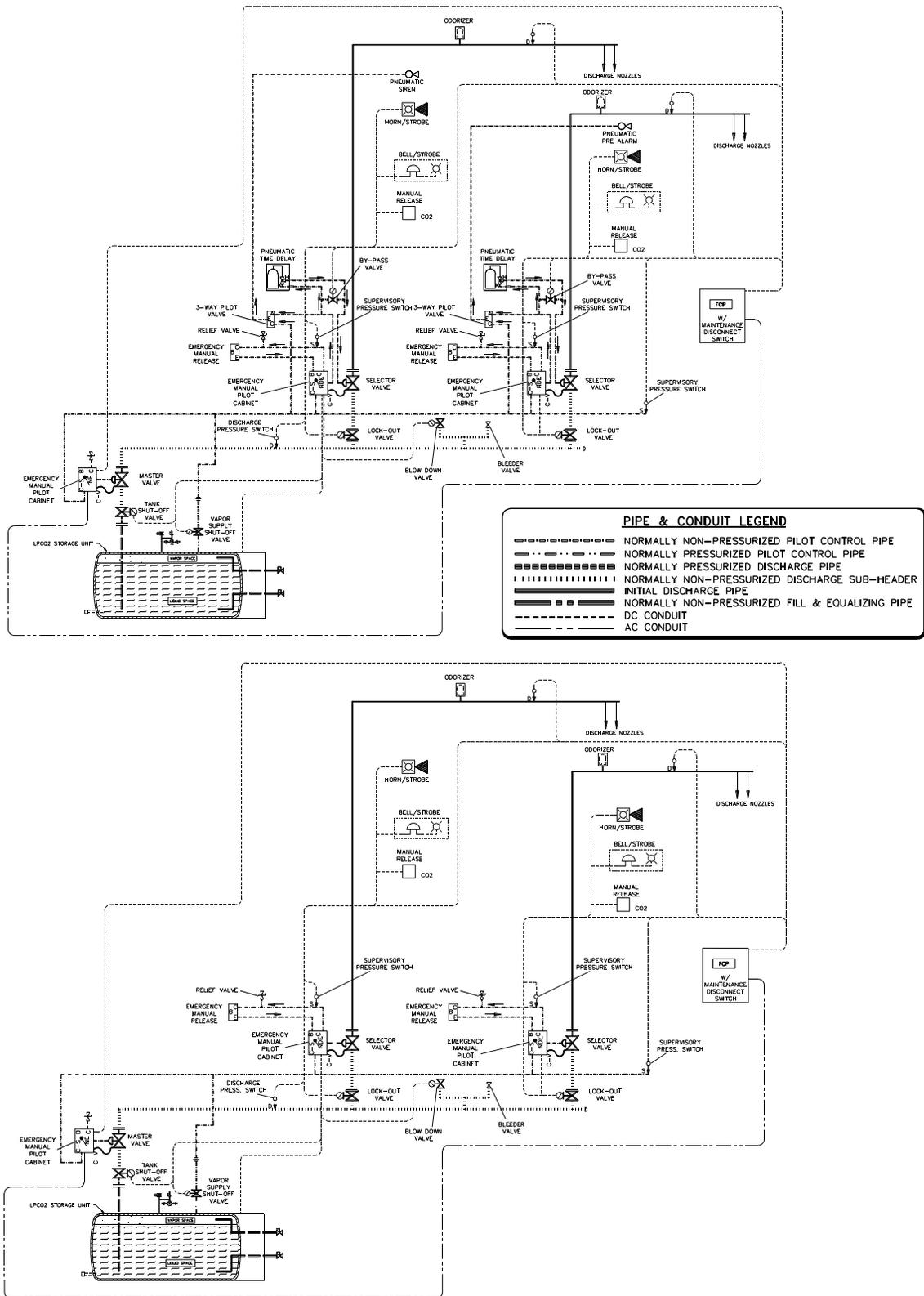
**4.3.3.7** For electrically operated systems, a service disconnect switch shall be provided.



NEMA 4, 4X, 7 & 9 BALL VALVE ASSEMBLIES						
VALVE SIZE	CHEMETRON S/N NEMA 4, 4X	CHEMETRON S/N NEMA 4, 4X, 7 & 9	DIMENSIONS			ASSY WT. IN LBS.
			A	B	C	
1/4	70985018	70985090	1.55	2.73	9.25	7
1/2	70985020	70985069	1.55	2.73	9.25	7
3/4	70985021	70985070	1.92	3.50	9.55	8
1"	70985022	70985071	1.92	3.60	9.55	9
1-1/4	70985023	70985072	2.10	3.93	9.85	10
1-1/2	70985024	70985073	2.47	4.55	10.05	12
2	70985025	70985074	2.66	4.94	10.25	12



Typical HPCO<sub>2</sub> Arrangements required by NFPA 12, 2005 Edition  
(Refer to Section 4.5.6.1)



*Master Valve with Selector Arrangements - Typical LPCO<sub>2</sub> Arrangements required by NFPA 12, 2005 Edition (Refer to Section 4.5.6.1)*

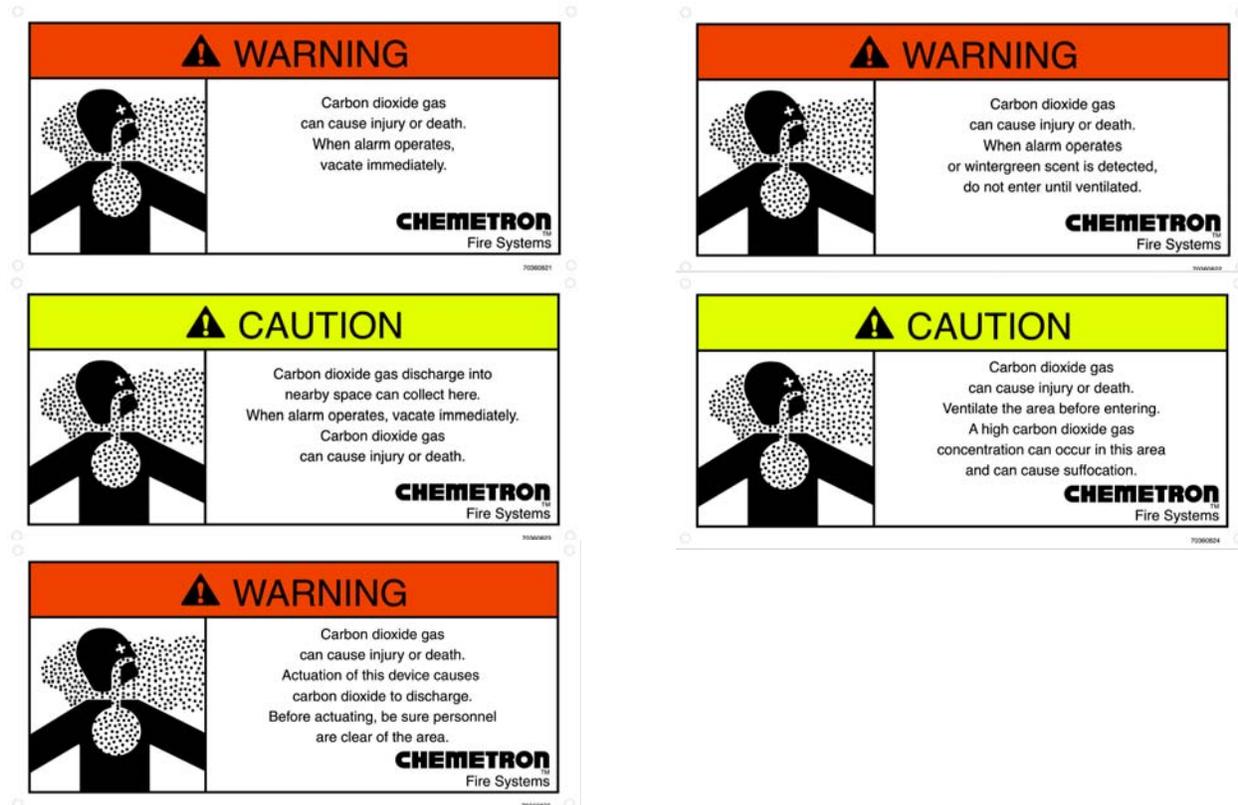
**4.3.2 Signs.**

**4.3.2.1** Warning signs shall be affixed in a conspicuous location in every protected space; at every entrance to protected spaces, in spaces near the protected spaces where it is determined that carbon dioxide could migrate, creating a hazard to personnel; and at each entrance to carbon dioxide storage rooms and where carbon dioxide can migrate or collect in the event of a discharge from a safety device of a storage container.

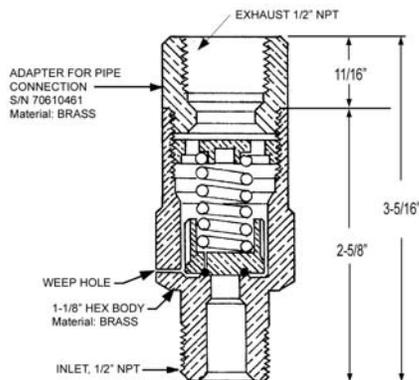
**4.3.2.2** For all new system installations, the safety sign format, color, letter style of signal words, message panel lettering, lettering size, and the safety provisions of symbols shall be in accordance with MNBV/ANSI Z535, *Standard for Environmental and Facility Safety Signs*.

**4.3.2.4** For existing system installations that have existing signs that meet the requirements of 4.3.2.1, the signage shall be considered to be acceptable if the facility has an effective training program in place covering all suppression-related signage, with all personnel with access to the protected space either trained on the signage or accompanied at all times by a person who has received the intended training.

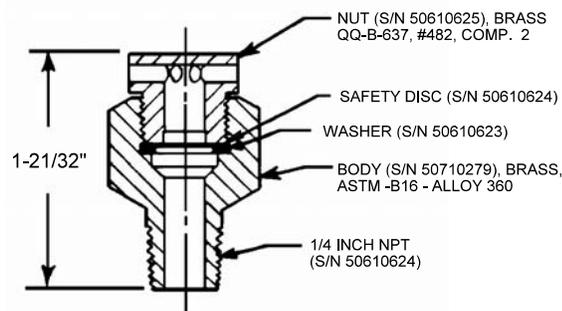
***The installation of the safety signs per 4.3.2 does not require any modifications to the installation and should be accomplished immediately.***



Bill of Common Materials			
DESCRIPTION	S/N	DESCRIPTION	S/N
Pneumatic Timer	10100947	Pneumatic Siren	70030380
Booster Valve / 3-way Pilot Control Valve	10610668	Nameplate "...vacate immediately"	70360821
Nameplate "...do not enter until ventilated"	70360822	Nameplate "...When alarm operates, vacate immediately..."	70360823
Nameplate "...Ventilate the area before entering..."	70360824	Nameplate "...Before Actuating..."	70360825
Odorizer Cartridge	10030080	Odorizer Cylinder without cartridge	10030054
1/2" Bleeder valve	10610573	1/4" Frangible disc relief (2650 - 3000 psi)	30710006
Safety relief valve 450 psi	10610753	4-pole Pressure switch	10170065
2-pole Pressure switch	10170089	Supervisory pressure switch (DC voltage only)	70170178
Supervisory pressure switch (AC voltage only)	70170177	1/2" Blocking valve/Selector valve	30610047
3/4" Blocking valve/Selector valve	30610048	1" Blocking valve/Selector valve	10610371
1-1/2" Blocking valve/Selector valve	10610369	2" Blocking valve/Selector valve	10610370
3" Blocking valve/Selector valve	10610733	4" Blocking valve/Selector valve	10610734
6" Blocking valve/Selector valve	10610740	Maintenance switch w/Key lockout	70170271
Maintenance switch, NEMA 4 w/pilot light & key lockout	70170220	Lockout valves (see ball valves below)	
1/4" Ball valve w/DPDT limit switch W/P (timer bypass)	70985018	1/2" Ball valve w/DPDT limit switch W/P	70985020
3/4" Ball valve w/DPDT limit switch W/P	70985021	1" Ball valve w/DPDT limit switch W/P	70985022
1-1/4" Ball valve w/DPDT limit switch W/P	70985023	1-1/2" Ball valve w/DPDT limit switch W/P	70985024
2" Ball valve w/DPDT limit switch W/P	70985025	1/4" Ball valve w/DPDT limit switch X/P (timer bypass)	70985090
1/2" Ball valve w/DPDT limit switch X/P	70985069	3/4" Ball valve w/DPDT limit switch X/P	70985070
1" Ball valve w/DPDT limit switch X/P	70985071	1-1/4" Ball valve w/DPDT limit switch X/P	70985072
1-1/2" Ball valve w/DPDT limit switch X/P	70985073	2" Ball valve w/DPDT limit switch X/P	70985074
3" Wafer valve w/SPDT limit switch	10610994	4" Wafer valve w/SPDT limit switch	10610995
6" Wafer valve w/SPDT limit switch	10610996	3" Wafer valve w/DPDT limit switch	10611068
4" Wafer valve w/DPDT limit switch	10611069	6" Wafer valve w/DPDT limit switch	10611070



*Safety Relief Valve (450 psi)*  
For use in L<sub>PCO<sub>2</sub></sub> piping systems where CO<sub>2</sub> can be trapped.



*Frangible Disk Assembly (Bursting Pressure 2650 to 3000 psi)*  
For use in H<sub>PCO<sub>2</sub></sub> piping systems where CO<sub>2</sub> can be trapped.