CHAPTER NINE

Carbon Dioxide (CO_2) Systems

Contents

- Required Permits and Submittal Requirements
- Ventilation and Detection Requirements
- Beverage Dispensing Applications
- Submittal Requirements

Purpose:

Proper installation of CO2 systems helps to protect the safety of everyone encountering these potentially life-threatening systems.

WHAT IS CO2?

Carbon dioxide (CO2) is a colorless, odorless, inert gas with a density that is heavier than air. When compressed and cooled to less than 87.8°F, gaseous CO2 becomes liquified. CO2 will remain in liquid form, regardless of the pressure applied, provided that its temperature is maintained below that critical point. Once the temperature rises above 87.8°F, CO2 will return to a gaseous state.

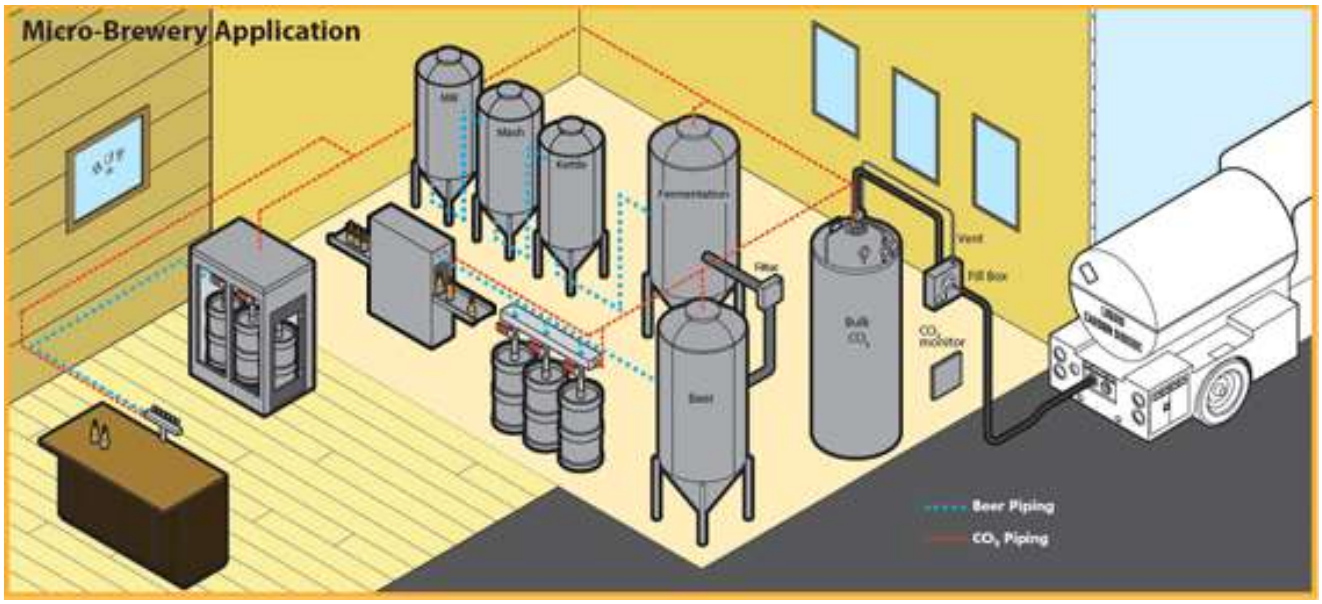
When in a gaseous state, CO2 can accumulate in hazardous amounts in low lying areas without sufficient ventilation, especially inside confined spaces. High concentrations can displace oxygen in air and cause suffocation.

USE OF LIQUID CO2 SYSTEMS

Because liquid CO2 is routinely used to carbonate beverages, liquid CO2 systems are commonly found in assembly occupancies, especially restaurants and micro-breweries. This is cause for concern because frequently owners, managers, staff, and patrons of these establishments are unaware of the associated risks with these systems. Some vendors have also installed systems without involving the building or fire department, therefore, compliance with applicable codes is called into question. Additionally, it is important for emergency responders to have advance knowledge of where these systems are located in the event of an emergency.

Requirements of this document shall be applied retroactively to existing systems within 12 months of discovery or annexation into Northwest Fire District boundaries.

Requirements of this document do not apply to systems utilizing LESS THAN 100 pounds of carbon dioxide.



REQUIRED PERMITS

CONSTRUCTION PERMITS

A fire construction permit is required to install or modify a compressed gas system utilizing carbon dioxide (CO2) in excess of 100 pounds or 875 cubic feet at normal temperature and pressure (NTP). Depending on the location of the installation, (Pima County or Town of Marana) submittals shall be routed to the appropriate location as outlined in Chapter 1-4: Where to Submit Plans in the Northwest Fire District Fire Code Construction and Development Handbook. See Chapter 9-11 of this document for permit submittal requirements.

CODES AND STANDARDS

Design and installation shall comply with the applicable provisions of the following codes and standards:

- 2018 International Fire Code (IFC) Sections 916 and 5307
- Northwest Fire District IFC Amendments
- 2016 NFPA 72: National Fire Alarm and Signaling Code

GENERAL CARBON DIOXIDE SYSTEMS REQUIREMENTS

The following requirements apply to all compressed gas systems utilizing CO2:

1. The fill port is to be piped to the outside atmosphere.
2. All venting (normal and emergency) is to be piped to the outside atmosphere.
3. When used, insulated liquid CO2 containers are to be anchored to the slab.
4. When used, CO2 compressed gas cylinders are to be properly secured from tipping or movement.
5. All hoses and fittings used within the systems are to be manufacturer approved.
6. Warning signs are required to be posted in accordance with this chapter.
7. A backup power source is required for all systems. Batteries are an acceptable option. Exception: backup power is not required when the system is monitored for loss of power and a trouble signal is initiated by the building's fire alarm control panel.
8. Battery backup is required for CO2 sensors/detectors that reset to an alarm condition upon loss of primary power.
9. Inspection and testing of the gas detection system shall be conducted annually, at a minimum. Sensor calibration shall be confirmed upon installation and performed at the frequency specified by the sensor manufacturer.
10. Any CO2 system found to be not in good working order shall be shut down and taken out of service immediately until appropriate corrective actions are made by professional service personnel.

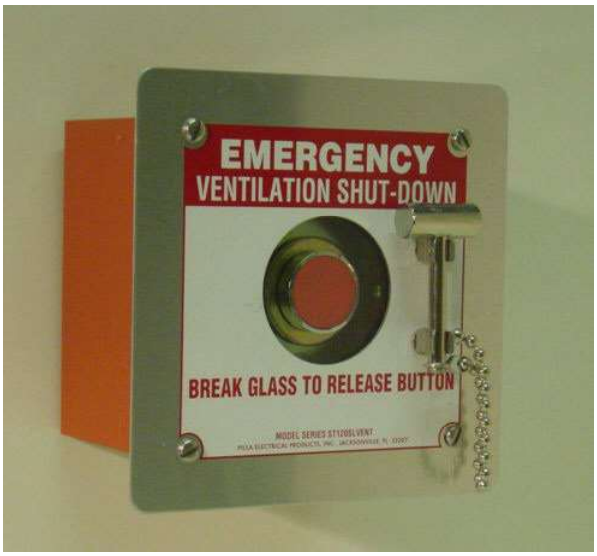
BEVERAGE DISPENSING APPLICATIONS

MECHANICAL VENTILATION

Mechanical ventilation is required to be installed in rooms or areas indoors where insulated liquid carbon dioxide storage tanks, cylinders, piping and equipment are located and other areas where a CO2 leak is expected to accumulate.

Mechanical ventilation systems shall be installed in compliance with the International Mechanical Code and must meet the following requirements:

1. Rooms containing CO2 shall be maintained at a negative pressure in relation to the surrounding area.
2. Mechanical ventilation shall be at a rate of not less than 1 cubic foot per minute per square foot.
3. Systems shall operate continuously unless alternative designs are approved, and system shall be operational during all times the building or space is occupied.
4. A manual shutoff control shall be provided adjacent to the access door or in another approved location. The switch shall be a break-glass type labeled VENTILATION SYSTEM EMERGENCY SHUTOFF.
5. Exhaust ventilation shall be taken from a point within 12 inches of the floor.
6. Exhaust and inlet air openings shall provide air movement across all portions of the floor or room.
7. Exhaust air shall not be recirculated.



A gas detection system installed in compliance with the International Fire Code may be installed in lieu of mechanical ventilation.

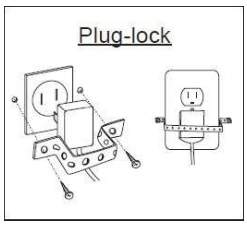
BEVERAGE DISPENSING APPLICATIONS

Gas Detection Systems

When mechanical ventilation requirements are not met, a gas detection system shall be provided.

Gas detection systems shall meet with following requirements:

1. Detection shall be provided in rooms, indoor areas and below-grade outdoor areas with insulated carbon dioxide systems.
2. CO2 sensors shall be installed within 12 inches of the floor at all points of use areas where the gas is expected to accumulate or where leaks are most likely to occur. These areas include, but may not be limited to:
    a. All storage and/or supply areas with CO2 containers, tanks or cylinders
    b. Areas where pure CO2 is piped into the building
    c. All mixing areas
    d. Other approved locations
3. Gas sampling shall be continuous.
4. A local alarm and strobe are to be provided in each room or area where sensors are located to provide audible and visible notification of an alarm condition. An additional notification appliance is required in an area occupied by members of the public (i.e. dining room).
    a. Strobes shall have a minimum candela rating of 110 with an amber lens installed.
    b. Alarm devices shall provide a minimum of 75 decibels at 10 feet.
5. A Central Unit or CO2 system annunciator shall be installed in a normally attended location where all alerts and tones can be heard, and all installed sensors must report to one central unit or annunciator.
6. Gas detection systems shall be permanently connected to the building's power supply with the electrical circuit for the CO2 detection system labeled and locked or power cords shall be connected to unswitched receptacles using approved, fixed restraints to secure the plug from tampering or accidental disruption of power.



BEVERAGE DISPENSING APPLICATIONS

Alarm Conditions and Monitoring

1. CO2 concentration of 5,000 ppm or .5% shall activate an audible and visible supervisory alarm in a normally attended location (CO2 system annunciator).
2. CO2 concentration of 30,000 ppm or 3% shall activate audible and visible alarms initiating evacuation of the building (CO2 alarm with amber strobe).
3. The gas detection system shall be monitored by the building fire alarm system when one is provided. Connections shall be approved and connected in accordance with the fire alarm equipment manufacturer's instructions. Exception: existing alarm panels without the capacity for additional signals or incompatible panels may be excluded with approval from the Fire Code Official.
4. Alarm signals from the CO2 gas detection system shall report to the Central Station as "CO2 Alarm". Exception: existing alarm panels without the capacity for additional signals or incompatible panels may be excluded with approval from the Fire Code Official.
5. Activation of the CO2 alarm system shall not activate the fire alarm notification appliances.
6. When a building fire alarm is not provided, additional audible and visible notification is required outside the building to notify emergency responders of a CO2 alarm condition. The notification device shall be labeled as a CO2 alarm with an amber lens and shall be activated upon initiation of the CO2 sensors.

ALARM SYSTEM COMPONENTS

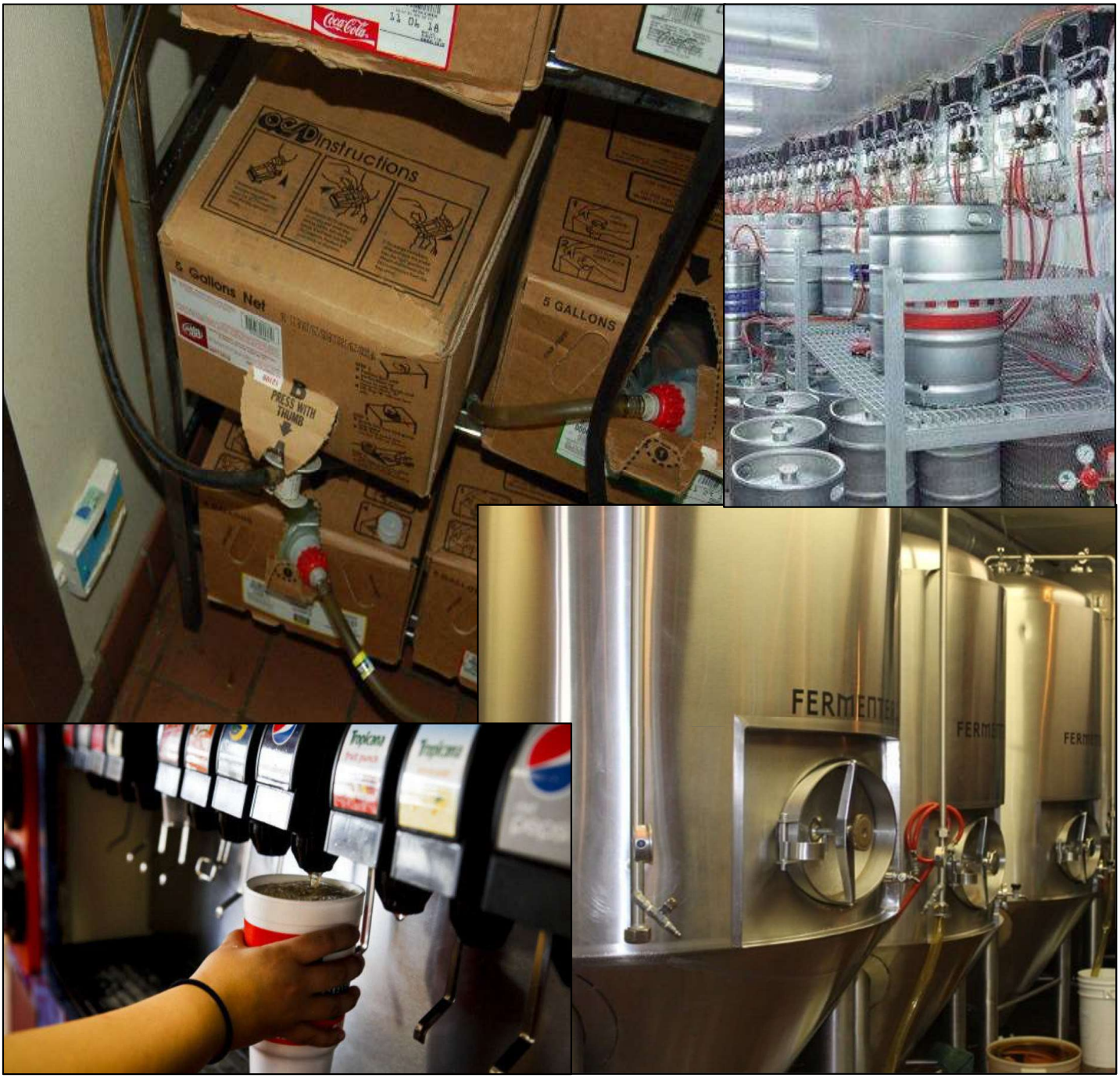
Strobe with Amber

CO_2 Sensor/Detector

Central Unit or Annunciator

SENSOR INSTALLATION LOCATIONS

Points of Use/Mixing Areas



SENSOR AND ALARM LOCATIONS

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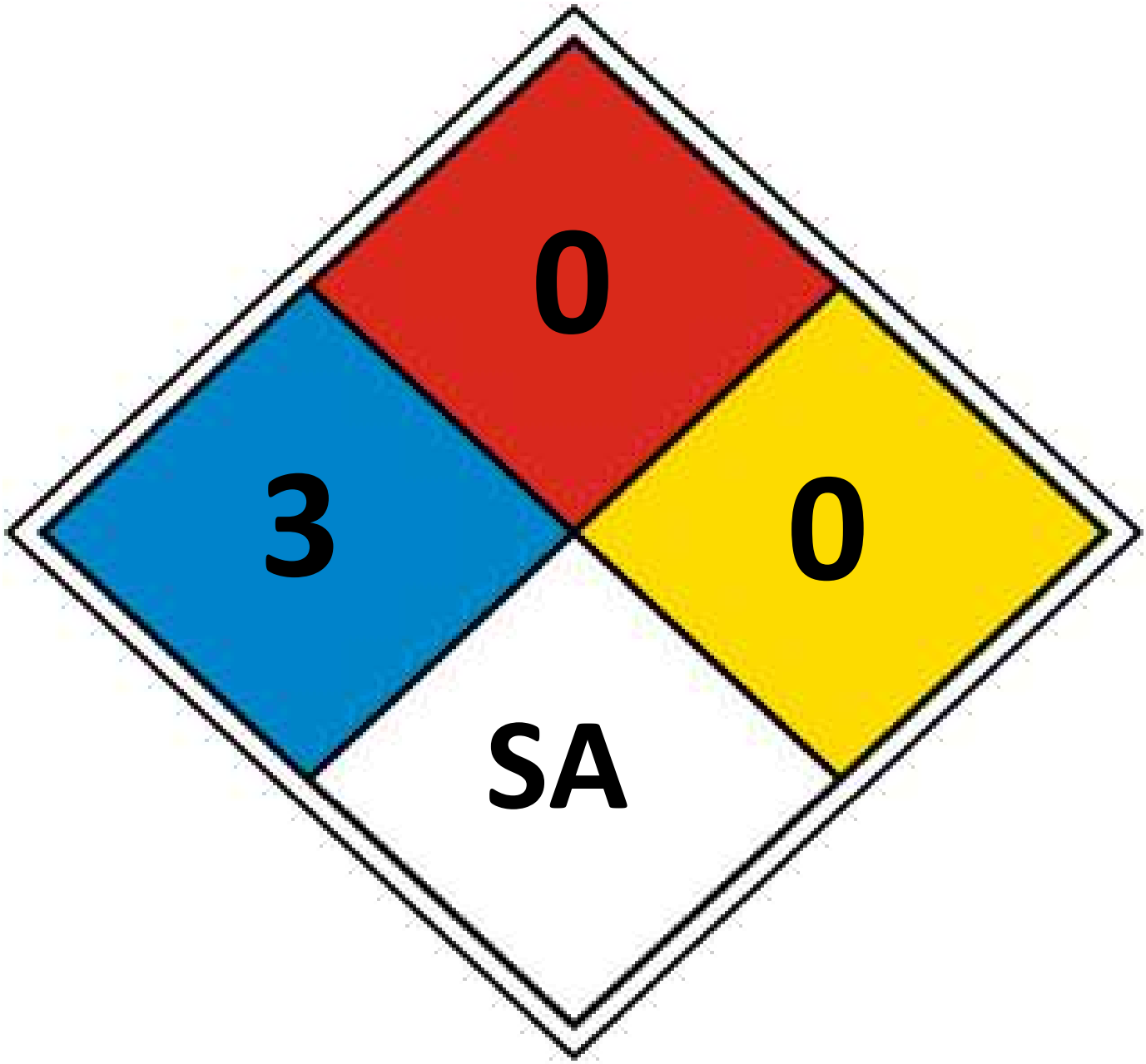
HAZARD IDENTIFICATION SIGNAGE

Where liquid CO2 containers are located in buildings, NFPA 704 placards displaying the hazard ratings shown below shall be posted at specific entrances (e.g. exterior doors closest to tanks, storage rooms doors) as determined by the fire code official.

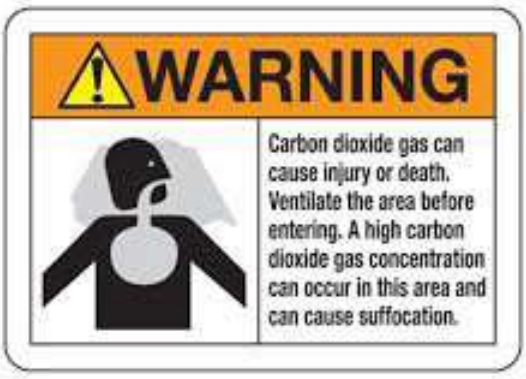
See Chapter 8: Hazardous Material Identification for sign specifications.

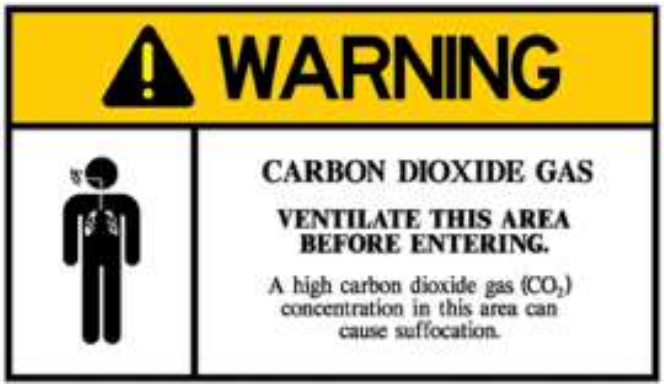


WARNING SIGNS

A warning sign shall be placed next to each audible/visual notification appliance.

A warning sign shall also be placed at the entrance to the room where CO2 tanks are located. Signs shall be a minimum of 7”H by 10” W.





PERMIT SUBMITTAL REQUIREMENTS

The following items are required to be provided when submitting plans for a Construction Permit. Incomplete submittals will not be accepted. Coordination between the system installing contractor and the fire alarm contractor is required.

1. Floor plan of the building showing the following components:
    a. When CO2 is supplied from a bulk CO2 system for use inside of a building, provide one of the following with the submittal:
        i. Plans for the mechanical ventilation system including calculations and electrical connections OR
        ii. Plans for the CO2 Gas Detection System showing the following items:
2. Locations of CO2 Alarm Components:
    a. CO2 sensor/detectors
    b. CO2 audible/visible alarms
    c. Central unit or annunciator
3. Method for connection to the fire alarm. NOTE: This work shall be performed by a licensed fire alarm contractor holding a valid Business Permit Certificate issued by the Northwest Fire District. See Chapter 1-3 of the Northwest Fire District Fire Code Construction and Development Handbook for information on obtaining a Business Permit Certificate. A separate Fire Alarm Permit is required; however, fire alarm work may be shown on the same floor plan as the CO2 system.
    a. Location of CO2 tanks or cylinders
    b. Mixing station location(s) and valves
    c. Fill port location
    d. Locations of required warning signage
4. Data sheets for all major components
5. Completed permit applications for each contractor:
    a. CO2 System Installer
    b. Fire Alarm Contractor