



## **Carbon Dioxide (CO<sub>2</sub>) Systems**

### **Contents:**

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

### **Purpose:**

Proper installation of CO<sub>2</sub> systems helps to protect the safety of everyone encountering these potentially life-threatening systems.

## WHAT IS CO<sub>2</sub>?

Carbon dioxide (CO<sub>2</sub>) 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 CO<sub>2</sub> becomes liquified. CO<sub>2</sub> 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, CO<sub>2</sub> will return to a gaseous state.

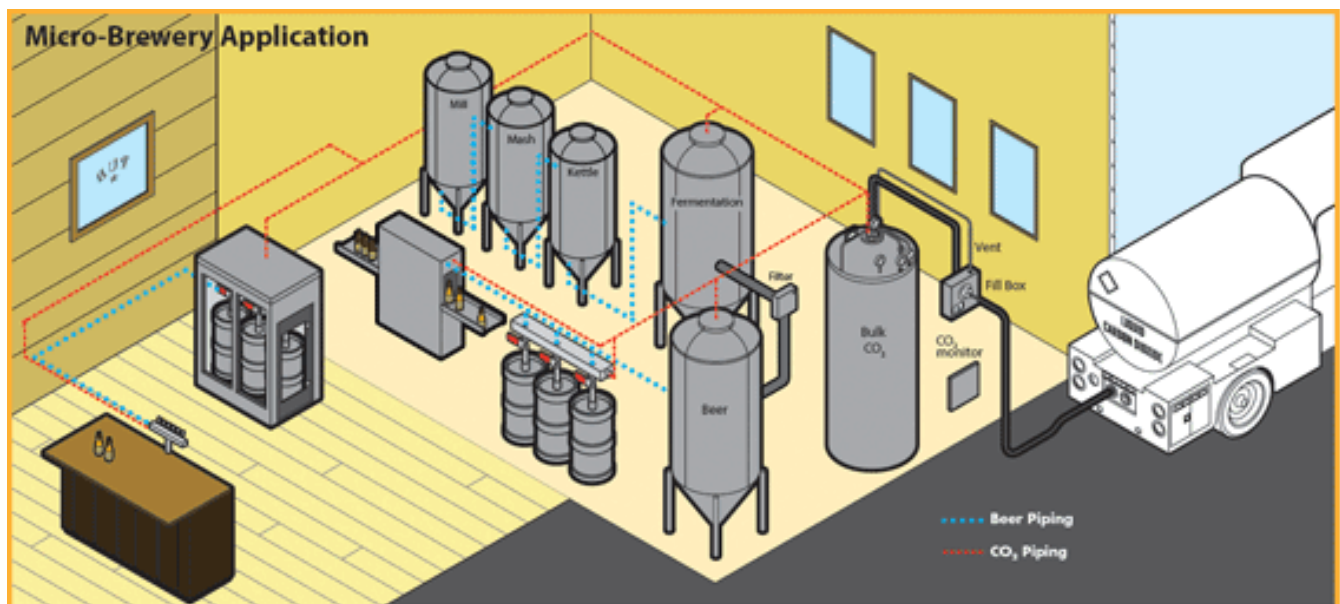
When in a gaseous state, CO<sub>2</sub> can accumulate in hazardous amounts in low lying areas without sufficient ventilation, especially inside confined spaces. High concentrations can displace oxygen in air and cause suffocation.

## USE OF LIQUID CO<sub>2</sub> SYSTEMS

Because liquid CO<sub>2</sub> is routinely used to carbonate beverages, liquid CO<sub>2</sub> 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 Golder Ranch Fire District boundaries.**

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



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# REQUIRED PERMITS

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## CONSTRUCTION PERMITS

A fire construction permit is required to install or modify a compressed gas system utilizing carbon dioxide (CO<sub>2</sub>) in excess of 100 pounds or 875 cubic feet at normal temperature and pressure (NTP). Depending on the location of the installation, (Pima County, Pinal county, Oro Valley, or Town of Marana) submittals shall be routed to the appropriate location.

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## 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

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## GENERAL CARBON DIOXIDE SYSTEM REQUIREMENTS

The following requirements apply to all compressed gas systems utilizing CO<sub>2</sub>:

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 CO<sub>2</sub> containers are to be anchored to the slab.
4. When used, CO<sub>2</sub> 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.
8. Battery backup is required for CO<sub>2</sub> 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 CO<sub>2</sub> 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 CO<sub>2</sub> 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 CO<sub>2</sub> 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.**

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# BEVERAGE DISPENSING APPLICATIONS

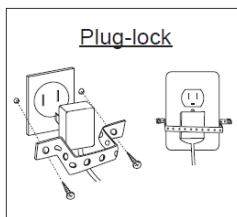
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## Gas Detection Systems

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. CO<sub>2</sub> 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:
  - All storage and/or supply areas with CO<sub>2</sub> containers, tanks or cylinders
  - Areas where pure CO<sub>2</sub> is piped into the building
  - All mixing areas
  - 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.
5. A Central Unit or CO<sub>2</sub> 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 CO<sub>2</sub> detection system labeled and locked or power cords shall be connected to un-switched receptacles using approved, fixed restraints to secure the plug from tampering or accidental disruption of power.



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# BEVERAGE DISPENSING APPLICATIONS

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## Alarm Conditions and Monitoring

1. CO<sub>2</sub> concentration of **5,000 ppm or .5%** shall activate an audible and visible **supervisory alarm** in a normally attended location (CO<sub>2</sub> system annunciator).
2. CO<sub>2</sub> concentration of **30,000 ppm or 3%** shall activate audible and visible alarms **initiating evacuation** of the building (CO<sub>2</sub> alarm with amber strobe).





## ALARM SYSTEM COMPONENTS



Strobe with Amber Lens



CO<sub>2</sub> Sensor/Detector



Central Unit or Annunciator

# SENSOR INSTALLATION LOCATIONS

## Points of Use/Mixing Areas





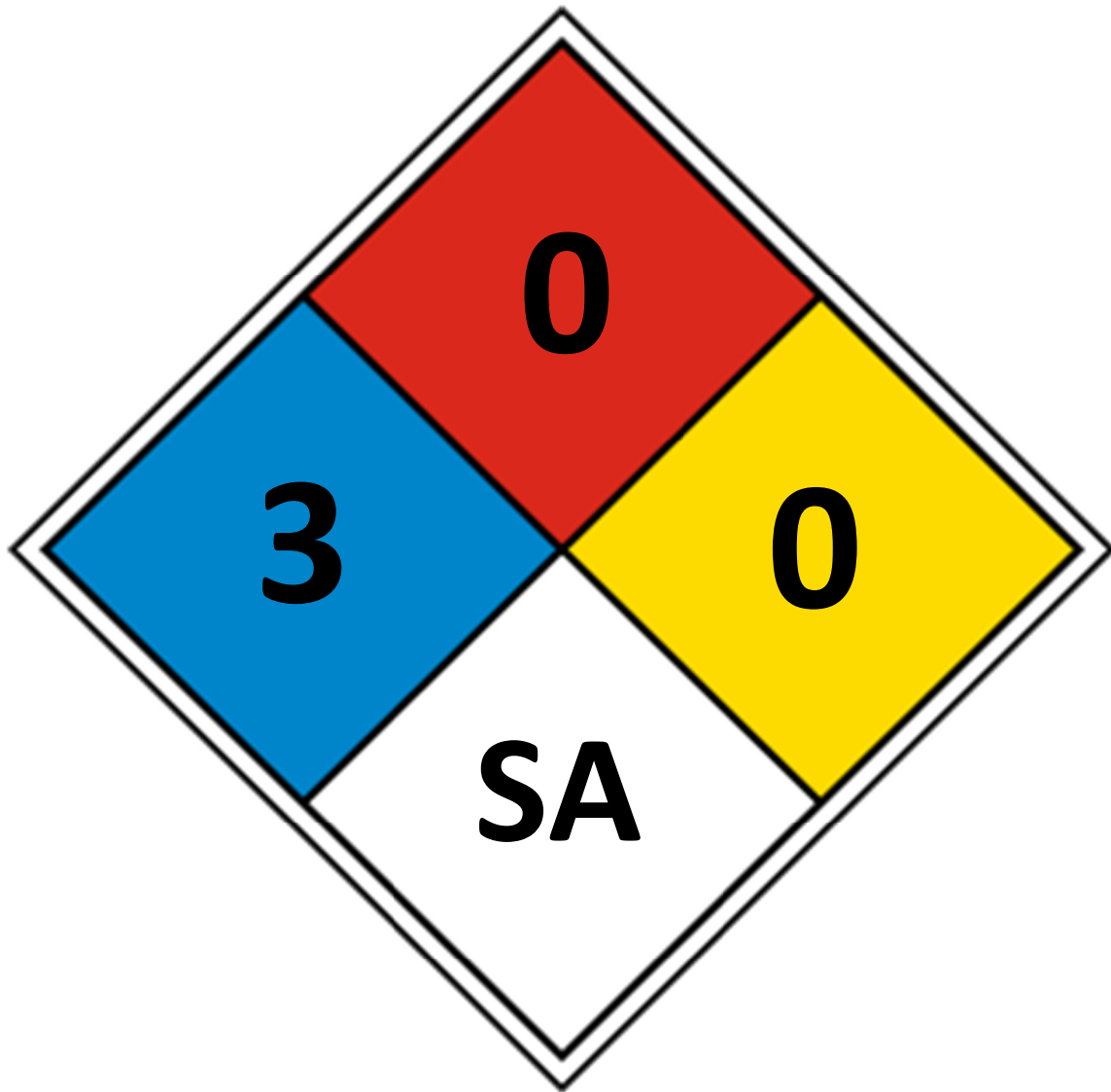
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## HAZARD IDENTIFICATION SIGNAGE

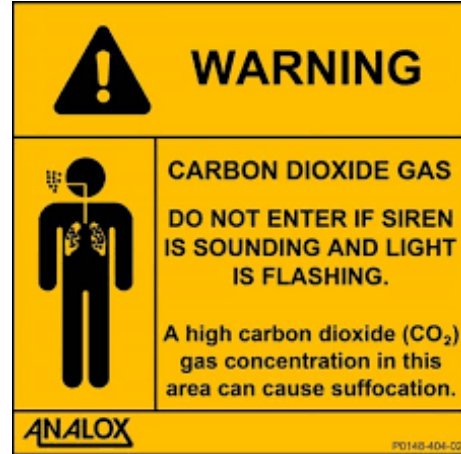
Where liquid CO<sub>2</sub> containers are located in buildings, NFPA 704 placards displaying the hazard ratings shown below shall be posted at specific entrances (e.g. exterior doors closest to tanks, storage rooms doors) as determined by the fire code official.

See **Chapter 8: Hazardous Material Identification** for sign specifications.

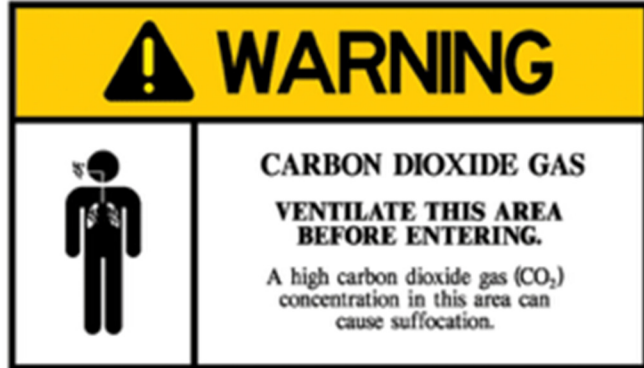
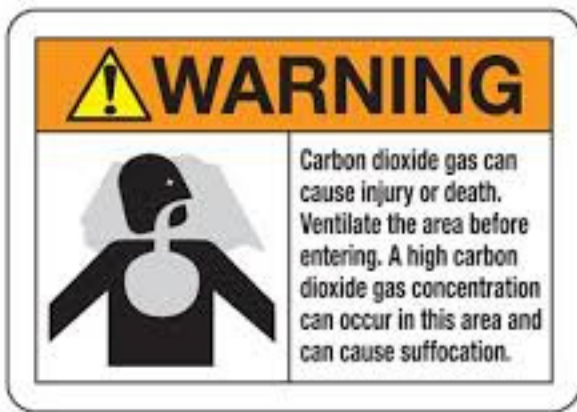


## WARNING SIGNS

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 CO<sub>2</sub> tanks are located. Signs shall be a minimum of 7"H by 10" W.



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## 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 CO<sub>2</sub> is supplied from a bulk CO<sub>2</sub> 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 CO<sub>2</sub> Gas Detection System showing the following items:
      1. Locations of CO<sub>2</sub> Alarm Components:
        - a. CO<sub>2</sub> sensor/detectors
        - b. CO<sub>2</sub> audible/visible alarms
      - b. Central unit or annunciator
      - c. Location of CO<sub>2</sub> tanks or cylinders
      - d. Mixing station location(s) and valves
      - e. Fill port location
      - f. Locations of required warning signage
2. Data sheets for all major components
3. Completed permit applications for each contractor:
  - a. CO<sub>2</sub> System Installer