

**CARBON DIOXIDE SYSTEMS FOR BEVERAGE
DISPENSING:
PLAN REVIEW AND REPORTING
REQUIREMENTS**



**Loveland Fire Rescue Authority
Community Safety Division**

JANUARY 2024

Carbon Dioxide Systems for Beverage Dispensing Installation Plan Review and Reporting Requirements

Scope

The intent of this guideline is to provide the information necessary to ensure that the design and installation of compressed gas containers, cylinders, tanks, and systems will comply with the applicable provisions of the 2021 International Fire Code Chapters 50 and 53 and NFPA 55.

Purpose

Carbon Dioxide (CO₂) is a colorless, odorless gas that asphyxiates by displacing oxygen in the air. Several fatal carbon dioxide incidents have occurred in restaurants where CO₂ leaked from large storage tanks serving carbonated beverage dispensers. These incidents led to the additional permitting and detection requirements for large CO₂ storage tanks being added to the International Fire Code.

Definitions

Asphyxiation: to lose consciousness by impairing normal breathing, to suffocate or smother

Dewar: a vacuum flask that holds a cryogenic or liquefied gas

Carbon Dioxide (CO₂) Detector: a device to measure the concentration of CO₂ in the air

Carbon Dioxide (CO₂) Indoor Storage: rooms or areas sheltered from the weather with a roof and enclosed on two or more sides with a solid wall. Subject to review by the code official, rooms or areas without a roof and with solid walls and doors on all sides, may be considered an indoor installation.

Liquid Carbon Dioxide (CO₂) Systems: An assembly of equipment consisting of one or more carbon dioxide supply containers, interconnecting piping, pressure regulators, and pressure relief devices

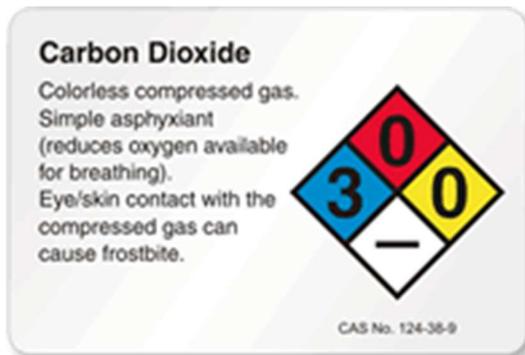
PEL: Permissible Exposure Limit for CO₂ gas is 5,000 PPM (0.5%) Time Weighted Average (TWA) @ 8 hours a day, 40 hours per week

STEL: Short-Term Exposure Limit for CO₂ is 30,000 PPM (3.0%) for less than 15 minutes

IDLH: Immediately Dangerous to Life & Health for CO₂ is 40,000 PPM (4.0%)

Carbon Dioxide Conversion Tables / Hazard Characteristics

Product Name	Cubic Feet/Pound	Pounds/Gallon	Cubic Feet/Gallon
Carbon Dioxide (CO ₂) CAS: 124-38-9	8.74	8.46	73.94



Fire Code Operational Permit Reporting Conditions

1. An operational permit is required for insulated liquid carbon dioxide systems with more than 100 lbs. (45.4 kg) of carbon dioxide used in beverage dispensing applications. Systems with more than 100 lbs. total in use and stored within the building shall require a permit, protection from damage, and detection or ventilation.
2. Carbon dioxide systems shall be installed so the storage tanks, cylinders, piping and fittings are protected from damage by occupants or equipment during normal facility operations.
3. Where insulated liquid carbon dioxide storage tanks, cylinders, piping and equipment are located indoors, rooms or areas containing storage tanks, cylinders, piping and equipment, and other areas where a leak of carbon dioxide is expected to accumulate, shall be provided with mechanical ventilation in accordance with Section 5004.3 and designed to maintain the room containing carbon dioxide at a negative pressure in relation to the surrounding area.

Exception: A gas detection system complying with IFC, Section 5307.3.2 shall be permitted in lieu of mechanical ventilation.

4. Where ventilation is not provided in accordance with IFC, Section 5307.3.1, a gas detection system shall be provided in rooms or indoor areas and in below-grade outdoor locations with insulated carbon dioxide systems. Carbon dioxide sensors shall be provided within 12 inches (305 mm) of the floor in the area where the gas is expected to accumulate or other approved locations.

The system shall be designed as follows:

1. Activates an audible and visible supervisory alarm at a normally attended location upon detection of a carbon dioxide concentration of 5,000 ppm (9000 mg/m³).
2. Activates an audible and visible alarm within the room or immediate area where the system is installed upon detection of a carbon dioxide concentration of 30,000 ppm (54 000 mg/m³).

Signage

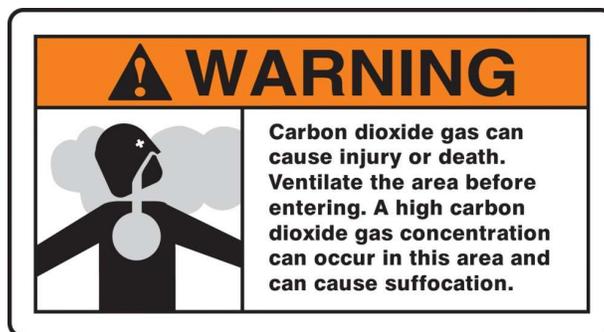
Rooms equipped with carbon dioxide sensors/alarms, must display warning signage at the entrance to the building, room, enclosure, or confined area where the container is located that warns occupants not to enter when alarms are activated.

The warning sign shall be at least 8 inches wide and 6 inches high and state the following:

CAUTION — CARBON DIOXIDE GAS.

Ventilate the area before entering.

A high carbon dioxide (CO₂) gas concentration in this area can cause suffocation.



Provide a graphic floor plan map of the area protected by the CO₂ emergency alarm system that is permanently mounted adjacent to the Carbon Dioxide (CO₂) Emergency Alarm.

Plans shall be of durable construction, easily readable in normal lighting, protected by a smooth, transparent, plastic surface and shall indicate the location of supply tank, points of use, and CO₂ detectors. The graphic map shall state "You Are Here" and be properly oriented to assist the responding fire fighters.

Exterior signs to be located adjacent to rear/side maintenance door. CO₂ letters to be mounted on exterior tank fill connection protective door. CO₂ Letters to be 3-inches in size (Subscript size for number 2 is optional). Letters shall contrast with background.

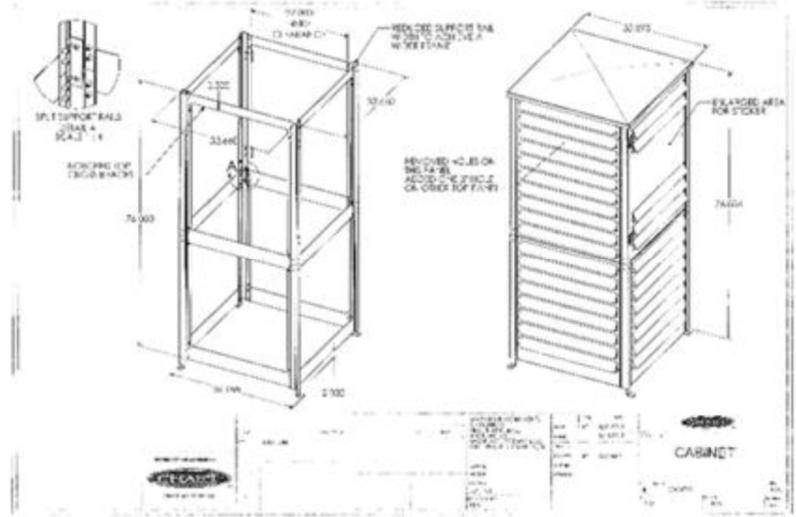


Training

Persons responsible for the operation of areas in which hazardous materials are stored, dispensed, handled or used shall be familiar with the chemical nature of the materials and the appropriate mitigating actions necessary in the event of a fire, leak or spill.

Exterior/Outdoor Carbon Dioxide Systems of One or More Containers of 100 Pounds or Greater

- Shall be above grade.
- Shall not be obstructed by more than three sides of the perimeter with supports and walls.
- Shall not be installed within 10 feet of elevators, unprotected platform ledges or other areas where falling would result; shall not be installed on roofs, shall not be installed with 36 in of electrical panels.
- Shall be safely supported; vessel foundation must be capable of supporting the full system weight.
- Supply line shall be UV resistant or protected conduit or appropriate covering.
- Shall be equipped with isolation valves installed on the fill line and tank discharge or gas supply line. They shall be designed/marked to indicate open or closed, shall be accessible, clearly marked or identified, and capable of being locked or tagged in closed position for servicing.
- When extreme temperatures prevail, overhead covers shall be provided. Compressed gas containers, cylinders and tanks, whether full or partially full, shall not be exposed to artificially created high temperatures exceeding 125°F or sub-ambient (low) temperatures unless designed for use under the exposed conditions.
- Areas used for the storage, use and handling of compressed gas containers, cylinders, tanks and systems shall be secured against unauthorized entry and safeguarded in an approved manner. (e.g., fence, expanded metal cage or cabinet).
- Guard posts or other approved means shall be provided to protect compressed gas containers, cylinders, tanks and systems indoors and out-doors from vehicular damage and shall comply with 2021 International Fire Code.
- Labeling - An NFPA 704 compliant Hazard Placard is required. This requirement is subject to verification at the time of the fire safety Inspection prior to issuance of an operational permit. Additional hazard warning signage specific to the material is required.



Liquid Carbon Dioxide Systems

Containers employed for storage or use of cryogenic fluids shall comply with Sections 5503.1.1 through 5503.1.3.2 and Chapter 50, 2021 International Fire Code.

Piping and Fittings

Piping systems shall be identified in accordance with ASME A13.1.

Identification. Markings for carbon dioxide (CO₂) piping systems shall consist of the content's name (carbon dioxide or CO₂) and direction-of-flow arrow. Markings shall be provided at each valve; at wall, floor, or ceiling penetrations; at each change of direction; and at not less than every 20 feet or fraction thereof throughout the piping run.

Piping, tubing, pressure regulators, valves, and other apparatus shall be kept gastight to prevent leakage.

Pressure Relief Valves

Containers, cylinders, and tanks shall be provided with a pressure gauge and a level gauge or device for indicating the quantity of liquid carbon dioxide.

These devices shall be designed for the temperatures and pressures associated with liquid carbon dioxide service.

Where containers, cylinders, and tanks are in locations remote from the filling connection, a means to determine when the containers have been filled to their design capacity shall be provided and shall be verifiable from the filling connection.

Emergency Shut Off

Emergency shutoffs shall be located at the point of use and at the tank, cylinder, or bulk source. These shutoffs shall be clearly marked. When hazardous materials are stored outside of buildings in stationary above-ground tanks or pressure vessels and are piped into a building, an emergency shutoff valve shall be installed at an approved location outside of the building. (NFPA 55, 7.1.11.1 and 7.1.11.2).

Securing of Containers

Stationary containers shall be secured to foundations in accordance with the 2021 International Building Code. Portable containers subject to shifting or upset shall be secured. Nesting shall be an acceptable means of securing containers

Lighting

When required, lighting, including emergency lighting, shall be provided for fire appliances and operating facilities such as walkways, control valves and gates ancillary to stationary containers.

Construction Drawings Requirements for New Carbon Dioxide for Beverage Dispensing Systems

Construction permits are required to install, repair damage to, abandon, remove, place temporarily out of service or close or substantially modify Carbon Dioxide systems with more than 100 pounds (45.4 kg) of CO₂ in use or storage or any combination thereof.

Construction drawings and specifications shall be complete and of sufficient clarity to indicate the entire work proposed and show in detail that the Carbon Dioxide (CO₂) system conforms to the current adopted provisions of the Fire and Building Codes and relevant laws, ordinances, rules, and regulations.

Construction or Shop Drawings shall be submitted for review and approval, **PRIOR** to installation.

No CO₂ beverage dispensing systems shall be installed on the site until a Fire Code Operational Permit has been issued.

Any work performed prior to the issuance of this Fire Code Operational Permit may result in a citation being issued.

If work is found to have commenced without approved plans and/or a proper permit, LFRA reserves the right to shut down any/all portions of the entire project deemed necessary to inspect, investigate and confirm that work has been done. Additional permit fees will be charged for working without a permit.

Permit applications submitted without the required information listed above may be returned and/or not accepted. The applicant will be notified either by phone and/or email the status of the application once the review has been completed.

Drawing Submittal Requirements

Each set of drawings and specifications shall, at a minimum, contain the following information, architectural, structural, mechanical, electrical drawings, specifications, and analysis:

- Drawings shall be generated by the installing company specific to the installation and shall not be copied.
- Plans shall be dimensioned and scaled.
- Floor plan of the building showing where gas is to be installed, distributed, or stored and location(s) of all means of egress (exits).
- The location of the storage containers, both full and empty.
- Identification of the type of gas, the quantity in cubic feet and pounds, and the type of storage containers.
- Adequate separation of incompatible products.
- A full equipment listing including manufacturer specifications include all UL or NRTL listings and evaluations for all parts and materials used in the project.
- The piping design plan identifying routing of pipe and method of labeling of piping as per ANSI A13.1.
- Location of shut off valves, relief valves and discharge points.
- Design pressure, maximum operating pressure and test pressure.
- Type, size and setting of pressure relief devices.
- Location and type of alarm system(s).
- Any gas cylinder storage room, including construction type, doors, and ventilation.
- Method of securing cylinders from accidental dislodgment or unauthorized access.
- Location of warning signs. Details for warning signs such as text, size, color and attachment method.
 - NFPA 704 Diamond
 - Caution – Carbon Dioxide Gas