

Orange County Fire Authority

Community Risk Reduction

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Carbon Dioxide Enrichment Systems



Guideline G-17

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Carbon Dioxide Enrichment Systems

PURPOSE

The Orange County Fire Authority (OCFA) has prepared this guideline to provide minimum requirements and local interpretations and practices that are considered to be in compliance with the 2016 California Fire Code (CFC). This is intended to provide information on the use of carbon dioxide (CO₂) enrichment systems. The requirements of this guideline shall not be construed as altering any existing code, law or regulation which may require fire protection features not covered or alluded to in these requirements, nor shall they waive any requirements of any code, law or regulation. The reader is cautioned that the information detailed in this guideline may or may not apply to their specific situation, and that the authority having jurisdiction (AHJ) retains final authority to determine compliance.

SCOPE

This guideline covers the installation, maintenance, operation and permitting requirements as they pertain to carbon dioxide (CO₂) enrichment systems in new and existing facilities under the jurisdiction of OCFA. This policy applies to the following:

- The use and storage of carbon dioxide (CO₂) compressed gas systems with more than 100 pounds of carbon dioxide (CO₂) or any system using any amount of carbon dioxide (CO₂) below grade.

Other methods of carbon dioxide (CO₂) gas enrichment are not permitted unless specifically approved by the Fire Code Official. The use of heaters to generate carbon dioxide (CO₂) is prohibited.

Codes and Standards

This policy is based on the 2016 CFC, Chapter 1, Section 104.1, Matters not provided for; Chapter 53, Compressed Gases; 2016 NFPA 55, Compressed Gases and Cryogenic Fluids Code.

Design and installation shall comply with the applicable provisions of the California Building Code, as amended, and this guideline.

Specifically, the CFC Section 102.9 and 104.1 permits the Fire Code Official to determine requirements that are essential for the public safety of an existing or proposed activity, building or structure, or for the safety of the occupants thereof, which are not specifically provided for by the CFC.

This guideline is based upon the recently incorporated provisions to the Fire Code including, but not limited to, a new Section 916 Gas Detection Systems and a new Section 5307 for compressed gases not otherwise regulated. The California State Fire Marshal is

supplementing the 2016 California Building Standards Code with these 2018 International Fire Code provisions, which should be effective statewide July 2018.

Definitions

Carbon Dioxide (CO₂) Enrichment System: A system where carbon dioxide (CO₂) gas is intentionally introduced into an indoor environment, typically for the purpose of stimulating plant growth.

Gas Detection System: A system or portion of a combination system that utilizes one or more stationary sensors to detect the presence of a specified gas at a specified concentration and initiate one or more responses required by this guideline such as notifying a responsible person, activating an alarm system, or activating/deactivating equipment. A self-contained gas detection and alarm device is not classified as a gas detection system.

SUBMITTAL

- **Carbon Dioxide (CO₂) Gas Enrichment System:** A plan submittal to OCFA and inspection is required for installation of or modification of carbon dioxide (CO₂) systems with more than 100 pounds of carbon dioxide (CO₂) and any system using any amount of carbon dioxide (CO₂) below grade for plant growing (husbandry) applications. Maintenance performed in accordance with the CFC is not considered to be modification and does not require a construction permit.
- **Gas Detection Systems:** A construction permit is required for installation of or modification to gas detection systems. Maintenance performed in accordance with the CFC is not considered a modification and shall not require a permit.
- **Requirements:** Plans shall be submitted to OCFA for all carbon dioxide (CO₂) systems for plant growing. The plans may be separated into individual plan sets for:
 - Process equipment, industrial ovens, tanks, etc.
 - Gas detection
 - Tenant improvement plan
 - Fire master plan
 - Architectural (only if H or L occupancy)
 - Fire sprinklers
 - Chemical Classification Packet (see OCFA Guideline G-06)

Additionally, comply with any additional permit applications and review requirements of the local Building Department. Applicable plan review and permit fees may apply.

Construction drawings and specifications shall bear the seal and signature of a licensed California professional engineer/architect who prepared the drawings/specifications and shall be complete and of sufficient clarity to indicate the entire scope of work proposed and show in

detail that the carbon dioxide (CO₂) system conforms to the provisions of this guideline, the CFC, CBC and relevant laws, ordinances, rules and regulations. Each set of drawings and specifications shall, at a minimum, contain the following information:

- A. Exact address and location of the work performed.
- B. Name and address of the business owner and property owner.
- C. Name and address of the person or firm responsible for the preparation of the drawings and specifications including the seal and signature of the California licensed architect and/or engineer responsible for the preparation of the drawings and specifications.
- D. Two complete sets of construction documents showing the construction of architectural, structural, mechanical, plumbing and electrical arrangements.
- E. One copy of specifications or notes that clearly describe the type, quality and finish of materials and the method of assembly, erection and installation of equipment to be installed with proper reference to accepted standards.
- F. Except for entirely interior installations, a plot plan showing the location of the proposed construction (i.e., tanks) and the location of every adjacent existing building on the property, roads, walks, utilities and other site improvements, all property lines, streets, alleys, easements and other public areas.
- G. Bulk tank installations may require an engineered structural foundation with a separate tank installation permit. Contact the City Building and Safety Department to determine requirements.
- H. Total aggregate quantity of liquid carbon dioxide (CO₂) in pounds, gallons, or cubic feet (at normal temperature and pressure).
- I. Location and total volume of the room where the carbon dioxide (CO₂) enrichment operation will be conducted. Identify whether the room is at grade or below grade.
- J. Location of containers relative to equipment, building openings and means of egress.
- K. Manufacturer's specifications and pressure rating, including cut sheets, of all piping and tubing to be used.
- L. A piping and instrumentation diagram (P&ID) that shows piping support and remote fill connections.
- M. Details of container venting, including but not limited to vent line size, material and termination location.
- N. Alarm and detection system and equipment.
- O. Seismic support for containers.

Operational Permits

Where required by the Fire Code Official, operational permits shall be issued upon final inspection and approval of the construction and equipment installation.

An annual compressed gas storage/use permit will be required for 6,000 cubic feet or more of carbon dioxide (CO₂) as an "Inert Gas" (1 pound of carbon dioxide (CO₂) = 8.74 cu/ft).

Operational permits shall be posted on site.

Site Inspection

OCFA and the local Building Department shall inspect and witness acceptance testing of the installation. Contact OCFA and the Building and Safety Department to confirm type and frequency of inspections required. Compliance with all CFC requirements shall be maintained at all times.

TECHNICAL

Safety Systems

- A. Equipment:** Pressure relief, vent piping, fill indicators, fill connections, vent terminations, piping systems and the storage, use and handling of the carbon dioxide (CO₂) shall be in accordance with CFC Chapter 53 and NFPA 55.
- B. Gas Detection System:** A gas detection system shall be provided in rooms or indoor areas in which the carbon dioxide (CO₂) enrichment process is located, in rooms or indoor areas in which container systems are located, and in other areas where carbon dioxide (CO₂) is expected to accumulate. Carbon dioxide (CO₂) sensors shall be provided within 12 inches of the floor in the area where the gas is expected to accumulate or leaks are most likely to occur. The system shall be designed as follows:
- 1) Activate a low-level alarm upon detection of a carbon dioxide (CO₂) concentration of 5,000 ppm
 - 2) Activate a high-level alarm upon detection of a carbon dioxide (CO₂) concentration of 30,000 ppm

Operation

Activation of the low level gas detection system alarm shall automatically:

- 1) Stop the flow of carbon dioxide (CO₂) to the piping system
- 2) Activate the mechanical exhaust ventilation system
- 3) Activate an audible and visible supervisory alarm signal at an approved location within the building

Activation of the high-level gas detection system alarm shall automatically:

- 1) Stop the flow of carbon dioxide (CO₂) to the piping system
- 2) Activate the mechanical exhaust ventilation system
- 3) Activate an audible and visible evacuation alarm both inside and outside of the carbon dioxide (CO₂) enrichment area, and the area in which the carbon dioxide (CO₂) containers are located

- C. Power Connections:** Gas detection systems shall be permanently connected to the building electrical power supply or shall be permitted to be plugged into an unswitched receptacle using an approved restraining means that secures the plug to the receptacle.
- D. Emergency and Standby Power:** Standby or emergency power shall be provided or the gas detection system shall initiate a trouble signal at an approved location if the power supply is interrupted.
- E. Pressurization and Ventilation:** Rooms or indoor areas in which carbon dioxide (CO₂) enrichment is provided shall be maintained at a negative pressure in relation to the surrounding areas in the building. A mechanical ventilation system shall be provided in accordance with the California Mechanical Code that complies with all of the following:
- 1) Mechanical ventilation in the room or area shall be at a rate of not less than 1 cubic foot per minute per square foot
 - 2) When activated by the gas detection system, the mechanical ventilation system shall remain on until manually reset
 - 3) The exhaust system intakes shall be taken from points within 12 inches of the floor
 - 4) The ventilation system shall discharge to the outdoors in an approved location
- F. Signage:** Hazard identification signs shall be posted at the entrance to where the carbon dioxide (CO₂) enrichment process is located, and at the entrance to the indoor area where the carbon dioxide (CO₂) containers are located. The sign shall be not less than 8 inches wide and 6 inches high and indicate:

CAUTION – CARBON DIOXIDE GAS

**Ventilate the area before entering.
A high carbon dioxide (CO₂) gas
concentration in this area can cause
asphyxiation.**

- G. Seismic and Structural Design:** Carbon dioxide (CO₂) system containers and piping shall comply with the seismic design requirements in Chapter 16 of the CBC and shall not exceed the floor loading limitation of the building.
- H. Container Refilling:** Carbon dioxide (CO₂) containers located indoors shall not be refilled unless filled from a remote connection located outdoors.
- I. Fire Alarm System Connections:** Gas sensors and gas detection systems shall not be connected to fire alarm systems unless approved and connected in accordance with the fire alarm equipment manufacturer's instructions.
- J. Inspection, Testing and Sensor Calibration:** Inspection and testing of gas detection systems shall be conducted not less than annually. Sensor calibration shall be confirmed at the time of sensor installation, and calibration shall be performed at the frequency specified by the sensor manufacturer.

