

## CARBON DIOXIDE LEAK DETECTION ALARM SUBMITTAL REQUIREMENTS AND DETAILS



### A. SCOPE

This document covers the installation, maintenance, operation and permitting requirements as they pertain to the use and storage of Carbon Dioxide (CO<sub>2</sub>) compressed gas systems with more than 100 pounds (45.4 kg) of Carbon Dioxide (CO<sub>2</sub>) or any system using any amount of Carbon Dioxide (CO<sub>2</sub>) below grade used in beverage dispensing applications in new and existing facilities within the City of Keller.

### B. CONSTRUCTION PERMITS

Construction permits are required to install, repair damage to, abandon, remove, place temporarily out of service or close or substantially modify Carbon Dioxide (CO<sub>2</sub>) systems with more than 100 pounds (45.4 kg) of Carbon Dioxide (CO<sub>2</sub>) or any system using any amount of Carbon Dioxide (CO<sub>2</sub>) below grade used in beverage dispensing applications.

A separate tank installation permit is required for bulk tank installations over 2,000 pounds.

Keller Fire-Rescue Fire Prevention Division will review all Carbon Dioxide (CO<sub>2</sub>) systems used in beverage dispensing applications including bulk tanks over 2,000 pounds. Upon approval by the Fire Marshal, fire construction permits will be issued.

To obtain required fire construction permit(s), the applicant must submit all required documentation online, in PDF format, through the city's electronic plan review submission portal.

**Applicable plan review and permit fees shall apply.** Fees are calculated based on the cost of the installation.

Construction permits shall only be issued to licensed contractors.

### C. SUBMITTAL REQUIREMENTS

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 (CO<sub>2</sub>) system conforms to the provisions of the 2021 IFC as amended and adopted, and the currently published Edition of NFPA 55, and relevant laws, ordinances, rules and regulations.

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

1. Exact address, legal description and location of the work performed.
2. Name and address of the owner.
3. Name and address of the person or firm responsible for the preparation of the drawings and specifications. If after review of the construction drawings and specifications, the Fire Marshal determines that the proposed Carbon Dioxide (CO<sub>2</sub>) system is inadequately designed, the Fire Marshal may require that the construction drawings and specifications bear the seal of a licensed Texas professional engineer.
4. A complete set of construction documents showing the construction of architectural, structural, mechanical, plumbing and electrical arrangements. **The full submittal, including plans, application, signed contract for the work showing cost, and materials cut-sheets shall be submitted online in PDF format through the eTRAKiT System.**
5. A 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.
6. ***Except for entirely interior installations***, a detailed 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.
7. Bulk tank installations over 2,000 pounds will require an engineered structural foundation with a separate tank installation permit. A complete set of structural drawings, specifications and analysis (calculations) shall be provided and shall bear the seal of a licensed Texas professional engineer.

## **CARBON DIOXIDE (CO<sub>2</sub>) SYSTEMS USED IN BEVERAGE DISPENSING APPLICATIONS REQUIREMENTS**

### **Specifics and Conditions:**

1. **Equipment.** The storage, use, and handling of carbon dioxide shall be in accordance with the Compressed Gases Chapter in the 2021 IFC and the applicable requirements of NFPA 55, Chapter 13. All equipment utilized in compressed gas systems shall be compatible with the intended gas and use.
2. **Containers, cylinders and tanks.** Gas storage containers, cylinders and tanks shall be designed, fabricated, tested, labeled and installed per manufactures' specifications and shall be maintained in accordance with the regulations of DOTn 49 CFR, Parts 100-185 or the ASME Boiler and Pressure Vessel Code, Section VIII.
  - a. **Location.** Location of gas storage containers, cylinders and tanks, inside or outside the building, shall be at an approved location.
  - b. **Security.** Gas storage containers, cylinders and tanks shall be secured in an approved manner to prevent overturning. Containers, cylinders and tanks located outside shall be secured and safeguarded against tampering and protected from physical damage if exposed to vehicle traffic.
  - c. **Design and construction.** Bulk tank installations over 2,000 pounds will require an engineered foundation and construction permit per the 2021 International Building Code.

**3. Piping systems.** Piping, tubing, fittings, valves and pressure regulating devices shall be designed and installed in accordance with approved standards and manufacturers' recommendations.

**a. Piping, tubing and hoses.** Piping, tubing and hose materials shall be compatible with carbon dioxide and rated for the temperatures and pressures encountered in the system. All hoses and tubing used in carbon dioxide service shall be designed for a bursting pressure of at least four times their design pressure. PVC/ABS and other types of rigid plastic piping are not approved materials. Acceptable piping for carbon dioxide shall be the following:

- i. Stainless steel A269 grade, which is either seamless or welded drawn over mandrel
- ii. Copper K grade, hard drawn seamless
- iii. Copper ACR grade (1/2 inch outside diameter or less) annealed seamless
- iv. Plastic/polymer materials rated for use with carbon dioxide and compliant with Code of Federal Regulations Title 21 FDA Part 177 Indirect Food Additives Polymers
- v. Additional approved piping, tubing and hoses found in the Compressed Gas Association (CGA) standards for carbon dioxide

**b. Fittings, joints and connections.** Fittings, joints and connections shall be subject to the approval of the fire and building departments.

- i. **Fittings and joints between gas supply containers and automatic shutoff valve.** Joints and fittings on the supply piping or tubing between the CO<sub>2</sub> supply source and the automatic system shutoff valve shall be threaded, compression or welded.
- ii. **Unused connections.** Unused piping or tubing connected to the supply system shall be capped or plugged. A closed valve will not be allowed in lieu of a cap or plug.

**c. Valves.** Piping systems shall be provided with valves as follows:

- i. **Pressure relief valves.** Pressure relief valves shall be provided and piped to the outdoors.
- ii. **System shutoff valve.** An automatic system shutoff valve shall be provided as near to the supply pressure regulator as possible and shall be designed to fail to a closed condition or close on loss of electrical power. Additional automatic shutoff valves may be provided at each point of use. **Back-up power is required in the event of power failure.**
- iii. **Appliance shutoff valves.** Each appliance shall be provided with a shutoff valve within 3 feet of the appliance. All shutoff valves shall be capable of being locked or tagged in the closed position for servicing.
- iv. **Check valves.** One-way flow check valves shall be installed at the most downstream end of copper runs that are used for beverage consumption.

v. **Accessibility and identification.** Valves and controls shall be readily accessible at all times. Normal and emergency system shut-off valves shall be clearly identified. All valves shall be designed or marked to indicate clearly whether it is open or closed.

d. **Venting.** Venting of gases shall be directed to an approved location outside the building. Insulated liquid carbon dioxide systems shall have pressure relief devices vented in accordance with NFPA 55.

B. **Protection from damage.** 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.

C. **Required protection.** Where carbon dioxide storage tanks, cylinders, piping and equipment are located indoors, rooms or areas containing carbon dioxide storage tanks, cylinders, piping and fittings and other areas where a leak of a carbon dioxide system can collect shall be provided with either ventilation or an emergency alarm system as follows:

1. **Ventilation.** Mechanical ventilation shall be in accordance with the 2021 *International Mechanical Code* and shall comply with all of the following:

- a. Mechanical ventilation in the room or area shall be at a rate of not less than 1 cubic foot per minute per square foot [0.00508 m<sup>3</sup>/(s • m<sup>2</sup>)].
- b. Exhaust shall be taken from a point within 12 inches (305 mm) of the floor.
- c. The ventilation system shall be designed to operate at a negative pressure in relation to the surrounding area.
- d. Ventilation shall run continuously or be activated by a sensor or detector to maintain an atmosphere of less than 5,000 ppm.
- e. A mechanical permit is required per the City of Keller Building Code.

2. **Emergency alarm system.** An emergency alarm system shall comply with all of the following:

- a. Continuous gas detection shall be provided to monitor areas where carbon dioxide (CO<sub>2</sub>) can accumulate. Detection equipment shall be provided to indicate carbon dioxide (CO<sub>2</sub>) levels at each point of use and in each storage area/room.
- b. Detectors shall be:
  - 1) listed or approved devices
  - 2) permanently mounted
  - 3) installed at a height of between 12 - 24 inches above the floor or as approved by the fire code official
  - 4) directly connected to building electrical and protected from accidental disconnection or damage
  - 5) auto calibrating and self "zeroing" devices are not permitted unless they can be zeroed and spanned
  - 6) located within manufacturers specified detection range for each

- point of use and storage location
- 7) listed to operate under environmental conditions such as temperature, humidity, and velocity variations.

c. Alarm set points shall be set at:

- i. 5,000 PPM (0.5%) Time Weighted Average (TWA) – Self re-setting (non- latching) alarm.
  - a) Notification for employees only in approved locations.
- ii. 15,000 PPM (1.5%) – Latching Alarm
  - a) Notification for employees only in approved locations
  - b) Initiate amber strobe and audible horn provided above the active detector.
  - c) Activation of automatic system shutoff valve
  - d) Requires a service company to investigate, repair and reset
- iii. 30,000 PPM (3.0%) – Latching Alarm
  - a) Initiate all amber strobes and audible horns provided in the vicinity of each interior storage container, cylinder or tank and at each point of use. Additional amber strobes and audible horns shall be placed at the entrances to below grade locations, confined spaces including small volume rooms, and at walk-in coolers.
  - b) The notification devices shall be rated a minimum of 80cd for a visible effect and 75 dBA for an audible effect and shall be mounted per NFPA 72 requirements.
  - c) Activation of automatic system shutoff valve
  - d) Evacuate room/area and call 911

d. Remote Annunciator Panel:

- i. Provide an annunciator panel/unit that annunciates the location of the CO2 detection zone in alarm by means of a directory LED (light-emitting diode) point display or LCD (liquid crystal display) to assist the responding fire fighters. **Annunciator panel/unit shall be installed in an approved location outside of the potentially CO2 contaminated areas.**

e. Signage shall be required adjacent to each horn/strobe within 4 inches as follows:

**“FLASHING LIGHT MEANS CARBON DIOXIDE LEAK DETECTED – EVACUATE IMMEDIATELY AND CALL 911”**

The sign shall have a minimum 2-inch block lettering with a minimum ½-inch stroke. The sign shall be on a contrasting surface of black on yellow and shall be of durable construction.

Warning signs shall be posted at the entrances to a room or confined area where the container is located. The warning sign shall be at least 8

inches (200 mm) wide and 6 inches (150 mm) high and state the following:

**CAUTION – CARBON DIOXIDE GAS**  
**VENTILATE THE AREA BEFORE ENTERING. A HIGH CARBON DIOXIDE (CO<sub>2</sub>) GAS CONCENTRATION IN THIS AREA CAN CAUSE SUFFOCATION**

**NFPA 704 placards for Simple Asphyxiants shall also be provided at the main entrance to storage rooms, areas or confined spaces.**

- D. Transfilling.** Filling and transfilling of gases between storage containers, cylinders and tanks and delivery vehicles shall be performed by qualified personnel using equipment and operating procedures in accordance with CGA P-1. Interior storage containers, cylinders and tanks shall be filled via remote fill ports on the exterior of the building at grade level. Exterior remote fill ports shall be fitted with a vent line to the outside. Delivery personnel shall have access to interior storage areas to inspect valves and piping prior to initiating filling operations.
- E. Inspection and testing.** All piping installations shall be visually inspected, calibrated, and pressure tested to determine that the materials, design, fabrication and installation practices comply with the requirements of the 2021 IFC and NFPA 55.
1. **Records.** A written record of all required inspections, testing, calibration, and maintenance shall be maintained in a log book on the premises containing the three (3) most current years of records and be available for review by fire inspection personnel.
    - a. **Required inspections and testing.** All piping installations shall be tested and inspected as follows:
      - i. **Acceptance testing.** Appliances and equipment shall not be placed in operation until after the piping system has been checked for leakage and detectors have been tested by a qualified service company. All piping installations shall be visually inspected and pressure tested prior to initial operation. The test pressure downstream of the pressure regulator shall be not less than 110% of the operating pressure. Joints shall be checked with a bubble-forming solution. Acceptance testing is required to be witnessed by Fire Code Officials.
      - ii. **Daily inspections.** All detectors and alarms shall be visibly inspected daily. These inspections are permitted to be conducted by trained employees.
      - iii. **Monthly inspections.** All storage vessels, piping, and appurtenances shall be visibly inspected monthly. These inspections are permitted to be conducted by trained employees.

- iv. **Semi-annual inspections.** Systems shall be visually inspected, gas detectors calibrated per manufacturer specification, alarms tested, and tested for leaks semi-annually by a qualified service company.
  - v. **Alterations and repair.** In the event alterations, repairs or additions are made, the affected piping shall be retested.
- b. **Calibration.** Detectors shall be checked for accuracy, calibrated to a reference gas concentration, and span reset.
- c. **Pressure testing.** Pipe joints shall be exposed for examination during the test.
- i. **Test medium.** The test medium shall be air, nitrogen, carbon dioxide, or an inert gas.
  - ii. **Section testing.** Piping systems shall be permitted to be tested as a complete unit or in sections. A valve shall not be subjected to the test pressure unless it can be determined that the valve, including the valve- closing mechanism, is designed to safely withstand the test pressure.
  - iii. **Regulators and valve assemblies.** Regulator and valve assemblies fabricated independently of the piping systems in which they are to be installed shall be permitted to be tested with inert gas or air at the time of fabrication. Test records shall be maintained.
  - iv. **Test preparation.** All joints and fittings shall be exposed for examination during and after the test.
    - a) **Pipe clearing.** Prior to testing, the interior of the pipe shall be cleared of all foreign material.
    - b) **Appliance and equipment isolation.** Appliances and equipment that are not to be included in the test shall be isolated from the piping by closing the appliance shutoff valve.
    - c) **Test pressure measurement.** Test pressure shall be measured with a pressure-measuring device designed and calibrated to read, record or indicate a pressure loss caused by leakage during the pressure test period. The source of pressure shall be isolated before the pressure tests are made. Mechanical gauges used to measure test pressures shall have a range such that the highest end of the scale is not greater than five times the test pressure.
    - d) **Test pressure.** The test pressure downstream of the pressure regulator shall be not less than 110% of the operating pressure. Where the test pressure exceeds 125 psig (862 kPa gauge), the test pressure shall not exceed a

value that produces a hoop stress in the piping greater than 50 percent of the specified minimum yield strength of the pipe or tubing. Pressures shall be adjusted smoothly and slowly to avoid pressure spikes.

- v. Test duration.** The test duration shall be not less than 10 minutes.
- vi. Visual inspection and cleaning.** After testing is complete and the pressure is reduced to at or below operating pressure, all joints shall be cleaned of bubble forming solution and visually inspected.
- vii. Detection of leaks and defects.** The piping system shall withstand the test pressure specified without showing any evidence of leakage or other defects. Any reduction of test pressures as indicated by pressure gauges shall be deemed to indicate the presence of a leak.
- viii. Corrections.** Where leakage or other defects are located, the affected portion of the piping system shall be repaired or replaced and retested.





**CARBON DIOXIDE (CO<sub>2</sub>) SYSTEMS USED IN BEVERAGE DISPENSING APPLICATIONS PERMIT APPLICATION**

THIS FORM SHALL BE COMPLETED AND SIGNED BY BUSINESS OWNER OR A REPRESENTATIVE OF THE PROPERTY OWNER APPLYING FOR THE PERMIT(S).

**PLEASE MAKE CHECKS PAYABLE TO THE CITY OF KELLER**

NAME OF BUSINESS: \_\_\_\_\_

MAILING ADDRESS: \_\_\_\_\_ CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

PERMIT SITE ADDRESS: \_\_\_\_\_ KELLER, 76248

CONTACT NAME: \_\_\_\_\_

CONTACT PHONE NUMBER: \_\_\_\_\_ E-MAIL: \_\_\_\_\_

GAS SUPPLY COMPANY NAME: \_\_\_\_\_

COMPANY PHONE NUMBER: \_\_\_\_\_ E-MAIL: \_\_\_\_\_

TYPE OF CO<sub>2</sub> STORAGE CONTAINER(S): \_\_\_\_\_

TOTAL QUANTITY OF CO<sub>2</sub> GAS ON SITE: \_\_\_\_\_

LOCATION OF CO<sub>2</sub> GAS STORAGE (PROVIDE DIAGRAM): # OF AREAS

\_\_\_\_\_

\_\_\_\_\_

(CHECK ALL THAT APPLY)

INDOOR \_\_\_\_\_ OUTDOOR \_\_\_\_\_ ENCLOSED ROOM \_\_\_\_\_ ABOVE GRADE \_\_\_\_\_ BELOW GRADE \_\_\_\_\_

NUMBER AND DESCRIPTION OF POINTS OF USE (PROVIDE FLOOR PLAN \_\_\_\_\_

\_\_\_\_\_

**I UNDERSTAND THAT KELLER FIRE-RESCUE PREVENTION DIVISION PERSONNEL WILL CONDUCT A SITE INSPECTION, AND IF THE INSTALLATION DOES NOT COMPLY WITH THE FIRE CODE, THE PERMIT MAY BE REVOKED WITHOUT A REFUND.**

SIGNATURE: \_\_\_\_\_ DATE: \_\_\_\_\_