OKLAHOMA CITY FIRE DEPARTMENT
Fire Marshal's Office
AHJ Policies and Guidelines

AHJ #: OKCAHJ-2019-02	**Subject of Policy:** Carbon Dioxide Enrichment Systems	
Code Reference: 2009 IFC 102.9, 2018 IFC 53, NFPA		
Reviewed By: Prince Morgan	**Title:** Assistant Fire Marshal	**Effective Date:** 02/08/2018
Approved By: Harold Thompson	**Title:** Fire Marshal	**Revision Date:** N/A

Purpose:
To provide uniform guidelines that will provide for safe operations in the installation, maintenance, operation and permitting of the use of Carbon Dioxide gas enrichment systems in plant growing (husbandry) applications in new and existing facilities within the City of Oklahoma City as follows:

- The use and storage of Carbon Dioxide (CO_2) compressed gas systems with more than 100 pounds (45.4 kg) of Carbon Dioxide (CO_2) or any system using any amount of Carbon Dioxide (CO_2) below grade.
- The use of natural gas burners.

Description of Code Reference:
2009 IFC section 102.9 (Matters not provided for) reads; 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 this code shall be determined by the *fire code official.*

2018 IFC Chapter 53 Compressed Gasses

Policy and Guidelines based on The Authority Having Jurisdiction (AHJ):

Carbon Dioxide (CO_2) compressed gas systems

Permits: Operational and/or Construction permits shall be required as set forth in 2018 IFC section 105. Operational permits shall be posted on site.

Permits are required to install, repair damage to, abandon, remove, place temporarily out of service or close or substantially modify Carbon Dioxide (CO_2) systems with more than 100 pounds (45.4 kg) of Carbon Dioxide (CO_2) or any system using any amount of Carbon Dioxide (CO_2) below grade used in plant growing (husbandry) applications.

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

Oklahoma City Fire Department, Fire Marshal's Office must review all Carbon Dioxide (CO_2) systems, including bulk tanks over 2,000 pounds. Upon approval by the Fire Marshal's Office permits will be issued.

Inspections will be performed by the Fire Department, Fire Prevention Division. 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_2) system conforms to the provisions of the Fire and Building Codes and relevant laws, ordinances, rules and regulations. Construction drawings shall include:

- Exact address and location of the work performed
- Name and address of the owner/tenant who operates the business.
- 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 Official determines that the proposed Carbon Dioxide (CO_2) system is inadequately designed, the Fire Code Official may require that the construction drawings and specifications bear the seal of a licensed Oklahoma professional engineer.
- Construction documents showing the construction of architectural, structural, mechanical, plumbing and electrical arrangements. Permits shall be obtained from the Development Center for architectural, structural, mechanical, plumbing and electrical work as required.
- 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.
- 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.
- Bulk tank installations over 2,000 pounds will require an engineered structural foundation with a separate tank installation permit. Two complete sets of structural drawings, specifications and analysis (calculations) shall be provided and shall bear the seal of a licensed Oklahoma professional engineer.

Natural gas burners

Permits are required to install, repair damage to, abandon, remove, place temporarily out of service or close or substantially modify Carbon Dioxide (CO_2) generators using natural gas burners in plant growing (husbandry) applications. Oklahoma City Fire Department, Fire Marshal's Office and Building Department Mechanical/Plumbing must review all Carbon Dioxide (CO_2) generators using natural gas burners used in plant growing (husbandry) applications. Upon approval by the Fire Marshal's Office, permits will be issued.

Permits shall be completed upon approval, issuance, and final inspections of required permits.

A separate annual compressed gas storage/use permit will be required for 6,000 cubic feet or more of Carbon Dioxide (CO_2) as an "Inert Gas." (1 pound of CO_2 = 8.74 cu/ft.)

Upon issuance of the carbon dioxide system permit, and after final installation of the system, the Oklahoma City Fire Department Fire Marshal's Office shall be notified of the need for an acceptance test (405-297-3584). The Installation of carbon dioxide burners will require a mechanical permit (in addition to the Fire permit} which must be finalized—that is, secured and "closed" through field inspections—prior to contacting the Oklahoma City Fire Department Fire Marshal's office to schedule final inspections and system acceptance testing. An Oklahoma City Fire Code Compliance Inspector will conduct a field inspection of the site. Upon successful inspection, the operational permit shall be approved. Compliance with all Oklahoma City Fire Code requirements shall be maintained at all times. Permit shall be posted

on site. Permit is valid for business/property owner and site address indicated on the permit. Permits are valid for one year and shall be renewed annually. Permit will be revoked if:

1. Any of the conditions or limitations set forth in the permit has been violated.
2. Compliance with a written order has not been achieved.
3. False statements or misrepresentation of information provided in the permit application are found.
4. The permit is issued in error, in violation of City ordinance or the International Fire Code.

BASIC CARBON DIOXIDE (CO_2) GAS ENRICHMENT SYSTEM REQUIREMENTS

CARBON DIOXIDE (CO_2) GAS ENRICHMENT SYSTEMS USING ON SITE SUPPLY TANKS AND/OR CYLINDERS REQUIREMENTS

Equipment: The storage, use, and handling of carbon dioxide shall be in accordance with International Fire Code 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. 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.

- **Location:** Location of gas storage containers, cylinders and tanks, inside or outside the building, shall be at an approved location.
- **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.
- **Design and construction**: Bulk tank installations over 2,000 pounds will require an engineered foundation and construction permit per the International Building Code (IBC).

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

- Stainless steel A269 grade, which is either seamless or welded drawn over mandrel
- Copper K grade, hard drawn seamless
- Copper ACR grade (1/2 inch outside diameter or less) annealed seamless
- Plastic/polymer materials rated for use with carbon dioxide

- Additional approved piping, tubing and hoses found in the Compressed Gas Association (CGA) standards for carbon dioxide

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

- Joints and fittings on the supply piping or tubing between the CO_2 supply source and the automatic system shutoff valve shall be threaded, compression or welded.
- 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.

Piping systems shall be provided with valves as follows:

- Pressure relief valves shall be provided and piped to the outdoors.
- 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.
- 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.
- Valves and controls shall be readily accessible at all times. Normal and emergency system shutoff valves shall be clearly identified. All valves shall be designed or marked to indicate clearly whether it is open or closed
- 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.

Required Protection

- 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.
- 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 grow room/areas where carbon dioxide is released and can collect shall be provided with an emergency alarm system as follows:
    a. Continuous gas detection shall be provided to monitor areas where carbon dioxide (CO2) can accumulate. Detection equipment shall be provided to indicate carbon dioxide (CO_2) levels in each grow cultivation area/room and interior carbon dioxide (CO_2) storage location.
    b. Detectors shall be:
        i. listed or approved devices
        ii. permanently mounted
        iii. installed at a height of no more than 48 inches above the floor or as approved by the fire code official
        iv. directly connected to building electrical and fire alarm systems and protected from accidental disconnection or damage
        v. auto calibrating and self “zeroing” devices are not permitted unless they can be zeroed and spanned
        vi. located within manufacturers specified detection range for each point of use and storage location

c. Activation of the emergency alarm system shall initiate amber strobes and audible horns provided in the vicinity of each interior storage container, cylinder or tank and at each point of release. 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. Provide audible visual devices at the following locations:
    i. Inside an interior storage room/area and outside the room/area at each entrance.
    ii. Inside grow cultivation room/areas.
d. Local alarm set points shall be set at: 5,000 PPM-Latching Alarm and shall comply with the following:
    i. Visual and audible notification in approved locations at room or area in alarm
    ii. Activation of automatic system shut off valve
    iii. Evacuate the room in alarm and contact a qualified service company to investigate and address the condition.
    iv. Reset of the emergency alarm to be conducted by qualified personnel.
e. Signage will be required adjacent to each horn/ strobe within 4 inches as follows:

- Storage Area/Room: "**DO NOT ENTER WHEN LIGHT IS FLASHING - CARBON DIOXIDE LEAK DETECTED**"

- Grow cultivation room/area dispensing: "**FLASHING LIGHT MEANS CARBON DIOXIDE LEAK DETECTED – EVACUATE ROOM**"

The sign shall have a minimum 2-inch block lettering with a minimum ½- inch stroke. The sign shall be on a contrasting surface and shall be of durable construction. Signage shall be provided at entrance doors to each grow cultivation room/area and at each entrance to storage rooms/areas:

NFPA 704 placards for Simple Asphyxiates shall also be provided at the exterior main entrance and at each entrance to storage rooms/areas. A minimum of one (1) portable carbon dioxide (CO_2) meter shall be in use during business hours.

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.

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 IFC. 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. All piping installations shall be tested and inspected as follows:

- 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 and Building Code Officials.
- ***Daily inspections***. All detectors and alarms shall be visibly inspected daily. These inspections are permitted to be conducted by trained employees.

- ***Monthly inspections***. All storage vessels, piping, and appurtenances shall be visibly inspected monthly. These inspections are permitted to be conducted by trained employees.
- ***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.
- Alterations and repair. In the event alterations, repairs or additions are made, the affected piping shall be retested.
- Calibration. Detectors shall be checked for accuracy, calibrated to a reference gas concentration, and span reset.
- ***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. Test prep. as follows:
        - ***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.

- Training. All employees shall receive annual training in hazard identification, physical properties, inspection, and emergency procedures. Training records shall be maintained on site and be available to fire inspectors upon request.

CARBON DIOXIDE (CO_2) GAS ENRICHMENT SYSTEMS USING A NATURAL GAS BURNER REQUIREMENTS

Equipment: Natural gas burners shall be listed, labeled and installed in accordance with the manufacturer's installation instructions. Piping systems, combustion and ventilation air and venting for natural gas appliances shall be designed in accordance with approved standards, the International Fuel Gas Code and manufacturer's recommendations.

Required Protection: Where natural gas burners are located indoors for carbon dioxide (CO_2) enrichment, grow room/ areas shall be provided with an emergency alarm system as follows:

- ***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_2) can accumulate. Detection equipment shall be provided to indicate carbon dioxide (CO_2) levels at each point of use and in each storage area/room.
    b) Detectors shall be:
        i. listed or approved devices
        ii. permanently mounted
        iii. installed at a height of no more than 48 inches above the floor or as approved by the fire code official
        iv. directly connected to building electrical and fire alarm systems and protected from accidental disconnection or damage
        v. auto calibrating and self "zeroing" devices are not permitted unless they can be zeroed and spanned
        vi. located within manufacturers specified detection range for each point of use and storage location
    c) Activation of the emergency alarm system shall initiate amber strobes and audible horns provided in the vicinity of each interior storage container, cylinder or tank and at each point of release. 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. Provide audible visual devices at the following locations:

        • Inside grow cultivation room/areas.

    d) Local alarm set points shall be set at: 5,000 PPM-Latching Alarm

i. Visual and audible notification in approved locations at room or area in alarm
ii. Activation of automatic system shut off valve
iii. Evacuate the room in alarm and contact a qualified service company to investigate and address the condition.
iv. Reset of the emergency alarm to be conducted by qualified personnel.

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

- Storage Area/Room: **"DO NOT ENTER WHEN LIGHT IS FLASHING - CARBON DIOXIDE LEAK DETECTED"**
- Grow cultivation room/area dispensing: **"FLASHING LIGHT MEANS CARBON DIOXIDE LEAK DETECTED – EVACUATE ROOM"**

The sign shall have a minimum 2-inch block lettering with a minimum ½- inch stroke. The sign shall be on a contrasting surface and shall be of durable construction. Signage shall be provided at entrance doors to each grow cultivation room/area and at each entrance to storage rooms/areas:

NFPA 704 placards for Simple Asphyxiates shall also be provided at the exterior main entrance and at each entrance to storage rooms/areas. A minimum of one (1) portable carbon dioxide (CO2) meter shall be in use during business hours

- ***Carbon monoxide (CO) detection:***
  a) Carbon monoxide gas detection shall be provided to monitor products of combustion continuously.
  b) Detectors shall be:
     i. listed or approved devices
     ii. permanently mounted
     iii. installed per manufacturer's recommendations and directions
     iv. directly connected to building electrical and fire alarm systems and protected from accidental disconnection or damage
  c) CO detection shall be set at 35 PPM and upon activation shall initiate the following:
     - Close the valve to each burner
     - Activate the mechanical exhaust systems
  d) All carbon dioxide (CO2) burner systems shall shut down in the event of a total loss of electrical power to the carbon monoxide (CO) detectors.
  e) A minimum of one (1) portable carbon monoxide (CO) meter shall be in use during business hours.

Inspection and Testing: All detectors, alarms and carbon dioxide (CO_2) burners must be visually inspected, calibrated, and tested to determine that the materials, design, fabrication and installation practices comply with the requirements of this code. 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. All detectors, alarms and carbon dioxide (CO_2) burner equipment shall be tested and inspected as follows:

- Appliances and equipment shall not be placed in operation until after the detectors, alarms, gas control valves and mechanical exhaust system have been tested by a qualified service company. Acceptance testing is required to be witnessed by Fire and Building Code Officials.
- **Daily inspections**. All detectors and alarms shall be visibly inspected daily. These inspections are permitted to be conducted by trained employees.
- **Monthly inspections**. All carbon dioxide (CO_2) burners and appurtenances shall be visibly inspected monthly. These inspections are permitted to be conducted by trained employees.
- **Semi-annual inspections**. Systems shall be visually inspected and gas detectors calibrated per manufacturer specification semi-annually by a qualified service company.
- **Annual testing.** All detectors, alarms, gas control valves and mechanical exhaust systems shall be tested annually by a qualified service company.
- Alterations and repair. In the event alterations, repairs or additions are made, the affected equipment shall be retested.
- Calibration. Detectors shall be checked for accuracy, calibrated to a reference gas concentration, and span reset.
- Training. All employees shall receive annual training in hazard identification, physical properties, inspection, and emergency procedures. Training records shall be maintained on site and be available to fire inspectors upon request.