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TITLE: **CARBON DIOXIDE IN CULTIVATION FACILITIES**

SCOPE: The following guideline covers the requirements for the submittal of permit applications for providing a carbon dioxide-enriched atmosphere in an indoor cultivation facility. This guideline covers two methodologies of providing carbon dioxide.

DEFINITIONS:

a) **Carbon Dioxide - Gas: Carbon Dioxide that is provided as a gas in high pressure cylinders, typically at approximately 2000 psi.**
b) **Carbon Dioxide: Liquid: Carbon Dioxide that is provided as a refrigerated liquid typically at approximately 109F degrees temperature.**
c) **Dewar: Vacuum insulated container designed to hold very cold refrigerated liquids.**
d) **Cultivation Facility: Facility designed to grow various plants typically in artificial light.**
e) **Carbon Dioxide Sensor: An electronic instrument that can detect the presence and concentration of Carbon Dioxide.**
f) **Solenoid: An electrically controlled device that will shut off the flow of gas at a source.**

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SUBMITTAL DESCRIPTION AND SPECIFICATIONS FOR CARBON DIOXIDE ENRICHMENT SYSTEMS:

Provide three (3) sets of plans and specifications.
Plans shall include:

1. Scaled plan view of facility site.
2. Scaled plan view of building showing all project areas.
3. Locations of carbon dioxide sensors.
4. Location of carbon dioxide supply.
5. Location of carbon dioxide supply piping.
6. Location of ventilation supply and exhaust grills in each room supplied with carbon dioxide.
7. Cut sheets for exhaust fans, sensors, solenoids & piping.

TWO OPTIONS TO PROVIDE CARBON DIOXIDE ENRICHMENT:

1. Large Centralized Dewar of Liquid Carbon Dioxide:

A. Vaporizer:
Liquid carbon dioxide containers are connected to a vaporizer (internally, externally of both) to provide gaseous carbon dioxide at a rapid rate.

B. Piping & Leak Testing:
The supply source is normally connected to a piping network to supply carbon dioxide to various areas in the cultivation facility. The piping material must be certified by the manufacturer as suitable for gaseous carbon dioxide service. Examples of approved piping include “K” copper, black pipe, and reinforced polyethylene tubing.

1. Plans
    a. Provide anticipated working pressure on plans.
2. Piping
    a. Label delivery piping every 20’ and at all joints and valves.
    b. Delivery piping to be secured per ASME B31 for hangar type & distance (see Appendix A – excerpt from B31 and MSS)
3. Leak Testing by Responsible Party
    a. Pressure test line for leaks using ASME B31.1 – 150% of working pressure for 10 minutes.
    b. Test gas can be air or an inert gas.

C. Solenoid:
The main supply line from either the Dewar or the vaporizer (if so equipped) must pass through an electric solenoid, which when activated, will stop the flow of carbon dioxide to the piping system. These solenoids must fail closed if there is a loss of power.

D. Sensors:
Each cultivation room shall contain carbon dioxide sensors installed every 10,000 sq. ft. ASHRAE 189.1P) or as specified by the sensor manufacturer, whichever is less. The sensor(s) shall be installed from 3-8 feet above finished floor (AFF) unless the manufacturer specifies a different height.

E. Sensor Availability:
The sensors are to be operational 24-hours/day.

F. Alarms:
Each carbon dioxide sensor will be connected to local only (not connected to the fire alarm system) visible/audible alarm warning devices which will warn occupants of the room to evacuate, and warm occupants outside of the room, not to enter. The visible alarm light is to be a color other than clear to avoid confusion with the fire alarm. The light is to be rotating or flashing. The lights in cultivation rooms are to be 5' to 8' AFF and normally placed above entry doors. If the room is sized such that there is more than 2500 square feet per audible/visual alarm, then additional, equally-distributed alarms will be required. The audible alarm must be at least 15 dB louder than ambient, throughout the room. Audible and visual alarms are not required to be on exterior doors to facility, unless exterior door opens directly into a room supplied with enriched CO2.

G. Alarm Tasks:
The carbon dioxide sensors shall have a set point not exceeding 5000 ppm, which is the OSHA PEL for carbon dioxide. At the set point, the sensor shall trigger three tasks:

1. Activate the visual/audible local alarm.
2. Close the solenoid at the supply source.
3. Activate the room's exhaust fans at a capacity of at least 1 cfm/ft2, until the carbon dioxide concentration drops to the designed concentration (Generally the designed set point will fall between 1500 – 2000 ppm). The actual make and model number of the exhaust fans will be specified on either of the plans or in the supplemental cut sheets, so that field verification of the exhausting capability of the fans can be confirmed.

Plans check will confirm that an application for a mechanical permit has been submitted. Ventilation will be cross-flow.

H. Sensor/Alarm Testing:
Sensors/Alarms will be tested per the following:

1. Initial commissioning -
    a. All carbon dioxide sensors will be tested with a 5000 ppm CO2 challenge gas. The documentation for the test shall show that at 5000 ppm CO2, the sensor will:
        1. Trigger the audible and visual alarms.
        2. Shut off the supply of CO2 to either the entire building or to the room served by the sensor.
        3. Activate the exhaust fans.

2. Annual Testing by Responsible Party:
    a. Prior to renewing the carbon dioxide permit, all carbon dioxide sensors will be tested with a 5000 ppm CO2 challenge gas. The documentation for the test, on company letterhead, shall accompany the annual renewal application and shall show that at 5000 ppm CO2, the sensor will:
        1. Trigger the audible and visual alarms.
        2. Shut off the supply of CO2 to either the entire building or to the room served by the sensor.
        3. Activate the exhaust fans.

I. Signage:
Signage of color contrasting to background, will be required adjacent to each horn/strobe as follows:

1. Outside of each carbon dioxide-enriched room. Sign shall convey the message: "Alarm indicates high carbon dioxide levels; do not enter room when audible/visual alarm is activated."
2. Inside of each carbon dioxide-enriched room. Sign shall convey the message: "Alarm indicates high carbon dioxide level; evacuate room when audible/visual alarm is activated.

J. 704 Placard:
The building entries will be equipped with 704 placards for liquid carbon dioxide that will read at least:

1. Flammability – 0
2. Health – 3
3. Reactivity – 3
4. SA (simple asphyxiat)

2. Tanks of Compressed Gaseous Carbon Dioxide: used in each individual cultivation room or centrally located and mani-folded together to serve the entire building area.

A. Piping & Leak Testing
The supply source is normally connected to a piping network to supply carbon dioxide to various areas in the cultivation facility. The piping material must be certified by the manufacturer as suitable for gaseous carbon dioxide service. Examples of approved piping include "K" copper, black pipe, and reinforced polyethylene tubing.

1. Plans
    a. Provide anticipated working pressure on plans.
2. Piping
    a. Label delivery piping every 20' and at all joints and valves.
    b. Delivery piping to be secured per ASME B31 for hangar type & distance (see Appendix A – excerpt from B31 and MSS).
3. Leak Testing by Responsible Party
    a. Pressure test line for leaks using ASME B31.1 – 150% of working pressure for 10 minutes.
    b. Test gas can be air or an inert gas.

B. Solenoids:
Two options:

1. The main supply line from centrally located mani-folded tanks must pass through a single electric solenoid, which when activated, will stop the flow of carbon dioxide to the piping system.
2. If the system has multiple tanks that are dedicated to individual rooms, there will be multiple solenoids dedicated to individual rooms, and when activated, only the flow of CO2, for the room that is in alarm, will have to be stopped.

C. Sensors:
Each cultivation room shall contain carbon dioxide sensors installed every 10,000 sq. ft. (ASHRAE 189.1P) or as specified by the sensor manufacturer, whichever is less. The sensor(s) shall be installed from 3–8 feet above finished floor (AFF) unless the manufacturer specifies a different height.

D. Sensor Availability:
The sensors are to be operational 24-hrs/day.

E. Alarms:
Each carbon dioxide sensor will be connected to local only (not connected to the fire alarm system) visible/audible alarm warning devices which will warn occupants of the room to evacuate, and warn occupants of the room to evacuate, and warn occupants outside of the room, not to enter. The visible alarm light is to be a color other than clear to avoid confusion with the fire alarm. The light is to be rotating or flashing. The lights in cultivation rooms are to be 5' to 8' AFF and normally placed above entry doors. If the room is sized such that there is more than 2500 square feet per audible/visual alarm, then additional equally distributed alarms will be required. The audible alarm must be at least 15dB louder than ambient, throughout the room. Audible and visual alarms are not required to be on exterior doors to facility, unless exterior door opens directly into a room supplied with enriched CO2.

F. Alarm Tasks:
The carbon dioxide sensors shall have a set point not exceeding 5000 ppm, which is the OSHA PEL for carbon dioxide. At the set point the sensor shall trigger three tasks:

1. Activate the visual/audible local alarm.
2. Close the solenoid at the supply source.
3. Activate the room's exhaust fans at a capacity of at least 1 cfm/ft2, until the carbon dioxide concentration drops to the designed concentration (generally the designed set point will fall between 1500-2000 ppm). The actual make and model number of the exhaust fans will be specified on either of the plans or in the supplemental cut sheets, so that field verification of the exhausting capability of the fans can be confirmed.

Plans check will confirm that an application for a mechanical permit has been submitted. Ventilation will be cross-flow.

G. Sensor/Alarm Testing

Sensors/Alarms will be tested per the following:

1. Initial commissioning
    a. All carbon dioxide sensors will be tested with a 5000 ppm C02 challenge gas. The documentation for the test shall show that at 5000 ppm CO2, the sensor will:
        1. Trigger the audible and visual alarms.
        2. Shut off the supply of CO2 to either the entire building or to the room served by the sensor.
        3. Activate the exhaust fans.

2. Annual Testing By Responsible Party
    a. Prior to renewing the carbon dioxide permit, all carbon dioxide sensors will be tested with a 5000 ppm CO2, the sensor will:
        1. Trigger the audible and visual alarms
        2. Shut off the supply of CO2 to either the entire building or to the room served by the sensor.
        3. Activate the exhaust fans.

H. Signage:

Signage of a color contrasting to background, will be required adjacent to each horn/strobe as follows:

1. Outside of each carbon dioxide-enriched room. Sign shall convey message: "Alarm indicates high carbon dioxide levels; do not enter room when audible/visual alarm is activated."
2. Inside of each carbon dioxide-enriched room. Sign shall convey message: "Alarm indicates high carbon dioxide level; evacuate room when audible/visual alarm is activated."

I. 704 Placards:

The building entries will be equipped with 704 placards for gaseous carbon dioxide that will read at least:

1. Flammability – 0
2. Health – 3
3. Reactivity – 3
4. SA (simple asphyxiat)

Carbon Dioxide Generators: (unvented natural gas fire heaters) are currently not allowed in Clark County, as they do not have a UL listing for the purpose of generating CO2.

PURPOSE:

1) **To adequately describe the expectations of the Fire Prevention Division for submittals involving use of liquid CO2 in a restaurant.**

2) **All portions of the liquid CO2 system must be integrated to work properly. This includes the source tank(s), distribution piping, monitor/sensors, and audible/visual alarms. All these items will be approved under the Cryogen permit (for liquid CO2 as a source) or Compressed Gas permit (for gaseous CO2 as a source).**

PERMIT REVISIONS AND RESUBMITTALS:

Revisions to approved plans are required to be submitted and approved. A copy of the previously approved plan shall accompany the revised submittal to facilitate the review. Clearly indicate all changes to the revised plans by cloud and delta number. When several changes have been made, the Plans Checker may also require a detailed list of changes.

Re-submittals to address a Letter of Correction will require a full submittal. These plans require a copy of the red lined plan from the previous submittal to facilitate the review. Clearly indicate all changes by cloud and delta number.

PLANS CHECK STATUS INSTRUCTIONS: The status of the review can be checked by logging on to:

http://www.clarkcountynv.gov →Departments→Building Fire Prevention Bureau →Plan Status Information

Or call: (702) 455-7139

INSPECTIONS SCHEDULING:

http://www.clarkcountynv.gov→Departments→Building Fire Prevention Bureau→Inspection Schedule/Cancel Information.

Or call: (702) 455-7316
A fire inspector will review your site in accordance with the approved plans and this guideline.

Clark County Department of Building and Fire Prevention may witness and accept inspection, testing and maintenance of fire and life safety systems conducted by approved individuals as required by and within the scope and authority of the Clark County Fire Code.
This Guideline does not take the place of the Fire Code and does not take precedence over any Fire Code requirement or position taken by the Fire Code Official. When a conflict exists between the requirements of this Guideline and the Fire Code or the opinion of the Fire Code Official, the Fire Code or opinion of the Fire Code Official prevails.

Appendix A

Piping Hangars from MSS-Sp-58 (from B31.3)

A. Pipe shall be adequately supported by pipe hanger and supports specified in PART II - PRODUCTS. Hangers for insulated pipes shall be sized to accommodate insulation thickness.

B. Horizontal steel piping shall be supported in accordance with ANSI/MSS SP-69 & SP-58 Tables 3 and 4, excerpts of which follow below:

NOMINAL PIPE SIZE	ROD DIAMETER	MAXIMUM SPACING
3/8" - 1¼"	3/8"	7'- 0"
1½"	3/8"	10'- 0"
2½"	1/2"	11'- 0"
3"	1/2"	12'- 0"
3½"	1/2"	13'- 0"
4"	5/8"	14'- 0"

C. Horizontal copper tubing shall be supported in accordance with ANSI/MSS SP-69 & SP-58 Tables 3 and 4, excerpts of which follow below:

NOMINAL TUBING SIZE	ROD DIAMETER	MAXIMUM SPACING
1/4" - 3/4"	3/8"	5'- 0"
1"	3/8"	6'- 0"
1¼"	3/8"	7'- 0"
1½"	3/8"	8'- 0"
2"	3/8"	8'- 0"
2½"	1/2"	9'- 0"
3"	1/2"	10'- 0"
3½"	1/2"	11'- 0"
4"	1/2"	12'- 0"

D. Provide means of preventing dissimilar metal contact such as plastic coated hangers, copper colored B-Line DURA-COPPER™ epoxy paint, or non-adhesive isolation tape (B-Line Iso-Pipe™). Galvanized felt isolators sized for copper tubing may also be used, B-Line B3195CT.

E. Support horizontal cast iron pipe adjacent to each hub, with 10 feet maximum spacing between hangers.

F. Install hangers to provide a minimum of 1/2 inch space between finished covering and adjacent work.

G. Place a hanger within 12 inches of each horizontal elbow.

H. Support vertical piping independently of connected horizontal piping. Support vertical pipes at every (other) floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.

I. Where several pipes can be installed in parallel and at the same elevation, provide trapeze hangers as specified in Section 2.02 C. Trapeze hangers shall be spaced according to the smallest pipe size, or install intermediate supports according to schedule in Section 3.01 B.

J. Do not support piping from other pipes, ductwork or other equipment which is not building structure.

Appendix A - continued

Providing proper support for long runs of PEX tubing

Supporting your PEX tubing

PEX = Cross-Linked Polyethylene

Long runs of PEX tubing have to be supported with proper hangers. It is generally recommended to fasten the tubing at every 32 inches when running it alongside a joist and at least every 6 feet if the tubing is supported by beams and running across them. Plastic straps and hangers are recommended but metal supports that are designed for use with plastic tubing can also be used. You shouldn't use supports that are too small or can cut, scratch or in any way damage the tubing. Since PEX tubing expands and contacts when water temperature changes, it should be able to easily move in its support. It is also necessary to inspect all of the supports to make sure that there are no sharp edges that could damage the tubing.

Vertical runs of PEX tubing should be supported at every floor and at the mid-floor level, or approximately, every 4-6 ft. When penetrating metal studs or other rigid surfaces, protect the tubing by using sleeving materials on all the penetrations. Regular nylon suspension pipe clamps may offer an easy and cost effective solution. It is also important to understand that PEX tubing expands and contracts as water temperature in the system changes. That is why it is recommended to allow 1/8" slack per foot of installed tubing (or approx. 1.5" per every 10ft). You can also create a loop in the PEX that is about 8-10 times the OD diameter of the tubing. Expansion will be accommodated by the tubing's flexibility for sizes smaller than and including 1" size tubing.

Among the products supplied by PexUniverse.com, the following can be used for horizontal and vertical support of PEX tubing: Tube Talons, Nylon Pipe Clamps, Snap-in Clips, Peter Mangone Clips and Staple system.