DENVER AMENDMENT PROPOSAL FORM
FOR CPD INTERNAL PROPOSALS TO THE 2016 DENVER BUILDING CODE AMENDMENTS AND THE 2018 INTERNATIONAL CODES

2018 CODE DEVELOPMENT CYCLE

1) Name: J.D. Lanz
   Denver Fire Department
   Date: 3/28/2019

2) Proposals should be drafted in Word with the only formatting that is needed being **BOLDING**, **STRIKEOUT** AND **UNDERLINING**. Please do not provide additional formatting such as tabs, columns, etc.

Please use a separate form for each proposal submitted.

Is separate graphic file provided?  ☒ Yes  ☐ No

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AMENDMENT PROPOSAL

Please provide all of the following items in your amendment proposal.

**Code Sections/Tables/Figures Proposed for Revision:**
Replace section 5307.4.

**Proposal:**

Delete and substitute as follows:

5307.4 CO2–enrichment systems. The design, installation and maintenance of CO2–enrichment systems with more than 100 pounds (45.4 kg) of CO2, and CO2–enrichment systems with any quantity of CO2–having a remote fill connection, shall comply with Sections 5307.4.1 through 5307.4.7:

5307.4.1 Documentation. The following information shall be provided with the application for permit:

1. Total aggregate quantity of liquid CO2–in pounds or cubic feet at normal temperature and pressure;
2. Location and total volume of the room where the CO2–enrichment operation will be conducted. Identify whether the room is at grade or below grade;
3. Location of containers relative to equipment, building openings and means of egress;
4. Manufacturer’s specifications and pressure rating, including cut sheets, of all piping and tubing to be used;
5. A piping and instrumentation diagram that shows piping support and remote fill connections;
6. Details of container venting, including but not limited to vent line size, material and termination location.
7. Alarm and detection system and equipment, if applicable.

8. Seismic support for containers.

5307.4.2 Equipment. Pressure relief, vent piping, fill indicators, fill connections, vent terminations, piping systems and the storage, use and handling of the CO₂ shall be in accordance with Chapter 53 and NFPA 55.

5307.4.3 Gas detection system. A gas detection system complying with Section 916 shall be provided in rooms or indoor areas in which the CO₂ enrichment process is located, in rooms or indoor areas in which container systems are located, and in other areas where CO₂ is expected to accumulate. CO₂ sensors shall be provided within 12 inches (305 mm) 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. Activates a low-level alarm upon detection of a CO₂ concentration of 5,000 ppm (9000 mg/m³);
2. Activates a high-level alarm upon detection of a CO₂ concentration of 30,000 ppm (54 000 mg/m³);

5307.4.3.1 System activation. Activation of the low-level gas detection system alarm shall automatically:

1. Stop the flow of 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 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 CO₂ enrichment area, and the area in which the CO₂ containers are located.

5307.4.4 Pressurization and ventilation. Rooms or indoor areas in which 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 International 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 cfm per square foot [0.00508 m³/(s • m²)];
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 (305 mm) of the floor.
4. The ventilation system shall discharge to the outdoors in an approved location.

5307.4.5 Signage. Hazard identification signs shall be posted at the entrance to the room and indoor areas where the CO₂ enrichment process is located, and at the entrance to the room or indoor area where the CO₂ containers are located. The sign shall be not less than 8 inches (200 mm) in width and 6 inches (150 mm) in height and indicate:

CAUTION – CO₂ GAS VENTILATE THE AREA BEFORE ENTERING:
A HIGH CO₂ (CO₂) GAS CONCENTRATION IN THIS AREA CAN CAUSE ASPHYXIATION.
5307.4.6 Seismic and structural design. CO₂ system containers and piping shall comply with the seismic design requirements in Chapter 16 of the International Building Code and shall not exceed the floor loading limitation of the building.

5307.4.7 Container refilling. CO₂ containers located indoors shall not be refilled unless filled from a remote connection located outdoors.

Section 5307.4 Carbon Dioxide (CO₂) gas enrichment systems using on-site supply tanks and/or cylinders in plant growing (husbandry) applications is replaced as follows:

5307.4. General. CO₂ enrichment systems using on-site supply tanks and/or cylinders with more than 100 pounds (45.4 kg) of CO₂ or any system using any amount of CO₂ below grade used in plant growing (husbandry) applications shall comply with Sections 5307.4.1 through 5307.4.12.

5307.4.1 Permits. Permits shall be required in accordance with Sections 105 and in accordance with Denver Fire Department policy.

5307.4.2 Equipment. The storage, use, and handling of CO₂ shall be in accordance with IFC Chapter 53, as amended, 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.

5307.4.2.1 Containers, cylinders and tanks. Gas storage containers, cylinders and tanks shall be designed, fabricated, tested and labeled with 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.

5307.4.2.1.1 Location. Location of gas storage containers, cylinders and tanks, inside or outside the building, shall be at an approved location.

5307.4.2.1.2 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.

5307.4.2.1.3 Design and construction. Bulk tank installations over 2,000 pounds will require an engineered foundation and construction permit in accordance with the Denver Building Code, or other approved engineered solutions.

5307.4.2.2 Piping systems. Piping, tubing, fittings, valves, and pressure regulating devices shall be designed and installed in accordance with approved standards and manufacturers’ recommendations.

5307.4.2.2.1 Piping, tubing and hoses. Piping, tubing, and hose materials shall be compatible with CO₂ and rated for the temperatures and pressures encountered in the system. All hoses and tubing used in CO₂ 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 CO₂ shall be the following:

a. Stainless steel A269 grade, which is either seamless or welded drawn over mandrel.

b. Copper K grade, hard drawn seamless.

c. Copper ACR grade (1/2 inch outside diameter or less) annealed seamless.
d. Plastic/polymer materials rated for use with CO₂.

e. Additional approved piping, tubing and hoses found in the Compressed Gas Association (CGA) standards for CO₂.

5307.4.2.2 Support. Gas piping shall not be attached or supported by any electrical light supports or wiring. All gas piping shall be supported by the building structures or other approved means.

5307.4.2.3 Identification. Markings for CO₂ piping systems shall consist of the content’s name 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.

5307.4.2.3 Fittings, joints and connections. Fittings, joints, and connections shall be subject to the approval of the fire code official.

5307.4.2.3.1 Fittings and joints between gas supply containers and automatic shutoff valve. Joints and fittings on the supply piping or tubing between the CO₂ supply source and the automatic system shutoff valve shall be threaded, compression or welded.

5307.4.2.3.2 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.

5307.4.2.3.3 Concealed connections. All fittings and joints shall be exposed and located adjacent to the supply source or points of use and shall be protected by a detector.

5307.4.2.4 Valves. Piping systems shall be provided with valves in accordance with Sections 5307.4.2.4.1 through 5307.4.2.4.4.

5307.4.2.4.1 Pressure relief valves. Pressure relief valves shall be provided and piped to the outdoors.

5307.4.2.4.2 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 closing on loss of electrical power to the valve and gas detection. Additional automatic shutoff valves may be provided at each point of use. Automatic shutoff valves shall be designed and located so that all phases (i.e., gas, liquid and solid) of CO₂ will not interfere with the operation of the device.

5307.4.2.4.3 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.

5307.4.2.4.4 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.

5307.4.2.5 Venting. Venting of gases shall be directed to an approved location outside the building. Insulated liquid CO₂ systems shall have pressure relief devices vented in accordance with NFPA 55.

5307.4.3 Protection from damage. CO₂ systems shall be installed so the storage tanks, cylinders, piping and fittings are protected from damage by occupants or equipment during normal facility operations.
5307.4.4 **Required protection.** Where CO$_2$ storage tanks, cylinders, piping and equipment are located indoors, rooms or areas containing CO$_2$ storage tanks, cylinders, piping and fittings and grow room/areas where CO$_2$ is released and can collect shall be provided with an emergency alarm system in accordance with Section 5307.4.4.1.

5307.4.1.1 **Gas detection system.** A gas detection system shall comply with all of the following:

1. Continuous gas detection shall be provided to monitor areas where CO$_2$ can accumulate. Detection equipment shall be provided to indicate CO$_2$ levels in each grow cultivation area/room and interior CO$_2$ storage location.

2. Detectors shall be:
   a. Listed or approved devices.
   b. Permanently mounted.
   c. Installed at a height of no more than 48 inches above the floor or as approved by the fire code official.
   d. Directly connected to building electrical supply and fire alarm systems and protected from accidental disconnection or damage.
   e. Auto calibrating and self “zeroing” devices are not permitted unless they can be zeroed and spanned.
   f. Located within manufacturers specified detection range for each point of use and storage location.
   g. Listed to operate under environmental conditions such as temperature, humidity, and velocity variations.

3. Activation of the gas detection system shall initiate amber horn/strobes provided in the vicinity of each interior storage container, cylinder or tank and at each point of release. Additional amber horn/strobes shall be placed at the entrances to below grade locations and confined spaces. The notification appliances shall be rated a minimum of 80cd for a visible and 75 dBA for audibility. Notification appliances shall be mounted per NFPA 72 requirements with the entire lens mounted between 80 inches and 96 inches above finished floor. Notification appliances shall be listed to operate in special environments, such as outdoors, indoors, high or low temperatures, and high humidity. Provide notification appliances at the following locations:
   h. Inside an interior storage room/area and outside the room/area at each entrance.
   i. Inside grow cultivation room/areas.

4. Local alarm set points shall be set at:

5,000 PPM – Latching Alarm

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

5. Signage shall be required adjacent to each horn/strobe as follows.

Storage area/room: “DO NOT ENTER WHEN LIGHT IS FLASHING - CO₂ LEAK DETECTED”

Grow cultivation room/area dispensing: “FLASHING LIGHT MEANS CO₂ LEAK DETECTED – EVACUATE ROOM”

The sign shall have a minimum 1-inch block lettering with a minimum ¼-inch stroke. The sign shall be on a contrasting surface of black on yellow and shall be of durable construction.

Signage on entrance doors to grow cultivation and storage rooms: 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 asphyxiants shall also be provided at the exterior main entrance and at each entrance to storage rooms/areas.

3. CO₂ Gas Detection Control Unit shall be:
   a. Listed or approved.
   b. Used as the required annunciator panel/unit and silencing switch.
   c. Connected to building electrical by either hardwiring (requiring a separate electrical permit from the building department) or non-spliced cord and plug connection that is visible from control unit and is labeled and protected from accidental disconnection or damage.
   d. Labeled and installed in an approved location outside of the potentially CO₂ contaminated areas and shall be secured from unauthorized access. Buildings with a fire department key box can secure the control unit with a lockable cover whereas all other covers shall be secured with an approved breakable tie or wire. Subject to field approval.

4. Wiring shall be:
   a. Wiring diagrams shall be provided for all initiating devices and notification appliances
   b. Pathway wiring, cable, and equipment shall be in accordance with 2017 NFPA 70, Article 760 and 770, as applicable
   c. Gas detection circuits shall be installed in a neat and workmanlike manner. Cables and conductors installed exposed on the surface of ceilings and sidewalls shall be supported by the building structure in such a manner that the cable will not be damaged by normal building use.
Such cables shall be supported by straps, staples, cable ties, hangers, or similar fittings designed and installed so as not to damage the cable. The installation shall also comply with Article 300 as well as other referenced articles.

d. Design shall account for voltage-drops for notification appliance circuits.

6. A minimum of one portable CO$_2$ meter shall be in use during business hours.

5307.4.5 Transfilling. Filling and transfilling of gases between storage containers, cylinders, 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. Interior supply containers, cylinders, and tanks shall be filled via a remote fill port on the exterior of the building positioned 3 feet from any man or overhead door and 3 feet above grade and 10 feet from air intakes and stairwells that go below grade. If the interior supply tank exceeds 1,000 pounds the fill connection port shall be positioned 10 feet from exits (man doors and overhead doors), air intakes, and 2 feet from all other openings (windows).

5307.4.6 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 this code.

5307.4.7 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 most current years of records and be available for review by fire inspection personnel.

5307.4.8 Required inspections and testing. All piping installations shall be tested and inspected in accordance with Sections 5307.4.8.1 through 5307.4.8.5.

5307.4.8.1 Acceptance testing. Appliances and equipment shall not be placed in operation until after the piping system has been checked for leakage and detectors, notification devices and automatic shutoff valves 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/or building officials. Provide an inspection report to the fire and/or building officials for the piping and joint visual inspection and pressure test.

5307.4.8.2 Daily inspections. All detectors and alarms shall be visibly inspected daily. These inspections are permitted to be conducted by trained employees.

5307.4.8.3 Monthly inspections. All storage vessels, piping, and appurtenances shall be visually inspected monthly. These inspections are permitted to be conducted by trained employees.

5307.4.8.4 Semi-annual inspections. Systems shall be visually inspected, gas detectors calibrated in accordance with manufacturer’s specification, alarms tested, and tested for leaks semi-annually by a qualified service company.
5307.4.5 Alterations and repair. In the event alterations, repairs or additions are made, the affected piping shall be retested in accordance with Section 5307.4.8.1.

5307.4.9 Reserved.

5307.4.10 Calibration. Detectors shall be checked for accuracy, calibrated to a reference gas concentration, and span reset.

5307.4.11 Pressure testing. Pipe joints shall be exposed for examination during the test.

5307.4.11.1 Test medium. The test medium shall be air, nitrogen, CO₂, or an inert gas.

5307.4.11.2 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.

5307.4.11.3 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 in accordance with Section 5307.4.8.1.

5307.4.11.4 Test preparation. All joints and fittings shall be exposed for examination during and after the test.

5307.4.11.4.1 Pipe clearing. Prior to testing, the interior of the pipe shall be cleared of all foreign material.

5307.4.11.4.2 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.

5307.4.11.4.3 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.

5307.4.11.4.4 Test pressure. The test pressures shall be as specified in Section 5307.7.2.1. 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.

5307.4.11.5 Test duration. The test duration shall be not less than 10 minutes.

5307.4.11.6 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.

5307.4.11.7 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.

5307.4.11.8 Corrections. Where leakage or other defects are located, the affected portion of the piping system shall be repaired or replaced and retested.
5307.4.12 Training. All employees shall receive annual training in hazard identification, physical properties, inspections, and emergency procedures. Training records shall be maintained on site and be available to inspectors upon request.

Note: Show the proposal using strikethrough, underline format. At the beginning of each section, one of the following instruction lines are also needed:
- Revise as follows
- Add new text as follows
- Delete and substitute as follows
- Delete without substitution

Supporting Information:

Carry over Denver Fire 2015 IFCA amendments as adopted by policy in October 2017. This provides specific language.

Note: The following items are required to be included:

**Purpose:** The proponent shall clearly state the purpose of the proposed amendment to physical, environmental and customary characteristics that are specific to the City and County of Denver (e.g., clarify the Code; revise outdated material; substitute new or revised material for physical, environmental and customary characteristics; add new requirements to the Code; delete current requirements, etc.)

**Reasons:** The proponent shall justify changing the current Code provisions, stating why the proposal is necessary to reflect physical, environmental and customary characteristics that are specific to the City and County of Denver. Proposals that add or delete requirements shall be supported by a logical explanation which clearly shows why the current does not reflect physical, environmental and customary characteristics that are specific to the City and County of Denver and explains how such proposals will improve the Code.

**Substantiation:** The proponent shall substantiate the proposed amendment based on technical information and substantiation. Substantiation provided which is reviewed and determined as not germane to the technical issues addressed in the proposed amendment shall be identified as such.

**Bibliography** (as needed): The proponent shall submit a bibliography when substantiating material is associated with the amendment proposal. The proponent shall make the substantiating materials available for review.

Referenced Standards:

None

List any new referenced standards that are proposed to be referenced in the code.

Impact:

*It has no effect. Same amendments from 2015 IFCA.*

Note: The proponent shall discuss the impact of the proposed amendment and indicate one of the following for each point below regarding the amendment proposal:

- The effect of the amendment proposal on the cost of construction;  □ Increase  □ Reduce  ☒ No Effect
- The effect of the amendment proposal on the cost of design;  □ Increase  □ Reduce  ☒ No Effect
- Is the amendment proposal more- or less-restrictive than the I-Codes;  ☒ More  □ Less  ☒ Same

Departmental Impact:

Click or tap here to enter text.

Note: The proponent shall discuss the impact of the proposed amendment and indicate one of the following for each point below regarding the amendment proposal:

- The effect of the amendment proposal on the cost of review;  □ Increase  □ Reduce  ☒ No Effect
- The effect of the amendment proposal on the cost of enforcement/inspection;  □ Increase  □ Reduce  ☒ No Effect