AMENDMENT PROPOSAL

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

**Code Sections/Tables/Figures Proposed for Revision:**
Replace section 5307.3.

**Proposal:**
Delete and substitute as follows:

**5307.3 Insulated liquid CO2 systems used in beverage dispensing applications.** Insulated liquid CO2 systems with more than 100 pounds (45.4 kg) of carbon dioxide used in beverage dispensing applications shall comply with Section 5307.3.1.

**5307.3.1 Ventilation.** Where insulated liquid CO2 storage tanks, cylinders, piping and equipment are located indoors, rooms or areas containing storage tanks, cylinders, piping and equipment, and other areas where a leak of CO2 is expected to accumulate, shall be provided with mechanical ventilation in accordance with Section 5004.3 and designed to maintain the room containing CO2 at a negative pressure in relation to the surrounding area.

**Exception:** A gas detection system complying with Section 5307.3.2 shall be permitted in lieu of mechanical ventilation.

**5307.3.2 Gas detection system.** Where ventilation is not provided in accordance with Section 5307.3.1, a gas detection system shall be provided in rooms or indoor areas and in below grade outdoor locations with insulated...
CO₂ systems. CO₂ sensors shall be provided within 12 inches (305 mm) of the floor in the area where the gas is expected to accumulate or other approved locations.

The system shall be designed as follows:

1. Activates an audible and visible supervisory alarm at a normally attended location upon detection of a CO₂ concentration of 5,000 ppm (9000 mg/m³).

2. Activates an audible and visible alarm within the room or immediate area where the system is installed upon detection of a CO₂ concentration of 30,000 ppm (54 000 mg/m³).

Section 5307.3 CO₂ (CO₂) Systems Used in Beverage Dispensing Applications is replaced as follows:

5307.3 CO₂ Systems Used in Beverage Dispensing Applications. CO₂ systems with more than 100 pounds (45.4 kg) of CO₂ or any system using any amount of CO₂ below grade used in beverage dispensing applications shall comply with Sections 5307.3.1 through 5307.3.8.

Definitions
Asphyxiation: to lose consciousness by impairing normal breathing, to suffocate or smother.

Dewar: a vacuum flask that holds a cryogenic or liquefied gas.

CO₂ Detector: a device to measure the concentration of CO₂ in the air.

CO₂ Gas Detection Control Unit: a system component that monitors inputs and controls outputs through various types of circuits.

Indoor use of CO₂: Rooms or areas sheltered from the weather and environmental conditions. Subject to review by the fire code official.

Liquid CO₂ Systems: An assembly of equipment consisting of one or more CO₂ supply containers, interconnecting piping, pressure regulators, and pressure relief devices.

PEL: Permissible Exposure Limit for CO₂ gas is 5,000 PPM (0.5%) Time Weighted Average (TWA) @ 8 hours a day, 40 hours per week.

STEL: Short-Term Exposure Limit for CO₂ is 30,000 PPM (3.0%) for less than 15 minutes.

IDLH: Immediately Dangerous to Life & Health for CO₂ is 40,000 PPM (4.0%).

5307.3.1 Permits. Permits shall be required as set forth in Section 105 and in accordance with Denver Fire Department policy.

5307.3.2 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.

5307.3.2.1 Containers, cylinders, and tanks. Gas supply containers, cylinders, and tanks shall be designed, fabricated, tested, labeled, and installed in accordance with manufacturers’ 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.

5307.3.2.1.1 Location. Location of gas supply containers, cylinders, and tanks, inside or outside the building, shall be at an approved location.

5307.3.2.1.2 Security. Gas supply 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.
5307.3.2.1 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 engineering methods.

5307.3.3 Piping systems. Piping, tubing, fittings, valves, and pressure regulating devices shall be designed and installed in accordance with approved standards and manufacturers’ recommendations.

5307.3.3.1 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:

1. Stainless steel A269 grade, which is either seamless or welded drawn over mandrel.
2. Copper K grade, hard drawn seamless.
3. Copper ACR grade (1/2 inch outside diameter or less) annealed seamless.
5. Additional approved piping, tubing and hoses found in the Compressed Gas Association (CGA) standards for CO₂.

5307.3.3.2 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.

5307.3.3.3 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.

5307.3.3.4 Fittings, joints, and connections. Fittings, joints, and connections shall be subject to the approval of the fire code official.

5307.3.3.4.1 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.

5307.3.3.4.2 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.

5307.3.3.4.3 All 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.

5307.3.3.5 Valves. Piping systems shall be provided with valves in accordance with Sections 5307.3.3.5.1 through 5307.3.3.5.5.

5307.3.3.5.1 Pressure relief valves. Pressure relief valves shall be provided and piped to the outdoors.
5307.3.3.5.2 **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 in a closed condition. Loss of electrical power to the valve and gas detection shall close the system automatic shut off valve. 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 devices. Automatic system shutoff valve shall have components that indicate the valve operating position, open or closed.

5307.3.3.5.3 **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.

5307.3.3.5.4 **Check valves.** One-way flow check valves shall be installed at the most downstream end of copper runs that are used for beverage consumption.

5307.3.3.5.5 **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.

5307.3.3.6 **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.

5307.3.3.6.1 **Beverage pumps.** Beverage pumps shall be vented to the outside.

5307.3.4 **Protection from damage.** CO₂ systems shall be installed so the supply tanks, cylinders, piping, fittings, and other appurtenances are protected from damage by occupants or equipment during normal facility operations.

5307.3.5 **Required protection.** Where CO₂ supply tanks, cylinders, piping, and equipment are located indoors, rooms, or areas containing CO₂ supply tanks, cylinders, piping, and fittings and other areas where a leak of a CO₂ system can collect shall be provided with either ventilation in accordance with Section 5307.3.5.1 or a gas detection system in accordance with Section 5307.3.5.2.

5307.3.5.1 **Ventilation.** Mechanical ventilation shall be in accordance with the *International Mechanical Code* and shall comply with all 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 [0.00508 m³/(s • m²)].

2. Exhaust shall be taken from a point within 12 inches of the floor.

3. The ventilation system shall be designed to operate at a negative pressure in relation to the surrounding area.

4. Ventilation shall run continuously or be activated by a sensor or detector to maintain an atmosphere of less than 5,000 ppm.

5. A mechanical permit is required in accordance with the *Denver Building Code*.

5307.3.5.2 **Gas Detection System.** A gas detection system shall comply with all the following:
1. Continuous gas detection shall be provided to monitor areas where CO\textsubscript{2} can accumulate. Detection equipment shall be provided to indicate CO\textsubscript{2} levels at each point of use and at each supply tank area/room.

2. Detectors shall comply with all the below:
   a. Listed or approved devices.
   b. Permanently mounted.
   c. Installed at a height of between 12 inches above the floor or as approved by the fire code official.
   d. Connected to building electrical by either hardwiring (requiring a separate electrical permit from the building department) or to a non-spliced cord and plug connection that is protected from accidental disconnection/damage or to a CO\textsubscript{2} gas detection system unit.
   e. Auto calibrating and self “zeroing” devices are not permitted unless they can be zeroed and spanned.
   f. Located within manufactures’ specified detection range for each point of use and supply tank location.
   g. Listed to operate under environmental conditions such as temperature, humidity, and velocity variations.

3. Alarm set points shall be set at:
   a. 5,000 PPM (0.5%) Time Weighted Average (TWA) – Self re-setting (non-latching) alarm.
      - Audible notification for employees only in approved locations with instructional signage.
   
   b. 15,000 PPM (1.5%) – Latching Alarm.
      - Audible notification for employees only in approved locations with instructional signage.
      - Requires a service company or approved trained employees to investigate, repair and reset.
   
   c. 30,000 PPM (3%) – Latching Alarm.
      - Initiate all amber horn/strobes provided near each interior supply container, cylinder, or tank and at each point of use. Additional amber horn/strobes shall be placed at the entrances to below grade locations, confined spaces including small volume rooms, and at walk-in coolers. The notification appliances shall be rated at a minimum of 80cd for visual intensity 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.
      - Activation of automatic system shutoff valve.
● Evacuate room/area and call 911.

● 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.

● Provide a graphic floor plan map of the area protected by the CO₂ gas detection system that is permanently mounted adjacent to the annunciator panel/unit or CO₂ gas detection control unit. Plans shall be of durable construction, easily readable in normal lighting, protected by a smooth, transparent, plastic surface and shall indicate the location of supply tank, points of use, and CO₂ detectors. The graphic map shall state “You Are Here” and be properly oriented to assist the responding firefighters.

● Provide a labeled and secured alarm silencing switch adjacent to the annunciator panel/unit that shall only de-activate the audible notification appliances (amber strobes shall remain on and automatic system shutoff valve shall remain closed) until the system is manually reset.

● Alarm silencing can only be performed by fire department personnel. Manual reset can only be performed by a qualified service company or fire department personnel.

● Alarm Signal shall be defined as the following: In buildings with a monitored sprinkler or fire alarm/detection system, the CO₂ gas detection system shall be connected to the building fire alarm control panel. This shall include a monitor modules or zones for a high alarm (30,000 ppm or 3.0%), a LED hazmat CO₂ alarm zone on the building annunciator, a non-latching supervisory CO₂ maintenance/testing bypass switch, and modified building graphic map indicating the location of the CO₂ gas detection control unit, annunciator panel/unit, CO₂ detectors, and CO₂ supply tank. Building fire alarm notification appliances shall not activate on this CO₂ hazmat alarm. The central station monitoring shall receive and dispatch a CO₂ hazmat alarm. A fire alarm permit is required per the Denver Building Code.

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

Outside the supply tank room or point of use area/room: “DO NOT ENTER WHEN LIGHT IS FLASHING – CO₂ LEAK DETECTED – EVACUATE IMMEDIATELY AND CALL 911”

Inside the supply tank room or point of use area/room: “FLASHING LIGHT MEANS CO₂ LEAK DETECTED – EVACUATE IMMEDIATELY AND CALL 911”

The sign shall have a minimum 1-inch block lettering with a minimum ⅛-inch stroke. The sign shall be on a contrasting surface of black on yellow and shall be of durable construction.

NFPA 704 placards for simple asphyxiants shall also be provided at the main entrance to supply tank rooms, areas, or confined spaces.

5.   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.

6. 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.

5307.3.6 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).

5307.3.7 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.

5307.3.7.1 Records. A written record of all alarm activations/resets, required inspections, testing, calibration, and maintenance shall be maintained in a log book on the premises containing the 3 most current years of records and be available for review by fire inspection personnel.

5307.3.7.2 Required inspections and testing. All piping installations shall be tested and inspected in accordance with Sections 5307.3.7.2.1 through 5307.3.7.2.5.

5307.3.7.2.1 Acceptance testing. Devices, appliances, and related equipment shall not be placed in operation until after the piping system has been checked for leakage as well as detectors, notification appliances 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 the fire code officials.
Provide an inspection report to the fire code official for the piping and joint visual inspection and pressure test.

5307.3.7.2.2 Daily inspections. All detectors and alarms shall be visually inspected daily. These inspections are permitted to be conducted by trained employees.

5307.3.7.2.3 Monthly inspections. All storage vessels, piping, and appurtenances shall be visually inspected monthly. These inspections are permitted to be conducted by trained employees.

5307.3.7.2.4 Semi-annual inspections. Systems shall be visually inspected, gas detectors calibrated in accordance with manufacturers’ specifications, alarms tested, and tested for leaks semi-annually by a qualified service company.

5307.3.7.2.5 Alterations and repair. In the event alterations, repairs, or additions are made, the affected piping shall be retested in accordance with Section 5307.3.7.2.1.

5307.3.7.3 Reserved.

5307.3.7.4 Calibration. Detectors shall be checked for accuracy, calibrated to a reference gas concentration, and span reset.

5307.3.7.5 Pressure testing. Pipe joints shall be exposed for examination during the test.

5307.3.7.5.1 Test medium. The test medium shall be air, nitrogen, CO₂, or an inert gas.

5307.3.7.5.2 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.

5307.3.7.5.3 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 5307.3.7.2.1.

5307.3.7.5.4 Test preparation. All joints and fittings shall be exposed for examination during and after the test.

5307.3.7.5.4.1 Pipe clearing. Prior to testing, the interior of the pipe shall be cleared of all foreign material.

5307.3.7.5.4.2 Appliance and equipment isolation. Devices, appliances, and equipment that are not to be included in the test shall be isolated from the piping by closing the device shutoff valve.

5307.3.7.5.4.3 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.

5307.3.7.5.4.4 Test pressure. The test pressures shall be as specified in Section 5307.3.7.2.1. Where the test pressure exceeds 125 psig (862 kPa gauge), the test pressure shall not exceed a value that produces a
The amendment proposal:

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

**Impact:**

It has no effect. Same amendments from 2015 IFCA.

**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; ☒ No Effect
- ☐ Increase
- ☐ Reduce

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h 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.

**5307.3.7.5.5 Test duration.** The test duration shall be not less than 10 minutes.

**5307.3.7.5.6 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.

**5307.3.7.5.7 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.

**5307.3.7.5.8 Corrections.** Where leakage or other defects are located, the affected portion of the piping system shall be repaired or replaced and retested.

**5307.3.8 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.

**Note:** Show the proposal using **strikeout**, 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.
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**Departmental Impact:**
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**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;  
- The effect of the amendment proposal on the cost of enforcement/inspection;