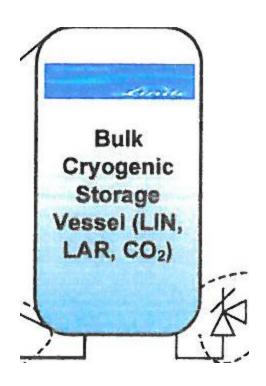
BULK LIQUID CO2



PROPERTIES AND USES

- CONSIDERED A COMPRESSED GAS
 - FLASHPOINT: Not flammable
 - BOILING POINT: -109.3 F / -78.5 C
 - TOXICITY: Not toxic
 - VAPOR DENSITY: I.53 at 70 F (21.1 C)
 - 8.7 cubic feet per pound

USES

- Pesticide
- Refrigerant
 - Processing foods
 - Preserving foods
 - Crusting of foods
- Refrigeration, Carbonated Beverages
- Aerosol propellant

HEALTH HAZARDS

- INHALATION CONCERNS
 - Increased Respiratory Rate
 - Headache
 - Subtle Physiological Changes for up to 5% concentration and prolonged exposure.
- Exposure to concentrations less than 5% for less than 15 minutes can cause physical symptoms including unconsciousness, injuries, or death

REASONS FOR CONCERNS

- Reported Incidents
 - Phoenix Arizona
 - 2 Firefighters, 2 civilian employees overcome in basement of McDonalds due to CO2 leak
 - Atlanta, Georgia
 - I woman killed in washroom
 - Ventilation fan not working, CO2 leak drifted into washroom
 - Glendale Heights, Illinois
 - Tank rupture at hose to tank fittings. NO injuries or deaths. Tank in basement. Proactive approach in educating company with dangers credited with preventing dangerous to catastrophic incident.

Phoenix Incident

http://www.youtube.com/watch?v=eY_H-CMvw0

GEORGIA INCIDENT

 McDonalds Hazmat, deadly carbon dioxide

GLENSIDE F.P.D INCIDENT

- A 175lb liquid CO2 tank suffered a complete failure and disconnect of a supply hose in a basement.
- The restaurant was recently served with a directive by the Bureau to install a detection device in the basement for this purpose.
- They only had our site training and warning signs in place

THE TANK

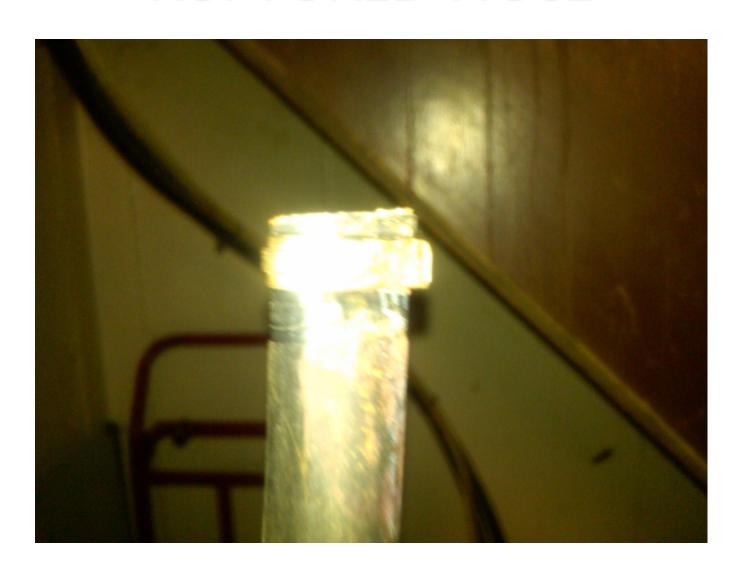


GAUGE AND FITTINGS





RUPTURED HOSE





Carbon Dioxide Used in Restaurants and Convenience Stores

- IFC, 2006 edition, Section 3002.1 & NFPA 55, 2010 edition, Section 3.3.43.1 Compressed Gas. A material, or mixture of materials which:
 - I. Is a gas at 68 F (20 C) or less at 14.7 psia (101 kPa) of pressure; and
 - 2. Has a boiling point of **68** F (20 C) or less at 14.7 psia (101 kPa) which is either liquified, nonliquified or in solution, except those gases which have no other health- or physical-hazard properties are not considered to be compressed until the pressure in the package exceeds 41 psia (28 kPa) at **68** F (20 C).

WHERE WE FIND LIQUID CO2

- ANY WHERE THERE IS A HUGE SODA DRAW
 - McDonalds
 - Burger Kings
 - Wendy's
 - Portillo's
 - 7-11's
 - Panda Express
 - Chipotle

Liquid CO2 Tanks

- Tanks are ASME tanks, not DOT
- ASME Tanks are designed to be permanent in nature
- Non-insulated cylinders are high pressure without a vent system.
- High pressure cylinders are DOT and not designed to be permanent in nature and should not be permanent.

- ASME tanks use cryo tube for filling
- Bevflex tubing is rated at 300 psi and is used between the tank and the syrup machines
- Temperature concerns for tubing is from fill box to the tank.
- Relief valve is set at 140 psi approx and should operate before bevflex fails.
- Vent system requirements are for constant fresh air. Usually normal air changes is adequate

INSTALLATION

- USUALLY INDOORS IN THE FOOD INDUSTRY
- CONSISTS OF THREE PRIMARY PARTS
 - STORAGE VESSEL
 - CONSISTS OF AN INNER VESSEL AND AN OUTER VESSEL CONSTRUCTED LIKE A THERMOS BOTTLE.
 - SPACE BETWEEN THE TWO VESSELS
 CONTAINS A NEARLY PERFECT VACUUM
 AND A SPECIAL INSULATION

VACUUM AND INSULATION
 MINIMIZE ENTRY OF UNWANTED
 HEAT INTO THE LIQUID CO2 STORED
 IN THE INNER VESSEL.



Liquid CO2 Tank (typical)

Pressure and Contents Gauges

- Vessel Pressure Gauge measures the pressure in the top (gas space) of inner vessel.
- Normal operating pressure range is 140 to 165 psig (pressures up to 300 psig can be seen for short periods after filling)
- The vessels content gauge is a mechanical device that uses pressure to measure liquid.
- The measurement is accomplished by comparing the low phase pressure (tanks gas space pressure) and high phase (tank pressure plus pressure created by weight of the liquid)



Typical venting/piping set up

Vessel Plumbing

- Performs 5 Functions
 - Liquid CO2 Fill Valve
 - Gas Supply (delivery regulators)
 - Pressure Maintenance ("Economizer" regulator)
 - Safety Valve (Vent/Relief Valves)
 - Pressure and contents measurement (gauges)

FILL LINE AND VENT LINE

- These lines join the CO2 tank to the exterior fill box.
- Fill hose is constructed with FDA compliant materials and is a pressure rated line.



EXTERIOR FILL CONNECTION

EXTERIOR FILL COMPONENTS

FILL CONNECTION: USUALLY QUICK CONNECT.

OVER-PRESSURE RELIEF VALVE

IFC, 2006 REQUIREMENTS

- Section 3001.2, Permits. Permits shall be required as set forth in Section 105.6
- Section/Table 105.6.8 Requires an operational permit for storage, use, or handling at normal temperatures and pressures in excess of 6,000 cubic feet.
 (8.7 cubic feet x 400 pounds = 3,480 cubic feet = no permit required!)

IFC, 2006 REQUIREMENTS (continued)

 Section 105.7 & 105.7.3 The fire code is authorized to issue construction permits when 105.6 requires an operational permit.

(8.7 cubic feet x 400 pounds = 3,480 cubic feet = no permit required to install!)

NFPA 55, 2005 and 2010 Requirements

- MUST BE ADOPTED TO APPLY!
- Section 4.1 Permits shall be obtained in accordance with the requirements of the jurisdiction in which the facility operates.
- Section 4.2.1.1 An emergency plan shall be prepared and updated wherever compressed gases or cryogenic fluids are produced, handled, stored, or used where required by the AHJ.

NFPA 55, 2005 and 2010 Requirements (continued)

Emergency Plan Requirements

- I. Emergency equipment and location
- Brief description of testing & maintenance program for emergency equipment
- 3. Indication that hazard ID labeling is provided for each storage area
- 4. Location of posted emergency procedure

NFPA 55, 2005 and 2010 Requirements (continued)

Emergency Plan Requirements

- 5. MSDS
- List of personnel designated and trained as liaison to FD
 - a. Aid in pre-emergency planning
 - b. Identifying location
 - c. Accessing MSDS
 - d. Knowing site Emergency Procedure
- 7. List of compressed gases in facility

NFPA 55, 2005 and 2010 Requirements (continued)

• Section 6.8 (2005) or 6.7 (2010) — When required by government regulations, an employee alarm system shall be provided to allow warning for necessary emergency action as called for the in the Emergency Action Plan.

FIRE SUPPRESSION REQUIREMENTS

- NFPA 55 2003, 2005, 2010 EDITIONS
 - Chapter 6 Section 6-11 in 2003 and Chapter 6 Section 6-9 in 2010 mandate sprinkler protection.
 - 6-11.1 (2003) and 6-9.1 (2010) state no required sprinkler protection if:
 - "rooms or areas that are of noncombustible construction with wholly noncombustible contents shall not be required to be protected by an automatic sprinkler system"

FIRE SUPPRESSION REQUIREMENTS con't

- NFPA 55 6-11.2 (2003) AND 6-9.2 (2010) COVER SPRINKLER DESIGN
 - States "the area in which compressed gases or cryogenic fluids are stored or used shall be protected with an automatic sprinkler system designed to be not less than that required by NFPA 13 for Ordinary Hazard Group 2 with a minimum design area of 3000 sq ft"
 - NFPA 13 (2002 Edition) Chapter 11 Figure 11.2.3.1.5
 - Ordinary Group 2 at 3000 sq feet = .17/3000 sq ft
 NO CHANGES IN 2007 OR 2010 EDITIONS

EXTERIOR INSTALLATIONS

- NFPA 55 Chapter 13 Section 13.3 regulates outdoor installations
- If in an enclosed structure outside of main structure must follow 13.2 for indoor installations (13.3.1)
- Above ground outdoor locations do not need leak detection or alarm system if tank system is unenclosed

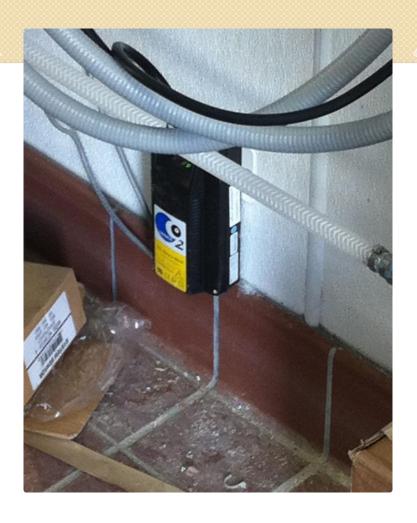
NFPA 55 13.3.1.1.1

- "To be considered unenclosed, enclosures constructed to limit access or provide a visual or architectural barrier for the installation shall be constructed in accordance with Section 6.5.2 for weather protection OR
 - Be constructed without a roof or overhead cover
 - Supports and walls shall not obstruct more than three sides nor more than 75% of the perimeter of the storage or use area with 25% of the perimeter being open to the atmosphere"

NFPA 55 13.3.1.1.2

- If the enclosure does not meet 13.3.1.1
 can be constructed if
 - Constructed without roof or overhead cover
 - Continuous mechanical exhaust ventilation is provided

- Basement installations are most dangerous due to the low lying areas
- These installations MUST have leak detection alarms installed at base of installation.
- MacCarb and NuCO2 (suppliers) cut sheets provide manufacturer information that states alarms are to be no higher than 18" off the floor.
- Stagnant or "potential stagnant" air areas need mechanical ventilation



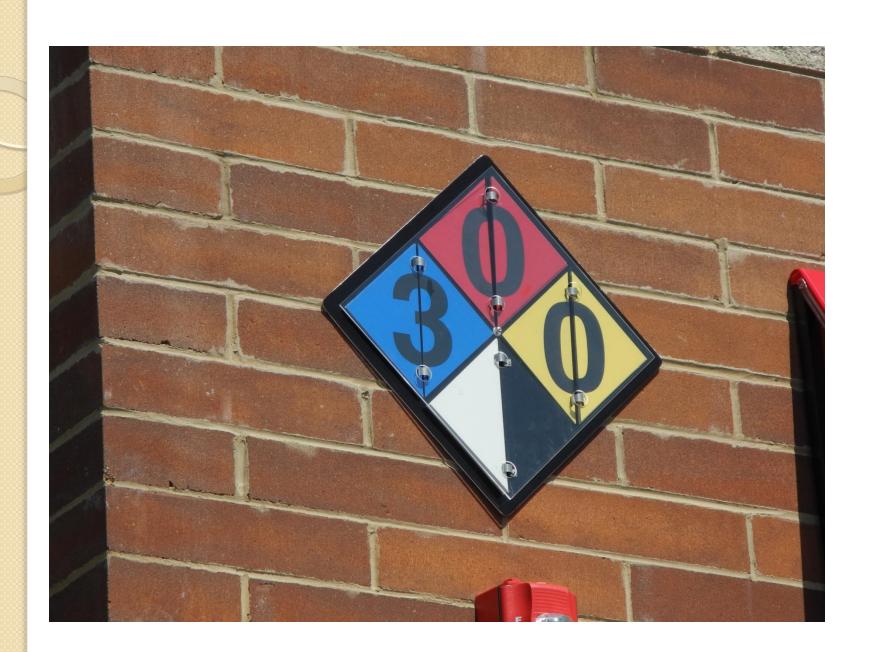
CO2 Alarm Installation



Employee Warning Alert System (typical)

WARNING SIGNS

- NFPA 704 symbols are required on the building (6.11.1 2010 Edition) at all entrances to locations where stored.
- Stationary Tanks shall have 704 signs visible from any direction of approach.
 - NFPA 55 2010 Chapter 7 Section 7-1.7.3.1 and 7-1.7.3.2



WARNING SIGNS con't

- NFPA 55, 2010, Chapter 13, 13.2.3
 - Warning sign shall be posted at the entrance to the building, room, enclosure, or confined area where the container is located.
 - Section 13.2.3.1: The warning sign shall be at least 8 inches wide and 6 inches high and state the following:
 - CAUTION CARBON DIOXIDE GAS
 - VENTILATE THE AREA BEFORE ENTERING
 - A High Carbon Dioxide (CO2) gas concentration in this area can cause suffication

WARNING SIGN EXAMPLES

WARNING



- LIQUID CARBON DIOXIDE
- DO NOT ENTER UNTIL VENTILATED
- CAN CAUSE INJURY SUFFOCATION OR DEATH

ADVERTENCIA



DIOXIDO DE CARBONO LIQUIDO

- NO INGRESE hasta que el lugar este adecuadamente ventilado
- Pueden producirse lesiones sofocacion, e incluso la muerte

WARNING/ADVERTENCIA

- IMMEDIATELY LEAVE THE AREA WHEN THE ALARM SOUNDS.
- NOTIFY A MANAGER THE ALARM IS SOUNDING
- DO NOT ALTER, TAMPER OR OBSTRUCT THIS ALARM UNDER PENALITY OF LAW
- ABANDONAR INMEDIATAMENTE LA ZONA CUANDO SUENA LA ALARMA
- NOTIFICAR A UN ADMINISTRADOR ESTÁ SONANDO LA ALARMA
- NO ALTERAR, MANIPULAR O OBSTRUIR ESTA ALARMA BAJO PENALITY DE DERECHO

RESPONSE CONCERNS

- CO2 leak alarms are local only.
- If responding to AFA, full gear is worn, however
- Response to an "alarm investigation" might be taken lightly and personnel may not be geared up properly causing a possible fatal issue
- No indication of the CO2 alarm on a fire alarm panel or annunciator.
- EMS responses

ENFORCEMENT CONCERNS

- NFPA 55 is not retroactive (1.4.1) however
 - Section I.4.2 allows AHJ to make it retroactive if they deem the "existing situation presents an unacceptable degree of risk"
 - Section I.4.3 allows "retroactive requirements of this code shall be permitted to be modified if their application clearly would be impractical in the judgment of the AHJ and only where it is clearly evident that a reasonable degree of safety is provided"

- There is a lot of room for inconsistency in retroactively enforcing NFPA 55.
 - What do you consider "reasonable degree of safety"
 - What dictates unreasonable degree of risk