FIRE DEPARTMENT • CITY OF NEW YORK

STUDY MATERIAL FOR THE CERTIFICATE OF FITNESS EXAMINATION

G-82

HANDLING AND DISPENSING OF CARBON DIOXIDE CONTAINERS

THIS TEST COVERS THE FOLLOWING:

DISPENSING AND HANDLING OF CARBON DIOXIDE CONTAINERS (G-82)

THIS TEST DOES NOT COVER THE FOLLOWING:

STORAGE AND USE OF CARBON DIOXIDE
Applicants who need a Certificate of Fitness for the **Storage** and **Use** of Carbon Dioxide must take the exam: **STORAGE, HANDLING, USE, AND REFILLING OF NON-FLAMMABLE COMPRESSED GASES (G-46)** -end-users

REFRIGERATING/AIR CONDITIONING SYSTEMS
Applicants who need a Certificate of Fitness for operating Refrigerating/Air Conditioning Systems must take the exam: **REFRIGERATING SYSTEM OPERATING ENGINEER (Q-99/Q-01)**

NEW APPLICANTS who**, HANDLE AND DISPENSE CARBON DIOXIDE (for soda carbonation)**	→	**Take this NEW G-82 COF**
CURRENT APPLICANTS WHO HAVE A **G-28 COF**	→	**Take this NEW G-82 COF when your current G-28 COF expires**
CURRENT APPLICANTS who have **G-97 COF** for dispensing of CO_2 for soda carbonation	→	**Take this NEW G-82 COF when current G-97 COF expires**
CURRENT APPLICANTS WHO HAVE: **G-97 COF (not for CO_2) G-15 G-41 G-49 G-50**	→	**Take the NEW G-79 COF when your current COF expires**
CURRENT APPLICANTS who have a valid **G-97 COF** for **STORAGE & USE of CO_2**	→	**Take the NEW G-46 COF when G-97 COF expires**
NEW APPLICANTS who **STORE** and **USE CO_2**	→	**Take the NEW G-46 COF**

CONTENTS

NOTICE OF EXAMINATION

Title: Examination for the Certificate of Fitness for Handling and Dispensing of Carbon Dioxide Containers (G-82).

Date of Test: Written tests are conducted Monday through Friday (except legal holidays) 8:00 AM to 2:30 PM.

- This COF was originally known as the G-28 COF exam and later as part of the G-97 COF exam. **This new G-82 COF exam specifically addresses the need for individuals that supply, deliver and dispense CO_2 for carbonation.** Upon expiration of old G-28 or the G-97, Certificate of Fitness holders will need to take the **NEW G-82** exam to get **Certificate of Fitness for handling and dispensing of carbon dioxide.**
- For **Storage and Use** of carbon dioxide the person should take the **G-46** Certificate of Fitness.
- The G-82 Certificate of Fitness is valid for three years, starting from the date that it is obtained.
- The G-82 is a city-wide Certificate of Fitness.

QUALIFICATION REQUIREMENTS

1. Applicants must be at least 18 years of age.
2. Applicants must have a reasonable understanding of the English language.
3. Applicant must provide two forms of identification, at least one identification must be government issued photo identification, such as a State-issued Driver's License or Non Driver's License or a passport.
4. Applicants must present a letter of recommendation from his/her employer. The letter must be on the employer's official letterhead, and must state the applicant's full name, experience and the address where the applicant will work. If an applicant is self-employed or the principal of the company, a notarized letter must be submitted attesting to his or her qualifications. The sample letters are available at the link below http://www.nyc.gov/html/fdny/html/c_of_f/cof_requirements.shtml or the Public Certification Unit, 1st floor, 9 Metrotech Center, Brooklyn.
5. Applicants not currently employed may take the test without the recommendation letter. If the applicants pass the test, the FDNY will issue a temporary letter (N-Letter) with a photo for the purpose of job seeking. The C of F card will not be issued unless the applicants are employed and the recommendation letter from his/her employer is provided.

APPLICATION INFORMATION

Application Fees: $25 for originals and $15 for renewals. The fee may be paid by cash, money order, credit card, debit card or personal check made payable to the New York City Fire Department. The $25 fee must be paid by all applicants prior to taking the Certificate of Fitness test.

Application Forms: Application forms are available at the Public Certification Unit, 1st floor, 9 Metro Tech Center, Brooklyn, NY 11201.

RENEWAL REQUIREMENTS

You will receive a courtesy notice of renewal 90 days before the expiration date of your COF; however, it is your responsibility to renew. It is very important to renew your C of F before it expires.

For renewal, send the renewal notification or a letter stating the C of F # with a fee of $15, money order or personal check payable to "Fire Department City of New York" to:

FDNY (Cashier's Unit)
9 MetroTech Center,
Brooklyn, NY 11201

Late renewals (90 days after the expiration date, up to 1 year) will incur a $ 25 penalty in addition to the renewal fee. Certificates expired over one year past the expiration date will not be renewed. New tests will be required. The FDNY also reserves the right to require the applicants to take a re-examination upon submission of renewal applications.

TEST INFORMATION

The G-82 test will consist of **25** multiple-choice questions, administered on a "touch screen" computer monitor. It is a time-limit test. A passing score of at least 70% is required in order to secure a Certificate of Fitness. Call (718) 999-1988 for additional information and forms.

WEBSITE

Please always check for the latest revised booklet at the FDNY website before you take the test, the Certificate of Fitness Study Material link, below
http://www.nyc.gov/html/fdny/html/c_of_f/cof_study_materials.shtml

STUDY MATERIAL AND TEST DECRIPTION

About the Study Material

This study material will help you prepare for the examination for the Certificate of Fitness for *handling and dispensing of carbon dioxide,* in gaseous and liquid form. The study material includes information taken from the New York City Fire Code Chapter 30, New York City Fire Rules, Compressed Gas Association standard CGA G-6-1984 and CGA G-6.1-1986. The exam covers this entire study material booklet and any tables. **This material will not be provided to you during the test. It is critical that you read and understand this booklet to help increase your chance of passing this exam.** The study material **does not** contain all of the information you need to know to dispense into carbon dioxide containers. It is your responsibility to become familiar with all applicable rules and regulations of the City of New York, even if they are not covered in this study material. In order to adequately prepare for the exam, you need to be familiar with the Fire Code Chapters 27, 30, Fire Rules Chapter 30, CGA-G-6-1984 and G-6.1-1986.

About the Test

The G-82 Certificate of Fitness exam consists of **25** multiple-choice questions with four alternative answers to each question. Only one answer is correct for each question. If you do not answer a question, or if you choose more than one alternative answer, the question will be scored as incorrect. A score of 70% is required in order to qualify for the Certificate of Fitness. Read each question carefully before marking your answer. There is no penalty for guessing.

Sample Questions

1. Which of the following are allowed to be used/displayed while taking a Certificate of Fitness examination at 9 Metro Tech Center?

I. cellular phone
II. study material booklet
III. reference material provided by the FDNY
IV. mp3 player

A. III only
B. I, II, and III
C. II and IV
D. I only

Only reference material provided by the FDNY is allowed to be used during Certificate of Fitness examinations; therefore, the correct answer would be A. You would touch "A" on the computer terminal screen.

2. If you do not know the answer to a question while taking an examination, who should you ask for help?

A. the person next to you

B. the firefighters in the testing room
C. the examiner in the testing room
D. you should not ask about test questions since FDNY staff cannot assist applicants

You should not ask about examination questions or answers since FDNY staff cannot assist applicants with their tests. Therefore, the correct answer would be D. You would touch "D" on the computer terminal screen.

3. If the screen on your computer terminal freezes during your examination, who should you ask for help?

A. the person next to you
B. the firefighters in the testing room
C. the examiner in the testing room
D. the computer help desk

If you have a computer related question, you should ask the examiner in the testing room. Therefore, the correct answer would be C. You would touch "C" on the computer terminal screen.

1. INTRODUCTION

This booklet outlines the New York City Fire Department's regulations, standards and procedures for the handling and dispensing of carbon dioxide, in gaseous and liquid form.

1.1 WHAT IS CARBON DIOXIDE?

Carbon Dioxide is a **liquefied nonflammable gas**. It is formed by the combination of carbon and oxygen atoms in a 1:2 ratio expressed by the chemical symbol CO_2. Carbon dioxide is a gas at normal atmospheric temperature and pressure. It is colorless and somewhat pungent although essentially odorless, and is about 1.5 times more dense than air. Depending on the temperature and pressure to which it is subjected, carbon dioxide may exist in the form of a solid, a liquid, or a gas. The majority of CO_2 applicants will be working for restaurants and other similar venues. CO_2 systems at those establishments are designed to deliver perfectly carbonated fountain soft drinks and draught beer.

1.2 CERTIFICATE OF FITNESS

The handling and dispensing of carbon dioxide shall be supervised by a person holding a G-82 Certificate of Fitness:

Handling: The handling of carbon dioxide in quantities requiring a permit shall be under the **personal supervision** of a person holding a G-82 Certificate of Fitness.


CERTIFICATE ISSUED BY NYC FIRE DEPT
CERT.# [redacted] N
ISSUED 12/11/2013 EXPIRES 01/14/2016
NAME [redacted]
HOME [redacted]
ADDR. STRATFORD, CT 06615
NOT FDNY EMPLOYEE
FEE $ 25.00 CAT.G-82 TYPE Fitness
DESC.HANDLING AND DISPENSING OF CARBON DIOXIDE
EMPLOYER Con Edison
WORK LOCATION ,

Dispensing: The dispensing of carbon dioxide container from any source shall be performed under the **personal supervision** of a person holding a G-82 Certificate of Fitness.

The G-82 Certificate of Fitness holders are responsible for ensuring that all Fire Department regulations related to the safe handling and dispensing of carbon dioxide on a premises are obeyed.

Business owner shall have proper permits as required and set forth on the next page. Stationary container and ancillary equipment shall be maintained in good working order and visually inspected not less than **once a month** by the G-82 Certificate of Fitness holder.

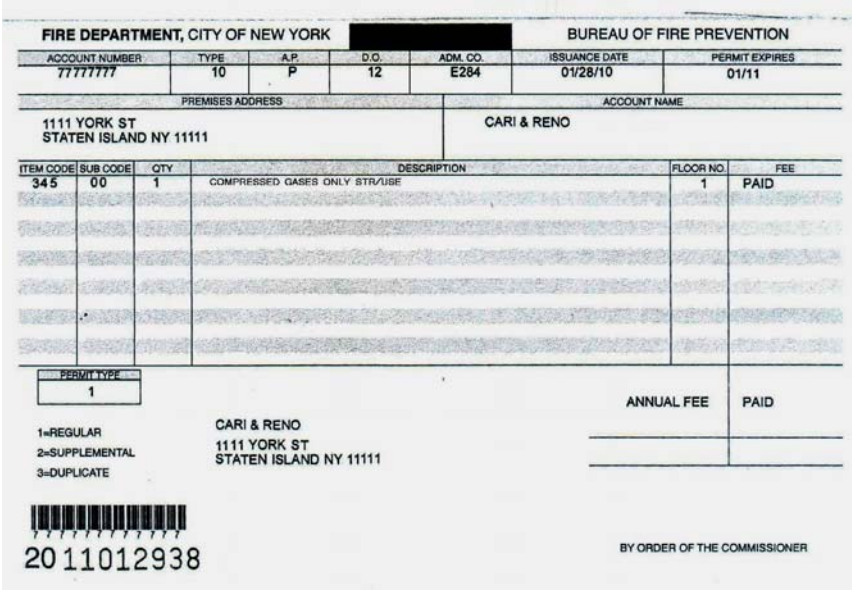
1.3 TYPES OF PERMITS

A permit is required to store, handle, use or transport carbon dioxide container(s) when the amount of carbon dioxide CO_2 gas/liquid is greater than **4,500 SCF** (68.6 gallons).

- **SITE-SPECIFIC PERMIT**

Such permit authorizes the permit holder to store, handle and use carbon dioxide at a specific premises or location. A site-specific permit is valid for 12 months only. Every permit or renewal shall require an inspection and shall expire after twelve months.

An example of an FDNY permanent permit



FIRE DEPARTMENT, CITY OF NEW YORK — BUREAU OF FIRE PREVENTION

ACCOUNT NUMBER	TYPE	A.P.	D.O.	ADM. CO.	ISSUANCE DATE	PERMIT EXPIRES
77777777	10	P	12	E284	01/28/10	01/11

PREMISES ADDRESS: 1111 YORK ST, STATEN ISLAND NY 11111

ACCOUNT NAME: CARI & RENO

ITEM CODE	SUB CODE	QTY	DESCRIPTION	FLOOR NO.	FEE
345	00	1	COMPRESSED GASES ONLY STR/USE	1	PAID

PERMIT TYPE: 1
1=REGULAR
2=SUPPLEMENTAL
3=DUPLICATE

ANNUAL FEE — PAID

CARI & RENO
1111 YORK ST
STATEN ISLAND NY 11111

20 11012938

BY ORDER OF THE COMMISSIONER

- **FDNY TRANSPORTATION PERMIT**

A FDNY transportation permit (sticker) and approval letter, which are issued by the Fire Department Hazardous Cargo Vehicle Inspection Unit are also required. The permit and the approval letter will be issued after the tank truck passed an inspection.

The FDNY transportation permit (sticker) must be displayed on the tank truck. A copy of the approved variance and the approval letter shall be kept in the vehicle performing the dispensing operation at all times, and shall be presented to the FDNY upon request.

Example of FDNY Transportation permit (sticker)

Month of inspection (will be punched), in this case February.

Year that the permit expires, in this case 2015.

EXAMPLE OF AN APPROVAL LETTER

FIRE DEPARTMENT

Hazardous Cargo Vehicle
Inspection Unit
245 Meserole Ave. Brooklyn, NY 11222
Phone: (718) 752-0296 / 0341 Fax: (718) 752 - 0402

Date: _____ **Account No.:**_____

Permit No.: _____
(Sticker No.)

Name & Address of Permit Applicant,

_____

_____

_____

The above referenced company has made an application for a (Transportation / Citywide) permit to Transport and or use:

_____,

And the Vehicle / Trailer was inspected satisfactorily on ___/___/___.

The approval applies only to the Vehicle / Trailer listed below:

Truck No._____ **Trailer No.**_____

Make of truck: _____ **Year:** _____ **Identification No.**_____

Make of trailer: _____ **Identification No.**_____

Inspected By: _____
Badge No.

Note: PERMIT EXPIRES (1) ONE YEAR FROM THE ABOVE DATE.

THIS LETTER SHALL BE CARRIED IN THE CAB OF THE TRUCK AND IT SHALL BE PRESENTED UPON REQUEST TO FIRE DEPARTMENT REPRESENTATIVE.

_____

Chief of Fire Prevention

Permits are **not transferable** and any change in occupancy, operation, tenancy or ownership must require that a new permit be issued. The Certificate of Fitness holder is responsible for making sure that all fire safety regulations and procedures pertaining to the premises are obeyed. Permits and Certificates of Fitness cards shall be readily available on the premises for inspection by NYC Fire Department representatives.

1.4 MATERIAL SAFETY DATA SHEETS (MSDS)

Material Safety Data Sheet (MSDS) information should be readily available. The material safety data sheet (MSDS) contains specific information about the health and physical hazards of the material used, as well as safe work practices and required protective equipment. It may also describe the material's physical characteristics and procedures that must be followed in case of an emergency. For example, the MSDS may list appropriate and inappropriate extinguishing agents. The Certificate of Fitness holder must refer to the MSDS when questions arise about handling, usage, or storage of hazardous chemicals or materials. The MSDS may also be requested by health care personnel to facilitate proper medical care in the event of chemical exposure.

2. DEFINITIONS

ASME CODE. American Society of Mechanical Engineers Boiler & Pressure Vessel Code.

APPROVED. Acceptable to the authorities having jurisdiction.

APPURTENANCES. All system components (excluding the container) such as pressure relief devices (PRDs), liquid level gauges, valves, pressure gauges, vaporizers, refrigeration systems, pumps, control equipment, and regulators.

CAPACITY. The amount of carbon dioxide the container will hold in pounds, tons, or kilograms under equilibrium conditions at normal operating pressure and temperature when dispensed with liquid to designed level.

COMPRESSED GAS. A material, or mixture of materials that is a gas at 68°F or less at 14.7 psia of pressure; and has a boiling point of 68°F or less at 14.7 psia that is either liquefied, nonliquefied or in solution at that temperature and pressure, except that gases which have no other health- or physical-hazard properties are not considered to be compressed until the pressure in the packaging exceeds 41 psia at 68°F. Compressed gases shall be classified as follows:

Nonliquefied compressed gases. Gases, other than those in solution, that are in a packaging under the charged pressure and are entirely gaseous at a temperature of 68°F.

Liquefied compressed gases. Gases that, in a packaging under the charged pressure, are partially liquid at a temperature of 68°F.

Compressed gases in solution. Nonliquefied gases that are dissolved in a solvent.

Compressed gas mixtures. A mixture of two or more compressed gases contained in a single packaging, the hazard properties of which are represented by the properties of the mixture as a whole.

COMPRESSED GAS CONTAINER. A pressure container designed to hold compressed gases at pressures greater than one atmosphere at 68°F.

COMPRESSED GAS SYSTEM. An assembly of components, such as containers, reactors, pumps, compressors and connecting piping and tubing, designed to contain, distribute or transport compressed gases.

CONTAINER. Insulated pressure vessel, ASME-coded, for the storage of carbon dioxide.

DESIGN PRESSURE. Highest pressure that the inner pressure vessel is designed to sustain in operation at the maximum allowable working pressure (MAWP). This is the sum of the MAWP, static liquid head when full, and any outer vacuum pressure if vacuum insulated.

DISPENSING. The pouring or transferring by other means of any material from a container, tank or similar vessel, which would release dusts, fumes, mists, vapors or gases to the atmosphere, unless such release is prevented by a device, equipment or system designed for that purpose.

DOTn. United States Department of Transportation.

EXCESS FLOW CONTROL. A fail-safe system or other approved device, equipment or system designed to shut off flow caused by a rupture in a pressurized piping system.

EXCESS FLOW VALVE. A valve inserted into a compressed gas container that is designed to shut off the flow of gas in the event that its predetermined flow is exceeded.

FILL BOX. The fill box is mounted on the outside of the facility and is used for filling the storage tank with liquid carbon dioxide. It is equipped with a self-closing fill connection which allows the CO_2 delivery person to easily fill the storage tank. Filling does not require the delivery person to enter the facility. The fill box also serves as a vent location where CO_2 gas from the storage tank safety relief valve can be released harmlessly to the outside. The fill box is permanently connected to the storage tank with a fill and vent hose. Maximum allowable pressure has to be clearly labeled on the fill box. The fill box must be locked with a secure key. The fill box must be located away from the entrance to the premises so as to prevent the fill box from being struck by the entrance door. Each container must have its own fill box.

GENERAL SUPERVISION. Supervision by the holder of any FDNY certificate who is responsible for performing the duties of the Certificate of Fitness holder but need not be personally present on the premises at all times.

HANDLING. The movement of a material in its container, the removal of the material from its container, or any other action or process that may affect the material, other than its storage or use.

HEALTH HAZARD. A classification of a chemical for which there is statistically significant evidence that acute or chronic health effects are capable of occurring in exposed persons. The term “health hazard” includes chemicals that are toxic, highly toxic and corrosive.

INCOMPATIBLE MATERIALS. Materials that, if mixed or combined, could explode, generate heat, gases or other byproducts, or react in a way hazardous to life or property.

LIQUID. A material having a melting point that is equal to or less than 68°F and a boiling point that is greater than 68°F at 14.7 psia. When not otherwise identified, the term “liquid” includes both flammable and combustible liquids.

LIQUID BULK CARBON DIOXIDE. Liquid bulk carbon dioxide is a low-pressure alternative to high-pressure compressed gas cylinders. Liquid

bulk carbon dioxide is stored on the premises at a lower pressure in stainless steel holding tanks.

LOW-PRESSURE CONTAINER. A storage container designed to withstand an internal pressure greater than 0.5 pounds per square inch gauge but not greater than 15 psig.

MATERIAL SAFETY DATA SHEET (MSDS). A document prepared in accordance with the regulations of the United States Department of Labor, as set forth in 29 CFR Part 1910.1200 or a federally approved state OSHA plan which sets forth information concerning a hazardous material. It contains health and physical hazards of the material used, procedures that should be followed in case of an emergency and safety work practices. MSDS does not show the cost of carbon dioxide.

MAXIMUM ALLOWABLE WORKING PRESSURE (MAWP). The maximum pressure permissible at the top of a container in its operating position for a designated temperature, as established by the container manufacturer.

NESTING. A method of securing flat-bottomed containers upright in a tight mass using a contiguous three-point contact system whereby all containers within a group have a minimum of 3 points of contact with other containers, walls or bracing.

NONFLAMMABLE GAS. A gas that does not meet the definition of a flammable gas.

NORMAL TEMPERATURE AND PRESSURE. A temperature of 70°F and a pressure of 1 atmosphere.

PERSONAL SUPERVISION. Supervision by the holder of any FDNY Certificate of Fitness is required to be personally present on the premises, or other proximate location acceptable to the FDNY, while performing the duties for which the certificate is required.

PRESSURE RELIEF DEVICE. Device that activates by pressure to prevent pressure from increasing above a predetermined maximum.

PRESSURE VESSEL. A closed vessel designed to operate at pressures above 15 psig.

QUALIFIED CARBON DIOXIDE TECHNICIAN. An individual who by reason of education, training, and experience knows the properties of carbon dioxide; is familiar with the equipment used to store, transfer, and use carbon dioxide; and understands the precautions necessary to safely use carbon dioxide equipment.

STANDARD CUBIC FEET (SCF). Cubic feet of gas at normal temperature and pressure.

STORAGE TANK (CONTAINER). The storage tank has a vacuum insulated stainless steel pressure vessel located inside a stainless steel outer jacket. The insulation prevents the cold liquid CO_2 from boiling away. It includes an automatic pressure building system to maintain adequate CO_2 gas withdrawal. The storage tank is protected from damage because of excessive pressure by a primary and secondary relief device

that vents outside into the fill box. A vent pipe has to vent to the outside air and it should be unobstructed.

SYSTEM. An assembly of equipment consisting essentially of the storage container, interconnecting piping, appurtenances, pressure relief devices, control valves, regulators, and control equipment.

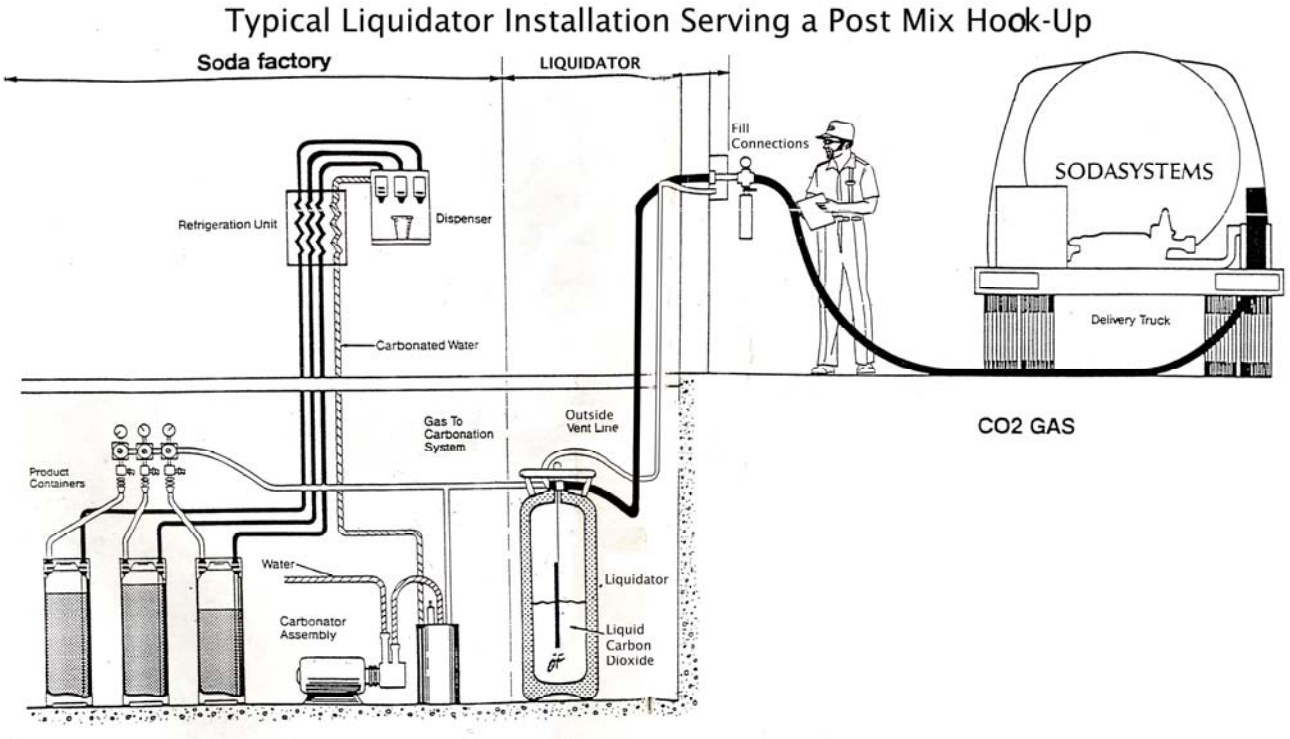
3. CARBON DIOXIDE

- **CHARACTERISTICS**

Carbon dioxide is a gas at normal atmospheric temperature and pressure. It is colorless and essentially odorless and is about 1.5 times more dense than air. Depending on the temperature and pressure to which it is subjected, carbon dioxide may exist in the form of a solid, liquid or a gas. The normal concentration of carbon dioxide in air is approximately 0.035% by volume. Inhalation of a relatively low concentration (about 3%) can cause uncomfortable physiological effects on the human system which, though temporary, must be avoided. In larger concentrations, asphyxia can result.

- **COMMERCIAL USES**

Virtually every restaurant uses Carbon Dioxide (CO_2) in bulk form to put the fizz in soft drinks. There are three main ingredients in soda drinks: water, syrup and carbon dioxide gas. It is the carbon dioxide gas that is responsible for the fizziness.



When the ingredients are combined, the carbon dioxide gas, syrup and water form a solution. The ingredients are mixed in a container and the empty space at the top of the container is filled with carbon dioxide gas. The bottle or can is then sealed. The carbon dioxide at the top of the

container is under pressure and prevents any of the dissolved carbon dioxide from escaping the solution. When the bottle is opened, a familiar hiss is heard and the carbon dioxide gas in the top of the bottle is released. The dissolved carbon dioxide can then escape the solution; the result is the familiar bubbling carbonated drink.

When a partially emptied bottle is recapped, more space is available for more carbon dioxide gas to escape solution, and the remaining liquid in the bottle becomes more flat. Because pressure cannot build up above an open bottle or cup, the soda in it will go completely flat within in a few minutes.

The physical characteristics as well as its special chemical properties all play a part in the widespread application of carbon dioxide in many diverse industries. The uses for carbon dioxide described in the following paragraphs are by no means complete but should serve to illustrate its versatility.

In its solid form, carbon dioxide (dry ice) is very cold and readily absorbs heat from its surroundings. This makes it an ideal expendable refrigerant for shipment of perishable commodities. Granulated and mixed with product for rapid cooling, it facilitates the deflashing of rubber parts in tumbling barrels and the pulverizing of heat sensitive materials. It is also used to cold-treat metals, shrink-fit machined parts, chill cold traps, and quick freeze food products.

Placed in a converter or sealed pressure vessel, solid carbon dioxide can provide a source of gaseous or liquefied carbon dioxide in areas where the normal supplies of liquefied carbon dioxide in containers or bulk are not readily obtainable.

Liquefied carbon dioxide is used as a refrigerant in closed compression and absorption systems similar to ammonia. It is used as an expendable refrigerant for rapidly reducing temperatures in chambers or conveyor tunnels, for low temperature testing of mechanical and electronic components, and for food freezing. It is also used as a fire extinguishing agent in both portable and large scale bulk systems.

Gaseous carbon dioxide obtained by vaporizing liquefied carbon dioxide is used to carbonate water for soft drinks, to provide an inert atmosphere as a preservative in packaged foods, to prevent fires by blanketing flammable materials, and as a shielding gas in welding metals, sometimes in combination with other gases.

- **HAZARDS**

Carbon dioxide is an odorless gas and should be treated as a material with poor warning properties. It is denser than air, and high concentrations can persist in open pits or tanks or low depression on the terrain.

- **HEALTH EFFECTS**

The response to carbon dioxide inhalation depends on degree and duration of exposure, and it varies greatly even in healthy, normal individuals. The medical term for the physiological effects of excess carbon dioxide in the blood is hypercapnia. Carbon dioxide can be dangerous even when normal oxygen levels are present. Low concentrations of carbon dioxide can be tolerated for a considerable period of time without noticeable effect or merely cause an unnatural feeling of shortness of breath. Inhalation of gaseous carbon dioxide can adversely affect body function. Skin, eye, or mouth contact with dry ice or compressed carbon dioxide can cause adverse effects. Gaseous carbon dioxide is an asphxiant. Concentrations of 10% or more can produce unconsciousness or death. Lower concentrations may cause headache, sweating, rapid breathing, increased heart beat, shortness of breath, dizziness, mental depression, visual disturbances and shaking. The seriousness of the latter manifestations depend on the concentration of carbon dioxide and the length of time the individual is exposed.

Skin or mouth contact with solid carbon dioxide or with gas or liquid carbon dioxide discharged from a container may result in frostbite, causing skin lesions or more serious injury from deep freezing of the tissues.

Eye contact with solid CO_2 or compressed CO_2 will cause corneal burn. Frostbite of the eye structure may also occur.

- **PERSONAL PROTECTIVE EQUIPMENT**

Certificate of Fitness holders should always wear heavy gloves and eye protection when there is a risk of exposure to carbon dioxide.

4. SIGNAGE

- **STORAGE ROOM**

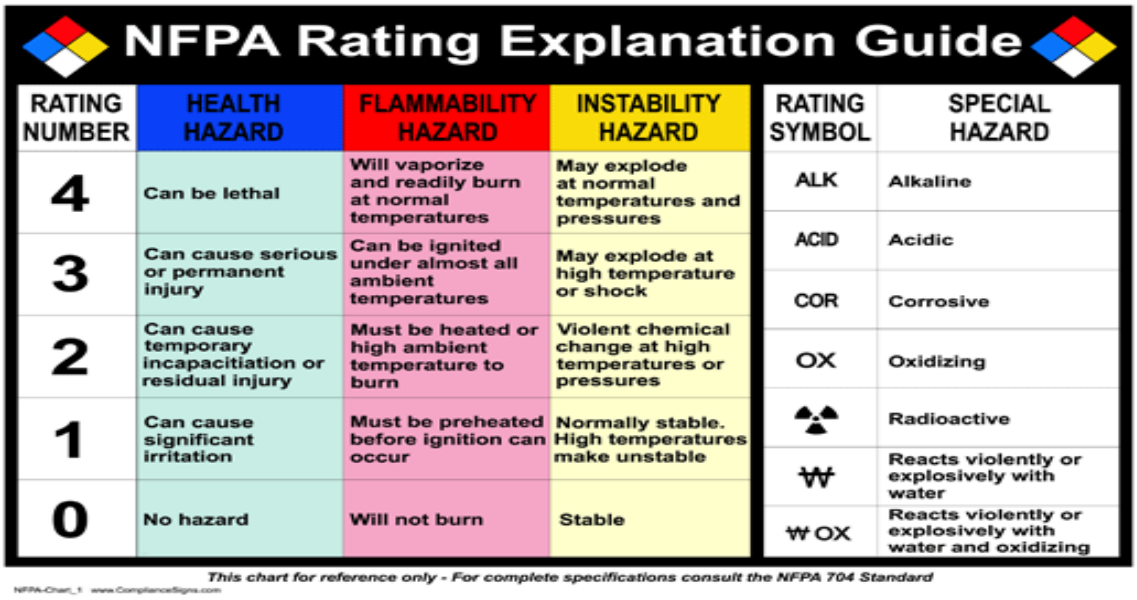
Warning signs shall be conspicuously posted at all entrances to any room in which a carbon dioxide container is located stating, **"WARNING: CARBON DIOXIDE STORAGE. CARE MUST BE TAKEN TO AVOID SUFFOCATION AND ASPHYXIATION."**

- **DISPENSE LINE CONNECTION**

Dispense connections shall have a label affixed indicating the maximum allowable working pressure of the system.

- **NFPA 704 DIAMOND SIGN**

Handling and dispensing of carbon dioxide is accompanied in the NYC Fire Code by a requirement for the use of consistent signage to alert people, including first responders, to the presence of flammable materials in a facility. A warning signage is required even when an FDNY permit is not. The intent of the signage is to provide an indication of the relative degree of harm that the material may pose. In general, the NFPA 704 sign system is used for storage of the hazardous materials on the premises. This simple system uses symbols, colors and numbers to readily communicate these concerns in a visual manner, and recognizes the fact that a material may pose more than one type of hazard.



NFPA Rating Explanation Guide

RATING NUMBER	HEALTH HAZARD	FLAMMABILITY HAZARD	INSTABILITY HAZARD
4	Can be lethal	Will vaporize and readily burn at normal temperatures	May explode at normal temperatures and pressures
3	Can cause serious or permanent injury	Can be ignited under almost all ambient temperatures	May explode at high temperature or shock
2	Can cause temporary incapacitiation or residual injury	Must be heated or high ambient temperature to burn	Violent chemical change at high temperatures or pressures
1	Can cause significant irritation	Must be preheated before ignition can occur	Normally stable. High temperatures make unstable
0	No hazard	Will not burn	Stable

RATING SYMBOL	SPECIAL HAZARD
ALK	Alkaline
ACID	Acidic
COR	Corrosive
OX	Oxidizing
	Radioactive
W	Reacts violently or explosively with water
W OX	Reacts violently or explosively with water and oxidizing

This chart for reference only - For complete specifications consult the NFPA 704 Standard

NFPA-Chart_1 www.ComplianceSigns.com

The basis of the system is a diamond-shaped sign that is divided into color-coded quadrants (see Carbon Dioxide diamond sign on the left on the next page). The left-most quadrant is colored blue and represents the *health* hazard posed by the material. **Carbon dioxide has a 3 in the**

health quadrant indicating that it "can cause temporary incapacitation or residual injury". The upper quadrant is red in color and indicates the relative *fire* hazard. Carbon dioxide has a 0 in the fire hazard quadrant, which indicates that it will not burn. The right-most quadrant is yellow and conveys the relative potential for *reactivity* of the material. Carbon dioxide has a 0 in the reactivity quadrant, which indicates that it is stable. The last quadrant, at the bottom, is white in color and serves to convey *"special"* information such as "OX" for oxidizer and "~~W~~" for water-reactive material. Carbon dioxide has no special hazards.

NFPA 704 SIGN FOR CARBON DIOXIDE

The diamond-shaped sign is required by the NYC Fire Code to be conspicuously displayed at the entrance to locations where carbon dioxide gas/liquids are stored, handled and used. The sign is also required for locations where carbon

The numbering system that is used to convey the hazards of a material uses a scale of 0 through 4 for each of the three hazard types (health, fire and reactivity). A number is placed in each box, specific to the material at hand. In each quadrant, a "0" represents the least concern and "4" represents the highest degree of hazard posed by a material. For instance, a "0" in the upper quadrant indicates a material that will not burn, while a "4" in the same quadrant indicates a gaseous material that will burn very readily. Intermediate numbers represent increasing levels of hazard in all categories, such as the "3" that is present in the "health" quadrant of the right figure above. This is indicative of a material that can cause permanent or serious injury upon exposure.

5. DESIGN AND INSTALLATION REQUIREMENTS

Carbon dioxide systems shall be installed in accordance with the NYC Building Code, Mechanical Code, Compressed Gas Association (CGA) standards CGA C-6-1984 and G-6.1-1986, and the equipment manufacturer's design specifications and instructions. CGA has released updates to those standards, and the Fire Department recommends that you become familiar with them. This booklet incorporates several of the updates from those standards.

5.1 ELECTRICAL REQUIREMENTS

Electrical equipment and wiring shall be installed and maintained in accordance with the requirements of NYC Electrical Code.

5.2 INSTALLATIONS

Low pressure carbon dioxide supply systems located at consumer sites usually consist of:

a. Specially designed storage containers
b. Distribution piping.
c. Carbon dioxide pumps,
d. Alarms, and
e. Other equipment (may be included to meet the requirements of certain installations)

Storage containers and piping are **INSULATED** to reduce heat absorption into the system and also to reduce the condensation of moisture on the exposed surfaces. Storage containers **may be** equipped with refrigeration systems to maintain the carbon dioxide temperature and pressure within required limits.

5.3 CONTAINERS

Compressed gas containers shall be **designed** and **fabricated** in accordance with the specifications of the ASME Boiler and Pressure Vessel Code or DOTn regulations, or be otherwise approved. Carbon dioxide containers and systems shall be **installed, operated** and **maintained** in compliance with the requirements of NYC Fire Code Chapter 30, NYC Fire Rules Chapter 30, Compressed Gas Association Standards CGA G-6-1984 and G-6.1-1986. Containers used for carbon dioxide storage shall be adequately insulated and may be equipped with refrigerating and vaporizing systems in order to keep the pressure within the design limitations.

General Container Information

Liquid carbon dioxide is usually charged for shipment into seamless steel containers complying with U.S. Department of Transportation

specifications. Normal tank operating pressure (see the gauge on the tank) is between 110-150psi. Tank pressure may be as high as 300 psi after deliver.

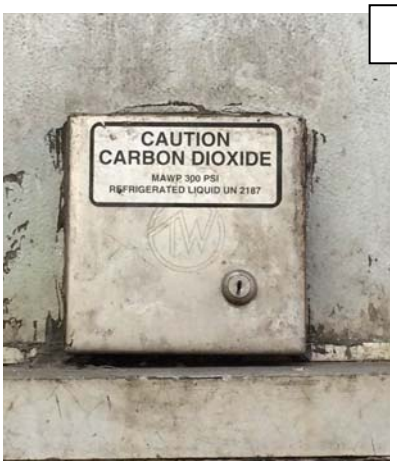
CO_2 Container

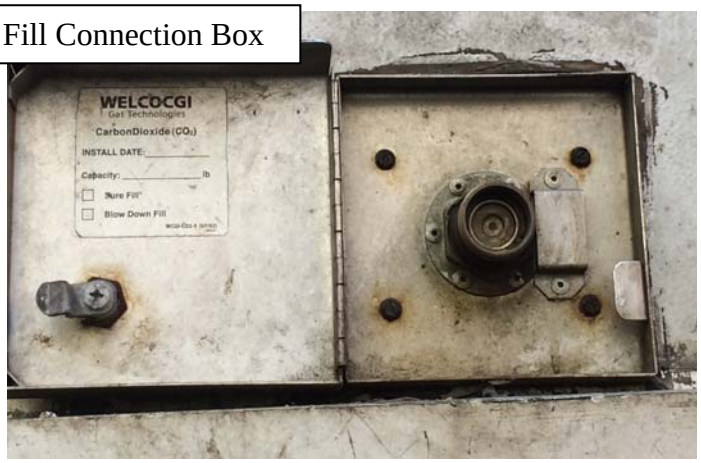
- **CONTAINER LOCATIONS**
  1) Carbon dioxide containers are generally filled from large cargo tank trailers; therefore, their location should provide easy access to driveway large enough for these delivery units.
  2) Containers should also be close to the point of use as possible.
  3) Containers should not be located in an area where they are subjected to temperatures above 100°F. Prolonged operation at these temperatures causes venting of carbon dioxide and possible damage to the refrigeration system.
  4) Dusty, oily, and corrosive locations should be avoided because of the damage or loss of efficiency they can cause to the refrigeration system. A dry, well –ventilated location is preferable.
  5) A container should be at least 2 ft. from any wall or other permanent obstruction that would tend to restrict the flow of air through the refrigeration condenser.

- **INITIAL FILL**

A container that has been out of carbon dioxide service, opened to the atmosphere, or newly installed, shall be properly purged with carbon dioxide vapor before filling. All water and contaminant gases shall be removed before filling, or the carbon dioxide distribution chain could

Fill Connection Box





become contaminated.

A typical method of purging a tank is to alternately pressurize the container with carbon dioxide vapor from a cargo tanker and then:

1) Vent from a tip connection to the atmosphere. Repeated pressurization and depressurization dilutes impurities to acceptable levels.
2) Do not use liquid carbon dioxide for purging and pressurization because it thermally shocks the pressure vessel and could lead to catastrophic failure.
3) Pressurize the container with carbon dioxide vapor to 200 psig after completing the initial purge and before introducing any liquid.

6. SPECIAL HAZARDS

Liquid carbon dioxide in a hose or pipe flows like water; however, when the pressure is reduced below **75.1 psia** the liquid changes into a mixture of vapor and solid carbon dioxide. Solid carbon dioxide, when formed in a pipe or hose, can create a plug and prevent depressurization this creates a safety hazard.

A dry ice plug can be ejected from any open end of a hose or pipe with enough force to cause serious injury to personnel, from the impact of the dry ice plug, or the sudden whip of the hose or pipe as the plug ejects, or both.

6.1 LIQUID LINE DEPRESSURIZATION

To prevent dry ice blockage, the liquid carbon dioxide shall be purged from the hose or pipe with vapor greater than 200 psig before reducing the pressure below 75.1 psia. This can be done by supplying carbon dioxide vapor to one end of the hose or piping system to maintain the pressure above the triple point while removing the liquid from the other end. This can be done by use of a cross-over line.

To prevent dry ice blocking, liquid piping shall be pressurized with carbon dioxide gas more than 200 psig before introducing liquid carbon dioxide.

- **CARBON DIOXIDE PRESSURE REGULATORS**

Pressure-reducing regulators are required when carbon dioxide vapor is required at pressures below storage pressures.
Carbon dioxide gas pressure regulators are not designed for liquid service. When liquid inadvertently passes through a carbon dioxide gas regulator, the resulting dry ice can damage the regulator. This can occur if the container is overfilled or the piping passes through a low temperature area of less than 0°F. A pressure relief device should be installed downstream of the carbon dioxide regulator to protect against over pressurization caused by regulator failure.

6.2 TRAPPED LIQUID

A volume of liquid carbon dioxide will expand as it warms. If it is forced to occupy a fixed volume, the internal pressure increases as the liquid warms and expands. As the temperature continues to increase, the pressure of the trapped liquid can exceed what the piping and hoses can withstand. This can cause the rupture of the hose or piping with possible injury and property damage.

To prevent trapped liquid from becoming a hazard, all liquid carbon dioxide piping and transfer lines shall be equipped with pressure relief devices located in all part of the system in which liquid can be trapped. This would include valves, check valves and pumps.

6.3 CONTAINER REFRIGERATION SYSTEMS

A mechanical refrigeration system may be used to maintain the desired operating pressure during periods of low usage or increased heat input.

The refrigeration unit removes heat from the contents by condensing carbon dioxide vapor or sub-cooling liquid. In vapor condensing units, the evaporation coil is installed in the vapor space of the container. The refrigeration system automatically operates to maintain a preset maximum pressure, typically 295 psig to 305 psig.

7. STORAGE AND HANDLING OF CARBON DIOXIDE

7.1 STORAGE

Containers must always be stored in the assigned location. Liquefied carbon dioxide is stored at low pressure.

Containers must **NEVER** be:

- allowed to reach a temperature exceeding 130°F (because of the excessive pressure that will occur above this temperature)
- stored in direct sunlight, near furnaces, radiators, or any other source of heat
- dropped or subjected to abnormal mechanical shock (storing them by elevators, gangways, or in location where heavy moving objects may strike or fall on them is prohibited)

Containers should be chained to a bulkhead or other suitable structure to prevent them from falling over. Container should be stored in dry well-ventilated locations. Ventilation systems should be designed to exhaust from the lowest point.

When liquid carbon dioxide is stored in a container and there is no product withdrawal, heat leak causes the temperature and pressure to rise and the liquid to expand. As long as there is a vapor space in the container, the pressure rises approximately 5 psi per °F.

7.2 HANDLING

G-82 Certificate of Fitness holders should be trained in the proper handling of carbon dioxide containers. They should also be informed of the hazards involved when approved procedures are bypassed, altered, or ignored.

There should be a logbook on the premises stating:

- Delivery dates
- Persons making deliveries and their Certificate of Fitness number
- Safety check of system and condition of system
- Truck Delivery Pressure

Since the pressure in a closed vessel containing carbon dioxide will increase with a rise in temperature, the possibility always exists that a container charged at a safe pressure at normal temperatures might reach a dangerously high pressure at high ambient temperatures. To prevent this from happening with normal usage, U.S. Department of Transportation regulations limit the amount of carbon dioxide that may be charged into a container.

The container, appurtenances and piping shall be protected against physical damage from moving vehicles or other hazards. All the piping

and appurtenances shall be free of water, oil, grease, and other foreign matter before placing the system in service.

- **SYSTEM MAINTENANCE, INSPECTION AND REPAIRS**

Systems shall be maintained in accordance with manufacturer's instructions. The system shall be maintained by a G-82 Certificate of Fitness holder only.

- **CONTAINER PROTECTION**

Compressed gas containers and systems shall be secured and protected against physical damage and tampering. Compressed gas containers and systems that could be exposed to physical damage shall be protected. Posts or other approved means shall be provided to protect compressed gas containers and systems indoors and outdoors from vehicular damage. Never use the containers as rollers, supports, or for any purpose other than to contain the content as received.

Compressed gas containers are allowed to be stored or used in direct sun light except in locations where extreme temperatures prevail. Containers shall be protected from direct contact with soil or unimproved surfaces to prevent bottom corrosion. The surface of the area upon which the containers are placed shall be graded to prevent accumulation of water. When extreme temperatures prevail, overhead covers shall be provided. Overhead covers shall also be provided to prevent accumulations of ice and snow on the valves of containers connected for use.

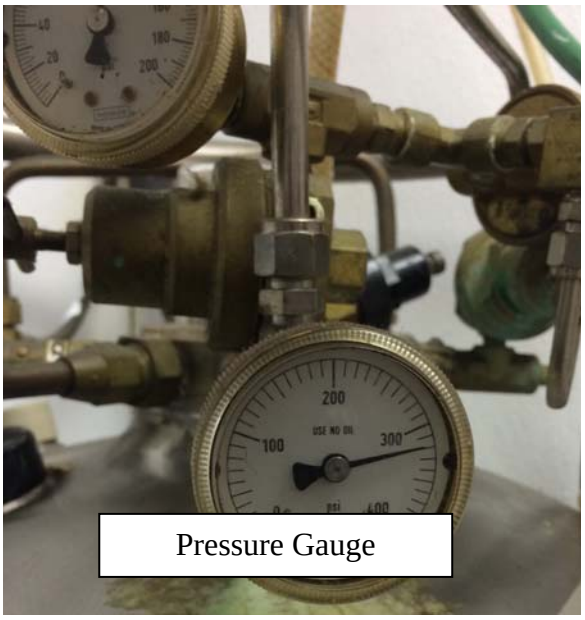
- **VALVE PROTECTION**

Compressed gas containers designed to be fitted with protective caps, collars or other protective devices shall have such caps or devices in place except when the containers are in use or are being serviced or dispensed. Valves of compressed gas containers designed to accept protection caps or other protective devices shall have such caps or devices attached. Outlet caps or plugs shall be in place except when the compressed gas containers are in use, or are being serviced or dispensed. The container valve must be closed at all times, except when the container is in active use.

7.3 INSPECTION OF SYSTEM IN SERVICE

- Frost spots, leaks, or any other indication of a possibly unsafe conditions; such as mechanical damage or corrosion shall be corrected by repairs or replacement of the faulty component.
- Each storage container shall be provided with a pressure gauge and a device for indicating the quantity of carbon dioxide.
- Connections to the containers necessary for proper operation of the system shall have shutoff valves. Three-way valves must be utilized to

facilitate inspection, repair or replacement of dual pressure relief devices.



- The valves shall be located as close to the container as practicable. Connections not in use shall be plugged or capped.
- Each pressure relief valve shall be tested at least **once every five years**. Care shall be exercised to avoid damage to pressure relief devices. Care shall also be exercised to avoid plugging by paint and dirt accumulations on pressure relief device channels or other parts which could interfere with the functioning of the device.
- If the start-to-discharge pressure is not within the limits required for the application and marked on the valve, it shall be repaired or replaced.
- Each pressure relief valve shall be tagged and dated at the time of testing.
- If the service of the carbon dioxide container is such that there is reason to believe corrosion has taken place to the pressure vessel or that cracking or other unsafe conditions may be present, contact the container manufacturer.
- If such evidence is noted or suspected, a more rigorous inspection shall be performed by the tank manufacturer or a person trained and authorized by the tank manufacturer holding a G-82 Certificate of Fitness, using modern commercial detection methods. Necessary repairs to the pressure vessel must be performed by qualified personnel.

If any unsafe condition is found during an inspection, the condition shall be promptly corrected, or the system shall be taken out of service until the condition can be corrected.

7.3.1 QUICK VISUAL CHECK

Items for a quick visual check:

- No extreme denting, gouging, or corrosion on the compressed gas container.
- The container protective cap/collar and the foot ring are intact and are firmly attached where applicable.

- The container is painted or coated to minimize corrosion.
- No damage is visible in the pressure relief valve or obstruction to discharge.
- There is no leakage from the compressed gas container.
- The container is installed on a firm foundation and is not in contact with the soil.

No service, repair, modification or removal of valves, pressure-relief devices or other compressed gas container appurtenances are allowed to be performed by unauthorized personnel. Leaking, damaged or corroded compressed gas containers shall be removed from service under the personal supervision of a G-82 Certificate of Fitness Holder.

7.3.2 REMOVING CONTAINERS FROM SERVICE

When empty containers are removed from service, **their valves should be tightly closed** to prevent air or moisture from entering them while they are being returned to the producer for re-dispensing.

A container that will be out-of-service at a consumer site for any period of time shall be maintained in a pressurized condition. If so equipped, the refrigeration unit shall be inspected before putting it back in service if it did not operate during the time the container was out of service. If the container has been depressurized or has been open to the atmosphere, other than for immediate repair or maintenance while out of service, an internal inspection is required.

7.4 LEAKS

While small leaks are inherent in any gas system, those of significant size raise the level of economic and safety risk. It is best practice to have a daily routine of observing the CO_2 system at a time when there is no dispensing of fountain soft drinks or draught beer (i.e. before the establishment opens up to public).

A) CHECK FOR LEAKS

- The first observation should be of the pressure gauges of the inlet nitrogen and carbon dioxide gas. Should these pressure gauges read “very low” or “zero”, there may be an out-of-gas situation. These pressures should be very similar to the pressures observed at the appropriate gas source. If there is a significant difference, there may be a leak in the lines between the gas source and the gas container.
- The next observation should be of the floats in the leak indicators. With no fountain soft drinks or draught beer being dispensed, these floats should be lower than the first line (0.1) on the indicators. If one or both are higher than this first mark, there could be a leak in one of the gas systems.

- The leak indicators can be used to isolate where that leak might be. By selectively closing the gas-out valves to the fountain soft drink system and the two draught beer gas blends and observing the reaction of the floats, operators can identify the system with the leak.
- If after closing a gas-out valve, the float for that gas sinks to the bottom of the indicator, then that gas system has a leak.
- The gas containers, valves, hoses, and related equipment should be inspected for physical damage. Special care should be taken to identify any defects that may cause a leak.
- Any defective components that are discovered **must be marked and be replaced before the equipment may be used a**gain. If any leak of gases is detected, that's where valves play a major role. They exist to isolate deficient components permitting service when and where needed. This equipment is very sensitive and must be repaired by a qualified repair specialist. PRV's are key components which must be tested according to New York City requirements every 5 years. The remaining components are non-critical. Valves exist to isolate deficient components permitting service when and where needed.

If a compressed gas container leaks and the leak cannot be remedied by simply tightening a valve gland or packing nut, close the valve and attach a tag stating that the compressed gas container is unserviceable. Remove the leaking compressed gas container outdoors to a well-ventilated location.

B) LEAK TESTING

The piping system shall be tested for **leaks** upon installation. The piping system shall be **retested for leaks at least once every ten (10) years**, or upon order of the Fire Department. The piping system shall not be subjected to a pressure that exceeds its maximum allowable working pressure.

Fixed gas detection system should be installed in rooms where CO_2 gas is being installed and where the soda machines are located. The gas detection system should be installed 4 to 6 feet above the floor. In areas where these gas detection systems are not installed those areas should be checked using a soap and water solution or a hand-held leak detection device. **NEVER CHECK FOR LEAKS WITH A FLAME.** First make sure that all connections are tight. Then open the container valve. If the installation has a leakage, frost-spots will begin to form. Keep in mind that liquid carbon dioxide will form dry ice (because of low temperature of the product) when there is a leak. The suspected fittings should be disconnected and cleaned. Then the connection is tightened and the checking procedure is repeated. If the frost-spots form again,

there is a problem with the connection. The fittings should be repaired or replaced before the equipment is used again.

C) NOTIFICATION OF LEAKS
The Certificate of Fitness holder who becomes aware of any leak from the container or ancillary equipment, or other indication that the system is not a good working order, shall notify the gas supplier and follow the supplier's instructions as to the return of the compressed gas container. Such system shall be promptly restored to good working order. Any container which has been repaired and requires requalification shall be retested in accordance with the requirements of the ASME Code or DOTn regulation under which it was manufactured.

7.5 AFTER REPAIRS
After the new container has been connected to the appliance, all connections must be checked for leaks. Most of these leaks occur at the top of the container in areas such as the valve threads, pressure safety device, valve stem and valve outlet.

7.6 DISPENSING CONTAINERS
Container dispensing is usually accomplished by pumping liquid carbon dioxide into the container to the desired net volume. The transfer of liquid CO_2 from one CO_2 container to another may be performed by direct transfer or by means of pressure differential or by a pump.

The more common dispensing method is by the means of pressure differential.

- Initially the tank gauge reads about 300 psi as does the truck pressure gauge.
- The G-82 Certificate of Fitness holder shall open the valve to reduce tank pressure to under 200 psi to allow for the liquid to transfer by the pressure differential.
- After the tank gauge drops to approximately 120 psi the COF holder beings filling, the gauge will increase to read approximately 200 psi.
- During the filling, the warmer vapor in tank is condensed by colder incoming liquid. Pressure vapor increases as liquid level increases.
- Once the tank pressure reads about 300 psi, liquid covers holes - vapor condensing stops. Pressure in tank and truck equalize. Liquid transfer from truck rapidly slows as tank pressure approaches truck pressure.
- The COF holder than opens valve to reduce pressure to allow for liquid to transfer from the truck. Liquid level covers vapor

condensing holes restricting attempts to reduce vapor pressure to facilitate additional filling.
- Attempts to introduce additional liquid result in rapid delivery pressure gauge rise signaling that container is full. Because pressure quickly equalizes, no additional transfer occurs.

During dispensing procedures the pressure vessel can never become completely full because of pressure rise and equilibrium temperature rise will cause the relief device to open.

Each low pressure stationary container shall have its own dispense connection and related piping.

(1) The dispense connection shall be located so as not to impede means of egress or the operation of sidewalk cellar entrance doors, including during the delivery process.
(2) Dispense connections shall be located outdoors, at least 3 feet from the hinged side of any door.

Carbon dioxide containers shall be dispensed from cargo tanks in compliance with the following requirements:

(a) the container shall not be subjected to a pressure that exceeds its maximum allowable working pressure; and
(b) the piping system shall not be subjected to a pressure that exceeds its maximum allowable working pressure.

7.6.1 OVERFILLING CONTAINERS

When the container becomes liquid full, the hydrostatic pressure rises at the rate of 850 psi per °F. Small, portable containers are not equipped with refrigeration. All storage containers can potentially become liquid full; however, this must be avoided. To prevent undue stresses to the container and nuisance cycling of the PRD (pressure relief device) with consequent product loss, liquid carbon dioxide storage containers should not be filled to a level that allows them to become liquid full before reaching the PRD setting, which is generally 350 psig.

The safe filling level depends on the temperature of the liquid being transferred into the container. The colder the liquid, the more vapor space required for liquid expansion. Under some circumstances it is possible to overfill bulk carbon dioxide containers. Typical reasons of over filling include refrigeration unit operating but not decreasing pressure, erratic level gauge operation, and excessive frost on vapor lines.

7.7 VENTING

Pressure relief devices on containers located in confined areas where carbon dioxide that is discharged cannot be dissipated shall be vented outdoors to a location remote from personnel. Vent lines shall be sized and arranged so as not to restrict the discharge of the pressure relief device.

7.8 MARKING AND LABELING

The following marks are required by the U.S. DOT to be plainly stamped on the shoulder, top head, or neck of all carbon dioxide containers.

(1) The U.S. DOT specification number, followed by the service pressure, for example, DOT-3A1800.
(2) A serial number and identifying symbol of the maker. The symbol must be registered with the U.S. DOT.
(3) The inspector's (third party) official mark and the date of the test to which the container was subjected in manufacture.

In addition to the described markings, carbon dioxide containers should be legibly marked with either a "CO_2" or "Carbon Dioxide" designation. Such marking shall be by means of stenciling, stamping, or labeling; shall not be readily removable; and shall be in accordance with CGA C-4, American National Standard Method of Marking Portable Compressed Gas Containers to Identify the Material Contained.

U.S. DOT regulations require that a 4-inch green label designating nonflammable gas be attached to each container containing carbon dioxide offered for transportation by common carrier. A label conforming to CGA C-7, Guide to the Preparation of Precautionary Labeling and Marking of Compressed Gas Containers is acceptable. Such a label must bear the name Carbon Dioxide and a green diamond containing the word Nonflammable. The label may also list additional warnings, instructions, and the company's name and address.

The CO_2 container must state "Approved by New York City Fire Department under the Certificate of Approval number".

- **WARNING SIGNS**

Appropriate warning signs should be affixed outside of those areas where high concentrations of carbon dioxide gas can accumulate. Example of such a sign is:

CAUTION – CARBON DIOXIDE GAS
Ventilate the area before entering.
A high CO_2 gas concentration
may occur in this area
and may cause suffocation.

Carbon dioxide monitoring should be carried out before entering any area in which carbon dioxide gas could have accumulated. If it has, the area shall be cleared by ventilation or a supplied-air respirator shall be worn while in the area.

Signage around CO_2 Container(s)

8. RESCUE AND FIRST AID CONSIDERATIONS

Do not attempt to remove the individual without utilizing proper rescue equipment or you may also become a casualty. If the exposed person is unconscious, obtain assistance and put into effect the established emergency procedures.

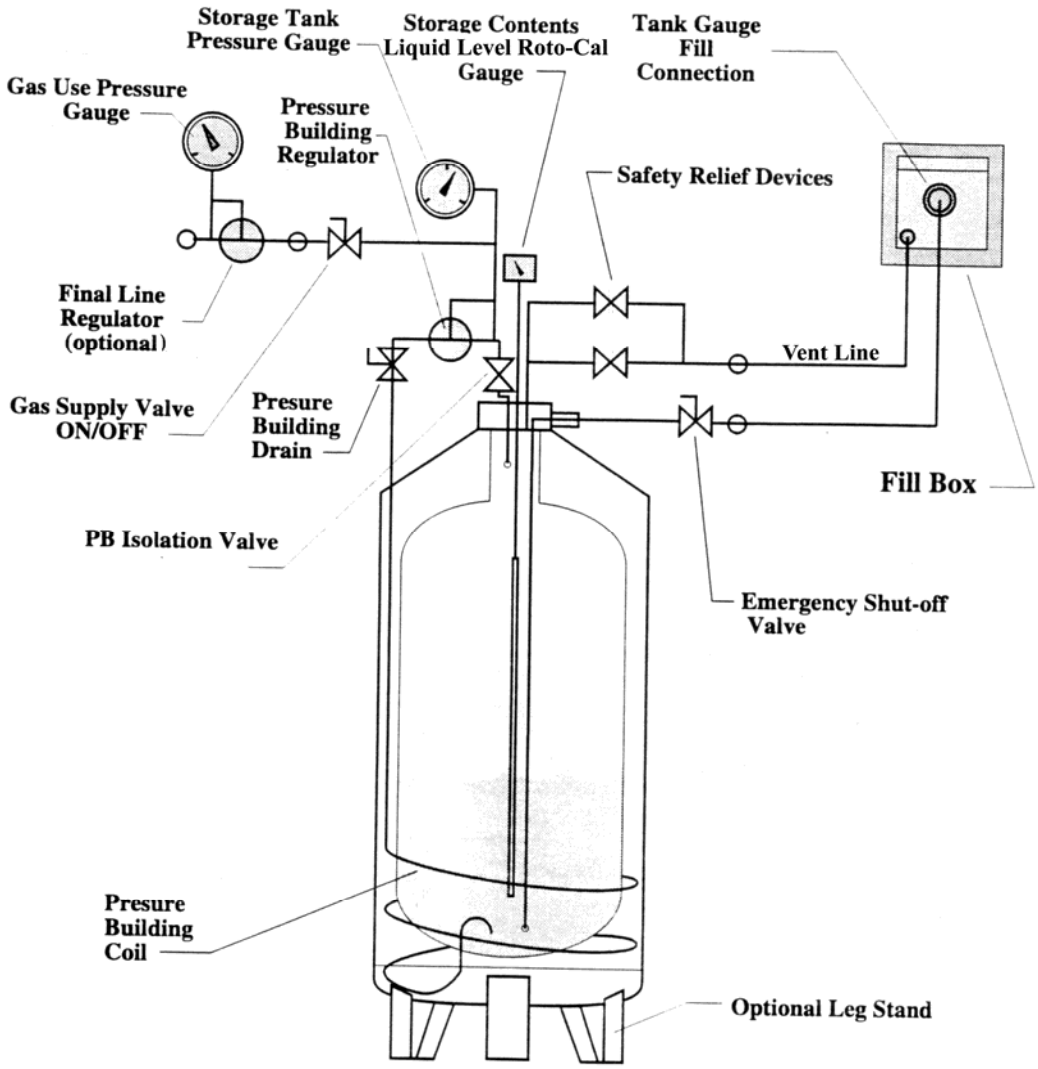
If a person has inhaled large amounts of carbon dioxide and is exhibiting adverse effects, move the exposed individual to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

If solid CO_2 or cold CO_2 gas comes in contact with the skin or mouth, stop the exposure immediately. If frostbite has occurred, obtain medical attention. Do not rub the area. Do not apply heat warmer than 107 degrees Fahrenheit.

If solid CO_2 or cold CO_2 vapor comes in contact with the eyes, stop the exposure immediately and obtain medical attention.

9. RELATED EQUIPMENT

CO_2 System Parts



- **CONTROL VALVE**

A control valve is on the top of each container. This valve can be opened or closed to control the discharge of the contents of the gas or liquid container. A handle is simply turned to control valve. **The control valve must be opened by hand.** Container valves shall be closed before moving a container.

- **PIPING SYSTEMS**

(1) **Piping, hose, fittings and other equipment** that comes in contact with carbon dioxide shall be metallic, certified by the manufacturer as suitable for carbon dioxide use and for the operating temperature and maximum operating pressure of the carbon dioxide system. For soda carbonation installations, the hose from the dispenser regulator to the

dispenser may be nonmetallic, provided the operating pressure is less than 125 psig.

(2) Dispense and vent lines shall be hard piped and designed to withstand a temperature of **-110F**.

(3) Valves, pressure regulators and pressure relief devices shall be suitable for carbon dioxide use and rated for the operating temperature and maximum operating pressure of the carbon dioxide system.

(4) Piping pressure relief valves shall be provided where liquid carbon dioxide can become trapped in the piping system. Pressure relief valves and vent lines from pressure relief valves shall not be provided with shut off valves or other obstructions which could render such valves inoperable.

(5) Pressure relief valves shall be provided on containers that contain more than **60 pounds** of carbon dioxide. Those containers shall have the pressure relief valve discharge outdoors. The soda carbonation dispensing pressure regulator relief valve is not required to discharge outdoors.

(6) Vent lines from pressure relief valves shall be of such a size, length and arrangement so as not to interfere with the proper operation of the valves. The size of the vents of pressure relief devices shall be equal or larger in size than the pressure relief device outlet size.

(7) For soda carbonation installations, the **dispenser pressure regulator** shall be designed to fail in the closed position.

(8) Piping shall be securely supported and braced, and installed with due allowance for thermal expansion and contraction. Expansion joints shall not be used. Piping shall be protected from physical damage.

(9) Insulation for carbon dioxide containers and ancillary equipment shall be of a noncombustible material.

(10) The regulator is connected to a hose that supplies the product to the appliance. This hose must be securely connected to the appliance. **Hoses must be as short as practical to protect hoses from damage**. When the carbon dioxide containers are used inside buildings, the hose must not pass through any partitions, walls, ceilings, or floors. Hoses are used to connect pieces of equipment subject to vibration or that require the ability to change position. They should not be used as a substitute for permanent piping.

(11) Hose and hose fittings shall be made of materials suitable for use with carbon dioxide. All hoses used in carbon dioxide service shall be designed for a bursting pressure of at least four times the pressure to which they may be subjected in service. Hose assemblies should be inspected at regular intervals for damage such as kinks, cracked or blistered inner liners, or damaged reinforcing braid. It is recommended that hoses be date stamped when purchased to allow for periodic replacement. Check for evidence of swollen, cracked, or defective inner liner and replace such hoses immediately. Evidence of such damage could be frost spots or leaks on the outer surface of the hose, pieces of elastomeric liner material being discharged from the hose, or higher than normal pressure losses in the hose.

(12) Piping, tubing, pressure regulators, valves and other apparatus shall be kept gas tight to prevent leakage. Valves utilized on compressed gas systems shall be suitable for the material and temperature intended and shall be accessible. **Valve handles shall not be removed or otherwise altered to hinder operation**.

The following types of pipe and fittings are not acceptable for liquid carbon dioxide service:

- Type F furnace butt welded steel pipe;
- Cast iron or malleable iron fittings and pipe;
- Cadmium plating for food service;
- A-120 galvanized steel pipe (A-106 galvanized is acceptable);
- Plastic pipe and fittings; and
- Carbon steel tubing (limited by external corrosion).

(13) Readily accessible **manual valves**, or **automatic remotely-activated fail-safe emergency shutoff valves**, shall be installed on supply piping and tubing at the point of use and at the tank, container or other source of supply.

(14) Emergency shutoff valves shall be clearly visible and readily accessible. A durable sign shall be conspicuously posted immediately adjacent to such valves to identify their location. Backflow prevention or check valves shall be provided when the backflow of hazardous materials could create a hazardous condition or cause the unauthorized discharge of hazardous materials.

Where gases having a hazard ranking of health hazard Class 3 or 4, or reactivity Class 3 or 4 in accordance with NFPA 704 are conveyed in pressurized piping above 15 pounds per square inch gauge, an approved means of leak detection and emergency shutoff or excess flow control shall be provided. Where the piping originates from within a hazardous

material storage room or area, the excess flow control shall be located within the storage room or area. Where the piping originates from any other source of supply, the excess flow control shall be located as close to the source of supply as practical.

Exceptions:

1. Piping for inlet connections designed to prevent backflow.
2. Piping for pressure relief devices.

Supply piping and tubing for gases having a health-hazard ranking of 3 or 4 in accordance with NFPA704 shall be in accordance with ANSI B31.3.