Product Manual

ChillZilla® Liquid Supply System
Liquid Carbon Dioxide

Patent no. 9,939,109 B2

Designed and Built by:

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Revision Log

Revision Level	Date	Description
A	03/09/2017	Original
B	06/11/2018	Added registered patent

Preface

General

The ChillZilla CO_2 Liquid Supply System for food freezing and dry ice production increases the refrigeration capacity of the liquid CO_2 by as much as 24% over traditional bulk tanks. The ChillZilla system incorporates a patent pending design to lower the saturation pressure of the liquid output without reducing the delivery pressure. With the aid of an external refrigeration system, an internal heat exchanger coil and an insulating baffle, the temperature of the liquid CO_2 is effectively reduced. This system subcools the saturated liquid CO_2 from 300 psig to 120 psig while the electric pressure building maintains the high tank vapor pressure necessary for consistent CO_2 delivery to the application. The result is an increase in refrigeration capacity in the liquid or an improved snow yield from 41 to 51%.

Product Highlights

- Reduce liquid CO_2 consumption by as much as 24%
- Reduce bulk tank minimum operating temperature from -40°F to -320°F with stainless steel inner vessel
- T304 stainless steel inner complies with food grade standards
- Improve bulk tank thermal efficiency with vacuum-insulated super insulation system
- Control freezing process more accurately by controlling liquid conditions
- Flexible system control allows lower tank operating pressure to further reduce operating costs
- Reduce deliveries at bulk tank site
- Reduce CO_2 emissions
- Liquid connection: 2” NPS, Python™ Vacuum Insulated Pipe-Ready

Product Manual

This manual contains information regarding the safe operation and handling of liquid carbon dioxide (CO_2) with the ChillZilla CO_2 Storage Tank. It should be thoroughly read and understood by anyone that operates the equipment. If there are any questions regarding the operation of the carbon dioxide storage tank, contact Chart’s Technical Service division at 1-800-400-4683.

The safety requirements for operating the ChillZilla CO_2 Storage Tank and handling or transporting extremely cold liquid products are shown in the Safety section. It is imperative that all persons having contact with the tank become thoroughly familiar with all maintenance, safety precautions, and procedures contained in this product manual.

The Introduction section discusses the general features of the tank and the theory of operation.

For information on how to uncrate and install the ChillZilla CO_2 Storage Tank please refer to the Installation Section of this manual. This section also contains information on site preparation and protection.

The Operations section will provide step-by-step procedures for basic operation of the storage tank.

Please refer to the Maintenance section for cleaning instructions, inspections, vacuum integrity check along with Troubleshooting and Repairs.

Please refer to the Specifications section for a complete listing of part numbers, liquid level charts, drawings and other technical information.

Terms

Throughout this manual safety precautions will be designated as follows:

Warning! Description of a condition that can result in personal injury or death.

Caution! Description of a condition that can result in equipment or component damage.

Note: *A statement that contains information that is important enough to emphasize or repeat.*

Acronyms / Abbreviations

The following acronyms / abbreviations are used throughout this manual:

ASME	American Society of Mechanical Engineers
BARG	Pressure Gauge (Metric)
CGA	Compressed Gas Association
CO_2	Carbon Dioxide
GPM	Gallons per Minute
HPC	High Pressure Control
kg/cm^2	Kilogram Force per Square Centimeter
kPa	Kilo Pascal
MAWP	Maximum Allowable Working Pressure
NER	Normal Evaporation Rate
PB	Pressure Builder
PN	Part Number
PSI	Pounds per Square Inch
PSIG	Pounds per Square Inch (Gauge)
VS	Vertical Storage

Safety

General

The ChillZilla CO_2 Liquid Supply System storage tank consists of an inner pressure vessel encased within an outer carbon steel vacuum shell. The container operates under low-to-medium pressure. Safety relief devices are used to protect the pressure vessel and vacuum casing, sized and selected in accordance with ASME standards they include a dual relief valve system to protect the pressure vessel, and a reverse buckling rupture disc or lift plate to protect the vacuum casing (outer vessel). The ChillZilla CO_2 storage tanks are designed and engineered for safe reliable operations, and are durable enough to provide many years of trouble-free operation. Strict compliance with proper safety and handling practices is necessary when using a ChillZilla CO_2 storage tank. We recommend that all our customers re-emphasize safety and safe handling practices to all their employees and customers. While every possible safety feature has been designed into the unit and safe operations are anticipated, it is essential that every user of the ChillZilla CO_2 storage tank carefully read all WARNINGS and CAUTIONS listed and enumerated in this safety section sheet and contained in the manual itself. Also read the information provided in the safety bulletins for Carbon Dioxide gas. Periodic review of this safety summary is recommended.

Safety Bulletin

Portions of the following information have been extracted from Safety Bulletin SB-2 from the Compressed Gas Association, Inc. Additional information on carbon dioxide and cryogenics is available from the CGA. Write to the (CGA) Compressed Gas Association, Inc., 1235 Jefferson Davis Highway, Arlington, VA 22202.

Cryogenic containers, stationary or portable, are from time to time subjected to assorted environmental conditions of an unforeseen nature. This safety bulletin is intended to call attention to the fact that whenever a cryogenic container is involved in any incident whereby the container or its safety devices are damaged, good safety practices must be followed. The same holds true whenever the integrity or function of a container is suspected of abnormal operation.

Good safety practices dictate the contents of a damaged or suspect container be carefully emptied as soon as possible. Under no circumstances should a damaged container be left with product in it for an extended period of time. Further, a damaged or suspect container should not be refilled unless the unit has been repaired and re-certified.

Incidents which require that such practices be followed include: highway accidents, immersion of a container in water, exposure to extreme heat or fire, and exposure to most adverse weather conditions (earthquake, tornadoes, etc.). As a rule of thumb, whenever a container is suspected of abnormal operation, or has sustained actual damage, good safety practices must be followed.

In the event of known or suspected container vacuum problems (even if an extraordinary circumstance such as those noted above has not occurred), do not continue to use the unit. Continued use of a cryogenic container that has a vacuum problem can lead to embrittlement and cracking. Further, the carbon steel jacket could possibly rupture if the unit is exposed to inordinate stress conditions caused by an internal liquid leak.

Prior to reusing a damaged container, the unit must be tested, evaluated, and repaired as necessary. It is highly recommended that any damaged container be returned to Chart for repair and re-certification.

The remainder of this safety bulletin addresses those adverse environments that may be encountered when a cryogenic container has been severely damaged. These are oxygen deficient atmospheres, oxygen enriched atmospheres, and exposure to inert gases.

Warning! ***Before removing any parts or loosening fittings, empty the container of liquid contents and release any vapor pressure in a safe manner. External valves and fittings can become extremely cold and may cause painful burns to personnel unless properly protected. Personnel must wear protective gloves and eye protection whenever removing parts or loosening fittings. Failure to do so may result in personal injury due to the extreme cold and pressure in the tank.***

Caution! ***Do not use oxygen equipment that is marked "For Oxygen Use" in CO_2 service. Failure to comply with these instructions may result in serious damage to the container.***

Oxygen Deficient Atmospheres

Warning! Carbon Dioxide vapors in air may dilute the concentration of oxygen necessary to support or sustain life. Exposure to such an oxygen deficient atmosphere can lead to unconsciousness and serious injury, including death.

Carbon Dioxide is colorless and odorless. It can replace the oxygen in the air when released in confined areas.

The normal oxygen content of air is approximately 21%. Depletion of the oxygen content in air, either by combustion or by displacement with inert gas, is a potential hazard and users should exercise suitable precautions.

One aspect of this possible hazard is the response of humans when exposed to an atmosphere containing only 8 - 12% oxygen. In this environment, unconsciousness can be immediate with virtually no warning.

When the oxygen content of air is reduced to about 15 - 16%, the flame of ordinary combustible materials, including those commonly used as fuel for heat or light, may be extinguished. Somewhat below this concentration, an individual breathing the air is mentally incapable of diagnosing the situation because the onset of symptoms such as sleepiness, fatigue, lassitude, loss of coordination, errors in judgment and confusion can be masked by a state of "euphoria," leaving the victim with a false sense of security and well being.

Human exposure to an atmosphere containing 12% or less oxygen leads to rapid unconsciousness. Unconsciousness can occur so rapidly that the user is rendered essentially helpless. This can occur if the condition is reached by an immediate change of environment, or through the gradual depletion of oxygen.

Most individuals working in or around oxygen deficient atmospheres rely on the "buddy system" for protection - obviously the "buddy" is equally susceptible to asphyxiation if he or she enters the area to assist the unconscious partner unless equipped with a portable air supply. Best protection is obtained by equipping all individuals with a portable supply of respirable air. Life lines are acceptable only if the area is essentially free of obstructions and individuals can assist one another without constraint.

If an oxygen deficient atmosphere is suspected or known to exist:

1. Use the "buddy system." Use more than one "buddy" if necessary to move a fellow worker in an emergency.
2. Both the worker and "buddy" should be equipped with self-contained or airline breathing equipment.

Carbon Dioxide

Warning! Accidental contact of liquid or solid CO_2 with the skin or eyes may cause a freezing injury similar to a burn. Handle liquid so that it will not splash or spill. Protect your eyes and cover skin where the possibility of contact with liquid CO_2 cold pipes and cold equipment, or cold gas exists. Safety goggles or a face shield should be worn if liquid ejection or splashing may occur or cold gas may issue forcefully from equipment. Clean, insulated gloves that can easily be removed and long sleeves are recommended for arm protection. Trousers without cuffs should be worn over the shoes to shed spilled liquid.

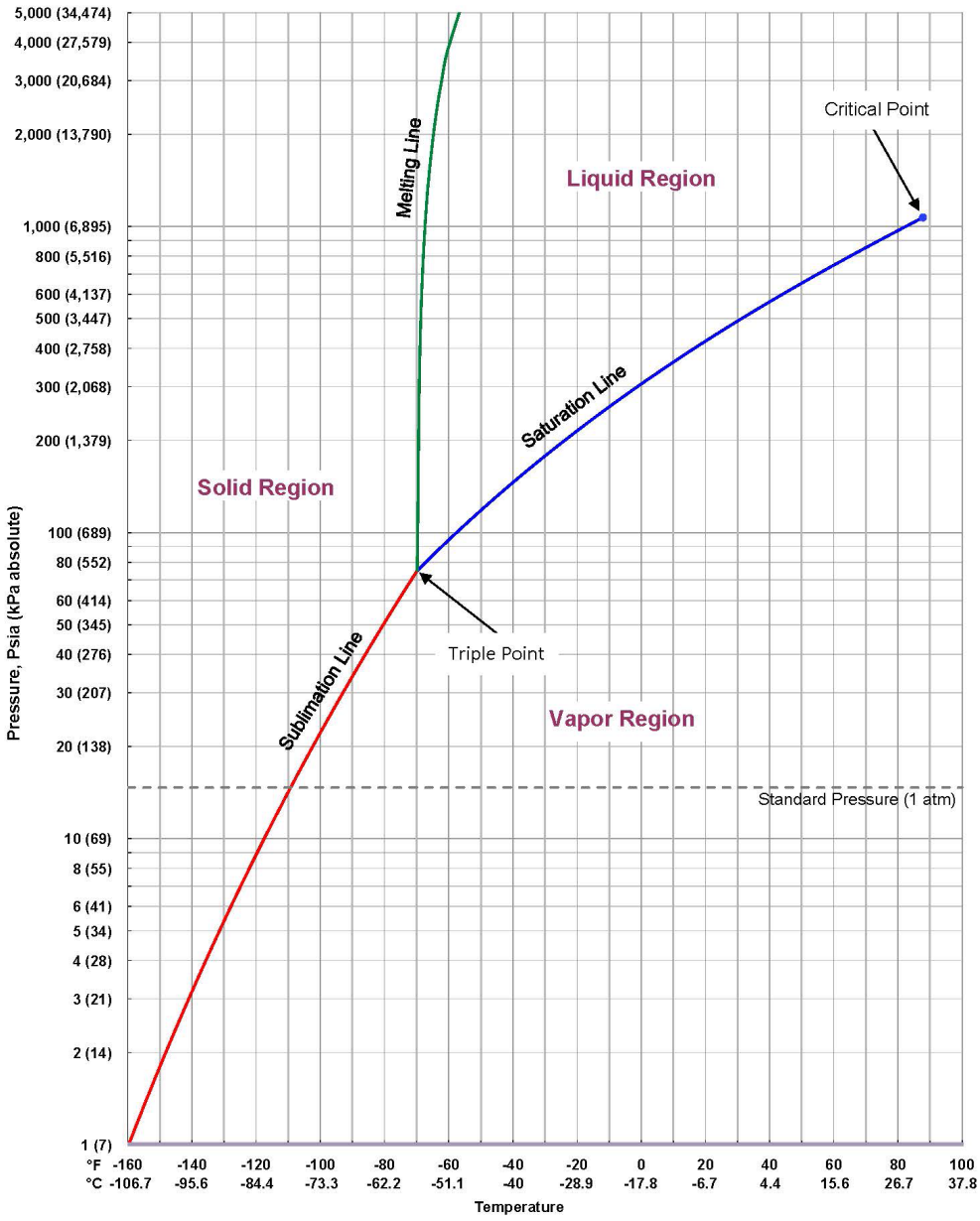
Carbon dioxide is a compound formed by the combination of carbon and oxygen atoms in a 1:2 ratio expressed by the chemical symbol CO_2. The weight percentages of carbon and oxygen are 27.3% and 72.7% respectively.

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 denser 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. At a temperature of -69.9°F (56.6°C) and a pressure of 60.43 psig (417 kPa) carbon dioxide can exist simultaneously in all three phases. This condition is known as the triple point. The phase diagram for carbon dioxide is shown in Figure A.

At temperatures above 87.9°F (31.1°C), carbon dioxide can exist only as a gas, regardless of the pressure. This is known as its critical temperature. As shown in Figure A, liquefied carbon dioxide can only exist in a sealed container between the triple point and critical point temperatures under pressure. There is a definite pressure-temperature relationship of the liquid and gas in equilibrium.

Carbon Dioxide Phase Diagram - Figure A



Personal Protective Equipment (PPE)

The following personal protective equipment is recommended when working around cryogenic liquid:

- Safety glasses with side shields to prevent cryogenic liquid from splashing into the eyes
- Chemical / Liquid resistant gloves to prevent cryogenic burns on exposed hands
- Long sleeve shirts to protect the arms
- Trousers without cuffs worn over closed shoes

Introduction

General

The Chart ChillZilla CO_2 Storage Tank is a self-contained system designed for the economical storage of liquid carbon dioxide with the ability to provide it to the application as subcooled liquid.

The VS (Vertical Storage) model is a medium pressure tank designed to store liquid and provide it as subcooled liquid or gas, to a customer application. This tank can also be connected to pumps for high pressure cylinder filling.

The Chart model designation for a particular tank can be found on the tank data plate and its associated paper work. The model designation is broken down as Model (VS), Capacity (50-TON), Inner Material (S), Insulation Type (C), MAWP (350).

Note: *Refer to the Specifications section of this manual to see the model specification, charts, schematics, and parts covered by the contents of this manual.*

Receiving Check Points

1. Check braces, skids, wooden chocks, and other shipping supports. Damage or deformation would indicate the possibility of mishandling during shipment.
2. Examine welded or brazed joints on plumbing for cracks or deformation, especially near valves and fittings.
3. Check points where pipes exit the tank for cracks or breaks.
4. Check relief valves for dirt or damage.
5. Check pressure within vessel on PI-1. If pressure is zero, extra precautions against contamination and impurities must be taken.
6. Examine the 5g impactograph. If it has sprung, damage may have occurred during shipment. Notify your company's tank specialist and/or Chart.
7. Check the container vacuum.

Features

The ChillZilla CO_2 Storage Tank is designed to provide a convenient, reliable, and economical method for the storage and delivery of CO_2. Important features of these containers include:

1. Long-term hold time due to highly efficient multi-layer composite insulation system with low vacuum.
2. An optional pressure building system that can be used to maintain working pressure during high withdrawal operations.
3. A refrigeration coil that allows a refrigeration system to be used to subcool the liquid to increase the cooling power of the CO_2 for food freezing, increase the efficiency of dry ice production, and negate any pressure rise in the tank during times of lower or no usage.
4. A bottom fill line and vapor return line allows the tank to be refilled from a liquid supply unit by pump transfer. The vapor return line also serves as the full trycock.
5. Simple and convenient piping controls.
6. Rugged carbon steel outer vessel and stainless steel inner vessel.

Physical Description

The ChillZilla CO_2 storage tank is designed for long-term storage of liquefied carbon dioxide under pressure in the range of 60.5 to 350 psig (4.3 to 24.6 kg/cm^2). Operation of the tank is fully automatic with the optional pressure building and/or refrigeration systems set to maintain preset pressure and flow conditions into customers' pipeline. While hardware may vary slightly from model to model, each unit essentially performs the same functions.

This storage tank is comprised of a stainless steel inner tank encased in an outer carbon steel vacuum shell. The insulation system between the inner and outer containers consists of multiple layer composite insulation and high vacuum to ensure long holding time. The insulation system, designed for long-term retention, is permanently sealed at the factory to ensure vacuum integrity.

The ChillZilla CO_2 storage tank is provided with legs for mounting. The legs have mounting holes for attachment to the facility pad.

Caution! To prevent possible tip over do not leave tank standing upright unless it is secured to its foundation (bolted down). Transporting and erection of the tank should be performed in accordance with rigging instructions available from Chart. Failure to comply with these instructions may result in serious damage to the container.

Lifting lugs are located on the tank. The lifting lugs are provided to facilitate handling. Moving requires the use of a crane and adherence to specific rigging instructions (see the Installation section of this manual for details on handling).

Safety Devices

The vessels are protected from over-pressurization with a tank pressure relief device. The normal relief device pressure setting is at the maximum allowable working pressure of the inner vessel.

The vacuum space is protected from over-pressurization by use of a tank annular space rupture disc assembly or lift plate assembly.

Note: *Safety devices meet all of the requirements of CGA Pamphlet S-1.3, Safety Relief Device Standards, Part 3, Compressed Gas Storage Containers.*

Operational System

The ChillZilla CO_2 storage system has the ability to be filled with product and deliver subcooled liquid for a specific application.

All operations are done completely with the control valves located on the underside of the tank. The valves are labeled for easy identification.

The schematic and nomenclature show how the plumbing circuitry operates. It is important that the operators be familiar with the plumbing control valves and their functions as shown in the Specifications section.

Filling

The following recommendations should be used to optimize tank filling:

1. Keep the transfer lines as short as possible. Long uninsulated transfer lines will result in higher fill losses and longer fill times.
2. Anytime liquid can be entrapped in a line between two valves, the line must be equipped with a safety relief device.
3. Conduct the filling operation in as short a time as possible.
4. Do not let the pressure in the filling system drop below 60.5 psig (4.3 kg/cm^2) to prevent formation of solid CO_2.

The vessel should be visually inspected before every fill for possible damage, cleanliness, and suitability for its intended gas service. If damage is detected (i.e., serious dents, loose fittings, etc) repair the unit as soon as possible.

Chart ChillZilla CO_2 storage tanks are shipped with low-purity gaseous nitrogen to prevent moisture from entering the tank. For this reason the tank should be thoroughly purged with the applicable gas prior to filling.

When filling the unit with liquid, the transfer may be made with a centrifugal pump.

Pump Transfer

Liquid carbon dioxide is transferred into the ChillZilla CO_2 tank with a two hose pumping system. Liquid is pumped into the bottom of the vessel while gas is recovered from the top. The pressure in the vessel remains constant during the pump transfer.

Pressure Building (Optional)

When a ChillZilla CO_2 storage tank is used for subcooled liquid, the normal operating pressure range is controlled by the pressure setting of the pressure building system.

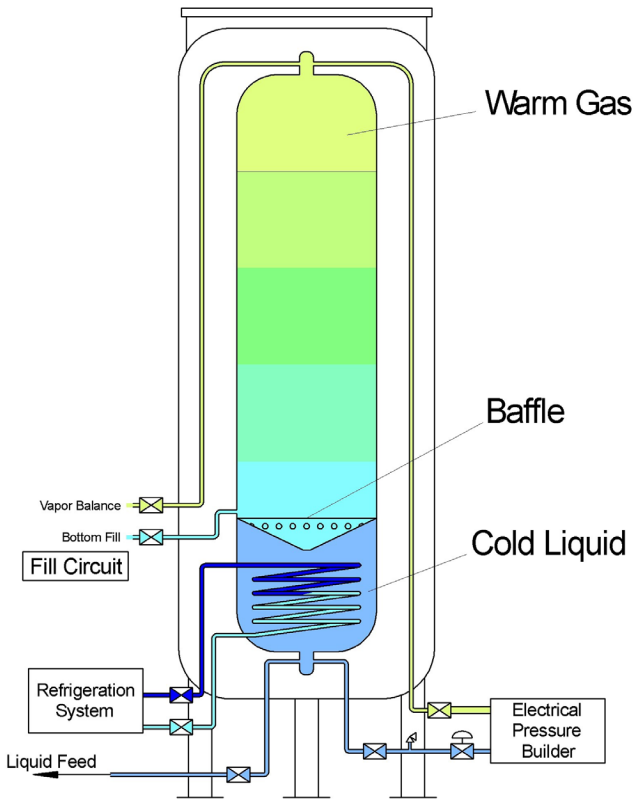
Pressure building systems can be added to the ChillZilla CO_2 storage tanks and should be sized to the expected gas withdrawal rate of the application. This tank stores subcooled liquid and because of this the pressure builder has a few specific design changes from a standard CO_2 pressure builder. The wetted components of the pressure builder must be stainless steel as the temperature of the liquid entering

the unit could be as cold as -45°F (-48°C). Additionally the pressure builder needs to be oversized because of the extra power needed to vaporize the colder liquid. Ask Chart for the recommended pressure builder for your ChillZilla CO_2 storage tank. The customer service phone number for industrial products is 1-800-400-4683.

Pressure building systems remove liquid from the bottom of the tank and vaporize it into gas by adding heat to it. The warmed gas is then returned to the top of the vessel where it raises the pressure in the tank. All pressure building systems need to have pressure switches to automatically turn on and off the flow of liquid into the pressure builder. Safety relief devices should be installed in the components lines wherever liquid can be trapped between valves.

Refrigeration Coil

The ChillZilla CO_2 tank works on the premise of subcooling the liquid inside the tank. This is done through refrigeration. An evaporator coil is mounted inside the bottom of the inner vessel of the tank. Refrigerant flows through this coil and cools the liquid to -45°F (-42.8°C). The following figure shows the basic layout of the ChillZilla CO_2 storage tank.



Refrigeration System (Optional)

In order to get the full benefit from the ChillZilla CO_2 system a refrigeration system needs to be connected to the tank. Chart has a recommended refrigeration unit for the ChillZilla CO_2 tank. These units can be purchased directly from Chart and are designed to operate with the ChillZilla CO_2 storage tank.

The standard refrigeration system consists of a 30 horsepower condensing unit, thermal expansion valve (TXV), and solenoid valve. The on/off operation of this unit is triggered by a pressure switch mounted on the pressure bulb in the storage tank. This system is designed so that the ChillZilla CO_2 storage tank delivers subcooled liquid at a flow rate of 42 lb/min and saturation pressure of 120 psig (-45°F, -42.8°C).

Pressure Bulb

The ChillZilla CO_2 storage tank has a pressure bulb built into the tank. The pressure bulb measures the saturation pressure of the liquid inside the bottom of the inner vessel. This pressure can then be used to determine the temperature of the liquid inside the tank and the amount of subcool on the liquid. A pressure switch mounted on the pressure bulb is used to turn the refrigeration system on and off.

The ChillZilla CO_2 system is designed to deliver 120 psig saturated liquid to the use point. When the pressure in the pressure bulb raises above 120 psig, the pressure switch turns the refrigeration system on cooling the liquid until the pressure drops below 120 psig. At this point the pressure switch turns the refrigeration system off. At this pressure the liquid is roughly -45°F (-42.8°C).

Liquid Withdrawal

If the ChillZilla CO_2 tank is to be placed in permanent liquid withdrawal service, it is strongly recommended that all liquid withdrawal lines are Python® Vacuum Insulated Pipe. The ChillZilla CO_2 tank is designed with a Python pipe connection on the main liquid withdrawal. This piping will efficiently bring the liquid to the application with the least amount of pressure rise.

Normal liquid withdrawal operations need to be performed at pressures above 60.5 psig (4.3 kg/cm^2) to prevent the formation of solid CO_2. Transfer of liquid at high pressure can lead to excessive splashing of the cold liquid which could result in burns to the operator and/or nearby personnel. Personnel should be fully instructed in the cautions associated with handling extremely cold fluids and the proper clothing and protective gear to be used.

Warning! ***Accidental contact of liquid or solid CO_2 with the skin or eyes may cause a freezing injury similar to a burn. Handle liquid so that it will not splash or spill. Review the Safety section for proper PPE requirements.***

Installation

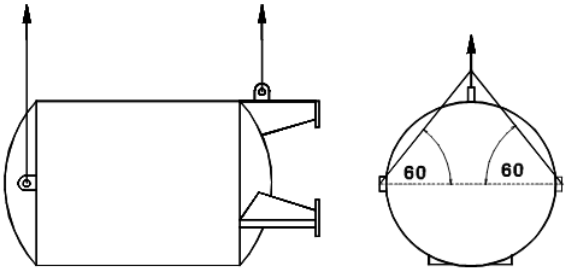
General

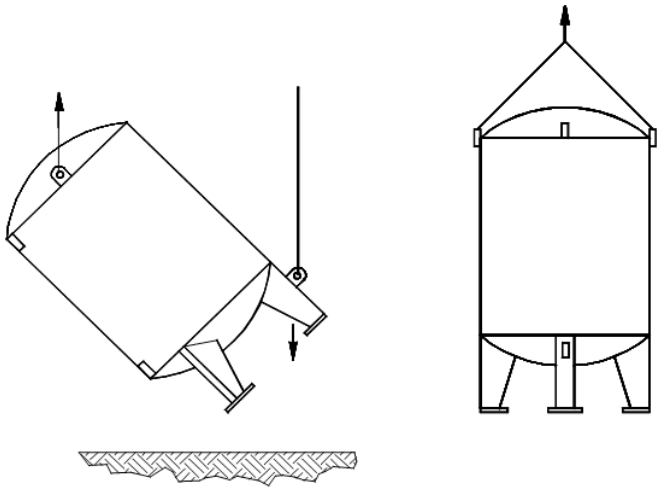
This section deals with receiving and uncrating of the ChillZilla CO_2 Storage Tank. It explains how to connect to the tank and unload it from the truck or shipping container. It provides the owner with a list of inspections that should be done before receiving the tank. It discusses general considerations for the tank's final location as well as making connections for the optional refrigeration unit and pressure builder.

Rigging/General Handling Instructions

Installation of a ChillZilla CO_2 storage tank at the storage site requires the use of a lift crane. The crane must be configured with two hoists. See diagram below.

Note: *If the pad is not completed when the tank arrives, arrangements should be made to have the unit taken from the truck and stored in a protected area.*





Unloading

1. Connect to the lifting lug on the top of the tank and on the leg as shown in the rigging illustration.
2. Disconnect any chains, straps, or shipping braces that may have been used to hold the tank to the truck bed.
3. Lift the tank only a few inches and check to make sure there are no additional connections between the tank and the trailer.
4. Remove the tank from the trailer and place it on the pad or designated hold area while the pad is being constructed.

Cargo Container

Container packaged tanks are shipped in a 20 or 40 ft. container on a roller system which is at the front end of the tank.

The following procedure should be followed for removal of the tank:

1. Remove banding from vessel.
2. Connect chains to forklift and vessel.
3. Use forklift to slide vessel out of container. Lift back end of tank and remove with two front shipping legs resting on rollers.

Note: *If two vessels are in shipping container, two steel blocks must be removed from the two front shipping legs of the rear vessel. Blocks are bolted to shipping container floor.*

ChillZilla CO_2 storage tanks shipped in convertible top cargo containers should be unloaded as follows:

1. Remove the convertible top and end rail from the cargo container.
2. Connect chains to tank.
3. With the tank lifted only a few inches off the cargo container's floor, slide the tank horizontally out of the end of the cargo container.
4. Lift the tank and place it on the pad or the designated hold area while the pad is being constructed.

Inspection

A receiving inspection is one of the most important operations in the life of the tank, and should be done thoroughly and conscientiously. Any indications of damage should be immediately reported to the freight company and Chart.

Receiving Checkpoints

1. Check braces, skids, wooden chocks, and other supports shipped with the tank. Damage or deformation would indicate the possibility of mishandling during shipment.
2. Examine welded or brazed joints on plumbing for cracks or deformation. Areas to check in particular are near valves and fittings.
3. Check the area where pipes exit from the tank for cracks or breaks.
4. Check the relief valves for dirt damage.
5. Check the pressure in the vessel with the Pressure Gauge (PI-1). If pressure is "0" extra precautions against contamination and impurities must be taken.
6. Examine the 5g impactograph located on the inside of one of the tank legs attached to the vessel head. If it has sprung, damage may have occurred during shipment. Notify your company's tank specialist and/or Chart.
7. Check the tank vacuum level using the vacuum check procedure described in the Introduction section.

Vacuum Test Procedure

Caution! Unauthorized changing of the Vacuum Probe (VR-1) will void vessel warranty.

1. The standard Chart Probe (VR-1) is the Hastings DV-6R probe. Select a compatible instrument to match this type of probe.
2. Remove the rubber cap on the probe outlet to expose the contacts.

Note: *The probe housing need not be removed for this step.*

3. Plug the instrument in to the probe and calibrate the instrument.
4. Open the Vacuum Probe Isolation Valve (HCV-5). Wait for five minutes then take a vacuum reading.

Note: *The valve handle protrudes through the protective housing and can be turned without opening the housing.*

5. Close the Isolation Valve (HCV-5) and take a second reading. Monitor the rate of vacuum pressure rise in the vacuum probe with the isolation valve closed. If the vacuum continues to rise at a constant rate, it is possible that the probe assembly is leaking. Consult the factory.
6. Verify that the Isolation Valve (HCV-5) is closed.
7. Replace rubber cap on probe.
8. Review the vacuum reading you recorded.
    a. If the first vacuum reading is above 20 microns, consult factory.
    b. If your last vacuum reading shows a steady increase from the first, consult the factory.

Site Considerations

If the ChillZilla CO_2 storage tank is to be installed at the user's site, the following should be considered prior to the installation.

Prime considerations in choosing a site for the tank are soil stability of the location, accessibility for servicing, and proximity to the liquid dispensing point.

Firm soil conditions are desirable to protect against settling of the facility and possible station damage. The foundation site must also be located such that drainage away from the foundation is ensured.

Since the ChillZilla CO_2 tank will be filled from a truck, it must be readily accessible. Generally, a location adjacent to a parking lot is most suitable. Since many liquid delivery hoses are 14 feet (427 cm) long, the tank should be situated no more than 10 feet (305 cm) from the closest possible access.

If the tank is to be located outside, the site selected should be such that the container and associated equipment (if any) will not be beneath or exposed by the failure of electric power lines, flammable or combustible liquid lines, or flammable gas lines.

Should the tank be located indoors, the building must be of noncombustible construction, be adequately vented and be used exclusively for gas storage.

Site Preparation

Site preparation considerations include selecting the proper foundation. However, before the foundation is laid it may be necessary to clear the site of all organic material and topsoil. Concrete pads are the most common foundations on which cryogenic containers are installed. They provide a highly stable, permanent location for the unit, as well as any other on-site support equipment that may be required (i.e., reserve cylinders, vaporizers, etc.) The construction of a firm base or foundation for the concrete pad is also important. A bed consisting of gravel or crushed stone may be required for the foundation to rest on.

Consultation with a local qualified engineer is suggested to recommend a pad design that meets local and state requirements for soil and climatic conditions, as well as seismic load requirements.

Site Protection

In many situations, the ChillZilla CO_2 storage tanks are vulnerable to damage. This may be due to tampering by unauthorized personnel, other equipment moving in the area, or a combination of these. Depending on the exposure, protection should be provided by either a fence or pylons.

Other Site Considerations

Installation of a ChillZilla CO_2 storage tank should be supervised by personnel familiar with their construction and intended use.

Following installation, all field erected piping and tank connection points should be tested at maximum operating pressure to check for leaks.

If during site preparation any questions arise concerning foundation, location, etc., it is advised that your local Chart distributor or the factory be consulted.

Pressure Builder Connections (Optional)

An optional pressure building kit can be ordered with the ChillZilla CO_2 storage tank. This kit (PN 20725976) includes all the necessary hardware and drawings to install the 12kW electric pressure builder onto the ChillZilla CO_2 storage tank.

A 480V 3-Phase 20 amp power circuit is required for the installation of this pressure builder. The P&ID drawing (20725786) shows the layout of the refrigeration unit.

Refrigeration Unit Connections (Optional)

An optional refrigeration unit can be ordered with the ChillZilla CO_2 storage tank. This unit (PN 14719139) includes just the refrigeration unit. An install kit (PN 20679120) contains all the necessary hardware and drawings needed to install the 30 hp refrigeration unit onto the ChillZilla CO_2 storage tank.

A 480V 3-phase 100-amp power circuit is required for the installation of the refrigeration unit. The P&ID drawing (20725786) shows the layout of the refrigeration unit.

Approximately 120 lbs of refrigerant R-404a is required to charge the system.

Warning! ***Installation of the refrigeration unit should be done by persons experienced and familiar with industrial refrigeration systems.***

Operations

This chapter provides the preparation, initial fill, gas use, liquid delivery, and refilling procedures for the ChillZilla CO_2 storage tank. Before performing any of the procedures contained in this chapter, become familiar with the location and function of the tank controls and indicators by studying the plumbing schematic and legend in the Specifications section of this manual.

Purging and Fill Considerations

The initial fill is usually performed on a warm tank - one that has not been in use for an extended period of time prior to filling. The warm container must be purged to ensure product purity.

When preparing the tank for filling or when changing service, the following items should be considered:

1. The vessel should be inspected for possible damage or unsuitability for intended use. If damage is detected (e.g. serious dents, loose fittings, etc.) remove the unit from service and perform repairs as soon as possible.

2. The vessel should be kept above 60.5 psig (4.3 kg/cm^2) to prevent formation of solid CO_2.

Caution! ***Failure to maintain a minimum tank pressure of 60.5 psig (4.3 kg/cm²) in a vessel containing CO_2 will result in the formation of solid CO_2 which can be very difficult to remove from the tank.***

3. To remove the moisture or foreign matter from the tank or tank lines, the vessel must be purged. Use a small amount of new product for purging when changing service and a small amount of the same product if the purge is to ensure purity or remove contaminants.

Tank Purging Procedure

Caution! ***The maximum purge pressure should be equal to 50% of the maximum operating pressure of the tank or 30 psi (2.1 kg/cm²), whichever is less. The maximum purge pressure must be determined before starting the purge operation to prevent drawing atmospheric contaminants back into the tank. A positive pressure of at least 5 psi (0.4 kg/cm²) must always be maintained in the tank.***

1. Attach the source of gas purge product to the vapor return (FC-2).

Note: *Chart CO_2 tanks ship with brass plugs in the following valves: Pressure Building Inlet and Outlet Valves (HCV-3 and HCV-11) and Aux Liquid Valve (HCV-18). These plugs are to be removed at time of installation.*

2. Close all valves except the Pressure Building Inlet and Outlet Valves (HCV-3, HCV-11), if pressure builder is installed, and Liquid Phase (high) and Gas Phase (low) Valves (HCV-10 and HCV-8).

Note: *When a solenoid valve is used to control the pressure building circuit, it must be energized.*

3. Open the Vapor Recovery Valve (HCV-4) to allow gas to flow into the tank.

4. Shut off the gas supply source (HCV-4) when pressure in the tank reaches the maximum purge pressure as indicated on Tank Pressure Gauge (PI-1).

5. Open the Equalization Valve (HCV-9), to prevent damage to the gauge before closing valves (HCV-8 and HCV-10). Close HCV-8/HCV-10.

6. Loosen the unions on either side of the Liquid Level Gauge (Ll-1). Both the high and low gauge valves should be opened wide and gas stream visually checked for signs of moisture. Provided no moisture is observed after blowing the lines for approximately two minutes, both valves should be closed. If moisture is observed in the gas stream, the gas should be discharged until it is clear of all moisture.

Note: *Careful check for moisture in the phase lines will ensure trouble-free operation of the liquid level gauge. Due to their small diameter, gauge lines are easily plugged by ice.*

7. Remove the Pressure Control Regulator PCV-3A/B toggle the Safety Relief Selector (HCV-15) both sides to purge entire circuit.

8. Open the Fill Valve (HCV-1) and reduce the tank pressure to 5 psi.

Warning! Hearing protection must be worn while tank is venting.

9. Close the Fill Valve (HCV-1) and replace the Pressure Control Regulators (PCV-3A/B).

10. Repeat purge procedures steps 2 through 4 and 8 & 9 at least five times until product purity has been obtained.

11. Reconnect the Liquid Level Gauge (LI-1), open the Liquid Level Control Valves (HCV-8 and HCV-10), then close the Equalization Valve (HCV-9).

12. Reinstall the Pressure Control Regulator (PCV-3A/B).

13. After purging the tank, but before filling, verify that the following valves are open or closed as indicated.

Valve	Position
Vapor Recovery Valve (HCV-4)	Closed
Bottom Fill Valve (HCV-1)	Closed
Equalization Valve (HCV-9)	Closed
Pressure Building Inlet Valve (HCV-3)	Closed
Pressure Building Outlet Valve (HCV-11)	Closed
Liquid Phase (high) Valve (HCV-10)	Open
Gas Phase (low) Valve (HCV-8)	Open
All other tank valves	Closed

Initial (Warm Tank) Filling Procedure

Note: *It is recommended that upon first fill the Chart CO_2 Cleaning Procedures be implemented to ensure cleanliness of tank.*

1. Purge tank to assure product purity.

2. Verify that the supply unit contains the proper product to be transferred and that the supply unit and tank fill fitting are for CO_2 service.

3. Verify that all valves except Liquid Phase (high) and Gas Phase (low) Valves (HCV-10 and HCV-8) are closed.

4. Connect the supply unit liquid transfer hose to Tank Fill Connection (FC-1).

5. Connect the vapor recovery transfer hose to the Tank Vapor Recovery Connection (FC-2)

6. Open Vapor Valve (HCV-4) slowly. Allow the tank and supply unit to equalize in pressure.

7. Open the Fill Valve (HCV-1) and begin to pump fill the tank.

8. Monitor tank pressure (PI-1) during fill.

9. Monitor Liquid Level Contents Gauge (Ll-1) during filling.

10. When tank nears full, open Vapor Return/Full Trycock Line Drain Valve (HCV-4A).

11. Stop the filling operation when liquid begins to discharge from Drain Valve (HCV-4A).

Caution! Do Not Overfill!

12. Close the Fill Valve (HCV-1) and the Vapor Recovery Valve (HCV-4).

13. Open Fill Line Drain Valve (HCV-1A) to relieve hose pressure.

14. Disconnect supply unit from tank at Fill and Return Hose Fittings (FC-1 and FC-2). It is recommended that the fill hose be allowed to defrost before removing.

15. Close Drain Valve (HCV-1A and HCV-4A) and replace caps on fill fittings.

16. Unit is now ready to place into service.

Preparing The Station For Operation

Preparing the ChillZilla CO_2 storage tank for operation consists of adjusting the pressure control valves for automatic operation and then valving open the circuits used to supply the gas requirements of the customer.

Normal operating valve position for a ChillZilla CO_2 tank is as follows:

Valve	Position
Bottom Fill Valve (HCV-1)(HCV-1A)	Closed
Vapor Recovery Valve (HCV-9)	Closed
Pressure Building Inlet Valve (HCV-3)	Open
Pressure Building Outlet Valve (HCV-11)	Open
Liquid Phase (high) Valve (HCV-10)	Open
Gas Phase (low) Valve (HCV-8)	Open
Aux Liquid Valve (HCV-18)	Open/Closed

Tank Vent Pressure Control

1. The tank operating pressure should never be vented below 165 psig (11.6 kg/cm^2) while liquid is in the vessel, in order to prevent liquid CO_2 temperature from dropping below minimum vessel design temperature.
2. Regulators (PCV-3A/B) are used to keep tank pressure from rising above maximum desired pressure. It is factory set at 340 psi so that normal venting will not be done by tank safety valves (PSV-1A/1B).

Refilling

A ChillZilla CO_2 tank that is in service must be refilled using Bottom Fill and Vapor Return Valves (HCV-1 and HCV-4). Proper filling procedures will ensure that there is no interruption of service or supply. Generally it is not necessary to vent the vessel down prior to filling.

Tank Refilling Procedure

1. Verify that the content of the supply unit is the proper product to be transferred.
2. Verify that the Fill and Vapor Valves are closed (HCV-1, HCV-4).
3. Verify that all other valves are in normal operating positions.
4. Connect the supply unit liquid transfer hose to tank Fill Connection (FC-1).
5. Connect the vapor recovery hose to the Vapor Connection (FC-2).
6. Open Vapor Valve (HCV-4) slowly. Allow the tank and supply unit to equalize in pressure.
7. Open the Fill Valve (HCV-1) and begin to pump fill the tank.
8. Monitor tank pressure (PI-1) during filling.
9. Monitor Liquid Level Contents Gauge (LI-1) and stop the filling operation when the gauge reads full.
10. When tank nears full, open Vapor Return/Full Trycock Line Drain Valve (HCV-4A).
11. Stop the filling operation when liquid begins to discharge from Drain Valve (HCV-4A).

Caution! Do Not Overfill!

12. Close the Fill Valve (HCV-1) and the Vapor Recovery Valve (HCV-4).
13. Open Fill Line Drain Valve (HCV-1A) to relieve hose pressure.
14. Disconnect supply unit from tank at fill and return hose fittings (FC-1 and FC-2). It is recommended that the fill hose be allowed to defrost before removing.
15. Close Drain Valves (HCV-1A and HCV-4A) and replace caps on fill fittings.
16. Verify that all other valves remain in normal operating positions.

Liquid Withdrawal Procedure

1. Connect customer line to liquid withdrawal connection.
2. Verify that all valves except Liquid Phase (high) and Gas Phase (low) Valves (HCV-10 and HCV-8) are closed.
3. Open Liquid Valve (HCV-18), Pressure Building Liquid Valve (HCV-3), and Pressure Building Vapor Valve (HCV-11) slowly to begin liquid flow.

Caution! Controls must be in place to stop gas flow if tank pressure falls below 60.5 psig (4.3 kg/cm^2).

4. Once the desired amount of liquid has been delivered, close the Liquid Withdrawal Valve (HCV-18).

Warning! Any time a pump is used for product withdrawal, there must be a vibration eliminator kit installed. Failure to do this may result in loss of tank vacuum. Contact your sales personnel for kit part number.

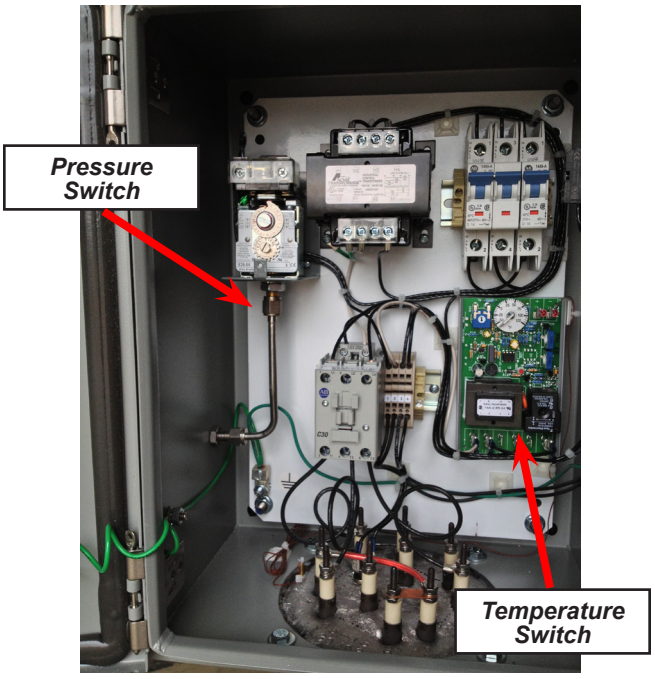
Pressure Builder Operation (Optional)

If equipped with a Chart supplied pressure builder the pressure switch which controls the on/off pressure for the pressure builder will be located inside the control box on top of the pressure building unit. A large flat blade screw driver is needed to open the panel and adjust the pressure setting. The large screw in the center of the pressure switch is used to adjust the pressure builder setting up and down.

There is also a temperature switch inside the Chart supplied pressure builder which is used to control when the heating element turns on and off. This switch is used to protect the heating element from overheating. It is located in the bottom right corner of the control box. Adjust this setting by spinning the dial located on the top of the sensor by hand.

The photo below shows the location of the two sensors inside the pressure builder control box.

The pressure builder supplied with your tank may not look exactly like this unit. If it does not, look for a sensor which has a tube plumbed into the outlet of the pressure builder. This is the pressure switch. The temperature switch will have a dial on it with units of either °F or °C.



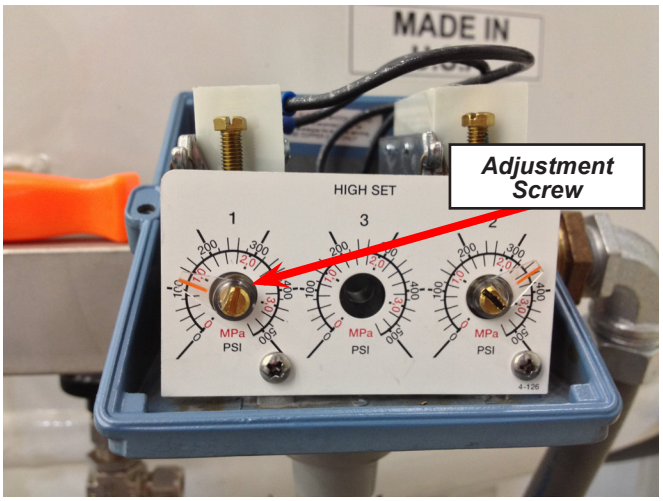
Refrigeration System Operation (Optional)

If equipped with a Chart supplied refrigeration unit three pressure switches need to be set in order for the refrigeration unit to operate correctly. The first pressure switch controls the opening and closing of the solenoid valve for the refrigerant supply to the ChillZilla CO_2 internal evaporation coil. It is located on the side of the tank near the fill connection.

The second pressure switch is called the Low Pressure Control (LPC) and is located inside the refrigeration units control panel. This pressure switch controls the on/off functionality of the compressor which pulls refrigerant through the system.

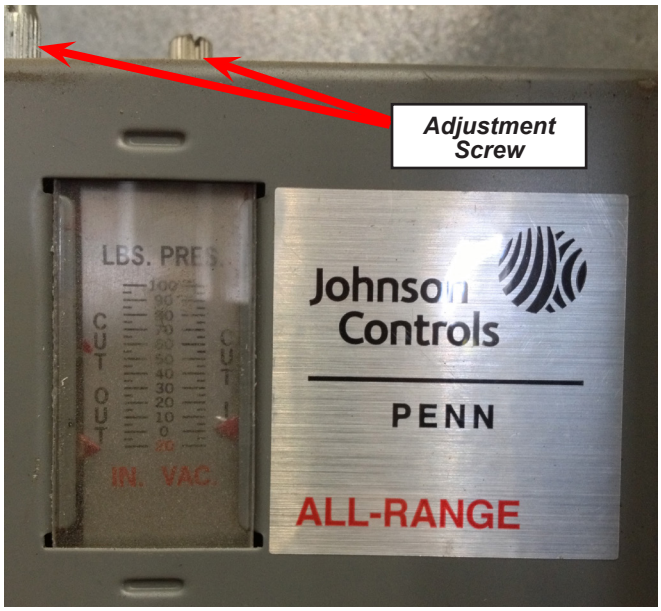
The third pressure switch is called the High Pressure Control (HPC) and is also located inside the refrigeration units control panel. This pressure switch controls the condensing fans to reduce the pressure in the liquid side of the system. Settings for all three pressure switches can be found in the following table. The 'cut in' is when the pressure switch turns on and the 'cut out' is when it turns off.

Pressure Switch	Function	Setting
Low Pressure Control	Cut in	0 psig
	Cut out	-20" Hg
High Pressure Control	Cut in	250 psig
	Cut out	200 psig
Pressure Bulb Pressure Switch	Cut in	125 psig
	Cut out	120 psig

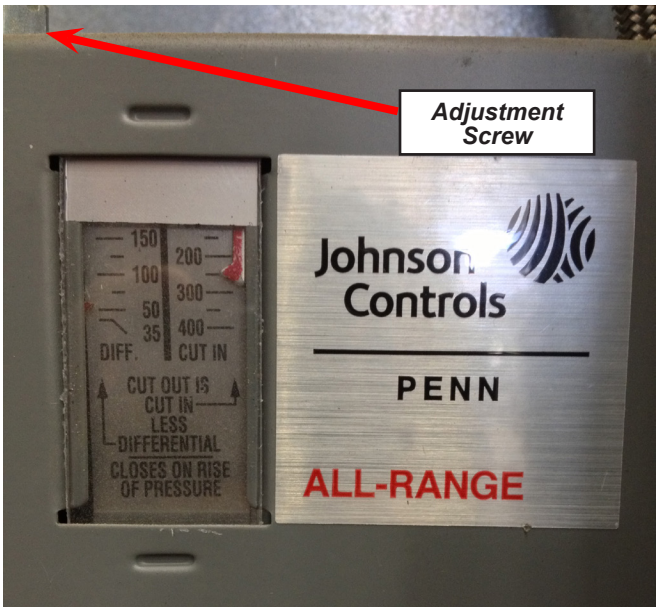


Pressure Bulb Pressure Switch

(see wiring drawing A-20753356 in Specification section of this manual)



Low Pressure Control Pressure Switch



High Pressure Control Pressure Switch

Maintenance

General

This section contains maintenance information, including troubleshooting and repair procedures. Service and/or repairs are not difficult because parts are easily accessible and replaceable. Before performing any of the procedures in this section be sure you are familiar with the location and function of controls and indicators shown and described in the Specifications section of this manual.

Before implementing any procedure described in this section, it is recommended that the Safety section be reviewed and fully understood.

Maintenance required usually becomes apparent during inspection of units before a fill routine, observations during and after a fill, and from improper performance of components. Proper and immediate action to correct any damage or malfunction is advised.

Persons making repairs to piping, valves, and gauges must be familiar with cleanliness requirements for components used in carbon dioxide service.

Compatibility and Cleaning

It is essential to always keep the ChillZilla CO_2 storage tank clean and free of grease and oil.

When replacing components, use only parts that are considered compatible with carbon dioxide.

Warning! ***Before conducting maintenance or replacing parts on a ChillZilla CO_2 storage tank, remove all liquid and release container pressure in a safe manner.***

Cleaning Procedure for Bulk CO_2 Storage Tanks

Normally carbon dioxide bulk tanks that receive and deliver carbon dioxide in liquid form do not require routine cleaning. Normal trace impurities are not concentrated by distillation in the tank and are simply passed on as product flows in and out of the tank.

In the event that contamination of the tank is suspected, the cleaning procedure described on this page is suggested.

The CO_2 tanks can be be cleaned by spraying clean CO_2 liquid from a delivery transport pumped at a rapid rate into an empty or nearly empty tank and flushing the effluent out of the bottom of the tank.

Note: *CGA pamphlet G-6.4 should be used as a guideline for all transfer of carbon dioxide into and out of bulk carbon dioxide storage tanks.*

The cleaning procedure consists of:

1. Emptying all or most of the liquid from the tank, as any product left in the tank will be lost in the cleaning procedure. Reduce tank pressure to approximately 80 psig to ensure sufficient pressure differential between tank and delivery unit to cause a high flow through the cleaning nozzle.
2. Connect transport pump hose to appropriate connection on the bulk tank and start transferring liquid. Recommended flow is approximately 50 GPM.
3. Slowly open bottom fill valve to discharge sediment and liquid CO_2 from tank.
4. This procedure should be run until acceptable levels of cleanliness of the effluent are obtained.

Cleaning Procedure

1. ChillZilla CO_2 tank contents should be reduced to approximately 500 pounds or less as any remaining product will be discharged or lost in the cleaning and flushing procedure.
2. Reduce ChillZilla CO_2 tank pressure to approximately 150 psi below transport pump capability to ensure vigorous flow into the tank. Do not reduce tank pressure below 80 psig.

Caution! ***Failure to maintain a minimum tank pressure of 60.5 psig (4.3 kg/cm²) in a vessel containing CO_2 will result in formation of solid CO_2 which can be very difficult to remove from the tank.***

3. Connect transport liquid pump hose to aux vapor line (C-4). It may be necessary to add a valve and CGA CO_2 fitting to make connection. Transport vapor return pump hose will not be used for this cleaning procedure.

4. Open Aux Vapor Valve and start filling procedure.
5. Monitor tank pressure during cleaning procedure, top filling may tend to collapse or reduce tank pressure. If pressure drops below 80 psig, stop cleaning procedure and allow pressure to build to an acceptable level before continuing.
6. Slowly open Bottom Fill Valve (HCV-1) to discharge sediment and liquid CO_2 from tank. Continue to monitor tank pressure and if pressure drops below 80 psig shut Bottom Fill Valve (HCV-1) and allow pressure to build to acceptable level before continuing.
7. Let cleaning cycle run for 3-5 minutes. Monitor discharged CO_2 until an acceptable level of cleanliness has been achieved.
8. When tank has reached acceptable cleanliness levels, close Bottom Fill Valve (HCV-1) and shut down transport pump. Close Aux Vapor Valve.
9. Blow down hose using procedures described in CGA pamphlet G-6.4.
10. Reconnect all previous connections that were removed during the cleaning procedure.
11. Follow standard filling procedure found in CGA pamphlet G-6.4.

Caution! Discharging liquid CO_2 into the atmosphere can produce high velocity dry ice particles which must be directed away from people or anything else that might be damaged in the process. A restricted valve may also become blocked with dry ice that may be ejected at any time at high velocity.

Periodic Inspection Intervals

In order to maintain the ChillZilla CO_2 storage tank in good operating condition, certain system components must be inspected on a periodic basis. If the tank is being operated in areas having either extreme hot or cold climates, inspection intervals should be shortened. (Refer to the repair procedures in this section for corrective procedures when a malfunctioning component is found during an inspection.)

Item	Interval
Valves and fittings for leaks and other malfunctions	Quarterly
Indicating gauges for malfunction	Annually
Relief valves to verify proper settings	2 years

Soldering/Welding

Before performing any soldering or welding work on a ChillZilla CO_2 storage tank, always exhaust any product from lines and purge thoroughly with nitrogen gas. Refer to the purging instruction in the Operations section.

Maintenance Checks and Adjustments

The following paragraphs provide instructions for performing the various ChillZilla CO_2 tank checks and adjustments. Only perform the procedure(s) if the unit is suspect of faulty operation.

Vacuum Integrity Check

Since all ChillZilla CO_2 storage tanks are vacuum insulated, any deterioration or loss of vacuum will be apparent by cold spots, frost, or condensation on the outside of the tank or evidenced by abnormally rapid pressure build-up. Unless one of these conditions is evidenced, the vacuum level should not be suspect.

In the event one of the above conditions exists, remove the unit from service as soon as possible and contact the factory for advice on vessel vacuum testing.

Pressure and Liquid Level Gauge Checks and Adjustments

Since an instrument specialist is normally required for making gauge repairs, it is advised that a defective gauge be replaced with a new unit and the defective one returned to your local Chart distributor or to the factory for repairs. However, before replacing a gauge there are a number of checks that can be performed.

The major cause of gauge malfunction is a leakage in the gauge line. Therefore as a first check, make certain that the gauge lines are leak tight. Other gauge checks include:

1. Checking the gauge lines for obstructions.

2. Checking for a leak at the liquid phase valve (HCV-10) and at the gas phase valve (HCV-8).

3. Verifying that the liquid level gauge is properly zeroed. The liquid level gauge is a differential pressure gauge used to indicate the amount of liquid in the tank. This gauge may occasionally require adjustment. To check and/or adjust the zero setting of this gauge, close the Low Pressure and High Pressure Valves (HCV-8 & HCV-10). With these valves closed, open the Equalization Valve (HCV-9). The gauge pointer should indicate zero. If the gauge pointer does not indicate zero, adjust the gauge until the zero setting is reached. After adjustment, close the Equalizer Valve (HCV-9) and slowly open the Gauge Valves (HCV-8 & HCV-10).

If these checks and adjustments fail to correct the problem, remove and replace the gauge. When returning the defective gauge to Chart for repair, indicate the nature of the difficulty experienced with the gauge in your letter of transmittal.

Caution! Before removing or adjusting either the tank pressure gauge or the liquid level gauge, make sure that the low pressure Liquid Phase Gauge Valve (HCV-10) and the Gas Phase Gauge Valve (HCV-8) are closed.

Troubleshooting

The following table is arranged in a Trouble/Possible Cause/Remedy format. The possible causes for specific problems are listed in descending order of significance. That is, check out the first cause listed before proceeding to the next. Repair procedures required, as listed in the remedy column, may be found in the Repair portion of this section. Perform all procedures in order listed and exactly as stated (Refer to drawings as required to locate system components identified in the troubleshooting guide.)

Trouble	Possible Cause	Remedy
Excessive tank pressure	Pressure building system is not functioning properly	Pressure switch or regulator is adjusted too high (Readjust it)
		PB unit won't shut off (Consult PB manufacturer
	Tank was just filled with higher pressure (warm) liquid	Vent Pressure (HCV-4) to restabilize at a lower pressure.
	Excessive shutdown time or low withdrawal rate, or excessive process heat input.	Vent tank properly to desired operating pressure. Investigate process system.
	Tank pressure gauge (PI-1) in error.	Confirm tank pressure with calibrated test gauge. If wrong, replace defective gauge.
	Inadequate vacuum.	Refer to "vacuum loss" in troubleshooting column.
Failure to maintain tank pressure	Pressure building system is not functioning properly.	Isolation Valves (HCV-3 & HCV-11) are closed. (Open them)
		Pressure switch (or regulator) is adjusted too low. (Readjust it)
		PB unit is faulty (Consult PB manufacturer)
	Relief Valve (PSV-1A/1B) or Control Valve (PCV-3A/B) leaking or frozen open	Replace defective valve.
	Piping leak	Soap test and repair
	Low liquid level.	Refill tank.
	Excessive withdrawal rate.	Consult factory (Chart).
Vacuum loss	Ruptured annular space Burst Disc (PSE-3 or PSE-5/VP).	Inner vessel or piping leak. Remove all product from the container and return to Chart.
	Leak in the burst disc caused by corrosion.	Remove all product from the container and return to Chart.

Trouble	Possible Cause	Remedy
Erratic or erroneous contents gauge readings.	Leaking gauge lines	Soap test and repair leak.
	Gauge needle is stuck.	Tap gauge. If this fails to correct the problem, inspect the needle and bend slightly, if necessary.
	Needle is not zero adjusted.	Refer to Gauge Adjustment.
	Gauge damaged or faulty.	Replace gauge.
Leaking Safety Relief Valve (PSV-1B/1A) or Pressure Control Valve (PSV-3A/B)	Dirt or ice under disc.	Reseat or replace valve as required.
	Valve improperly seated.	
	Damaged seat or disc.	Replace valve.

Repair

Replacement, rather than repair, of damaged components with Chart approved parts is recommended. However, when repair of damaged components is required, follow the instructions below.

Caution! ***The ChillZilla CO_2 tank should always be allowed to return to ambient temperature before repair work is performed. Remove all liquid and release pressure from the tank as necessary before replacing any component(s) exposed to pressure or to liquid CO_2.***

When disassembly of a ChillZilla CO_2 tank assembly is required, removed parts should be coded to facilitate reassembly. Reassembly of parts should always be performed in the reverse manner in which they are disassembled. Parts removed during disassembly should be protected from damage, thoroughly cleaned, and stored in protective polyethylene bags if not immediately reinstalled. Clean all metal parts with a good industrial cleaning solvent. All rubber components should be washed in a soap and warm water solution. Air dry all cleaned parts using an oil-free, clean, low-pressure air source. Before reassembly, make sure that all parts are thoroughly cleaned and have been degreased. Cleaning will prevent valves and regulators from freezing while in service and prevent contamination of the liquid product.

When removing components from a ChillZilla CO_2 tank remember to always plug pipe openings as soon as they are exposed. Plastic pipe plugs of a clean plastic film may be used for this purpose.

Valve Repair

Note: *Always have an adequate supply of ChillZilla CO_2 system spare parts in your inventory; refer to the Specifications section for recommended components.*

When a defective valve is suspected, remove and repair the assembly as described below. If a valve is leaking through the packing, tighten the packing nut first to see if the leakage will stop before removing the valve.

Note: *Unless valve component parts are available in inventory, a defective valve should be replaced with a new assembly.*

1. Remove all liquid from the tank.
2. Release pressure in the tank by slowly opening vapor recovery valve (HCV-4) until venting stops, and gauge (PI-1) reads 0 psig.
3. Remove the defective valve from the container.
4. Disassemble the valve and inspect all piece parts.
5. Clean all metallic parts in a suitable solvent and other parts in a warm water and soap solution followed by a thorough warm water rinse.
6. Air dry all components using a clean low pressure air source.
7. Replace all worn, deformed or damaged parts.
8. Repack the valve. Either preformed or twisted Teflon filament packing can be used. When using twisted Teflon filament packing, untwist Teflon and use only a single strand. Pack Teflon tightly; otherwise, moisture can get into the valve and freeze when the valve is cold.

9. Reassemble the valve. Make sure that mating surfaces are clean and properly seated. If the repaired valve is not to be reinstalled immediately, seal it in a polyethylene bag for storage. Apply a label to the bag such as “CLEAN VALVE. DO NOT OPEN BAG UNLESS UNIT IS TO BE INSTALLED.”

Tank Safety Relief Valve (PSV-1A/1B)

The safety relief valve will open and release gas to protect the tank from over-pressurization. The relief valve cannot be repaired; it needs to be replaced when it shows signs of leaking or malfunctioning.

Testing After Repair

After making repairs requiring disassembly or parts replacement, leak test all valves and piping joints that were taken apart and reconnected. Do not return the ChillZilla CO_2 tank to service until all leaks have been corrected or retested.

Returning Defective Components

If a defective component or assembly is to be returned to the factory for repair, carefully package the unit for shipment in a durable container enclosed in an outer carton to prevent further damage. In your letter of transmittal, state the nature of the problem, checks already made, repairs attempted, etc. This information will enable most repair work to be performed faster and more economically. Contact Chart customer service at (1-800-247-4446 or 1-800-241-7452) prior to any component return.

Specifications

Model	Gross Capacity		Net Capacity		MAWP*		Diameter		Height		Tare Weight**		NER %/day
	Ton	Tonne	Ton	Tonne	psig	barg	in	mm	in	mm	lbs.	kg	in CO_2
50-TON	48.1	43.6	45.8	41.5	350	24.1	114	2,900	406	10,312	56,900	25,810	.04

*MAWP - Maximum Allowable Working Pressure **Weights are for ASME design

P&ID Drawing

Model	Drawing PN
VS-50TON	20725786

ChillZilla CO_2 System Layout Drawing

Model	Drawing PN
VS-50TON	20732713

Recon Install Drawing

Model	Drawing PN
VS-50TON	20679120

Electric PB Install Drawing

Model	Drawing PN
VS-50TON	20725976

Liquid Level Chart

Bulk Tank 50 ton CO2 Service 150 psig Saturation Pressure					
%Full	Level	Volume (Total product in tank)			
	"H_2O	Liters	Gal	Lbs	SCF
100%	361.6	41,297	10,910	100,454	883,533
98%	354.6	40,463	10,689	98,480	866,167
96%	347.7	39,625	10,468	96,498	848,733
94%	341.1	38,831	10,258	94,620	832,217
92%	334.1	37,993	10,037	92,638	814,783
90%	327.2	37,155	9,815	90,656	797,350
88%	320.6	36,361	9,606	88,778	780,834
86%	313.7	35,523	9,384	86,796	763,400
84%	306.7	34,685	9,163	84,814	745,966
82%	299.8	33,847	8,942	82,831	728,533
80%	293.2	33,053	8,732	80,954	712,017
78%	286.2	32,216	8,510	78,971	694,583
76%	279.3	31,378	8,289	76,989	677,149
74%	272.7	30,584	8,079	75,112	660,633
72%	265.8	29,746	7,858	73,129	643,200
70%	258.8	28,908	7,637	71,147	625,766
68%	251.9	28,070	7,415	69,165	608,333
66%	245.3	27,276	7,206	67,287	591,817
64%	238.3	26,438	6,984	65,305	574,383
62%	231.4	25,600	6,763	63,323	556,949
60%	224.8	24,806	6,553	61,445	540,433
58%	217.9	23,968	6,332	59,463	523,000
56%	210.9	23,130	6,110	57,481	505,566
54%	204.0	22,292	5,889	55,499	488,132
52%	197.4	21,499	5,679	53,621	471,616
50%	190.4	20,661	5,458	51,639	454,183
48%	183.5	19,823	5,237	49,657	436,749
46%	176.9	19,029	5,027	47,779	420,233
44%	170.0	18,191	4,805	45,797	402,799
42%	163.0	17,353	4,584	43,815	385,366
40%	156.1	16,515	4,363	41,833	367,932
38%	149.5	15,721	4,153	39,955	351,416
36%	142.5	14,883	3,932	37,973	333,983
34%	135.6	14,045	3,710	35,990	316,549
32%	128.7	13,207	3,489	34,008	299,115
30%	122.1	12,413	3,279	32,130	282,599
28%	115.1	11,575	3,058	30,148	265,166
26%	108.2	10,737	2,837	28,166	247,732
24%	101.6	9,944	2,627	26,288	231,216
22%	94.6	9,106	2,405	24,306	213,782
20%	87.7	8,268	2,184	22,324	196,349
18%	80.8	7,430	1,963	20,342	178,915
16%	74.2	6,636	1,753	18,464	162,399
14%	67.2	5,798	1,532	16,482	144,966
12%	60.3	4,960	1,310	14,500	127,532
10%	53.7	4,166	1,101	12,622	111,016
8%	46.8	3,328	879	10,640	93,582
6%	39.8	2,490	658	8,658	76,149
4%	32.9	1,656	438	6,686	58,803
2%	25.5	856	226	4,792	42,147
0%	10.2	0	0	2,768	24,342

Wiring Drawing (A-20753356)