Product Manual

BulkLite® 1400

Horizontal Storage Unit

Designed and Built by:

Chart Inc.

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Part Number 20674169 Rev. C

Contents

Revision Log

Revision Level	Date	Description
A	04/2013	Initial publication
B	01/06/2015	Reformat and update trademark
C	06/27/2018	Specs and weights update

Preface

General

The BulkLite 1400 storage unit is a compact horizontal bulk storage tank designed for economical turnkey installations. The tank can be installed on common precast concrete foundations, asphalt or directly on to class five gravel. The integrated forklift channels provide for easy mobility without a crane, further reducing the installation costs. The low profile and low cost installation is ideal for accounts that specify a height restriction and/or pad restriction due to property constraints. The BulkLite storage unit is also a good solution for temporary installations. The plumbing is conveniently located on one end of the vessel for easy access in tight locations and it can be filled from a standard transport or an Orca™ MicroBulk Delivery System.

Note: *Not designed to be moved with cryogenic product.*

Product Highlights

- Compact, horizontal low profile: 69” H x 72” W x 189” L
- Integrated large forklift channels provide for easy mobility and secure mounting for an economical installation
- Forklift channels are 44” center to center (34-3/4” min x 53-1/4” max) and provide a stable and secure mounting base without the need for a concrete pad
- On board high-efficiency gas use vaporizer provides up to 2000 SCFH
- Integrated high-efficiency pressure builder supports gas use flows up to 8000 SCFH
- Integrated flat fin pressure builder with PCV-1 (combo regulator) with single pressure adjusting screw for easy changes to the pressure builder and economizer settings
- Durable, ergonomic plumbing with isolation valves for long service life, easy operation and field maintenance
- Low NER is ideal for low usage accounts with longer delivery cycles for low distribution costs
- Liquid withdrawal package option available: 1” vacuum-insulated female bayonet, vent connected back pressure regulator and low-range PCV-1 spring for low liquid loss and accurate tank pressure control.

Product Manual

This manual contains information regarding the safe operation and handling of the BulkLite 1400 storage unit. It should be thoroughly read and understood by anyone that operates the equipment.

If there are any questions regarding the operation of the BulkLite 1400 storage unit contact Chart Technical Service at 1-800-400-4683.

The safety requirements for operating the tank and handling or transporting products are listed in the Safety section of this manual. Use this Safety section as a “Safety Checklist” each time the equipment is being used.

The Introduction section discusses the general features and highlights of the tank along with detailed descriptions of the working parts of the BulkLite 1400 storage unit. There are also labeled photos available in this section to help identify valves and gauges.

Receiving inspection is one of the most important operations of the BulkLite 1400 storage unit. Detailed instructions are provided in the Inspection and Installation section of this manual.

The Commissioning section will walk through purging, leak checking and inspection of safety circuits.

In the Operations section detailed information on the initial fill, refilling and gas and liquid withdrawal procedures can be found.

Refer to the Maintenance section for replacing of gauges, valves, rupture discs etc. There is also a troubleshooting table in this section that will aid in answering some common questions.

The Specifications section provides the user with a flow diagram and a contents table.

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 are used throughout this manual:

ASME	American Society of Mechanical Engineers
Ar	Argon
BAR	Pressure (Metric)
BARG	Pressure (Metric) (Gauge)
CFM	Cubic Feet per Minute
CGA	Compressed Gas Association
CM^2	Centimeter Squared
H_2O	Water
LOX	Liquid Oxygen
Kg	Kilograms
MAWP	Maximum Allowable Working Pressure
N_2	Nitrogen Gas
NER	Normal Evaporation Rate
NFPA	National Fire Protection Association
O_2	Oxygen
PSF	Pounds per Square Foot
PSI	Pounds per Square Inch
PSIG	Pounds per Square Inch (Gauge)
SCF	Standard Cubic Feet
SCFH	Standard Cubic Feet per Hour

Safety

Safety Statement

All operators should have a full and complete understanding of the content of this manual before operating the equipment described. This manual is intended to describe the operation of the equipment and not intended to supersede any site-specific standards.

As with any cryogenic system, it should be observed that any non-insulated piping can get extremely cold and should not be touched by exposed skin. If the system requires maintenance, it should be shut down and allowed to warm-up.

If maintenance is to be done on the system, such as changing valve seats, it is extremely important that the pressure be relieved from the system through the vent valves and that the liquid isolation valves are closed.

Safety Summary

Strict compliance with proper safety and handling practices is necessary when using a cryogenic system. 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 the user of the cryogenic system carefully read and fully understand all ***Warning!*** and ***Caution!*** notes listed in this safety summary and enumerated below.

Also read the information provided in the Safety Bulletin for Oxygen and Inert Gases following this Safety Summary. Periodic review of the Safety Summary is recommended.

Warning! ***In an oxygen enriched atmosphere, flammable items burn vigorously and could explode.***

Warning! ***DO NOT permit smoking or open flame in any area where oxygen is stored, handled, or used. Failure to comply with this warning may result in serious personal injury.***

Excess accumulation of oxygen creates an oxygen-enriched atmosphere (defined by the Compressed Gas Association as an oxygen concentration above 23%). Certain items considered non-combustible in air may burn rapidly in such an environment. Keep all organic materials and other flammable substances away from possible contact with oxygen; particularly oil, grease, kerosene, cloth, wood, paint, tar, coal, dust, and dirt which may contain oil or grease.

Caution! ***Before removing any parts or loosening fittings, empty the cryogenic 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.

Warning! ***Accidental contact of liquid gases with 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, cold pipes and 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 be easily removed and long sleeves are recommended for arm protection. Cuffless trousers should be worn over the shoes to shed spilled liquid.

Warning! ***If clothing should be splashed with liquid oxygen it will become highly flammable and easily ignited while concentrated oxygen remains.***

Such clothing must be aired out immediately, removing the clothing if possible, and should not be considered safe for at least 30 minutes.

Warning! Use only replacement parts that are compatible with liquid oxygen and have been cleaned for oxygen use.

Do not use regulators, fittings, hoses, etc., which have been previously used in a compressed air environment. And do not use oxygen equipment for compressed air. Failure to comply with these instructions may result in serious damage to the container.

Caution! Before locating oxygen equipment, become familiar with the relevant National Fire Protection Association (www.nfpa.org) standards for "Compressed Gases and Cryogenic Fluids Code" and with all local safety codes.

The NFPA standard covers general principles recommended for installing bulk oxygen systems on industrial and institutional consumer premises.

Safety Bulletin

A portion of the following information is extracted from Safety Bulletin SB-2 from the Compressed Gas Association, Inc. (www.cganet.com). Additional information on nitrogen, argon and liquid cylinders is available in CGA Pamphlet P-9. Write to the Compressed Gas Association, Inc., 1235 Jefferson Davis Highway, Arlington, VA 22202.

From the CGA Safety Bulletin:

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 that 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 in water, exposure to extreme heat or fire, and exposure to most adverse weather conditions (earthquakes, 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.

Oxygen Deficient Atmospheres

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

When the oxygen content of air is reduced to about 15 or 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.

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

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 atmosphere containing 12% oxygen or less 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 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 an unconscious partner unless equipped with a portable air supply.

Best protection is obtainable by equipping all individuals with a portable supply of respiratory air. Lifelines 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:

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

Oxygen Enriched Atmospheres

An oxygen enriched atmosphere occurs whenever the normal oxygen content of air is allowed to rise above 23%. While oxygen is non-flammable, ignition of combustible materials can occur more readily in an oxygen rich atmosphere than in air; and combustion proceeds at a faster rate although no more total heat is released.

It is important to locate an oxygen system in a well-ventilated location since oxygen-rich atmospheres may collect temporarily in confined areas during the functioning of a safety relief device or leakage from the system.

Oxygen system components, including but not limited to, containers, valves, valve seats, lubricants, fittings, gaskets and interconnecting equipment including hoses, shall have adequate compatibility with oxygen under the conditions of temperature and pressure to which the components may be exposed in the containment and use of oxygen.

Easily ignitable materials shall be avoided unless they are parts of equipment or systems that are approved, listed, or proved suitable by tests or by past experience.

Compatibility involves both combustibility and ease of ignition. Materials that burn in air may burn violently in pure oxygen at normal pressure - and explosively in pressurized oxygen.

In addition, many materials that do not burn in air may do so in pure oxygen, particularly when under pressure. Metals for containers and piping must be carefully selected, depending on service conditions. The various steels are acceptable for many applications, but some service conditions may call for other materials (usually copper or its alloys) because of their greater resistance to ignition and lower rate of combustion.

Similarly, materials that can be ignited in air have lower ignition energies in oxygen. Many such materials may be ignited by friction at a valve seat or stem packing, or by adiabatic compression produced when oxygen at high pressure is rapidly introduced into a system initially at low pressure.

Nitrogen and Argon

Nitrogen and argon (inert gases) are simple asphyxiants. Neither gas will support or sustain life and can produce immediate hazardous conditions through the displacement of oxygen. Under high pressure these gases may produce narcosis even though an adequate oxygen supply, sufficient for life, is present.

Warning! ***Nitrogen and argon vapors in air dilute the concentration of oxygen necessary to support or sustain life.***

Inhalation of high concentrations of these gases can cause anoxia, resulting in dizziness, nausea, vomiting, or unconsciousness and possibly death.

Individuals should be prohibited from entering areas where the oxygen content is below 19% unless equipped with a self-contained breathing apparatus.

Unconsciousness and death may occur with virtually no warning if the oxygen concentration is below approximately 8%. Contact with cold nitrogen or argon gas or liquid can cause cryogenic (extreme low temperature) burns and freeze body tissue.

Persons suffering from lack of oxygen should be immediately moved to areas with normal atmospheres.

Note: *Self contained breathing apparatus may be required to prevent asphyxiation of rescue workers.*

Assisted respiration and supplemental oxygen should be given if the victim is not breathing. If cryogenic liquid or cold boil-off gas contacts a worker's skin or eyes, the affected tissues should be promptly flooded or soaked with tepid water (90°F; 32°C).

DO NOT USE HOT WATER. Cryogenic burns, which result in blistering or deeper tissue freezing, should be examined promptly by a physician.

Chart customer stations are designed with the following safety features:

- A vacuum maintenance system specifically designed to provide long life and all possible safety provisions.
- Safety relief devices to protect the pressure vessel and vacuum casing sized and selected in accordance with ASME standards to include a dual relief valve. While Chart equipment is designed and built to the most rigid standards, no piece of mechanical equipment can ever be 100% foolproof.

Introduction

Congratulations, you now own a Chart BulkLite 1400 horizontal storage unit. The new BulkLite 1400 storage unit is a compact horizontal bulk storage tank designed for economical turnkey installations. The tank can be installed on common precast concrete foundations, asphalt or directly on class five gravel (aggregates 3/4" and smaller), depending on code restrictions. Liquid Oxygen (LOX) requires a pad.

A Chart vessel is designed for long-term storage of cryogenic liquefied gases under pressure in the range of 5 psi (0.4 kg/cm^2) to the MAWP (Maximum Allowable Working Pressure). Operation of the station can be fully automatic with the unit's regulator system set to maintain preset pressure and flow conditions into a customer's pipeline.

The vessel is comprised of an alloy steel inner tank encased in an outer carbon steel vacuum shell. The insulation system between the inner and outer containers consists of composite insulation and high vacuum to ensure long holding time. The insulation system designed for long-term vacuum retention is permanently sealed at the factory to ensure vacuum integrity. The units have a tank pressure relief device, which is set at the factory. As a secondary pressure relief device, the container is further protected from over-pressurization by a rupture disc. The bursting disc will rupture completely to relieve inner tank pressure in the event the tank relief valve fails and pressure exceeds the rupture disc setting. The vacuum space is protected from over-pressurization by use of a tank annulus rupture disc assembly. Pressure relief devices used on Chart vessels designed for the U.S. specifications meet the requirements of CGA Pamphlet S-1.3, “Pressure Relief Device Standards, Part 1, for Stationary Vessels.”

Lifting lugs are secured to the top head of the container. The lifting lugs are provided to facilitate handling. Moving requires the use of a crane and adherence to specific rigging instructions, which may vary from vessel to vessel. Forklift channels are also provided to place the tank - which must be empty - with a standard forklift.

Note: *Not designed to be moved with cryogenic product in the tank.*

Basic Components

For the purposes of this manual, a "Storage Tank" is designed to store and deliver a cryogenic gas or liquid for use at low pressures.

A storage tank is made up of a tank, piping, safety devices, and gauges.

Tank

Most tanks for the common cryogenic liquids, with capacities between 100 gallons and 100,000 gallons, are similar in principle. An "inner vessel" or "liquid container" is supported within an "outer vessel" or "vacuum jacket" with super insulation in the space between the vessels and evacuated. Necessary piping connects from inside the inner vessel to outside the vacuum jacket.

Gauges and valves, to indicate and control the product in the vessel, are mounted outside of the vacuum jacket. Legs or saddles to support the whole assembly are welded to the outside of the vacuum jacket.

Inner Vessel

Inner vessel is designed, fabricated, tested and stamped in accordance with the ASME Section VIII Division 1 for Unfired Pressure Vessels. Inner vessel materials must have good ductility at cryogenic temperatures. Austenitic stainless steel, SA-240 T304, is the inner vessel material and is designed for a maximum working pressure of 250 psig (17.24 barg).

The vessel is cleaned for oxygen service.

Jacket

Outer vessel, intended only for vacuum, is not Code designed or stamped. Since they do not operate at cryogenic temperatures, they are made of carbon steel. Stainless steel standoffs are used where cold piping penetrates the outer vessel, to protect the mild steel from being excessively chilled.

Inner Vessel Supports

The main supports for the inner vessel are made from materials that have a low thermal conductivity and excellent structural strength.

Insulation

This tank uses multi-layer super insulation for improved thermal performance and lower overall tank weight.

Internal Piping

The piping is austenitic stainless steel, again because of its low conductivity, strength, ductility and availability. Piping connected to the liquid phase (bottom) of an inner vessel is "trapped"- bent in some manner that produces the effect, if not the appearance, of a sink trap near the inner vessel. With a properly trapped line and a closed valve outside, most of the pipe is full of vapor and heat flow to the stored liquid is minimized. (If the line were not trapped, liquid would stand - or try to stand - against the closed valve outside the jacket, and heat flow to the liquid would be drastically increased).

Jacket Supports

These horizontal storage tanks are supported on four saddles, welded to the bottom of the jacket. Overall tank dimensions and saddle spacing are shown in the Specifications section of this manual.

External Piping

For handling of atmospheric gases, materials of external piping include stainless steel pipe and fittings with bronze valves, assembled by silver brazing and welding. See the schematics shown in the Specifications section for more information.

Filling System

This tank is furnished with a "Top Fill" line and a "Bottom Fill" line for filling. The top fill line terminates with a spray header inside the top of the inner vessel.

Pressure Build System

A pressure build system is needed in many situations to keep tank pressure high enough to provide the desired flow of product.

The principle of the pressure build system is simple.

1. Liquid product flows by gravity from the bottom of the inner vessel to a heater outside the vacuum jacket.
2. Vaporized product flows back to the top of the inner vessel.
3. As more and more gas fills the space above the liquid the pressure inside the vessel increases.

The major components to make this work are a heater and a means of control.

The heater is an assembly of aluminum fin tubes exposed to the atmosphere. This assembly is called a Vaporizer. As liquid flows through the vaporizer it is heated and becomes a vapor (a gas), thus the term vaporizer.

The control is typically a conventional pressure reducing spring and diaphragm regulating valve. This valve opens when the downstream pressure drops below the set point of the regulator and closes when tank pressure rises to the set point.

The Pressure Builder sub-system consists of an “Inlet Isolation Valve,” “Pressure Build Strainer,” “Pressure Build Regulating Valve,” “Pressure Build Coil,” “Line Safeties,” and a “Vapor Shut-off Valve.” The sub-system is connected between the pressure build liquid line and the pressure build vapor return line.

The “Inlet Isolation” valve and the “Vapor Shut-off” valve are normally left open, but can be closed if repairs on the coil or the regulating valve are needed.

The vessel is supplied with the pressure build coil and controls.

Safety Devices

The tank safety valve, used to prevent excessive pressure buildup in the inner vessel, is a standard ASME safety relief valve, except that materials are selected, and the valve is cleaned for oxygen service. The valve is soft-seated to minimize leakage below the set point. The tank safety valve is set at the maximum allowable working pressure of the inner vessel, and is sized by CGA rules to relieve the boil-off expected if the tank were to experience a loss of vacuum.

The inner vessel is protected by rupture discs with a room temperature rated rupture pressure that is 50% above the safety valve setting. This rating is necessary to avoid premature creep failure of the disc, and is still slightly below the inner vessel maximum tested pressure. These tanks have a fully replaceable style rupture disc in a union style holder.

This tank has "dual” safeties. A safety valve and a rupture disc safety head are connected to each of the two outlets of a three-way valve, the inlet of which is connected to the tank vent line. The three-way valve is of a design that always has at least one of its outlets connected to the inlet, but can isolate either outlet. This permits removing a safety device for test or repair without blowing the tank down to atmospheric pressure.

Jacket safety heads are intended to relieve any positive pressure, which might result from a leak in an inner vessel, from the jacket. The standard jacket safety is a Chart design stainless steel nozzle with an O-ring. Being held closed only by atmospheric pressure external, this nozzle will relieve at extremely low positive jacket pressure.

Pressure relief devices used on Chart vessels designed for the U.S. specifications meet the requirements of CGA Pamphlet S-1.3, “Pressure Relief Device Standards, Part 1, for Stationary Vessels.”

Vacuum

The standard vacuum gauging equipment is a thermocouple vacuum gauge tube. This tube is a Hastings model DV-6R and will require a Hastings vacuum gauge to measure vacuum level.

Full Trycock

The "Full Trycock" is an internal line that ends inside the inner vessel at the highest level to which the vessel is intended to be filled, and has a valve outside the outer vessel. If this valve is opened during the later stages of filling, it will emit very cold vapor until the liquid level reaches the open end of the line, when it will start to emit liquid. The change from vapor emission to liquid emission is both visible and audible. At this point the fill should be terminated.

Gauges

The standard method of measuring contents is by means of a differential pressure instrument (“Contents Gauge”) connected to the top and bottom of the tank which reacts to the pressure difference caused by the weight of the liquid. A content table, showing the quantity of contents as a function of gauge reading, is shown in the Specifications section.

These instruments are not directly affected by the total tank pressure; however product density does change with total pressure. Because of the density change, contents tables in gallons vary considerably with pressure; and because the average density is not directly related to the tank pressure, it is very difficult to select the correct table to use.

However, the number of pounds or equivalent standard cubic feet, of product represented by any given gauge reading changes very little with product density and pressure.

These instruments are connected with three valves - a liquid side shut-off (HCV-10), a gas side shut-off (HCV-8), and an equalization valve (HCV-9). The equalization valve creates a bypass around the liquid level indicator (LI-01). It connects the liquid side to the gas side and is used for checking the instrument. By closing both shut-off valves and opening the equalization valve, the pressure is made the same on both sides of the instrument and a properly operating instrument will read "0" inches of water, regardless of the tank pressure.

If the two shut-off valves and the equalization valve are left open, at the same time, the instrument lines become a small “pressure build-up circuit” and cause a slow rise in tank pressure. Always follow proper procedures when working on the liquid level gauge to avoid damage to the gauge.

The tank pressure gauge (PI-1), which indicates pressure inside the inner vessel, is a standard Bourdon tube pressure gauge that has been cleaned for oxygen service.

Gauge / Valve Photos

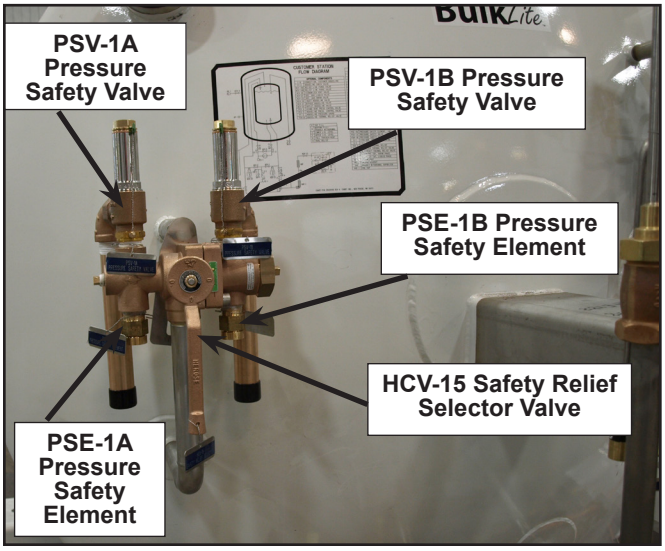


Figure 1 - Tank front, left side

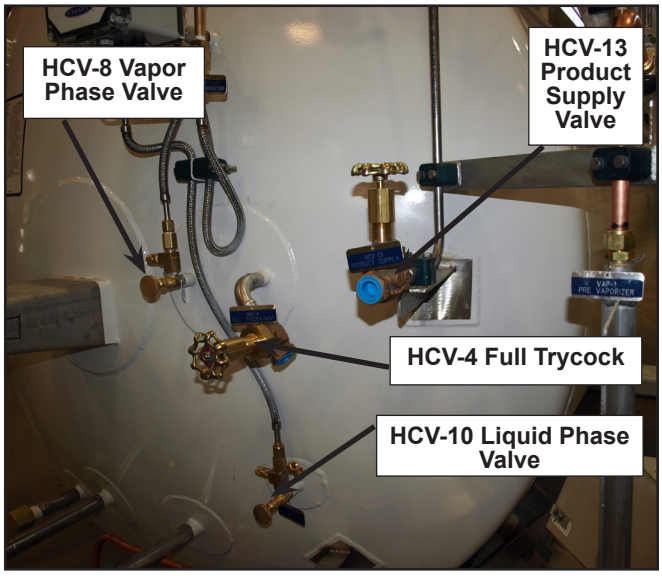


Figure 2 - Tank front, right side

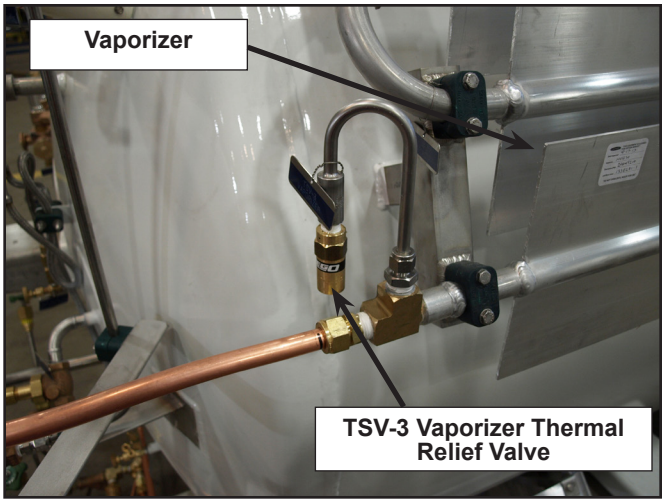


Figure 5 - Vaporizer and Vaporizer Thermal Relief Valve

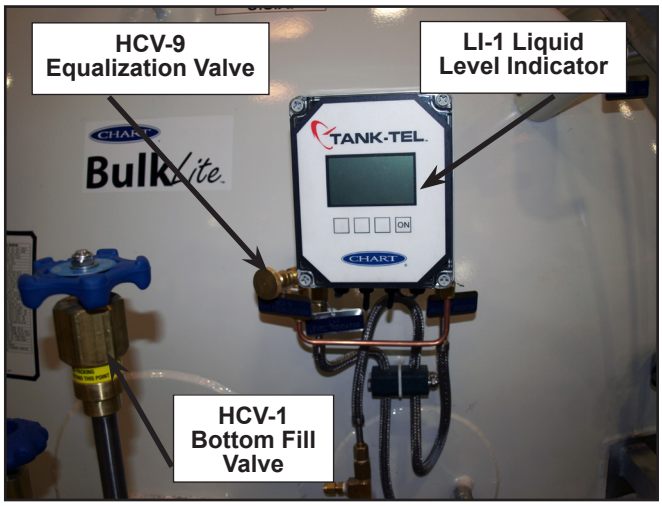


Figure 3 - Tank front, upper right

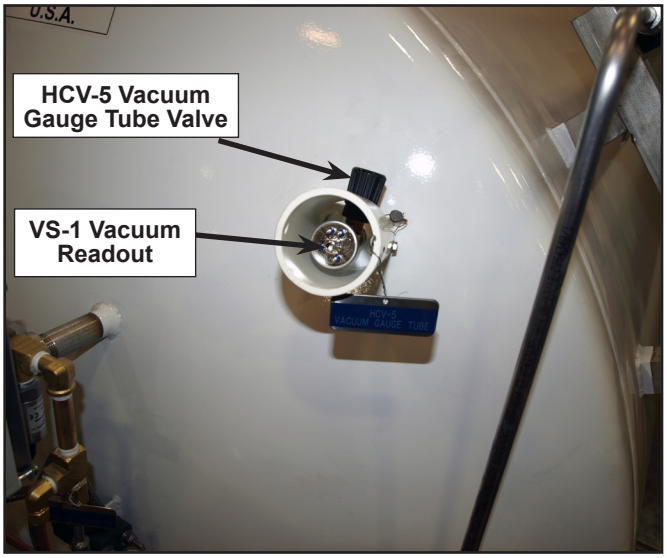


Figure 6 - Vacuum Gauge Tube

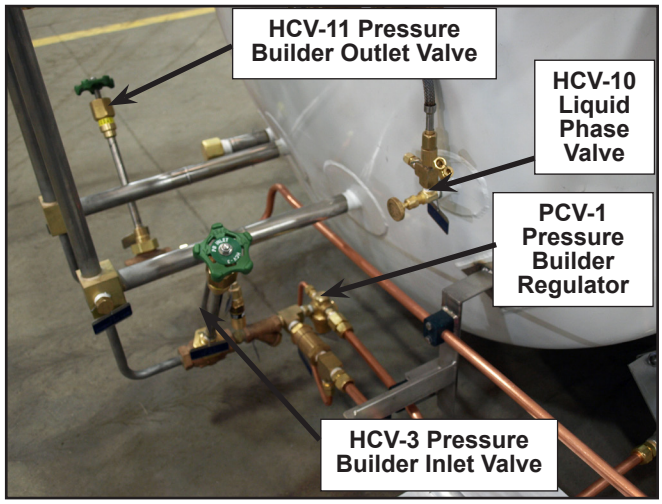


Figure 4 - Tank front, bottom right

Inspection and Installation

Receiving inspection is one of the most important operations in the life of the tank, and should be done thoroughly and conscientiously so as to find any possible indications of damage, and prevent expensive surprises during first use of the vessel on-site.

Cryogenic storage and distribution tanks are carefully designed and engineered to hold a cryogenic liquid with minimum losses from conduction, convection and radiation. These tanks are not designed to be operated from any position except the designed horizontal position. Stationary vessels are not designed for transport over rough roads, railroad tracks, etc.

Upon receiving the BulkLite 1400 Horizontal Storage Unit, inspect for the following:

- Any shipping damage to the tank including dents, cuts, and broken or bent plumbing components. Report damage to the shipping company immediately.
- Examine welded or brazed joints on plumbing for cracks or deformation, especially near valves and fittings.
- Check points where pipes exit the tank for cracks or breaks.
- Check relief valves and burst discs for dirt or damage.
- Examine the 5g impactograph. This is typically found on the inside of one of the tank's legs. If it has sprung, damage may have occurred during shipment. Notify your company's tank specialist and/or Chart.
- Check for gas pressure in the inner vessel. Vessels are shipped with 10 to 20 psig nitrogen pressure. If the pressure is in this region on arrival, the piping must be free from leaks. If pressure is zero, extra precautions against contamination and impurities must be taken.
- Check the insulation space pressure with a suitable thermocouple vacuum gauge. Make note of the ambient temperature when the vacuum is read. Temperature changes affect the vacuum reading in a warm empty vessel.
  - **If warm vacuum is above 20 microns, consult factory.**
- Your BulkLite is shipped with NF purity nitrogen gas. Purging is necessary prior to filling

Vacuum Check Procedure

The standard Chart vacuum probe is a Teledyne-Hastings DV-6R probe. Select a compatible instrument to read the output of the vacuum probe.

Caution! Unauthorized changing of the vacuum probe will void vessel warranty.

1. Remove the rubber cap on probe outlet to expose contact. Note that probe housing need not be opened to do this.
2. Plug the instrument into the probe and calibrate the instrument.
3. Open the vacuum probe isolation valve. Wait for 5 minutes and take vacuum reading. Note that valve handle protrudes through protective housing and can be turned without opening the housing.
4. Close the isolation valve and take a second reading. Monitor the rate of rise in the vacuum probe with 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.
5. Verify that the isolation valve is closed.
6. Replace the rubber probe cap.
7. Compare the vacuum reading obtained now to the reading taken prior to shipping.

Storage

If tank will be stored for a considerable period:

- Protect it from vandals and "valve twiddlers";
- Maintain a positive pressure of nitrogen in the inner vessel;
- Keep openings sealed against rain, dirt and insects; and
- Monitor jacket vacuum.

Installation Procedure

The BulkLite 1400 Horizontal Storage Unit has two lifting lugs on the tank top. These lifting lugs allow for placement of the skid by an overhead crane. If a crane is not available, the skid has fork truck access at the sides.

Chart storage tanks are not designed to be lifted or moved unless empty. Never place or move a filled storage tank.

The BulkLite 1400 storage unit may be placed on a pre-cast concrete foundation, asphalt pad or on a class 5 gavel bed, if codes permit. NFPA requires a "firm concrete or masonry foundation."

Caution! If the tank will contain liquid oxygen, it must be placed on a pad. Be sure to check and follow local or special regulations concerning tank siting.

Placement of BulkLite 1400

The tank has a tare weight of 5,200 lbs and a 36” load center. An appropriately sized fork truck should be used to unload/move the tank. Most fork trucks are marked with a maximum load and load center. If the load center of your truck is different than 36” the maximum load for your truck at this distance must be calculated to ensure safe operation. The following equation will help you calculate the maximum load for you truck at a 36” load center.

Fork truck load center in inches / 36 inches x fork truck max load in lbs = New safe load in lbs

The tank should be placed in a location with easy access to all sides of the unit. The tank should receive a maximum amount of sunlight and airflow. There should be convenient access to the controls and gauges and all connections from the tank. If the tank is surrounded by fencing, allow at least three feet – and ideally more – around the tank for access. One must be able to check the tank gauges and controls.

Consideration should also be given to the external vaporizer orientation. The vaporizer should receive a maximum amount of sunlight and wind exposure for optimal operation.

Important considerations:

- The BulkLite 1400 assembly weighs approximately 5,200 lbs. empty (2,359 kg).
- It is important that the sun and wind contact both the external vaporizer and pressure build coils to insure optimal operation of the unit and prevent the unusual buildup of ice.
- Do not locate the BulkLite 1400 near equipment that produces excessive moisture, such as cooling towers, drains, etc.

Permanent placement without a pad is acceptable providing the local substrate can handle the weight and the local jurisdiction clears the installation. The BulkLite 1400 weights 21,300 lbs when it is full of argon liquid. With 10 ft^2 of supporting surface under the tank the distributed weight is 2,100 psf. Please note the following chart for approximate load bearing capacity.

Soil Bearing Capacity Table	
Type of Soil	**Load Bearing (Pounds Per Square Foot)**
Rock w/ Gravel	6,000 psf +
Gravel	5,000 psf
Sandy Gravel	5,000 psf
Sand	3,000 psf
Silt Sand	3,000 psf
Silt Gravel	3,000 psf
Gravel w/ Clay	3,000 psf
Clay	2,000 psf
Sandy Clay	2,000 psf
Silt Clay	2,000 psf

Connections

This tank will require connections to the “Liquid Draw” lines and top fill and bottom fill connection.

Make sure all the materials, cleaning and joining procedures are suitable for oxygen service.

Be sure to install a safety valve in any section of piping where liquid or very cold vapor could be trapped between shut-off or regulating valves, and in the customer's line.

Test all joints.

Note: *The isolation valve on the bulk tank liquid line should not be opened until all plumbing connections are complete.*

Commissioning

With all lines connected, commission the system. The commissioning steps are:

1. Purge
2. Leak check
3. Safety check

Purging the Tank

The vessel should arrive with a positive pressure of nitrogen. It is necessary to purge the vessel with clean, dry nitrogen to achieve the required purity.

Caution! It is important to purge the tank with warm, dry gas (gas of service) before running the system with liquid. Water vapor can cause ice crystals to form, which may cause controls to freeze open or close.

Purging will depend on the supplies and equipment available. The major point is that no liquid should be allowed in the vessel until the gaseous contents are of the desired purity. Once contaminated liquid is in the vessel, it is a slow and costly operation to get it out completely.

The maximum purge pressure should be equal to 50% of the maximum operating pressure of the tank or 30 psi (2.1 kg/cm^2), whichever is less. The maximum purge pressure should 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/cm^2) must always be maintained in the tank.

Note: *The pressure building/economizer regulator or pressure building regulator in the dual regulator system is normally set to build pressure to 120 psi. When this pressure is used as the purge pressure, DO NOT adjust the regulator adjusting screw.*

1. Attach the source of liquid purge to the fill connection.
2. Close all valves except the pressure build-up valves and liquid level gauge vapor phase and liquid phase shutoff valves.
3. Open hose drain valve, and allow source to vent through hose.
4. Vent until slight frosting appears on hose.
5. Open hose drain valve and allow source to vent through hose. Vent until slight frost appears on the hose, then close hose drain valve.
6. Open the bottom fill valve enough to allow liquid to flow slowly into the tank through the bottom fill line. The gradual flow enables the liquid to vaporize in the line and pressure buildup coil and slowly build up pressure in the inner tank.
7. Shut off the liquid supply source when the pressure in the tank reaches the maximum purge pressure as indicated on tank pressure gauge.
8. Open the fill line drain valve slowly to avoid splashing of the liquid. Drain all liquid from the tank. The appearance of gas (vapor) at the drain indicates that all liquid has been drained.
9. Close drain valve and bottom fill valve.
10. Open the liquid level gauge equalization valve to prevent damage to the gauge before closing the liquid level gauge vapor phase and liquid phase shut-off valves. When all liquid is drained, close the liquid level gauge vapor phase and liquid phase shut-off valves.
11. Loosen the unions on either side of the liquid level gauge. Both the upper and lower liquid level gauge valves should be opened wide and the gas streams 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: *A 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.*

12. Open the vapor vent valve and full trycock valve. The top fill valve will have to be vented by opening hose drain valve.
13. Repeat purge procedures 2 through 6 and 10 at least three times to ensure product purity.
14. Reconnect the liquid level gauge, open the liquid level control valves and then close the equalization valve.
15. After purging the tank, but before filling, verify that the following valves are open or closed as indicated.

Valve	Position
Bottom fill valve	Closed
Top fill valve	Closed
Vapor vent valve	Closed
Full trycock valve	Closed
Liquid level gauge equalizing valve	Closed
Product supply valve	Closed
Pressure building inlet/outlet valves	Closed
Economizer isolation valve	Closed
Liquid level gauge liquid phase valve	Open
Liquid level gauge vapor phase valve	Open

Vessel Purge

It is good practice to blow out all lines - particularly gauge lines - during the cool-down phase of the initial fill.

When all connections to the BulkLite 1400 are made, pressure the complete system using low-pressure gas. With all the lines connected, follow these steps:

1. Crack open the Bulk Tank Isolation Valve to allow a low flow of liquid to flow to the system.
2. Regulate the valve to assure that liquid vaporizes in the feed line.
3. Allow the pressures to equalize.

Leak Check

Leak check all fittings by spraying them with a liquid soap solution. Bubbles indicate loose fittings. Although the system is pressure tested at the factory, it is not uncommon for threaded fittings to vibrate loose during shipment.

Inspect Safety Circuits

Check all fittings, lines and relief valves to assure that they did not incur damage during shipment. If damage has occurred, repair the system with proper procedures and components.

Operation

Initial Fill

The initial fill is usually performed on a warm vessel that has not been in use for an extended period. The warm container must be purged to ensure product purity.

Filling of the tank may be from the plant or initially from a transport.

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

- 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.
- The vessel may be filled by pumping or pressure transfer. If vessel pressure is at least 50 psi (3.5 kg/cm^2) less than the maximum allowable pressure of the supply unit, liquid may be transferred by pressure transfer. If the normal working pressure of the station is equal to or greater than the maximum allowable pressure of the supply unit, liquid must be pumped into the tank.
- 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.

When changing service, the approved CGA (or other keyed) fitting will have to be installed for connection FC-1.

The important consideration is: **FILL A WARM TANK SLOWLY.** Once the tank is filled and the regulating valves set, the vessel is ready to go into service.

Be sure manual valves are as listed below, and open any additional shut-off valve to the customer's piping.

Valve	*Position*
Vacuum Valve	Closed tight and sealed
Thermocouple Tube Shut-Off	Closed
Full Trycock	Closed
Contents Gauge By-Pass	Closed
Vent Valve	Closed
Contents Gauge Liquid & Vapor	Open, at least partially
Liquid Withdrawal Valve(s)	Open
Top Fill	Open
Vapor Shut-Off Valve	Open
Pressure Build Manual Valve	Open

1. Purge tank to assure product purity
2. Verify that the content of the supply unit is the proper product to be transferred.
3. Verify that all valves except liquid phase-high (HCV-10) and gas phase-low (HCV-8) are closed.
4. Connect the supply unit transfer hose to tank fill connection (FC-1).

***Note**: Cool down the transfer hose prior to filling by opening hose drain valve (HCV-7) and venting the supply unit through the hose for approximately three minutes. Close drain valve (HCV-7).*

5. Open bottom fill valve (HCV-1) slowly.
6. For **PRESSURE TRANSFER** allow pressure to build up in the liquid supply unit until it is at least 50 psi (3.5 kg/cm^2) higher than station pressure. Open the discharge valve on the supply unit to begin flow.

   (or)

   For **PUMP TRANSFER** make the required connections to the pump. Open the supply unit transport discharge valve slowly. Maintain pump discharge pressure from 50 psi (3.5 kg/cm^2) to 100 psi (7.0 kg/cm^2) higher than the tank pressure. Fill slowly.
7. Monitor pressure in tank during filling. If pressure rises above supply pressure, or near relief valve pressure, the tank may have to be vented through the vapor vent valve (HCV-4), should pressure continue to rise, the fill may have to be interrupted to allow pressure to drop.
8. Monitor liquid level contents gauge (LI-1). When the gauge indicates approximately three-quarters full, open full trycock valve (HCV-4).
9. When liquid spurts from full trycock valve (HCV-4), immediately stop fill at the supply source and close full trycock valve (HCV-4).
10. Close bottom fill valve (HCV-1).
11. Drain residual liquid in the fill hose via drain valve.
12. Relieve fill hose pressure by loosening the hose at fill connection; then disconnect the hose. It is recommended that the fill hose be allowed to defrost to prevent moisture from being drawn inside the hose.

Refilling Tank

Note: *Filling a cryogenic vessel through the bottom tends to raise pressure in the vessel as gases in vapor space are compressed. Filling through the top tends to lower pressure as gases in head space are cooled down and re-liquefied.*

1. Verify that the contents of the supply unit are the proper product to be transferred.
2. Verify that the bottom and top fill valves are closed.
3. Verify minimum required operating pressure in vessel.
4. Verify that all other valves are in normal operating positions.
5. Connect the supply unit transfer hose to tank fill connection.

Note: *Cool and purge down the transfer hoses prior to filling by opening hose drain valve (HCV-7) and the supply unit discharge valve for approximately three minutes or until hose begins to frost. Close drain valve.*

6. Open top fill valve completely.
7. For **PRESSURE TRANSFER** allow pressure to build up in the liquid supply unit until it is at least 50 psi (3.5 kg/cm^2) higher than station pressure. Open the discharge valve on the supply unit to begin flow.

   (or)

   For **PUMP TRANSFER** make the required connections to the pump. Open the supply unit transport discharge valve slowly. Close pump circulating valve slowly, so as not to lose pump prime. Maintain pump discharge pressure from 50 psi (3.5 kg/cm^2) to 100psi (7.0 kg/cm^2) higher than tank pressure.
8. Monitor pressure in vessel as indicated. If pressure begins to drop to near the minimum operating pressure, begin to open bottom fill valve, and throttle top fill valve, until pressure stabilizes.
9. Monitor liquid level contents gauge. When the gauge indicates approximately three-quarters full, open full trycock valve.
10. When liquid spurts from full trycock valve, stop fill at the supply source and close full trycock valve.
11. Close tank fill valve.
12. Drain residual liquid in the fill hose via drain valve.
13. Relieve fill hose pressure by loosening the hose at the fill connection, and then disconnect the hose.

Gas Withdrawal Procedure

1. Connect customer line to vessel gas use connection or to the optional final line connection if used.
2. Verify that all valves except gauge liquid phase and gauge gas phase are closed.
3. Open product supply valve, pressure building inlet valve, PB outlet valve, and economizer shut-off valve to start gas flow. At this time, final line pressure gauge will be indicating pressure in the customer line and the system will automatically deliver gas until stopped, or vessel is empty.
4. The liquid regulator will not open until the set pressure is reached, thus preferentially drawing vapor off the head space.
5. Once the required amount of product has been delivered (or to close the tank down for an extended period of time), stop gas flow by closing gas use valve.

Normal operating valve positions for a BulkLite unit are:

Valve	Position
Bottom Fill Valve	Closed
Top Fill Valve	Closed
Vapor Vent Valve	Closed
Full Trycock Valve	Closed
Liquid Level Gauge Equalizing Valve	Closed
Hose Drain Valve	Closed
Product Supply Valve	Open
Pressure Building Inlet/Outlet Valves	Open
Economizer Isolation Valve	Open
Liquid Level Gauge Liquid Phase Valve	Open
Liquid Level Gauge Vapor Phase Valve	Open

Liquid Withdrawal Procedure

Note: *To use the BulkLite 1400 storage unit for liquid, use the "Liquid Withdrawal Package," which consists of a 1" vacuum-insulated female bayonet; vent connected back pressure regulator and low-range PCV-1 spring for low liquid loss and accurate tank pressure control.*

A non-vacuum jacketed isolation valve can also be ordered for an un-insulated liquid withdrawal.

1. Connect customer line liquid withdrawal connection.
2. Verify that all valves except gauge liquid phase valve and the gauge gas phase valve are closed.
3. Observe pressure building regulator/economizer regulator or pressure building regulator in the dual regulator system setting as indicated on the station pressure gauge. If station pressure is too high, open vent valve to relieve excessive gas. It is possible that regulator springs will require changing for lower operational pressure.
4. Open liquid withdrawal valve slowly to begin liquid flow.
5. Once the desired amount of liquid has been delivered, close the liquid withdrawal valve.

Maintenance

Re-evacuating the Vessel

The insulation space should be re-evacuated any time the pressure gets too high. What pressure is "too high" cannot be exactly defined. It will depend on the application. Heat leak into the vessel increases gradually with pressure. An installation using large quantities of product at fairly steady rates can stand more heat leak than one using small quantities of gas or one having long periods of no gas consumption at all.

Evacuation of super insulation requires special knowledge and Chart field service should be contacted. For re-evacuating, the pump should be equipped to prevent back flow of pump fluid into the converter in case of power failure. A solenoid valve or electropneumatic vacuum valve in the pumping line will do this and will also stop loss of tank vacuum. A trap in the pumping line, large enough to hold the pump's entire fluid charge, will prevent fluid back flow but will not prevent loss of tank vacuum.

For re-evacuating a cold tank, a compound pump of 8 to 10 cfm capacity is suggested. For a warm tank, where pressures are likely to be higher and gas volumes are likely to be larger, a single-stage pump of 20 to 30 cfm capacity is more suitable.

In either case a suitable flexible hose is needed. This can be either flexible metal or reinforced rubber.

To re-evacuate a cold tank:

1. Connect the pump and hose to the tank evacuation valve,
2. Start the pump and evacuate the line; then
3. Slowly open the tank evacuating valve.

It is desirable to have a thermocouple tube at the pump, and to check that the pump and line blank-off is as low as they should be, before opening tank valve.

The thermocouple gauge can be used while pumping to get an idea of progress. Sometimes there is an appreciable gradient within a tank insulation space while pumping: when the pumping is stopped, pressures equalize and pressure at the tube may increase. Therefore, when evacuation appears complete, close the evacuating valve, wait 10 minutes, and reread the gauge. If there is no change, evacuation is complete.

Replacing the Thermocouple Tube

1. Close the gauge shut-off valve. In unscrewing the old tube, be very careful not to disturb the joint on the other side of the valve.
2. Put thread-sealant on a new tube (starting one thread from the open end) and screw it into the valve. Again, be careful of the joint behind the valve.

Note: *Teflon tape is a good sealant for most pipe thread joints, but it is useless on vacuum joints*

3. Check for leakage.

Replacing the Liquid Level Gauge

If the liquid level gauge (LI-1) is ever damaged and needs to be replaced, these procedures need to be followed to ensure a proper transition that does not damage the new gauge.

1. Close liquid side isolation valve (HCV-10)
2. Close gas side isolation valve (HCV-8)
3. Open equalization valve (HCV-9)
4. If the gauge does not read “0” in H_2O, or if there is anything else wrong with the gauge it can now be removed from the tank
5. Install new liquid level gauge (LI-1)
6. Ensure the equalization valve (HCV-9) is OPEN
7. Confirm that the new gauge reads “0” in H_2O
8. Open gas side isolation valve (HCV-8)
9. Open liquid side isolation valve (HCV-10)
10. Close equalization valve (HCV-9)

Replacing Jacket Safety O-Rings

On tanks for atmospheric gases, it is entirely practical to replace o-rings while the tank is in service.

1. Break the vacuum with dry nitrogen,
2. Lift off the safety head cover, and
3. Remove the old o-ring. Be careful not to scratch the groove surfaces.
4. Carefully clean the o-ring groove, the sealing surface and the new o-ring.
5. Coat the new o-ring with a very thin layer of vacuum grease,
6. Place it in the o-ring groove, and
7. Install the cover.
8. Hold the cover down until there is enough vacuum to hold it.

Replacing the Rupture Disc

The rupture disc is a throw-away style and must be replaced entirely if ruptured.

1. Switch selector valve (HCV-15) to other side.
2. Depressurize the isolated side of the relief valve system by opening HCV-16A or HCV-16B. If the tank is not equipped with HCV-16A or HCV-16B then slowly loosen PSE-1A or PSE-1B allowing pressure to escape.
3. Remove burst disc (PSE-1A or PSE-1B).
4. Install new burst disc (PSE-1A or PSE-1B), making sure that mating surfaces are clean and properly seated. Use an oxygen compatible liquid thread sealant to prevent leaking.

Replacing the Inner Vessel Safety Valve

1. Isolate the bad safety valve with the switch valve and wait for the safety valve to defrost.
2. Open the safety test valve, if equipped (optional), to vent off excess pressure.
3. Unscrew the short outlet tube from the safety valve.
4. Unscrew the safety valve from the inlet fitting, using two wrenches to minimize the strain on inlet piping.
5. Put suitable thread sealant on the inlet threads of the new safety valve.
6. Install safety valve, again using two wrenches.
7. Install outlet tube in safety valve, aiming it down and under the tank.
8. Open the switch valve to new safety valve and test inner joint.

Replacing the Line Safety Valves

1. Isolate the safety valve by closing appropriate manual valves (be sure this won't unnecessarily upset your customer's operations).
2. Bleed the line section by use of the corresponding bleed valve.
3. Remove the safety, using one wrench on the safety valve and another on the fitting.
4. Install new safety valve, using suitable thread sealant and again using two wrenches to avoid twisting piping.
5. Reopen manual valves closed above.
6. Check for leaks.

Troubleshooting

The following table is arranged in a Trouble/Probable Cause/Remedy format. The probable causes for specific problems are listed in descending order of significance. That is, check out the first cause listed before proceeding to the next.

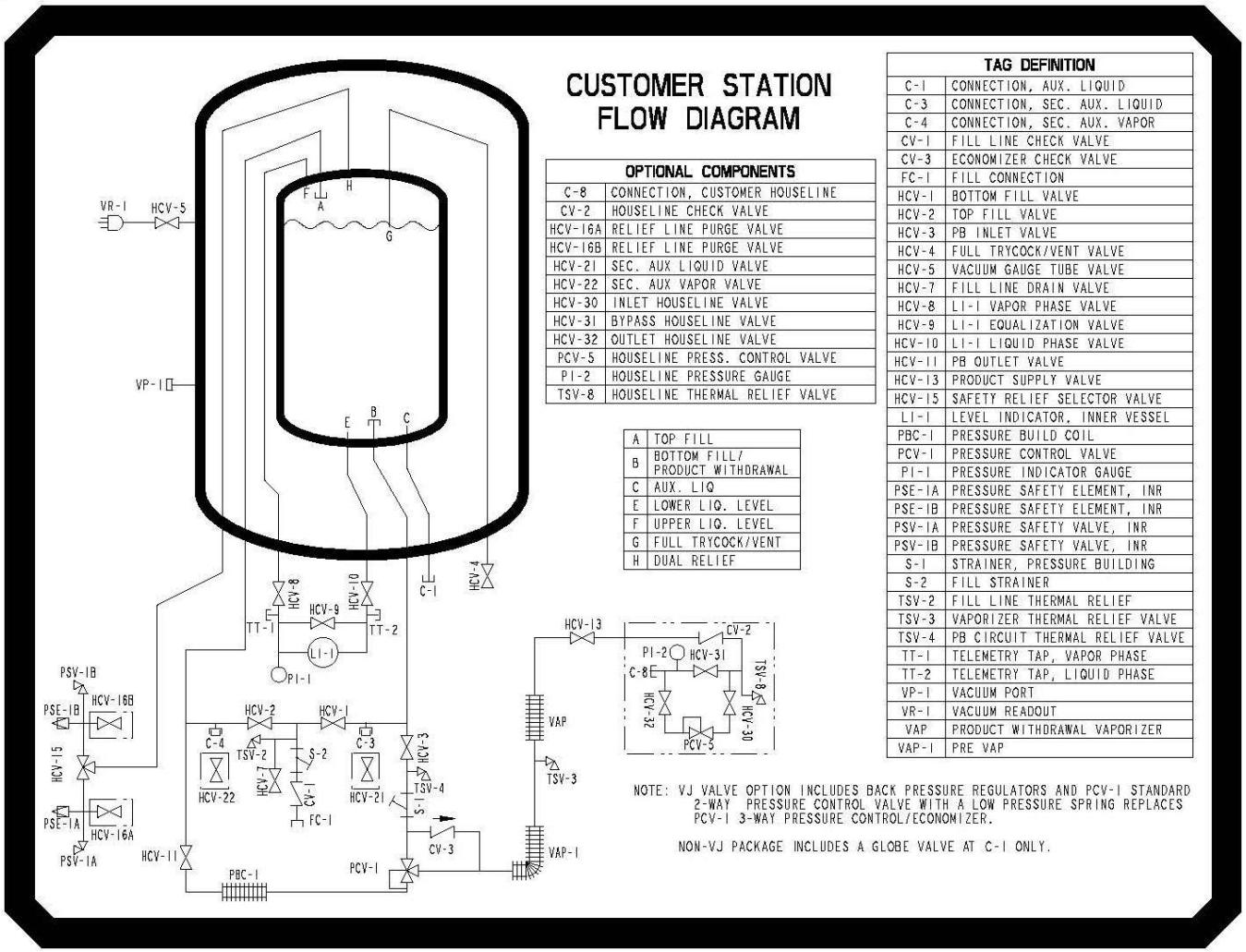
Problem	*Cause / Diagnosis*	*Correction*
Too much pressure in the tank	Low / No product usage	To ensure no venting of product or excess pressure in the tank, ensure that product usage is at least the same if not more than the NER of the tank. For the BulkLite tank the NER is 0.45% for N_2. So you should use at least 0.45% of the 1,400 gallon tank - or 6.3 gallons - daily.
Not enough pressure in the tank	Pressure builder inlet valve closed	Ensure that both the pressure builder inlet valve (HCV-3) and the pressure builder return valve (HCV-11) are open.
	Overdrawing the tank	Draw less product from the tank in order to allow the pressure builder to keep up.
Tank will not build enough pressure	Pressure builder inlet valve partially closed	Ensure that both the pressure builder inlet valve (HCV-3) and the pressure builder return valve (HCV-11) are open.
	Pressure builder regulator set too low	Check the screw setting on the pressure building regulator (PCV-1). Screw it in to increase the pressure builder setting.
No pressure but tank contains product	Manual vent valve open	Ensure that the manual vent valve (HCV-4) is closed. Pressure building from this point will be very slow. To help pull liquid into the pressure building coil (PBC-1), open the gas use valve (HCV-13) or draw product from the tank. This should pull liquid into the pressure building coil and build some subcool in the tank, allowing the pressure to build more quickly.
	Safety valve is leaking	Ensure all safeties are closed (PSV-1A, PSV-1B). If a safety valve has opened to relieve pressure in the tank, it may freeze open. Switch safeties using safety selector valve (HCV-15), or thaw out the frozen safety.
Pressure surges during normal operation	Check valve in gas withdrawal line	This is normal. At startup or during periods of heavy draw, the vaporizer will pull in a large quantity of liquid. This liquid then flashes to gas rapidly and back pressure closes the check valve (CV-3). More product is not drawn into the vaporizer until the pressure drops below the tank pressure.
Pressure in the tank but not supplying enough gas.	Gas supply valve partially closed	Ensure all valves in the gas supply line are fully open (HCV-3, HCV-13).
	Undersized tank	A BulkLite 1400 tank is rated for 2000 scfh with the attached vaporizer and pressure builder. The attached pressure builder is capable of sustaining flows up to 8,000 scfh if additional vaporizers are provided. If pressure builder is operating correctly and there is still not enough flow, then the tank is undersized for the application.
Gas too cold at usage point	Overdrawing the vaporizer	Draw less product from the tank in order to allow the vaporizer to keep up, or • Add trim heaters, or • Add additional vaporization A BulkLite 1400 tank is rated for 2,000 SCFH with the attached vaporizer.

Problem	Cause / Diagnosis	Correction
Safety valves open	Liquid in vaporizer during normal operation	During times of long or heavy draw, the system will pull a large amount of liquid into the vaporizer. When the demand is shut off and the pressure in the vaporizer is not bled back into the tank fast enough, the safety (TSV-3, TSV-4) may open to relieve pressure in the vaporizer.
	Pressure in the tank is higher than 250 psig	To ensure no venting of product or excess pressure in the tank, ensure that product usage is at least the same if not more than the NER of the tank. For BulkLite the NER is 0.45% for N2. So you should use at least 0.45% of the 1,400 gallon tank - or 6.3 gallons - daily.
Safety valves stuck open	Frozen open	Switch safeties using safety selector valve (HCV-15) or warm safeties to get them to close.
Liquid level gauge reads too low	Too much liquid in the liquid phase line	There may be a leak in the high phase DP line to atmosphere and/or leakage across the isolation equalization valve. This valve could also leak to atmosphere. These leaks allow liquid to push up toward the gauge (still in the vacuum space), thus reducing the level reading. Also, check the zero point of the liquid level gauge. The gauge could also be defective. If so, replace gauge.
Liquid level gauge reads too high	Leaks? Defective gauge?	If the liquid level gauge reads too high, it could be leaks to atmosphere on the low phase DP line (but would need to be big). Check the zero point. Check for defective gauge.
Liquid level gauge reading is bouncing	Not enough subcool on the liquid	If the tank is at or near 0 psig, there is very little to no subcool on the liquid. This affects the liquid in the liquid phase line. Adding some subcool to the tank will stabilize the reading.
Pressure gauge is not reading correctly	Isolation valve closed	Ensure gas phase isolation valve (HCV-8) is open so tank pressure gauge can detect tank pressure.
	Bad / Broken pressure gauge	Replace pressure gauge (PI-1)
Frost on the outside of the tank away from any piping	Bad vacuum	Check the vacuum level of the tank using vacuum connection (VR-1); ensure valve (HCV-5) is open to check vacuum level. If the vacuum level is above 100 microns call Chart for service.
Frost around a valve which is shut off	Valve packing is leaking	Leak check the valve packing and tighten if necessary. If packing still leaks, follow valve repair instructions.

Specifications

Gross Capacity		Nominal Capacity		MAWP*		Flow Rate**		Width		Height		Length		Weight***		NER %/day	
Gal	Liters	Gal	Liters	psig	bar	SCFH	m³/hr	in	mm	in	mm	in	mm	lbs	Kg	O_2/Ar	N_2
1380	5224	1330	5035	250	17.2	2000	56.6	72	1829	69	1753	189	4800	5200	2359	.28	.45

*MAWP - Maximum Allowable Working Pressure, Section VIII Div. 1 ASME code.
**Eight hours continuous flow @ 80% duty cycle in room temp w/LN_2.
***Weights are for ASME design.



Contents Table

BulkLite 1400: Nitrogen saturated @ 25.0 psi. The table shows quantity of contents as a function of gauge reading.

Level (in H_2O)	Volume (gal)	Weight (lb)	GasVol (SCF)
0	0	0	0
0.6	0	132	1,817
1	3	152	2,100
2	16	230	3,172
3	33	340	4,691
4	55	474	6,548
5	79	629	8,683
6	107	801	11,057
7	136	988	13,639
8	168	1,188	16,403
9	202	1,400	19,329
10	238	1,623	22,399
11	274	1,854	25,595
12	313	2,094	28,904
13	352	2,341	32,310
14	392	2,594	35,801
15	433	2,852	39,363
16	475	3,114	42,986
17	518	3,380	46,657
18	560	3,649	50,366
19	603	3,920	54,100
20	647	4,191	57,850
21	690	4,463	61,604
22	733	4,735	65,352
23	776	5,005	69,082
24	819	5,273	72,784
25	861	5,539	76,446
26	903	5,800	80,058
27	944	6,057	83,607
28	984	6,309	87,082
29	1,023	6,555	90,470
30	1,061	6,793	93,757
31	1,098	7,023	96,929
32	1,133	7,243	99,971
33	1,166	7,453	102,867
34	1,198	7,650	105,596
35	1,227	7,835	108,138
36	1,254	8,003	110,467
36.9	1,275	8,135	112,279

Warranty

Chart Inc. warrants to the purchaser of any Chart manufactured equipment that for ninety (90) days after invoice said Chart manufactured equipment shall be free from any defects in workmanship and materials, and that for five (5) years after the date of shipment to the original purchaser said Chart manufactured equipment will maintain all vacuum and performance standards for said equipment as published by Chart on the date of invoice.

Purchaser agrees that as a pre-condition to any Chart liability hereunder, purchaser shall fully inspect all goods immediately upon delivery to purchaser and shall give Chart written notice of any claim or purported defect within ten (10) days after discovery of such defect. As a further pre-condition to any Chart liability hereunder, purchaser shall return said purportedly defective equipment, freight prepaid, to the plant of the manufacturer. Chart shall inspect all returned equipment, and, if said equipment is found defective, shall, at its option as purchaser's sole and exclusive remedy, repair or replace such equipment or any defective component or part thereof which proves to be defective, or refund the net purchase price paid by the original purchaser. Alterations or repairs by others or operation of such equipment in a manner inconsistent with Chart accepted practices and all operating instructions, unless pre-authorized in writing by Chart, shall void this warranty. Chart shall not be liable for defects caused by the effects of normal wear and tear, erosion, corrosion, fire or explosion.

Chart's sole and exclusive liability under this Warranty is to the original purchaser and shall not exceed the lesser of the cost of repair, cost of replacement, or refund of the net purchase price paid by the original purchaser. Chart is not liable for any other losses, damages, or costs of delays, including incidental or consequential damages. CHART SPECIFICALLY MAKES NO WARRANTIES OR GUARANTEES, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, OTHER THAN OR WHICH EXTEND THOSE WARRANTIES EXPRESSED HEREIN.