Product Manual

Siphon 100™ Bulk Storage Tank

Designed and Built by:

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Contents

Revision Log

Revision Level	Date	Description
A	07/13/2011	Initial publication
B	03/14/2014	Reformat and update
C	04/01/2014	Add Thermosiphon Diagram to Pump Installation section
D	06/11/2015	Add VS-1500 information to manual

Preface

General

Chart has engineered the Siphon 100™ system to provide an economical, reliable and high performance pumping system for high pressure and liquid cylinder filling. Current cryogenic tank and pumping systems have worked for years, but increased efficiencies are now available with the Siphon 100 system.

The Siphon 100 system combines two revolutionary technologies in cryogenic bulk tanks. Its improved and patented "thermal-siphoning" system reduces and efficiently reprocesses the heat of pumping. Additionally, this system's composite insulation is 30% to 70% more efficient than Perlite in reducing the effects of heat from the atmosphere.

Product Advantages

- Simple and reliable pump start-up in three minutes with 100% product utilization
- Thermal-siphon design manages heat from pump cool-down, keeping storage tank pressure down
- Pump priming at tank pressure of 10 psi (0.69 bar) or less without the necessity for pressure building
- Vacuum insulated pod provides colder liquid to pump reducing cavitation
- Extended legs add head pressure to pump without increasing liquid inventory for improved pump performance
- Reduce liquid cylinder & Orca™ MicroBulk Delivery System filling losses
- Longer life of high-wear pump parts
- Capability to operate two pumps at once (liquid and HP pump)
- Adapters available to match all standard pumps
- Inner vessel designed and built to ASME Section VIII Division 1 Code
- Backed by an industry-leading 5-year vacuum warranty

Product Manual

The Siphon 100 Bulk Storage Tank Product Manual is designed to be used in conjunction with all vertical cryogenic storage tanks with the plumbing and pump operation provided by Chart. If there are any questions regarding the operation of the tank, contact Chart's Technical Service division at 1-800-400-4683.

This manual contains information regarding the safe operation and handling of liquid nitrogen, argon, and oxygen with the tank. It should be thoroughly read and understood by anyone that operates the equipment.

The schematics, piping illustrations, and parts list on the drawings show a reference number for each component used on the tank. The reference numbers may refer to the same functional component between the various models. The reference numbers will be used throughout this manual to draw specific attention to a component while describing its function, operation, or repair.

The safety requirements for operating the tank and handling or transporting extremely cold liquid products are shown in the Safety section. Use this safety section as a "Safety Check-List" each time the equipment is being used.

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

In the Installation section there are illustrations for how to uncrate and install the tank.

The Pump Installation section gives a step by step procedure for the basic installation of pumps.

For information on how to operate the tank refer to the Operations section.

Refer to the Maintenance section for information on how to maintain the tank.

The Specification section describes the specific tank models covered by this manual. This section includes a P&ID and O&D along with a component function table. This section should be reviewed first and referred to as the rest of the manual is read.

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.*

Abbreviations & Acronyms

The following abbreviations and/or acronyms may be used throughout this manual:

Ar	Argon
ASME	American Society of Mechanical Engineers
BAR	Pressure (Metric)
CGA	Compressed Gas Association
Kg	Kilograms
Kg/cm^2	Kilagram force per square centimeter
MAWP	Maximum Allowable Working Pressure
N_2	Nitrogen
NER	Normal Evaporation Rate
NPSH	Net Positive Suction Head
NFPA	National Fire Protection Association
O_2	Oxygen
PB	Pressure Building
PN	Part Number
PSF	Pounds per Square Foot
PSI	Pounds per Square Inch
PSIG	Pounds per Square Inch (Gauge)

Safety

General

The Siphon 100 tank consists of an inner pressure vessel encased within an outer carbon steel vacuum shell. The container operates under low-to-medium pressure, but is protected from over pressurization by use of a rupture disc and a safety relief valve. Safety relief devices are used to protect the pressure vessel and vacuum casing, sized and selected in accordance with ASME and other standards to include a dual relief valve and rupture disc system to protect the pressure vessel, and a lift plate protects the vacuum casing (outer vessel). The tanks are designed and engineered for safe, reliable operations, and will provide many years of trouble-free operation. Strict compliance with proper safety and handling practices is necessary when using a 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 units and safe operations are anticipated, it is essential that every user of the tanks carefully read all warnings and cautions listed in this safety section and contained in the manual itself. Also read the information provided in the safety bulletins for oxygen and inert gases. Periodic review of this safety summary is recommended.

Safety Bulletin

Portions of the following information is extracted from Safety Bulletin SB-2 from the Compressed Gas Association, Inc. Additional information on oxygen, nitrogen, argon, and cryogenics is available from the CGA.

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.

***Caution!* Before locating oxygen equipment, become familiar with the NFPA standard No. 55 "Compressed Gases and Cryogenic Fluids Code" and with all local safety codes.**

Oxygen Deficient Atmospheres

***Warning!* Nitrogen and argon 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.**

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.

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 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 obtainable 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.

Oxygen Cleaning

When replacing components, only use parts which are considered compatible with liquid oxygen and have been properly cleaned for oxygen service (Refer to CGA Bulletin G-4.1 "Equipment Cleaned for Oxygen Service"). Do not use regulators, fittings, or hoses which were previously used in a compressed air environment on these tanks. Only oxygen compatible sealants or Teflon tape should be used on threaded fittings. All new piping joints should be leak tested with an oxygen compatible leak-test solution.

Oxygen Enriched Atmospheres

An oxygen-enriched atmosphere occurs whenever the normal oxygen content of air is allowed to rise above 23%. While oxygen is nonflammable, 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 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 proven 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 alloy) 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.

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.

Nitrogen and Argon

Nitrogen and argon (inert gases) are simple asphyxiates. 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.

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. 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 worker's skin or eyes, the affected tissue should be flooded or soaked with tepid water (105-115ºF or 41-46ºC). DO NOT USE HOT WATER. Cryogenic burns that result in blistering or deeper tissue freezing should be examined promptly by a physician.

Introduction

General

The Siphon 100 tanks are compact and self-contained cryogenic systems designed for the economical storage of liquid nitrogen, oxygen, or argon with the ability to provide liquid to a pump for filling either liquid or gas cylinders.

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 (3000), Inner Material (S), Insulation Type (C), MAWP (175).

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

Features

The tanks are optimized during manufacture for pumping applications with the following specific enhancements:

- Extended one-piece legs.
- Liquid line traps are located below the sump of the pumps being attached.
- Baffles within the inner vessel separate liquid flow in and out of the siphon system.
- Automatic recirculation of the liquid to provide cold liquid to the pump at all times.
- Highly efficient proprietary low loss insulation.
- A set of tank to pump transition piping kits, designed for specific pump models, to provide minimum product loss and repeatable pump starts.

Physical Description

A Chart vessel is designed for long-term storage of cryogenic liquefied gases under pressure.

The vessel 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 fiber, and high vacuum to ensure minimum heat leak. The insulation system, designed for long-term vacuum retention, is permanently sealed at the factory to ensure vacuum integrity.

The stations are leg mounted on one-piece extended legs. On the 1500 gallon units lifting lugs are secured to one leg and to the top head of the container. On larger units, lifting lugs are located on the top and bottom heads. 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. Use tie down lugs provided when transporting tanks on tractor trailer. Do not tie down with pad located at the base of the legs.

Caution! Tanks are not designed to be moved with liquid in the inner container. Vessels must be drained completely before being lifted or moved.

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.

Controls used to operate the system are mounted under and on the sides of the vessel. The pressure gauge and liquid level gauge are located at eye level for ease of viewing.

The current standard piping design does not require a separate pressure building or economizer circuit, as exhaustive tests of the design have shown that no pressurizing is required in order to prime pumps.

The piping can be field modified to add pressure building capabilities should it be used in conventional gas applications.

Safety Devices

The vessels are protected from over-pressurization with a tank pressure relief device. The normal relief device pressure setting is at the operating pressure of the inner vessel. Other relief valve pressure settings are available as long as they are not greater than the operating pressure of the inner vessel.

Each container is further protected from over-pressurization by a secondary rupture disc assembly. This bursting disc will rupture to completely 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 annular space rupture disc assembly.

Note: *Safety devices meet all of the requirements of CGA Pamphlet S-1.2 Safety Relief Device Standards, Part 2, Cargo and Portable Tanks for Compressed Gases.*

Operational Systems

The various models have the same general operating system. Each model has the ability to be filled with a cryogenic product and deliver liquid to the pump for cylinder filling.

The vessel pumping operation is limited to opening and closing liquid supply to the pump(s). This is done with either an air actuated automatic valve connected to a control panel or manual suction and return valves. The air actuated valve with a timer system is recommended.

The following section will discuss the theory behind these operations. The illustrations show a vertically configured tank.

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

The schematic, illustrations, and component function table in the Specifications section show how the plumbing circuitry operated for the specific model of tank. It is important that the operators be familiar with the plumbing control valves.

Filling General

The following recommendations should be used to optimize tank filling:

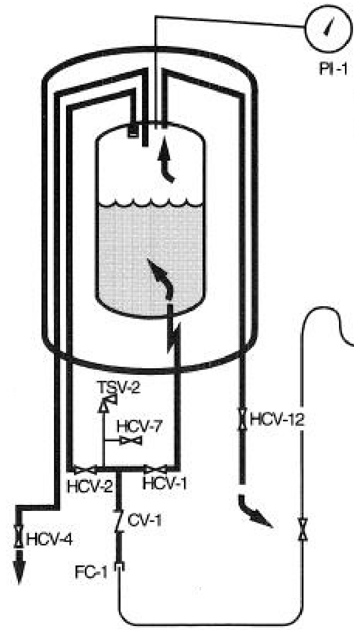
1. Keep the transfer lines as short as possible. Long non-insulated transfer lines will result in higher fill losses and longer fill times.
2. Anytime liquid can be entrapped in a line between two valves, the line must be equipped with a safety relief device.
3. Conduct the filling operation in as short a time as possible.

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.

When filling the unit with liquid, the transfer should be made with a centrifugal pump or through a pressure transfer operation.

Pressure Transfer Filling (Figure A)

Liquid will always flow from a vessel of higher pressure to one with low pressure. This method is commonly used to fill a small tank by connecting a transfer line between the delivery source and the top fill valve (HCV-2) of the tank.



Pressure Transfer
Figure A

Liquid may be transferred into the tank so that venting is not necessary. The top fill valve (HCV-2) on the tank has a spray header that will splash the incoming cold liquid onto the somewhat warmer gas in the tank. The cold liquid will actually collapse the vessel pressure while being sprayed into the warmer gas. The bottom fill valve allows liquid to be transferred into the tank at a fast rate. The tank pressure can be maintained at a constant pressure level (PI-1) by opening the bottom fill valve (HCV-1) completely and throttling open the top fill valve to lower and maintain a constant pressure. All efforts should be made to fill the vessel only through the top fill, in order to lower the vessel pressure as much as possible. The full trycock valve (HCV-4) spits liquid when the vessel becomes full. Do not over fill the tank.

If the pressure in the receiving tank is higher than the transport, blow down of the pressure in the receiving tank may be required.

Since there are many variables in pressure transfer deliveries, it is also possible to connect a transfer line between the delivery source and the bottom fill valve (HCV-1) of the tank. The transfer takes place as the vent valve (HVC-12) of the tank is opened. This allows gas to escape and lowers the pressure in the receiving tank. The full trycock valve (HCV-4) spits liquid when the vessel becomes full. Do not overfill the tank.

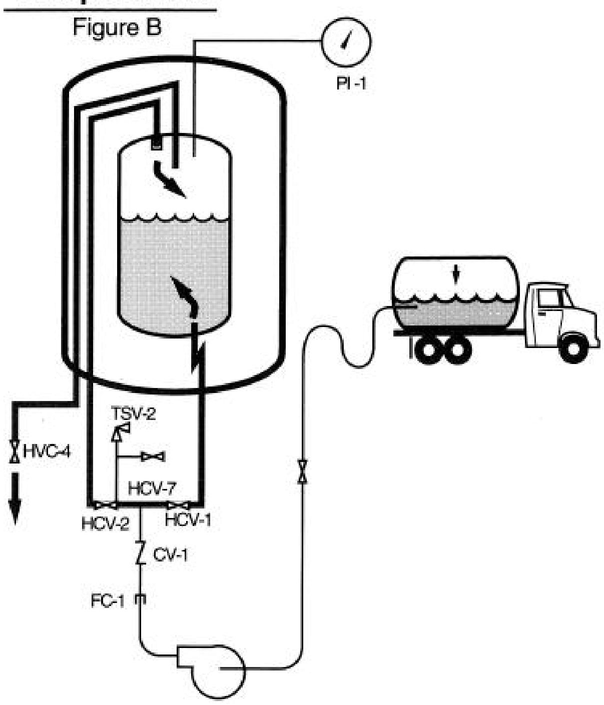
Pump Transfer Filling (Figure B)

The pump transfer method is the most commonly used to fill the tank.

Top filling lowers the product losses associated with filling. Liquid may be pumped into the tank so that venting is not necessary. The top fill valve (HCV-2) has a spray header that will splash the incoming cold liquid onto the somewhat warmer gas in the tank. The cold liquid will actually collapse the vessel pressure while being sprayed into the warmer gas. The bottom fill valve allows liquid to be pumped into the tank at a fast rate. All efforts should be made to fill the vessel only through the top fill, in order to lower the vessel pressure as much as possible. The full trycock valve (HCV-4) spits liquid when the vessel becomes full. Do not over fill the tank.

Pump Transfer

Figure B

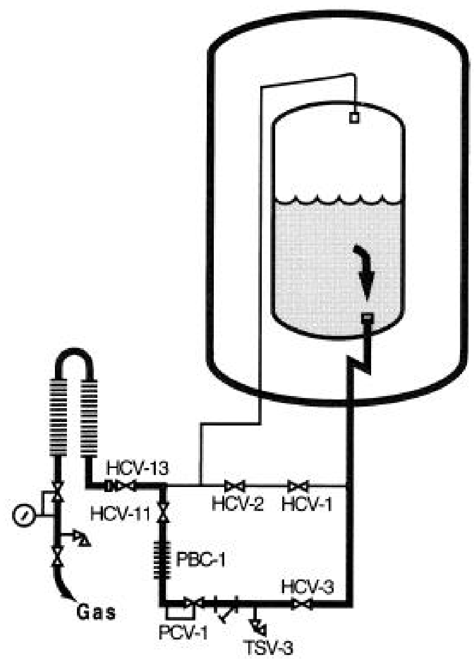


Gas Withdrawal (Figure C)

When a tank is used for gas withdrawal, a customer station add-on kit is available, suited particularly for applications where infrequent high flow requirements interspersed with long periods of no flow. This kit consists of a single regulator and PB coil that can be installed between the legs of the vessel that serves a dual function of maintaining pressure in the (PI-1) vessel and dispensing liquid to the gas use vaporizer.

Gas Withdrawal

Figure C



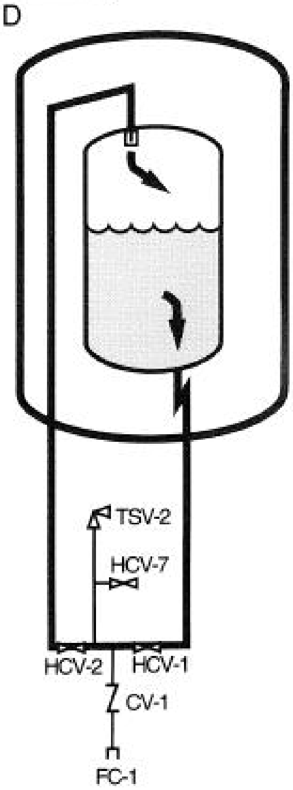
When the supply of gaseous product is the primary operation of the tank, external vaporizers and an additional regulator must be added after the gas use valve (HCV-13) to step down the pressure to the gas application. This regulator is found in the final line option provided by Chart.

Pressure Building (Figure D)

The standard vessel has no PB coil. In case of necessity, such as with very high proportion of liquid cylinder fills, pressure can be raised by allowing liquid to enter the top and bottom fill lines by opening the respective valves (HCV-1 & HCV-2).

Pressure Building

Figure D



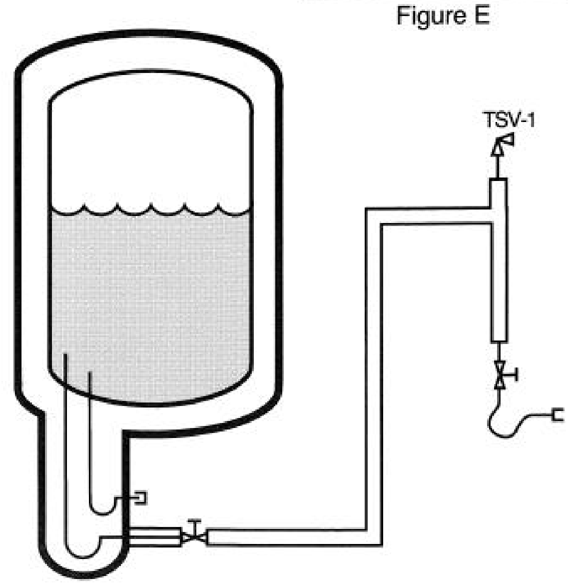
Liquid Withdrawal (Figure E)

If the tank is to be placed in permanent liquid withdrawal service, it is recommended that the liquid withdrawal line be connected to vacuum jacketed piping on the Siphon Pod. The piping will efficiently bring the liquid to the application with the least amount of pressure rise.

Liquid product should be drawn at low pressure from the vessel via one of the siphon connections. It is not recommended that the connection on the bottom fill line (C-3) be used, as this will result in higher losses than required.

Liquid Application

Figure E



Normal liquid withdrawal operations are performed at lower pressure (approx. 50 psig or less)(3.5 Kg/cm^2) to reduce flash-off losses and splashing. For this reason, the pressure building circuit is not necessary for liquid withdrawals. Transfer of liquid at higher pressure can lead to excessive splashing of the cryogenic liquid which could result in burns to the operator and/or nearby personnel. Transfer of liquid at high pressure will result in substantial product losses. All personnel should be fully instructed in the cautions associated with handling cryogenic fluids and the proper clothing and protective gear to be used.

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 cold equipment, or cold gas exist. Safety goggles or a face shield should be warn. Clean, insulated gloves that can easily be removed and long sleeves are recommended for arm protection. Cuffless trousers should be warn over the shoes to shed spilled liquid.***

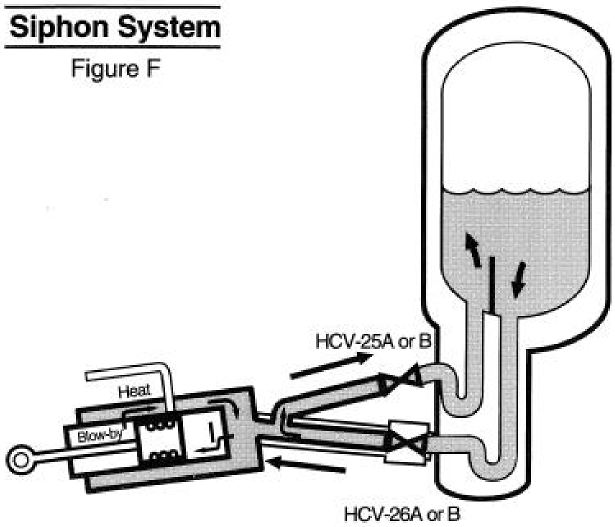
If a higher operating pressure is desired (other than that available through normal heat leak), an optional pressure building kit can be installed.

Siphon Withdrawal (Figure F thru I)

The Chart siphon system causes a continual flow of cold liquid to flow in front of the pump inlet. The liquid returns to the bottom of the inner vessel to distribute the heat picked up from the pumps into the cold liquid.

Siphon System

Figure F



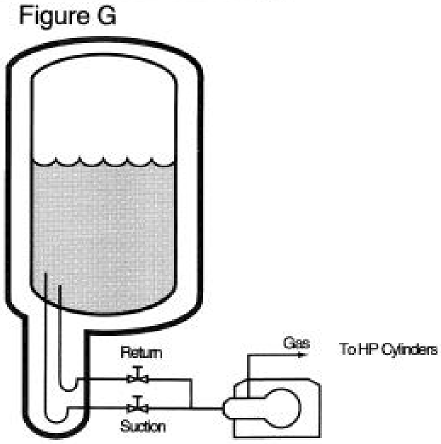
The vessel is designed to efficiently dispense liquid to:

1. A high pressure pump, using patented siphon technology to provide optimum liquid to the pump at all times.

   The siphon feed and return lines are connected to the high pressure pump through a piping adapter that allows for a continuous flow of cold liquid at the inlet of the pump. Flow is controlled by gate and/or ball valves.

High Pressure Cylinder Pump

Figure G

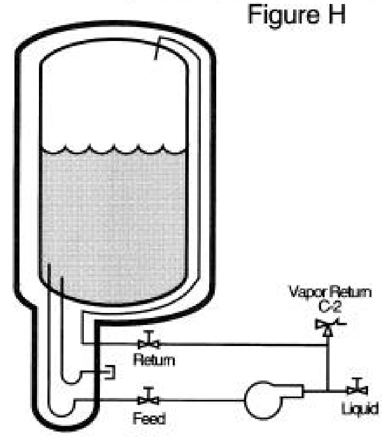


2. With a liquid transfer pump, the very low position of the liquid trap aids in priming and cool-down.

   The liquid transfer pump is connected to the siphon feed or return outlets. A recirculation connection is made to the auxiliary vapor connection to aid in pump priming. Pump cool-down is achieved by opening both the feed and recirculation lines. Once prime has been achieved, the recirculation line is slowly closed, while the pump outlet is opened.

Liquid Delivery Pump

Figure H

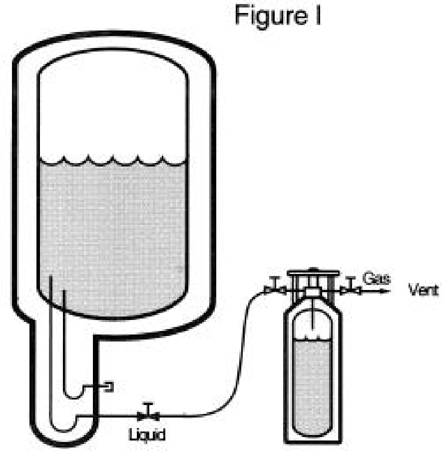


3. Pressure transfer: The efficient insulation of the vessel will keep liquid at lower saturation pressures, thus reducing flash losses.

   The fill may be done directly from the siphon feed or return lines. A throttling control - such as the Lo-Loss™ Liquid Filling System may be used for optimum results.

Liquid Pressure Transfer

Figure I



Installation

General

This section deals with receiving the Siphon 100 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 and discusses general considerations for the tank's final location.

Handling Instructions

Installation of a tank at the storage site requires the use of a lift crane.

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. Store the tank in a horizontal position until it can be placed on a properly constructed pad.*

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.

Unloading (Cargo Container)

The tank is held in a 20' or 40' 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:

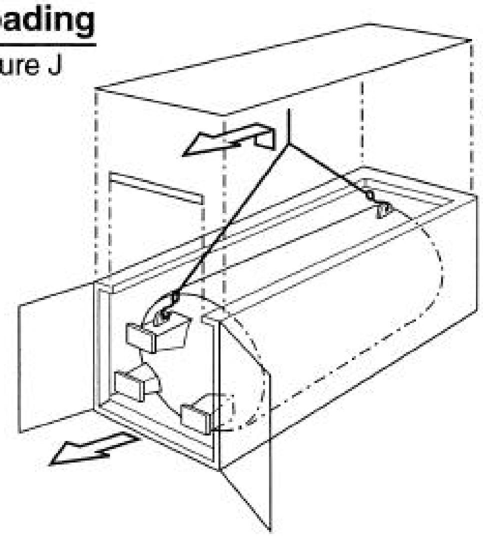
1. Remove banding from vessel.
2. Connect chains to pulley, crane or forklift and vessel.
3. Slide vessel out of container. Lift back end of tank and remove with two front shipping legs resting on rollers.

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.*

Tanks shipped in convertible top cargo containers (Figure J) can be unloaded as follows:

1. Remove the convertible top and end rail from the cargo container.
2. Connect slings 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.

Unloading
Figure J



Rigging Details

The illustrations in Figures K and L show the proper methods for handling and erecting the tank.

Note: *The two crane method (Figure L) is preferred for* ***ALL*** *VS-Siphon 100 Tanks,*

Rigging 1500 Gallon Siphon Tanks

1. Loosen tie-down straps, chains, or any other device used to hold the vessel in place. Lift vessel onto level ground, using hook-points on the top head and the leg (Figure K, step 1).

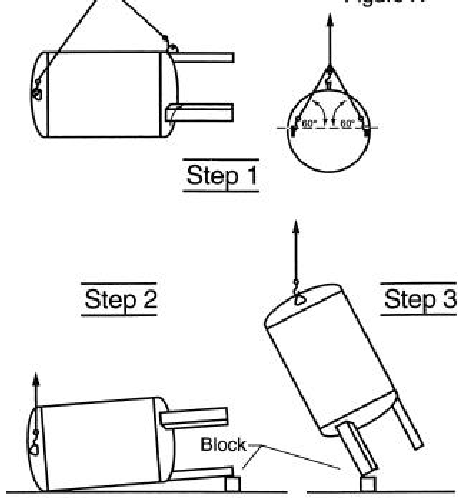
2. Connect appropriate slings to hook-points on top head of vessel. Ensure that there is at least a 60° angle between the straps (Figure K, step 2).

3. Verify that piping components will not touch the ground when the vessel is tipped on its legs. If necessary, use wood blocks underneath the leg pads.

4. Begin to lift the vessel by the tops lugs on the top head.

5. Slowly bring vessel to vertical position, being careful not to slide the vessel legs along the ground (Figure K, step 3).

6. Locate the vessel on the pad. If anchor bolts have been pre-cast into the foundation, place vessel on anchor bolts.



Unloading
Figure K

Note: *Anchor bolts must fit loosely. Anchor bolts that fit too tightly tend to bend the leg. Abnormal stresses can occur to the leg and damage to the bottom head, up to and including loss of vacuum, may occur.*

If anchor bolts have not been cast into the pad, where code permits, drill appropriate holes in the pad and install them.

7. Verify that vessel is vertical with a plumb-line. Shims may be used; grout shimmed legs if needed.

Rigging 3000 Gallon & Larger Siphon Tanks - Preferred Method

1. Loosen tie-down straps, chains, or any other device used to hold the vessel in place. Lift vessel onto level ground, using hook-points on the top head and the leg.

2. Connect appropriate slings straps to hook-points on top head of vessel. Ensure that there is at least a 60° angle between the straps. Connect second crane hook to lifting lug at base of tank (Figure L, step 1)

3. Begin to lift the vessel evenly (Figure L, step 2).

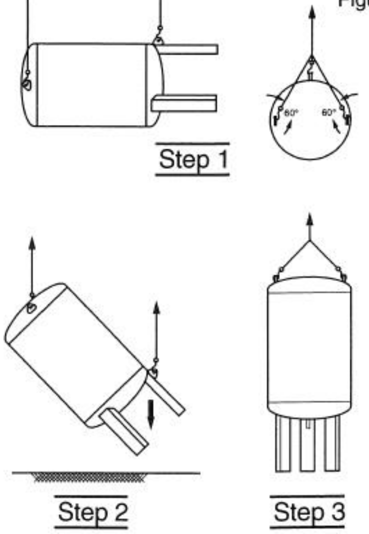
4. Slowly bring vessel to vertical position by lifting on top head and lowering the legs. When tank is in vertical position remove the lower lifting cable (Figure L, step 3).

5. Locate the vessel on the pad. If anchor bolts have been pre-cast into the foundation, place vessel on anchor bolts.

Note: *Anchor bolts must fit loosely. Anchor bolts that fit too tightly tend to bend the leg. Abnormal stresses can occur to the leg and damage to the bottom head, up to and including loss of vacuum, may occur.*

If anchor bolts have not been cast into the pad, drill appropriate holes in the pad and install them.

6. Verify that vessel is vertical with a plumb-line. Shims may be used; grout shimmed legs if needed.



Rigging
Figure L

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 and burst discs for dirt damage.
5. Check the pressure in the vessel with the pressure gauge (G-1). If pressure is "0" then 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 test procedure.

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 that the probe housing need not be removed for this step.
3. Plug the instrument to the probe and calibrate the instrument.
4. Open the vacuum probe isolation valve. Wait for 5 minutes and take and record a vacuum reading. Note that the valve handle protrudes through the protective housing and can be turned without opening the housing.
5. Close the isolation valve 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 25 microns, consult factory.
   b. If your last vacuum reading shows a steady increase from the first, consult the factory.

Site Considerations

Site selection (Per NFPA Bulletins and the CGA)

Prime considerations in choosing a site for the vessel 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 vessel 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 only 14 ft/427 cm long, the tank should be situated no more than 10 ft/305 cm from the closest possible access.

The site selected should be such that the vessel 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.

Site Preparation

Site preparation considerations include selecting the proper foundation. However, before the foundation is laid the site must be cleared of all organic material and topsoil. In addition, the site soil bearing must be capable of 2000 psf minimum. If this cannot be substantiated, a local professional engineer should be consulted. The construction of a firm base or foundation for the station is of prime importance. Most often, this will be concrete; however, steel frames may also be used. In either case, a firm bed consisting of gravel or crushed stone is required for the foundation to rest on.

Concrete Foundations

Concrete pads are the most common foundations on which stations are installed. They provide a highly stable, permanent location for the unit, as well as any on-site support equipment required (reserve cylinders, additional vaporizers, etc.). Pad thickness depends on the model used. Reinforcement rods are required in the foundations. Consult with a local architect or engineer for size and location.

The concrete pad must be capable of developing a minimum compression strength of 3,000 psi at 28 days. Generally, all concrete work shall be in accordance with ACI 318R-71 and the reinforcing steel shall conform to ASTM A305. Anchor bolts, nuts, and washers shall be ASTM A307. If other codes apply, the pad should be designed by a licensed engineer or architect. All exposed parts should be coated with an aluminum paint or equivalent. Skirted pads need only be used if required by local codes. If used, install as required, but below the local frost line.

Lateral dimensions of the concrete pad are arbitrary. Experience indicates that at least 24” of clearance on each side of tank is desirable. More space must be allowed for high pressure cylinders, pumps, additional vaporizers, and other equipment that will be connected to the vessel. Minimum recommended pad dimensions, based on two foot clearance are:

Model	Minimum Pad Dimensions
VS-1500	12’ x 14’
VS-3000	14’ x 16’
VS-6000	17’ X 19’
VS-9000	19’ X 21’
VS-11000	20’ X 22’
VS-13000	20’ X 22’
VS-15000	20’ X 22’

Tanks and pumps with adapter’s provided may take up two foot more depending on the pump make and model. Consult Chart for proper size foundation if in doubt.

A firm bed for the concrete is required. This is necessary to protect the pad and equipment from damage due to shifting of the ground beneath it. If good soil conditions exist, the ground need only be well compacted prior to pouring the concrete. If the setting is less favorable, a 4” layer of crushed limestone beneath a 2” layer of sand will provide a satisfactory bed for the pad. This bed should be formed in a trench recessed into the ground and of the same dimensions as the pad.

Note: *The information and design herein contained is intended only as a general outline of nominal requirements. Soil and climate conditions, as well as seismic load requirements, will require modifications to meet local conditions. Consultation with a local qualified engineer is suggested. Chart disclaims any warranty with respect to the fitness and/or adequacy of the design and information contained herein.*

Site Protection

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

Other Site Considerations

Installation of a Chart 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.

When oxygen is the stored product, the site must be permanently placarded to indicate the following, or an equivalent type warning:

OXYGEN

NO SMOKING

NO OPEN FLAMES

Note: *NFPA 50 should be reviewed when installing a Siphon 100 tank in oxygen service.*

Each tank system installed on consumer premises should be inspected annually. Weeds and long dry grasses must be cut back within 15 ft/457 cm of any bulk oxygen storage container.

Seismic Consideration

Siphon 100 tanks are designed for installation in most seismic zones. Certification, documentation and third party analysis may be necessary depending on local codes. Consult factory for details before installation.

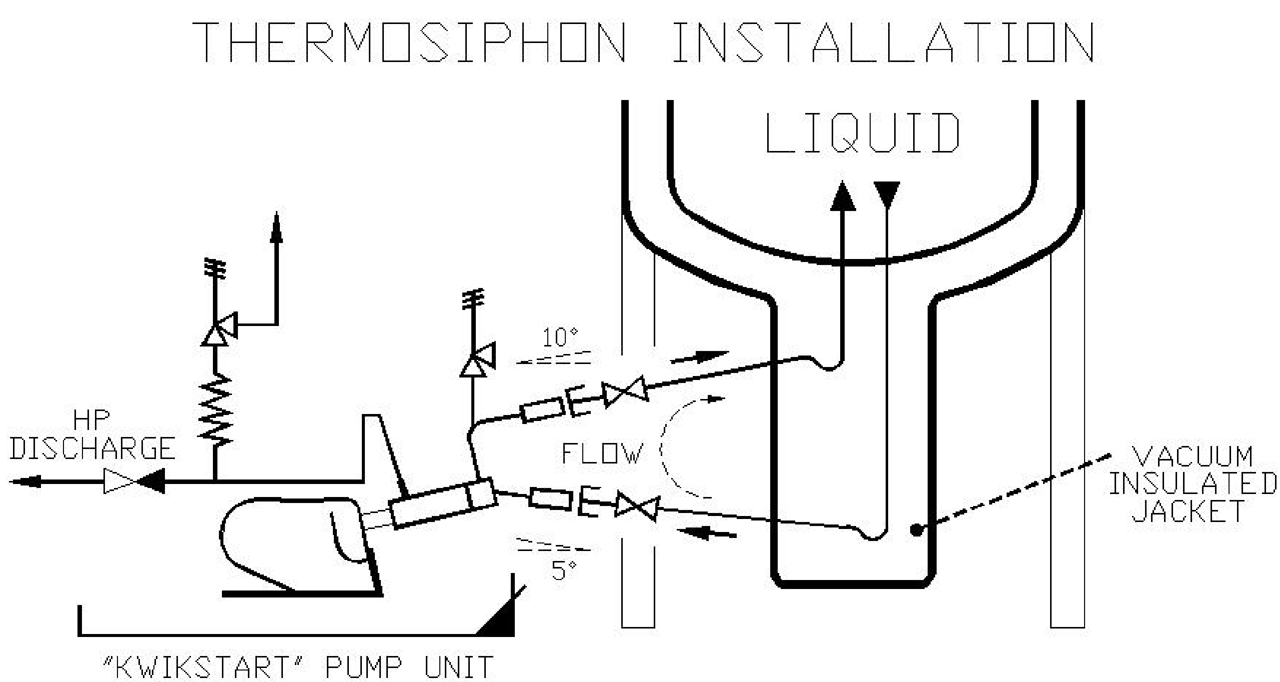
Pump Installation

General

In order to promote the most efficient pumping at the lowest losses, a pump adapter kit should be used with the vessel to connect the pumps to the vessel. Currently there are several commonly used kits, one for the horizontal pump, and one for an inclined pump. Further kits exist for the low NPSH pumps.

Chart provides installation kits for use with pumps manufactured by all major pump suppliers. The kits consist of required piping and valves to hook up a pump to the Siphon 100 tank pump connections correctly. Generally, existing pumps being installed to a new Siphon 100 tank will have to be raised off the foundation so as to meet the requirement that the suction line flow be upwards towards the pump. New pumps being purchased for use with the Siphon 100 tanks may have bases already optimized by the manufacturer.

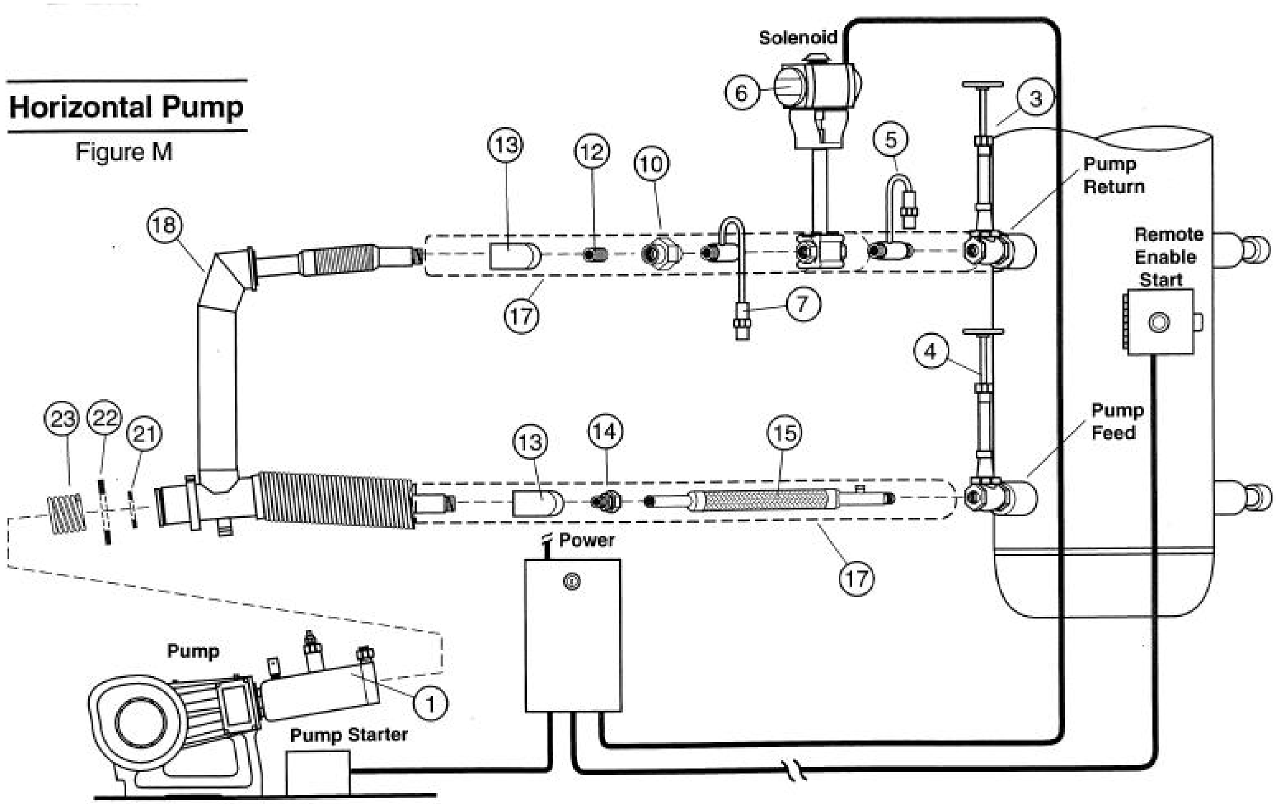
Installation of high pressure pumps to the Siphon 100 tanks is very similar to installations to pumps to conventional tanks, and similar "good practices" apply.



Good Practice	Reason
Install pumps as close as possible to the tank outlet. There should be as few valves, abrupt size changes, etc., as possible.	Liquid will warm up while in the piping between the tank and the pump. The longer the piping, the more heat will be picked up, and the less siphon effect there will be. The channels positioning the legs may be removed after the vessel has been bolted onto the foundation in order to move the pumps closer to the Siphon outlet.
Entire length of the suction line should be sloped upwards towards the pump.	The suction line trap is at the very bottom of the siphon pod. By sloping the lines upwards, this allows any gas bubbles that may form to flow freely away from the trap.
Entire length of the return line should be sloped upwards towards the tank at least 5° (10° to 15° would be optimum).	This allows gas bubbles that may have been formed to travel freely up the return stream. No traps are formed.
Maintain 1” piping as much as possible.	The siphon principle ensures that a constant flow of liquid occurs through the lines, independent of whether the pump is operating or not. Reducing the lines to smaller diameters will reduce the flow of liquid through the Siphon.
Pump should have inlet filter.	If the pump suction adapter does not contain an inlet filter, one should be added to the piping so as to prevent contaminants from entering the pump.
Flexible hose connections at pump suction and pump return.	To minimize piping loads and vibration at the pump.
Safety relief valves between all valves that could entrap liquid. Remember that the pump inlet and outlet are similar to check valves.	Entrapped liquid between two valves can reach pressure in excess of 14,000 psi upon warm-up.
Pump is properly anchored to concrete.	Prevents excessive vibration which will cause damage to piping and the pump.
Splash or drip pans underneath all components that could leak, or drip liquid air.	Prevents damage to the foundation. Safety issue.
Full flow valves.	To reduce flow restrictions as much as possible.

Horizontal Pump

Figure M



Transfer Pumps

Chart recommends that transfer pumps be connected in a manner similar to conventional vessel, using the HCV-19 vapor return line as the pump recirculation line.

Decanting

The tank may be emptied by the use of high pressure pumps, liquid transfer pumps or pressure transfer. Of these, pressure transfer may be less desirable, as the standard tank does not come equipped with a PB coil installed. Should pressure in the vessel be required, the top and bottom fill valves may be opened to act as a small PB system.

Horizontal Pump Installation Kit

This kit is designed to connect a horizontal pump to tank using a vacuum jacketed bayonet connection to supply liquid directly into the jacketed sump of the pump with a minimum input of heat.

This kit contains the following components:

Air Operating Ball Valve	1
VJ Bayonet Head Piece	1
Unions, Elbows, Assorted Fittings	1
Ring Compressor	1
Time Delay Unit	1

The kit works with the following Paul Type Pumps:

Manufacturer	Model	Chart Interface Kit
ACD	WDPD	10660011
ACD	NPDP	10660011
ACD	GAPD	10660011
ACD	SZNDPD	10713135
Woodland	WCPH	10660011
CCI	LXR	10660011
Cryo-Star	SPDT 30/40	10694587
Cryo-Star	GAPD 41/40	10694595

Placement:

The distance of the pump from the tank is defined by the interface kit that can be acquired from Chart. The interface kit consists of a vacuum jacketed bayonet assembly that fits into the housing of the pump to provide a thermally efficient hook-up.

Consideration must be given to maintenance of the pump in deciding the exact orientation of the pump to the tank. In order to perform maintenance operations, the hook-up kit bayonet must be withdrawn from the pump. Although the hook-up kit contains flexible sections in order to dampen vibrations, these may not be flexible enough to be compressed significantly. It is therefore recommended that the pump be placed at a 45° or 90° angle with respect to the Siphon outlet. If a 90° angle is required, the elbow used should be a long radius elbow to keep flow restrictions to a minimum. By placing the assembly at an angle, the hook-up assembly can be withdrawn from the pump once the unions have been loosened.

Inclination:

The hook-up kit is included to facilitate movement of any gas bubbles that may form to the Siphon return. Specifically, the pump inlet line is inclined upwards to the pump, and the pump is inclined upwards toward the tank (in some cases the whole base may be inclined).

Foundation:

Most reciprocating pumps - particularly when pumping at very high pressure - will vibrate significantly. It is therefore mandatory to anchor the pump base to the concrete foundation with at least four properly sized anchor bolts.

The cold end of the pump must be raised to a 5° angle. This can best be done by either modifying the base to raise the cold end, or by shimming the front end of the pump skid base so that the whole assembly is at a 5° angle. Base thickness may vary, so it is possible that the whole base must be raised slightly in order for the pump to connect to the hook-up kit without force.

Supports:

If automatic valves are being used on the system, it may be advantageous to add supports for these valves, particularly if the pump is going to be used at pressures in excess of 3000 psig. Weld plates have been provided on the housing in order to make this easier.

Installation

1. For the Siphon 100 tank to perform optimally, the cold end of the pump (Item 1) should be inclined at an angle approximately 5° upwards towards the tank, to ensure that bubbles formed and blowby gases can be removed from the pump as rapidly as possible.

2. De-pressurize the vessel by opening the vent valve (HCV-12).
3. Screw the nipple with the relief valve (Item 5) to the valve (Item 3).
4. Screw the air operated ball valve (Item 6) to the nipple. The flow arrow should point to the tank.
5. Screw a nipple with relief valve (Item 7) into the air valve (Item 6).
6. Screw on the union (Item 10) to the nipple (Item 7).
7. Attach the 450 elbows (Item 13) to the siphon pipe (Item 18).
8. Thread the nipple (Item 12) and half of the union (Item 10) into the elbow (Item 10).
9. Thread the compression fitting (Item 14) into the lower elbow (Item 13).
10. Temporarily move the pump assembly into place by connecting both halves of the upper union (Item 10)
11. Install the flex pipe (Item 15 may have to be cut to length.) and tighten the union and compression fitting.
12. Push the pump filter spring (Item 23) onto the filter, and insert the filter into the front of the Siphon hook-up bayonet assembly. The spring should be between the end of the filter housing and the siphon assembly (Item 1).
13. Lightly grease the o-ring (Item 22) with Krytox or similar oxygen compatible lubricant, and slide onto the flange of the bayonet assembly.
14. Unbolt the cold end plate of the pump (Item 1).
15. Bolt on the two halves of the ring-compressor sleeves to the end of the cold end.
16. Slide the Teflon/steel compression seal (Item 21) onto the front of the bayonet. The metal side should be facing the pump (Item 1).
17. Gently push the bayonet into the front of the pump, ensuring that the compression seal is evenly compressed (about 1”).
18. With the adapter at 1” depth, unbolt the two halves of the compression rings and bolt the flange to the pumps. Ensure that bolts - if stainless steel - are liberally coated with an oxygen compatible anti-galling compound.
19. Securely bolt pump to foundation, ensuring that angle of pump cold end of 5° is maintained.
20. Pressurize siphon assembly to ensure that all joints are tight.
21. Install air line to ball valve control solenoid. Pressure should not exceed 100 psig supply (85 psig will open valves).
22. Install timing circuit set to three minute pump cool down and ten minute return valve closing, after the pump stops.

Inclined Pumps Installation Kit

This kit is designed to connect an inclined pump to the Siphon 100 tank.

This kit contains the following components:

Air Operating Ball Valve	1
Flex Lines	1
Unions, Elbows, Assorted Fittings	1
Time Delay Unit	1

The kit works with the following Inclined Pumps:

Manufacturer	Model	Interface Kit
ACD	P-1600	10675731
ACD	P-1700	10675731
CVI	PD-3000	10675731
Woodland	WCP	10675731

Placement:

The distance of the pump from the tank is defined by the interface kit that can be acquired from Chart. The interface kit consists of flexible sections that can be connected to the inlet and outlet of the pump. The length of the hook-up kits is too short to make vacuum jacketing effective unless it is equipped with bayonet inlet and outlet connections.

Consideration must be given to maintenance of the pump in deciding the exact orientation of the pump to the tank in order to perform a maintenance operation. For example, on some models the sump can be tipped upwards to simplify maintenance; placement must be such that tipping the sump is possible. The hook-up kit contains flexible sections in order to dampen vibrations. These are flexible enough to undo the unions. It is therefore recommended that the pump be placed such that the outlets face the Siphon 100 tank.

Adapters may be required to connect to the 1” piping that the hook-up kit is based around.

Inclination:

The hook-up kit piping is inclined to facilitate movement of any gas bubbles that may form towards the siphon return.

Foundation:

Most reciprocating pumps - particularly when pumping at very high pressures - will vibrate. Care must be taken therefore to anchor the pump base to the concrete foundation with at least four properly sized anchor bolts.

The pump assembly may have to be raised, to ensure that the sump inlet is above the Siphon 100 outlet, so that the connecting hose is at an inclination upwards towards the pump. The pump should not, however, be raised so much that the sump return line is above the siphon return. The return line must slope upwards towards the Siphon 100 tank. The amount to be raised will vary depending on the manufacturer's base design.

Supports:

If automatic valves are being used on the system, it may be advantageous to add supports for these valves, particularly if the pump is going to be used at pressures in excess of 3000 psig.

This kit also works with vertical sump pumps:

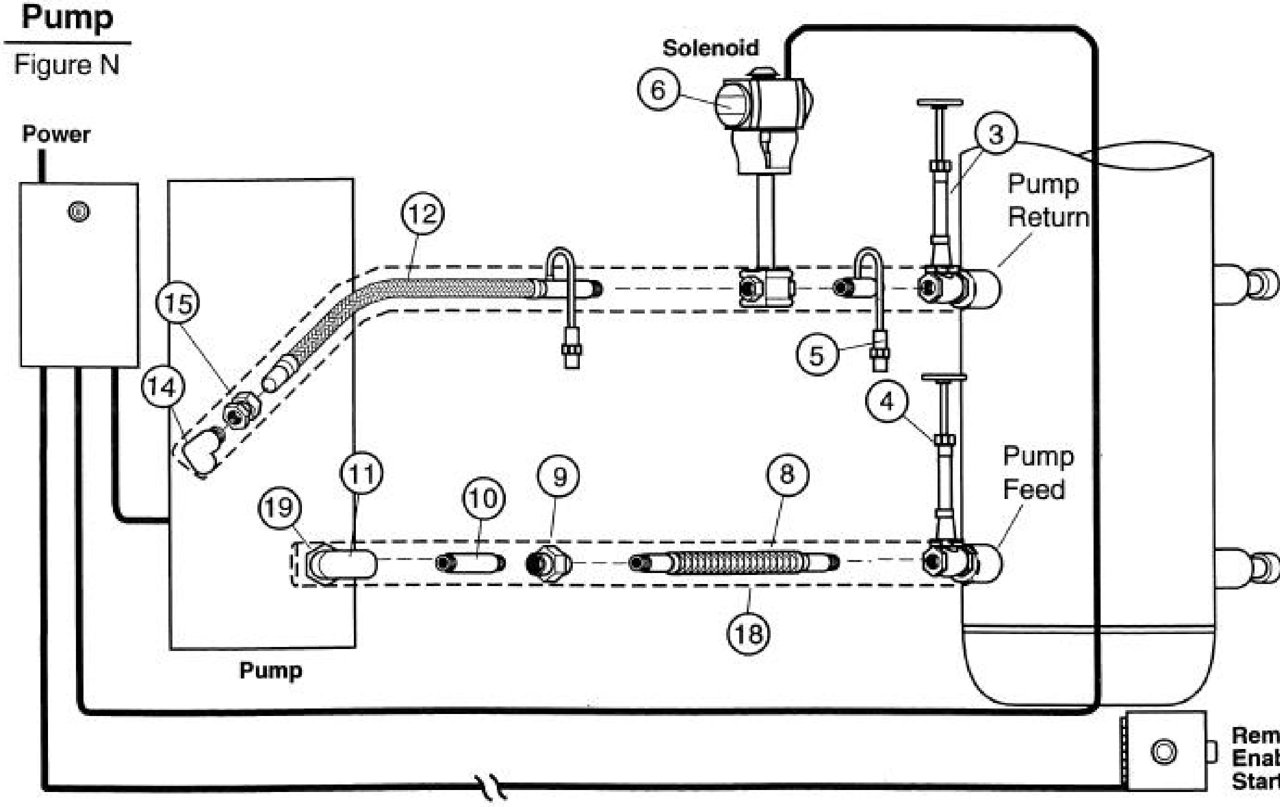
Manufacturer	Model	Interface Kit
CVI	PD-2020	10675731
Woodland	WPC	10675731

Installation of Kit No. 10675731 W/ Inclined or Vertical Pumps:

1. Care must be taken during the installation to ensure that lines are located in such a way that no traps can form where air pockets, or vapor locks, may form.
2. Screw the nipple with the relief valve to the valve (Item 3).
3. Screw the air operated ball valve (Item 6) to the nipple. The flow arrow should point to the tank.

Vertical Pump

Figure N



4. Screw the flex hose with relief valve (Item 12 may have to cut to length later) into the air valve (Item 6).
5. Connect the flexible lines (Item 8) to the valve (Item 4).
6. Connect union (Item 19) to pump inlet. An adapter bushing to go to the 1” union size may be needed.
7. Connect the street elbow (Item 11) to the pump inlet bushing.
8. Connect the flex hose (Item 8) to the isolation valve.
9. Move the pump into place and connect the nipple (Item 10) to the pump inlet (Item 11) by loosening the union (Item 9).
10. Connect an elbow (Item 14) to the pump return, and attach 1” ferrule connector (Item 15).
11. Cut the flex return piece (Item 12) to size to the connector. Clean as required.
12. Securely bolt pump to floor.
13. Pressurize siphon assembly to ensure that all joints are tight.
14. Install air line to ball valve control solenoid (Item 5). Pressure should not exceed 100 psig.
15. Install optional timing circuit in series with motor starter control wire. Ensure that timing is set to open valve at approximately three minutes prior to pump start and to close around 10 minutes after stop of pump.

Pumping Operation Timing Module

The timing module is designed to assist the pump operator to minimize pressure rise and gas losses by limiting the amount of time that liquid is circulating through the pump to a minimum. While liquid is circulating it is picking up heat. The timing module ensures that liquid circulates through the pump only for a brief cool down period, and continues circulating through the pump after pump shutdown for a brief period to allow manifold changes.

The timing module consists of a cool down or prime timer, which is generally adjusted to three minutes; and a post-pump timer that generally is adjusted to ten minutes. Relays in the timing module will actuate the solenoid for the air operated automatic ball valve.

Specific timing ranges can be adjusted in the field.

The cycle operates as follows:

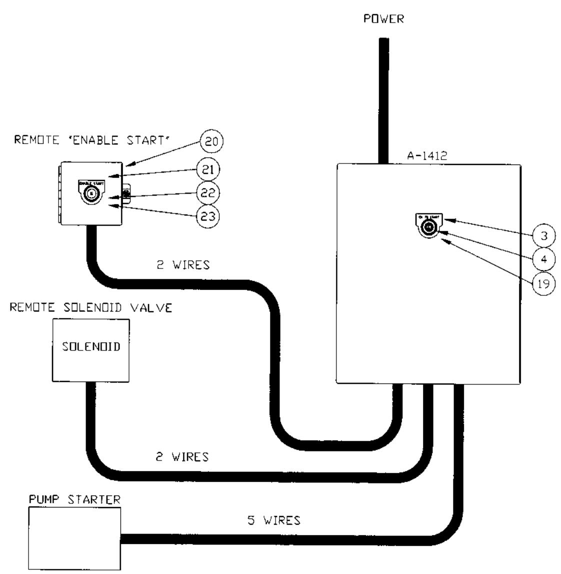
Time = 0 Minutes	Start Timer. Solenoid activates and opens air actuated ball valve. Time = 3 minutes Pump Operates
Pump Stops or is not initially started	Post Pump Timer Starts. If pump is restarted during this interval, Post Pump Timer goes back to start.
Pump Stops + 10 Minutes	Everything reset and a 3 minute cool down is required before the pump can start.

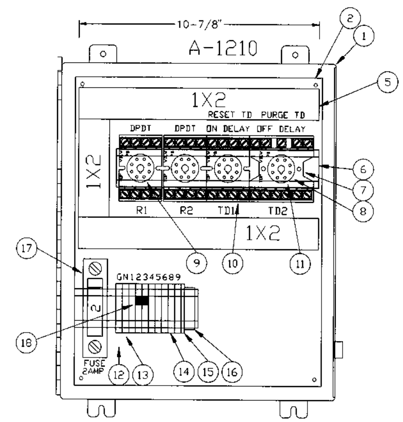
Circuit Operation

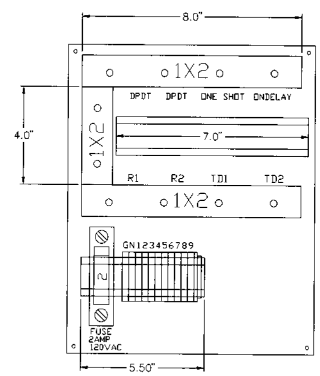
When the remote “enable start” push button is pushed R2 is energized and locks itself on. At the same time power is applied to TD-1, TD-2 and the solenoid valve (SV-1). TD-1 begins its timing period (cool down). During this time the starter is prevented from being started. At the end of this time TD-1 transfers its contacts and allows the starter to be started. This is displayed by lighting the “OK TO START” lamp. At this time TD-2 begins its timing period (reset timing). The timing period of TD-2 determines the time allowed to restart the remote starter. Whenever the remote starter is energized the TD-2 timer is reset. If the starter stops for any reason TD-2 begins its timing period. If TD-2 completes its timing period R2 is dropped out and the cycle must start over again.

Note: *In rare cases some materials not provided by Chart will have to be used in pump installation. The installer should have various 1” fittings such as 450 elbows, 900 elbows, nipples, etc. An instrument to read the tank vacuum is also a must.*

DWG NO. D-10683386

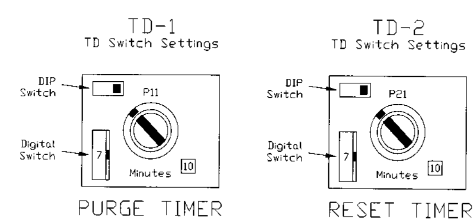






PARTS LIST

ITEM	PART NUMBER	DESCRIPTION	MANUFACTURER
1	VJ1210HWPL2	NEMA 4 ENCLOSURE 12 X 10 X 5.25	VYNCO
2	MP1412A	MOUNTIMG PANEL 11 X 9 STEEL	VYNCO
3	U00	LEGEND (OK TO START)	SPRECHER+SCHUH
4	080LDVD	LAMP GREEN FULL VOLTAGE	GE
5	W2X1	WIRE TROUGH	TYTON
6	101598.26	MOUNTING RAIL	ENTRELEC
7	SR3P06	(TD2) 11 PIN OCTAL RELAY SOCKET	IDEC
8	RTE-P2-AC120	(TD2) DELAY ON BREAK TIMING RELAY	IDEC
9	RR2P-U	(R1, R2) DPDT 120 VAC RELAY	IDEC
10	SR2P06	(R1, R2, TD1) 8 PIN OCTAL RELAY SOCKET	IDEC
11	RTE-P1-AC120	(TD1) DELAY ON MAKE TIMING RELAY	IDEC
12	165113.16	GNDING TERMINAL	ENTRELEC
13	195116.00	BEIGE COLORED TERMINAL	ENTRELEC
14	115116.07	GRAY COLORED TERMINAL	ENTRELEC
15	118368.16	END SECTION	ENTRELEC
16	103002.26	END BLOCK	ENTRELEC
17	116303.24	FUSE BLOCK	ENTRELEC
18	116541.12	JUMPER	ENTRELEC
19	LAM 120MB	120 VAC LAMP	GE
20	5133705	ENCLOSURE NEMA 12 4 X 4 X 2	CANTEX
21	U00	LEGEND (ENABLE START)	SPRECHER+SCHUH
22	080PVG	MOMENTARY PUSH BUTTON	GE
23	080BF10V	NORMALLY OPEN CONTACT BLOCK	GE
24			
25			
26			
27			



CIRCUIT OPERATION

WHEN THE REMOTE 'ENABLE START' PUSH BUTTON IS PUSHED TD-1 IS ENERGIZED AND LOCKS ITSELF ON.

AT THE SAME TIME POWER IS APPLIED TO TD-2 AND THE SOLENOID VALVE. (SV-1).

TD-1 BEGINS ITS TIMING PERIOD. (PURGE TIMING)

DURING THIS TIME THE STARTER IS PREVENTED FROM BEING STARTED.

AT THE END OF THIS TIME, TD-1 TRANSFERS ITS CONTACTS AND ALLOWS THE STARTER TO BE STARTED.

THIS IS DISPLAYED BY LIGHTING THE 'OK TO START' LAMP

AT THIS TIME TD-2 BEGINS IT'S TIMING PERIOD. (RESET TIMING)

THE TIMING PERIOD OF TD-2 DETERMINES THE TIME ALLOWED TO RESTART THE REMOTE STARTER.

WHEN EVER THE REMOTE STARTER IS ENERGIZED THE TD-2 TIMER IS RESET.

IF THE STARTER STOPS FOR ANY REASON TD-2 BEGINS IT'S TIMING PERIOD.

IF TD-2 COMPLETES IT'S TIMING PERIOD TD-1 IS DROPPED OUT AND THE CYCLE MUST START OVER AGAIN.

REV.	ECO #	REVISION DESCRIPTION	BY	DATE
B	8887	ADD SHEET 3of3	JJC	11/1/95

DISC # M:DWG
APPROVED | DATE
DRAWN BY JJC 11/1/95
CHK'D BY
PROJ. ENGR.
MFG. ENGR.
MFG. SERV.
QUAL. CONT.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: FRACTIONS ± 1/16" ANGLES ± 1° 2 PLACE DECIMALS ± 3 PLACE DECIMALS ±

NEXT ASS'Y | USED ON | NEXT ASS'Y | FINAL ASS'Y
APPLICATION | QUANTITY REQ'D

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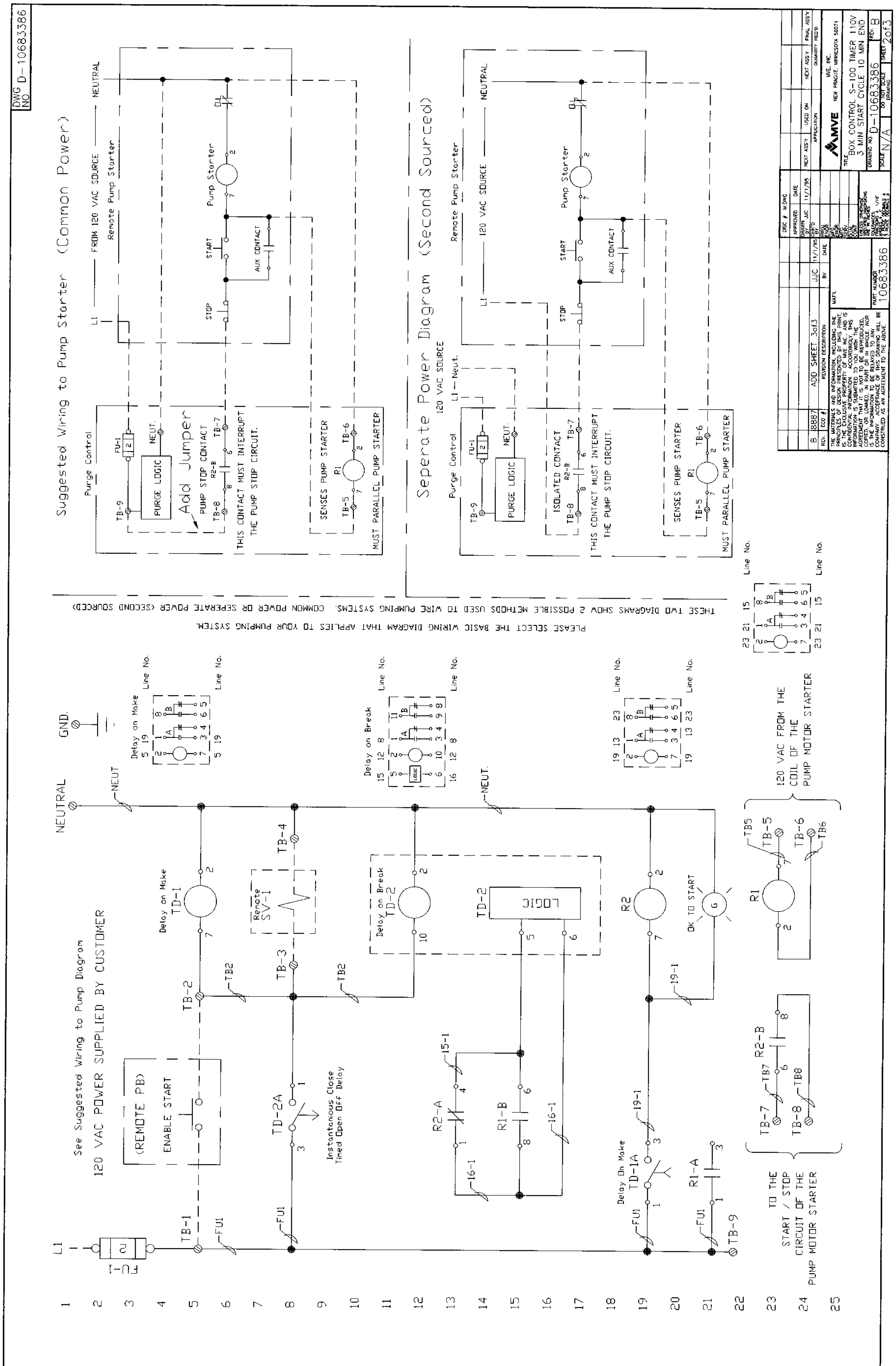
MAT'L
PART NUMBER 10683386

MVE
MVE, INC.
NEW PRAGUE, MINNESOTA 56071

TITLE BOX CONTROL S-100 TIMER 110V 3 MIN START CYCLE 10 MIN END
DRAWING NO. D-10683386 REV. B
SCALE N/A DO NOT SCALE DRAWING SHEET 1of3


DWG NO D-10683386
Suggested Wiring to Pump Starter (Common Power)
Seperate Power Diagram (Second Sourced)
See Suggested Wiring to Pump Diagram
120 VAC POWER SUPPLIED BY CUSTOMER
THESE TWO DIAGRAMS SHOW 2 POSSIBLE METHODS USED TO WIRE PUMPING SYSTEMS. COMMON POWER OR SEPERATE POWER (SECOND SOURCED)
PLEASE SELECT THE BASIC WIRING DIAGRAM THAT APPLIES TO YOUR PUMPING SYSTEM.
120 VAC FROM THE COIL OF THE PUMP MOTOR STARTER
TO THE START / STOP CIRCUIT OF THE PUMP MOTOR STARTER
BOX CONTROL S-100 TIMER 110V 3 MIN START CYCLE 10 MIN END

DWG NO. D-10683386

ELECTRICAN NOTES:

1. THE PUMP STARTER CONTROL VOLTAGE MUST BE WIRED FOR 120VAC.
2. R1 IS REQUIRED TO SENSE THE OPERATION OF THE PUMP STARTER COIL. THE R1 COIL, TERMINATED AT TB-5 AND TB-6, MUST PARALLEL THE PUMP STARTER COIL.
3. CONTACT R2-B, TERMINATED AT TB-7 AND TB-8 IS PROVIDED AS AN ISOLATED CONTACT
   WHICH IS USED IN THE PUMP STARTER CIRCUIT TO STOP OR PREVENT THE PUMP STARTER FROM BEING STARTED.
   THEREFORE THE CONTACT R2-B MUST BE PLACED IN SERIES WITH THE PUMP STARTER STOP CIRCUIT.
   THE EXACT CIRCUIT MIGHT VARY DEPENDING ON ADDITIONAL ITEMS OR EXTERNAL DEVICES ADDED TO THE SYSTEM.
   HOWEVER THE CONCEPT REMAINS THE SAME, R1 MUST BE PARALLED WITH THE STARTER COIL AND R2-B MUST BE IN SERIES WITH THE STOP CIRCUIT.

INSTALLATION:

1. POWER WIRING 120 VAC
   DETERMINE THE SYSTEM WIRING METHOD.
   IF COMMON POWER IS USED A JUMPER FROM TB-9 TO TB-8 MUST BE INSTALLED.
   IF SEPERATE POWER IS USED BE SURE THAT THE JUMPER BETWEEN TB-9 AND TB-8 IS REMOVED.
2. WIRE THE ENABLE START PUSH BUTTON TO TB-1 AND TB-2.
3. WIRE THE R1 COIL ACROSS THE STARTER COIL FROM TB-5 AND TB-6.
4. WIRE THE ISOLATED CONTACT R2-B INTO THE PUMP STARTER STOP CIRCUIT TB-7 AND TB-8.

REV.	ECO #	REVISION DESCRIPTION	BY	DATE
B	8887	ADD SHEET 3of3	JJC	11/1/95

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PART NUMBER 10683386

DRAWN BY JJC 11/1/95

MVE MVE, INC. NEW PRAGUE, MINNESOTA 56071

TITLE BOX CONTROL S-100 TIMER 110V 3 MIN START CYCLE 10 MIN END

DRAWING NO. D-10683386 REV. B

SCALE N/A DO NOT SCALE DRAWING SHEET 3of3

Operations

This section provides the preparation, initial fill, gas use, liquid delivery and refilling procedures for the vessel described in this manual. Before performing any of the procedures contained in this section, become familiar with the location and function of the controls and indicators.

Purging and Fill Considerations

The initial fill is usually performed on a warm vessel, one that has not been in use for an extended period. 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.
2. The vessel may be filled by pumping or pressure transfer. If internal tank 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.
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.

Note: *Gas pressure from the delivery vehicle can be used to purge the tank.*

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

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/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.

1. Attach the source of liquid or gas purge product to the fill connection (FC-1).
2. Close all valves except the liquid phase (HCV-10) and gas phase (HCV-8) valves.
3. Open drain valve (HCV-7), and allow source to vent through hose. Vent until slight frosting appears on hose. Close drain valve (HCV-7).
4. Open the bottom fill valve (HCV-1) 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 to slowly build up pressure in the inner tank.
5. Shut off the liquid supply source when the pressure in the tank reaches the maximum purge pressure as indicated on tank pressure gauge (PI-1).
6. Open the fill line drain valve (HCV-7) 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.
7. Close drain valve (HCV-7) and bottom fill valve (HCV-1).
8. Open the liquid level gauge equalization valve (HCV-9) 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 (HCV-8 & HCV-10).

9. Loosen the unions on either side of the liquid level gauge (LI-1). Both the upper and lower liquid level gauge valves (HCV-8 & HCV-10) 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.*

10. Open the vapor vent valve (HCV-12) and full trycock valve (HCV-4). The top fill valve (HCV-2) will have to be vented by opening hose drain valve (HCV-7).

11. Repeat purge procedure 2 through 6 and 10 at least three times to ensure product purity.

12. Reconnect the liquid level gauge (LI-1), open the liquid level control valves (HCV-8, HCV-10), then close the by-pass valve (HCV-9).

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

Valve	Position
Bottom fill valve (HCV-1)	Closed
Top fill valve (HCV-2)	Closed
Vapor vent valve (HCV-12)	Closed
Full trycock valve (HCV-4)	Closed
Liquid level gauge equalizing valve (HCV-9)	Closed
Liquid level gauge liquid phase valve (HCV-10)	Open
Liquid level gauge vapor phase valve (HCV-8)	Open

Initial (Warm Tank) Filling Procedure

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.

   If a **PRESSURE TRANSFER** is to be made, 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)

   If a **PUMP TRANSFER** is to be made, 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.

6. 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-12). Should pressure continue to rise, the fill may have to be interrupted to allow pressure to drop.

7. Monitor liquid level contents gauge (LI-1). When the gauge indicates approximately three-quarters full, open full trycock valve (HCV-4).

8. When liquid spurts from full trycock valve (HCV-4), immediately stop fill at the supply source and close full trycock valve (HCV-4).

9. Close bottom fill valve (HCV-1).

10. Drain residual liquid in the fill hose via drain valve (HCV-7).

11. 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.

Note: *Pressure in the tank may rise during the next 48 hours or until the tank liquid reaches equilibrium.*

Vessel Refilling Procedure

Note: *Filling a cryogenic vessel through the bottom tends to raise pressure in the vessel as gases in the 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 is the proper product to be transferred.
2. Verify that the bottom and top fill valves are closed (HCV-1, HCV-2).
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 (FC-1).

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 (HCV-7).*

6. Open top fill valve (HCV-2) completely.

   If a **PRESSURE TRANSFER** is to be made, 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)

   If a **PUMP TRANSFER** is to be made, 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 100 psi (7.0 kg/cm^2) higher than tank pressure.
7. Monitor pressure in vessel as indicated. If pressure begins to drop to near the minimum operating pressure, begin to open bottom fill valve (HCV-1), and throttle top fill valve (HCV-2), until pressure stabilizes.
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), stop fill at the supply source and close full trycock valve (HCV-4).
10. Close tank fill valves (HCV-1, HCV-2).
11. Drain residual liquid in the fill hose via drain valve (HCV-7).
12. Relieve fill hose pressure by loosening the hose at the fill connection, and then disconnect the hose.

Liquid Withdrawal Procedure

1. Connect customer line liquid withdrawal connection (C-5 or C-6).
2. Open liquid draw valve slowly to begin liquid flow.
3. Once the desired amount of liquid has been delivered, close the valve.

Liquid Withdrawal Procedure
(High Pressure Cylinder Pump)

1. Open appropriate isolation gate valves (HCV-25A and HCV-25B).
2. Verify that all valves and related controls downstream of the pump are in appropriate positions to start cylinder filling.
3. Start timing cycle or open actuated ball valve.
4. Wait for the correct cool-down time to have passed. Usually three minutes.
5. Start pump. Fill cylinders to correct pressure. Shut down the pump.
6. If no further pumping is expected, close actuated valve.
7. After fifteen minutes, close manual isolation valves (HCV-25 or HCV-26).

Liquid Withdrawal Procedure
(Liquid Pump)

1. Open appropriate isolation gate valve (HCV-26B) and recirculation valve connected to the Secondary Aux Vapor connection to start cooling down the pump.
2. Verify that all valves downstream of the pump are in appropriate positions to start cylinder filling.
3. After frost has developed on the pump housing, approx. six minutes, start the pump to verify if prime has been achieved.

4. If prime has been achieved, shown by an increase in pressure in the pump outlet, proceed to slowly close the recirculation to start to drive liquid under pressure to the vessels being filled. If prime has not been achieved, continue cool-down for an additional three minutes and attempt to achieve prime again.

5. At any time that liquid is not being filled into receiving vessels, open recirculation valve to maintain pump in operation.

6. If no further pumping is expected, close valves and relieve liquid in the lines.

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 vaporizer inlet valve (HCV-13), pressure building valve (HCV-3), vapor shutoff valve (HCV-11), 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.

Note: *In the event tank pressure exceeds the setting of the economizer system after a long shut-down, the regulator (PCV-1) will not open until the vessel pressure has reached the set-point. Until that time, vapor from the vapor space will flow through (HCV-13) into the vaporizer, thus preferentially draining off head pressure.*

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.

4. Normal operating valve positions are as follows:

Valve	Position
Bottom Fill (HCV-1)	Closed
Top Fill (HCV-2)	Closed
Vapor Vent (HCV-12)	Closed
Full Trycock (HCV-4)	Closed
Equalization (HCV-9)	Closed
Drain (HCV-7)	Closed
Vaporizer Inlet (HCV-13)	Open (Optional Valve)
PB Inlet (HCV-3)	Open (Optional Valve)
PB Outlet (HVC-11)	Open (Optional Valve)
Vapor Phase (HCV-8)	Open
Liquid Phase (HCV-10)	Open

Tank Management

1. Monitor the tank daily. Record:
   a. Pressure
   b. Liquid level
   c. Number of cylinders filled (high pressure)
   d. Number of liquid cylinders filled.
   e. Number of hours the pump or pumps were running.

2. Allow the tank to be lowered to at least 70% empty before it is refilled.

3. Call Chart customer service when you suspect a problem with the tank or adapters (800-400-4683).

4. Always top fill the Siphon 100 tank after the initial fill.

Maintenance

This section contains vessel maintenance information, including troubleshooting and repair procedures. Before performing any of the procedures in this section, be sure you are familiar with the location and function of controls and indicators discussed in other sections. It is recommended that the Safety Summary and Product Safety Bulletins be reviewed and understood fully.

Compatibility and Cleaning

It is essential to always keep the vessel clean and free of grease and oil. This is particularly important for units used in oxygen service. It is equally important for tanks used in nitrogen and argon service since the temperature of liquid nitrogen or argon is below the liquefaction temperature of air; thus making it possible to condense liquid oxygen from air on the piping and vaporizer surfaces.

When replacing components, use only parts that are considered compatible with liquid oxygen and have been properly cleaned for oxygen service. (Refer to CGA Bulletin G-4.1 “Equipment Cleaned for Oxygen Service”.) Do not use regulators, fittings, or hoses that were previously used in a compressed air environment. Only oxygen compatible sealants or Teflon tape should be used on threaded fittings. All new joints should be leak tested with oxygen compatible leak test solution. When de-greasing parts use a suitable solvent for cleaning metallic parts.

Caution! ***Before maintenance or replacing parts on the Siphon 100 tank release container pressure in a safe manner. Replacement of certain parts may also require that the container contents be completely emptied.***

Periodic Inspection

In order to maintain a cryogenic vessel in good operating condition, certain system components should be inspected on a periodic basis. Those components requiring periodic inspection are listed in this manual. In vessels being operated in areas having extreme hot or cold climates, inspection intervals should be shortened.

Periodic Inspection Intervals

Item	*Interval*
Valves and fittings for leaks and other malfunctions	Quarterly
Indicating gauges for malfunctions	Annually
Relief valves to verify proper settings	2 years
Tank burst disc (BD-1)	2 years*

*Requires replacement; refer to the information on tank burst disc replacement in this section.

Soldering

Before performing any soldering work, always exhaust oxygen from the oxygen lines and purge with nitrogen gas. Refer to purging instructions in the Pump Installation section.

Vacuum Integrity

These vessels are equipped with vacuum thermocouple gauge tubes and vacuum integrity may be tested with a vacuum meter. Deterioration or loss of vacuum will be apparent by cold spots, frost, or condensation on the jacket, or evidenced by abnormally rapid pressure buildup. Unless one of these conditions is evident, the vacuum level should not be suspected. In the event one of the above conditions exist, contact the factory for advice on vessel vacuum testing.

Normal Evaporation Rate (NER) Test

Testing may be performed to verify that the container evaporation rate is within normal limits. To perform this test, a totalizing gas flow meter and a standard stop watch are required. Use the follow procedure to perform the evaporation rate test.

Note: *To perform this test accurately, the container must be allowed to cool down for four days prior to testing. During the cool-down period, do not withdraw liquid from the container. Also, during the cool-down period, keep the tank vent valve (HCV-12) open.*

1. Verify that the container is filled to at least 1/2 capacity.
2. Using a suitable rubber hose with appropriate adapter fittings, connect the totalizing gas flow meter to the vent line of the tank under test.
3. When the large sweep needle begins to turn, indicating flow through the meter, check all hose connections for leaks by using a leak-test solution (i.e., soapy water).
4. To begin the test, start the stop watch and then record the beginning meter reading.
5. After 30 minutes, record the meter reading and stop watch time.
6. Compare the difference between the start and end values obtained.
7. If the test value is greater than the tabulated value shown on the tank specification chart contact the factory for further instructions.

Pressure and Liquid Gauges
(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. 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 low pressure valve (HCV-10) and at the high pressure valve (HCV-9).
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, open equalization valve (HCV-9), close the low pressure and high pressure valves (HCV-8 and HCV-10). 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, crack open (HCV-8 and HCV-10) and slowly close equalization valve (HCV-9). Then open wide (HCV-8 and 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 level gauge valve (HCV-10) and the high pressure liquid level gauge valve (HCV-8) are closed.***

Troubleshooting

Refer to the table below and on the next page for troubleshooting procedures. The table is arranged in a Trouble/Probable Cause/Remedy format. Note that 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. Repair procedures required, as listed in the remedy column, may be found in the Repair portion of this chapter. Perform 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 (vessel vents through the relief valve frequently).	Leaking valves to pump assembly (constant frosting of pump lines even when pump is not operating).	Check that valves are closed.
		Repair or replace.
	Siphon connection leaks (frost or audible noise).	Tighten connections.
		Verify that valves seat properly.
	Tank was just filled with higher pressure (warm) liquid.	Vent pressure (HCV-12) to re-stabilize at a lower pressure.
	Excessive shutdown time or low withdrawal rate.	NER is greater than use rate. Vent tank properly to desired operating pressure.
	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.

Trouble	Possible Cause	Remedy
Failure to maintain tank pressure.	Cannot pressure transfer liquid adequately. Pressure below 20 psi.	Open HCV-1 and HCV-2 to use fill circuit as an auxiliary PB circuit.
	Relief valve (PSV-1) leaking or frozen open.	Replace defective valve.
	Tank burst disc (PSE-3) ruptured.	Replace burst disc.
	Piping leak.	Soap test and repair.
	Low liquid level.	Refill tank.
	Excessive withdrawal rate.	Consult factory (Chart).
Vacuum loss.	Ruptured annular space burst disc (Item PSE-3).	Inner vessel or piping leak. Remove all product from the container and return to Chart.
	Leak in the burst disc (Item PSE-3) caused by corrosion.	Remove all product from the container and return to Chart.
	Sweat or frost appears on the outer vessel, indicating marginal vacuum levels.	Perform an NER test on the container. If unsatisfactory, return to Chart.
Erratic or erroneous contents gauge readings.	Leaking gauge lines.	Soap test and repair leak.
	Gauge needle is stuck.	Lightly 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 is damaged or faulty.	Replace gauge.
Leaking safety relief valve (PSV-1A/B)	Dirt or ice under disc.	Re-seat or replace valve as required.
	Valve improperly seated.	
	Damaged seat or disc.	Replace valve.
Ruptured tank bursting disc (PSE-1A/B).	Excessive tank pressure.	Replace disc.
	Atmospheric corrosion and/or fatigue.	Replace disc.
	Interior corrosion.	Replace disc after blowing out line.
	Defective disc.	Replace disc.
Pump will not prime.	Tank is empty (vessel is empty at approximately 6" - piping will not frost).	Refill.
	Actuated valve will not open. (Indicator on valve)	Check pressure source. Check controls.
	Time too short. (Repeat prime cycle)	Check delay timer.
	Pump will not reach pressure.	Repair pump.
Pump will not start.	Check for power at pump (check fuses, delay timer, thermocouple - if available).	1. Change fuses. 2. Change timing relays. 3. Change thermocouple relay.

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 on the next pages.

Warning! ***High pressure gas presents grave hazards in the event of a line rupture, improper cleaning, or other abnormal situation. It is imperative that the operator of the system be well trained in the operation of high pressure gaseous systems.***

Caution! ***The piping should always be allowed to return to ambient temperature before repair work is performed. Vent or drain the tank as necessary before replacing any component(s) exposed to pressure or to cryogenic liquid.***

When disassembly of a tank assembly is required, removed parts should be coded to facilitate re-assembly. Reassembly of parts should always be performed in the reverse manner in which they were 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 soap and warm water solution. Air dry all cleaned parts using a clean, low pressure air source. Before reassembly, make sure that all parts are thoroughly cleaned and have been de-greased. Cleaning will prevent valves from freezing while in service and also prevent contamination of the liquid product.

When removing components from a vessel 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

Caution! ***For valves in liquid service, including the pump suction and return, the tank must be empty of all liquid and pressure before starting valve repair.***

When a defective valve is suspected, remove and repair the assembly as described in this manual. If a valve is leaking through the packing, tighten the packing nut first to see if the leakage will stop before removing the valve. The packing is best tightened when the valve is warm. If a safety relief valve fails, the defective assembly should be discarded and a new valve installed.

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

1. Empty the tank completely of liquid before repairing a valve in liquid service.
2. Release pressure in the vessel by opening vent valve (HCV-12).
3. Remove the defective valve and seat assembly.
4. Disassemble the valve and inspect all piece parts.
5. Clean all metallic parts with a good industrial cleaner, and all rubber & Teflon parts in a warm water and soap solution.
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 Pump Strainer Service

1. If the pump feed lines have a strainer incorporated, this should be inspected during pump maintenance.
2. Lock out electrical start system on pump.
3. Close both pump isolation valves and remove the line relief valve to thoroughly de-pressurize the system.
4. Open unions connecting the hook-up piping from the vessel. Follow disassembly procedures to remove the connection from the pump.
5. Remove the strainer from the mouth of the piping and clean or replace the screen as required.
6. Thoroughly air dry the cleaned assembly using a low pressure oil-free or nitrogen source.
7. Reinstall the strainer and assembly and connect the hook-up kit.
8. Install the line relief valve and open isolation valves.

Tank Burst Disc (PSE-1) Repair

The tank burst disc is a safety relief device that will rupture completely to relieve inner tank pressure in the event tank relief valve fails or is unable to accommodate sufficient flow. Due to changes in pressure in the vessel, the disc will flex, gradually harden, embrittle, and consequently rupture at a lower pressure. The tank burst disc should be replaced at least every two years.

1. Open vent valve (HCV-12) to vent pressure from the inner tank vapor space, or switch selector valve (HCV-15) to other side.
2. Remove tank burst disc (PSE-1A/B).
3. Install new burst disc, making sure that mating surfaces are clean and properly seated. Use an oxygen compatible liquid thread sealant to prevent leaking.

Tank Safety Relief Valve (PSV-1)

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

Testing After Repair

After making repairs requiring disassembly or part replacement, leak test all valves and piping joints that were taken apart and reconnected. Do not return the vessel 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.

Specifications

Model	Gross Capacity		Net Capacity		MAWP*		Diameter		Height		Weight**		NER %/ day in O_2	NER % / day in N_2
	Gal	Liters	Gal	Liters	psig	bar	in	mm	in	mm	lbs	Kg		
VS-1500SC	1,640	6,208	1,580	5,981	250	17.2	66	1,676	240	6,096	6,200	2,818	.35	.56
VS-3000SC	3,150	11,924	3,030	11,470	175	12.1	86	2,184	271	6,883	12,800	5,810	.25	.40
VS-6000SC	6,010	22,750	5,770	21,842	175	12.1	86	2,184	425	10,795	21,300	9,660	.15	.24
VS-9000SC	9,354	35,410	8,990	34,031	175	12.1	114	2,896	398	10,109	32,100	14,560	.10	.16
VS-11000SC	11,410	43,192	10,960	41,438	175	12.1	114	2,896	457	11,608	37,900	17,191	.10	.16
VS-13000SC	13,470	50,989	13,060	49,437	175	12.1	114	2,896	516	13,106	44,300	20,094	.10	.16
VS-15000SC	15,520	58,750	15,060	57,008	175	12.1	114	2,896	575	14,605	50,600	22,952	.10	.16

*MAWP - Maximum Allowable Working Pressure. **Weights are for ASME design. (NER) = Nominal Evaporation Rate

Liquid Level Charts

Liquid level charts follow this section and are also available on Chart's website (http://literature.chart-ind.com/). Click here for instructions on downloading the application.

O&D Drawings (unit specific)

Model	Drawing PN
VS-3000	C-14240785
VS-6000	C-14240785
VS-9000	C-14221779
VS-11000	C-14221779
VS-13000	C-14221779
VS-15000	C-14221779

P&ID Drawings (unit specific)

Model	Drawing PN
VS-1500	C-20875621
VS-3000	C-14276930
VS-6000	C-14276930
VS-9000	C-14225761
VS-11000	C-14225761
VS-13000	C-14225761
VS-15000	C-14225761

Component Function Table

Ref. No.	Description	Function
PSE-1A PSE-2A*	Tank Pressure Safety Element	The safety element, typically a disc that will rupture completely to relieve inner tank pressure in the event the tank relief valve (PSV-1A/B) malfunctions and pressure reaches 1.5 times the maximum allowable working pressure.
PSE-3	Annulus Pressure Safety Element	The lift plate will rupture, automatically detach, in the event pressure in the container vacuum jacket reaches atmospheric pressure.
FC-1	Fill Connection	The connection point used for filling cryogenic liquid into the customer station.
C-2	Auxiliary Vapor	Connection that can be used to recirculate liquid from transfer pumps that have primed, in the event that the receiver is not ready to be filled.
C-3	Auxiliary Liquid	The connection point that could be used for liquid supply to a PB coil. This connection is normally capped.
C-4	Auxiliary Vent	The connection point that could be used for vapor return from a PB coil. This connection is normally capped.
C-5AA C-5B	Siphon Return	The point at which the inlet to the pump is connected. This connection is a capped 1” NPT thread when tank is shipped.
C-6A C-6B	Siphon Feed	The point at which the inlet line to the pump is connected. This connection is a capped 1” NPT thread when tank is shipped.
CV-1	Fill Check Valve	The check valve used to prevent reverse flow through line fill fitting during a liquid fill operation.
FC-1	Fill Connection	The connection through which the vessel is filled. It is generally keyed to the particular gas that the vessel is set up for.
PI-1	Pressure Gauge	The indicator used to show inner vessel vapor pressure.
LI-1	Liquid Level Gauge	An indicator used to show the quality of liquid in the station in inches of water. The contents chart for each tank size converts the readings to gallons of oxygen, nitrogen, or argon at 0 psi pressure.
PBC-1*	Pressure Building Coil	The coil used to vaporize liquid and build vapor pressure in the tank.
PCV-1*	Pressure Building and Gas Use Regulator	The regulator serves dual functions by automatically controlling the set pressure in the vessel, as well as controlling liquid to the gas use vaporizer.
TSV-2 TSV-3*	Thermal Safety Relief Valve	The relief valve that automatically relieves pressure in line whenever pressure exceeds the 350 psi setting due to entrapped liquid.
PSV-1A PSV-1B	Tank Relief Valve	The safety relief valve used to automatically relieve inner tank pressure when the pressure exceeds the maximum allowable pressure.
S-1*	Strainer	The filtering device used to protect the pressure build-up system from damage by contaminants.
HCV-2	Top Fill Valve	The valve which is normally used for transferring liquid into the top of the customer station. This valve is normally closed except during top filling.
HCV-1	Bottom Fill Valve	The valve which is used to transfer liquid into the bottom of the customer station. Generally not used.
HCV-12	Manual Vent Valve	The valve used to vent pressure from the inner tank vapor space. This valve is normally closed.
HCV-3*	Pressure Building Valve	The valve used to control flow into the pressure building system of the vessel. This valve is normally open.

Ref. No.	Description	Function
HCV-11*	Pressure Building Isolation Shutoff Valve	The valve used to isolate inner tank vapor to flow into the external vaporizer where it is converted into gas. This valve is open except during maintenance.
HCV-13*	Gas Use Valve (Liquid to Vaporizer)	The valve used to allow liquid or vapor to flow into the external vaporizer where it is converted into gas. This valve normally is open.
HCV-8 HCV-10	Liquid Phase (high) and Gas Phase (Low) Valves	These instrument valves are used to isolate the liquid level gauge and pressure gauge from the inner tank. These valves are normally open.
HCV-9	Equalization Valve	The valve used for equalizing the high phase and low phase sides of the liquid level gauge (LL-1). This valve is normally closed, except during servicing of calibration.
HCV-7	Drain Valve	The valve used to drain any trapped liquid in the transfer hose at completion of fill, and to cool down the hose before liquid transfer. This valve is normally closed.
HCV-6	Evacuation Valve	The valve used to evacuate the container vacuum space. This valve is always closed. DO NOT touch or attempt to manipulate this valve.
HCV-5	Valve, Vacuum Gauge Tube	The valve which isolated the annulus from the vacuum sensing tube. This valve should always be closed unless vacuum is being measured.