RATERMANN

MANUFACTURING, INC.

ARCTIC FOX®

Cryogenic Tanks

Instructions for 3000L VHP Cryogenic Liquid Tank

Note: ***Do not attempt to use or maintain this unit until you read and understand these instructions. Do not permit untrained persons to use or maintain this unit. If you do not fully understand these instructions, contact your supplier for further information.***

PREFACE

This operating manual is applicable for **3000L Arctic Fox**® cryogenic vessel that is manufactured for **Ratermann Mfg., Inc.** The main contents of the operating manual include the information about safe use, operation and maintenance of container. Any personnel that will operate this equipment must read and understand the contents of this operating manual. Please connect with us if you have questions regarding operation.

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Referenced codes of all components of the tank are marked at the flow scheme. These codes are quoted in introductions of the functions, operation or maintenance of each component to arouse the special attention of these accessories.

GLOSSARY

In this manual, the safety precautions terms are denoted as follows:

"Warning" shows that the personnel may be injured or die in certain condition.

"Notice" shows that the equipments or the parts may be damaged in certain condition.

"Note" shows that the content is very important, and should be emphasized or repeated.

CONTAINER SAFETY

Pressure Hazard – The containers covered by this literature may contain pressure up to 500 psig (34.5 bar.) Sudden release of this pressure may cause personal injury by issuing cold gas or liquid, or by expelling parts during servicing. Do not attempt any repairs on these containers until all pressure is released, and the contents have been allowed to vaporize to ensure no pressure build-up can occur.

Extreme Cold – Cover Eyes and Exposed Skin – Accidental contact of skin or eyes with any cryogenic liquid or cold issuing gas may cause a freezing injury similar to frostbite. Protect your eyes and cover your skin when handing the container or transferring liquid, or in any instance where the possibility of contact with liquid, cold pipes, and cold gas may exist. Safety goggles or a face shield should be worn when withdrawing liquid or gas. Long-sleeved clothing and gloves that can be easily removed are recommended for skin protection. Cryogenic liquids are extremely cold and will be at temperature below -300˚ F (-184˚ C) under normal atmospheric pressure.

Keep Equipment Well Ventilated – Although some of the gases used in these container are non-toxic and non-flammable, they can cause asphyxiation in a confined area without adequate ventilation. An atmosphere that does not contain enough oxygen for breathing will cause dizziness, unconsciousness, or even death. These gases cannot be detected by the human senses and will be inhaled normally as if they were air. Ensure there is adequate ventilation where these gases are used and stored liquid containers or only in a well ventilated area.

Replacement Parts Must be "Cleaned for Oxygen Use" – Some materials, especially non-metallic gaskets and seals, can be a combustion hazard if used in oxygen or nitrous oxide service, although they may be acceptable for use with other cryogenic liquids. Use only **Ratermann** recommended spare parts, and be certain parts used on cleaning oxygen or nitrous oxide are marked "cleaned for oxygen service." For information on cleaning, consult the Compressed Gas Association (CGA) pamphlet G-4.1, "cleaning for Oxygen Services" or equivalent industrial cleaning specifications.

Install Safety Relief Devices in Cryogenic Liquid Lines – When installing piping or fill hose assembly, make certain a suitable safety relief valve is installed in each section of plumbing between shut off valves. Trapped liquefied gas will expand as it warms and may burst hoses or piping causing damage or personal injury.

NOTE: For detailed information on the handling of cryogenic liquids, refer to the Compressed Gas Association publication: P-12 "Safe Handling of Cryogenic Liquids" available from the Compressed Gas Association, Inc., 1235 Jefferson Davis Highway, Arlington, VA 22202.

GENERAL INFORMATION

The 3000L cryogenic vessel is designed to store and transport liquid oxygen (LO_2), liquid nitrogen (LN_2) and liquid argon (LAr). The design, fabrication, inspection and acceptance shall be in compliance with the requirements specified in the following standards and criterions.

continued on next page

1. ASME SECTION VIII DIV 1 2013 ED.
2. ASME Code Sect. II Part D, 2013 Ed.

The cryogenic insulated pressure vessel is depicted as follows: the insulation structure is high vacuum multi-layer insulation, the material of inner vessel is SA240 304; the material of outer shell is also SA204 304.

Valves, instruments and safety accessories are arranged at the top of the container for convenient management and operation.

Detailed information of working principle is shown in flow scheme ***(Figure 1).***

Main technical parameters are described in the following **Table 1**.

Table 1 MAIN TECHNICAL PARAMETERS FOR 3000L TANK

TECHNICAL PARAMETER	UNIT	CRITERIA（PARAMETER） INNER VESSEL	CRITERIA（PARAMETER） OUTER SHELL	REMARK
MEDIUM	/	LN_2, LO_2, LAr	—	/
WORKING PRESSURE	MPa	3.45	-0.1	/
DESIGN PRESSURE		3.45	-0.1	/
COLDSTRECHTING PRESSURE		5.5	/	/
LEAKAGE TEST PRESSURE		3.45	Helium leakage detect	/
RELIEF VALVE OPENING PRESSURE		3.45	/	/
RELIEF VALVE BACK PRESSURE		3.11	/	/
BURSTING PRESSURE OF BURSTING DISC		4.14	/	/
RELIEF VALVE OPENING PRESSURE OF PIPES		4.14	/	/
OPERATING TEMPERATURE	˚C	-196	Normal temperature	/
DESIGE TEMPERATURE		-196	50	/
EFFECTIVE VOLUME	L	2580	/	
CAPACITY		3000	/	
MAIN MATERIALS	/	SA240 304	SA240 304	/
CONTAINER SIZE	mm	Φ 1318×2490	Φ 1508×2838	O.D×length
DAILY EVAPORATION RATE	%/d	≤ 1%（LN_2）/ ≤ 0.60%（LN_2）		/
TARE	kg	2002/4060		/
PAYLOAD		3169 (LOX)	2252 (LIN) 3920 (LAr)	/
INSULATION TYPE	/	High vacuum multi-layer insulation		/
OUTER SIZE	mm	1800×1800×2980		L × W × H

Table 1 continued on next page

Table 1 MAIN TECHNICAL PARAMETERS FOR 3000L TANK

continued from previous page

Capacity	Units	3000L
Liquid(Gross)	Liters	3000
Liquid(Net)	Liters	2580
Liquid(Gross)	Gallons	793
Liquid(Net)	Gallons	682
Nitrigen(N_2)	ft^3	58940
Oxygen(O_2)	ft^3	72677
Argon(Ar)	ft^3	71123
Carbon Dioxide(CO_2)	ft^3	51099
Carbon Dioxide(CO_2)	lbs	5846

Performance

Ner(N_2,O_2,Ar)	% per day	≤0.60%(LN_2)
Ner(CO_2)	lb per day	≤4*
Gas Flow(N_2,O_2,Ar)	ft^3/hr	2825
Gas Flow(CO_2)	ft^3/hr	1060
Gas Flow((CO_2)	Pounds/hr	130

Dimensions

Height	Inches	121
Footprint(LXW)	Inches	75*75
Skid/Pallet(LXW)	Inches	66*66
Empty Weight	Pounds	4404

Pressure Ratings:

Relief Valve Settings	PSIG	500
Operating Pressure	PSIG	450
Design Specification		ASME VIII-1

Handling the Container

The 3000L vessels have an inner container and an outer container with an insulated vacuum space between them. Any abuse (dents, dropping, tip-over, etc.) can affect the integrity of the containers insulation system.

When fully loaded, the 3000L in argon service will contain 8,642 lbs. (3,920 Kg) of product. While moving a full container, you may be handling 13,046 lbs. (5,918 Kg) and you should treat the load accordingly by forklift with correct load capacity.
Do not attempt to move these containers by any other means. While moving the containers, the following precautions should be observed.

- Non D.O.T. – Tanks should only be moved when empty of product.
- Never lay the container on its side. Always ship, operate and store the unit in a vertical or upright position.
- When loading or unloading the container from a truck, use a hand truck, lift gate, crane or parallel loading dock. Never attempt to manually lift the unit.
- To move the container over through surfaces, or to lift the container, attach an appropriated sling to the lifting points cut into the welded support posts, and use a portable lifting device that will handle the weight of the container and its contents.

FREIGHT DAMAGE PRECAUTIONS

ANY FREIGHT DAMAGE CLAIMS ARE YOUR RESPONSIBILITY. Cryogenic liquid containers are delivered to your carrier from **Ratermann** in new condition. When you receive our product you may expect it to be in that same condition. For your own protection, take time to visually inspect each shipment in the presence of the carrier's agent before you accept delivery. If any damage is observed, make an appropriate notation on the freight bill. Then ask the driver to sign the notation before you receive the equipment. You should decline to accept containers that show damage which may affect serviceability.

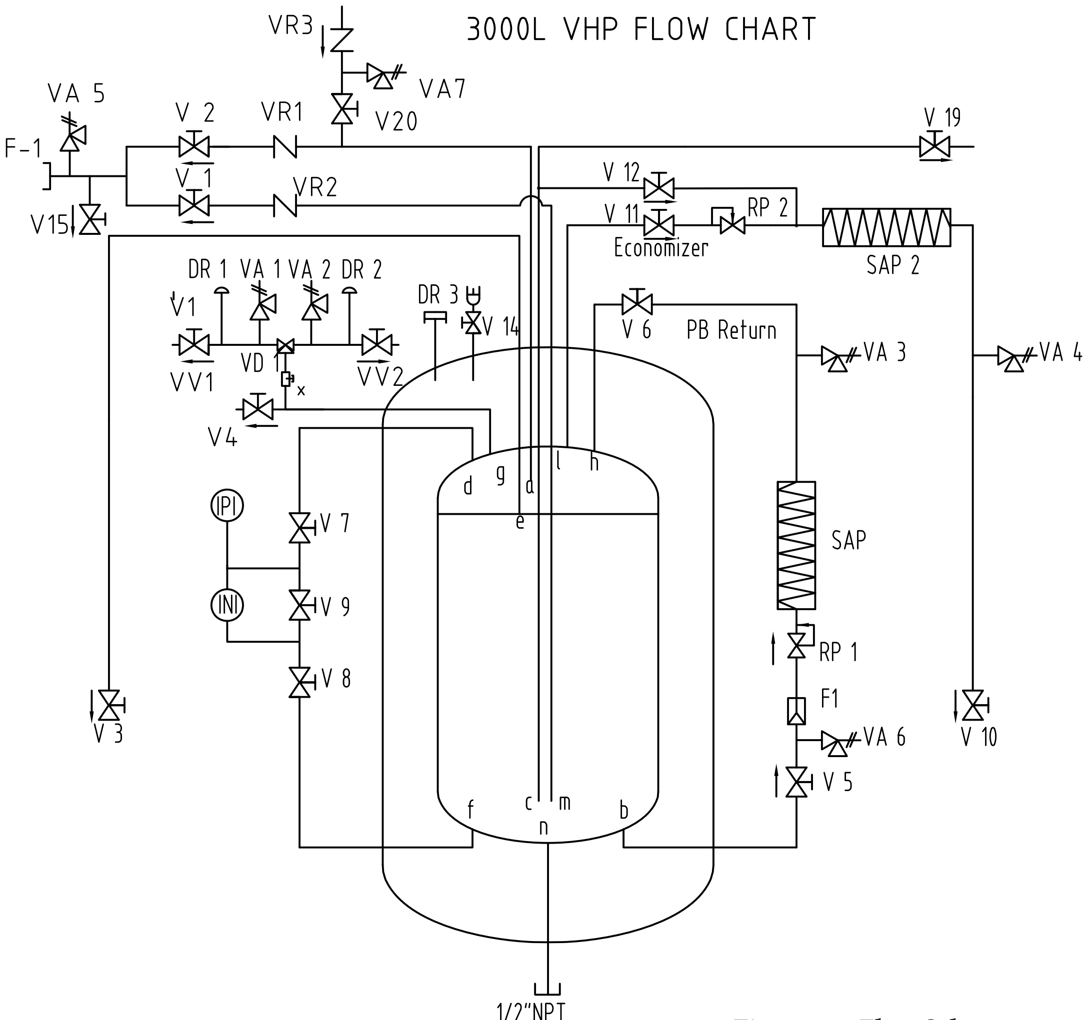

Figure 1 – Flow Scheme

Mark	Name	Mark	Name
a	Top fill	e	Vent/full trycock
b	Liquid withdraw	f	Liquid vapor
c	Liquid use	g	Safety
d	Gas vapor	h	PB out
l	Economizer	n	Liquid reserve
m	Bottom fill		

Table 2 3000L TANK FEATURES *See diagram from page 7*

MARK	NAME	SIZE	RMI® PART NUMBER
V1	Bottom Fill Valve	3/4”	**Pt # GVMSB-D-A-ACBA**
V2	Top Fill Valve	3/4”	**Pt # GVMSB-D-A-ACBA**
V3	Vent/Full Frycock Valve	3/8”	**Pt # VR-38F218TB-S**
V4	Tank Blowdown Valve	1/2”	**Pt # VR-12F12F**
V5	Build Pressure Valve	1/2”	**Pt # CBV-B12-SH-SSOH**
V6	BP Isolation Valve	1/2” NPT	**Pt # VR-12F12F**
V7	LP Level Gauge Valve	1/4” NPT	**Pt # RO-CFF250G**
V8	HP Level Gauge Valve	1/4” NPT	**Pt # RO-CFF250G**
V9	Gauge Equalization Valve	1/4” NPT	**Pt # RO-CFF250G**
V10	Gas Use Valve	3/8”	**Pt # VR-38F218TB-S**
V11	Economizer Isolation Valve	3/8”	**Pt # VR-38F38F**
V12	AUXI Liquid Valve	3/8”	**Pt # VR-38F38F**
V14	Vacuum Probe Valve	1/8”	**Pt # TGT-6R**
V15	Fill Line Purge Valve	1/4”	**Pt # VR-14F14F**
V19	Liquid Delivery Valve	3/8”	**Pt # VR-38F218TB-S**
VV1	Relief Line Purge Valve	1/4”	**Pt # RO-CFF250G**
VV2	Relief Line Purge Valve	1/4”	**Pt # RO-CFF250G**
VR1	Top Fill Check Valve	3/4”	**Pt # 05412.2027.0007**
VR2	Top Fill Check Valve	3/4”	**Pt # 05412.2027.0007**
VD1	Relief System Divertor Valve	1/2”	**Pt # 06510.2040.6026**
PRD-1	Rupture Disc	1/2”	**Pt # BD-12-500IN**
PRD-2	Rupture Disc	1/2”	**Pt # BD-12-500IN**
VA1	Pressure Relief Valve	1/2”	**Pt # SVB-A-500-FCHH**
VA2	Pressure Relief Valve	1/2”	**Pt # SVB-A-500-FCHH**
VA3	PB Circuit Thermal Relief Valve	1/4”	**Pt # PR-600**
VA4	PB Circuit Thermal Relief Valve	1/4”	**Pt # PR-600**
VA6	PB Circuit Thermal Relief Valve	1/4”	**Pt # PR-600**
VA5	Fill Line Thermal Relief Valve	1/4”	**Pt # PR-600**
VA7	Fill Line Thermal Relief Valve	1/4”	**Pt # PR-600**
VA-1	Vaporizer	DN20	**Call for Part Number**
F1	Strainer	1/2” NPT	**Pt # 08413.0400.0006**
IPI	Pressure Indicator	1/4” NPT	**Pt # PGST-SS212FFCBM14-600-OX**
DR3	Outer Jacket Rupture Disc	1.5”	**Call for Part Number**
INI	Level Gauge	1/4” NPT	**Pt # DG1516-B3.5V-0-110H2O-OX**
SAP	Pressure Build Coil	–	**Call for Part Number**
RP1	Pressure Building Regulator	1/2” NPT	**Pt # CR-12450**
RP2	Economizer Regulator	3/8” NPT	**Pt # CE-SISO-475**
SAP2	Vaporizer	–	**Call for Part Number**
F-1	Fill Connection	1.5”	**Call for Part Number**
V20	Top Fill	1/2”	**Pt # CBV-B12-SH**
VR3	Top Fill	1/2”	**Pt # CV-503B-T-5-X**

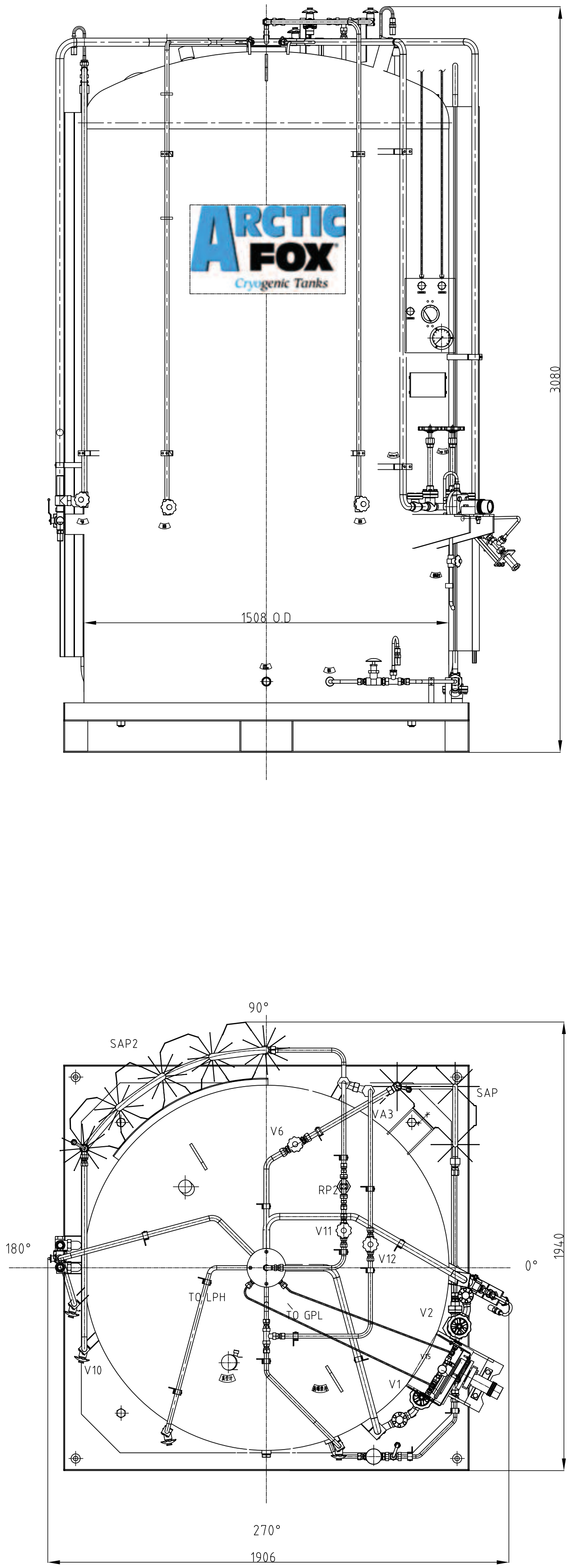

Figure 2 – Piping Diagram

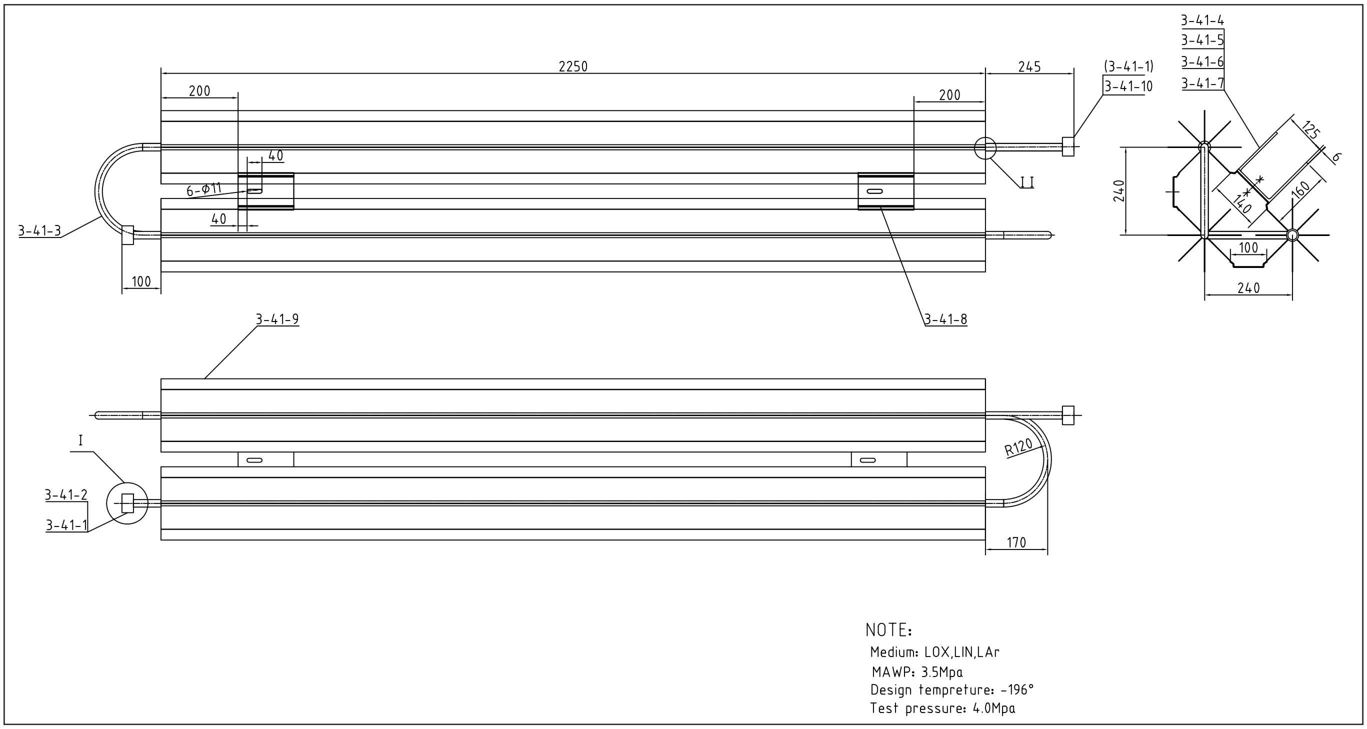

Figure 3 – Pressure Building Vaporizer

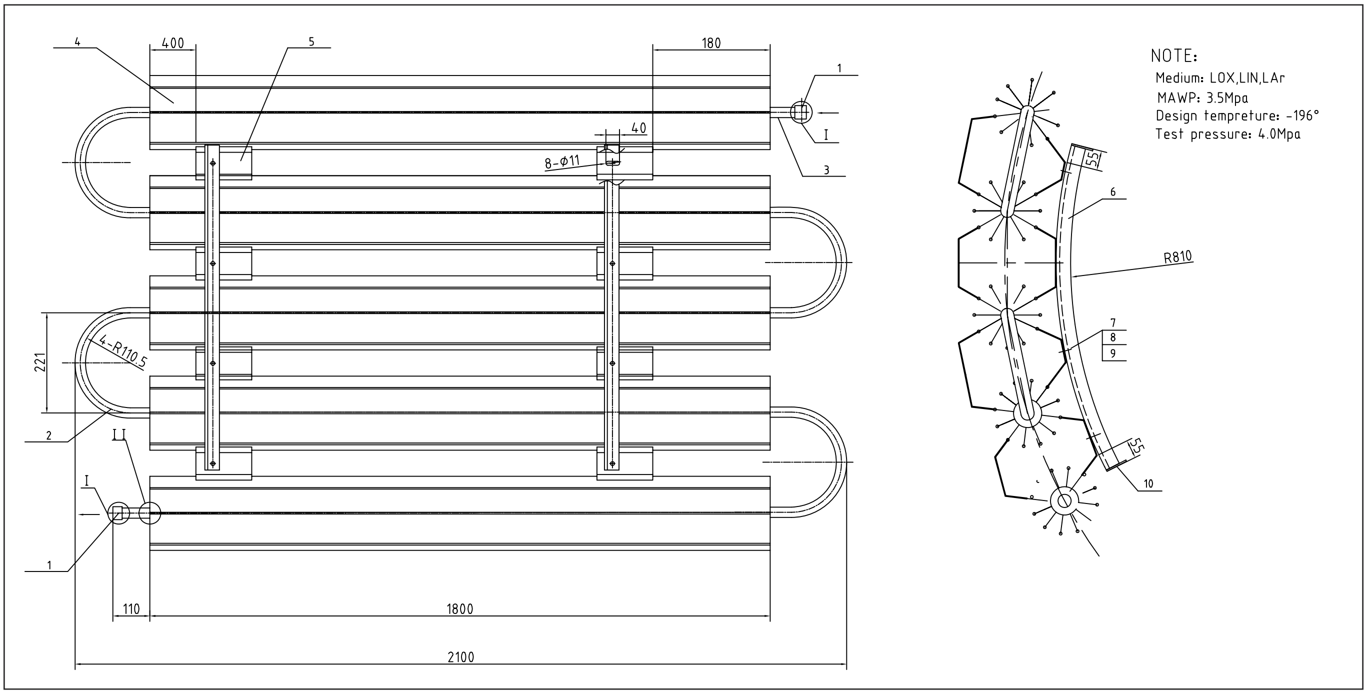

Figure 4 – External Gas Use Vaporizer

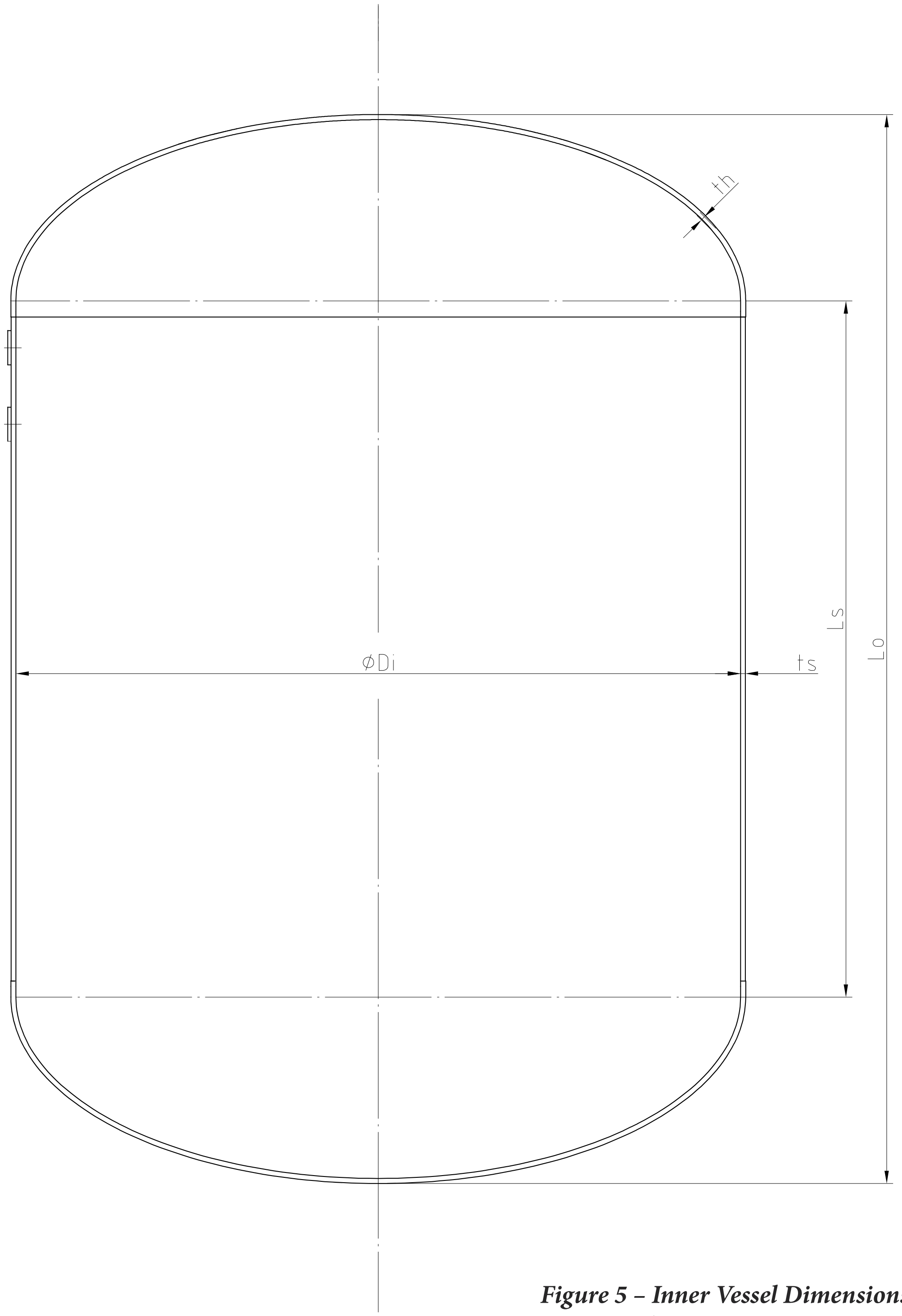

Figure 5 – Inner Vessel Dimensions for 3000L tank.

	Di (mm)	ts (mm)	th (mm)	Ls (mm)	Lo (mm)
3000L	1300	9	10	1836	2490

The container will store up to 2,580 liters of product and can deliver either liquid or gas. The following component and circuit descriptions (as shown in ***Figure 1***) are pertinent to the operation of all containers and should be read before attempting operation. The components may be identified on the component location illustration.

External Vaporizer – A liquid container for gas service must have a heat exchanger that functions as a gas vaporizer coil to convert liquid product to gas continuously during withdrawal. The capacity of this circuit is sufficient to vaporize liquid as gaseous product is withdrawn. The capacity of this circuit is sufficient to vaporize product at a flow rates up to 2,825 SCF/H. If a greater continuous demand is put on the vaporizer, an external vaporizer should be added to properly warm the gas and avoid malfunction, or damage, to gas regulators, hoses, and other downstream components.

Pressure Building – A Pressure building circuit is used to ensure sufficient driving pressure during high withdrawal periods. This function is actuated by opening a hand valve that creates a path from the liquid in the bottom of container, through the Pressure building regulator to gas space in the top. When the pressure building valve is open, and the container pressure is below the pressure building regulator setting, liquid taken from the inner container is vaporizer in a heat exchanger. The expanding gas is fed into the upper section of the container to build pressure. The resulting pressure will drive either the liquid or gas delivery system. Pressure Building is not normally required unless container pressure drops below the gas output pressure desired. If, for example, the container pressure gauge reads 75 psig, and your gas pressure requirement is 100 Psig, the pressure building valve may be opened to build container pressure to 125 psig.

Economizer – An economizer circuit withdraws gas preferentially from the head space over the liquid in the container – gas that would otherwise be lost to venting. Excess pressure in the head space of container is relieved by allowing gas to flow from this area directly to the Use valve outlet while gas is being withdrawn from the container; yet normal operating pressure is preserved to ensure uninterrupted product away product delivery. The economizer is automatic and requires no operator attention.

The GAS USE Valve – This valve controls the gas outlet that allows product withdrawal through the internal vaporizer. It has the CGA connection that matches the gas service for which the container is configured.

The LIQUID Valve – Liquid product is withdrawn from the container through the connection controlled by this valve. It has the CGA fitting that is required for liquid line connections. The valve is open for liquid withdrawal after connecting a transfer hose with compatible fittings to the liquid line connection.

The VENT Valve – This valve controls a line into the head space of the container. It is used during the fill process. The vent valve acts as a fill point during a pump transfer, or to vent the head space area while liquid is filling the inner container during a pressure transfer fill through the LIQUID valve.

The Pressure Gauge – The pressure gauge displays the internal container pressure in pounds-per-square-inch or in kilo Pascals.

The Liquid Level Gauge – The liquid level gauge displays the internal container liquid level in inch H_2O.

The Top Fill Valve – Liquid product is added through the connection controlled by this valve.

The Bottom Fill Valve – Liquid product is added through the connection controlled by this valve.

Relief Devices – These cylinders have gas service relief valve and inner container bursting disc with setting of 34.5 bar and 600 psig respectively.

Note: The PB valve (V-6), The Economizer valve (V-11) and The Auxi liquid valve (V-12) shall keep opening when the tank is in the work conditions.

WITHDRAWING GAS FROM THE CONTAINER

To withdraw gas from the container connect a suitable pressure regulator (RP-1) to the USE connection (V-10), and the output of regulator to your external equipment. Then open the USE (V-10) and the PRESSURE BUILDING valves (V-5). When the container pressure reaches 125 psig, set the pressure regulator (R-1) for the desired delivery pressure.

Increasing Gas Supply Capacity – Two or more liquid containers may be manifold together. Accessory manifolds are available for use in creating a higher capacity gas supply system. The container can supply gas at flow rates up to 3500 SCF/H using only its vaporizer. At low flow rates, the gas supplied will be at near ambient temperature. As the flow demand is increased, the gas will become proportionately colder. If greater vaporizing capacity is required, an accessory external vaporizer is available. When an external vaporizer is used, it must be connected to the USE valve (V-10) and the regulator (RP-1) moved to the output of external vaporizer.

DROPPING TANK PRESSURE

Use main vent valve. There is also a secondary vent valve to increase the blow down speed, pressure in tank needs to be reduced typically 25% lower than transfill pressure or pressure of transfill pump. See manufacturer fill tank specifications for filling pressure.

FILL THE TANK

Cryogenic liquid containers must always be filled by weight to ensure there is enough gas head space (ullage) for liquid to expand as it warms. Using the procedure below, first determine the proper filled weight of each container. The weight derived is then used in either the Pump Transfer of Pressure Transfer filling procedures that follow.

Determine Proper Fill Weight

1. Visually inspect the container. Do not attempt to fill containers with broken or missing components.
2. Move the container to a filling station scale and weight it both with and without the fill hose attached to determine the weight of the fill line assembly. The difference is the fill line weight.
3. To determine the weight at which the fill should be stopped, add the desired filling weight (from the Table next page), the transfer line weight, and the Tare Weight from the container's date plate.

FILLING WEIGHT TABLE

MEDIUM	WEIGHT
ARGON	8,642 lbs. (3920 kg)
NITROGEN	4,964 lbs. (2252 kg)
OXYGEN	6,986 lbs. (3169 kg)

** For Liquid Level Gauge Calibration, please see below Diagram 1A.*

LIQUID LEVEL CALIBRATION

LIQUID LEVEL (mm)	VOLUME(L)		
	LIQUID OXYGEN (LO_2)	LIQUID NITROGEN (LN_2)	LIQUID ARGON (LAr)
200	103	187	70
400	322	513	233
600	554	842	422
800	788	1170	609
1000	1020	1499	797
1200	1254	1827	985
1400	1486	2156	1174
1600	1720	2484	1363
1660	1789	2580	1418
1800	1952		1551
2000	2184		1738
2200	2417		1927
2340	2580		2060
2600			2303
2700			2580

ρLN2=808m3/Kg
ρLO2=1140m3/Kg
ρLAR=1410m3/Kg

Diagram 1A – Liquid Level Gauge Reference Calibration

LIQUID LEVEL CALIBRATION

LIQUID LEVEL (inch)	VOLUME(L)		
	LIQUID OXYGEN (LO_2)	LIQUID NITROGEN (LN_2)	LIQUID ARGON (LAr)
8	105	191	72
16	328	524	239
24	566	857	430
32	803	1191	620
40	1039	1525	813
48	1275	1859	1004
56	1512	2192	1195
64	1749	2527	1386
66	1809	2580	1434
72	1985		1577
80	2221		1768
88	2459		1960
92	2580		2056
96			2151
102			2342
106			2580

ρLN2=808m3/Kg
ρLO2=1140m3/Kg
ρLAR=1410m3/Kg

Diagram 1A – Liquid Level Gauge Reference Calibration

WITHDRAWING LIQUID FROM THE CONTAINER

Attach a transfer hose to the LIQUID connection and open the adjacent LIQUID valve (V-19). The pressure in the container will drive liquid product out through the valve as long as the container pressure exceeds that of the receiver.

The rate of liquid withdrawal from these containers is variable depending on the gas phase and saturation temperature of the liquid.

FILL THE TANK

Cryogenic liquid containers must always be filled by weight to ensure there is enough gas head space (ullage) for liquid to expand as it warms. The weight derived is then used in either the Pump Transfer of Pressure Transfer filling procedures that follow.

Pressure Transfer Filling Method

Filling a liquid container using the pressure transfer method is common for 22 psig (1.5 bar/152 kPa) service where the product is used for refrigerant purpose. This method may also be used for higher pressure containers to increase liquid holding time. A fill is accomplished by first establishing a pressure difference between the source vessel and the 3000L tank (higher pressure at the bulk vessel). The pressure differential will then push the liquid from the storage vessel to the container being filled. This method is employed when no transfer pump system is available, or if a greater control over liquid temperature is desired.

Fill the container is accomplished through the Top Fill valve (V-2) and the Bottom Fill valve (V-1) while the VENT valve is open or partially open to control product pressure. Careful control of pressure will control the amount of heat retained in the liquid. Lower pressure results in colder liquid transferred to the container an increases, or lengthens, product hold time. Pressure Transfer Filling Procedure (Low Pressure Source) – Once you have determined the proper full weight for a container, connect a transfer hose to the Top Fill and the Bottom Fill fitting from a low pressure source of liquid.

Pressure Transfer Filling Procedure ***(Low Pressure Source)*** – Once you have determined the proper full weight for a container, connect a transfer hose to the Top Fill and the Bottom Fill fitting from a low pressure source of liquid.

1. Open the supply valve. Then, on the 3000L, open the Top Fill, Bottom fill and VENT valves to begin fill.
2. During the fill, monitor the container pressure and maintain a pressure of 10-15 psig (0.7-1 bar/69-103 kPa) by throtting the VENT valve.
3. When the full weight is reached, close both the Top&Bottom Fill and VENT valves.
4. Close the liquid supply valve and open the dump valve on the fill line assembly.
5. Disconnect the fill line from the container and remove the container from the scale.

Pump Transfer Filling Method

When a pump is used for filling liquid containers, the fill may be accomplished through the Top valve and the Bottom Fill valve. Filling through the Top&Bottom Fill valve may provide colder liquid and longer holding time before the liquid warms to the point where venting begins, but will require more frequent venting and greater product loss.

Pump Transfer Filling Procedure – This method applies to containers in gas service that are equipped with a 230 psig (16 bar/1586 kPa), 350 psig (24.1 bar/ 2410 kPa), 500 psig (34.5 bar/3450 kPa) relief valve. Liquid is admitted through the VENT valve and recondenses gas in the head space during the fill. The fill line is connected from the liquid supply to the VENT valve on the container. Both the fill line and the container should be pre-cooled prior to the beginning the fill process. Proper full weight is determined by the previously explained method.

1. Open the supply valve. Then, on the container being filled, open the Top fill valve and Bottom fill valve to begin the fill. Start the pump at this time.
2. Observe the container pressure closely. If the pressure approaches the relief valve setting (or the dump pressure rating) stop the fill process at the supply and open the fill line dump valve to vent excess pressure. As soon as the pressure has dropped to a level that will allow you to resume the fill, close the dump valve and restart the pump (or reopen the supply valve.)
3. When full weight is reached, close the Top&Bottom fill valve. Stop pump (where applicable), close liquid supply valve and open the dump valve on fill line assembly to vent trapped liquid.
4. Disconnect the fill line from the container and remove the container from the scale.

MAINTENANCE PROCEDURES

Read the Safety Precautions in the front of this manual before attempting any repairs on these containers. Also follow these additional safety guidelines while performing container maintenance.

✓ Never work on a pressurized container. Open the vent valve as a standard practice during maintenance to guard against pressure build-up from residual liquid.

✓ Use only repair parts cleaned for oxygen service. Be certain your tools are free of oil and grease. This is a good maintenance practice, and helps ensure you do not create a combustion hazard when working on containers for oxygen or nitrous oxide service.

✓ Leak test connect after every repair. Pressurize the container with an appropriate inert gas or leak testing. Use only approved leak test solutions and follow the manufacturer's recommendations.

REGULATOR MAINTENANCE

A spring-loaded regulator is employed for the pressure building and economizer circuit. This regulator can be adjusted on the container, replaced, or checked and adjusted off the container in a readily fabricated bench adjustment fixture.

Regulator Adjustment – On Container

1. Fill the container with the appropriate liquid product.
2. Open the Pressure Building Valve and allow the container pressure to stabilize for about an hour. Note the point where the pressure stabilizes.
3. Adjust the screw on the top of the regulator to raise or lower the pressure to the desired point. When decreasing the setting, the pressure building valve must be closed and the container vented to a lower pressure. Then repeat Step 2 in order to observe the change.

Regulator Removal or Replacement Procedure

1. Close manual Pressure Building Valve
2. Vent the container to atmospheric pressure
3. Loosen and remove both the tube connections on the pressure building and economizer output sides of the regulator.
4. Remove the regulator from the container by unscrewing the valve body and elbow from the output of the Pressure Building Valve.
5. Repair the regulator and readjusted its setpoint using the bench test setup.
6. To install a replacement or readjusted regulator, apply PTFE tape to the elbow on the container and thread the Valve body onto the elbow.
7. Reconnect the tube connections to the regulator and tighten.
8. Pressurize the container and check it for leaks.

CHECKING CONTAINER PERFORMANCE

Cryogenic containers are two container, one within the other. The space between the containers acts as a highly efficient thermal barrier including high technology insulation, a vacuum, and a vacuum maintenance system. Each serves a very important part in the useful life of the container. The high technology insulation is very effective in preventing radiated heat from entering the inner container.

Unfortunately, the perfect vacuum cannot be achieved since trace gas molecules begin to enter the vacuum space from the moment of manufacture. The vacuum maintenance systems consist of materials which gather trace molecules from the vacuum space. The maintenance system can perform its function for years, but it has a limited capacity. When the vacuum maintenance system is saturated it and no long maintain the vacuum integrity of the container. The change will be very gradual and my go unnoticed for several years. When the vacuum in the insulation space is no longer effective, the following symptoms may appear.

1. With liquid in the container and pressure building/vaporizer coil not in use, the outer casing will be much colder than comparative containers.
2. Frost, indicating the liquid level, may be visible on the outer casing of the container.

continued on next page

3. The container may appear to "sweat" if the air surrounding the container is hot and humid.
4. The relief valve will open continuously until the container is empty.
5. The container will hold pressure for several days but will not hold liquid.

HAND VALVE REPAIR

Hand valve are an integral part of the container, and the valve bodies rarely need replacement. However, the handwheel and internal parts of the valves are renewable.

Valve Disassembly Instructions

1. Open valve by turning handwheel counterclockwise as far as it will go to release any trapped gas in the system.
2. Using a screwdriver, remove handwheel Screw and Washer by turning counter-clockwise to allow removal of Spring Retainer, Washer, Spring, Seal, handwheel and Bonnet Washers. Discard these parts.
3. Using a large adjustable wrench to hold valve body, remove Bonnet by turned counterclockwise with a 15/16 in. socket wrench that is capable of developing at least 80 ft. lbf (11kgfm) torque.
4. Remove the following parts from the valve body and discard Stem, Stem Gasket, Seat Assembly and Bushing.
5. Inspect body and clean if necessary, be sure interior and seal areas are free from dirt, residue and foreign particles.

Valve Replacement Instructions

1. Partially thread Seat Assembly (seat disc first) into large end of Bushing leaving a tang of nipple assembly exposed about 1/8 in. beyond top of Bushing.
2. Insert Seat Assembly (seat disc first) with attached Bushing, into valve body until properly seated.
3. Place Stem Gasket carefully over Stem convex side facing downward.
4. Insert slotted end of Stem into valve body, making sure that slot fully engages tang of Seat Assembly.
5. Place Bonnet over Steam and while holding square end of Stem to keep it from turning, thread Bonnet into valve body. Hold body with one wrench and using another wrench (15/16 in. socket), tighten Bonnet to 80 ft. lbf (11 kgfm) torque.
6. Install Bonnet Washers over Stem on Bonnet.
7. Place Handwheel over Stem and on Bonnet.
8. Install Seal over Steam into recess of Handwheel.
9. Install Seal Washer over Seal at the bottom of Handwheel recess shown.
10. With the flat side facing downward, place Retainer Washer on top of Seal.
11. Align the holes of these parts and place Spring over Seal.
12. Place Spring Retainer over assembly as shown, keeping center hold aligned with parts installed in Steps 6-11.
13. Install Screw and Washer (over retainer) Tighten firmly with a screwdriver, turning clockwise.
14. Turn Handwheel completely clockwise to close valve. Re-pressurize container and leak check valve.

TROUBLESHOOTING

The following chart is provided to give you some guidance in determining the probable cause and suggested action for some problems that may occur with cryogenic liquid containers. This chart is specifically tailored to your tank.

TROUBLESHOOTING CHART

Symptom	Possible Cause	Corrective Action
Consistently low operating pressure	1. Relief valve open at low pressure 2. Economizer side of Economizer Regulator stuck open 3. Cold liquid 4. Leaks	1. Remove and replace relief valve. 2. Remove and replace regulator 3. Open pressure building valve. With P.B. inoperative, the container will build pressure over time, or an external pressure source can be used to pressurize container.
No pressure shown on container pressure gauge	1. Bad container pressure gauge. 2. Open inner container bursting disc. 3. Leaks in valves or plumbing. 4. Cold liquid	1. Remove and replace bad gauge. 2. Remove and replace bursting disc. Pressurize container and check relief valve operation. 3. Leak test and repair leaks. For valve repairs, see Maintenance section. 4. Open pressure building circuit.
No pressure showing but container is full.	1. Broken pressure gauge. 2. Vent valve open/P.B. valve closed. 3. Faulty relief valve.	1. Replace pressure gauge. 2. Close vent valve, open P.B. valve. 3. Replace relief valve.
Container full and liquid level gauge but very low pressure	1. Liquid to cold 2. Possible leak in vent valve. 3. Faulty relief valve.	1. Open P.B. valve or allow to stand. 2. Rebuild valve 3. Replace valve

Container is cold and may have ice or frost on outer casing. Will not hold liquid over night. Relief valve is vent gas.	1. Vacuum loss. Check NER. 2. Defective P.B/Economizer regulator.	1. Consult with Rater-mann for course of action.Do not attempt to put additional liquid in container. 2. Look for P.B. coil patter in ice. Close P.B. valve. Replace or reset regulator
Container vents through relief valve when in use.	Pressure Building and Economizer Regulator set above relief valve setting. Economizer side of regulator clogged or stuck open.	Remove and reset or replace regulator.
Container vents after fill but quits after awhile.	This may be caused by residual heat vaporizing some liquid inside container and is a normal condition.	Symptom should go away once container reaches operating temperature and liquid reaches its saturation point at container operating pressure.
Container vents gas continuously through relief valve.	Heat leak may be too great.	Perform container performance evaluation test per Maintenance section to determine if container vacuum is adequate.

WARRANTY

Disclaiming – Covers workmanship and defective parts.
Only covers parts and labor for repair of tank.
Tank and working component, valves and regulator warranty is 1 year.
Tank vacuum warranty is 5 years.