



ORCA XT-2500/2000 Gen II
OPERATION MANUAL
LIN/LAR /LOX



ORCA MICRO-BULK DELIVERY SYSTEM

CHART INC

DISTRIBUTION AND STORAGE DIVISION

407 Seventh Street Northwest

New Prague, MN 56071

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MANUAL 14891836

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Section 1 Overview

Service

The ORCA XT-2500/2000 Cryogenic System has been designed for years of safe and dependable operation. In the event service is required, contact:

Chart Inc. at 1-800-400-4683.

Address

The ORCA XT-2500/2000 Micro-Bulk Delivery System is designed and manufactured by:

**Chart Inc.
Distribution & Storage Division
407 Seventh Street Northwest
New Prague, MN 56071**

Manual Explanation

This operation manual is designed to be used for the **ORCA Model XT-2500/2000** and contains information regarding the safe operation in nitrogen, argon and oxygen services. **It should be thoroughly read and understood by anyone that operates, or is exposed to this equipment.** This manual is intended to provide the cryogenic service employee with the necessary information needed to operate the ORCA XT-2500/2000 Micro-Bulk Delivery System. The schematics and parts lists refer to reference numbers for each component. The reference numbers will be used throughout this manual to draw specific attention to a component while describing its function or operation.

Designed Use

The standard ORCA XT-2500/2000 Micro-Bulk Delivery System is designed for the safe and efficient transport of liquid nitrogen, argon or oxygen.

Design Modification

DO NOT use this product in any manner not consistent with the instructions outlined in this Operation Manual! NEVER alter the design, or perform service that is not consistent with the instructions outlined in this Manual without the prior written approval of Chart Inc!

Compatibility and Cleaning

Always keep the ORCA XT-2500/2000 clean and free from grease and oil. Use care when cleaning with high-pressure water or steam cleaning equipment. **DO NOT direct the cleaning nozzle into the electronic components.** When replacing components, use only parts which are considered compatible with liquid oxygen. Do not use regulators, fittings, or hoses, which were previously used in compressed air or carbon dioxide environments. Use only oxygen compatible sealants on threaded connections. All new joints should be leak tested with an oxygen compatible leak test solution at a minimum of 35 psig. Failure to comply with these instructions may result in serious personal injury, death, or damage to the container. Once a system has been contaminated, the vessel may not be returned to oxygen service without extremely extensive cleaning methods.

Safety Summary

While every possible safety precaution has been taken to ensure safe operation and maintenance of the ORCA XT-2500/2000 delivery vessel, it is imperative that all persons having contact with the ORCA become thoroughly familiar with all maintenance, safety precautions, and procedures contained in this operation manual. **If for any reason any part or parts of this manual becomes confusing or the information provided is not completely understood contact a Technical Service Representative at Chart Inc. 1-800-400-4683 before proceeding with the operation or repair of the vessel.**

General

The ORCA XT-2500/2000 consists of two separate vessels which are known as the “Pulse” tank and “Main” tank. Each is constructed with a stainless steel inner vessel encased within an outer carbon steel vacuum shell. The pulse tank has a maximum allowable working pressure of 350 psi and has a capacity of 79 gallons (300 liters). The main tank has a maximum allowable working pressure of 217 psi with a capacity of 2,295 gallons for the XT-2500 and 1,850 gallons for the XT-2000. Both vessels are protected from over-pressurization by use of a safety relief valve system. Safety relief devices are used to protect the inner vessels and vacuum casings and are sized and manufactured in accordance with ASME and other standards.

Cryogenic

A product retaining a temperature of **-150° F or colder**. ORCA Systems maintain gases efficiently in a cryogenic liquid state. Gases can be most efficiently *stored* as liquids. Gases may be liquefied by compression or cooling them until they liquefy (see Vaporization/Condensation). In order to be maintained in a liquid state, each gas must be kept at or below their respective boiling temperatures.

Cryogenic Temperatures

The ORCA XT-2500/2000 system employs cryogenic temperatures to store the product in its liquid state.

Gas-Boiling Temperatures (at 0 psig):

Argon	-302° F
Nitrogen	-320° F
Oxygen	-297° F

Warnings

Fatal or severe injury, fire, explosion, or suffocation may result depending on the type of liquid used in this system if the operating personnel fail to observe the safety precautions.

Nitrogen and argon vapors in the air may dilute the concentration necessary to support or sustain life. Exposure to such an oxygen deficient atmosphere can lead to unconsciousness, serious injury, or even death. 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. Inhalation of high concentrations of these gases can cause anoxia, resulting in dizziness, nausea, vomiting, unconsciousness, and possibly death! Unconsciousness and death may occur with virtually no warning if the oxygen content is below 8%.

Before removing any parts or loosening of fittings empty the cryogenic container of liquid contents and release any vapor pressure in a safe manner. External valves and fittings can become extremely cold and may cause painful burns to personnel unless properly protected. Personnel must wear protective gloves and eye protection whenever removing parts or loosening fittings. Failure to do so may result in personal injury due to the extreme cold and tank pressure. Accidental contact of liquid gases to 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, cold equipment, or cold gas exists. Safety goggles and/or a face shield should be worn if liquid ejection, splashing, or cold gas contact is possible. Clean, insulated gloves that can easily be removed and long sleeves are mandatory for arm protection. Cuff-less trousers should be worn over the shoes to shed any spilled liquid.

If cryogenic liquid or cold boil-off gas contacts a worker's skin or eyes, the affected tissues should be promptly flooded or soaked with tepid water (105-115°F; 41/46° C). DO NOT USE HOT WATER. A physician should examine cryogenic burns that result in blistering or deeper tissue freezing promptly.

In the event of known or suspected container vacuum problems (even if an extraordinary circumstance such as those noted above have not occurred), do not continue to use the unit.

Continued use of a cryogenic container that has a vacuum problem can lead to carbon steel 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 by qualified personnel. 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 gasses.

Oxygen Deficient Atmospheres

The normal oxygen content of air is approximately **21%**. Depletion of oxygen content in air, either by combustion or by displacement with inert gas, is a potential hazard and users should exercise suitable precautions. One aspect of this possible hazard is the response of humans when exposed to an atmosphere containing only **8 to 12%** Oxygen. In this environment, unconsciousness can be immediate with virtually no warning. When the oxygen content of air is reduced to about **15 or 16%**, the flame of ordinary combustible materials, including those commonly used as a 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.

Human exposure to atmospheres 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 immediate change of environment, or through the gradual depletion of oxygen.

Most individuals in or around oxygen deficient atmospheres rely on the “Buddy System” for protection. Obviously, the “Buddy” is equally susceptible to asphyxiation if he or she enters the area to assist an unconscious partner unless equipped with a portable air supply. Equipping all individuals with a portable supply of respirable air ensures best protection.

DO NOT attempt to remove an individual without utilizing proper rescue equipment or you may also become a casualty. If the exposed person is unconscious, obtain assistance and put into effect the established emergency procedures. Lifelines are acceptable only if the area is essentially free of obstructions and individuals can assist one another without constraint.

All new piping joints should be leak tested with a compatible leak-test solution. Once a system has been contaminated through improper or careless parts cleaning or replacement, the vessel may not be returned to service without extremely extensive and complex cleaning methods. If oxygen deficient atmosphere is suspected or known to exist: Use the “Buddy System”. Use more than one “Buddy” if necessary to remove a fellow worker in an emergency. Both the worker and “Buddy” should be equipped with self-contained breathing equipment.

If an oxygen deficient atmosphere is suspected or known to exist: Use the “Buddy System.” Use more than one “Buddy” if necessary to remove a fellow worker in an emergency. Both the “Worker and the Buddy” should be equipped with a self-contained breathing equipment. Persons suffering from lack of oxygen should be immediately moved to areas with normal atmospheres. **A 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.

Oxygen Enriched Atmospheres

An oxygen enriched atmosphere occurs whenever the normal oxygen content of air is allowed to rise above **23%**. While oxygen is non-flammable, ignition of combustible materials can occur more readily in an oxygen rich atmosphere than in air; and combustion proceeds at a faster rate. 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 conditions of temperature and pressure to which the components may be exposed in the containment and use of oxygen. In an oxygen-enriched atmosphere, flammable items burn vigorously and can explode. Excess accumulation of oxygen creates an oxygen enriched atmosphere (defined by the Compressed Gas Association as an oxygen concentration above **23%**). Certain items considered non-combustible in air might burn rapidly in such an environment. Keep all organic materials and other flammable substances away from possible contact with oxygen; particularly oil, grease, kerosene, cloth, wood, paint, tar, coal, dust, and dirt which may contain oil or grease. Do not permit smoking or open flame in any area where oxygen is stored, handled, or used. Failure to comply with this warning may result in serious personal injury including death. Components may be exposed in the containment and use of oxygen. Compatibility involves both combustibility and ease of ignition. Materials that burn in air may burn violently in pure oxygen at normal pressure, and explosively in

pressurized oxygen. In addition, many materials that do not burn in air may do so in pure oxygen, particularly when under pressure. Metals for containers and piping must be carefully selected, depending on service conditions. The various steels are acceptable for many applications, but some service conditions may call for other materials (usually copper or its alloys) because of their greater resistance to ignition and lower rate of combustion. Similarly, materials that can be ignited in air have lower ignition energies in oxygen. Many such materials may be ignited by friction at a valve seat or stem packing, or by adiabatic compression produced when oxygen at high pressure is rapidly introduced into a system initially at low pressure.

ORCA XT-2500/2000 Theory of Operation

The XT-2500/2000 has the ability to be filled with a cryogenic product and deliver that product with the use of the patented "Pulse Transfer" technology. **Because of its unique design, the XT-2500/2000 requires no onboard pump to deliver up to 40 gallons per minute utilizing the low flow dispense, and up to 80+ gallons per minute depending on temperature and humidity conditions.**

One key feature of the ORCA XT-2500/2000 system is the "SMART" flow meter that is designed to sense the filling status of a Perma-Cyl[®] and terminate the delivery automatically when filling is completed. This provides the benefit of greater safety and operator freedom during the filling process.

The ORCA XT-2500/2000 System leverages the principles of cryogenics to minimize losses in delivering gas molecules to the use point. The following section of this manual will discuss the theory behind the ORCA XT-2500/2000 System by explaining the principles of cryogenics and provide the user with information necessary to properly understand and identify components and system functions.

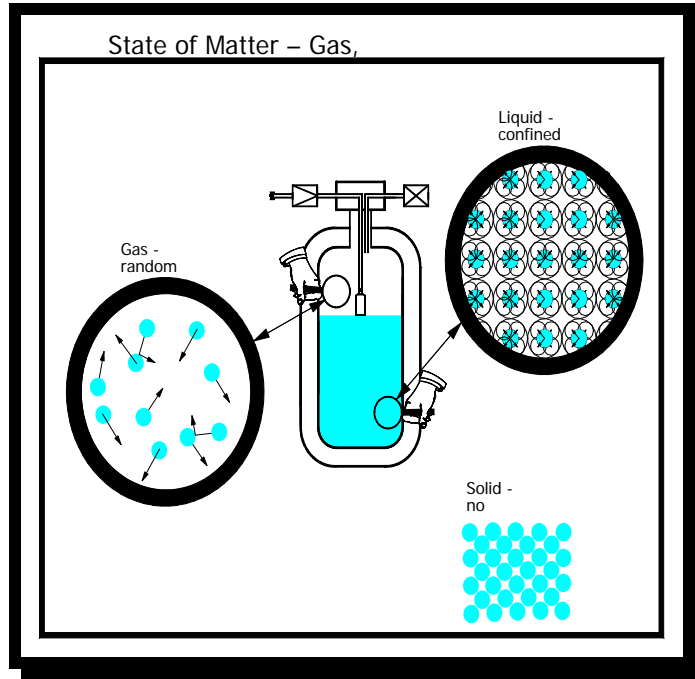
Terminology of Cryogenics

States of Matter

Matter can exist as a gas, liquid, or a solid. Two phase liquid is a liquid with gas bubbles or slugs of gas, due to lack of pressure to maintain equilibrium. Gas and liquid can exist at a range of temperatures. Temperature is a measure of the amount of energy within the solid, liquid, or gas.

Gas is defined as molecules in random motion, liquid is defined as molecules in confined motion, and solid is defined as molecules with no motion (see figure 1).

Figure 1 - States of Matter (Gas, Liquid, and Solid)



Saturation

Defined as point at which liquid and vapor co-exist at the same pressure (temperature).

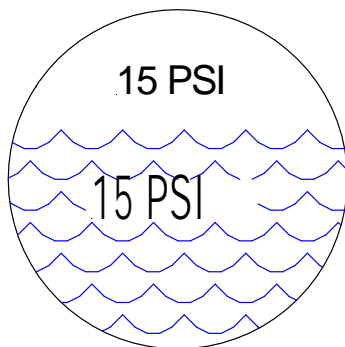
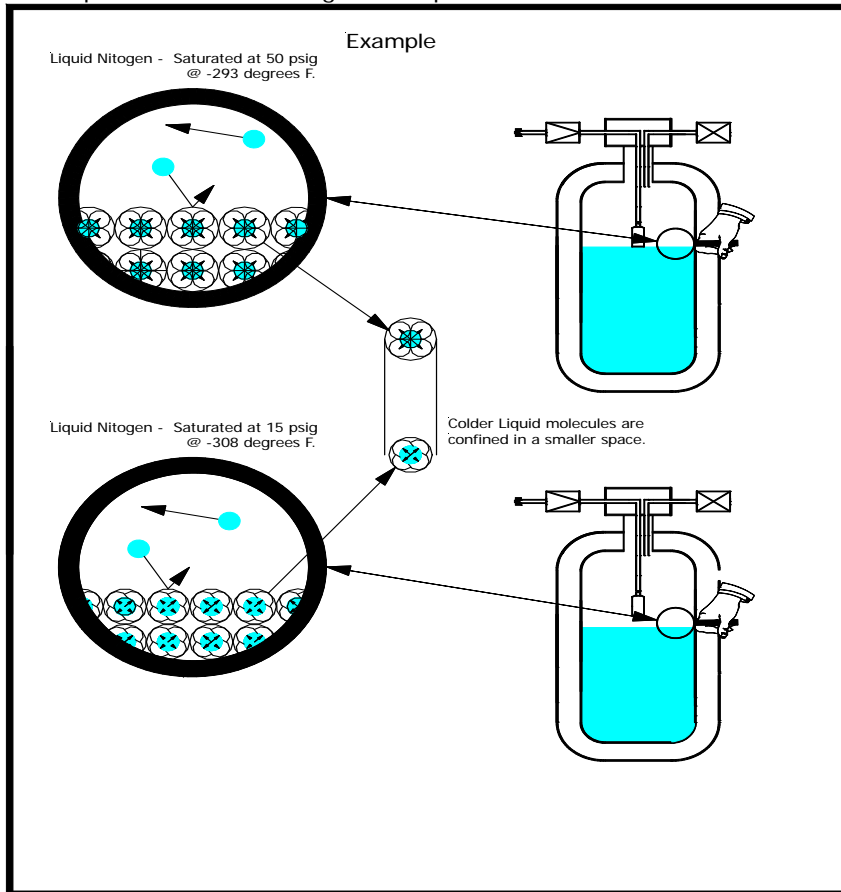


Figure 2

Liquid density, temperature, and equilibrium pressure change with the saturation level of the liquid. Saturation can also be described as an energy state. Liquid molecules at a higher energy state (warmer) take up more space. Figure 3 depicts liquid nitrogen at 50 psig saturation and 15 psig saturation.

Figure 3-Liquid Saturation

Saturation - Liquid can exist at a range of temperatures. Each temperature state has a pressure at which the gas and liquid motion are constant.



Equilibrium

In a closed vessel the gas and liquid temperatures are the same. If there is a temperature difference between the gas and liquid (with the tank closed), the gas and liquid will change their temperatures until they are equal.

Saturation Pressure

Pressure (usually in psi) that is used to describe the current condition of a liquid and gas within a closed container.

Vaporization

Changing liquid into vapor by warming the liquid for the purpose of tank pressure building or for gas use. The Orca XT-2500/2000 System uses pressure building coils, shown in Figure 4, to accomplish this.

Figure 4-Orca XT-2500/2000 Pressure Building Coils



Vapor Pressure

Pressure of the vapor space within the tank. Measured by reading the tank pressure gauge.

Condensation

The conversion of vapors into liquid by cooling the vapors.

Inner Cylinder

The inner cylinder is the container in which the liquid product is stored. It is constructed of high quality alloy steel and its exterior is wrapped with a multi-layered insulation.

Outer Cylinder

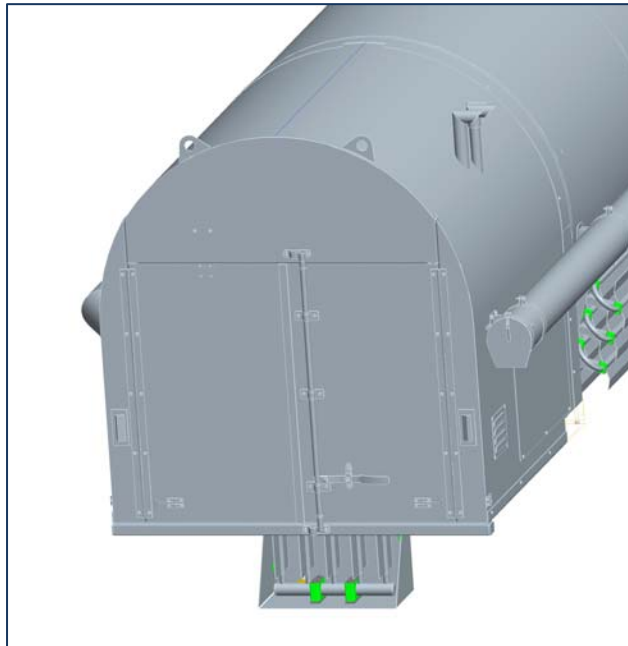
The outer vessel houses the inner cylinder and serves as the chamber in which a vacuum is drawn to minimize the transfer of heat from the outer cylinder to the inner cylinder where the product is stored.

Annulus

The annulus volume of space is between the outer and inner cylinders that minimize the transfer of heat from the outer cylinder to the inner cylinder where the product is stored.

Plumbing Cabinet

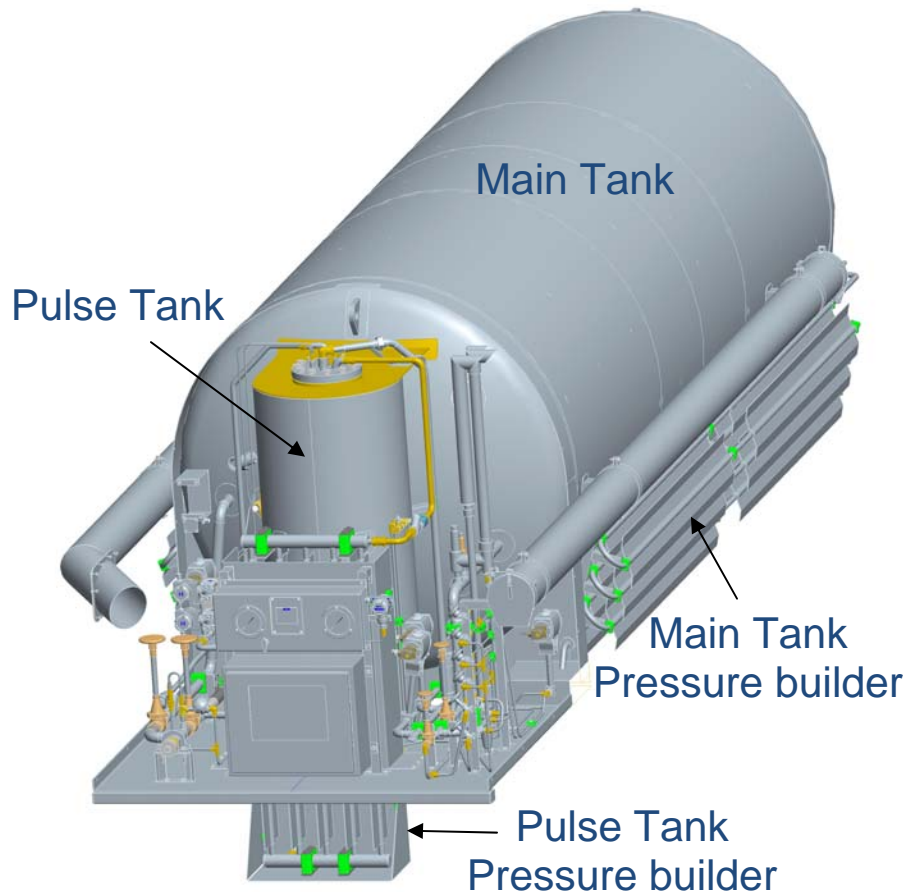
The plumbing cabinet houses the electronics and plumbing components for the ORCA. It is also referred to as the “Dog House.”



ORCA XT-2500/2000 System Components/Terms

Main Storage Tank

The main storage tank is a horizontal vessel with a gross storage volume of 2,295 gallons on the XT-2500 and 1,850 gallons on the XT-2000 and is constructed per CGA-341 guidelines (25.3 psig road relief). It has a maximum allowable working pressure of 217 psig. The inner cylinder is the container in which the liquid product is stored. It is constructed of stainless steel and its exterior is wrapped with a multi-layered insulation. The outer vessel which is constructed of carbon steel, houses the inner cylinder and serves as the chamber in which a vacuum is drawn to minimize the transfer of heat from the outer cylinder to the inner cylinder where the product is stored.



Main Tank Pressure Builder



The main tank pressure builder consists of two large coils, one mounted on each side of the main storage tank. These coils receive high pressure liquid from the pulse tank when the unit is in the high flow mode. The pressure from these coils pressurizes the main tank up to a maximum of 205 psi.

Pulse Tank & Pressure Builder



Pulse Tank & Valve to the Pressure Builder



Pulse Tank Pressure Builder

- The pulse tank is vertically mounted 79 gallon vessel which is designed for making deliveries to Perma-Cyls[®] and liquid cylinders in the low flow mode. The delivery hose is permanently mounted to the low flow circuit and is stowed in the plumbing cabinet. The pulse tank has a maximum allowable working pressure of 350 psi and a maximum pressure setting for pressurization of 330 psi. When the XT-2500/2000 is in the high flow mode, the pulse tank delivers high pressure liquid to the main tank pressure building circuit.

Section 2 General Maintenance

Overview

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

Persons making repairs to piping, valves, and gauges should be fully familiar with cleanliness requirements for components. It is recommended that all parts be kept clean for oxygen service, even if being used with other cryogenes.

12-24 VDC Electrical System

The 12-24 VDC (low voltage) electrical system is powered by the 12 VDC system of the truck chassis or the Genset battery if trailer mounted.

Orca XT-2500/2000 Vessel Mounting Brackets and Bolts

The mounting brackets from just in front of the suspension cross members to the rear most are rigged mounted. The mounts to the front are designed to flex. Periodic inspection of the brackets and bolt torque's is recommended. The bolts at the flex mounts should be tightened until they are in contact then tighten and compress the springs an additional 3/16" to 1/4".



Figure 15

CAUTION!

Before conducting maintenance or replacing parts on the ORCA XT-2500/2000 system, release container pressure in a safe manner. Replacement of certain parts may require that the entire contents be completely emptied.

Orca XT-2500/2000 Periodic Inspection

In order to maintain the Orca XT-2500/2000 unit in good operating condition, certain system components must be inspected on a periodic basis. These components requiring periodic inspection are listed in Table 1 - Periodic Inspection.

ORCA XT-2500/2000 PERIODIC INSPECTION	
<u>Inspection Item</u>	<u>Interval</u>
Valves and fittings for leaks, malfunction etc.	Monthly and during operation
Air system and lines	3 months
Control wiring	2 months
Indicating gauges for malfunction	6 months
Relief valves to verify proper settings	1 year

Table 1 - Periodic Inspection

Prior to Each Operation - Inspect for loose or damaged cabling, piping and connections, etc. Check for proper pre-start conditions.

Every Three Months - Visually inspect all components of the system. Clean and inspect all connections, electrical cabling and instrument console.

Every Twelve Months - Thoroughly check entire system. Inspect all parts for wear and replace as necessary. Clean and repair all electrical components as needed. Repair or replace worn or damaged cabling and connectors.

Section 3 Plumbing Cabinet Components & Systems



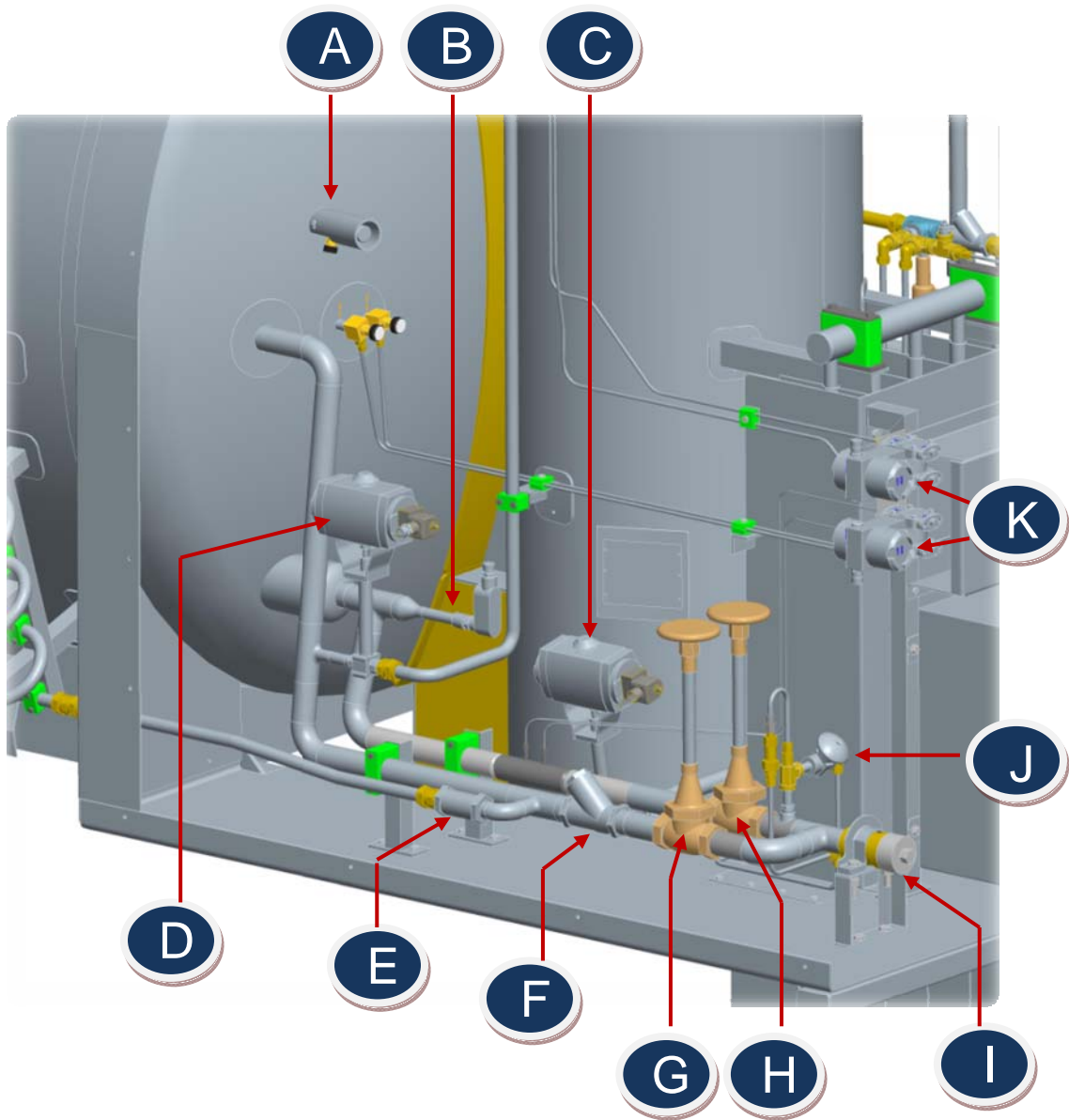
Roadside

Center

Curbside

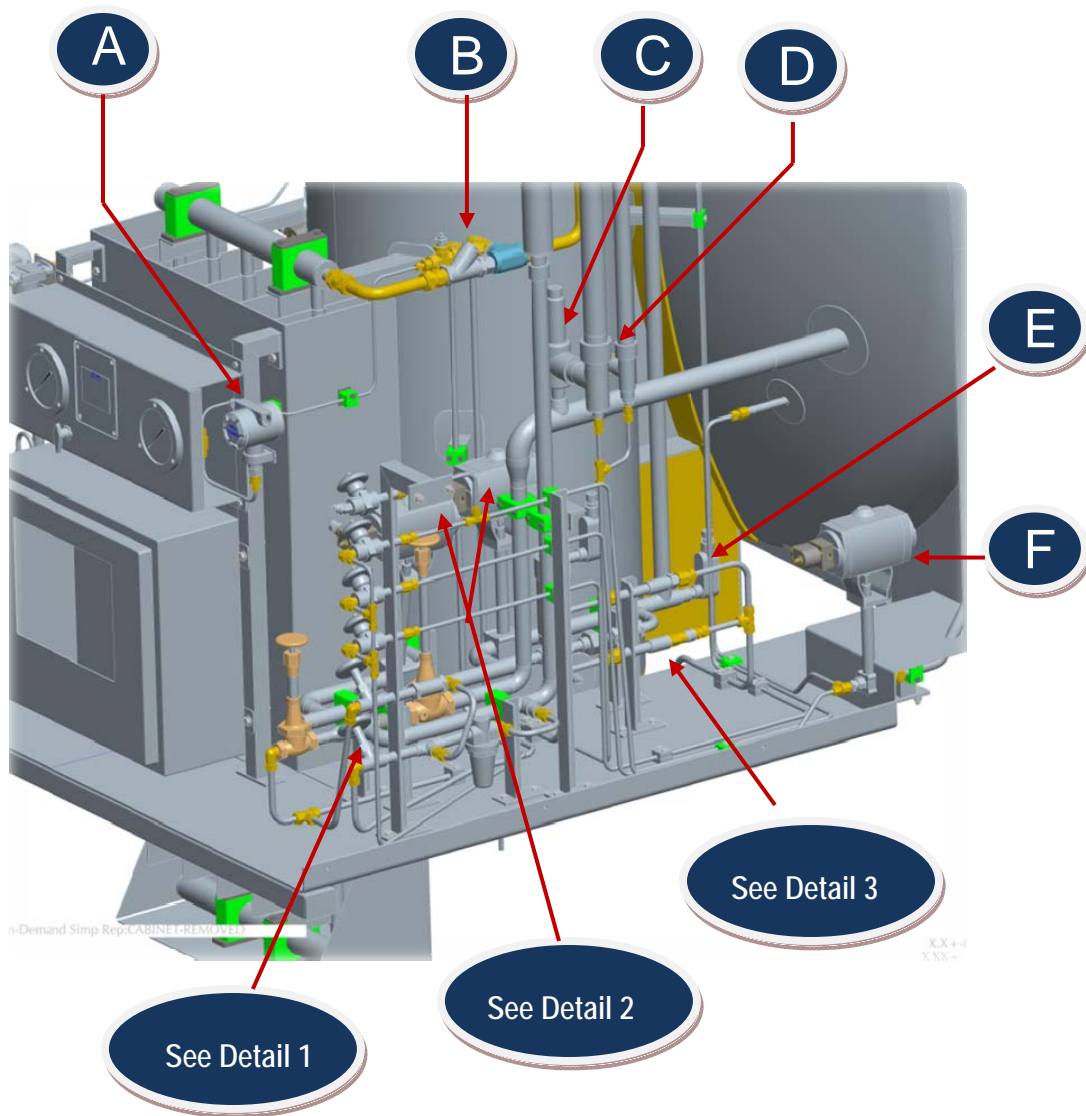
This is a view of the Orca XT-2500/2000 plumbing cabinet. In this section we will discuss in detail, plumbing cabinet components and systems. To aid in this we will break the Cabinet into 3 areas - Roadside, Center (system control and monitoring), and Curbside.

Plumbing Cabinet-Roadside



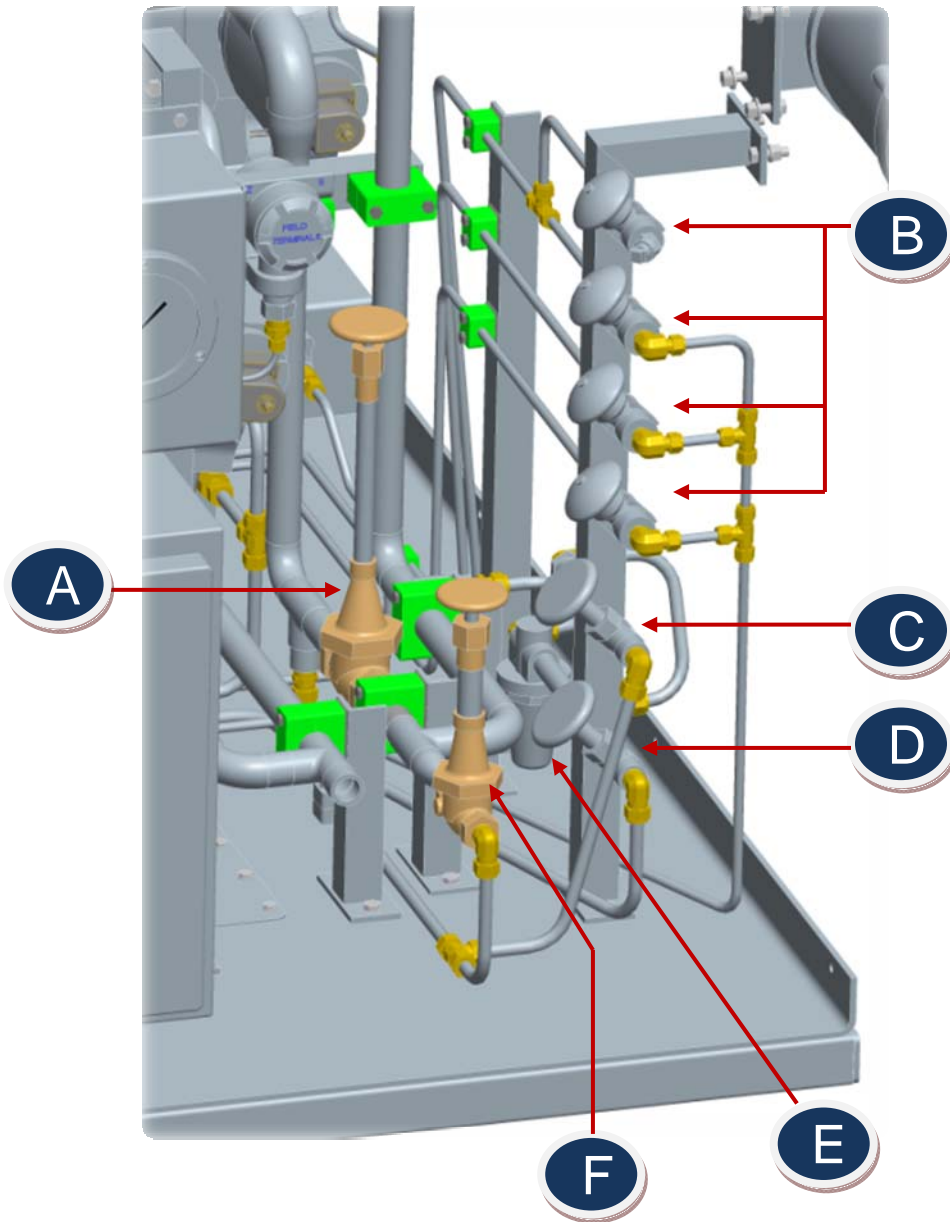
Item	Tag	Part Number	Description
A	TC-1	10826906	Hastings TC DV-6R
B	RTD -2	10929382	Temp. Sensor 9" LG
C	AOV-3	14667041	Pulse Tank P.B. Valve
D	AOV-2	14667041	Vent-To Bulk
E	CV-8	11919653	Check Valve P.B. Return
F	CV-3	11721655	Check Valve Fill Line
G	V-3	10927184	Top Fill Valve
G-1	Repair Kit	10997879	Top Works
H	V-1	10927184	Bottom Fill/ High Flow Dispense
H-1	Repair Kit	10997879	Top Works
I-1	DC-2	11940250	1 ½" CGA - LOX
I-2	DC-2	11941068	1 ½" CGA - LIN
I-3	DC-2	11941050	1 ½" CGA - LAR
I-4	DC-2	11941033	2 ½" CGA - LIN
I-5	DC-2	11941041	2 ½" CGA - LAR
I-6	DC-2	14131221	3" CGA - LOX
J	V-9	1713202	Fill Line Drain
J-1	SV-4	11670000	Safety Relief Fill Line
K	DP-1/DP-2	10945294	Differential Pressure Transmitter

Plumbing Cabinet Curbside



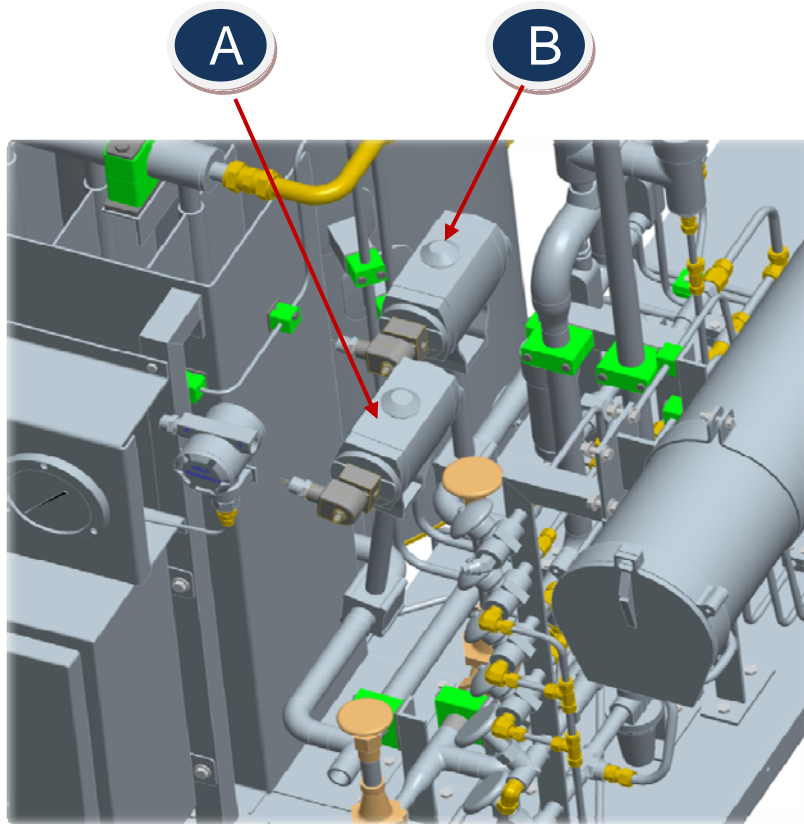
Item	Tag	Part Number	Description
A	PT-1	11043743	Pressure Transmitter
B	CV-1	11208931	Check valve ½ FPT
C	SV-1B	14694859	Relief valve 240 PSI
D	SV-1A	14694841	Relief Valve 217 PSI
E	RTD -1	10929382	Temperature Sensor
F	AOV -5	14667041	Main Tank P.B. Valve

Plumbing Cabinet Curbside – Detail 1



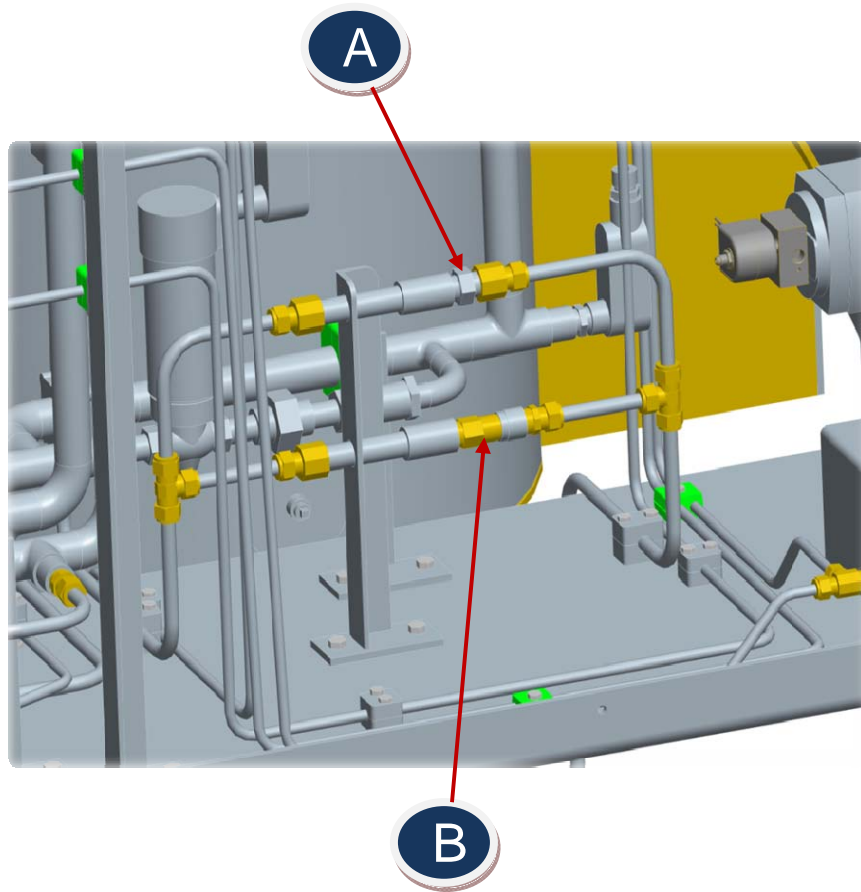
Item	Tag	Part Number	Description
A	V-5	10927192	Main Tank Vent
B	V-18, V-23, V-33, V-34	1713202	Valve 3/8"
C	V-42	10992891	Pulse Tank Road Relief
C-1	CV-6	11051090	Road Relief Check Valve
D	V-2	10992891	Main Tank Road Relief
E	PCV-1	1720412	Road Relief Regulator
F	V-50	1718802	Pulse Tank Vent

Plumbing Cabinet Curbside – Detail 2



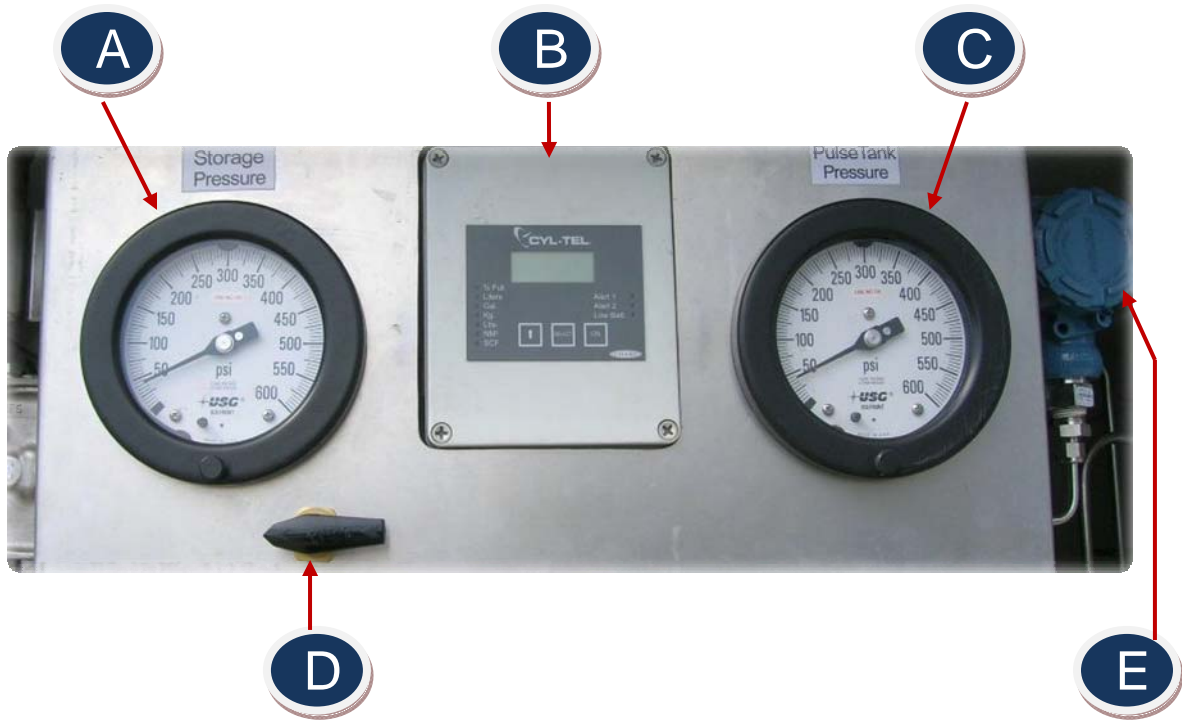
Item	Tag	Part Number	Description
A	AOV-6	14667050	High Flow MB Valve
B	AOV-1	14667050	Low Flow Dispense
Parts For Valve 14667050			
1		11890061	Coupling Repair Kit #MK508
2		13930784	12VDC Coil Parker #C111C1
3		11879583	Actuator Only - Worcester
4		13061697	Ball Valve SS Worcester
5		13875391	Ball Replacement 1" #17622
6		10802445	Ball Valve Repair Kit Seat/Seal
7		13930784	Repair Kit Actuator #15 RK39

Plumbing Cabinet Curbside – Detail 3



Item	Tag	Part Number	Description
A	BD-1	11526569	Rupture Disc 525 PSI
B	SV-3	11488591	Relief Valve 350 PSI

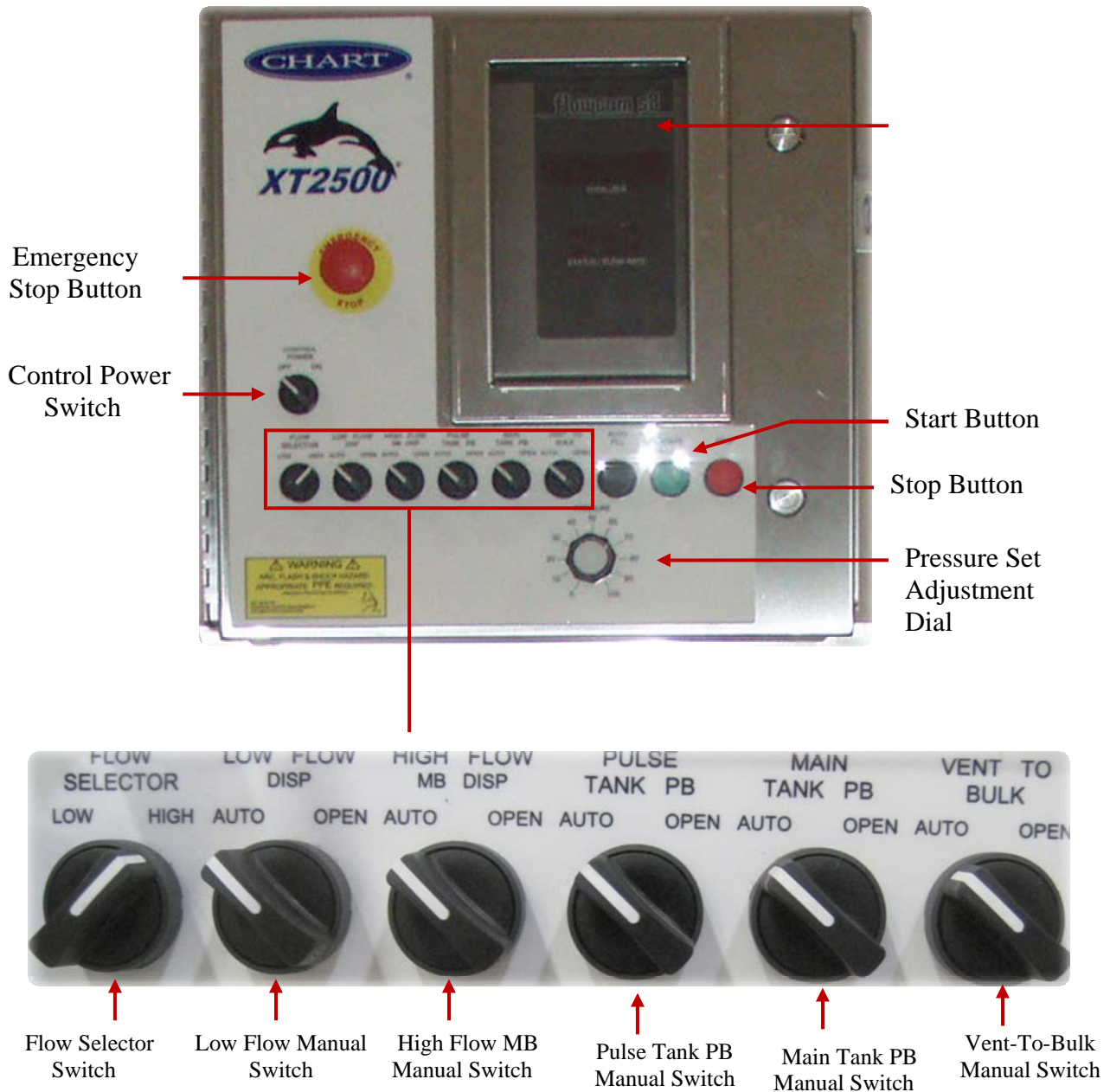
Control Gauge Panel



Item	Part Number	Description
A	11702121	0-600 PSI Pressure Gauge
B	13141662	Cyl-Tel Gauge
C	11702121	0-600 PSI Pressure Gauge
D	11939013	5 -Way Valve
E	11043743	Pressure Transmitter 0-500PSIG

Control Panel

The control panel, which is protected against electrical sparking, is enclosed in a NEMA X4 enclosure, and is UL Listed. Components include the Flowcom S8 flow processor, and various control switches. The primary controls (control power, emergency stop, mode selection switch and system ready light) are located on the face of the control panel.



Control Panel Switches (Cont.)

Emergency Stop Button - The emergency stop or “E-Stop” is located on the front of the control panel and provides an immediate way to stop the system from operating in the event should an emergency occur. When the red plunger is depressed, the system power will be shut off and all air operated valves will close. To de-activate the E-Stop button, turn the red plunger to the right until the plunger moves out.

Control Power Switch - The control power switch turn on the 12 VDC system components including the Flowcom S8 flow meter, differential pressure transmitters, and the printer.

Flow Selector Switch – The flow selector switch is used to select the delivery will be made from the pulse tank (low) or main tank (high).

Manual Over-ride Switches - There is a manual over-ride valve switch for each of the five air operated valves on the XT-2500/2000, dispense low flow, pressure build pulse tank, vent to bulk (pulse tank to main storage), dispense high flow, and pressure build main storage tank. While the unit is designed primarily to operate these valves automatically under normal operations, the operator may need to operate one or more of the valves manually for different operations. For example; the operator may want to transfer a high pressure in the pulse tank to the main storage tank. This could be accomplished by activating the manual “Vent to Bulk” lever.



Start Button - The start button begins the operation processes in pressure building and dispensing.

Stop Button – The stop button ends the operation process and puts the system into a standby mode.



P.B. Adjust

The P.B. adjust, (pressure builder adjust) is a dial that allows the operator to set the required pressure setting for delivery. As the dial is turned, the pressure setting is displayed on the Flowcom S8 totalizer display.



Dome Light/Work Lights

Two features of the lighting system are a dome light to provide light to the plumbing cabinet and two work lights that can be directed while making a delivery. To operate the dome light and work lights, turn on the switch located on the plumbing cabinet dome light.



Service Lights Switch (Interior Cabinet)



Service Lights
(Exterior Cabinet Road & Curbside)

Plumbing Cabinet Doors

The interior of the plumbing cabinet doors have numerous labels which include Flowcom S8 fault code chart, liquid level chart, plumbing schematic, technical service data, general troubleshooting table, printer, and standard operating procedures.



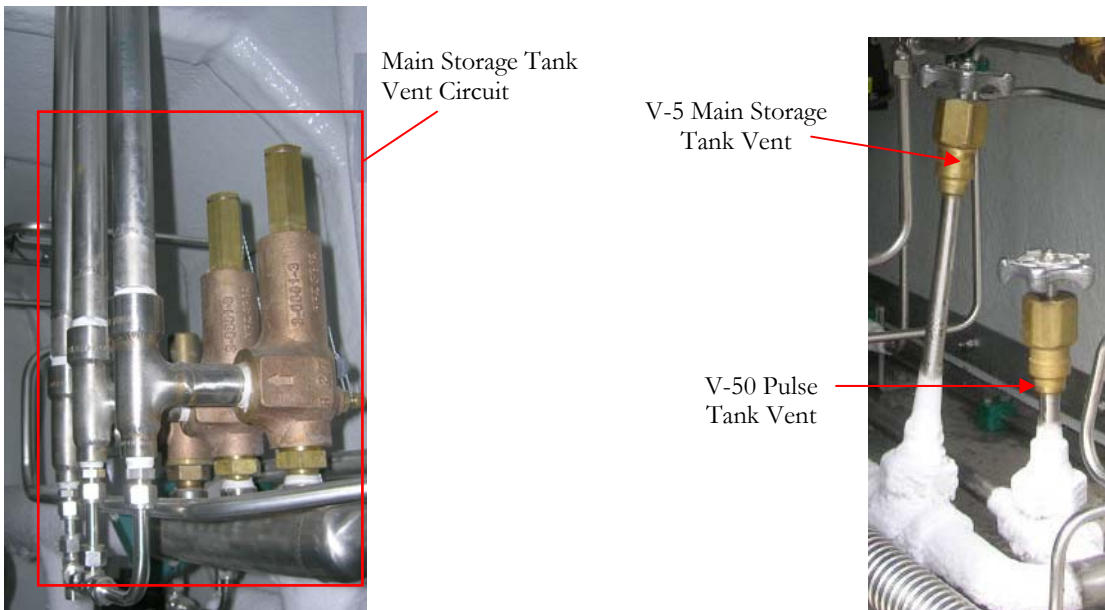
Anti-Tow Valve

Located at the top of the piping cabinet and positioned to be operated when the doors close, is the anti-tow valve. It is pneumatically connected to the air brakes and which can only be released when the plumbing cabinet doors are closed. The plumbing cabinet doors can only be closed when the delivery hose and remote pendant are stowed back in the cabinet. **This feature protects the equipment from damage in the event of a drive away accident due to the equipment not being properly stowed. Under no circumstances should the Anti-Tow Valve be disconnected or altered in any way!**



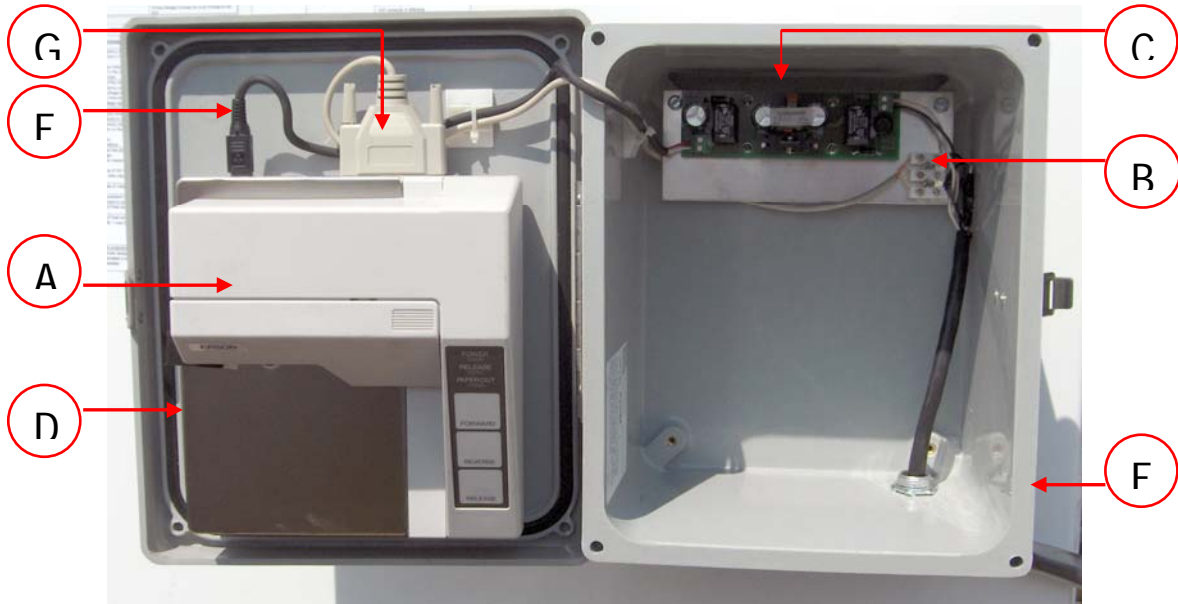
Vent Circuit

The vapor vent valve (V-5), when open, relieves the vapor pressure in the main storage tank. The pulse tank vent valve (V-50) relieves vapor pressure in the pulse tank. The vent circuit includes safety relief valves (SV-1A, SV-1B and SV-1C). There is a duplicate (SV-1A and SV-1B) on the main storage tank relief valves. These main storage tank relief valves are set at the maximum allowable working pressure (MAWP) of the main storage tank, which is 240 psi. These valves are sized to safely relieve the tank during a loss of vacuum. The third relief valve (SV-1C) is set at 350 psi and is sized to satisfy the code requirements for tank venting in a fire condition. The pulse tank relief valve is set to the maximum allowable working pressure (MAWP) of the pulse tank which is 350 psi. The pulse tank relief circuit also has a burst disc which is set at 525 psi. The road relief circuit is designed to be open when in transit to prevent the vessel pressure from exceeding 25.3 psi.



Ticket Printer

The ticket printer (EPSON TM295) is directly connected to the flow processor via a serial data link. The printer requires a 24-volt power source. A DC/DC converter is supplied to convert the truck or trailer 12-volt power to 24 volts. The system allows printing in a customized ticket form as well as a standard ticket on a plain sheet of paper. Additionally, it can also be used to print the system's parameter and audit trail information.



Printer and Components			
Item	Description	Part Number	Qty
A	Printer Ribbon	11693421	1
B	Terminal Block	outside supplier	1
C	DC/DC 12-24 VDC Converter	10963978	1
D	Printer - Epson	913700	1
E	Printer Box	11720142	1
F	Printer Power Cord 6'	11764428	1
G	Printer Data Cable	11764436	1

Printing a Ticket

Upon completion of the delivery, information relating to the delivery of product can be printed onto a standard or custom job ticket.

The standard delivery contains the following information:

Transaction Number, Product, and Quantity

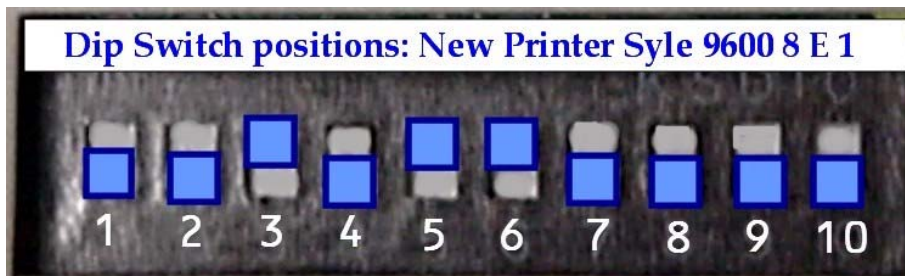
- 1. Switch the printer power “ON”.**
- 2. Press the Printer “RELEASE” button.**
- 3. Insert the ticket.**
- 4. Press the printer “FORWARD” button to lock ticket in place.**
- 5. Press and hold the “STOP” button until “E” appears in the status window.**
- 6. Press the “START” button to print the ticket.**
- 7. Press the printer “RELEASE” button to remove the ticket.**
- 8. Additional tickets (duplicate) can be printed by repeating the steps above.**
- 9. To erase the transaction and/or error messages, press and hold the “STOP” button until it clears.**

Printer Dip Switches

Due to a design change of the EPSON printer TM295, the so called FWD protocol is not available on the new style printer model. In order to use these printers in the same way with our flow meters, a software update in the Flowcom S8 may be necessary. The new printer model can be identified by its serial number which starts with "F7...." These printers will be supported by the following software releases or a later version:

- V6.73.1 or later (runs on CPU02 and supports most applications) - works with both printer models.
- V2.78.1 or later for standard applications except Orca (runs on CPU01) - works with new printer style only.
- V2.08.2 or later for Orca (runs CPU01) - works with new style printer only.

The new printer model also requires different interface settings to be adjusted via DIP switches:



Metering System

The metering system is made up of four main components - Flow Meters, Differential Pressure Transmitters, the RTD-Resistance Temperature Device and the Flowcom S8.

Flow Meter



The function of the flow meter is based on an obstruction in the line that causes a pressure drop. This differential pressure is measured along with the temperature of the liquid to calculate mass flow. It has no moving parts, unlike turbine meters typically found in the industry. This makes it a very low maintenance item, since there are no turbines or moving parts to be damaged by the gas. The XT-2500/2000 has two flow meters. One for the low flow and one for the high flow.

Differential Pressure Transmitters (DP Transmitters)

Two differential pressure transmitters are used on the XT-2500/2000 System. One each for low and high flow dispensing. The DP transmitters measure a change in pressure (pressure drop) across the meter sections and relay this information to the flow processor in the form of a 4- 20 milliamp signal. **Note: If programming is required contact Chart for assistance.**



Low Flow Transmitter

High Flow Transmitter

Resistance Temperature Device (RTD)

The resistance temperature devices (RTD's) are located in the low and high flow dispense plumbing. The probe is used to accurately measure the temperature of the liquid being metered. The resistance of the element at the end of the probe varies with temperature. Based on this temperature a density is assigned. The temperature probe is a 4-wire resistance temperature device (RTD). They are also referred to as PT 100.



Flowcom S8 Flow Processor



The flow processor is used for calculating, integrating, system controlling, and displaying the mass flow. The push button controls allow the operator to start the pressure building sequence, start and stop the delivery, to view audit trail information, initiate the print out of the delivery ticket and to clear the counter. The totalizer window displays the amount of product dispensed, the liquid level in the pulse tank, and the current pressure builder setting. The status/flow rate window displays the mode the flow processor is in and flow rate while the product is being dispensed. Note: If programming is required contact a Technical Service Representative at Chart at 1-800-400-4683.

Operation of the XT-2500/2000

Filling the XT-2500/2000-First use

Filling the XT-2500/2000 - Warm Tank/Purge

The XT-2500/2000 is shipped under pressure with a low purity nitrogen atmosphere to keep out moisture. **IT MUST BE PURGED PRIOR TO USE.** While purging through the various lines, observe the tank pressure indicating gauge (PI-1). Make sure that the tank pressure does not go below **5 psig**. Before filling, be sure that protective eyeglasses and gloves are being worn.

Pre-cool the XT-2500/2000 tank by blowing cold gas from the source tank into the fill line. Open the vapor vent valve (V-5) and check the temperature of the exit gas. When the exit gas is cold enough to frost the vent assembly stop the flow of gas from the source tank and slowly start the flow of liquid. Keep open the vapor vent valve (V-5) to manage XT-2500/2000 vessel pressure. Important: Cooling the tank down slowly will prevent uneven cooling and uneven contraction. Stainless steel from ambient to cryogenic temperatures will shrink 1/32" per 12" of length. Uneven shrinking can cause high stresses in supports and attachments, resulting in damage to the vessel.

1. Attach the source of liquid or gas purge product to the fill CGA connection on the XT-2500/2000 vessel.
2. Open the source tank feed valve and the fill valve on the XT-2500/2000 allowing gas to flow slowly into the tank. Build the tank pressure to 40 psi.
3. Close the fill valve on the XT-2500/2000 and close the source tank feed valve. Purge the trapped space by opening the fill line drain.
4. Crack the compression fittings on either side of the liquid level gauge, allowing gas to flow. Terminate the purge prior to the line getting cold. Tighten compression fittings and leak check.
5. Open the fill line drain and the fill valve. Purge for two minutes. Close the fill valve and the fill line drain.
6. Note: **Build pressure by repeating steps 1 and 2, when the XT-2500/2000 tank pressure drops below 20 psi.**
7. Open the full trycock. Purge for two minutes. Close full trycock valve.

8. Open the pressure building valve manually, using the manual pressure building selection switch on the control panel. Crack the compression fitting at the outlet of the pressure building coil and open the pulse tank vent, and purge for two minutes. Tighten the compression fitting and leak check.
9. Open the manual dispense selection switch on the control panel. Open the low flow dispense valve on the end of the XT-2500/2000 delivery hose.
10. Purge for two minutes. Close the dispense valve and return the manual dispense selection switch on the face of the control panel to the “off” position.
11. Open the empty trycock, main road relief, and pulse tank road relief valves and purge for two minutes. Close the empty trycock, main road relief and pulse tank road relief valves.
12. Vent tank to 5 psi using the vapor vent valve (V-5).
13. Repeat steps 7 and 8 three times.
14. After purge is complete, check the gas in the XT-2500/2000 tank for purity.
15. After purging the tank, but before filling, verify that the following valves on the XT-2500/2000 vessel are open:
 - V-11 Vapor Phase Valve
 - V-12 Liquid Phase Valve

Filling the XT-2500/2000-Normal Use

Filling the XT-2500/2000 (after initial Fill/Purge)

The piping has a top fill circuit. The high flow dispense piping can also be used as a bottom fill circuit. If filling the tank with liquid saturated at a higher pressure (temperature) than what currently is in it, bottom filling is recommended. If filling the tank with liquid saturated at a lower pressure (temperature) than what currently is in it, top filling is recommended. This will minimize the tank pressure rise and minimize the venting required to manage the tank pressure. Filling with liquid saturated at pressure at or above the tank pressure rating (50 psi) will require excessive venting. Lowering the saturation pressure of a liquid will require the liquid to boil. Cold gas is heavy! Minimize venting during filling. Try to use as cold a source of liquid as possible. Note: either pressure transfer or pump filling can accomplish filling the XT-2500/2000 system. **The best results will be obtained when the pressure in the supply unit is at least 25 pounds more than the receiving unit (XT-2500/2000 tank).** As pressure fluctuates, adjusting the main tank vapor vent valve (V-5) on the XT-2500/2000 tank and the fill/drain valve on the supply unit may regulate the pressure.

Whenever possible, the truck should be on a level surface when filling. If the vehicle is not level, instrument readings as well as the full trycock points may not be

accurate. Wear gloves and protective goggles when working with any cryogenic material. Contact with cryogenic materials can result in severe frostbite and injuries similar to burns. Make sure that the road relief valves are closed prior to filling the XT-2500/2000 vessel.

Purging the Fill Line

Connect the fill hose from the supply vessel to the XT-2500/2000 fill connection.

1. Open the fill line drain valve on the XT-2500/2000.
2. Slightly open the bottom fill valve on the supply tank.
3. Run product through the line to thoroughly purge the fill hose for 2-3 minutes.
4. Once the fill hose is purged, close the fill line drain (V-9) on the XT-2500/2000 and the bottom fill valve on the supply tank until the ready to commence filling of the XT-2500/2000 tank.

Top Filling the XT-2500/2000

If the source liquid is cold, top filling lowers the product losses during filling. The top fill valve on the XT-2500/2000 vessel has a spray header that will splash the incoming cold liquid onto the somewhat warmer gas in the tank. The cold liquid will condense the warmer gas reducing the vessel tank pressure. Check the tank. If the tank is cold, top filling is recommended. This will result in the pressure in the tank being reduced.

1. If necessary, start the pressure-building device on the supply unit.
2. With the supply tank connected open the top fill valve on the XT-2500/2000 fill circuit.
3. When the liquid level in the XT-2500/2000 tank is at the halfway point, open the full trycock valve.
4. When the XT-2500/2000 tank is full, liquid will vent out of the full trycock valve. Close the full trycock valve and close the liquid supply tank fill and drain valves. Open the fill line drain valve.
5. Close the top fill valve on the XT-2500/2000.
6. When the hose indicates no pressure, close the fill line drain and remove the hose from the CGA fill connection on the XT-2500/2000 vessel.
7. Replace the CGA fill fitting cover onto the XT-2500/2000 fill connection and stow the delivery hose.
8. Open road relief valves.
9. Close the plumbing cabinet doors.

Filling Levels-CGA 341

The XT-2500/2000 can be filled using the full trycock method as the full indication – if the weight doesn't exceed the road weight limits or the truck gross vehicle weight rating and the gross vehicle axle rating (GVWR/GVAR). Tanks operating under CGA-341 must have a relief system that prevents the vessel pressure from exceeding 25.3 psig. The XT-2500/2000 is supplied with a road relief system that can be used to maintain the vessel pressure at or below 25.3 psig.

Maintaining Cold Liquid

Saturation Pressure	Liquid Nitrogen Temperature	Liquid Oxygen Temperature	Liquid Argon Temperature
psi	Deg F	Deg F	Deg F
0	-320	-297	-303
10	-311	-288	-293
15	-308	-284	-289

Reasons for Cold Liquid

1. Cold liquid is denser. Denser liquid has more cubic feet of gas per gallon of liquid.
2. Filling low-pressure cylinders (22 psi) with warm liquid (above 15 psi) results in the main safety venting for extended periods of time after the fill is complete.
3. Cold liquid (10 psi or less) is essential in filling open dewars. Cold liquid will minimize vent losses, optimize fill times, and improve safety.
4. Collapsing of vapor space in receiving tank is achieved.

What is Cold Liquid

Cold liquid is liquid saturated at 15 psi or less.

XT-2500/2000 Automatic Mode Operation - Low Flow

Upon arrival to the delivery site:

1. Turn ignition key to the “accessories” position to supply 12VDC to the XT-2500/2000 control cabinet. (truck mount)
2. Open the rear cabinet doors.
3. Close the main storage and pulse tank road relief valves.
4. Turn on the Flowcom S8 by pressing the ON/OFF switch.
5. After “boot-up” the Flowcom S8 will display the current pressure building setting in the totalizer display (upper display on the Flowcom S8 front face).
6. If the pulse tank needs to be filled, follow the pulse tank fill instructions to accomplish required liquid level (trycock full for low flow dispense).
7. Press the STOP button on the Flowcom S8 to display 0.0 in the totalizer display (upper), and -S- (standby) in the status/flow rate display (lower). If the totalizer needs to be cleared from the previous delivery, follow the “Clearing the Totalizer” instructions (below).
8. Select “low” flow, using the “low/high” selector switch on the control panel.
9. Remove transfer hose from the cabinet and attach to the receiving tank (fill fitting/ Perma-Cyl[®] or liquid connection/non Perma-Cyl).
10. Note receiving tank pressure (blow down receiving tank if pressure is greater than 220 psi).
11. Set the pressure builder setting to the required setting by turning the pressure building adjustment dial located on the control panel (setting must be 100 psi over receiving tank pressure).
12. Open valve V-41 at the end of the transfer hose.
13. Press the start button to begin pressure building. Pressure in the pulse tank will be displayed in the totalizer display (upper) and “P” (pressure building) will be displayed in the status display (lower).
14. When the set pressure is reached, “GO” will be displayed in the status display (lower).

15. Press the start button on the Flowcom S8 to open the low flow dispense valve on the XT-2500/2000 and begin delivery (if filling non Perma-Cyl[®], open liquid valve and vent valve on receiving tank).

Automatic Mode-Fill Termination

The delivery can be stopped by:

1. Pressing the “STOP” button,
2. By auto tank shut-off while filling a Perma-Cyl.
3. By closing the transfer hose dispense valve (V-41). The Flowcom S8 displays the total amount of product delivered and an “-S-“ in the status display window. The flow processor is now in a “standby status” where additional product can be metered/delivered and added to this total. Following shut down, the remaining liquid in the delivery hose will flow back into the XT-2500/2000 via a check valve.

XT-2500/2000 Automatic Mode Operation - High Flow

Upon arrival to the delivery site:

1. Turn ignition key to the “accessories” position to supply 12VDC to the XT-2500/2000 control cabinet. (truck mount)
2. Open the rear cabinet doors.
3. Close the main storage and pulse tank road relief valves.
4. Turn on the Flowcom S8 by pressing the ON/OFF switch.
5. After “boot-up” the Flowcom S8 will display the current pressure building setting followed by the liquid level of the pulse tank in % full in the totalizer display (upper display on the Flowcom S8 front face).
6. If the pulse tank needs to be filled, follow the pulse tank fill instructions to accomplish required liquid level (90% for high flow dispense).
7. With the pulse tank liquid level set, press the stop button on the Flowcom S8 to display 0.0 in the totalizer display (upper), and -S- (standby) in the status/flow rate display (lower). If the totalizer needs to be cleared from the previous delivery, follow the “clearing the totalizer” instructions (below).
8. Select “high” flow, using the “low/high” selector switch on the control panel.
9. Remove transfer hose from the hose tube and attach to the receiving tank and the high flow dispense CGA fitting on XT-2500/2000. Note receiving tank pressure (blow down receiving tank if pressure is greater than 185 psi).
10. Set the pressure builder setting to the required setting by turning the pressure building adjustment dial, located on the control panel (setting must be 50 psi over receiving tank pressure).
11. Purge the transfer hose by opening the bottom fill valve on the receiving (bulk tank) and opening the fill line drain on the XT-2500/2000.
12. Press the start button on the Flowcom S8 (pulse tank liquid level in % full will be displayed in the totalizer display).
13. Press the start button to begin pressure building. Pressure in the main tank will be displayed in the totalizer display (upper) and “P” (pressure building) will be

- displayed in the status display (lower). (The system will automatically cycle the pulse tank pressure builder on and off during the main tank pressure building sequence. The pulse tank will be supplying the main tank pressure building coils, mounted on the sides of the main tank, with high pressure liquid for main tank pressure building.)
14. When the set pressure is reached, "GO" will be displayed in the status display (lower).
 15. Press the start button on the Flowcom S8 to open the high flow dispense valve. Open the high flow manual valve to begin delivery.

Filling a Perma-Cyl® (First Fill/ Warm Tank):

1. Fill the Perma-Cyl until the tank pressure reaches 40 psi.
2. Open the main vent valve on the Perma-Cyl and vent the tank to 10 psi.
3. Close the main vent valve on the Perma-Cyl.
4. Fill the Perma-Cyl until the tank pressure reaches 40 psi.
5. Open the main vent valve on the Perma-Cyl and vent the tank to 10 psi.
6. Close the main vent valve on the Perma-Cyl.
7. Repeat this procedure a minimum of **FOUR TIMES**.
8. The Perma-Cyl is now purged and cooled.

Note: The Perma-Cyl is shipped with low purity nitrogen gas. Purging is necessary prior to filling. During first fill, only fill the vessel to 75% full to allow for liquid expansion experienced with a new (warm) tank. Each fill there after it can be filled to 100% full. All valves on an empty Perma-Cyl should always be kept closed to prevent the inner vessel and plumbing from being contaminated.

Manual Mode

Manual Over-ride Valve Controls

There is a manual over-ride valve switch for each of the five air operated valves on the XT-2500/2000 - Dispense Low Flow, Pressure Build Pulse Tank, Vent to Bulk (pulse tank to main storage), Dispense High Flow, and Pressure Build Main Storage Tank. While the unit is designed primarily to operate these valves automatically under normal operations, the operator can operate the system entirely manually if required.



Pulse Tank Refill Procedures

Pulse Tank Re-Fill On-Site

- Open AOV-2 (vent to bulk) using the manual over-ride control
- Close AOV-2 manual over-ride control when main storage and pulse tank pressures equalize
- Open manual pulse tank vent valve V-50 to begin filling
- When flow is indicated, throttle V-50 to minimize venting
- When pulse tank is filled to the required level, close V-50

Clearing the Totalizer

To clear the totalizer:

Push and hold the “stop” button until an “-E-“ appears in the flow processor flow rate/status display of the flow processor.

Push and hold the “stop” button again until an “-L-“ appears in the flow processor flow rate/status display of the flow processor.

Push and hold the “stop” button again until an “-S-“ appears in the flow processor flow rate/status display of the flow processor.

The totalizer is now cleared.

Printing and Print Mode

- Switch printer power “ON”.
- Press printer “release” button
- Insert ticket.
- Press printer “forward” button to lock ticket in place.
- Press and hold the “stop” button until “-E-“ appears in the status display.
- Press the “start” button to print the ticket.
- Press printer “release” button to remove the ticket.
- Repeating the above steps can print additional tickets. (duplicate)

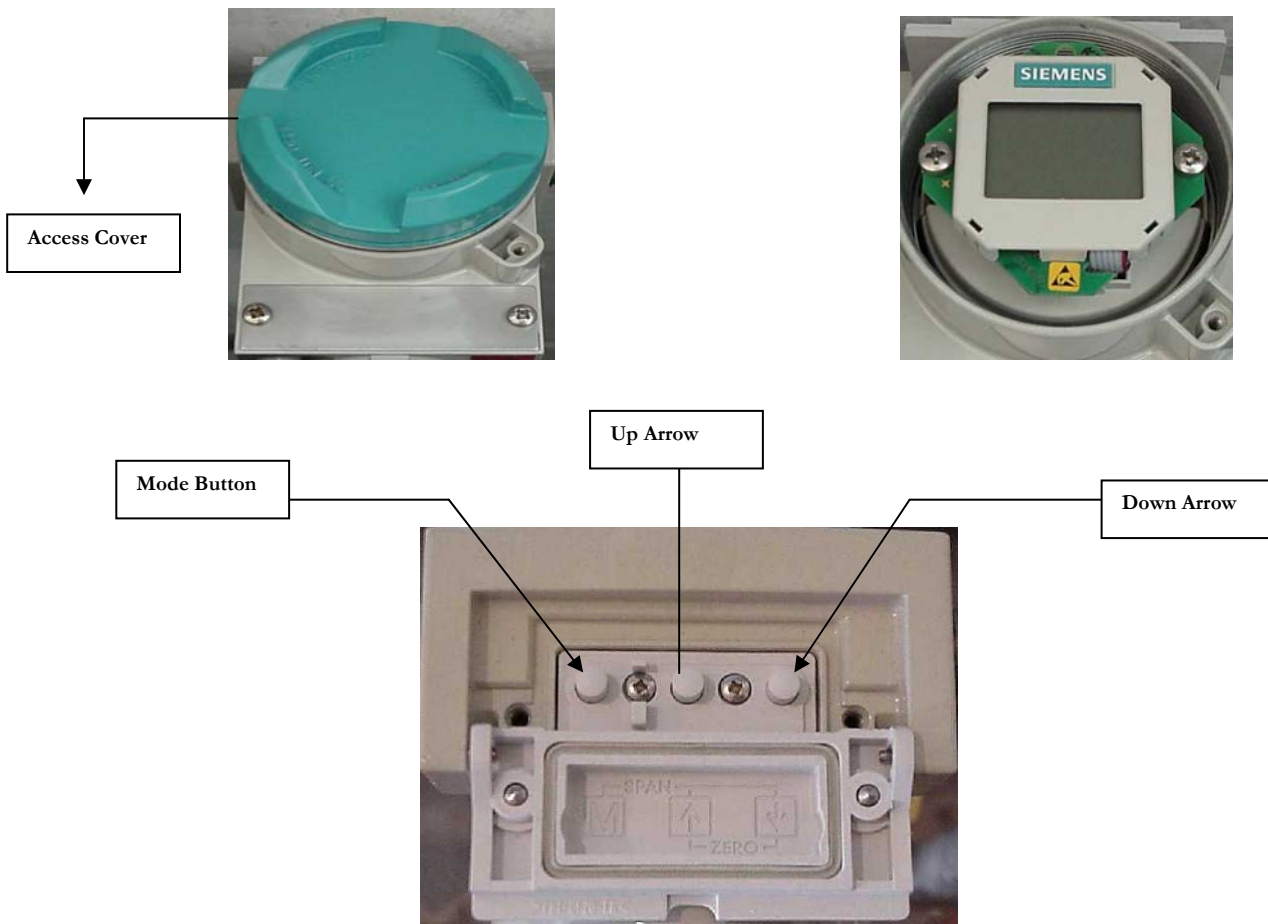
Over-Road Pressure Control

- Reduce main storage and pulse tank pressures to 25-30 psi by opening AOV-2 (vent to bulk) using the manual over-ride control and opening V-5.
- Close vent to bulk manual over-ride and V-5.
- Open road relief valves V-2 and V-42.
- Close cabinet doors.

Note: This tank is designed to operate under the cryogenic liquids (DOT 173.320) Exception. This requires that the pressure in transit is less than 25.3 psig.

Differential Pressure Transmitter Programming Instructions:

1. Remove the cover for the LCR screen
2. Loosen the two (2) phillips head screws to access the programming buttons
3. Push the mode button to move to parameter #6
4. Push the up/down button to enter the appropriate value for P6
Value P6 = 1200
5. Push the mode button to move to parameter #7
6. Push and hold the up and down buttons simultaneously until the numbers disappear and reappear at 0
7. Push the mode button to move to parameter #11
8. Push the up/down button to enter the appropriate value for P11
a) P11 = SR Linear
9. Push the mode button to move to parameter #2
10. Push the up/down button simultaneously to zero the value for P2 to 4.000
11. Push the mode button to move out of the parameter setting mode
12. Repeat to verify.



Flow Processor Troubleshooting Table

Flow Meter Status Display and Error Messages - Software Version P.2.08.0		
Screen Display	Status	Description
“-S-“	Standby mode	System is ready for delivery. In the automatic mode, start the delivery pressing start.
“-E-“	End of Delivery	Metering is completed. Ticket can be printed at this time.
“-L-“	Liquid Level Pulse Tank	In this mode the Flowcom S8 will display the liquid level of the pulse tank in percent full
“-P-“	Pressure Building	In this mode the unit is allowing the flow of liquid into the pressure building coil
“LLL”	Low temperature	The liquid temperature has exceeded the lower limit of the current temperature setup. Verify that the temperature limits and that the current product matches parameter settings
“HHH”	High temperature	The liquid temperature has exceeded the upper limit of the current temperature setup. Verify that the temperature limits and that the current product matches parameter settings
“L10”	Metered flow rate below meterable range.	Metering is stopped if “L10” is displayed. In the automatic mode L10 only appears during the startup time out. In the manual mode, “L10” appears any time the flow drops below the meterable range.
“H99”	Metered flow rate above meterable range.	Metering is stopped if flow rate exceeds the meterable range. In the automatic mode the delivery will be terminated and “H99” will be displayed. In the manual mode if the flow rate exceeds the meterable range the totalizing of the delivery is stop until the flow rate is lowered to the acceptable range.
“E01”	Printer Error	If the printer is off, the paper is out or data transfer is interrupted, this message will appear for 5 seconds. Resolve the printer error and press start the ticket will be printed (original).
“E11”	Measured temperature is too low.	This may be caused by any of the following: <ul style="list-style-type: none"> -Temperature sensor PT100 is not connected properly. -Temperature range switching is defective. -Constant current source is defective -The product parameter does not match the actual product being metered. -A/D converter is defective
“E12”	Main DP Transmitter Fault	The controller reads a 4 to 20 ma signal from the MAIN DP transmitter. If the signal is less than 3.8 ma or higher than 19.9 ma when the system is powered up, “E12” will be displayed. Check the following: <ul style="list-style-type: none"> -Leaks in the sensor lines to the MAIN DP transmitter. -Dispensing during start up. -Defective MAIN DP transmitter. -Defective power supply to MAIN DP transmitter.
“E13”	Auxiliary DP Transmitter Fault	The controller reads a 4 to 20 ma signal from the AUX. DP transmitter. If the signal is less than 3.8 ma or higher than 19.9 ma when the system is powered up, “E13” will be displayed. Check the following:- <ul style="list-style-type: none"> -Leaks in the sensor lines to the AUX. DP transmitter -Defective AUX. DP transmitter.
“E16”	Calibration/Configuration mode	During calibration and configuration, the security switch is removed to allow communication. If the switch is not replaced (delivery position) and a delivery is attempted “E16” is displayed. During this error no

		metering is possible.
"E20"	Main Setup Fault	The main setup data is lost or not correct due to one of the following: -main setup parameters not entered or entered incorrectly. -EEPROM defective -EEPROM cannot be addressed
"E21"	Ram-Check Fault	RAM data lost. Normal with first operation. This fault can be cleared by pressing the "Stop" button. If this fault occurs with each system power up, the CPU may need to be exchanged.
"E23"	Configuration Data Error	"Public Data Are Missing or Checksum found incorrect during startup.
"E24"	Non-Critical (Public) Data Fault	
"E31"	PT100 Temperature Sensor Fault	The Temperature Sensor is defective or not connected properly. The current is out of tolerance.
"PE 01"	Calculation Fault	General division error
"PE 02"	Calculation Fault	Division of a long variable by zero
"PE 03"	Calculation Fault	Division of a floating variable by zero
"PE 04"	Calculation Fault	Overflow of a floating variable by zero
"PE 05"	Calculation Fault	Underflow of a floating variable by zero

Note: Error messages can be cleared by holding "stop button" for five seconds. If error messages do not clear then consult the manual.

Microbulk Mode “Low” Flow

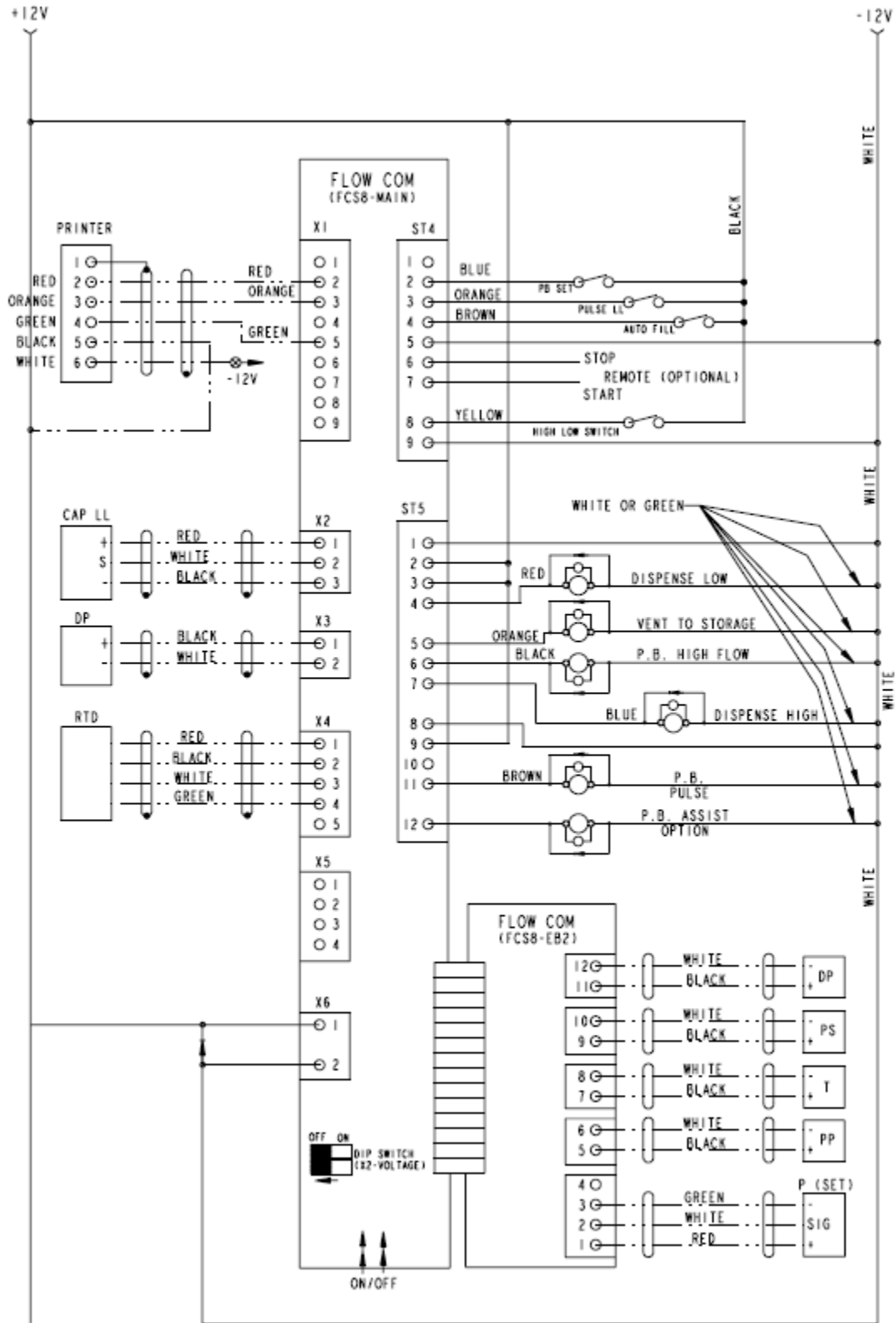
- Attach hose and open Hose Valve V-41
- Select “Low ” with the Flow Selector Switch
- Turn system on with the Control Power switch
- Fill Pulse Tank by opening Pulse Tank Vent Valve V-50 and Pulse Tank Trycock Valve V-34 until product flows from trycock, then close V-50 and V-34
- Adjust delivery pressure with Pressure Adjust Dial (min 100 PSI over receiving tank)
- Push “Start” button (green). Pressure builds to set point
- When “GO” is displayed on Status display, press “Start” button to begin delivery
- Terminate delivery by:
 - Pressing “Stop” button (red)
 - Auto Tank Shutoff (Permacyls)
 - Close Hose Valve V-41.
- Disconnect and stow hose (liquid in hose drains back into system)
- Print ticket and clear totalizer

Microbulk Mode “High” Flow

- Attach hose and open Hose Valve V-41
- Select “High” with the Flow Selector Switch
- Verify High Flow Lockout Switch is in “Off” position
- Turn system on with the Control Power switch
- Fill Pulse Tank by opening Pulse Tank Vent Valve V-50 and Pulse Tank Trycock Valve V-34 until product flows from trycock, then close V-50 and V-34
- Adjust delivery pressure with Pressure Adjust Dial (min 50 PSI over receiving tank)
- Push “Start” button (green). Pressure builds to set point
- When “GO” is displayed on Status display, press “Start” button to begin delivery
- Terminate delivery by:
 - Pressing “Stop” button (red)
 - Auto Tank Shutoff (Permacyls)
 - Close Hose Valve V-41
- Disconnect and stow hose (liquid in hose drains back into system)
- Print ticket and clear totalizer

Bulk Mode “High” Flow

- Attach hose and purge as required
- Select “High” with the Flow Selector Switch
- Turn High Flow Lockout Switch is to “On” position
- Turn system on with the Control Power switch
- Fill Pulse Tank by opening Pulse Tank Vent Valve V-50 and Pulse Tank Trycock Valve V-34 until product flows from trycock, then close V-50 and V-34
- Adjust delivery pressure with Pressure Adjust Dial (min 50 PSI over receiving tank)
- Push “Start” button (green). Pressure builds to set point
- When “GO” is displayed on Status display, press “Start” button
- Open Manual Dispense Valve V-1 to begin delivery
- Terminate delivery by pressing “Stop (red) button
- Close Manual Dispense Valve V-1
- Disconnect and stow hose
- Print ticket and clear totalizer



PERMA-CYL®

ON-SITE STORAGE SYSTEM - MICROBULK SOLUTIONS

The Perma-Cyl® storage system allows users to enjoy the benefits of on-site gas delivery. Gone are the hassels, waste, and expense of full-for-empty gas cylinders. Using Perma-Cyl tanks, there are no cylinders to change, no residual gas losses, no back, hand or foot injuries from handling cylinders, and no lost or damaged cylinders.

The Perma-Cyl is reliable, efficient, and more economical than comparable transportable cylinders. Designed for a higher level of thermal efficiency, they can hold their gas contents longer with lower pressure rise than other similar vessels. Their extraordinary thermal quality limits product losses during extended periods of little gas use.

The innovative Perma-Cyl storage system incorporates a top fill float designed to allow single-hose filling without losses. It automatically shuts off the Orca® delivery unit for a safe and reliable fill.

PRODUCT BENEFITS

- The first fill-at-site solution for packaged or cylinder gas users
- Fast filling capable
- Single hose no-loss/low-loss filling
- Automatic fill shutoff when used with Orca
- Extended holding times
- Telemetry ready with Cyl-Tel® gauge



PRODUCT ADVANTAGES

- Sizes, pressures and configurations to meet most applications
- Capacities from 230 liters to 3,000 liters (60.8 gal to 715 gal)
- Pressures from 235 psig to 500 psig (16.2 barg to 34.5 barg)
- Patented automatic fill shut-off feature with optional fill box allows for remote filling from outside the building or compound when a Perma-Cyl is installed indoors
- Orca automatically safely stops the fill process when Perma-Cyl is full
- Patented Cyl-Tel gauge supports remote alarms or telemetry communications
- High-pressure high flow models for laser assist applications
- Combination pressure control regulators with micrometer adjustment knob or screw
- Outdoor or indoor installation and operation

PERMA-CYL[®]

ON-SITE STORAGE SYSTEM - MICROBULK SOLUTIONS

SPECIFICATIONS														
MODEL	230L MB/LCCM Sq/Rnd Base w/Casters	230L HP/LCCM Sq/Rnd Base w/Casters	265L MB/LCCM Sq/Rnd Base w/Casters	265L HP/LCCM Sq/Rnd Base w/Casters	300L MP Plate Base	450L HP Plate Base	450L MP Plate Base	450L WP Plate Base	700L HP Plate Base	1000L HP/WHP Plate Base	1500L HP/WHP Pallet Base	2000L HP/WHP Pallet Base	3000 L HP/WHP Pallet Base	3000 L HP/WHP Horizontal Forklift Base
CAPACITY (Liters)														
Gross	240	240	276	276	330	450	450	450	688	1,056	1,550	2,042	2,911	2,911
Net	230	230	265	265	300	420	420	420	645	950	1,455	1,945	2,707	2,707
CAPACITY (Gallons)														
Gross	63.4	63.4	72.9	72.9	81.2	118.9	118.9	118.9	181.8	279.0	409.5	539.5	770	770
Net	60.8	60.8	70.0	70.0	79.3	111.0	111.0	111.0	170.4	251.0	384.4	513.9	715	715
MAWP														
psig	230	350	230	350	300	350	250	500	350	350/500	350/500	350/500	350/500	350/500
barg	15.9	24.1	15.9	24.1	20.7	24.1	17.2	34.5	24.1	24.1/34.5	24.1/34.5	24.1/34.5	24.1/34.5	24.1/34.5
MAXIMUM PRE-SET OPERATING PRESSURE														
psig	125	300	125	300	250	300	125	450	300	300/450	300/450	300/450	300/450	300/450
barg	8.6	20.7	8.6	20.7	17.2	20.7	8.6	31.0	20.7	20.7/31.0	20.7/31.0	20.7/31.0	20.7/31.0	20.7/31.0
DESIGN SPECIFICATIONS														
	DOT	DOT	DOT	DOT	ASME	DOT/ASME	ASME	DOT/ASME	ASME	ASME	ASME	ASME	ASME	ASME
STORAGE CAPACITY (1)														
Nitrogen														
SCF	5,024	4,734	5,769	5,769	7,380	8875/10332	10,332	7922/10332	15,860	24,350	35,790	47,847	66,592	66,592
Nm ³	142	134	152	152	193	271/272	272	271/272	449	689	1,013	1,257	1,750	1,750
Oxygen														
SCF	6,244	5,930	7,186	7,186	9,100	11124/12260	12,760	11124/12260	19,600	30,070	44,220	59,089	82,239	82,239
Nm ³	177	168	189	189	184	315/336	336	315/336	554	850	1,250	1,553	2,161	2,161
Argon														
SCF	6,073	5,763	6,982	6,982	8,850	10812/12478	12,478	10812/12478	19,160	29,400	43,220	57,786	80,425	80,425
Nm ³	172	163	183	183	234	306/328	328	306/328	542	832	1,223	1,519	2,115	2,115
CO₂														
SCF	N/A	4,500	N/A	N/A	N/A	8312/8200	N/A	8312/8200	12,608	19,960	29,340	38,048	52,954	N/A
Nm ³	N/A	N/A	N/A	N/A	N/A	235/232	N/A	235/232	357	564	830	1,000	1,390	N/A
THERMAL PERFORMANCE (2) (NER%/Day)														
N ₂	1.8%	1.8%	2%	2%	1.2%	1.9%/1.6%	1.6%	1.9%/1.6%	1%	1%	1%	1%	1%	1%
O ₂ -Ar	1.12%	1.12%	1.4%	1.4%	.74%	1.2%/1%	1%	1.2%/1%	.62%	.62%	.62%	.62%	.62%	.62%
CO ₂	.6%	.6%	N/A	N/A	.4%	.6%/1.5%	.5%	.6%/1.5%	.3%	.3%	.3%	.3%	.3%	.3%
GAS DELIVERY RATE (LIN/LAR/LOX)														
SCF/H	400	400	400	400	500	575	575	575	660	960	1,350	1350/2000*	1350/2000*	2,000
Nm ³ /h	10.5	10.5	10.5	10.5	14.1	15.1	15.1	15.1	18.6	25.2	35.4	35.4/52.4	35.4/52.4	52.4
GAS DELIVERY RATE (CO₂)														
SCF/H	N/A	133	N/A	N/A	N/A	192	192	192	220	320	450	450/667	450/667	N/A
Nm ³ /h	N/A	3.8	N/A	N/A	N/A	5.4	5.4	5.4	6.2	9.0	12.7	12.7/17.5	12.7/17.5	N/A
DIMENSIONS														
Diameter														
In	26	26	26	26	26	30	30	30	42	42	48	48	59	59
mm	660	660	660	660	660	762	762	762	1,067	1,067	1,219	1,219	1,499	1,499
Height														
In	61.8/62	61.8/62	64.6/64.8	64.6/64.8	67	69	69	69	62.5	82	92/91	118.5/119.5	122/122.5	71
mm	1570/1575	1570/1575	1641/1646	1641/1646	1,702	1,753	1,753	1,753	1,588	2,083	2337/2311	3,010/3,035	3099/3112	1,803
Tare Weight														
lbs	300	340	340	340	450*	688*	605*	812*	1,250*	1500/1750*	2200/2500**	2600/2950**	3300/4250**	3800/4250**
kg	136	154	154	154	204	312	274	368	567	680/794	998/1134	1179/1338	1497/1928	1724/1928

All specifications are subject to change without prior notice.

1) Values are based on net capacity at 300 psig (0 barg) for ASME vessels. CO₂ vessels are based on net capacity at 0 psig (0 barg). DOT vessels are per code.

2) Values are based on gross capacity.

3) Optional 3,500 SCF/H (92 Nm³/h) flow kit available.

All dimensions are measured from the floor to the top of the highest plumbing component.

Patents: 5,787,942 • 5,954,101 • 5,136,852 • 6,542,848 - Other Patents Pending

DOT - Department of Transportation, 4L Code

ASME - American Society of Mechanical Engineers, Section VIII, Division 1

Contact Factory for Canadian Approvals.

*Weights do not include lab base option. (base option: 265 lbs)

**Weights include lab bases.

CYL-TEL®

DIGITAL ELECTRONIC LIQUID LEVEL GAUGE

Cyl-Tel® is a digital electronic level gauge designed specifically for the Perma-Cyl®. The Cyl-Tel provides an accurate liquid level reading, and the output is available in seven units of measure for user-friendly operation. Designed for rugged applications, it has a water-resistant case suitable for outdoor use. The Cyl-Tel is also telemetry-ready for a wide variety of systems, including OnSite.

CYL-TEL ADVANTAGES

- Improves customer readability by eliminating calibration charts
- Programmable to tank geometry and service for improved accuracy
- Improves customer security
- Telemetry-ready outputs adaptable to many systems
- Optional interface board available for 1-5V DC and 4-20mA outputs
- Battery or 12V DC powered (required for telemetry)
- Accommodates telephone modem board or Cyl-Tel² wireless front panel with internal batteries



Cyl-Tel is standard on 300L and larger Perma-Cyls



Optional Cyl-Tel² for wireless communication with DataOnline

The Cyl-Tel² is a wireless telemetry tank monitoring system designed by Chart in partner with DataOnline exclusively for the MicroBulk market. The Cyl-Tel² is a low cost, reliable, easy to install and user-friendly liquid level gauge with built-in cellular communications. It is powered by a battery pack for installation flexibility.

CYL-TEL² ADVANTAGES

- Integrated cellular wireless communications
- Internal battery-powered for indoor or outdoor installations
- DataOnline managed information
- Front face electronics interchangeable with Cyl-Tel



CYL-TEL®

DIGITAL ELECTRONIC LIQUID LEVEL GAUGE

Cyl-Tel Gauge Specifications	
<p>Physical</p> <ul style="list-style-type: none"> • Approximately 4.75" w x 3.25" h x 3.75" d • Mounting compatible with current differential pressure gauges used on Chart/MVE products • Gauge is in a water-resistant enclosure (NEMA 4) • Range - 0-160" H₂O • Pressure - 500 psig maximum • Differential Pressure - 30 psig maximum • CE Listed <p>Electrical Inputs</p> <ul style="list-style-type: none"> • 12VDC at 500mA (AC Adapter) • Optional battery powered, 9VDC <i>(level only, Inactive Telemetry)</i> <p>Outputs</p> <ul style="list-style-type: none"> • Two independent programmable alert levels, programmable in 5% increments up to 100% for phone transmitter or local alert relay • Electronic pulse output connection for interface board, satellite and cellular telemetry systems • Low battery indicator • Unit of measure indicator <i>(See Programmable Features)</i> • Large 5 character x 0.4" High LCD Display <p>Sensor Accuracy</p> <p>± 2.5% of Full Scale</p> <p>Operator Interface</p> <p>Keypad</p> <p>Operating Temperature</p> <p>-30°C to +70°C</p>	<p>Display Resolution</p> <p>% Full = 5%</p> <p>Gal = 1</p> <p>L = 1</p> <p>Lbs = 1</p> <p>Kg = 1</p> <p>SCF = 10</p> <p>NM = 1</p> <p>Programmable Features</p> <ul style="list-style-type: none"> • Product Type: LN₂, N₂O, LAr, O₂, CO₂ <p>Unit of Measure</p> <p>Gallons (Gal)</p> <p>Liters (L)</p> <p>Pounds (Lbs)</p> <p>Kilograms (Kg)</p> <p>Standard Cubic Feet (SCF)</p> <p>Normal Cubic Meters (NM³)</p> <p>Inches H₂O (no light indicator)</p> <p>Percent Full (% Full)</p> <p>Alert Programmability</p> <ul style="list-style-type: none"> • Alert 1 programmable from 0% to 100% in 5% increments • Alert 2 programmable from 0% to 100% in 5% increments <p>Interface Board (optional)</p> <ul style="list-style-type: none"> • Voltage output 1-5VDC • Current output 4-20mA

Your Local Representative



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Chart Industries, Inc.
U.S. : 1-800-877-3093
Worldwide: 1-952-758-4400
www.chart-ind.com

PN 11083315

Warranty Statement

Standard XT-2500/2000 Warranty

Chart Standard Warranty

Chart Purchased Parts

Chart Inc. will pass on all warranties offered to us by our vendors. This is for those items which, Chart Inc. purchases from them directly. Below is a list of the major items with their warranty periods. For the items not listed below Chart Inc. will warranty the replacement period for a time frame of **90 days** after the ship date of the XT-2500/2000 Unit. If warranty replacement of part is required, the XT-2500/2000 will be repaired at the nearest Chart Inc. Authorized Service Provider, by the Purchaser, or Chart Inc. personnel in the field. This warranty is subject to the exclusions above.

Major Components

Resistance Temperature Device (RTD)	1 Year from shipment of XT-2500/2000
Differential Pressure Transmitter (DP Transmitter)	1.5 Year from shipment of XT-2500/2000
Spin-On Connector	6 Months from date of shipment of XT-2500/2000
Meter Element	Life of XT-2500/2000
AOV-1	1 Year from Shipment of XT-2500/2000
AOV-2	1 Year from Shipment of XT-2500/2000
AOV-3	1 Year from Shipment of XT-2500/2000
AOV-4	1 Year from Shipment of XT-2500/2000
AOV-5	1 Year from Shipment of XT-2500/2000
XT-2500/2000 Delivery Hose	1 Year from Shipment of XT-2500/2000
Flowcom Flow Processor	6 Months from date of shipment of
Printer	6 Months from date of shipment of

Standard Warranty

Workmanship and Vacuum

Chart Inc. warrants all ORCA Delivery Tanks manufactured to be free from defects in material and workmanship for **ONE YEAR** after shipment, subject to the exclusions listed below and statements on the preceding and following pages. We also guarantee that the Annular Space Pressure will not exceed 20 Microns, when the Inner Vessel is cold, within **ONE YEAR** of the date of shipment of the ORCA Unit. Provided neither the Evacuation Valve nor the Vacuum Gauge Valve has been tampered or disturbed so as to bleed gas into the Annulus, and that no other misuse or abuse of the equipment has caused the excessive pressure. If warranty repair is required, the ORCA Unit will be repaired at the nearest Chart Authorized Service Provider, by the Purchaser, or Chart Inc personnel in the field, or at Chart Inc. at the discretion of Chart Inc. and in accordance with the [attached Warranty Claims Procedure](#).

Exclusions

- Chart Inc. accepts no liability for any work performed or cost incurred by the customer, or others, without Chart Inc. express prior written approval.
- Chart Inc.'s obligations under this warranty are expressly limited to repair or replacement of any part or workmanship that Chart Inc. manufactured and found to be defective within **ONE YEAR** after ship date of ORCA Unit.
- Chart Inc. is not liable for any other losses, damages, product losses, cost of delays, freight charges, or excess costs for repairs made outside the 48 adjacent United States, including incidental or consequential damages.
- For Warranty Claims please call [Chart Inc. Customer Service Center at 1-800-400-4683](#).

Chart Standard Warranty

Claim Procedure

- All Warranty Claims are to be requested in writing and previously authorized by Chart Inc. The address to sent the request to is:

Chart Inc
Attn. Customer Service
407 Seventh Street Northwest
New Prague, MN 56071

- Telephone approval can be obtained for faster response by contacting [Customer Service at 1-800-400-4683](#). However this warranty claim is to be followed by a letter in writing to Chart Inc within **14 days** of the claim. Customer Service will issue a RMA (Returned Merchandise Authorization) Number that is a tracking number that will be required on all documentation, correspondence, and invoices that maybe sent to Chart Inc for payment of credit.
- All Warranty Claims submitted to Chart Inc for credit must be submitted within **21 days** of the date the purchaser receiving their vendors invoice for services rendered. This Credit Request must include the RMA Number that was provided by Chart Inc otherwise the Credit Request will be considered invalid.
- Documentation, photographs (if applicable) and the RMA Number must accompany any invoice before payment will be made by Chart Inc.
- Vacuum Pumping of any units, requires prior authorization from Chart Inc and all procedures must be adhered to or the warranty will be void.
- On Chart Inc purchased parts, Chart Inc will replace all defective parts at no charge if it is less than **90 days** from date of shipment. If the items are listed on the Major Components List and between **90 days** and the end of the warranty period stated Chart Inc will replace parts at no charge excluding labor and other items listed in the exclusion section. Chart Inc will send out parts with an invoice at Purchasers full price and will give credit back to your account when the parts in question are received at Chart Inc and determined to be within the warrant period.
- Authorization must be obtained from Chart Inc prior to shipment of any units to our location or any other repair facility for warranty work.