Taylor-Wharton

L SERIES -

Operation and Instruction Manual

XL-100, XL-160, XL-180, XL-230 and XL-240

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

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Taylor-Wharton

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1. Container Safety:

WARNING: *Following safety precautions are for your protection. Before performing installation, operating, or maintenance procedures read and follow all safety precautions in this section and in reference publications. Failure to observe all safety precautions can result in property damage, personal injury, or possible death. It is the responsibility of the purchaser of this equipment to adequately warn the user of the precautions and safe practices for the use of this equipment and the cryogenic fluid stored in it..*

- **Pressure Hazard** – The containers covered by this literature may contain pressure up to 230 psig (16 bar/1586 kPa.) 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 repair on these containers until all pressure is released, and the contents have been allowed to vaporize to ensure no pressure build-up can occur. Before performing installation, operation, or maintenance procedures, read and follow all safety precautions in this section and in reference publications. Failure to observe all safety precautions can result in property damage, personal injury, or possible death. It is the responsibility of the purchaser of this equipment to adequately warn the user of the precautions and safe practices for use of this equipment and cryogenic fluid being used.

- **Extreme Cold – Cover Eyes and Exposed Skin** – Accidental contact of cryogenic liquid or cold issuing gas with the skin or eyes may cause a freezing injury like frostbite. Handle the liquid so that it won't splash or spill. Protect your eyes and cover the skin where the possibility of contact with the liquid, cold pipes and cold equipment, or the cold gas exists. Safety goggles or a face shield should be worn if liquid ejection or splashing may occur, or cold gas may be issued forcefully from equipment. Clean, insulated gloves that can be easily removed and long sleeves are recommended for arm protection. Cuffless trousers should be worn outside boots or over the shoes to shed spilled liquid. Cryogenic liquids are extremely cold and will be at temperatures below -300oF (-184oC) under normal atmospheric pressure.

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

- **Replacement Parts Must be 'Cleaned for Oxygen service'** – Some materials, especially nonmetallic gaskets and seals, can be a combustion hazard if used in oxygen or nitrous oxide service. Use only Taylor-Wharton recommended spare parts, and be certain parts used are properly cleaned to prevent contamination of stored products. For information on cleaning, consultthe Compressed Gas Association (CGA) pamphlet G-4.1, “Cleaning for Oxygen Service” or equivalent industrial cleaning specifications.

- **Install Relief Valves in Cryogenic Liquid Lines** – When installing piping or fill hose assemblies, make certain a suitable safety relief valves are 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 detail information on the handling of cryogenic liquids, refer to the Compressed Gas Association publication: P-12 "Safe Handling of Cryogenic Liquids." Available from the Compress Gas Association, 8484 Westpark Drive, Suite 220, McLean VA 22202, USA. Please* ***pay attention to all laws, rules, and recommendations about handling of cryogenic liquefied gases and materials that are valid in your country.***

2. General Information

The XL-100, XL-160, XL-180, XL-230 and XL-240 are vacuum-insulated, stainless steel containers designed to store and transport cryogenic liquid nitrogen. The container is designed and constructed according to DOT 4L standards and may be used for over-the-road transportation, as well as on-site storage and supply in a wide range of applications.

3. Handling of the Container

The L-Series containers are very rugged liquid cylinders. All Cryogenic liquid containers 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 container's insulation system.

Please refer to the specification table with regards to weight for each model respectively and you should treat the load accordingly. The attachment points provided on the XL-160 and180 will allow you to use a hand truck or a hoist to handle these loads properly. XL-100, XL-230 and XL-240 will allow you to use the caster wheel for movement. Do not attempt to move these cylinders by any other means.

When moving the cylinder, the following precautions should be observed:

- Never lay the container on its side. Always ship, operate, and store the unit in a vertical or upright position.

- **The liquid cylinders should only be moved by utilizing an appropriate cylinder cart, roller base or overhead crane over smooth, level and even floor surface.**

- Do not roll a liquid cylinder with the handling ring.

- When loading or unloading the container from a truck, use a lift gate, a crane, or a parallel loading dock. Never attempt to manually lift the unit.

- To move the container over rough surfaces or to lift the container, attach an appropriate 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.

- Liquid cylinders are generally not designed to be permanently mounted on a truck. Depending on the design of the fixation, the permanent transversal vibrations and resonances put a high stress on the inner vessel supports, so that Taylor-Wharton cannot keep the warranty for the vacuum. Please seek advice from Taylor-Wharton to look for possible solutions.

A pull handle is provided on the OD 26” (OD 660mm) outer body of the cylinder with round base caster to move the cylinder around. Those pull handles should only be used to move cylinders over flat and smooth surface. The proper handing method is to hold the handrail ring and the pull handle on the shell with both hands at the same time when pulling the cylinder around. Do not use the handles to pull cylinders up or down inclines. Also, they should not be used to lift cylinders, with or without products in them.

The cylinder with caster wheel design is only used when frequent and short distances are required. Before utilizing this method of transportation, make sure the area over which the liquid cylinder is to be moved is flat and smooth.

Before moving cylinders with locked caster wheels, make sure both wheels are unlocked.

Freight Damage Precautions. *Any freight damage claims are your responsibility. Cryogenic liquid containers are delivered to your carrier from Taylor-Wharton’s dock in a new condition. When you receive our product, you may expect it to be in the 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 note 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.*

4. Specification

MODEL	XL-100	XL-160	XL-180
Dimensions			
Diameter, in (mm)	20 (508)	20 (508)	20 (508)
Height, in (mm)			
RB	47.6 (1210)	55.7 (1415)	62.8 (1595)
SB	N/A	N/A	N/A
Weight Empty (Nominal), lb (kg)			
RB	175 (79)	214 (97)	236 (107)
SB	N/A	N/A	N/A
Capacity, Gross, Liters	103	163	186
Capacity, Useable Liquid, Liters	98	160	180
Weight of Contents Maximum lb. (kg) Based on DOT Rated Service Pressure			
Oxygen	NIL	NIL	NIL
Nitrogen	173 (78)	273 (124)	311 (141)
Argon	NIL	NIL	NIL
Normal Evaporation Rate*			
(% Capacity per Day)			
Oxygen	NIL	NIL	NIL
Nitrogen	3.8%	1.3%	1.25%
Argon	NIL	NIL	NIL
Relief Valve Setting, psig (bar/kPa)	22 (1.5 / 152)	22 (1.5 / 152)	22 (1.5 / 152)
Inner Container Bursting Disc, Psig (bar / kPa)	176 (12 / 1213)	176 (12 / 1213)	176 (12 / 1213)
Pressure Building Circuit Setting, psig (bar / kPa)	N/A	N/A	N/A
Design Specifications			
TC	4LM	4LM	4LM
DOT	4L	4L	4L
Rated Service Pressures (bar/kPa)	100 (6.9 / 690)	100 (6.9 / 690)	100 (6.9 / 690)

Specification cont…

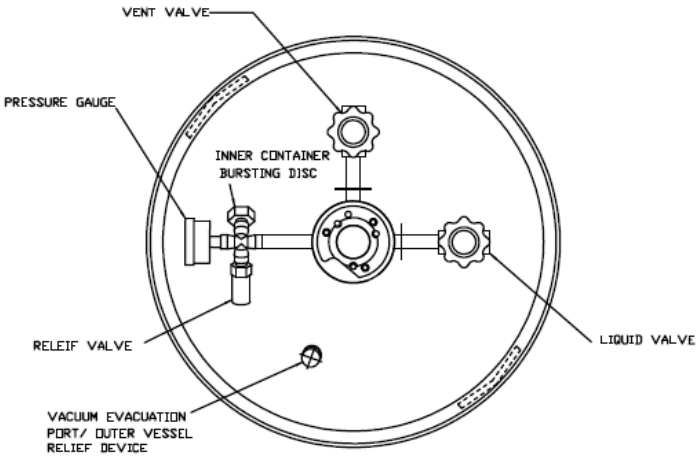
MODEL	XL-230	XL-240
Dimensions		
Diameter, in (mm)	26 (660)	26 (660)
Height, in (mm)		
RB	56.1 (1425)	57.5 (1460)
SB	61.5 (1563)	56.0 (1473)
Weight Empty (Nominal), lb (kg)		
RB	326 (148)	380 (172)
SB	390 (177)	410 (186)
Capacity, Gross, Liters	240	250
Capacity, Useable Liquid, Liters	230	240
Weight of Contents Maximum lb. (kg) Based on DOT Rated Service Pressure		
Oxygen	517 (235)	599 (272)
Nitrogen	364 (166)	419 (190)
Argon	626 (286)	733 (332)
Normal Evaporation Rate* (% Capacity per Day)		
Oxygen	0.9%	0.9%
Nitrogen	1.4%	1.4%
Argon	0.9%	0.9%
Relief Valve Setting, psig (bar/kPa)	22 (1.5 / 152)	22 (1.5 / 152)
Inner Container Bursting Disc, Psig (bar / kPa)	176 (12 / 1213)	176 (12 / 1213)
Pressure Building Circuit Setting, psig (bar / kPa)	15 (1.0 / 103)	15 (1.0 / 103)
Design Specifications		
TC	4LM	4LM
DOT	4L	4L
Rated Service Pressures (bar/kPa)	200 (13.8 / 1380)	200 (13.8 / 1380)

Specifications are subject to change without prior notice.
** Vented NER based on Useable Liquid capacity.*

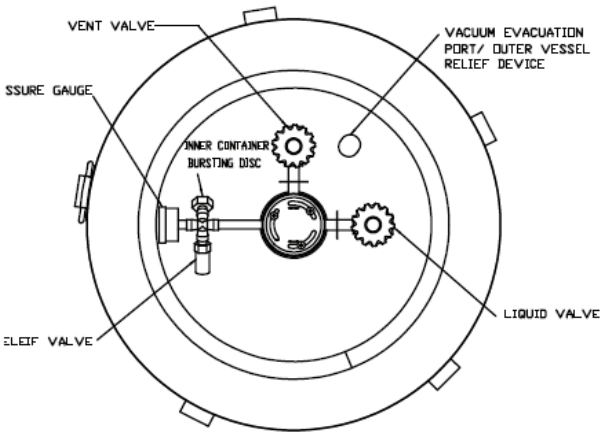
5. Operation

The XL-100/XL-160/XL-180/XL-230/XL-240 indicates their respective liquid storage capacities in liters of product. The XL-100, XL-160 and XL-180 are designed for liquid nitrogen service. The XL-230 and XL-240 are designed for liquid nitrogen, oxygen and argon services. The following component and circuit descriptions are pertinent to the operation of all the containers and should be read before attempting operation. Components may be identified on the Component Location illustration.

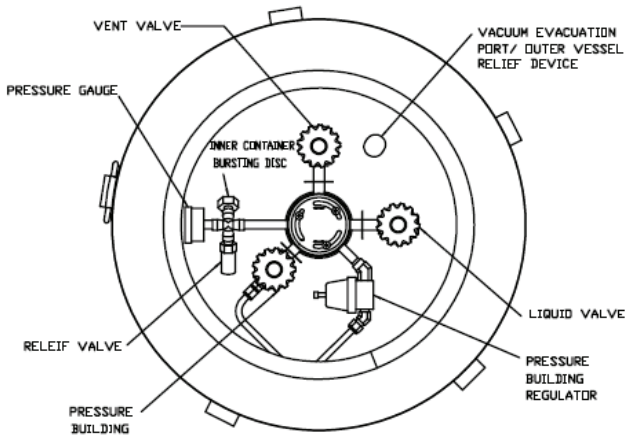
6. Component Description



XL-100/XL-160/XL-180

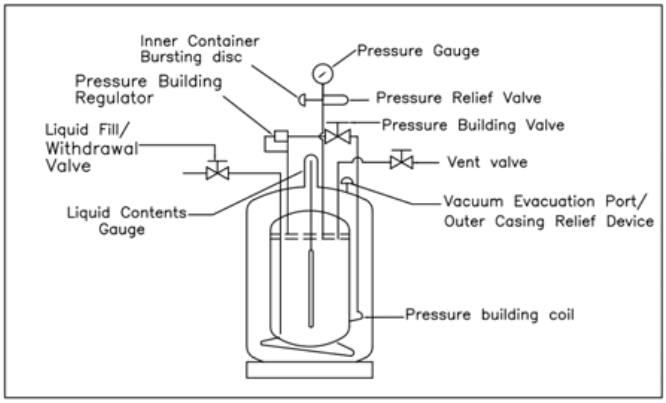


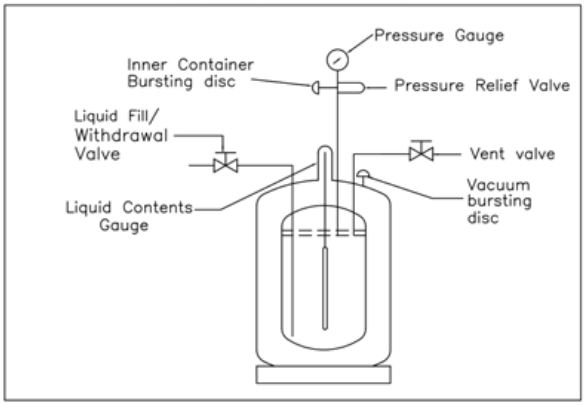
XL-230/240 Without Pressure Building Circuit



XL-230/240 With Pressure Building Circuit

Flow Diagram





- ### Liquid Fill/Withdrawal Valve

  Liquid product is filled into or withdrawn from the container through the connection controlled by this valve. It is equipped with a connection (CGA fitting) specifically required for the liquid service, for which the container is configured. If the liquid service changes, this connection must be changed as well. The valve is opened for liquid fill or liquid withdrawal after connecting a transfer hose with compatible fittings to the liquid line connection.

- ### 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 fill point during the 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 vent line serves as full try cock of the inner container fill volume.

- ### Pressure Building Valve (XL-230/240 with P.B. Circuit)

  This valve isolates the liquid in the bottom of the container from the Pressure Building Regulator. This valve must be open to build pressure inside the container.

- ### Pressure Gauge

  The pressure gauge displays the internal container pressure in pound-per-squareinch or in kilo Pascal.

- ### Liquid Content Gauge

  The container liquid content gauge is a float type liquid level sensor that indicates container liquid content through a magnetic coupling to a yellow indicator band. This gauge is an indication of approximate container contents only and should not be used for filling; liquid cylinder should be filled by weight. If the level indicator does not move when container is filled, it may indicate that the magnetic field between the level indicator and the gauge has been uncoupled. The indicator should recouple itself as the container is empty.

- ## Inner Container Relief Devices

  These cylinders have inner container pressure relief valve and inner container burst disc with setting of 22 psig (1.5 bar/152 kPa) and 176 psig (12 bar/1213 kPa) respectively.

- ## Pressure Building Coil

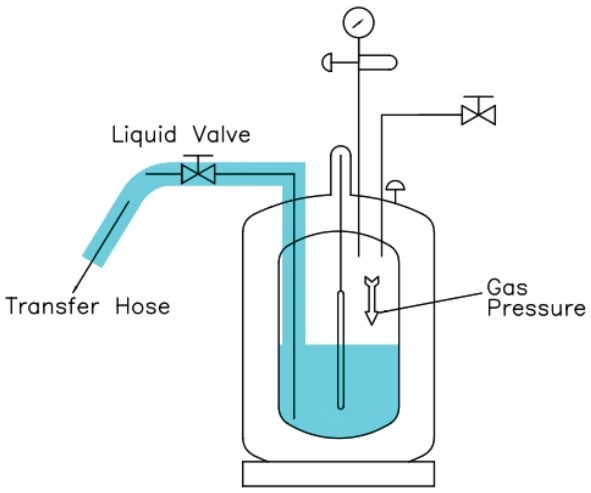
  A pressure building circuit is used to ensure sufficient driving pressure during high withdrawal periods. The function is actuated by opening the pressure building valve that creates a flow from the bottom of the container, through the pressure building coil, the regulator into the gas space in the top. When the pressure building valve is open, and the container pressure is below the set pressure of the regulator, liquid taken from the bottom of the container is warmed up and vaporized in the pressure building coil as heat exchanger which is inside the outer casing. The expanding gas is fed into the upper section of the container to build up pressure. The resulting pressure will drive the liquid delivery system.

  Pressure Building is not often required unless container pressure drops below the output pressure desired. For many applications, where the container pressure is rising due to low withdrawal rates, it may make sense to deactivate the pressure building circuit by closing the pressure building valve.

7. Withdrawal Liquid from the Container

Attach a transfer hose to the LIQUID connection and open the adjacent LIQUID valve. The pressure in the container will drive liquid product out 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 container pressure and the saturation temperature of the liquid. With liquid saturated at 22 psig (1.5 bar/152 kPa) withdrawal rate of up to 6 liters/min can be obtained.



Liquid Withdrawal

Caution: *As a rule, always close the valve before you disconnect the hose when the container is empty, to avoid contamination.*

8. Filling the Container

Cryogenic liquid containers that operate below 25 psig (1.7 bar/172 kPa) may be filled by weight or by volume. The latter method depends on the filler observing liquid product exiting the vent as indication that the container is full. Both methods are listed here. Be certain to observe all safety precautions associated with the handling of cryogenic liquids. Using the procedure below, first determine the proper filled weight of each container. The weight derived is then used the Pressure Transfer filling procedures that follow.

WARNING: *Filling operations should take place only in well-ventilated areas. Accumulations of product gas can be very dangerous (refer to the safety precautions in the front of these instructions). Always maintain adequate ventilation.*

Filling the Container by Weight of Contents

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 below), the transfer line weight, and the Tare Weight from the container's data plate.

FILLING WEIGHTS

Fluid \ Model	XL-100	XL-160	XL-180	XL-230	XL-240
NITROGEN	176 lb. (80 kg)	278 lb. (126 kg)	317 lb. (144 kg)	409 lb. (186 kg)	426 lb. (193 kg)
OXYGEN	N/A	N/A	N/A	582 lb. (264 kg)	607 lb. (275 kg)
ARGON	N/A	N/A	N/A	714 lb. (324 kg)	744 lb. (338 kg)

4. Once you have determined the proper fill weight for the container, connect a transfer hose to the LIQUID fitting from low-pressure sources of liquid.

5. Open the supply valve. Then, on the XL-100/160/180/230/240, open the LIQUID and VENT valves to begin the fill.

6. During the fill, monitor the container pressure and maintains a pressure of 10-15 psig (0.7-1 bar/69-103 kPa) by throttling the VENT valve.

7. When full weight is reached, closed both the LIQUID and the VENT valves.

8. Close the liquid supply valve and open the dump valve on fill line assembly.

9. Disconnect the fill line from the container and remove the container from the scale.

Filling the Container by Volume

1. Visually inspect the container. Do not attempt to fill containers with broken or missing components.

2. Connect a transfer hose to the LIQUID fitting from low pressure sources of liquid.

3. Open the supply valve. Then, on the XL-100/160/180/230/240, open the LIQUID and VENT valves to begin the fill.

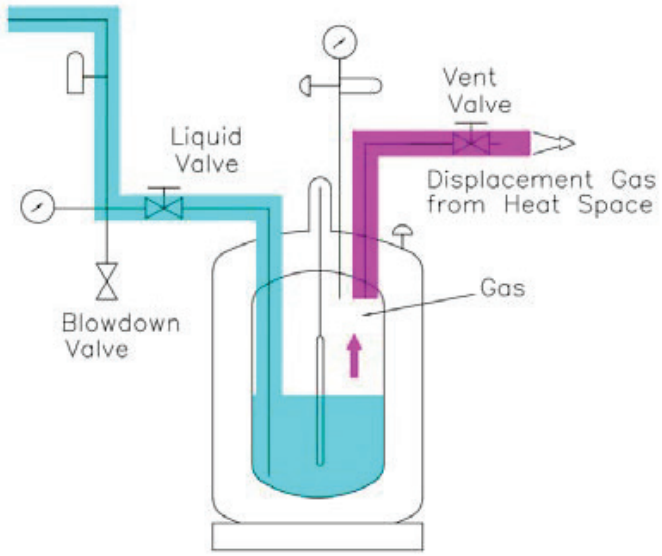
4. When liquid begins to spit from the VENT valve, quickly close the LIQUID valve and then VENT valve. Both valves must be closed before the container relief valve opens.

5. Disconnect the fill line from the container.

Filling a liquid cylinder using the pressure transfer method is common for 22 psig (1.5 bar/152 kPa) service where the product is used for refrigerant purposes. This method may also be used for higher pressure cylinders to increase liquid holding time. A fill is accomplished by first establishing a pressure difference between the source vessel and the XL-100/160/180/230/240 (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 is a greater control over liquid temperature is desired.

Filling the container is accomplished through the LIQUID valve 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 and increases, or lengthens, product holding time.

Pressure Transfer Filling



Fill Hose

Taylor-Wharton fill hose for the XL-100/160/180/230/240 are designed to transfer specific liquefied gases to, or from, the containers. Cryogenic transfer hoses are constructed of stainless steel for the transfer of cryogenic liquids and are available in six feet (1.8 m) lengths with 3/8 in. NPT fitting one end and CGA service-specific female fittings on the other.

TRANSFER HOSE CHART

Description (Service/Hose Length)	Cylinder Connection(s)	End Fittings	Part Number
Inert (N2, Ar) Service 6 ft. (1.8m) Stainless Steel	LIQUID or VENT Valve	CGA 295 to 3/8in. NPT	1600-9C66
Oxygen Service 6 ft. (1.8m) Stainless Steel	LIQUID or VENT Valve	CGA 440 to 3/8in. NPT	GL50-8C53

**Taylor-Wharton offers metal hoses for filling and withdrawal as accessories.*

9. Repair and Maintenance

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

- **Never work on a pressurized container.** Opening the vent valve as a standard practice during maintenance to guard against pressure build-up from residual liquid.
- **Containers that are in service for oxygen may contain residual oxygen.** Many materials and working practices together with oxygen can be a combustion hazard. For that reason, an oxygen container must be sufficiently emptied and rinsed with nitrogen for instance, to remove the oxygen from the container before repair and maintenance work can start.
- **Use only repair parts suitable for oxygen service. This basic rule is also valid for containers, which are at that time not in oxygen service, because they may be in the future.** Be certain your tools are free of oil and grease. This is good maintenance practice and helps ensure you do not introduce any contaminants to the plumbing of the container and do not create a combustion hazard when working on containers for oxygen or nitrous oxide service.
- **Leak test connections after every repair.** Pressurize the container with appropriate inert gas for leak testing. Use only leak test solutions and follow the manufacturer's recommendations. "Snoop" Liquid Detector is one approved solution.

WARNING: *For O2 System User: Residue of leak detectors solutions can be flammable. All surfaces to which the leak detector solutions have been applied must be adequately rinsed with portable water to remove all traces of residue. Reference CGA G-4. Section 4.9.*

10. Change of Product Service (Applicable for XL-230 & XL-240)

XL-230 & XL-240 Cylinders may be converted from one service to another within the confines of the services for which the containers are designed if a change of product service should be desired. For this conversion, the connection fittings on the pipes must be exchanged, further the scale on the liquid level gauge.

Container Modification

Empty the container and open the vent valve to allow residual liquid to evaporate and to prevent the container from building up pressure.

Caution: *Always change the fittings, never use adapters if the service shall be changed. The following procedures address the physical changes to the container only. For detailed procedures on the decontamination of the container itself, refer CGA pamphlet C-10 "Changes of Service for Cylinders including Procedures for Inspection and Contamination Removal."*

1. Unscrew the fittings of the connections to the vent (gas blow) line, the use (gas withdrawal) line and the liquid (fill/ withdrawal) line –one after the other-, with standard wrenches. Screw in the new fittings for the desired medium service. Seal with Teflon/ PTFE band or similar oxygen compatible thread sealant.

2. Remove the protective cover over the liquid level gauge. Exchange the snap on indicator on the liquid level gauge against the indicator for the new medium from the service change kit, then reinstall the protective cover.

3. Carry out a leak test on all fittings that have been exchanged. Change the stickers or decals on the container for the gas service.

PRODUCT SERVICE CHANGE CONNECTIONS

Gas Service	Valve Name	Connection Designation
OXYGEN	LIQUID VENT	CGA 440 CGA 440
NITROGEN	LIQUID VENT	CGA 295 CGA 295
ARGON	LIQUID VENT	CGA 295 CGA 295

11. Purge Procedure

After changing the cylinder product service, determine the level of purity in the pressure vessel. If the pressure vessel contents purity is unacceptable, perform a purge procedure to reduce contaminants. The following procedure is recommended for the applications:

1. Attach warm nitrogen, N2, source to the liquid fill/withdrawal valve. Approximately 20 psig pressure should be achieved. *The positive pressure must always be maintained in the cylinder during purge procedure to prevent drawing atmospheric contaminants back into the cylinder.*

2. Closed all valves. Before venting into the atmosphere ensure that such a venting is allowed by all applicable site regulations and codes.

3. Open vent and use valves. Vent the inner vessel to 5 psig (34kPa), as indicated on the pressure gauge. Close vent and use valves.

4. For cylinder equipped with PRESSURE BUILDING REGULATOR, at this low pressure 5 psig (0.35 bar), loosen the compression fitting connections on the pressure build regulator so that N2 vented through this connection. Then retighten the connections while the cylinder is still having positive pressure.

5. Repeat purge procedure 1 through 3 until an acceptable product purity is achieved.

6. After completion of cylinder purge, make sure that all valves are closed.

12. The Regulator Maintenance (for XL-230/240 with P.B Circuit)

A spring-loaded regulator is employed for the pressure building circuit. This regulator can be adjusted on the container, or it can be replaced. It is also possible to check and adjust the regulator off the container in a readily fabricated bench adjustment fixture.

Please note: *One clockwise turn of the adjustment screw will raise the set point by approximately 30 psig (2 bar /207 kPa). See the chart below to determine the range of adjustments for the regulator. Do not attempt to set the regulator to pressure outside of its design range.*

REGULATOR ADJUSTMENT RANGES

Part No.	Normal Setting	Range
6999-9018	15 psig 1.0 bar 103 kPa	2 to 25 psig 0.1 to 1.7 bar 14 to 172 kPa

Regulator Adjustment on the Container

1. Fill the container to approximately 2/3 with appropriate liquid product.

2. Open the pressure building valve and allow the container to stabilize, until the pressure does not change any more, about half an hour. Note the point, when the pressure stabilizes, this is the set pressure of the dual pressure building/economizer regulator.

3. Adjust the screw on the top of the regulator to raise or lower the pressure to the desired point. To increase the set pressure by clockwise turning the adjustment screw on the regulator. Watch the pressure in the container increase until it stabilizes. If you want to lower the set pressure, turn it anticlockwise, then close the pressure building valve, and vent the container to a pressure below the desired set pressure. 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 the atmospheric pressure.
3. Loosen the elbow tube connector on the pressure building 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 readjust its setpoint using the bench test setup.
6. To install a replacement or readjusted regulator, apply Teflon 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.

Regulator Adjustment - Bench Procedure

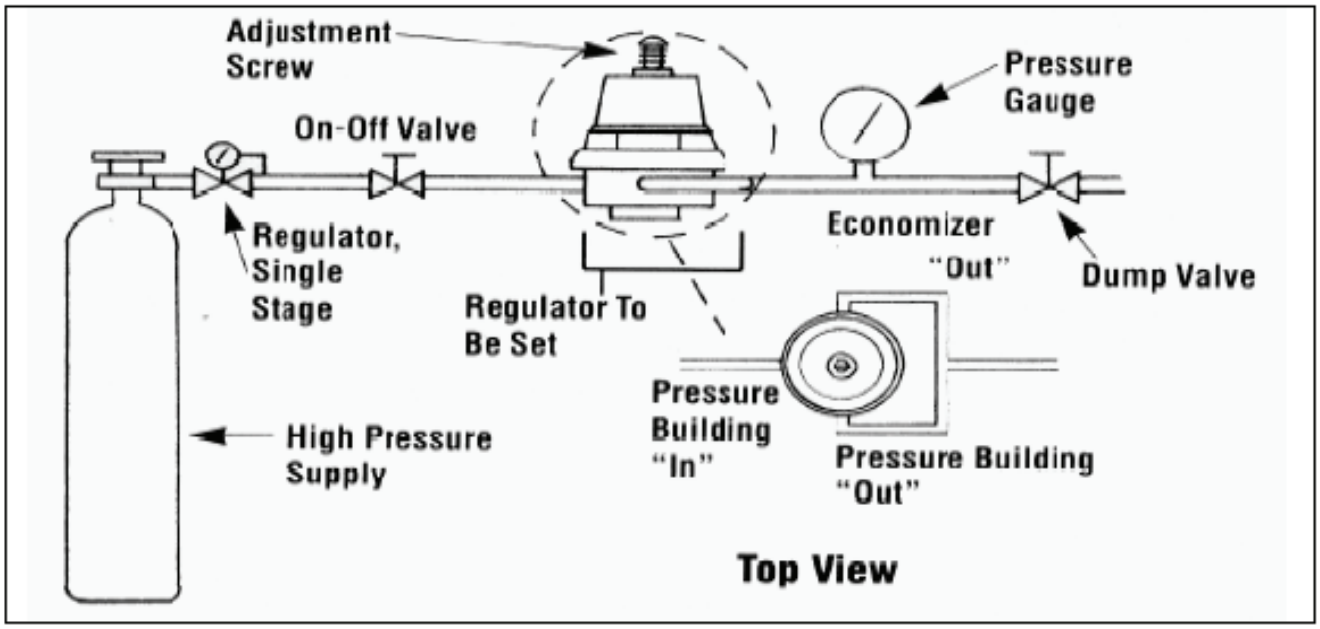
Assemble the regulator adjustment fixture, and the regulator to be adjusted, as shown in the accompanying illustration.

1. Leak test joints between the high-pressure cylinder regulator and the dump valve. Joints must leak free before proceeding.
2. Close the ON/OFF valve, and the dump valve.
3. Slightly open the high-pressure cylinder valve.
4. Set the high-pressure regulator above the desired set point for the Pressure Building setpoint.
5. Slowly open ON/OFF valve and observe the downstream pressure gauge.
6. When the regulator under test closes, the P.B. set point may be read on the downstream pressure gauge.
7. Close the ON/OFF valve and open the Dump valve.

8. To reset the regulator, loosen the locknut on the adjusting screw. Raise the set point by turning the adjusting screw clockwise; lower the set point by turning the screw counterclockwise. After adjustment, repeat steps 5 and 6 to check the setting before reinstalling the regulator on the liquid container.

Note: *The regulator has directional gas flow. The arrow on the regulator body must point in the direction indicated in the Bench Adjustment Fixture illustration.*
The economizer portion of the regulator has already opened approximately 20 psig (1.4 bar/ 138 kPa) below the pressure building setpoint.

Regulator Bench Adjustment Fixture



13. Checking Container Performance

The cryogenic container consists of two containers, one inside 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 radiation reaching 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 system consists of materials which gather trace gas 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 can no longer maintain the vacuum integrity of the container. The change will be very gradual and may 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 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.

3. The container may appear to be '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.

Similar symptoms can be observed if the pressure building is activated or damaged. Pressure building valve and / or dual pressure building/economizer regulator may be defective or need to be re-adjusted / replaced. It can be observed by an iced or very cold regulator, valve, and pipes from a damaged vacuum.

14. Checking Normal Evaporation Rate (NER- Test)

If you have reason to suspect a loss of the vacuum integrity, you can check the container's Normal Evaporation Rate. Before you start testing, check first the integrity of the Vacuum Evacuation Port/ Outer Vessel Relief Device. If the Vacuum Evacuation Port/ Outer Vessel Relief Device is defective, there is no more need for the test. In that case the container would need to be re-evacuated after the reason for the vacuum loss was found. In case there is a vacuum leak, for instance by a crack in the outer or inner casing, on the neck tube, or on one of the pipes, a repair would make no more sense for economic reasons. Please contact your dealer.

If the Vacuum Evacuation Port/ Outer Vessel Relief Device is ok, carry out the NERTest. The test measures the actual product loss over time.

Please note: *The Pressure Building Valve must remain closed during the test; otherwise, the pressure building process would increase the evaporation and distort the test result. It must be ensured that the Pressure Building Valve closes 100%.*

1. Fill the container with liquid nitrogen with the following weight:
   - XL-100 with 75 pounds (34 kg)
   - XL-160, XL-180, XL-230 and XL-240 with150 pounds (68kg).

2. Close the liquid fill/withdrawal valve and open the vent valve and allow it to remain open during the test.

3. The liquid nitrogen boils because it is pressurized. After 24 hours the saturation process should be finished, so that the evaporation from the container is stabilized. Then weigh it, and record the weight, time, and date.

4. Repeat the weighting after 24 hours and again after 24 hours.

$$\text{Daily NER} = \frac{[\text{Weight (step3)} - \text{Weight (step 4)}]}{[\text{Time between Step 3 and Step 4 in hours}]} \times 24$$

5. The results will be most reliable if the container is not moved during this time. The resulting weight loss over 24 hours is the daily evaporation rate. You can of course also measure weight and time at any time of the day to find the hourly evaporation and to calculate the daily evaporation rate. The measured values must be a linear function of time.

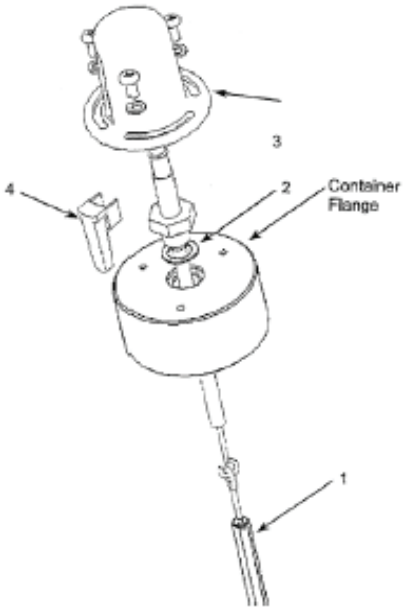
Compare the results of your test to the 'as manufactured' NER value in the specification sections of this manual. A container in service should maintain an NER value of less than two times the new specification. Any test results greater than two times the listed value is indicative of a failed or failing vacuum. If NER is found to be high, contact Taylor-Wharton or your distributor.

An increased evaporation rate is shown by fast pressure building, but it is not dangerous, because the container is protected by a pressure relief valve and an inner container bursting disc. There are no objections against a further operation of the container, if there is a continuous and enough withdrawal, at least until a blowing pressure relief valve shows that the evaporation rate of the container is too high and the vacuum to deteriorate for the present application.

15. Liquid Content Gauge

This device consists of the gauge assembly with a float rod beneath an indicator under a clear plastic protective cover. When the gauge is assembled, a level indicator ring is magnetically coupled to the top of a float rod and moves up or down with the changing liquid level in the container.

If the indicator ring stays in the bottom position, although there is still liquid in the container, this can be a sign for an interrupted magnetic coupling between the ring and the float rod. The indicator ring will be picked up again by the magnetic field once the container is empty. You can also try to lift the ring in its position with a magnet from outside.



Components of the Contents Gauge:
1 - Float rod
2 - Sealing
3 - Cover
4 - Scale (Snap-on)

16. Replacement Instruction

Caution: ***Please refer to section "Repair and Maintenance" before doing the following replacement.***

Liquid Level Indicator Replacement

a, Removing the Full View Contents Gauge

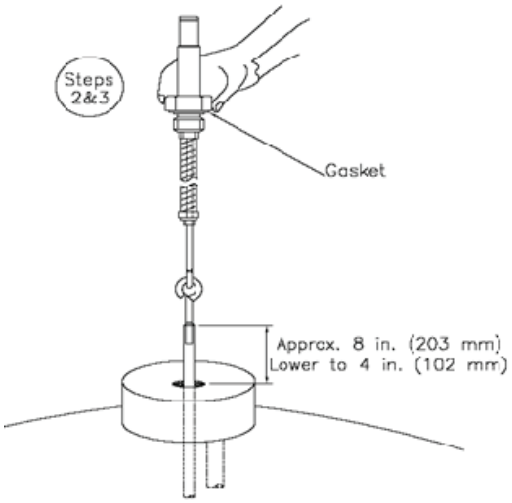
1. Vent all pressure from the container.
2. Remove the protective cover by removing three bolts from the base of the cover.
3. Unscrew the gauge body using a wrench on hex fitting at base of the indicator.
4. Lift the entire gauge assembly free of the container. The gauge assembly is long and may be very cold. Gloves should be used to protect your skin.

WARNING: ***Cold surfaces should never be handled with bare skin. Use gloves and other protective clothing when performing this procedure.***

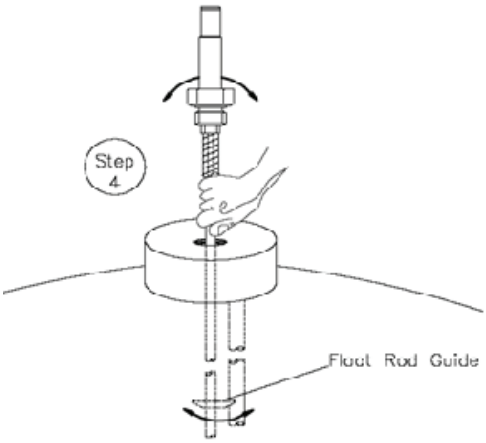
b, Liquid Content Gauge Installation

Before installing or repairing a new liquid content gauge, inspect the gasket seals. If any damage is apparent, replace the gasket.

1. When inserting the gauge assembly, lower the float rod through the gauge opening until about 8 inches (203 mm) of the float rod remains above the container.
2. Grasp the clear cover portion of the gauge assembly with two fingers so that the assembly hangs free and "plumb."
3. Lower the assembly about 4 inches (102 mm) slowly and try to keep the rod in the center of the threaded entrance hole as you do. If you are careful during this portion of insertion, you will drop the float rod straight through the guide ring inside the cylinder.



4. To confirm that the rod is correctly positioned in the cylinder, stop where you can still grasp the top of the rod and try to swing the lower end from side to side.



5. When the rod is engaged in the guide ring, the rod will be restricted to lower end movement of about ½" inches (12.7 mm); if you can feel greater movement, withdraw the rod to the point where its top is 8 inches (203 mm) above the gauge opening and try again.

6. When you are satisfied that the float rod is correctly installed, lower the assembly the rest of the way into the container until the top portion threads can be engaged.

7. Screw the gauge in place and hand torque to about 20 lbs-ft (2.8 kgf-m). Leak checks the connection of gauge to the flange.

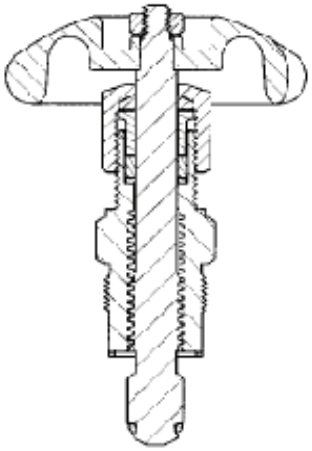
CAUTION: *When installing the gauge assembly, care must be taken to ensure that the float rod is inserted through "guide ring" located on the liquid withdrawal line inside the container. If the gauge does not engage this ring, the contents indication will be inaccurate, or the gauge may be damaged in use.*

Hand Valve Replacement

Hand valves 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. The illustration below is a view of the valve replaceable part used on Taylor-Wharton liquid container.

Valve Repair Kit Assembly (P/N 1750-9C35)

→ 3/8" Rego Globe



a, 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 large adjustable wrench to hold valve body, remove Bonnet by turning counterclockwise with a 15/16-inches socket wrench that capable of developing at least 80 lbs-ft (11 kgf-m) torque.

3. Remove the handwheel assembly from the valve body and discard. Inspect the body and clean if necessary; be sure interior and seal areas are free from dirt, residue, and foreign particles.

CAUTION: Do not apply force after the valve is fully open.
Do not scratch or mark the internal surface of valve.

b, Valve Replacement Instructions

1. Thread handwheel assembly into valve body until properly seated.

2. Turn the handwheel completely clockwise to close the valve. Re-pressurize container and leak check valve.

Pressure Relief Valve / Inner Container Bursting Disc / Pressure Gauge Replacement

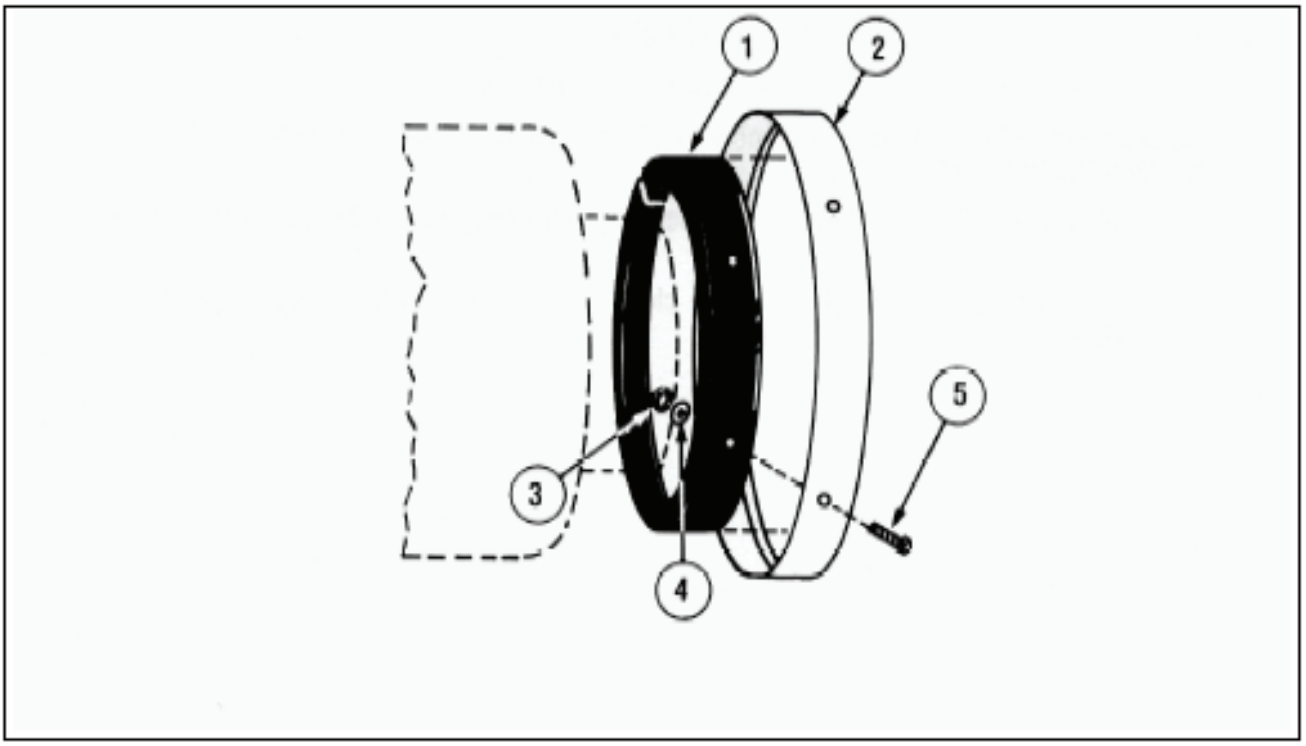
Unscrew the part to be removed by suitable socket wrench. Apply approved sealing tape to the thread of new parts to be installed. Using a suitable socket wrench, screw back the parts to its connection. Leak test connection after replacement (refer to section “Repair and Maintenance”).

Foot Ring Parts Replacement

COMPONENT FOR SHOCK MOUNT FOOT RING (XL-160 & XL-180)

Item No	Description	Part No.	Qty.
1	Rubber Shock Ring	XL50-4C18	1
2	Foot Ring	XL50-4C19	1
3	Hex Nut	6311-1042	3
4	Washer	6430-0125	3
5	Carriage Bolt	6620-0401	3

Shock Mount Foot Ring- Exploded View



Replacement of Shock Mount Foot Ring

1. Empty or transfer all contents of tank. Vent to atmospheric pressure.

2. Gently lay the container on its side and unbolt the three (3) carriage bolts that attached the foot ring and rubber ring to the tank.

3. Slide off the damaged foot ring and rubber shock ring.

4. Assemble rubber shock ring into new foot ring and force over shock mount ring on container. Use a rubber hammer to drive the rubber shock ring into place.

5. Using a ½ inch drill bit, drill holes through rubber so that the carriage bolt slides in smoothly.

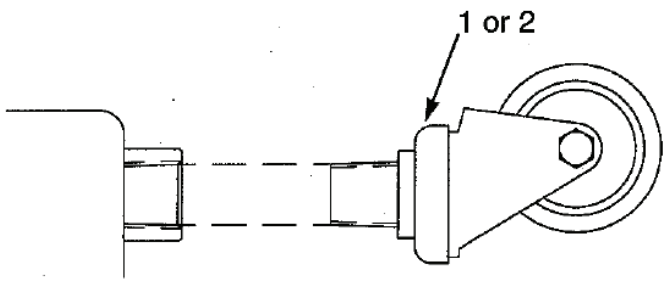
6. The holes in foot ring must be position in alignment with holes in shock mount ring. Using the 3 bolts, washers and nuts, fasten the new parts to the container.

7. After securing the shock mount ring, gently lift the container to the upright position and inspect your work.

***Note:** If the original Shock Mount Ring is badly damaged, we recommend that an NER test is performed to ensure that no internal damage has resulted from the impact of the shock mount ring.*

Caster Wheel(s) for XL-100 Replacement

Item No	Description	Part No.	Qty
1	2 ½" Diameter Caster	7300-9025	3
2	2 ½" Diameter Caster with Brake	7300-9030	2



Replacement of Caster(s)

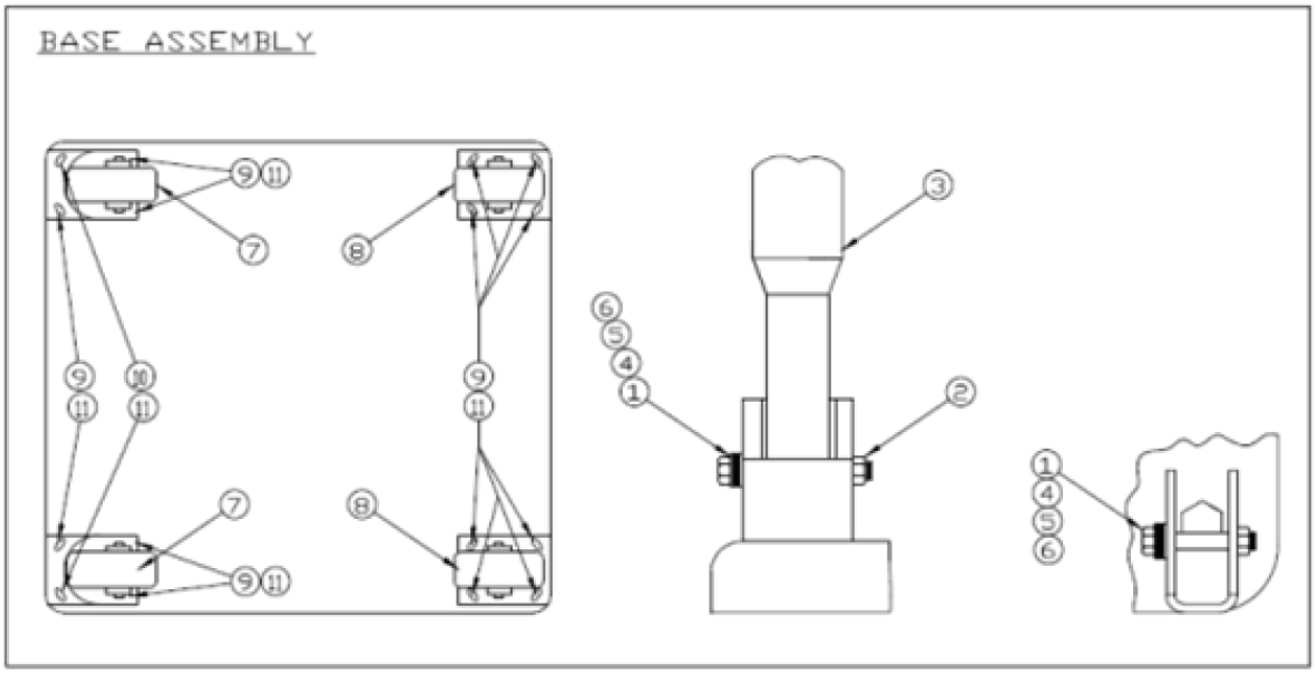
1. Empty or transfer all contents of tank. Vent to atmospheric pressure.
2. Gently lay the container on its side.
3. Loosen and remove caster(s) to be replaced.
4. Apply two drops of thread sealant to threaded caster post.
5. Insert new caster(s) into threaded tube and tighten.
6. After replacing and securely tightening caster(s) gently lift the tank to the uplifting position.

Square Base Parts Replacement

COMPONENT FOR SQUARE BASED ASSEMBLY

Item No	Description	Part No.
1	Cap screw, Hex Head, ½"-13UNC, S.S.	6164-1753
2	Hex Nut, Nylon Insert	6331-1183
3	Handle Assembly	XL65-9C31
4	Flat Washer, S.S.	6460-9024
5	Spring Washer, S.S.	6460-9025
6	Flat Washer, Teflon	6160-9026
7	Caster, Swivel 4 in. Dia. Wheel	7300-9021
8	Caster, Rigid 4 in. Dia. Wheel	7300-9022

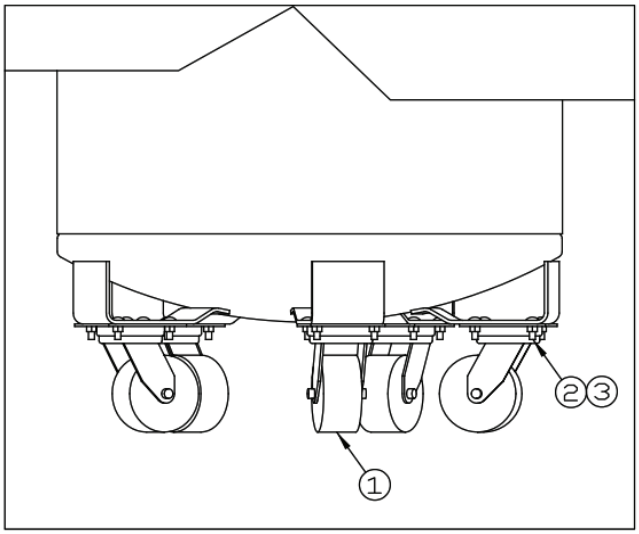
9	Carriage Bolt,3/8”-16UNC, 1 ¼” L, S.S.	6160-4766
10	Hex Head Cap screw,3/8”-16UNC, 1” L, S.S	6164-1133
11	Elastic Stop Nut, S.S.	6368-9110



Round Base Parts Replacement

COMPONENT FOR ROUND BASE ASSEMBLY

Item No	Description	Part No.	Qty
1	Caster wheel, Swivel 4” Dia., Polyurethane	7300-9023	5
2	Carriage Bolt, M8 X 25MM Lg, Stn Stl	6160-4763	20
3	Elastic Stop Nut, M8, Stn Stl	6311-1044	24



17. Trouble Shooting Chart

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

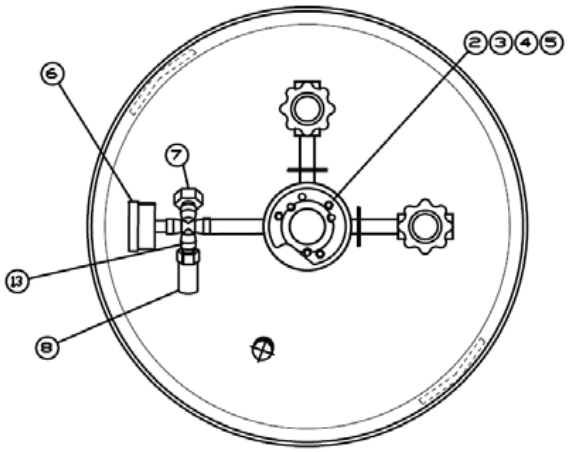
No	Symptom	Possible Cause.	Corrective Action
1	Consistently low operating pressure.	1. Relief valves open at low pressure. 2. Cold liquid.	1. Remove and replace relief valve. 2. The container will build pressure over time, or an external pressure source can be used to pressurize container.
2	No pressure 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. 5. Possible leak at VENT valve. 6. Faulty relief valve.	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. 5. Replace valve. 6. Replace valve
3	No pressure showing but container is full by weight.	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.
4	Container is cold and may have ice or frost on outer casing. Will not hold liquid overnight. Relief valve is venting gas.	1. Vacuum loss. Check NER. 2. Defective P.B. regulator (where applicable).	1. Consult with Taylor-Wharton for course of action. Do not attempt to put additional liquid container. 2. Look for P.B coil pattern in ice. Close P.B. valve. Replace or reset regulator.

6	Ice formation on bottom of container when P.B. valve is closed (where applicable).	1. Pressure building valve not closing properly. 2. Leak in pressure building system topworks.	1. Replace or rebuild valve. 2. Leak test piping connections and tighten fitting if needed.
7	Container vents through relief valve when in use.	Pressure Building Regulator set above relief valve setting (where applicable).	Remove and reset or replace regulator.
8	Container vents after fill but quits after a while.	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 the liquid reaches its saturation point at container operating pressure.
9	Container vent 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.
10	Level indicator stuck ½ full. Yellow indicator ring will not move.	Float rod stuck on or in float rod guide.	Reinstall. See Contents Gauge Installation section.
11	Level indicator at bottom of gauge. Container full of product.	Indicator disengaged from gauge rod. Caused by dropping the container.	Recouple indicator using re-engagement ring.

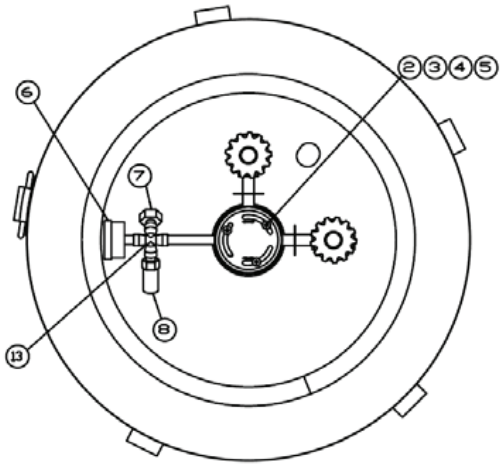
18. Replacement Parts

This replacement parts list includes a recommended inventory quantity which allows you to order parts on timely basis to keep all your containers in service. When placing orders, please use the nomenclature and part numbers in this section.

COMPONENT LOCATIONS



XL-100/XL-160/XL-180



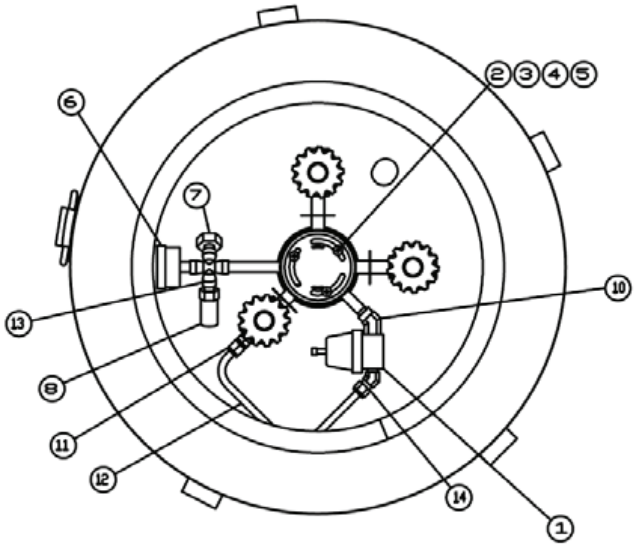
XL-230/240 Without Pressure Building Circuit

Replacement Parts for XL-100/160/180 and XL-230/240 (without PB)

Index No	Descriptions	Part No.	Recommended for 10 Units
2	*Gasket, Glass Filled Teflon, Contents Gauge	7701-0083	5 Each
3	Liquid Level Indicator Inert Spring W/ Float Rod:		
	• XL100	GL45-9C60	1 Each
	• XL160	GL45-9C63	1 Each
	• XL180	GL45-9C67	1 Each
	• XL230	GL45-9C61	1 Each
	• XL240	GL45-9C62	1 Each
	Nitrogen, indicator Scale	GL45-9C79	4 Each
	Oxygen, indicator Scale	GL45-9C80	4 Each
4	Screw, brass, 1/4inch-20 UNC x 5/8 inch	6114-1088	10 Each
5	Washer, Lock, ¼ inch, stainless steel	6460-2025	10 Each
6	Gauge, Pressure 0-60 psig (0-4 bar/0-414 kPa)	7702-6198	2 Each

7	Safety Head, 176 psig (12 bar/1213 kPa)	L240-9C20	2 Each
8	Relief valve, 22 psig (1.5 bar/152 kPa)	1700-9069 (Rego) 6913-9069 (Generant)	5 Each 5 Each
9	Valve Repair Kit	1750-9C35	3 Each
13	Cross Assembly	GL55-9C29	2 Each
16	***End Fittings for Hand Valves** LIQUID (CGA 440)-oxygen LIQUID (CGA 295)-nitrogen VENT (CGA 440)-oxygen VENT (CGA 295)-nitrogen *Decal, Warning *Decal, Nitrogen service *Decal, Oxygen service	 6514-8992 7355-4712 6514-8892 7355-4712 1700-9C07 GL55-9C51 GL55-9C52	 5 Each 5 Each 5 Each 5 Each 4 Each A/R A/R

*Not illustrated



XL-230/240 With Pressure Building Circuit

Replacement Parts for XL-230PB and XL-240PB

Index No	Descriptions	Part No.	Recommended for 10 Units
1	P.B Regulator,15 psig (1 bar/103 kPa)	2200-9C36	2 Each
2	Liquid Level Indicator Inert Spring W/ Float Rod:	7701-0083	5 Each

3	Liquid Level Indicator Inert Spring W/ Float Rod:		
	• XL230PB	GL45-9C61	1 Each
	• XL240PB	GL45-9C62	1 Each
	Nitrogen, indicator Scale	GL45-9C79	4 Each
	Argon, indicator Scale	GL45-9C81	4 Each
	Oxygen, indicator Scale	GL45-9C80	4 Each
4	Screw, brass, 1/4inch-20 UNC x 5/8 inch	6114-1088	10 Each
5	Washer, Lock, ¼ inch, stainless steel	6460-2025	10 Each
6	Gauge, Pressure 0-60 psig (0-4 bar/0-414 kPa)	1700-9C10	2 Each
7	Safety Head, 176 psig (12 bar/1213 kPa)	L240-9C20	2 Each
8	Relief valve, 22 psig (1.5 bar/152 kPa)	1700-9069 (Rego)	5 Each
		6913-9069 (Generant)	5 Each
9	*Valve Repair Kit	1750-9C35	3 Each
10	Street Elbow, Male, Brass 45^{O}X1/4in. MNPT**	6814-2078	2 Each
11	Connector, Male, Brass, 3/8 in. ODTcomp x 1/4in. NPT-EXT	4570-1960	2 Each
12	Tube, P.B. Line	L240-9C01	2 Each
13	Cross Assembly	GL55-9C29	2 Each
14	Elbow, Male, 3/8 ODT x ¼ in. NPT 45^{o}	6814-9233	2 Each
15	***End Fittings for Hand Valves**		
	LIQUID (CGA 440)- oxygen	6514-8992	5 Each
	LIQUID (CGA 295)-argon/nitrogen	7355-4712	5 Each
	VENT (CGA 440)-oxygen	6514-8892	5 Each
	VENT (CGA 295)-argon/nitrogen	7355-4712	5 Each
	*Decal, Warning	1700-9C07	4 Each
	*Decal, Nitrogen service	GL55-9C51	A/R
	*Decal, Oxygen service	GL55-9C52	A/R
	*Decal, Argon service	GL55-9C53	A/R

*Not illustrated

19. Accessories

Accessories available for use with Taylor-Wharton XL-Series containers are:

-Manifold, Automatic and Manual
-Container Hand Trucks
-Vaporizer adding up to 250 cfh (6.6 cu.m/h) each
- PN: VP50-7C10

-Transfer Hoses (O_2, N_2, and AR)
- PN: 1600-9C66 6 ft X CGA 295 X 3/8” NPT LIQUID / VENT N2/AR Service
- PN: GL50-8C53 6 ft X CGA 440 X 3/8” NPT LIQUID / VENT O2 Service

-Cryogenic Phase Separators
- PN: 1193-8C80 2 ¾” X 1 3/8” OD (3/8” NPT)
- PN: 1193-8C82 1 ¼” X 1” OD (3/8” NPT)
- PN: 1193-8C83 1¼” X 1/2” OD (1/8” NPT)

For additional information concerning the accessory of your choice, please consult the separate manuals on accessories or call Taylor-Wharton.

Disclaimer

Taylor-Wharton is not being liable for any consequential, special, or incidental damage or accidents resulting from the delivery, use, or maintenance of delivered XL-Series Cylinder (including loss of any liquid product or materials stored in liquid product), or from any cause whatsoever by accepting delivery of the products sold hereunder. Any claims regarding the containers must be reported immediately in written form to TW after receipt of the XL-Series Cylinder, or whenever damage becomes obvious. The XL- Series Cylinder may not be put in or kept in operation before clarification and repair of the damage, and it must be put out of any service and stored in a suitable form. The XL-Series Container may be put in service again only with the written consent of TW.

Furthermore, the 'Terms of Sales or Acknowledgement' of Taylor-Wharton apply.

QUALITY WARRANTY CERTIFICATES
TAYLOR-WHARTON
XL SERIES LIQUID CYLINDERS

Taylor-Wharton warrants to the original purchaser that the internal structural support system of each XL Series Liquid Cylinder shall be free of defects in materials and workmanship for the life of the product if it is used and maintained according to Taylor-Wharton's published instructions. Taylor-Wharton warrants to the original purchaser of the following:

1. Vacuum Deterioration: The Vacuum system employed on each XL Series Liquid Cylinders is warranted to maintain thermal performance or Net Evaporation Rate (NER) within 10% of Taylor-Wharton's published specifications for a period of five years from date of shipment to the initial purchaser if the product is used and maintained according to Taylor-Wharton's published instructions.
2. Plumbing and control Valves: All components supplied by Taylor-Wharton and used on this product are warranted to be free from defects in materials and workmanship, in the normal service for which the product was manufactured, for a period of one year from the date of shipment to the original purchaser.

To validate the warranty, the purchaser must abide to the following: 1) Immediate discontinue use of the product to further investigation. 2) Purchaser to confirm that defect is due to either of the above by written notice to Taylor-Wharton within 48 hours after confirmation of a claimed defect. Upon receiving official notice, Taylor-Wharton will act as follows: 1) Were the defect is due to vacuum deterioration, Taylor-Wharton will ask the purchaser to return such product freight prepaid to Taylor-Wharton for further evaluation to validate to warranty claim. If the claimed defect is confirmed by Taylor-Wharton's inspection will submit a report to customer, at its option and as the purchaser's sole remedy, repair or replace such product or any component part thereof or refund the original purchase price. If no defect is found or after correction of a confirmed defect, Taylor-Wharton will return the equipment at purchaser's expense. 2) If the defective is due to plumbing and control valves, Taylor-Wharton will require sending replacement parts to the purchaser for reinstallation by purchaser.

This warranty is voided by alterations or by repairs of others. Taylor-Wharton shall not be liable under this warranty, or otherwise, for defects caused by negligence, abuse or misuse of the product, corrosion, fire, heat, or the effects of normal wear. Any related components or other equipment manufactured by others which may be sold with Taylor-Wharton's products are not covered by this warranty.

THIS WARRANTY IS IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE. TAYLOR-WHARTON SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES RESULTING FROM THE DELIVERY, USE OR FAILURE OF THE PRODUCT (INCLUDING LOSS OF ANY MATERIAL STORED IN THE PRODUCT), OR FROM ANY OTHER CAUSE WHATSOEVER BY ACCEPTING DELIVERY OF THE PRODUCT SOLD HEREUNDER, THE PURCHASER ACKNOWLEDGES THAT THIS LIMITATION OF REMEDIES IS REASONSABLE AND ENFORCEABLE. IN NO EVENT SHALL TAYLORWHARTON'S LIABILITY EXCEED THE PURCHASE PRICE FOR THE PRODUCT.

Taylor-Wharton

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