Thermo
SCIENTIFIC

Model
8120
180 liter, LN_2 Supply Tank

Operating and Maintenance Manual

Manual No: 8008120 Rev. 1

Read This Instruction Manual.

Failure to read, understand and follow the instructions in this manual may result in damage to the unit, injury to operating personnel, and poor equipment performance.

CAUTION! All internal adjustments and maintenance must be performed by qualified service personnel.

The material in this manual is for information purposes only. The contents and the product it describes are subject to change without notice. Thermo Scientific makes no representations or warranties with respect to this manual. In no event shall Thermo be held liable for any damages, direct or incidental, arising out of or related to the use of this manual.

MANUAL NUMBER 8008120

REV	ECR/ECN	DATE	DESCRIPTION	By
--	--	1/05	Clarified page references in Specifications and the parts list in Operation	ccs
1	--	7/03	Updated information from manufacturer	ccs
0	--	9/96	Manufacturer's manual	deg

Safety

MVE has conducted a rigid test program for liquid cylinders, both internally and through an independent testing laboratory, to verify the safety of MVE equipment. MVE cylinders are safely designed with the following features:

(1) An exclusive all stainless steel support system designed to withstand many years of rugged service.

(2) A stainless steel neck tube that is designed not to break in case of a minor accident, such as a liquid cylinder being inadvertently tipped over.

(3) A vacuum maintenance system specifically designed to provide long life and safety provisions.

(4) Safety relief devices to protect the pressure vessel and vacuum casing, sized and selected in accordance with CGA Pamphlet S-1.1 “Safety Relief Devices for Cylinders.” The safety of the inner pressure vessel is controlled by a pressure relief valve and rupture disc. A reverse buckling rupture disc protects the vacuum casing from overpressure.

While MVE equipment is designed and built to rigid standards, no piece of mechanical equipment can ever be made 100% safe. Strict compliance with proper safety and handling practices are necessary when using a liquid cylinder or other compressed gas equipment. We recommend that all our customers reemphasize safety and safe handling practices to all their employees and customers. While safety features have been designed into the unit and safe operations are anticipated, it is essential that the user of these liquid cylinders carefully read to fully understand all WARNINGS, CAUTIONSand Notes listed in this safety section and enumerated below. Also read to fully understand the information provided in the Safety Bulletins for Oxygen and Inert Gases located in Section 19 of this Manual. Periodic review of the Safety Summary is recommended.

WARNING! Excess accumulation of oxygen creates an oxygen enriched atmosphere (defined by the Compressed Gas Association as an oxygen concentration above 23 percent). In an oxygen enriched atmosphere, flammable items burn vigorously and could explode. Certain items considered non-combustible in air may burn rapidly in such an environment. Keep all organic materials and other flammable substances away from possible contact with oxygen; particularly oil, grease, kerosene, cloth, wood, paint, tar, coal dust, and dirt which may contain oil or grease. DO NOT permit smoking or open flames in any area where oxygen is stored, handled, or used. Failure to comply with this warning may result in serious personal injury.

WARNING! Nitrogen and argon vapors in air may dilute the concentration of oxygen necessary to support or sustain life. Exposure to such an oxygen deficient atmosphere can lead to unconsciousness and serious injury, including death.

WARNING! The Dura-Cyl/Cryo-Cyl Series, with its stainless steel support system is designed, manufactured, and tested to function normally for many years of service. MVE does not suggest or warrant that it is ever safe to drop a liquid cylinder or let it fall over in oxygen or any other cryogenic service. In the event a liquid cylinder is inadvertently dropped, tipped over, or abused, slowly raise it to its normal vertical position. Immediately open the vent valve to release any excess pressure in a safe manner. As soon as possible, remove the liquid product from the vessel in a safe manner. If the vessel has been used in oxygen service, purge it with an inert gas (nitrogen). If damage is evident or suspected, return to MVE prominently marked “LIQUID CYLINDER DROPPED, INSPECT FOR DAMAGE”.

WARNING! Before removing cylinder parts or loosening fittings, completely empty the liquid cylinder of liquid and release the entire 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 because of the extreme cold and pressure in the cylinder.

Do You Need Information or Assistance on Thermo Scientific Products?

If you do, please contact us 8:00 a.m. to 6:00 p.m. (Eastern Time) at:

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Our **Sales Support** staff can provide information on pricing and give you quotations. We can take your order and provide delivery information on major equipment items or make arrangements to have your local sales representative contact you. Our products are listed on the Internet and we can be contacted through our Internet home page.

Our **Service Support** staff can supply technical information about proper setup, operation or troubleshooting of your equipment. We can fill your needs for spare or replacement parts or provide you with on-site service. We can also provide you with a quotation on our Extended Warranty for your Thermo Scientific products.

Whatever Thermo Scientific products you need or use, we will be happy to discuss your applications. If you are experiencing technical problems, working together, we will help you locate the problem and, chances are, correct it yourself...over the telephone without a service call.

When more extensive service is necessary, we will assist you with direct factory trained technicians or a qualified service organization for on-the-spot repair. If your service need is covered by the warranty, we will arrange for the unit to be repaired at our expense and to your satisfaction.

Regardless of your needs, our professional telephone technicians are available to assist you Monday through Friday from 8:00 a.m. to 6:00 p.m. Eastern Time. Please contact us by telephone or fax. If you wish to write, our mailing address is:

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Introduction

General

The MVE, Inc. (MVE) Cryo-Cyl Series cryogenic liquid cylinders (Figure A) are double walled, vacuum and multi-layer insulated cylinders designed for the transportation and storage of liquefied gases. These liquid cylinders are designed for the transportation and storage of cryogenic products which can be used as either gas or liquid. All of the Cryo-Cyl Series liquid cylinders can be used for liquid argon, liquid nitrogen, and liquid oxygen.

Figure A

The Cryo-Cyl Series liquid cylinders have model distinctions for low pressure liquid withdrawal (LP). See Specifications for more detail.

The Cryo-Cyl Series liquid cylinders also have capacity distinctions; the number after their name that designates net capacity in liters (the Cryo-Cyl 180 indicates 180 liters capacity). See Specifications for more detail.

The portable liquid cylinders provide a reliable, convenient, and economical method for the transportation and delivery of liquefied gas products. They are primarily used as a self-contained gas supply. They can be used with a variety of accessories such as the M-45 Manifold to provide larger gas storage capacities.

Cylinder Design

The Cryo-Cyl Series liquid cylinders are designed, manufactured, and tested to the requirements of the U.S. DOT and Transport Canada 4L specification. They are specifically authorized by the U.S. Department of Transportation for the transporting of liquid nitrogen, oxygen, argon, carbon dioxide, and nitrous oxide. They are specifically authorized by Transport Canada for the transporting of liquid nitrogen, oxygen, and argon.

The inner pressure vessel is constructed of stainless steel and supported within an outer stainless steel vacuum jacket. The support system is an all stainless steel internal support, designed for low heat leak and high strength.

The illustration in Figure B shows the major components of the Cryo-Cyl Series liquid cylinders.

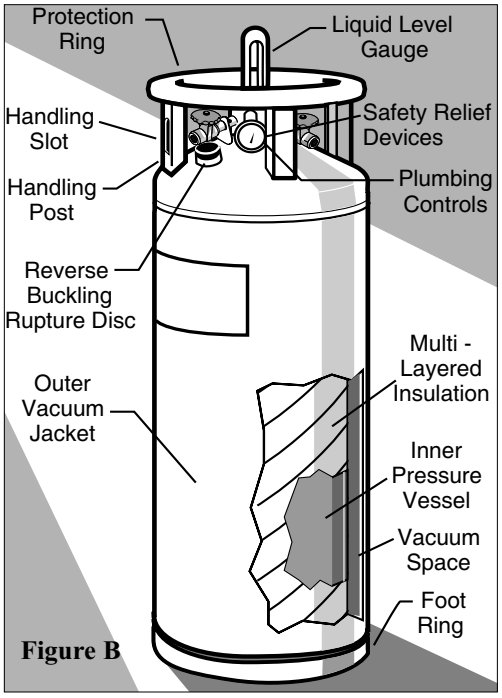


Figure B

The space between the inner and outer vessel makes up the insulation system. Multiple-layer insulation and high vacuum assures long holding time. The insulation system is designed for long term vacuum retention and is permanently sealed at the factory. The vacuum space is protected from over pressurization by the use of a reverse buckling rupture disc.

The outer vacuum jacket of the liquid cylinder contains an internal vaporizer which converts the cold liquid to gas. The internal pressure building system allows for immediate use of the cylinder by automatically building pressure to the preset operating pressure and maintaining it there during gas withdrawal.

Each liquid cylinder is equipped with a stainless steel ring to protect the plumbing components. The ring on the Cryo-Cyl is connected to the cylinder with two handling post. The post has slots for ease in handling with a hand truck or an overhead hoist.

The Cryo-Cyl Series cryogenic liquid cylinders are constructed with all operating controls situated at the top of the cylinder for ease in gas withdrawal and liquid dispensing operations. In a stand-alone operating environment it enables the user, through use of the vent, liquid, pressure building, and pressure relief devices, to completely control the liquid cylinder's operation.

To protect the inner pressure vessel from over pressurization, the unit includes a safety pressure relief valve. The liquid cylinders are further protected from over pressurization by a bursting disc that acts as a secondary relief device. These devices meet the requirements of CGA Pamphlet S-1.1 “Pressure Relief Device Standard - Part 1- Cylinders For Compressed Gases.”

A back control regulator is used to build and maintain operator pressure while assuring a no-loss operation under normal usage during gas withdrawal service. The no loss portion of the regulator (referred to as the economizer) allows gas withdrawal directly from the vapor space of the cylinder until liquid cylinder head pressure is reduced to the normal operating range. This important feature is useful whenever a liquid cylinder has been inactive for a period of several days or whenever normal heat leak may have created an increase in head pressure.

For precise regulation of the outlet gas, add a final line gas regulator at the gas use connection. The operating pressure can be increased to the pressure control valve setting (if necessary) by changing the regulator.

These MVE liquid cylinders provide a complete self-contained liquid or gas supply system for industrial, laboratory, or hospital use.

Responsibilities of Distributors and Fillers of the Liquid Cylinders

MVE states below the responsibilities of the filler of any cryogenic liquid cylinder:

1. The cylinder must be in a safe condition. The filler is responsible for confirming that any cylinder to be filled is in its proper working condition. This includes that:
   - It has an acceptable vacuum.
   - The relief system is in place and functioning.
   - There is no structural damage to the cylinder.
   - All warning labels are in place and legible.
2. Do not overfill the cylinder. The cylinders are not to be filled beyond the recommended filling weight for the liquid being dispensed.
3. Dispense only to knowledgeable users. The filler must determine that the user is knowledgeable about the general characteristics of the product and the proper safety precautions for its use. Do not allow customers to fill their own cylinders.
4. Dispose of cylinders properly. To eliminate the risk of injury from the improper reuse of cryogenic (vacuum jacketed) cylinders, before disposal, destroy the cylinder’s pressure retaining capability.

Features

General

The MVE cryogenic liquid cylinders were designed to furnish a convenient, reliable, and economical method for the transportation and delivery of liquefied gases. Important features of these liquid cylinders include:

* The Cryo-Cyl Series liquid cylinders are constructed with an all stainless steel internal support system designed for low heat leak and high strength.
* These cylinders are easily handled by one person.
* Gas stored in liquid form in a Cryo-Cyl Series liquid cylinder is more pure than gas stored in conventional cylinders.
* During periods of non-use, pressure will rise in a cryogenic liquid cylinder. The highly efficient insulation system minimizes the rate of pressure rise. This allows for a reasonable period of nonuse without any venting of product from the pressure relief valve.
* Internal pressure building and vaporization systems permit a continuous flow of gas without need for an external vaporizer.
* The pressure control regulator automatically maintains working pressure with minimum product loss.
* Cylinders can be used singularly or can be manifolded to provide a continuous gas supply.

Performance

The performance of a liquid cylinder can be shown in its ability to hold a cryogenic liquid and dispense it as a gas.

The normal evaporation rate (NER) is an indication of how well the insulation system performs its ability to hold cryogenic liquid. The Cryo-Cyl Series NER is shown in the Specifications chart.

The pressure building system can be measured by how fast it can increase pressure in the liquid cylinder and how well it maintains pressure while gas is being withdrawn from the cylinder.

The performance of the vaporizer to convert cold liquid into gas is shown by how the outlet gas temperature drops as the gas flow rate increases.

Specifications

Physical Characteristics	
Diameter - inches. (cm.)	20 (50.8)
Height - inches (cm.)	63.5 (161.3)
Empty Weight - lbs. (kg.)	210 (95.2)
Fill Weight	See pg. 4-2
Design Specification (DOT/CTC)	4L
DOT Service Pressure psig (BAR)	100 (6.9)
Relief Valve Setting psig (BAR)	22 (1.5)
Normal Operating Pressure psig	10-100
(BAR)	(0.7-6.9)
Normal Evaporation Rate	
• Nitrogen	1.5%
• Oxygen or Argon	1.0%
Gross Capacity (liters)	(196)
Storage Capacity, Liquid (liters)	(185)
Liquid Level Gauge	Float
Construction Material	Stainless
Pressure Building Regulator	
psig	0-25
(BAR)	(0-1.7)
Finish	Stainless
Base Construction	Stainless Steel Footring

Notes:

1) At lower relief valve settings, weights and capacities are higher. See Fill Weight Table on pg. 4-2.
2) Peaks of up to 4 X continuous flow rates can be sustained for 5 minutes if the vaporizer coils are allowed to thaw in between.
3) Height may vary on caster base models depending on specified wheel diameter.
4) With optional pressure builder.

Theory of Operation

General

The various liquid cylinders of the Cryo-Cyl Series have the same general operating characteristics. Each model of liquid cylinder has the ability to be filled with a cryogenic product, build pressure inside the vessel, and deliver either liquid or gas for a specific application.

The following section discusses the theory behind these operations. Later sections give a step-by-step procedure for the operation on each specific models of liquid cylinder.

Liquid cylinder operation is done completely with the control valves located on the top of the tank. The valves are labeled and color coded for easy identification: Fill/Liquid Valve - blue; Gas Use Valve - green; Vent Valve - silver; Pressure Building Valve - green.

The schematic, illustrations and Figure C show how the plumbing circuitry operates for the four major models of liquid cylinders. It is important that the operators be familiar with the plumbing control valves and their functions.

Filling Procedures

The following recommendations should be used to optimize liquid cylinder filling:

* Keep the transfer lines as short as possible. Long uninsulated transfer lines will result in higher fill losses and longer fill times.
* Anytime liquid can be entrapped in a line between two valves, the line must be equipped with a safety relief device.
* Conduct the filling operation in as short a time as possible.
* Do not overfill; fill only to the weight allowable by specification.
* Use minimum number of bends, valves and reducers.
* Use as large a transfer line as possible; at least 1/2" ID.

MVE recommends the "Lo-Loss" system for liquid cylinder filling. For information ask for Form 2072 on the "Lo-Loss" from MVE.

The liquid cylinder should be visually inspected before every fill for possible damage, cleanliness and suitability for its intended gas service. If damage is detected (e.g. serious dents, loose fittings, etc.), remove it from service and repair the unit as soon as possible.

All MVE liquid cylinders are tested for performance with low-purity liquid nitrogen. For this reason, liquid cylinders intended for use in another service should be thoroughly purged with the applicable gas prior to filling.

When filling a liquid cylinder with a cryogenic liquid, the transfer may be made with a centrifugal pump or through a pressure transfer operation.

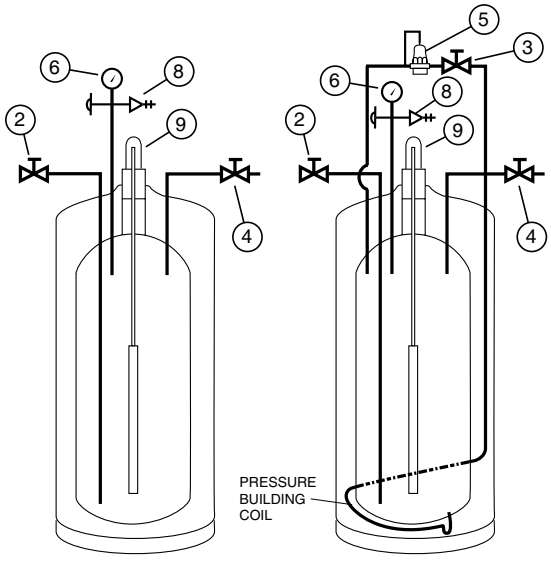


Figure C

Cryo-Cyl LP **Cryo-Cyl LP/ with PB Option**

Item **Plumbing Controls and Function**

1. Gas Use Valve – Used for gas withdrawal.
2. Fill / Liquid Valve – Used for filling or liquid withdrawal operations.
3. Pressure Control Valve – Used to isolate (on/off) the pressure control regulator.
4. Vent Valve – Used to vent pressure.
5. Pressure Control Manifold– Used to automatically maintain pressure .
6. Pressure Gauge – Indicates cylinder pressure.
7. Combination Regulator MCR– Used to automatically maintain pressure.
8. Pressure Relief Valve – Used to limit pressure in the liquid cylinders.
9. Liquid Level Gauge – Used to approximate the liquid contents of the liquid cylinder.

Pressure Transfer

Liquid will always flow from a vessel of higher pressure to one with low pressure. This method is commonly used to fill liquid cylinders by connecting a transfer line between the delivery source and the Fill/Liquid valve of the liquid cylinder. The transfer takes place as the vent valve of the liquid cylinder is opened. This allows gas to escape and lowers the pressure in the liquid cylinder. This method should always be used for liquid only vessels such as the Cryo-Cyl LP. Figure D shows the pressure transfer method of filling.

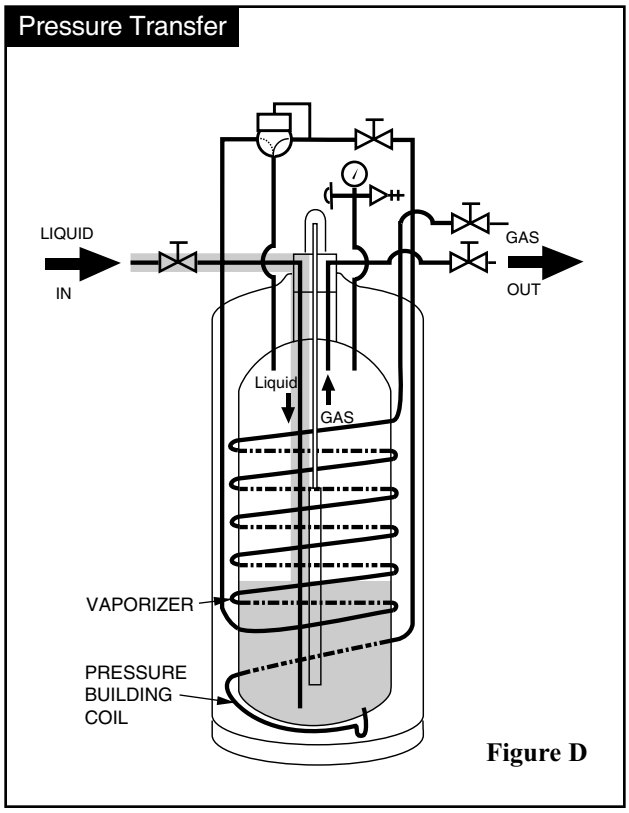


Figure D

Liquid Withdrawal

If the liquid cylinder is to be placed in permanent liquid withdrawal service, it is recommended that the cylinder be refitted with a 22 psig relief valve to minimize loss due to flash-off.

CAUTION! Before making a liquid transfer, be sure that protective eye glasses and gloves are being worn.

To withdraw liquid from a liquid cylinder, connect a transfer line from the liquid valve fitting to the user's receiving vessel (Figure E). Open the liquid valve to obtain the preferred rate of flow. Close the liquid valve when the user's vessel has been filled. To prevent contamination, when the cylinder has been emptied, all valves should be closed. To minimize flash-off and spillage, use a phase separator on the end of the transfer line. Normal liquid withdrawal operations are performed at lower pressure (approximately 22 psig) to reduce flash-off losses and splashing. For this reason, the pressure building valve is customarily closed during liquid withdrawals. Transfer of liquid at higher pressures can lead to excessive splashing of the cryogenic liquid which could result in burns to the operator and/or nearby personnel. All personnel should be fully instructed in the cautions associated with handling cryogenic fluids and the proper clothing and protective gear to be used.

If a higher operating pressure is desired (other than that available through normal heat leak), the pressure building valve may be opened for a short time until the preferred pressure has been obtained. If automatic pressure building for liquid service is necessary, a low pressure building regulator may be installed to replace the pressure building regulator supplied with the unit.

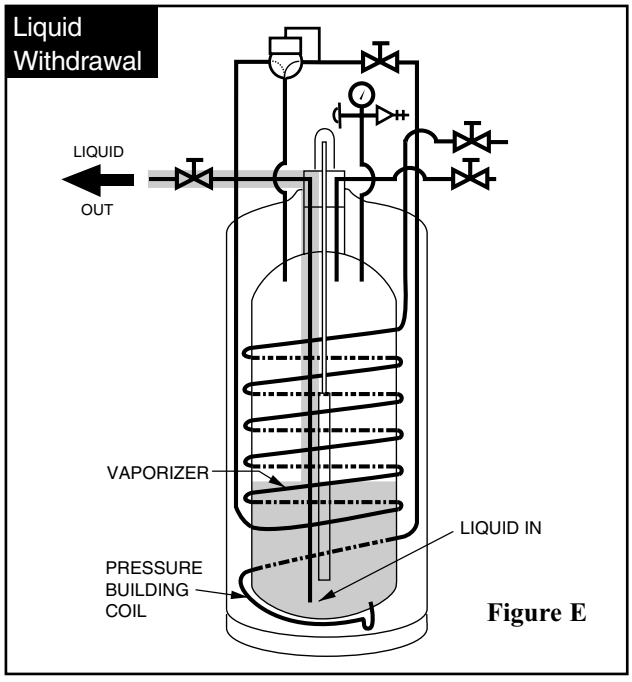


Figure E

Operation

The Cryo-Cyl 180 LP cryogenic liquid cylinders have been designed to transport, store and dispense liquid oxygen, nitrogen or argon in their liquid states only. Liquid product is generally used at ambient or very low pressures. The Cryo-Cyl LP has a working pressure of 22 psig (1.5 BAR) to allow for transfer into vented cryogenic dewars or equipment. The pressure is maintained in the liquid cylinder through its normal heat leak of the cylinder. The pressure will rise in the closed cylinder as its liquid contents boil off. It is normal for the pressure to reach the relief valve setting of 22 psi (1.5 BAR) and vent slowly into the atmosphere. The transportation of the cryogenic products in these liquid cylinders is not regulated by the DOT/TC since the pressure is normally below 25 psi (1.7 bar).

Pressure Building (Option)

The Cryo-Cyl LP is equipped with an internal pressure building coil and plumbing stubs for the optional PB valve and regulator. The following procedure should be used for maintaining pressure during liquid withdrawal if the pressure building option is part of the Cryo-Cyl LP cylinder.

1. Open the PB isolation valve (Item 3) prior to liquid withdrawal.
2. Allow the pressure to rise in the cylinder until the regulator shuts off the PB circuit.
3. Transfer liquid as described in this operational sheet.
4. Close the PB valve when liquid transfer is complete.

Filling Procedures

The Cryo-Cyl LP is equipped with a Liquid and Vent valve that are used for filling. Use a pressure transfer fill as the proper filling method for this style of cylinder. The delivery tank pressure should be as low as practical for the transfer to be efficient. Use the following procedure.

CAUTION! Before making a liquid transfer be sure that protective eyeglasses and gloves are being worn.

1. Sample the residual gas that is in the cylinder. Purge the cylinder if necessary to insure the proper purity.
2. Place the cylinder on the filling scale. Record the weight. Compare this weight to the registered tare weight on the data plate. The difference is the weight of the residual gas.
3. Connect the transfer hose to the fill valve (Item 1). Record the new weight. The difference between this weight and the initial weight is the weight of the transfer hose.
4. To determine the total filling weight add the tare weight of the cylinder, the hose weight and the proper filling weight from the table. The table indicates the product across the top and the liquid cylinder model down the side. Connect the two columns to find the proper weight.

   Example: The Cryo-Cyl 120 LP for oxygen at 22 psi (1.5 BAR) has a product weight of 285 pounds (129 kg).
5. Open the cylinders vent (Item 3) and liquid (Item 1) valves. Open the transfer line shut-off valve to begin the flow of product.
6. When the scale reads the calculated total filling weight, turn off the liquid valve (Item 1) on the cylinder. Close the vent valve (Item 3).
7. Close the transfer line shut-off valve and relieve the pressure in the transfer line. Remove the transfer line. Remove the cylinder from the scale.

CAUTION! The transfer hose will have pressure in it that must be relieved before the hose is completely removed.

Operating Pressure

The liquid cylinder will maintain a normal operating pressure of 22 psig (1.5 BAR). Normal liquid withdrawal operations are performed at lower pressure to reduce flash-off losses and splashing. Transfer of liquid at higher pressures can lead to excessive splashing of the cryogenic liquid which could result in burns to the operator and/or nearby personnel. All personnel should be fully instructed in the cautions associated with handling cryogenic fluids and the proper clothing and protective gear to be used.

Liquid Withdrawal

Cryogenic liquid can be pressure transferred from the liquid cylinder to other cryogenic equipment that operates at a lower pressure than the liquid cylinder. To make a liquid transfer, follow this procedure:

CAUTION! Before making a liquid transfer, be sure that protective eyeglasses and gloves are being worn. If the transfer is being made to an open top vessel, the transfer pressure should be as low as possible and a phase separator should be used to eliminate splashing and hose whip.

1. Connect the transfer hose to the liquid valve (Item 1) of the cylinder.
2. Connect or place the other end of the hose onto the inlet of the cryogenic equipment that will receive liquid. Atmospheric dewars are filled with a phase separator mounted to the open end of the hose.
3. Refer to the receiving equipment manual for procedures to open the fill valve and vent valve of the receiving equipment.
4. Open the liquid valve (Item 1) on the liquid cylinder. This valve can be adjusted to obtain the proper liquid flow rate.
5. When the transfer is complete, close the receiving equipment's valve. Close the liquid valve (Item 1) on the cylinder and relieve pressure from the hose.
6. Disconnect or remove the hose from the receiving equipment.

Filling Weight Table

MODEL*	**Cryo-Cyl 180LP**
NITROGEN	327 lbs. (148 kg)
OXYGEN	465 lbs. (211 kg)
ARGON	573 lbs. (260 kg)

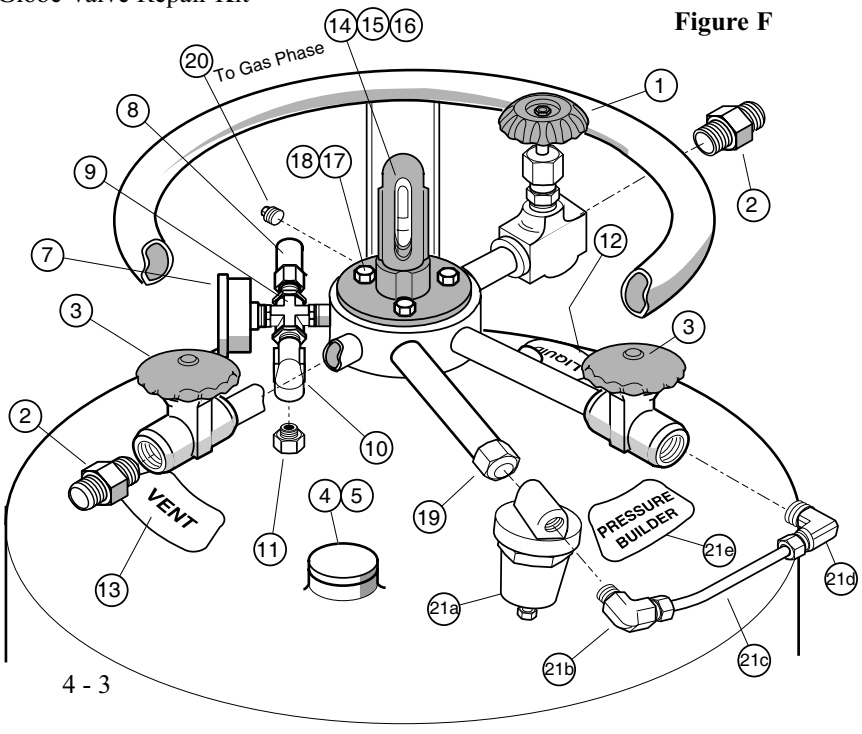
Note: Filling weights are shown as the maximum weight recommended by code. Their related volumes may vary with product density.

* *Relief valve setting at 22 psig (1.5 BAR)*

Item	Part No	Qty	Spares *	Description
1	10552618	1		Globe Valve - 3/8" FPT (Liquid) (Blue)
2	11-1007-2	2	1	Male Connector – 1/2" ODT X 3/8" MPT (Argon or Nitrogen)
2	11-1011-2	2	1	Male Connector – 5/8" ODT X 3/8" MPT (Oxygen)
3	17-1001-2	2		Globe Valve – 3/8" FPT (Vent) (P.B.)
4	39-1066-6	1		Dust Cap (Vacuum Rupture Disc)
5	38-1494-5	1		Warranty Seal
7	20-1516-9	1	1	Pressure Gauge (0-100 psi)
8	18-1001-2	1	1	Relief Valve (22 psi)
9	12-1292-2	1		Cross – 1/4" FPT
10	12-1046-2	1		Street Elbow – 1/4" MPT
11	19-1162-2	1	1	Rupture Disc (200 psi)
12	38-3059-9	1		Decal (Liquid/Fill)
13	38-3061-9	1		Decal (Vent)
14	–	1	1	Level Gauge (see pg 6-3)
15	23-0009-4	1	1	O-ring (silicon)
16	54-1048-6	1	1	Level Gauge Protector (Yellow)
17	29-1050-1	3		Bolt – 1/4-20 X 5/8" Lg. (S.S.)
18	29-1060-1	3		Lockwasher – 1/4" (S.S.)"
19	12-1075-2	1		Brass Cap – 1/4” FPT
20	12-1081-2	1		Brass Plug – 1/4” MPT
21	10658826	–		Pressure Building Regulator Kit (OPTIONAL)
21a	10582809	1		Pressure Building Regulator-
21b	1011432	1		Male Elbow - 3/8” OD x 1/4” MPT
21c	8512163	1		Copper Tubing - 3/8” ODT-5”
21d	1011442	1		Male Elbow - 3/8” OD x 3/8” MPT
21e	3830589	1		Decal (Pressure Builder)
	9715759		1	Globe Valve Repair Kit

** Recommended spare parts*

Figure F



Troubleshooting

The troubleshooting section of this manual deals with the normal operating conditions and the problems that may occur with the Cryo-Cyl Series liquid cylinders. The troubleshooting guide assumes that the tank is in its normal operating environment having a cooled down inner vessel and a reasonable vacuum. Before troubleshooting an operational problem, the liquid cylinder should be examined for vacuum.

Loss of Vacuum

The loss of vacuum on a liquid cylinder is usually associated with excessive cylinder frosting or rapid pressure rise. Excessive pressure rise, however, can be normal. A new liquid cylinder or one that has not been used recently is considered to have a warm inner vessel. Warm cylinders will build pressure fast after filling and vent off the excess. A liquid cylinder that has been filled and not used will build pressure and vent the excess off. The higher the pressure was in the storage tank at the time of filling the faster the liquid cylinder will vent off.

Excessive pressure rise can also be an indication of vacuum loss. The Cryo-Cyl Series liquid cylinders are equipped with a outer jacket rupture disc that will reverse and tear if there is a loss of vacuum. The rupture disc is protected from the environment and tampering by a metal “Warranty Seal”. DO NOT REMOVE the metal warranty seal. If the rupture disc has blown the warranty seal will pop off. The rupture of the disc indicates an inner vessel leak. Return the liquid cylinder to the factory for repair. If the rupture disc is intact and a vacuum loss is still suspected, perform an evaporative loss rate test.

Problem	Problem Cause	Corrective Action
Liquid cylinder builds excessive pressure or builds pressure too fast.	Low usage.	If daily gas usage is under 100 SCF (2.8 NM3), the cylinder will build pressure. In liquid service, the cylinder should be equipped with low pressure relief valve and regulator. Normal pressure rise should not be more than 50 psi (3.4 BAR)per day.
	Cylinder is over filled.	If the cylinder is filled past the vent trycock or past the DOT specified fill weight, the pressure may rise rapidly after a fill.
	Pressure building regulator is set improperly or leaks.	If the pressure builds and stays at a pressure higher than desired, adjust the pressure building regulator to a new setting
		If the pressure builds to the relief valve setting and the P. B. coil near the bottom of the tank is cold or frosted, replace the regulator.
	Vacuum is deteriorating.	This can be accompanied by cold or frost occurring evenly over the cylinder surface. Refer to the trouble-shooting section on frost.
Liquid cylinder pressure is too low.	Pressure builder valve is closed.	Open Valve.
	Pressure building regulator is set too low.	Adjust the regulator as described in Section 16, page 60 (For gas service)
	Pressure building regulator is not opening properly.	Bench test the regulator for full flow at the set pressure as described in Service and Maintenance.
	Usage is too high.	Refer to Specifications for maximum recommended delivery rates; or to Performance for pressure building capacities.
	Cylinder is leaking.	Check for frost on lines or on top of head. Listen for hissing, soap test joints for leaks. Isolate leak and call MVE for repair details.
Frost occurs around the circumference of the shell 4" to 8" (10.2 to 20.4 cm) from the floor.	Cylinder is building pressure with the pressure building circuit.	This is normal if the cylinder pressure is lower than the pressure building regulator setting.
	Frost is residual from last fill or earlier use.	This is normal. A ring of ice or an oval shaped ice ball often remains on the cylinder for days after the last use or fill.
Frost occurs around the circumference of the shell 10" (25.4 cm)from the floor and up. Frost spot spirals up the shell.	Cylinder is vaporizing liquid into gas.	This is normal. The frost should melt within two hours after the gas use stops

(continued on next page)

Problem	Problem Cause	Corrective Action
Frost occurs on head or knuckle.	Residual frost remains from last fill or recent product use.	This is normal. Ice may remain for days after a fill or heavy use.
	Sight gauge is leaking.	Check for gas escaping from under sight gauge. Refer to Service and Maintenance for repair.
Frost occurs evenly over the cylinder surface.	The gas withdrawal rate is high. Both the P. B. and gas use vaporizers are frosted.	This is normal.
	Cylinder has lost vacuum.	This is accompanied by high rate of pressure rise or high loss rate. Call MVE for return instructions.
Miscellaneous frost spots on cylinders.	Cylinder may have internal damage.	Call MVE for evaluation or repair/return information.
Delivery gas is too cold.	Delivery rate exceeds recommended delivery.	Refer to Theory of Operation for recommended maximum delivery rates.
In liquid delivery, liquid is mixed with high amount of gas.	Cylinder pressure is higher than optimum for liquid withdrawal.	Refer to Service and Maintenance for instructions on resetting the cylinder pressure for liquid use. Also, use a phase separator on the end of the transfer hose.
In CO_2 service, cylinder does not deliver product properly.	Possible dry ice blocks have formed in system.	Refer to Reliquefying Solid CO2 procedures following.

For further information contact Chart's Technical Service Department at (800) 400-4683.

Service and Maintenance

General

This section contains the information regarding the liquid cylinder care and maintenance. It includes the particular maintenance procedures for changes to the operating pressure, service pressure and liquid service changes. When performing a procedure that is described in this section, refer to the Operation section for a components item number and location.

Safety

Before implementing any procedure described in this section, it is recommended that the Safety section and Product Safety Bulletins be read and fully understood.

Cleaning

Always keep cylinders clean and free from grease and oil.

When repairing containers, use only parts which are considered compatible with liquid to be used and which have been properly cleaned for this specific liquid service. Do not use regulators, fittings, or hoses which were previous used in a compressed air service. Use only compatible sealants or Teflon tape on the threaded fittings. All new joints should be leak tested with an specifically compatible leak test solution.

CAUTION! Before conducting maintenance or replacing parts on a cylinder, release container pressure in a safe manner. Replacement of certain cylinder parts may also require that the container contents be completely emptied.

Changing Service

The Cryo-Cyl Series liquid cylinders are designed to hold any of the gas products specified. They can easily be modified to work as well with nitrogen as oxygen. The fittings and decals need to be changed and the inner vessel needs to be purged.

If a cylinder is changed from inert (argon or nitrogen) to CO2 service, the relief valve must be changed to a CO2 relief valve.

WARNING: Once a cylinder is used in CO2 service, it can not be used for other gas products, especially oxygen or nitrous oxide.

WARNING: Whenever converting a Nitrogen or Argon cylinder to Oxygen use, inspect the cylinder to assure cleanliness.

Recommended Inner Vessel Purging (with a Vacuum Pump)

Before any operation that involves pressure or handling of a cryogenic fluid, be sure that all safety precautions are taken.

1. Open the vent to remove any pressure that has built in the inner vessel.
2. Open the pressure building valve to boil away any cryogenic liquid that remains in the vessel.
3. Warm the inner vessel with warm nitrogen gas through the liquid valve. Check the gas temperature as it escapes through the open vent valve. Continue until it is warm.
4. Close the liquid valve, gas use and pressure building valves.
5. Attach a vacuum pump to the vent valve and evacuate the inner vessel to 26 inches of mercury.
6. Break the vacuum to 5 psig (0.3 bar) with high purity gas as required by the service of the container.
7. Repeat steps 6 and 7 twice.
8. Close all valves and remove the vacuum and gas purge lines. The container is now ready for filling.

Fittings and Decals

It is very important that the proper fittings for the specific gas product being transported are installed on the liquid cylinder. The Compressed Gas Association regulates the fitting design so that equipment compatibility is based on gas product. This keeps from having a nitrogen tank attached to a hospital's oxygen supply. DO NOT use fitting adapters. The proper fittings are shown in the Operation section parts lists.
The decals should be placed on the tank as shown in Figure Y. The decal's part numbers are shown with the illustration. The sight gauge decal (shown in Figure DD) should be located so that the bottom of the decal lines up with the ridge on the sight gauge tube.

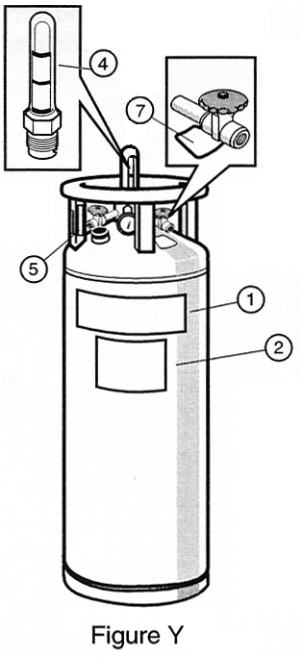


Figure Y

Decals and Labels

Part #	Desc.
Item 1	**Data Plate**
10662892	Cryo-Cyl 180LP
Item 2	**Label**
10580264	Argon
10580272	Oxygen
10580281	Nitrogen
10591140	Carbon Dioxide
10591131	Nitrous Oxide
Item 4	(See Liquid Gauge Chart)
Item 5	(See Data Plate)
Item 6	**Valve Tag**
38-1159-9	Gas Use
38-1158-9	Liquid Use
38-1160-9	Vent
38-1502-9	Vent/Gas Use
Item 7	**Decal**
38-3058-9	Pressure Building
38-3059-9	Liquid
38-3060-9	Gas Use
38-3061-9	Vent

Changing The Service Pressure

The inner pressure vessels used in the Cryo-Cyl Series liquid cylinders are designed and rated to a maximum operating pressure by the DOT. All of the vessels have been proof tested for that rating. The maximum pressure rating is shown in Specifications, and on the liquid cylinders data plate. DO NOT install a relief valve with a higher pressure than specified. Lower pressures are commonly used for limiting the maximum pressure of the liquid.

The relief valve can be changed in the following manner:

1. Open the vent valve and release all pressure from the vessel. If the liquid cylinder is in CO_2 service the vessel must be emptied of product.
2. Remove the relief valve. DO NOT attempt to repair or reset the relief valve.
3. Remove the metal identification tag.
4. Install the new identification tag and relief valve; use oxygen compatible thread sealant or teflon tape.
5. Pressurize the container and leak test with oxygen compatible snoop solution.

Changing Operating Pressure

The Cryo-Cyl Series containers have preset operating pressures and preset pressure building and economizer regulators. These settings can be changed using the procedures that follow.

Cryo-Cyl in Liquid Service

When a container is dedicated to a liquid dispensing service, change the operating pressure as follows.

1. Release pressure in the container by opening the vent valve.
2. Isolate the pressure control regulator by turning off the pressure builder valve. The heat leak of the liquid cylinder will be enough to maintain the pressure at 22 psig (1.5 BAR).
3. Replace standard pressure relief valve with one to maintain the desired operation pressure (22 psig is normal). Use an oxygen compatible liquid thread sealant (or Teflon tape) to prevent leaking.
4. Pressure test all new joints using an oxygen compatible leak test solution.

Bench Setting a Pressure Control Regulator

1. Connect the pressure control regulator to a nitrogen pressure source as shown in Figure G.
2. Connect economizer out port to tee on PB outside of regulator with a piece of tubing.
3. Close valve B.
4. Open the pressure source valve (follow appropriate safety rules.)
5. Open valve C slowly.

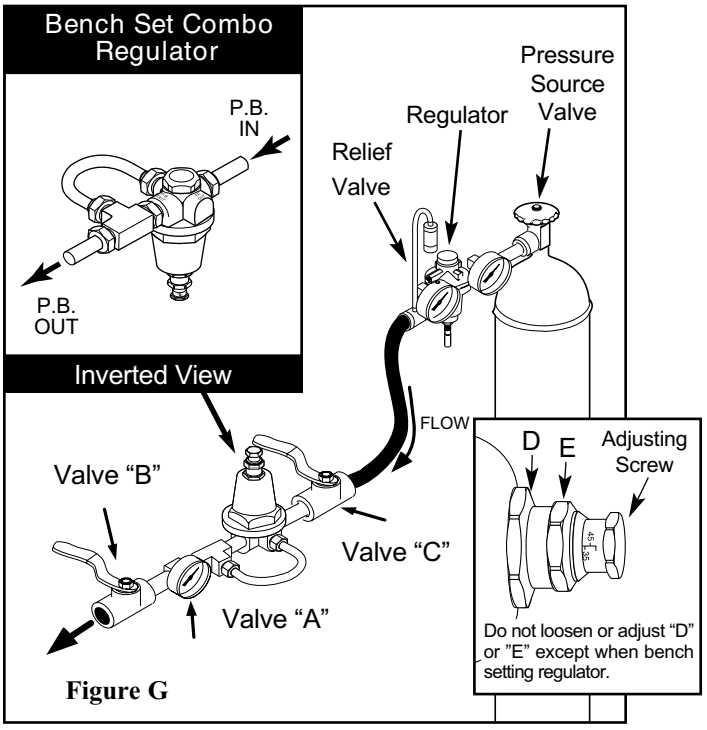


Figure G

6. Pressure gauge A will indicate the pressure to which the regulator has been set. The pressure can be increased by turning the adjusting screw in. The pressure may be decreased by turning the screw out; however, after each adjustment outward it will be necessary to open and then close valve B to relieve excess pressure.
7. This setting should match the calibrated scale. If it does not, go to step #8.
8. Loosen lock nut “D” and adjust screw “E” until calibrated scale matches set pressure. When completed, tighten locknut “D”. “D” and “E” are only to be loosened or adjusted during bench setting procedure.

Note: Factory Setting …… 300 psi

Level Gauge

The liquid level gauge in the Cryo-Cyl LP model is a float and spring that approximates the amount of product in the container. The design of this gauge makes it possible to use the same float and spring for nitrogen, oxygen and argon. However, the liquid level decal must be changed for each product. The decals are marked N for nitrogen, O for oxygen, and A for argon.

If the gauge is malfunctioning, it should be removed from the container and repaired. The following procedure should be followed (see Figure H):

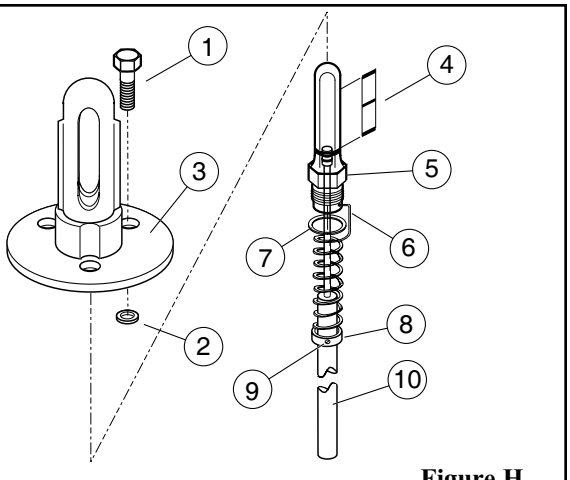


Figure H

1. Open the vent valve and release any pressure that is in the container.
2. Remove the nylon sight gauge protector (Item 3).
3. Unscrew and remove the sight gauge (Item 5).
4. Replace any damaged parts, stretched springs or bent floats.
5. Adjust the sight gauge assembly as follows:
   a. Hold the sight gauge assembly allowing the float to hang freely.
   b. The top of the indicator's white tip should be in the empty zone.
   c. Loosen the spring retainer (Item 8) and adjust the spring up and down the float rod until the indicator hangs freely in the right location. Tighten the spring retainer.
   d. Replace the O-Ring/Gasket (Item 7).
   e. Insert the float and sight gauge assembly into the container. Make sure that it engages in the float guide located approximately 21 inches into the container.
   f. Tighten the sight gauge to 1/4 turn past hand-tight (150in/lb) and replace the protector.

WARNING! Remove all pressure from the Cryo-Cyl before repairing the liquid level gauge. Gloves should be worn when handling the float rod to prevent burns.

WARNING: DO NOT clean the plastic sight gauge with solvent cleaners.

Parts

1) 29-1050-1	3	Stainless Steel Screw - 1/4'-20NC X 5/8"
2) 29-1060-1	3	Lockwasher – 1/4" Split Type S.S.
3) 54-1048-6	1	Sight Gauge Protector – Sight Glass (Yellow) (LP)
4) 38-3065-9	1	Sight Gauge Decal (Nitrogen)
5) 54-1108-6	1	Liquid Level Sight Gauge
6) 54-1059-1	1	Extension Spring
7) 23-0009-4	1	O-Ring (Silicone)
8) 10561266	1	Spring Retainer - 180 and 200 w/ Sight Glass
9) 29-5232-1	1	Set Screw
10) 54-1136-9	1	Float Rod Assy - Cryo-Cyl 180LP w/ Sight Glass

Rebuilding the Operational Valves

The valves that are used on the Cryo-Cyl models have a spring loaded rotary stem. This automatically compensates for thermal shrinkage and wear.

When a defective valve is suspected, follow this procedure to repair it.

Disassembly and Repair Procedure

Caution! To avoid binding due to freezing at cryogenic temperatures, entry of moisture into the upper valve stem area must be prevented. Seals, gaskets and washers must be in good condition and installed carefully and properly. Torque recommendations must be strictly followed.

Disassembly

1. Referring to Figure I, open valve by turning handwheel counterclockwise as far as it will go to release any trapped gas in the system.

CAUTION: Do not apply force after valve is fully open.

2. Using a screwdriver, remove handwheel screw and washer (Items 3 & 14) by turning counterclockwise to allow removal of spring retainer, washer, spring, seal washer, seal, handwheel, and bonnet washers (Items 2, 8,4, 13,10,1 and 7). Discard these parts.
3. Using a large adjustable wrench to hold valve body, remove and discard bonnet (Item 5) by turning counterclockwise with a 15/16" socket wrench that is capable of developing at least 1000 in/lbs. torque.
4. Remove these parts from the valve body and discard: stem, stem gasket, seat disc and nipple assembly, and bushing.
5. Inspect body and clean if necessary, be sure interior and seal areas are free of dirt, residue, and foreign particles.

CAUTION! Do not scratch or mar internal surfaces of valve.

Reassembly

1. Partially thread seat disc and nipple assembly (Item 12) (seat disc first), into large end of bushing (Item 9), leaving tang of nipple assembly exposed about 1/3" beyond top of bushing (nipple must rotate freely in bushing).
2. Insert seat disc and nipple assembly (Item 12) (seat disc first), with attached bushing, into valve body until properly seated.
3. Place stem gasket (Item 15) carefully over stem (Item 6) convex side facing downward.
4. Insert slotted end of stem into valve body, making sure that slot fully engages tang of seat disc and nipple assembly.
5. Place bonnet (Item 5) over stem and, while holding square end of stem to keep it from turning, thread bonnet into valve body. Hold body with one wrench and, using another wrench (15/16 socket), tighten bonnet to 1000 in/lbs. torque.

CAUTION! Hex section of bonnet (Item 5) must be free of burrs or raised edges and top of bonnet must be absolutely flat to provide an effective seal with bonnet gasket washer (Item 7).

6. Install bonnet washer (Item 7) over stem (Item 6) on bonnet.

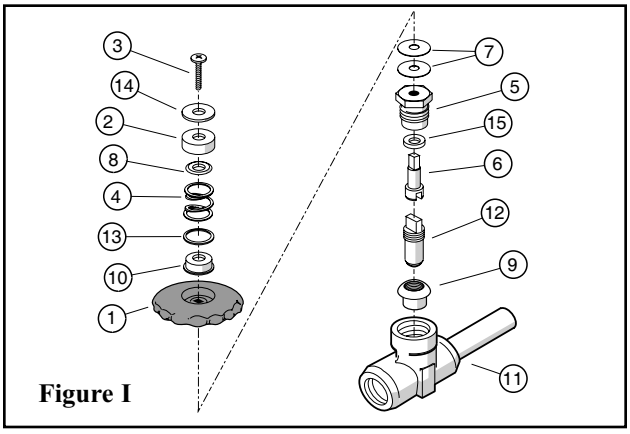


Figure I

Item	Description	Qty	Part Number
1	Handwheel	1	Included in Valve Repair Kit P/N 97-1575-9 (Except Item 11 which is not available as a repair part).
2	Spring Retainer	1	
3	Screw	1	
4	Spring	1	
5	Bonnet	1	
6	Stem	1	
7	Bonnet Washer	2	
8	Washer	1	
9	Bushing	1	
10	Seal	1	
11	Body and Tube	1	
12	Seat Disc & Nipple Asm	1	
13	Seal Washer	1	
14	Washer	1	
15	Gasket	1	

7. Place handwheel (Item 1) over stem and on bonnet.
8. Install seal (Item 10) over stem into recess of handwheel.
9. Install seal washer (Item 13) over seal at the bottom of handwheel recess as shown.
10. With the flat side facing downward, place retainer washer (Item 8) on top of seal.
11. Align the holes of these parts and place spring (Item 4) over seal.
12. Place spring retainer over assembly as shown, keeping center hole aligned with parts installed in steps 6-11.
13. Install washer and screw (Items 3 & 14) over retainer. Tighten firmly with a screwdriver, turning clockwise.
14. Turn handwheel (Item 1) fully clockwise to close valve.
15. Pressurize system, check valve for proper operation and check all seal points for leaks by inspecting thoroughly.

Safety Bulletin

General

Cryogenic containers, stationary or portable, are from time to time subjected to assorted environmental conditions of an unforeseen nature. This safety bulletin is intended to call attention to the fact that whenever a cryogenic container is involved in any incident whereby the container or its safety devices are damaged, good safety practices must be followed. The same holds true whenever the integrity or function of a container is suspected of abnormal operation.

Good safety practices dictate that the contents of a damaged or suspect container be carefully emptied as soon as possible. Under no circumstances should a damaged container be left with product in it for an extended period of time. Further, a damaged or suspect container should not be refilled unless the unit has been repaired and recertified.

Incidents which require that such practices be followed include: Highway accidents, immersion of a container in water, exposure to extreme heat or fire, and exposure to most adverse weather conditions (earthquakes, tornados, etc.). As a rule of thumb, whenever a container is suspected of abnormal operation, or has sustained actual damage, good safety practices must be followed.

In the event of known or suspected container vacuum problems (even if an extraordinary circumstance such as those noted above has not occurred), do not continue to use the unit. Continued use of a cryogenic container that has a vacuum problem can lead to possible embrittlement and cracking. Further, the carbon steel jacket could possible rupture if the unit is exposed to inordinate stress conditions caused by an internal liquid leak.

Prior to reusing a damaged container, the unit must be tested, evaluated, and repaired as necessary. It is highly recommended that any damaged container be returned to MVE, Inc. for repair and recertification. The remainder of this safety bulletin addresses those adverse environments that may be encountered when a cryogenic container has been severely damaged. These are oxygen deficient atmospheres, oxygen enriched atmospheres, and exposure to inert gases.

Oxygen Deficient Atmospheres

The normal oxygen content of the air is approximately 21%. Depletion of oxygen content in air, either by combustion or by displacement by 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 fuel for heat or light, may be extinguished. Somewhat below this concentration, an individual breathing the air is mentally incapable of diagnosing the situation because the onset of symptoms such as sleepiness, fatigue, lassitude, loss of coordination, errors in judgment and confusion can be masked by a state of “euphoria”, leaving the victim with a false sense of security and well-being.

Human exposure to atmospheres containing 12% or less oxygen leads to rapid unconsciousness.
Unconsciousness can occur rapidly, rendering the user essentially helpless. This can occur if the condition is reached by an immediate change of environment, or through the gradual depletion of oxygen. Most individuals working in or around oxygen deficient atmospheres rely on the “buddy system” for protection – obviously, the “buddy” is equally susceptible to asphyxiation if he or she enters the area to assist an unconscious partner unless equipped with a portable air supply. Best protection is obtained by equipping all individuals with a portable supply of respirable air. Life lines are acceptable only if the area is essentially free of obstructions and individuals can assist one another without constraint.

If an oxygen deficient atmosphere is suspected or known to exist:

1. Use the “buddy system”. Use more than one “buddy” if necessary to move a fellow worker in an emergency.
2. Both the worker and the “buddy system” should be equipped with self-contained or air-line breathing equipment.

Nitrogen

Nitrogen (inert gas) is a simple asphyxiant.
This gas will neither support nor sustain life and can produce immediate hazardous conditions through the displacement of oxygen. Under high pressure these gases may produce narcosis, even though an adequate oxygen supply sufficient for life is present.

Nitrogen vapors in air dilute the concentration of oxygen necessary to support or sustain life. Inhalation of high concentrations of these gases can cause anoxia, resulting in dizziness, nausea, vomiting, or unconsciousness and possible death. Individuals should be prohibited from entering areas where the oxygen content is less than 19% unless equipped with a self-contained breathing apparatus. Unconsciousness and death may occur with virtually no warning if the oxygen concentration is below approximately 8%. Contact with cold nitrogen or argon liquid can cause cryogenic (extreme low temperature) burns and freeze body tissue.

Persons suffering from lack of oxygen should be immediately moved to areas with normal atmospheres.
Self-contained breathing apparatus may be required to prevent asphyxiation of rescue workers. Assisted respiration and supplemental oxygen should be given if the victim is not breathing. If cryogenic liquid or cold boil-off gas contacts the skin or eyes, the affected area should be promptly flooded or soaked with tepid water (105-115ÞF; 41-46Þ C). Do not use hot water. Cryogenic burns which result in blistering or deeper tissue freezing should be examined promptly by a physician.

Additional information on nitrogen gas is available in CGA Pamphlet P-9.
Write to:
Compressed Gas Association, Inc
New York, NY 10110.

THERMO FISHER SCIENTIFIC STANDARD PRODUCT WARRANTY

(LN_2 Vacuum)

The Warranty Period starts two weeks from the date your equipment is shipped from our facility. This allows for shipping time so the warranty will go into effect at approximately the same time your equipment is delivered. The warranty protection extends to any subsequent owner during the first year warranty period.

During the first year, component parts proven to be non-conforming in materials or workmanship will be repaired or replaced at Thermo's expense, labor included. *LN_2 Vacuum Integrity is covered for two years.* Installation and calibration are not covered by this warranty agreement. The Technical Services Department must be contacted for warranty determination and direction prior to performance of any repairs. Expendable items, glass, filters and gaskets are excluded from this warranty.

Replacement or repair of components parts or equipment under this warranty shall not extend the warranty to either the equipment or to the component part beyond the original warranty period. The Technical Services Department must give prior approval for return of any components or equipment. At Thermo's option, all non-conforming parts must be returned to Thermo postage paid and replacement parts are shipped FOB destination.

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL OR IMPLIED. NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL APPLY. Thermo shall not be liable for any indirect or consequential damages including, without limitation, damages relating to lost profits or loss of products.

Your local Thermo Sales Office is ready to help with comprehensive site preparation information before your equipment arrives. Printed instruction manuals carefully detail equipment installation, operation and preventive maintenance.

If equipment service is required, please call your Technical Services Department at 1-888-213-1790 (USA and Canada) or 1-740-373-4763. We're ready to answer your questions on equipment warranty, operation, maintenance, service and special application. Outside the USA, contact your local distributor for warranty information.

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