Perma-Cyl 450 ZX VHP
Operating Manual

CHART®

TABLE OF CONTENTS

SECTION 1 PREFACE

General

This operating manual describes the specifications, operation and maintenance of the Perma-Cyl 450 ZX model. Included within this manual is information regarding the safe operation and handling of liquid nitrogen, argon, oxygen and carbon dioxide within the cylinder. It should be thoroughly read and understood by anyone that operates the equipment. If there are any questions regarding the operation of the Perma-Cyl 450 ZX, contact Chart Technical Service at:

Chart, Inc.
407 Seventh St. NW
New Prague, MN 56071
(800) 400-4683

This manual is intended to provide the user with all the necessary information needed to install, operate and maintain the Perma-Cyl 450 ZX.

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

Section 2 discusses the general features of the tank and the theory of operation.

The safety requirements for operating the cylinder including the handling and transporting cryogenic products are shown in Section 3. Use this safety section as a “Safety Check-List” each time the equipment is being used.

Section 4 and 5 shows the schematics and specifications for the Perma-Cyl 450 ZX.

Section 6 gives a step by step procedure for the basic operation of the tank.

Section 7 and 8 indicate how to troubleshoot, maintain and repair the cylinder.

Section 9 provides you with an explosive view of each tanks plumbing along with a corresponding parts list.

Terms

Throughout this manual safety precautions will be designated as follows:

WARNING - Description of a condition that can result in personal injury or death.

CAUTION - Description of a condition that can result in equipment or component damage.

NOTE - A statement that contains information that is important enough to emphasize or repeat.

Abbreviations

The following abbreviations and acronyms are used throughout this manual:

CBM	Center Back Mount Gauge
CGA	Compressed Gas Association
FPT	Female Pipe Thread
MPT	Male Pipe Thread
NPT	National Pipe Thread
NR	Not Required
ODT	Outside Diameter Tube Size
PB	Pressure Builder
P/N	Part Number
PPM	Parts per Million
PSI	Pounds per Square Inch
PSIG	Pounds per Square Inch (Gauge)
SCF	Standard Cubic Feet
SCM	Standard Cubic Meters
SS	Stainless Steel
NM^3	Normal Cubic Meters

SECTION 2 INTRODUCTION

Tank Design

The Perma-Cyl 450 ZX cryogenic container is a vacuum insulated cylinder that was designed to furnish liquid and gaseous oxygen, nitrogen, argon or $C0_2$ on a reliable, economical basis. The tank holds 450 liters of cryogenic product. The tank is pressure rated at 500 psig. This 450 liter tank **doesn't** have an internal pressure builder or internal vaporizer.

The insulation system is comprised of multiple layers of foil and paper that are incorporated with a very low vacuum. The vacuum is factory sealed and with the aid of internal molecular sieve it should remain low for the life of the container. This insulation system coupled with design of the support system minimizes the pressure rise when the tank is left idle. If the container is left unused for a period of time the pressure will build to the safety relief valve setting. However, if the container is used in gas withdrawal service after pressure has built, the economizer system will automatically reduce the head pressure in the container without loss of product.

The design and construction of the Perma-Cyl 450 ZX is aimed at building the most durable tank available today. The inner vessel is constructed of stainless steel and designed to the applicable pressure vessel code. The outer container is constructed of stainless steel to make the Perma-Cyl 450 ZX a maintenance free container. The Perma-Cyl 450 ZX is mounted in a Hot Dipped Galvanized carbon steel pallet.

The inner pressure vessel is protected from over-pressurization by a safety relief valve. The Perma-Cyl 450 ZX, the pressure is set at 500 psig with a rupture disc set at 700 psig. The outer container of vacuum space is protected by a reverse buckling rupture disc that is set at a maximum of 25 psig.

System Design

The Perma-Cyl 450ZX is the newest addition to the Perma-Cyl Family of liquid cylinders, designed for high-pressure, high-flow industrial gas applications. With the on-board, heat-exchanger system, the Perma-Cyl 450ZX is rated at a flow rate at of 2000scfh while sustaining 420 to 450 psig. Flows over 2000scfh can be achieved with reduced duty cycles and added vaporization.

The Perma-Cyl 450ZX is contained completely within a 47" deep x 47" wide x 82" High pallet. The pallet system can be moved by fork truck or lifted by the lugs at the top of the pallet. The portable design makes it a quick-response solution for demanding industrial gas applications, such as industrial laser-assist gas.

The piping uses industry proven valves and components. The operation of the system is simple and is modeled after a standard liquid cylinder.

Responsibilities of Distributor and Fillers of Liquid Cylinders

Chart is stating below the responsibilities of the filler for the Perma-Cyl 450ZX.

1. The cylinder must be in safe condition.

The filler is responsible for confirming that the Perma-Cyl 450ZX 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 Perma-Cyl 450ZX is not to be filled beyond the recommended filling limits described in this manual.

3. Dispense only to knowledgeable users.

The filler must determine that the user is knowledgeable about the general characteristics of the product and 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.

We recommend:

1. Purge the cylinder's contents.

2. Drill multiple holes through the cylinder and its vacuum casing or otherwise puncture the tank.

Do it yourself! Don't assume it will be done by the scrap dealer.

SECTION 3 SAFETY

While Chart equipment is designed and built to the most rigid standards, no piece of mechanical equipment can ever be made 100% foolproof. Strict compliance with proper safety and handling practices are necessary when using a cryogenic manifold device of other compressed gas equipment. We recommend that all our customers re-emphasize safety and safe handling practices to all their employees and customers. While every possible safety feature has been designed into the Perma-Cyl 450 ZX and safe operations are anticipated, it is essential that the customer carefully read and fully understand all **WARNING** and **CAUTION** notes listed in the safety summary and enumerated below

WARNING: Excess accumulation of oxygen creates an oxygen enriched atmosphere (define by the Compressed Gas Association as an oxygen concentration above 23 percent). In oxygen enriched atmosphere flammable items burn vigorously and could explode. Certain items considered noncombustible 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 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: Before removing cylinder parts or 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.

CAUTION: Use only replacement equipment, which is compatible with oxygen and has been cleaned for oxygen use. Do not use regulators, fittings, hoses, etc., which have been previously used in a compressed air environment. Similarly, do not use oxygen equipment for compressed air. Failure to comply with these instructions may result in serious damage to the liquid cylinder.

CAUTION: The Perma-Cyl 450ZX should be moved using a fork truck that lifts the cylinders from beneath the pallet. The Perma-Cyl 450ZX must be used and stored in a vertical position. Do not lay, store, or ship a liquid cylinder on its side. Failure to comply with these procedures may result in damage to the liquid cylinder.

Handling the Perma-Cyl 450ZX

The Perma-Cyl 450ZX is mounted on a hot dipped galvanized carbon steel pallet. The preferred handling method is a forklift that lifts the pallet-mounted tank from beneath the pallet. However, overhead lifting by using lugs located on the top of the pallet or on top of the cylinder is permitted. Lifting of the Perma-Cyl 450ZX should be performed only with equipment rated for the weight of the cylinder, pallet and contents combined (see specification section of this manual).

This container should remain upright at all times. Never lay the unit on its side to move or transport it. Careless handling can cause damage to the support system and internal plumbing, which may result in serious personal injury.

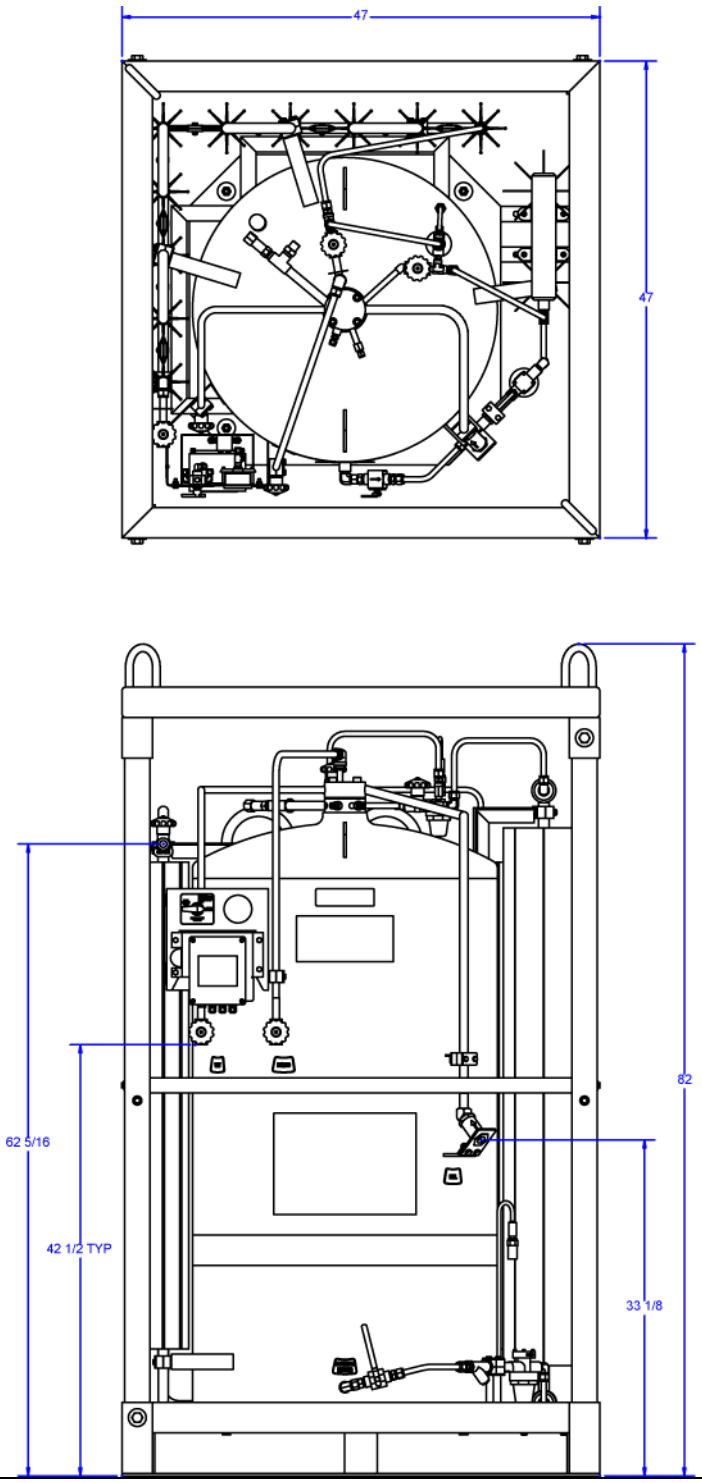
Shipping the Perma-Cyl 450ZX

The transportation of the Perma-Cyl 450ZX is permitted at pressures up to the relief valve setting. The inner vessel is coded per DOT 4L.

The transportation of the Perma-Cyl 450ZX is permitted at pressures less than 25.3 psig. The inner vessels of these models are coded per ASME.

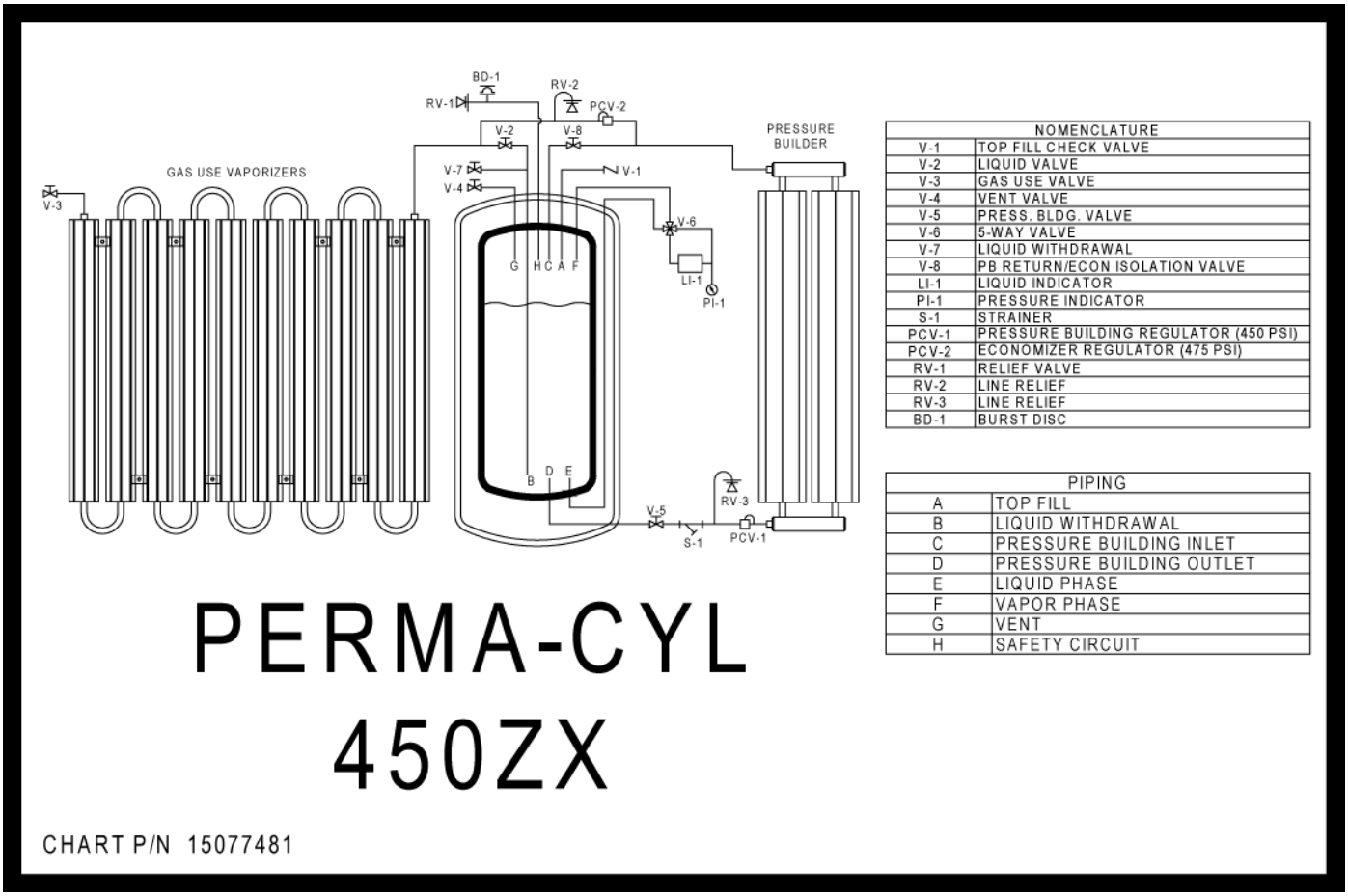
SECTION 4 GENERAL ARRANGEMENT and FLOW SCHEMATICS

Pallet and Vessel Dimensional Drawing - Perma-Cyl 450ZX



Dimensions (cylinder)	
Diameter inches (cm)	30 (76.2)
Height inches (cm)	61.3 (155.7)
Dimensions (frame)	
Height inches (cm)	82 (208.3)
Base Width inches (cm)	47 (119.38)
Base Depth inches (cm)	47 (119.38)
Weights (overall)	
Tare lbs (kg)	1450 (660)
Full Nitrogen lbs (kg)	2253 (1024)
Full Oxygen lbs (kg)	2583 (1174)
Full Argon lbs (kg)	2834 (1288)

Flow Diagram Perma-Cyl 450ZX



NOMENCLATURE	
V-1	TOP FILL CHECK VALVE
V-2	LIQUID VALVE
V-3	GAS USE VALVE
V-4	VENT VALVE
V-5	PRESS. BLDG. VALVE
V-6	5-WAY VALVE
V-7	LIQUID WITHDRAWAL
V-8	PB RETURN/ECON ISOLATION VALVE
LI-1	LIQUID INDICATOR
PI-1	PRESSURE INDICATOR
S-1	STRAINER
PCV-1	PRESSURE BUILDING REGULATOR (450 PSI)
PCV-2	ECONOMIZER REGULATOR (475 PSI)
RV-1	RELIEF VALVE
RV-2	LINE RELIEF
RV-3	LINE RELIEF
BD-1	BURST DISC

PIPING	
A	TOP FILL
B	LIQUID WITHDRAWAL
C	PRESSURE BUILDING INLET
D	PRESSURE BUILDING OUTLET
E	LIQUID PHASE
F	VAPOR PHASE
G	VENT
H	SAFETY CIRCUIT

Controls and Function

#	Plumbing Controls & Function	#	Plumbing Controls & Function
V-1	Fill/Liquid Valve - Used for filling or liquid withdrawal operations.	RV-2	Line Safety – Protects over pressurizing between the PB feed valve and PB regulators.
V-2	Liquid Use Valve - Use for Liquid withdrawal.	PI-1	Pressure Gauge - Indicates cylinder pressure.
V-3	Gas Use Valve - Use for gas withdrawal.	LI-1	Liquid Level Gauge – Indicates cylinder liquid level based on differential pressure within the cylinder.
V-4	Vent Valve - Used to vent pressure.	BD-1	Burst Disc - Secondary relief device.
V-5	Pressure Building Valve - Isolates the pressure building system.	PCV-1	Pressure building Regulators - Used to automatically build as required.
RV-1	Safety Relief Valve - Primary relief device.	PCV-2	Economizer Regulator - Used to automatically reduce pressure as required.

SECTION 5 SPECIFICATIONS

Model

Size 450 liters
Pressure VHP (500 psi MAWP)
Part Number - *14906137*

Capacity

Liquid (Gross) (liters) 450
Liquid (Net)** (liters) 420
Gas (N) ft 3 /Nm 3 7922/ 208.2
Gas (O2) ft 3 /Nm 3 10,519/ 276.4
Gas (Arg) ft 3 /Nm 3 10,241/ 269.1
Gas (CO2) ft 3 /Nm 3 7960/ 209.2
Gas (N2O) ft 3 /Nm 3 7516/ 197.5

Performance

NER (N) % per day 2.0
NER (O2 or Arg) % per day 1.25
NER (CO2 or N2O) % per day 0.5
Gas Flow (N)* ft 3 /hr / Nm 3 /hr 2000/ 52.6***

Dimensions & Pressure Ratings

Diameter (cylinder) in/ cm 30 /76.2
Height (cylinder) in/ cm 61.3 /155.7
Base Width (frame) in/ cm 34/ 86.4
Base Depth (frame) in/ cm 42/106.7
Base Height (frame) in/ cm 73.8/ 187.5
Tare Weight lb/ kg 1400/ 636**
Relief Valve Setting psig/ bar 500/ 34.5
DOT Rating 4L412
* At 450 psig sustained pressure
** Weights are approximate and vary with pallet design
*** Higher flows can be achieved with reduced duty cycles and/or additional vaporization.

SECTION 6 OPERATIONS

Initial Inspections

When the container is first received it should be inspected for shipping damage. Never fill a damaged container.

The Perma-Cyl 450 ZX is shipped with low purity nitrogen gas in them. For this reason any container that is to be put into oxygen or argon service should be thoroughly purged with the applicable gas.

Purging the Perma-Cyl 450 ZX

Before any operation that involves pressure or handling of cryogenic fluids, be sure that all safety precautions are taken. See Section 3, “Safety” for review.

The Perma-Cyl 450 ZX system is designed to be used for liquid nitrogen, argon or oxygen service. Chart (and the Compressed Gas Association) does not encourage unnecessary and frequent changing of service to the vessel. However, if it is necessary to make a service change, to ensure product purity, or to remove any moisture or foreign material from the tank and tank lines, the Perma-Cyl 450 ZX vessel must be purged.

Note: To prevent drawing atmospheric contaminates back into the tank, a positive pressure of at least 5 PSIG must be maintained in the tank.

CAUTION: While purging through the various lines, observe the tank pressure indicating gauge. Make sure that the pressure does not go below 5 PSIG.

Warning: Protective eyeglasses and gloves must be worn.
Note: Build pressure by repeating steps 1 and 2, when the pressure drops below 20psi.

a. Attach the source of liquid or gas purge product to the Fill line.

b. Open the source tank feed valve and the Perma-Cyl 450 ZX Fill Valve allowing liquid or gas to flow slowly into the tank. Build pressure to over 100 PSI.

c. Close the Perma-Cyl 450 ZX Fill Valve and the close the source tank feed valve. Purge the trapped space by opening the Fill Line Drain.

d. With the Perma-Cyl 450 ZX Fill Valve closed, open the Gas Use Valve (Ref #2). Purge for one minute. Close the Gas Use Valve (Ref #2).

e. With the PB Feed Valve (Ref #3) closed; crack the compression fitting on the downstream side of the PB Feed Valve. Purge for one minute. Tighten the compression fitting.

f. Vent the tank to by opening the Vent Valve (Ref #4). Close the Vent Valve (Ref #4) when the tanks is approximately 20 psig.

g. Repeat steps a through f three times.

h. After purge is complete, check gas in tank for purity. If gas does not meet the purity standard repeat the above procedure.

Purging the Perma-Cyl 450 ZX with a vacuum pump

Before any operation that involves pressure or handling of cryogenic fluids, be sure that all safety precautions are taken. See Section 3, “Safety” for review.

a. Open the vent valve to remove any pressure that has built in the inner vessel.

b. Open the pressure building valve to boil away any cryogenic liquid that remains in the vessel.

c. After the liquid has been boiled away and the outside of the container shows no frost, close the pressure building valve.

d. Warm the inner vessel with warm nitrogen gas through the liquid valve. Check the gas temperature as it escapes through the open vent valve.

e. Close the liquid valve, gas use and pressure building valves.

f. Attach a vacuum pump to the vent valve and evacuate the inner vessel to 26 inches of mercury.

g. Break the vacuum to 5 psig with high purity gas, either nitrogen, argon or oxygen, as required by the service of the container.

h. Repeat steps f and g twice.

i. Close all valves and remove the vacuum and gas purge lines. The container is now ready for filling.

Filling Procedures

The Perma-Cyl 450 ZX may be filled with liquid from a liquid supply unit either by a pumping or a pressure transfer. If internal pressure of the cylinder is at least 20 psi less than the maximum allowable pressure of the delivery unit, liquid may be transferred by a pressure transfer. If the normal working pressure of the cylinder is equal to or greater than the maximum allowable pressure of the supply unit, liquid must be pumped into the tank.

Before filling the cylinder it should be visually inspected for possible damage or unsuitability for intended use. If damage is detected (e.g., serious dents, loose fittings, etc.), remove the unit from service and conduct the necessary repairs as soon as possible.

Filling the Perma-Cyl 450 ZX

The Perma-Cyl 450 ZX is regulated by the US DOT/Transport Canada for transporting liquid oxygen, nitrogen or argon. The filling of these liquid cylinders must be done by product weight. This will allow enough gas space above the liquid to keep the Perma-Cyl 450 ZX from becoming liquid full if its pressure rises to the relief valve setting. The filling weight table indicates the correct product weight for the various relief valve settings. The relief valve setting for the Perma-Cyl 450 ZX is 500 psig. The filling procedure will show the proper way to use the filling weight table.

Filling can be accomplished by either a pressure transfer or pump fill. The following procedure should be used, (Ref. #'s used below correspond with Section 5 schematics).

1. Sample the residual gas that is in the Perma-Cyl 450 ZX. Purge the cylinder if necessary to insure the proper purity.

2. Place the Perma-Cyl 450 ZX 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 liquid valve (Ref. #1). Record the 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 Perma-Cyl 450 ZX, the hose weight and the proper filling weight from the table in this section. The table indicates the product across the top and the relief pressure down the side. Connect the two columns to find the proper weight.

5. Open the cylinders vent (Ref. # 4) and liquid valves (Ref. # 1). 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 (Ref. # 1) on the cylinder. Close the vent valve (Ref. # 4).

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.

Gas Withdrawal

The Perma-Cyl 450 ZX will deliver gas at various flow rates and temperatures for different applications. The flow rate is controlled by the equipment which is being supplied gas from the Perma-Cyl 450 ZX. The continuous flow rate indicates the flow rate that will normally provide gas at a reasonable temperature and should not be exceeded. Higher flow rates may provide very cold gas that could damage the equipment that they are attached to. To supply gaseous product follow this step by step procedure. (Ref. #'s used below correspond with section nomenclature).

- Connect the proper regulator to the liquid cylinders gas use outlet.
- Connect the proper tubing or hose between the final line regulator and the receiving equipment.
- Open the pressure building valve (Ref. # 3).
- Allow pressure (refer to gauge) to build to the operating pressure (450 psig).
- Open the gas use valve (Ref. # 2).
- Adjust the gas use regulator for the proper delivery pressure.
- When the gas delivery is completed, close all valves.

CAUTION: All valves on an empty Perma-Cyl 450 ZX should always be kept closed to protect the inner vessel and plumbing from being contaminated.

The operator should review the safety precautions found in Section 3 "Safety" before conducting a gas or liquid withdrawal operation. Safety glasses and gloves should always be worn.

At flow rates up to 2000scfh (duty cycle dependent) the Perma-Cyl 450 ZX is capable of delivering warm gas through the line regulator. As the flow rate increases the temperature of the gas decreases. If the cold temperature becomes a problem at a desired flow rate, an external vaporizer can be added. Attach this vaporizer directly in series with the gas use connection and place the line regulator at the exit of the vaporizer.

CAUTION: Pressure should be allowed to escape from the transfer hose before it is completely removed. A hose drain and relief valve should be installed in all transfer lines.

Liquid Withdrawal into Liquid Cylinders

The Perma-Cyl 450 ZX can be used to dispense liquid through the Liquid Feed/Withdrawal line. Flow rates of 10-15 gallons/minute can be achieved. Because of the pressure rating of the ZX special caution should be taken when dispensing into cylinders rated at lower pressures.

Fill Procedure

- Vent the receiving tank below the initial pressure of the Perma-Cyl 450 ZX.
- Confirm that the PB Feed Valve on the receiving tank is closed.
- Note the receiving tanks relief valve setting.
- Open the PB Feed Valve on the Perma-Cyl 450 ZX
- If the receiving tanks relief valve setting is less than the Perma-Cyl 450 ZX, close the PB valve at the receiving tanks relief valve setting.
- Attached the transfer hose
- Initiate the transfer of liquid by slowly open the liquid valves.
- Open the vent of the receiving tank to minimize pressure rise.

- If the receiving tanks relief valve setting was less than the ZX, open the PB Feed valve on ZX to maintain pressure at the relief valve.
- When the tank is full, close the Feed/Withdrawal valve on the ZX.
- Crack open the end of the hose to allow the hose to vent and open the receiving tanks liquid valve.

Liquid Withdrawal into Open Dewars

The Perma-Cyl 450 ZX can fill open Dewars. To prevent excessive flashing of liquid, start the delivery with cold liquid.

Fill Procedure

- Vent the Perma-Cyl 450 ZX to less than 20psig.
- Open the PB Feed Valve build pressure to 50psig.
- Connect the transfer hose with the phase separator the Perma-Cyl 450 ZX Liquid Feed/Withdrawal line
- Slowly open the Liquid Feed/Withdrawal line dispensing the liquid into the open dewar.
- Throttle the feed valve to minimize splashing and flashing.
- Close the feed valve when the dewar is full.

Liquid Withdrawal into Perma-Cyl Liquid Cylinders

The Perma-Cyl 450 ZX can be used to dispense liquid into a fill line of the Perma-Cyl (top fill). Flow rates of 10-15 gallons/minute can be achieved. Because of the pressure rating of the ZX special caution should be taken when dispensing into cylinders rated at lower pressures.

Fill Procedure

- Vent the receiving tank below the initial pressure of the Perma-Cyl 450 ZX.
- Confirm that the PB Feed Valve on the receiving tank is closed.
- Note the receiving tanks relief valve setting.
- Open the PB Feed Valve on the Perma-Cyl 450 ZX
- If the receiving tanks relief valve setting is less than the Perma-Cyl 450 ZX, close the PB valve at the receiving tanks relief valve setting.
- Attached the transfer hose to the fill line of the Perma-Cyl.
- Initiate the transfer of liquid, by slowly opening the liquid valve on the ZX.
- Open the vent of the receiving tank **only** if the pressure well above the initial pressure of the ZX.
- If the receiving tanks relief valve setting was less than the ZX, open the PB Feed valve on ZX to maintain pressure at the relief valve.
- A pressure spike or an audible sound (float closing) will occur when the tank is full, close the Feed/Withdrawal valve on the ZX.
- Crack open the end of the hose to allow the hose to vent.
- Remove the hose when the hose has safety vented.

CAUTION: The container can become contaminated once it is emptied, if the liquid and vent valves are not closed.

Fill Weights

The contents of the Perma-Cyl 450 ZX can be determined by means of a differential pressure gauge, calibrated in inches of water column, which is mounted to the left front gauge bracket. The calibration charts on the following pages show contents conversions for O_2, N_2, Arg, CO_2, and N_2O.

Filling Weight Table					
Relief Valve Setting	**Argon**	**Nitrogen**	**Oxygen**	**Carbon Dioxide**	**Nitrous Oxide**
PSIG	**Lbs.**	**Lbs.**	**Lbs.**	**Lbs.**	**Lbs.**
0 to 45	1316	752	1069	__	__
46 to 75	1287	732	1039	__	__
76 to 105	1257	712	1019	1069	1029
106 to 170	1207	693	990	1039	1000
171 to 230	1178	683	970	1029	980
231 to 295	1138	673	950	1009	960
296 to 360	1118	643	921	990	941
361 to 450	1099	603	900	970	920
** 451 to 540	1059	574	871	910	861
BAR	**Kg.**	**Kg.**	**Kg.**	**Kg.**	**Kg.**
0 to 3.1	597	341	485	__	__
3.2 to 5.2	584	332	471	__	__
5.3 to 7.2	570	323	462	485	467
7.3 to 11.7	547	314	449	471	454
11.8 to 15.9	534	310	440	467	444
16.0 to 20.3	516	305	431	458	435
20.4 to 24.1	507	292	417	449	426
24.2 to 31.0	498	273	408	440	417
** 31.1 to 37.2	480	260	395	413	390

NOTE: Filling weights are shown as the maximum weight allowed by code. Their related volumes may vary with product density. ** Normal Factory Setting.

Calibration Charts

Calibration Chart															
Perma-Cyl 450 ZX															
H2O	**Oxygen**			**Nitrogen**			**Argon**			**CO_2**			**N_2O**		
IN.	GAL	LB	CU FT	GAL	LB	CU FT	GAL	LB	CU FT	GAL	LB	CU FT	GAL	LB	CU FT
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0	1.0	10	120	2.0	14	187	0.7	8	80	0.9	9	83	0.9	9	79
4.0	3.8	36	437	6.9	47	645	2.6	31	297	3.4	35	303	3.1	33	289
6.0	7.7	73	882	13.1	89	122	5.5	64	615	7.0	70	616	6.4	68	591
8.0	12.0	115	1389	19.4	131	1811	8.9	103	996	11.1	112	978	10.2	109	946
10.0	16.6	158	1904	25.8	174	2400	12.5	145	1406	15.4	155	1351	14.3	151	1318
12.0	21.0	200	2420	32.1	217	2989	16.2	188	1819	19.6	197	1724	18.3	194	1689
14.0	25.5	243	2935	38.4	259	3578	19.8	231	2232	23.8	240	2097	22.3	237	2061
16.0	30.0	286	3451	44.7	302	4168	23.5	273	2645	28.1	283	2470	26.3	279	2433
18.0	34.5	328	3966	51.1	345	4756	27.2	316	3058	32.3	325	2842	30.3	322	2804
20.0	39.0	371	4481	57.4	387	5345	30.8	359	3471	36.6	368	3215	34.4	365	3176
22.0	43.4	414	4997	63.7	430	5934	34.5	401	3883	40.8	411	3588	38.4	407	3548
24.0	47.9	456	5512	70.0	473	6522	38.2	444	4296	45.1	453	3961	42.4	450	3919
26.0	52.4	499	6027	76.4	515	7111	41.8	487	4709	49.3	496	4334	46.4	493	4291
28.0	56.9	542	6543	82.7	558	7700	45.5	529	5122	53.5	539	4707	50.4	535	4662
30.0	61.3	584	7058	89.0	601	8289	49.2	572	5535	57.8	581	5080	54.5	578	5034
32.0	65.8	627	7573	95.3	643	8878	52.8	615	5947	62.0	624	5453	58.5	621	5406
34.0	70.3	670	8089	101.7	686	9467	56.5	657	6360	66.3	667	5826	62.5	663	5777
36.0	74.8	712	8604				60.2	700	6773	70.5	709	6199	66.5	706	6149
38.0	79.3	755	9120				63.9	743	7186	74.8	752	6572	70.5	749	6521
40.0	83.7	798	9635				67.5	785	7599	79.0	795	6945	74.6	791	6892
42.0	88.2	840	10150				71.2	828	8012	83.2	837	7318	78.6	834	7264
44.0	92.7	883	10666				74.9	871	8424	87.5	880	7690	82.6	877	7635
46.0	97.2	926	11181				78.5	913	8837	91.7	923	8063	86.6	919	8007
48.0	101.7	968	11696				82.2	956	9250	96.0	965	8436	90.6	962	8379
50.0							85.9	999	9663	100.2	1008	8809			
52.0							89.5	1041	10076						
54.0							93.2	1084	10489						
56.0							96.9	1127	10901						
58.0							100.5	1169	11314						

Metric Calibration Chart															
Perma-Cyl 450 ZX															
H2O	**Oxygen**			**Nitrogen**			**Argon**			**CO_2**			**N_2O**		
IN.	Liters	KG.	M^3	Liters	KG.	M^3	Liters	KG.	M^3	Liters	KG.	M^3	Liters	KG.	M^3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0	4.0	5	3	7.6	6	5	2.7	4	2	3.6	4	2	3.2	4	2
4.0	14.4	16	12	26.2	21	18	10.0	14	8	13.0	16	9	11.8	15	8
6.0	29.0	33	25	49.7	40	35	20.7	29	17	26.5	32	17	24.2	31	17
8.0	45.7	52	39	73.6	60	51	33.5	47	28	42.1	51	28	38.8	49	27
10.0	62.7	72	54	97.6	79	68	47.3	66	40	58.2	70	38	54.0	69	37
12.0	79.6	91	69	121.5	98	85	61.2	85	52	74.2	89	49	69.2	88	48
14.0	96.6	110	83	145.4	118	101	75.1	105	63	90.3	109	59	84.4	107	58
16.0	113.5	130	98	169.4	137	118	89.0	124	75	106.3	128	70	99.6	127	69
18.0	130.5	149	112	193.3	156	135	102.8	143	87	122.4	148	81	114.8	146	79
20.0	147.4	168	127	217.2	176	151	116.7	163	98	138.4	167	91	130.0	165	90
22.0	164.4	188	142	241.2	195	168	130.6	182	110	154.5	186	102	145.3	185	100
24.0	181.3	207	156	265.1	214	185	144.5	201	122	170.5	206	112	160.5	204	111
26.0	198.3	226	171	289.0	234	201	158.4	221	133	186.6	225	123	175.7	223	122
28.0	215.2	246	185	313.0	253	218	172.3	240	145	202.7	244	133	190.9	243	132
30.0	232.2	265	200	336.9	272	235	186.1	259	157	218.7	264	144	206.1	262	143
32.0	249.2	284	214	360.8	292	251	200.0	279	168	234.8	283	154	221.3	282	153
34.0	266.1	304	229	384.8	311	268	213.9	298	180	250.8	302	165	236.5	301	164
36.0	283.1	323	244				227.8	318	192	266.9	322	176	251.8	320	174
38.0	300.0	343	258				241.7	337	204	282.9	341	186	267.0	340	185
40.0	317.0	362	273				255.6	356	215	299.0	360	197	282.2	359	195
42.0	333.9	381	287				269.5	376	227	315.0	380	207	297.4	378	206
44.0	350.9	401	302				283.3	395	239	331.1	399	218	312.6	398	216
46.0	367.8	420	317				297.2	414	250	347.2	419	228	327.8	417	227
48.0	384.8	439	331				311.1	434	262	363.2	438	239	343.1	436	237
50.0							325.0	453	274	379.3	457	249			
52.0							338.9	472	285						
54.0							352.8	492	297						
56.0							366.6	511	309						
58.0							380.5	530	320						

SECTION 7 TROUBLESHOOTING

Problem	Probable Cause	Corrective Action
Perma-Cyl 450 ZX builds excessive pressure	Low usage.	If daily usage is under 100 SCF, the cylinder will build pressure. In liquid service, the cylinder should be equipped with low pressure relief valve and regulator.
	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 replace the regulators.
	Vacuum is deteriorating.	This can be accompanied by cold or frost occurring evenly over the cylinder surface. Refer to the troubleshooting section on frost.
Perma-Cyl 450 ZX pressure is too low.	Pressure building regulator is set too low.	Adjust the regulator as described in the Section 8, maintenance.
	Pressure building regulator is not opening properly.	Bench test the regulator for full flow at the set pressure as described in Section 8, maintenance.
	Economizer regulator is set below the pressure building regulator setting.	The economizer regulator must be set 15-25 psi greater than the pressure building regulator as described in Section 8, maintenance.
	Usage is too high.	Refer to Section 6, specifications for the maximum recommended delivery rates.
	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 Chart for repair details.

Problem	Probable 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.
Frost occurs evenly over the cylinder surface.	The gas withdrawal rate is high. Both the PB 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 Chart for return instructions.
Miscellaneous frost spots on cylinder.	Cylinder may have internal damage.	Call Chart for evaluation or repair/return instructions.
Delivery gas is too cold.	Rate exceeds recommended delivery rate.	Refer to Section 6, specifications 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.	Reset 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.	Pressurize the cylinder to 100 psi or above to re-liquefy from CO2 dry ice.

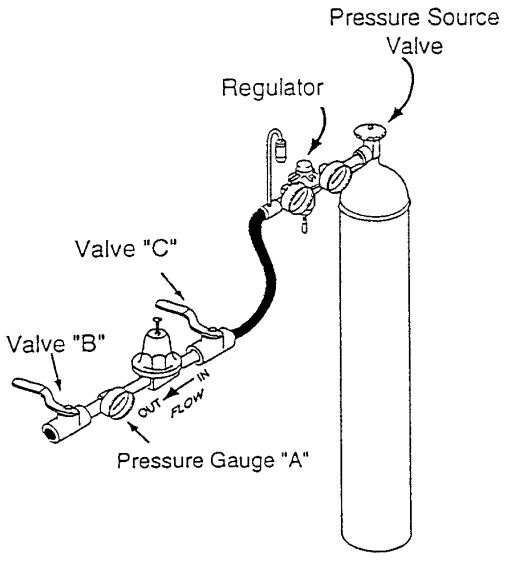
SECTION 8 MAINTENANCE

Adjusting Regulator Pressure Ranges

Use the following procedure to change the pressure range for either the pressure building or economizer regulator.

1. Remove the liquid product from the cylinder. Vent the cylinder of all pressure.
2. Remove the regulator from the cylinder.
3. Place the regulator body in a vise with the bonnet and adjusting screw pointed up.
4. Back out the adjusting screw until there is no spring pressure on it.
5. Carefully remove the spring.
6. Replace the spring and reassemble.
7. Bench set the regulator as shown in this section.

Bench Set-Up for Pressure Building Regulator



Alternate Regulator Springs			
Pressure Builder		**Economizer**	
Pressure (PSI)	**Spring Part No.**	**Pressure (PSI)**	**Spring Part No.**
2-25	57-1003-1	0-30	57-1024-1
15-65	57-1019-1	30-50	57-1021-1
40-100	57-1011-1	51-80	57-1015-1
100-250	57-1020-1	81-150	57-1016-1
		151-250	57-1034-1
		200-400	57-1030-1

Bench Setting a Pressure Building Regulator

1. Connect the pressure building regulator to a nitrogen pressure source as shown in figure above.
2. Close valve B.
3. Open pressure source valve (follow appropriate safety rules).
4. Open valve C slowly.
5. 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.
6. This procedure may be repeated as many times as necessary to obtain the proper setting.
7. After the proper setting is obtained, secure the lock nut on the adjusting screw.

NOTE: Factory setting:

Perma-Cyl 450VHP 450 psig

SEE: Page 33 for Bench Setting Combo Pressure Building/Economizer Regulator

Bench Setting an Economizer Regulator

1. Connect the inlet of the economizer regulator to a pressure source as shown in figure below.
2. Open the valve at the pressure source (follow appropriate safety rules).
3. Slowly open valve B just enough to allow some gas to escape.
4. Pressure gauge A will indicate the setting to which the economizer regulator is set. This setting may be increased by turning the adjusting screw in, or lowered by turning the adjusting screw out.

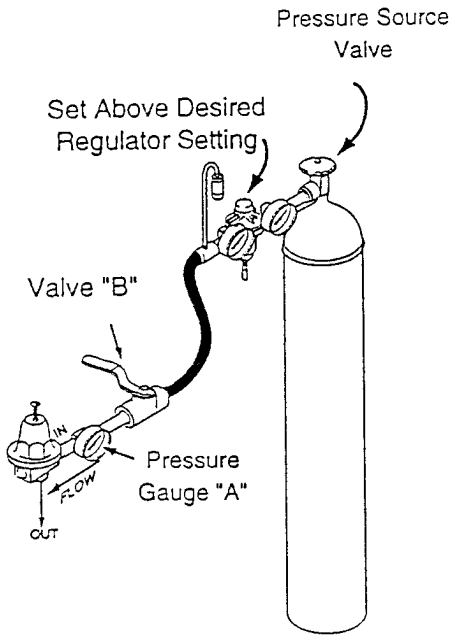
5. Gas will flow through the economizer regulator when the pressure of the gas reaches the pre-set setting.

NOTE: Factory Setting:

Perma-Cyl 450VHP 450 psig

Not Applicable for Mega-Cyl 450MP/HP with Combo Pressure Building/Economizer Regulator.

Bench Set-Up for Economizer Regulator



Procedure for Adjusting Combo Pressure Building/Economizer Regulator

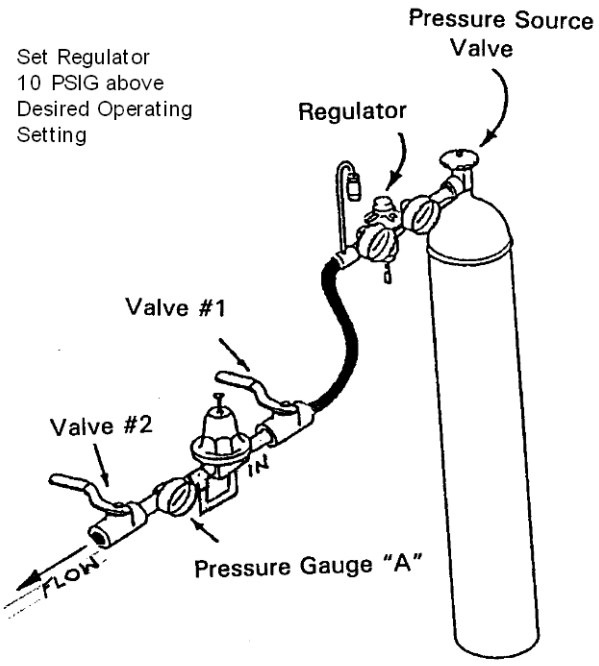
1. Connect the combo regulator to a pressure source as shown on page 34.
2. Close Valve #2.
3. Open the pressure source valve (follow the appropriate safety rules).
4. Open Valve #1 slowly.

5. 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 can be decreased by turning the adjusting screw out. However, after each adjustment outward it will be necessary to open and then close Valve #2 to relieve excess pressure.

6. This procedure may be repeated as many times as necessary to obtain the proper setting.

7. After the proper setting is obtained, secure the lock nut on the adjusting screw.

Bench Set-Up for Combo Regulator



Rebuilding the Operational Valves

The valves that are used on the Mega-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.

1. Open the vent valve and release any pressure that is in the container.

2. If the valve to be repaired is the vent valve, allow it to warm up before it is disassembled.

3. If the valve to be repaired is the pressure building valve, the container should be emptied of product and pressure.

4. Remove the valve handle screw (Item 3), washer (Item 14), retainer cap and spring assembly (Items 2, 4, 8, 10, and 13).

5. Remove the valve handle (Item 1) and Teflon thrust washer (Item 7).

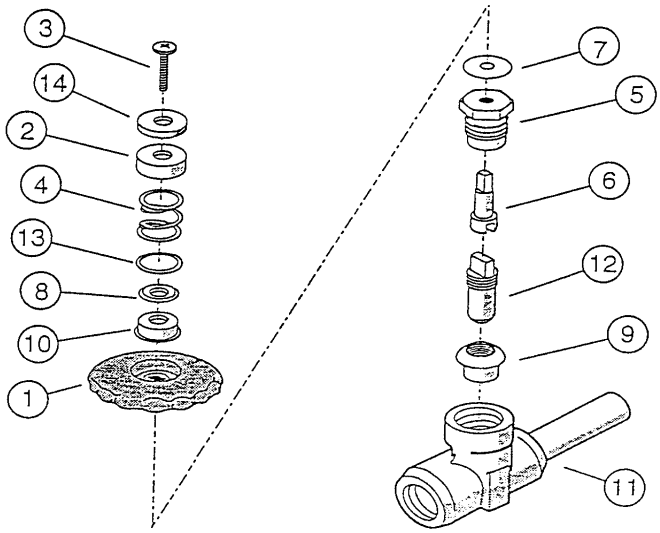
6. Unscrew bonnet (Item 5) to remove stem (Item 6) and stem seal.

7. Pick out body insert (Item 12) and plug assembly (Item 9).

8. Clean seat.

9. Replace parts as needed and reassemble in reverse order.

Globe Valve Components



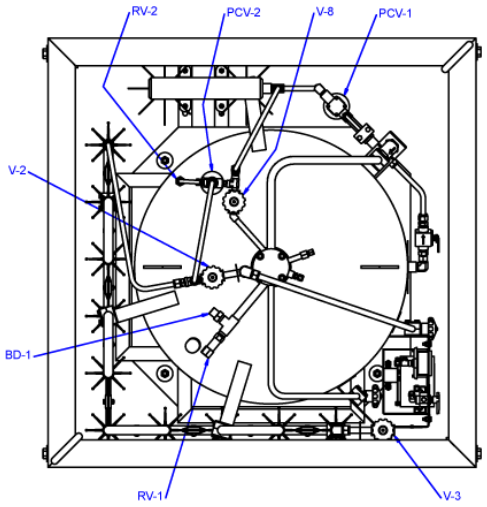
Item	Part No.	Qty	Spares *	Description
1	17-1078-9	1	1	Hand wheel
2	17-1086-9	1	1	Spring Retainer
3	17-1084-9	1	1	Screw
4	17-1077-9	1	1	Spring
5	17-1081-9	1	1	Bonnet
6	17-1089-9	1	1	Stem
7	17-1088-9	1	1	Gasket
8	17-1087-9	2	2	Washer
9	17-1082-9	1	1	Threaded Body Insert
10	17-1076-9	1	1	Seal
11	—	—	—	Body Assembly
12	17-1083-9	1	1	Seat and Nipple Assembly
13	17-1080-9	1	1	Washer
14	17-1085-9	1	1	Washer and Screw
—	97-1575-9	—	1	Valve Repair Kit (Includes items 1-14, except 11)

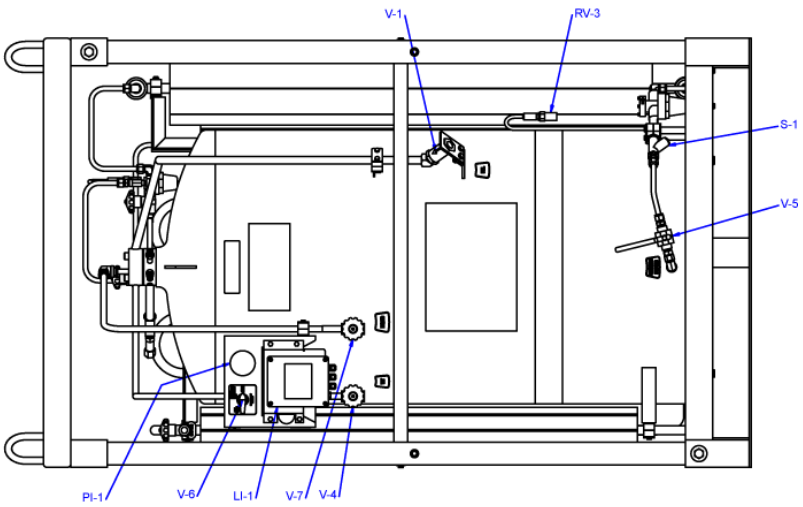
*Recommended spare parts

** Parts are also available in complete packages.

SECTION 9 PARTS IDENTIFICATION

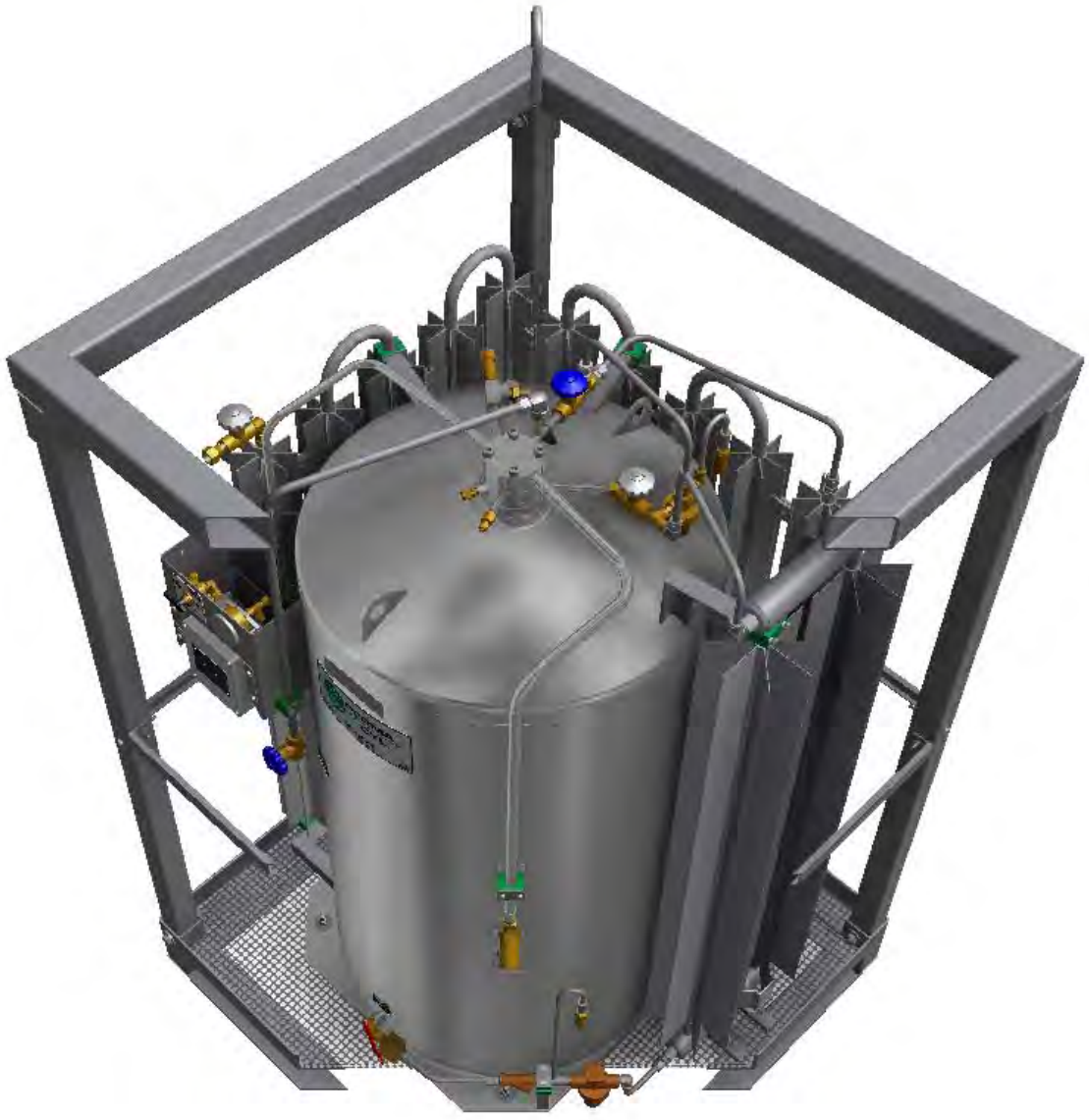
Perma-Cyl 450





Item	Part No.	Qty	Description	Item	Part No.	Qty	Description
V-1	11051090	1	Check Valve – 1/2 FPT (Fill)	SK	4010542	2	Dust Cap – ½" ODT (Argon or Nitrogen)
V-2	11906060	1	Globe Valve – 3/8 FPT (Liquid Isolation)	SK	1110072	2	Male Connector – ½" ODT x 3/8" MPT (Argon or Nitrogen)
V-3	11905981	1	Globe Valve – 3/8 FPT (Gas Use)	SK	1110112	2	Male Connector – 5/8" ODT x 3/8" MPT (Oxygen)
V-4	11905956	1	Globe Valve – 3/8 FPT (Vent)	SK	4010022	1	Gas Outlet – 3/8" MPT x CGA-580 (Argon or Nitrogen)
V-5	1712202	1	Ball Valve – 1/2 FPT (Pressure Builder)	SK	4010012	1	Gas Outlet – 3/8" MPT CGA-540 (Oxygen)
V-6	11939013	1	5-Way Crossover Valve – (LL Gauge Isolation)	SK	4010562	1	Gas Outlet – CGA-320 (CO_2)
V-7	11906043	1	Globe Valve – 3/8 FPT (Liquid Use)	SK	4010602	2	Gas and Liquid Outlet – CGA-326 (N_2O)
V-8	11905999	1	Globe Valve – 1/4 FPT (Economizer Isolation)	SK	4010552	1	Dust Cap – CGA 580 (Argon or Nitrogen)
PCV-1	11635511	1	Regulator – 1/2 FPT set @ 450 PSI (Pressure Builder)	SK	3911206	1	Dust Cap - CGA-540 (Oxygen)
PCV-2	10619675	1	Regulator – 1/4 FPT set @ 475 PSI (Economizer)	SK	4010552	1	Dust Cap – CGA-320 (CO_2)
RV-1	11385111	1	Pressure Relief Valve (Main) – 1/2 MPT 500 PSI	SK	4010552	2	Dust Cap – CGA-326 (N_2O)
RV-2 RV-3	1812702	2	Pressure Relief Valve (Line) – 1/4 MPT 550 PSI		3811599	1	Metal Tag (Gas Use)
BD-1	11526622	1	Safety Rupture Disc – 1/2 MPT x 1/2 MPT (700 psig/48.3 BAR) 316SS DISC				
PI-1	13909811	1	Pressure Gauge – 1/8MPT CBM (0-600 PSI)				
LI-1	13141662	1	Cyl-Tel Liquid Level Gauge – 1/4 FPT				
S-1	11529090	1	Inline Wye Strainer – 1/2 FPT		11207779	1	Schematic 450 ZX

REVISION LOG – Initial Release: April 2011		
LETTER	**DATE**	**DESCRIPTION**



Manual No. 15078273
Revision 0 Dated 04/2011
Technical Service 800-400-4683
www.chartparts.com