PERMA-CYL®

230/265/300/450/700/1000/1500

Manual #10961999

Operating Manual

MicroBulk Solutions

CHART

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Revision Log	Description
Rev A (06/20/01)	Correct part number on pages 20 and 21, item number 8 from 10746447 to 11488591
Rev B (04/02/02)	Updated Perma-Cyl line for configured to order.
Rev C (10/1/03)	General Update
Rev D (10/31/05)	Replace 5-way valve 11627651 with 11939013 per ECO# 12252.

Any comments or suggestions about this manual should be mailed in writing to:

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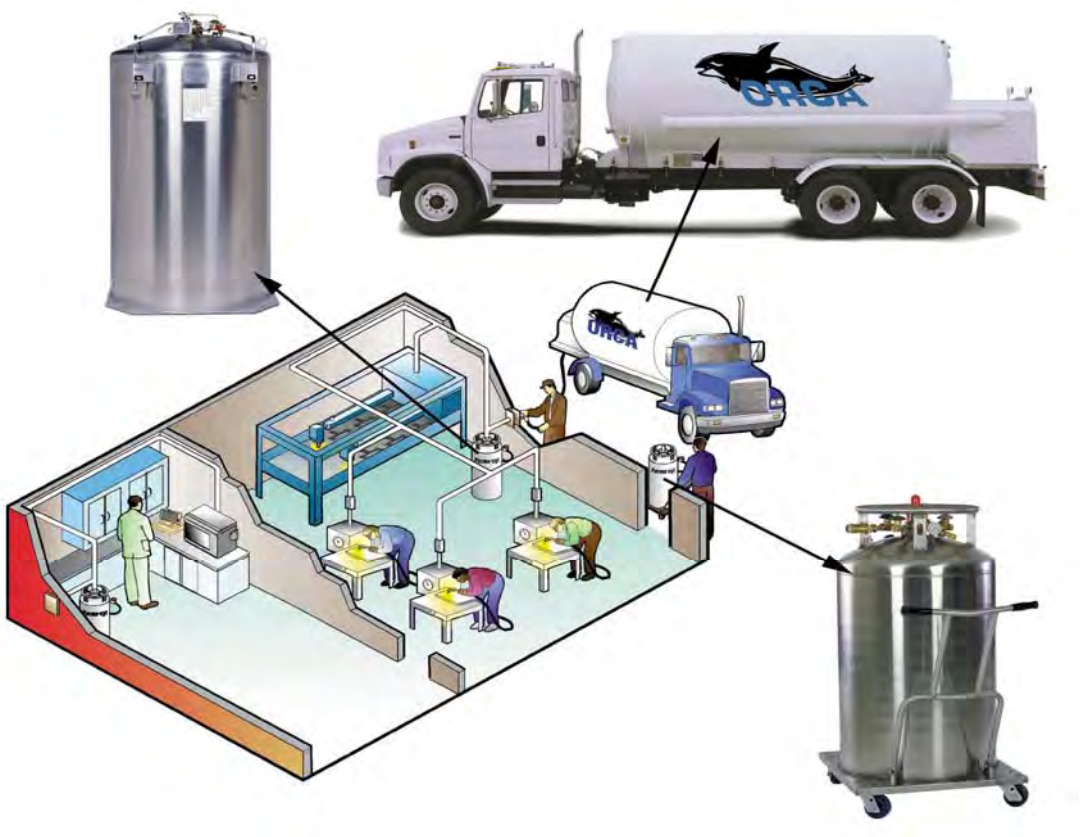
INTRODUCTION 2

The Perma-Cyl is an innovative design evolving from proven technology we have been using for years on our liquid cylinders. What makes the Perma-Cyl design revolutionary is the fast fill capability, no loss/low loss fill with automatic fill termination, extended hold time and telemetry compatibility. When filled by an Orcamobile, the Perma-Cyl vessel is designed to have an actual fill-time of three minutes or less (smaller models) with zero losses under normal conditions. The vessel will allow liquid to be held for long periods without venting, limiting product losses during periods of nonuse. The new Cyl-Tel gauge features an accurate user-friendly display and is "telemetry ready" to connect to Chart's phone line, cellular or satellite systems.

This manual is a documentation of Perma-Cyl cryogenic liquid cylinders by Chart Inc. Its purpose is to provide the users with the necessary information for the operation and the maintenance of the following tanks; Perma-Cyl 230/265 MP/HP LCCM DOT, Perma-Cyl 230/300 MP/HP, Perma-Cyl 450MP/HP/VHP, Perma-Cyl 700 HP, Perma-Cyl 1000 HP/VHP, and Perma-Cyl 1500 HP/VHP.

The manual is divided into following sections.
Section 2 - Introduction to Perma-Cyl liquid cylinders.
Section 3 - Theory of operations.
Section 4 – Perma-Cyl installation guidelines that should be followed.
Section 5 – Instructions for the Cyl-Tel level gauge and Telemetry.
Section 6 - Safety procedures needed in the operation of the tanks.
Section 7 - The plumbing illustrations and the part listings.
Section 8 - The Warranty on the Perma-Cyl products.
Section 9 - Specifications for the Perma-Cyl tanks.
Section 10 – Perma-Cyl Troubleshooting.
Section 11 – Additional References.



1 INITIAL INSPECTION

Upon receipt of the Perma-Cyl, remove the protective wrapping and inspect for the following:

1. Any shipping damage to the Perma-Cyl including dents, cuts, and broken or bent plumbing components. Report damage to the shipping company immediately.
2. Warranty card, Operator Instructions Sheet, and Users Manual.
3. The Perma-Cyl is shipped with low purity Nitrogen gas. Purging is necessary prior to filling.

1.1 GENERAL

The Perma-Cyl model liquid cylinder is designed to, store and deliver liquid oxygen, nitrogen or argon as a cryogenic liquid. The Perma-Cyl can build and maintain pressure from the automatically regulated pressure building circuit. A continuous liquid or gas flow can be provided from these cylinders. Regardless of size, all Perma-Cyls operate on the same principals of operation.

C A U T I O N

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

1.2 FILLING PROCEDURES

During a first fill, only fill the vessel to 75% full to allow liquid expansion experienced with a new "hot" tank. Each fill there after can be filled to 100% full. See **ORCA Manual** for Procedures

1.3 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:

C A U T I O N

If liquid can be trapped in the transfer system, a suitable relief valve must be installed to prevent over pressurization.

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 connection 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. This valve can be adjusted to obtain the proper liquid flow rate.
5. The pressure building valve can be opened to build and maintain a higher cylinder pressure during liquid transfer.
6. When the transfer is complete, close the receiving equipment's valve. Close the liquid valve and relieve pressure from the hose.

7. Disconnect or remove the hose from the receiving equipment.

1.4 GAS WITHDRAWAL

The Perma-Cyl will deliver gas at various flow rates and temperatures for different applications. The equipment that is being supplied gas from the Perma-Cyl controls the flow rate. Higher flow rates may provide very cold gas that could damage the equipment to which they are attached. To supply gaseous product, follow this step by step procedure.

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.

1. Connect the proper regulator to the liquid cylinder's gas use outlet.
2. Connect the proper hose between the final line regulator and the receiving equipment.
3. Open the pressure building valve.
4. Allow pressure (refer to gauge) to build to the operating pressure.
5. Open the gas use valve.
6. Adjust the gas use regulator for the proper delivery pressure.
7. When the gas delivery is completed, close all valves.

CAUTION

All valves on an empty Perma-Cyl 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 1 Initial Inspection, 1.1 General before conducting a gas or liquid withdrawal operation. Protective eyeglasses and gloves should always be worn**.**

At low flow rates, the Perma-Cyl Series 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.

BACK of an ORCA TRUCK

INSTALLATION COMMON CODES AND STANDARDS

The installer will need to find out what local city ordinances and which rules they are mandated to follow. One of the following standards may apply; Uniform Fire Code (UFC), Compressed Gas Association (CGA), and the National Fire Protection Association (NFPA, for oxygen only).

1. Uniform Fire Code standards
- Article 75
- Flammable Cryogenic fluids
- Inert Cryogenic fluids
- Oxidizer Cryogenic fluids
- Article 80
- Section 311 states cryogenic storage indoors must be less then 1000 Lbs. water capacity or less, equivalent to a 450 Liter tank

2. Compressed Gas Association
- Pamphlet P-9 Inert Gases
- Section 9 & 10 storage liquid cylinders capacity indoors
- No capacity given but list approximately 30 gallons
- Must be well ventilated
- Section 12 Storage Bulk capacity indoors
- See Pamphlet P-18
- Pamphlet P-18 Bulk Inert Gases
- Section 5.2 Indoor storage
- No capacity given
- Must be well ventilated
- Fill, full try cock, vent, and relieves must be piped outside
- Warning signs are required
- Pamphlet G-4 Oxygen Gases
- Section 6 Oxygen storage and handling safety
- Section 7 Oxygen storage
- Capacity of 45 gallons
- Area must be well ventilated preferable outside
- Keep away from flammable materials
- Section 9 Bulk Oxygen Systems
- No capacity listed

Refers to NFPA 50 for direction

National Fire Protections Association
- NFPA 50 Bulk Oxygen Systems
- Section 1-3 Bulk Oxygen Systems are 658 liters (which includes all tanks in system) and larger
- Chapter 2 locations for bulk oxygen tanks
- Section 2-1.1 Storage can be outside above ground or inside a non-flammable or limited combustible building (see NFPA 220 for description of building requirements)
- Area must be adequately vented and used exclusively for that purpose
- Section 2-2 list distances for special items
- Section 3-5.8 area must be marked with permanently marked placards

Note: Items listed above are only paraphrased and are only to be used as a reference to find sections of the listed codes which apply to the storage of cryogenic tanks. All items listed in the codes must be followed and adhered to in order to comply. There maybe other codes which apply to your installation. Check with your local authorities

REGULATIONS VARY IN EVERY PART OF THE COUNTRY. ALWAYS CONSULT LOCAL CODES!

INSTALLATION TOOLS AND SUPPLIES

For more information please refer to the Perma-Cyl Installation manual PN 11630833

GENERAL

Installation of the Perma-Cyl System requires that certain tools and supplies are available. For simple and economical installations, the following supplies and tools should be maintained, however, not all installations will require them.

INSTALLATION SUPPLIES

- Silicone Sealant (clear and white)
- 2" PVC Pipe and Elbows
- ¼" Plastic Screw Anchors
- ¼" x 1" Self-Tapping Screws
- 9" Cable Ties
- PVC Cement
- Duct Tape
- Teflon Tape
- PVC Flanges
- Chalk or Marker
- Leak Check Solution

INSTALLATION HARDWARE

Hardware	MVE P/N
Perma-Cyl Wall Box	11045036
Perma-Cyl Wall Box AR QD	11074494
Perma-Cyl Wall Box Inert Flare	11074486
Perma-Cyl Wall Box N2 QD	11074478
Perma-Cyl Wall Box O2 Flare	11074523

Warning:
When using the following tools, suitable eye and ear protection must be worn. Failure to do so could result in serious personal injury.

INSTALLATION TOOLS

Electric Hammer Drill: Used for drilling holes and chiseling brick. Accessories include:

- ¾" x 21" Scaling Chisel
- 2 ½" Core Bit
- 1" x 21: Drill Bit (Masonry)
- ¼" x 13" Masonry Bit
- ½" Masonry Bit

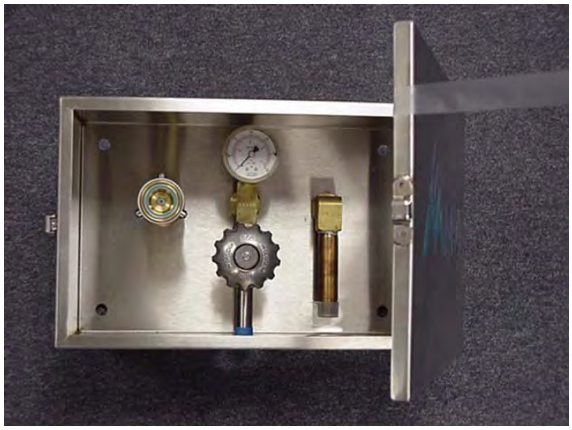
7 ¼" Builder's Circular Saw: Used for scoring brick and cutting wood exteriors. Accessories include:

- Masonry Cutoff Wheel
- Combination Blade

Reciprocating Saw: Used for cutting through wood walls. Accessories include:

- ¼" and 3/8" Masonry Bits
- Set of Twist Drills
- 2 ½" Hole Saw

Oxy-Acetylene Torch: Used for cutting rebar in poured concrete walls and floors.



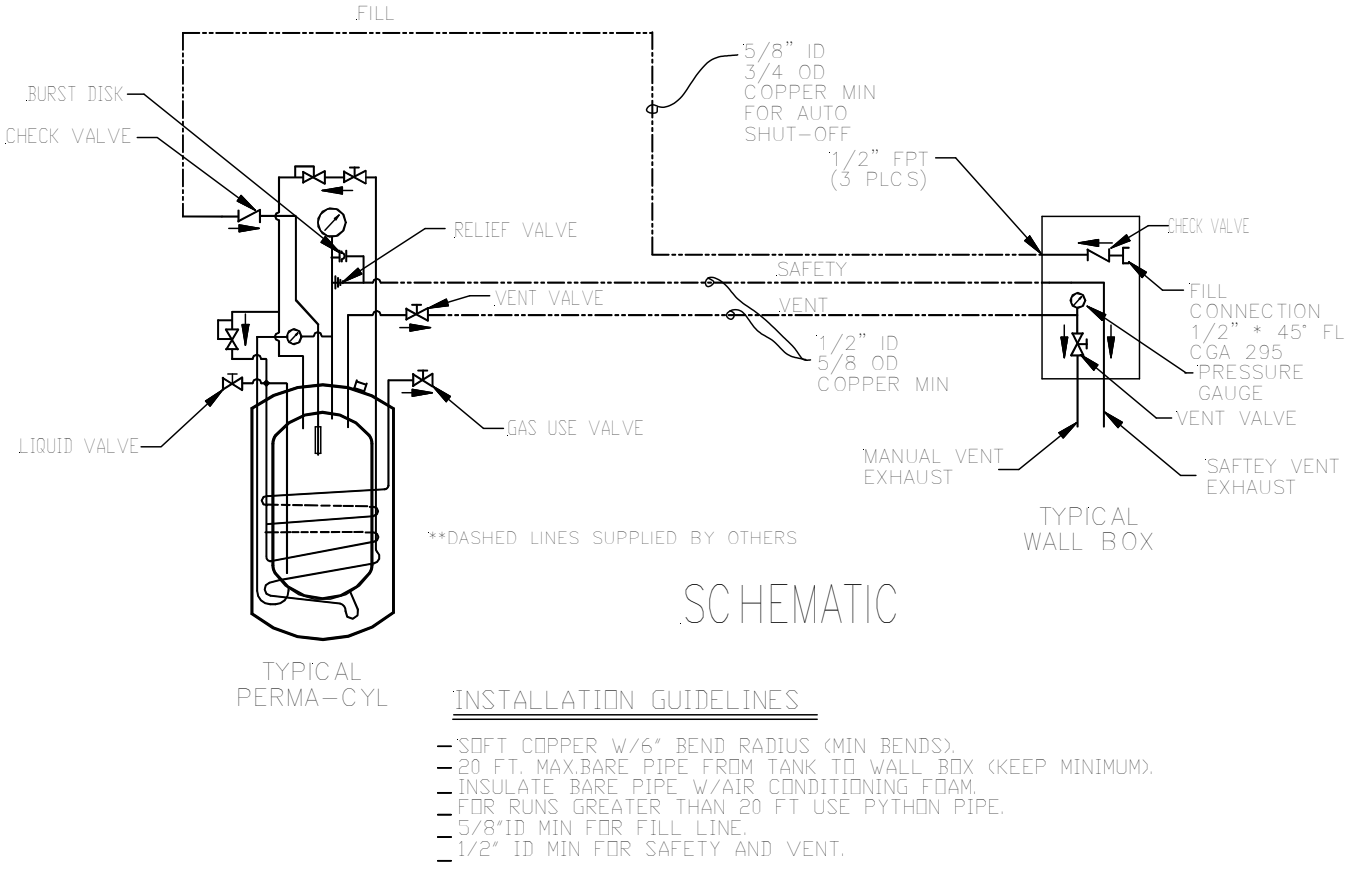
ADDITIONAL REQUIRED SUPPLIES

- Hand Truck with Strapping Attachment
- Torpedo Level
- Carpenter Square
- Extension Cord
- Oetiker clamp Pliers
- Step Ladder
- Caulk Gun
- Assorted Hand Tools
- Flashlight

INSTALLATION OF HOSES AND LINES

GENERAL

Running the liquid fill hose and vent hoses from the fill box to the tank, will most likely be done differently at each location. By following the basic rules and guidelines listed below, the lines can be run easily and as simply as possible. A typical wall box installation is diagrammed below. Note the guidelines for piping to be used.



Note: Please refer to Perma-Cyl Installation Manual (P/N 11630833) for more detailed installation instructions.

LINE CONNECTION TO FILL BOX PANEL

1. Fasten NPT connection on vent hose to the NPT fitting on the back of the control panel.
2. Fasten NPT connection on fill hose to the NPT fitting on the back of the control panel.
3. Fasten NPT connection on safety vent to the NPT connection on the back of the wall box.
4. Feed all lines back into building while pushing panel back into the fill box.
5. Loosely fasten panel into box (it will be removed for pressure checking later).

SLAB BUILDINGS

The tank distance from the outside box will vary from 12 inches to 15 running feet. The lines are generally attached to the wall by conduit straps every 18 inches. It is not necessary to run lines through a conduit sleeve, but if lines are exposed to a high traffic area and it is apparent lines may be damaged, it would be best to run them through a conduit sleeve for protection. The sleeve material generally used is 2" PVC piping.

1. Feed the liquid fill and vent hoses through PVC wall flange (on inside wall, if used).
2. If the lines are being run without sleeving material, proceed to step 8.
3. If sleeving material is being used, size and cut the sleeve material to the proper length with a 90-degree elbow toward the wall flange.
4. Feed the lines through PVC sleeve and elbows.
5. Bond the sleeve and elbow together, only if necessary, with PVC glue. Bond as little as possible for future service.
6. Run sleeving conduit to tank.
7. Attach PVC sleeve to wall with conduit straps.

Run lines to tank. Attach lines to wall with conduit straps every two to three feet.

BOLTING TO FLOOR

The Perma-Cyl tank is equipped with a flange on the bottom that has four holes for attachment. To ensure a safe environment, the tank ***must*** be bolted to the floor.

1. Place tank in position with gauges facing forward.
2. Mark holes on floor, move tank.
3. Drill holes using ½" masonry bit.
4. Blow out dust and insert masonry anchors.
5. Move tank back into position over holes and install lag bolts.
6. Tighten bolts.

CONNECTING LINES TO THE STORAGE TANK

1. Connect liquid fill hose to inlet NPT fitting on the tank.
2. Connect vent line hose to vent NPT fitting on the tank, open the vent valve.
3. Connect safety vent line to NPT fitting on tank (Safety Vent Assembly needed).
4. Connect delivery line to the gas use flare fitting on the tank.

Prior to installing the lines on the tank, any residual pressure should be vented off. This is done by opening the vent line.

FILLING PROCEDURES, ASME:

Please refer to the ORCA Manual for correct filling procedures for a Perma-Cyl.

ORCA TRUCK

FILLING PROCEDURES, DOT:

The Perma-Cyl is regulated by the Department of Transportation(US DOT) for transporting liquid oxygen, nitrogen, argon, carbon dioxide, and nitrous oxide. The filling of these liquid cylinders must be done by product weight. This will allow enough gas space above the liquid to keep the liquid cylinder 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 standard relief settings are 230 psig (15.9 BAR), 350 psig (24.1 BAR), and 550 psig (37.9 BAR).

Filling can be accomplished by either pressure transfer or pump fill. The following procedure is for a pressure transfer fill.

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 fitting. 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 proper filling weight from the table. The table indicates the product across the top and the relief valve pressure down the side. Connect the two columns to find the proper weight. Example: Perma-Cyl 230, Nitrogen at 350 psig (24.1 BAR) has a product weight of 343 pounds.

5. Open the cylinders' vent and liquid 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 on the cylinder. Close the vent valve.

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.

NOTE: The Perma-Cyl DOT models can also be filled by the ORCA and will automatically shut off at the correct fill level.

Filling Weight Table

Relief Valve Setting	Perma-Cyl 230 MP DOT (230 psig max. RV) Perma-Cyl 230 HP DOT (350 psig max. RV) Gross Capacity=240 liters				
	Argon	**Nitrogen**	**Oxygen**	**Carbon Dioxide**	**Nitrous Oxide**
PSIG	**Lbs.**	**Lbs.**	**Lbs.**	**Lbs.**	**Lbs.**
0 to 45	702	401	570	-	-
46 to 75	686	390	554	-	-
76 to 105	670	380	543	570	549
106 to 170	644	369	528	554	533
**171 to 230	628	364	517	549	522
231 to 295	607	359	506	538	512
**296 to 360	596	343	491	528	501

Filling Weight Table

Relief Valve Setting	Perma-Cyl 265 MP DOT (230 psig max. RV) Perma-Cyl 265 HP DOT (350 psig max. RV) Gross Capacity=276 liters				
	Argon	**Nitrogen**	**Oxygen**	**Carbon Dioxide**	**Nitrous Oxide**
PSIG	**Lbs.**	**Lbs.**	**Lbs.**	**Lbs.**	**Lbs.**
0 to 45	807	461	655	-	-
46 to 75	789	449	637	-	-
76 to 105	771	437	625	655	631
106 to 170	740	425	607	637	613
**171 to 230	722	418	595	631	601
231 to 295	698	412	582	619	588
**296 to 360	686	394	564	607	576

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

** Normal Factory Settings.

Filling Weight Table

Relief Valve Setting	Perma-Cyl 450 HP DOT (350 psig max. RV) Gross Capacity=450 liters				
	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

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

** Normal Factory Setting.

Cyl-Tel Quick-Start Instructions

Keypad Operation

1 Single Key Operations.

1.1 **ON** Key.
If you *PRESS* and *HOLD* the **ON** key for 10 seconds the DPG will run through its startup diagnostics tests. When the test is complete, all the red LED's will turn off unless an alarm is present.

1.2 **SELECT** Key.
This key allows you to select a variable that you have incremented to and advances you to the next field.

1.3 ⇧ Key.
This key allows you to scroll through all available options within a field.

2 Multiple Key Operations.

2.1 Changing Displayed Units.
While holding the **SELECT** and **ON** keys, press the ⇧ key to toggle between units. The line of green LED's on the left side of the box defines which units are being used. When no LED is lit, the display is in *"inches of H_2O*".

2.2 Setting Alerts.

1) *PRESS* and *HOLD* the ⇧ and **SELECT** keys for 5 seconds. This will allow you to enter the Alert menu. The first digit of the alarm setting will be blinking.

2) Set the first digit to the desired setting using the ⇧ key to increment.

3) Use the **SELECT** key to move to the next digit. Use the ⇧ key to increment that digit.

4) Continue until Alarms 1 and 2 are set.

2.3 Configure liquid parameters.

1) *PRESS* and *HOLD* the ⇧ and **SELECT** keys for 10 seconds, bypassing the alarm setting menu.

2) Choose the correct liquid type for the tank by incrementing with the ⇧ key.

3) The **SELECT** key will move to the tank configuration menus.

2.4 Configure tank parameters.

1) The tank parameter menus are entered after the liquid type is chosen.

2) Enter tank length using the ⇧ key to set the parameter and the **SELECT** key to move to the next digit.

3) After the tank length is complete, the tank diameter should be entered using the ⇧ and **SELECT** keys.

4) Choose the tank orientation, horizontal or vertical, using the ⇧ key. Press the **SELECT** key when complete.

5) Bypass the tank calibration menu for the time being by pressing the **SELECT** key. (Factory setting : 0)

6) Enter the liquid density pressure using the ⇧ key to increment and the **SELECT** key to finish.

2.5 Calibrating the DPG

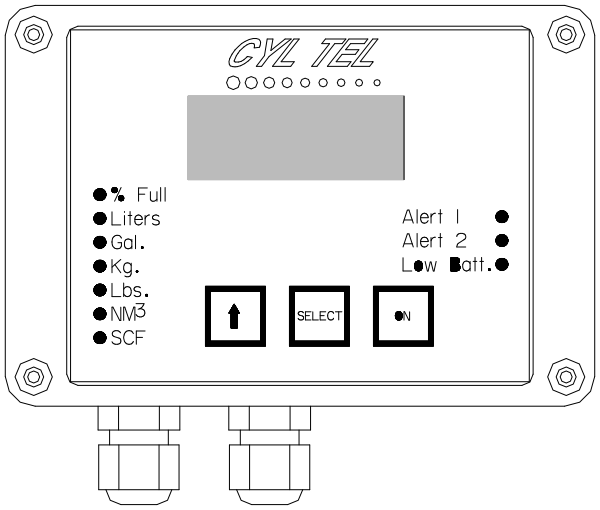
With the 4-way valve closed, take a reading of % full off the meter.
Note: The calibration constant must be changed if the reading is different than 0%.

1) Enter the calibration menu by passing through the tank parameter menus until the calibration constant menu is reached.

2) The calibration constant can be any number between –9 and 9 with each step being approximately 3%. Change the constant from 0, using the ⇧ key, to achieve the proper reading.
3) Continue until the meter reads 0% full.

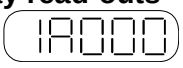
4) The 4-way valve should be opened for operation when complete.

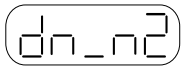
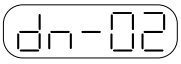
NOTE: NEVER leave the 4-way valve closed for extended periods of time.

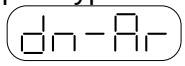
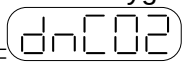
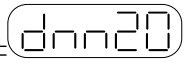


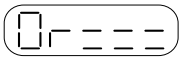
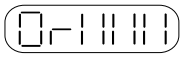
Reference Information

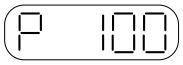
Display read-outs

Alarms: Alarm 1 ⇐  Alarm 2 ⇐ 

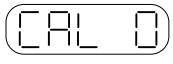
Liquid Types: Nitrogen ⇐  Oxygen ⇐ 

Argon ⇐  Carbon Dioxide ⇐  Nitrous Oxide ⇐ 

Orientations: Horizontal ⇐  Vertical ⇐ 

Operating pressure: Example⇐ 

(Select pressure closest to the saturation pressure of liquid for best level of accuracy.)

Calibration: Example ⇐  (Factory setting : 0)

CAUTION: The GAUGE Sensor cannot be exposed to a differential pressure greater than 30PSIG. If exposed to a differential pressure greater than 30PSIG the sensor will be damaged.

Troubleshooting the Cyl-Tel Gauge

Symptom	Possible Cause	Remedy
Cyl-Tel gauge does not turn on.	Battery dead, low, installed incorrectly or missing.	Replace battery.
	Transformer not plugged in or faulty wiring.	Inspect wiring and insure transformer is plugged in.
	Electrical supply circuit breaker tripped.	Reset circuit breaker.
	Faulty Cyl-Tel.	Replace Cyl-Tel front (p/n 11520503). Call 1-800-400-4683.
Cyl-Tel display is powered, but stays at zero.	No product in cylinder.	Ensure there is liquid in cylinder.
	Four-way valve in “Service” position	Turn valve to “Normal” position.
	Four-way valve installed incorrectly	See user manual to confirm proper installation
	Parameters are improperly set	Verify **EACH** parameter setting. The "P" setting as well as the inner dimensions can affect the accuracy of the gauge.
	Sensor plug not on pins inside Cyl-Tel.	Open Cyl-Tel and verify sensor plug is attached to pins.
	Faulty Cyl-Tel.	Replace (p/n 11018142). Call 1-800-400-4683.
Cyl-Tel display always reads full.	Parameters are improperly set.	Verify **EACH** parameter setting. The "P" setting as well as the inner dimensions can affect the accuracy of the gauge.
	Faulty Cyl-Tel (Sensor may be damaged).	Replace (p/n 11018142). Call 1-800-400-4683.
Alerts do not operate.	Alerts improperly set, or not set.	Verify alert settings. Refer to Cyl-Tel manual.
Liquid level oscillates with Four-way valve in either position.	Four-way valve leaking externally	Replace Four-way valve. (p/n 11026353)
Liquid level display does not zero when Four-way valve is in “maintenance” position	Calibration point needs adjusting.	Adjust "Cal" setting. Refer to Cyl-Tel manual.
	Four-way valve leaks internally	Replace Four-way valve (p/n 11026353)
Liquid level displayed not accurate.	Wrong "P" setting.	Change setting to reflect the proper saturation pressure. Refer to Cyl-Tel manual for details.
	Calibration point needs adjusting.	Adjust "Cal" setting. Refer to Cyl-Tel manual.

Troubleshooting the Cyl-Tel Phone Transmitter

Symptom	Possible Cause	Remedy
Transmitter will not program.	Bad connections.	Verify the following: Power connections, J3 connector on transmitter to programming cable, and programming cable to receiver card.
	Low battery voltage.	Battery voltage must be above 9 volts.
	Faulty transmitter.	Try programming a different transmitter. If successful, the first transmitter is faulty. Replace. Call 1-800-400-4683.
	Faulty programming cable.	Replace cable.
Transmitter will not light up or send	No power to transmitter	Check 12 VDC power source.
"Receiver Adapter Error"	The card is busy. Incorrect setup of software, hardware, the receiver card is not seated in slot, or the receiver card has been damaged.	System will operate normally. Call 1-800-400-4683 for assistance.
Computer will not receive calls.	No dial tone.	Verify phone line at receiver card has dial tone - plug line into a phone and listen for tone.
	Wrong phone number programmed in transmitter.	Verify number programmed into transmitter.
	Wrong phone line plugged into receiver card.	Verify phone line.
	Bad phone line.	Check phone line-MUST be analog. Service if necessary.
Receive "Call Overdue" message.	Transmitter not installed at customer site, damaged or power interrupted.	Verify transmitter is installed and working properly (test call). If not, make account inactive in the account setup.
	"Days between test calls" parameter not the same in account setup and transmitter.	Make sure these values are the same.
Computer cannot initialize card.	Card is not configured correctly, or is not seated properly.	Verify hardware settings and ensure card is properly seated.
	Faulty or damaged receiver card.	Replace. Call 1-800-400-4683.

Chart Inc. offers a full line of telemetry options that help maximize tank performance and minimize delivery costs. A brief overview of the most common systems are summarized below.

Phone Reorder System

This low cost system consists of a phone transmitter at each Perma-Cyl site and a call receiver box at the distributor. When the vessel reaches each of its two programmable low levels, the phone transmitter calls the distributor's computer and notifies them of the level. This system requires a phone transmitter at every site and a one-time charge for the software and call receiver but there are no on going costs.

OnSite System

The OnSite system consists of a daughter circuit board in the Cyl-Tel and a Scout Phone transmitter. The system records liquid levels throughout the day and sends the information once a day to the OnSite website. The data is secure and password protected and can be accessed anywhere an internet connection is available. Tank usage patterns and ORCA routing can be done easily with the OnSite program. Each installation requires a Cyl-Tel daughter board and a Scout phone modem. There is a monthly charge each Scout modem.

Cyl-Tel2 – DataQwest System

The Cyl-Tel2 is designed to work with the celular telemetry system offered by DataQwest. Each gauge is its own transmitter where it records and transmits data to the DataQwest website daily. Each tank requires a Cyl-Tel2 gauge and there is a monthly charge for the service.

NOTE: For each telemetry system, an external power supply is required.

WARNING
Excessive 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 form 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 and sustain life. Exposure to such an oxygen deficient atmosphere can lead to unconsciousness and serious injury, including death.

WARNING
*** Perma-Cyl 230L, 450L and 1000L models are suitable to transport full of liquid.**
*** Perma-Cyl 1500L models can be transported with no more than 250L of liquid. Transporting these cylinders with more than 250L can damage or destroy the neck tube and support system of the cylinder.**
*** For over-the-road transportation, the pressure in all cylinders must be reduced to no more than 22 PSIG.**

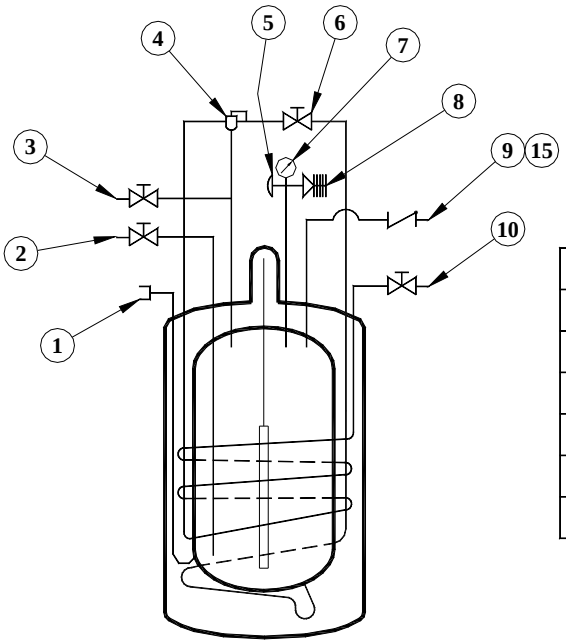
WARNING
The Perma-Cyl, with its stainless steel support system is designed, manufactured, and tested to function normally for many years of service. MVE does not suggest or warrant that it is ever safe to drop a liquid cylinder or let it fall over in oxygen or any other cryogenic service. In the event 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 extreme cold and pressure in the cylinder.

WARNING
Any welding that is done on the outside of the Perma-Cyl can cause loss of vacuum and will VOID any warranty on the unit.

PERMA-CYL 230/265 LCCM SCHEMATICS

Side View

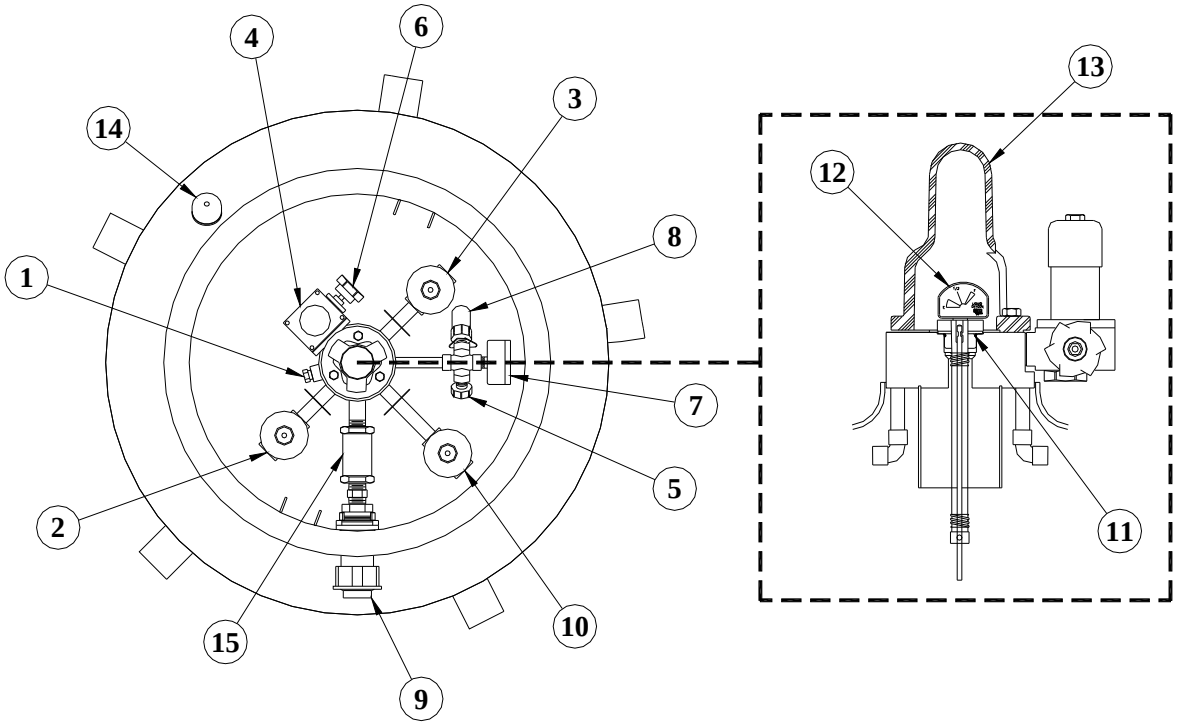


P/N	DESCRIPTION	REV
10939687	Perma-Cyl 230 MP RB DOT	C
10896592	Perma-Cyl 230 MP SB DOT	C
11191674	Perma-Cyl 230 HP RB DOT	C
11187211	Perma-Cyl 230 HP SB DOT	C
11844137	Perma-Cyl 265 MP RB DOT	C
11511463	Perma-Cyl 265 MP SB DOT	C

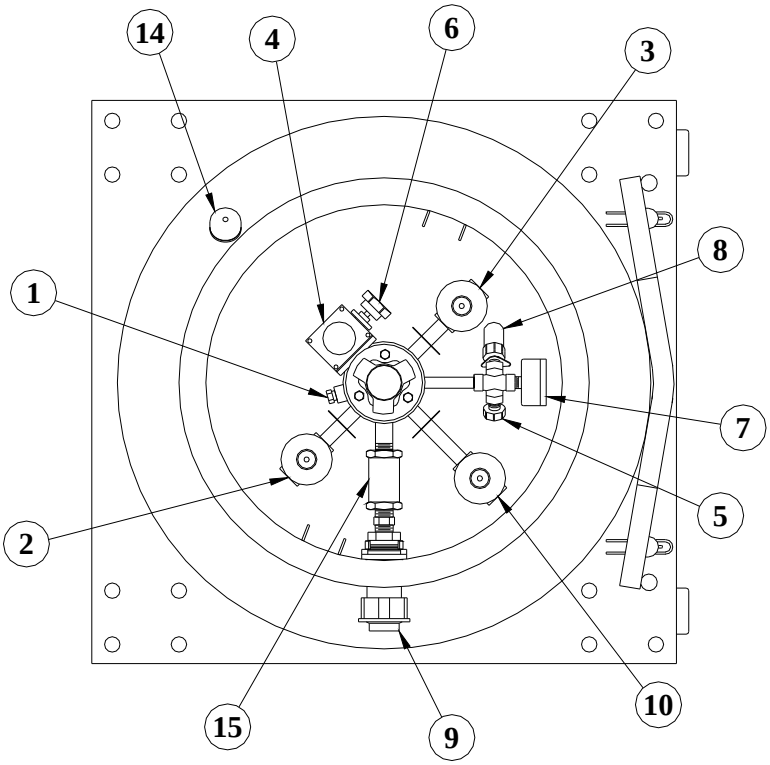
Parts List

Item #*	Description	Item #*	Description
1	High Phase Port	8	Primary Relief
2	Liquid Use Valve	9	Quick Disconnect
3	Vent Valve	10	Gas Use Valve
4	LCCM PB/Econo Regulator	11	Roto Cal Plug/O-Ring
5	Rupture Disc	12	Roto Cal Gauge
6	PB Valve	13	Protective Cap
7	Pressure Gauge	14	Pump Out Port
		15	Check Valve
**Item #'s correspond with all schematics. See pg 17 for Item #'s 11-14.*			

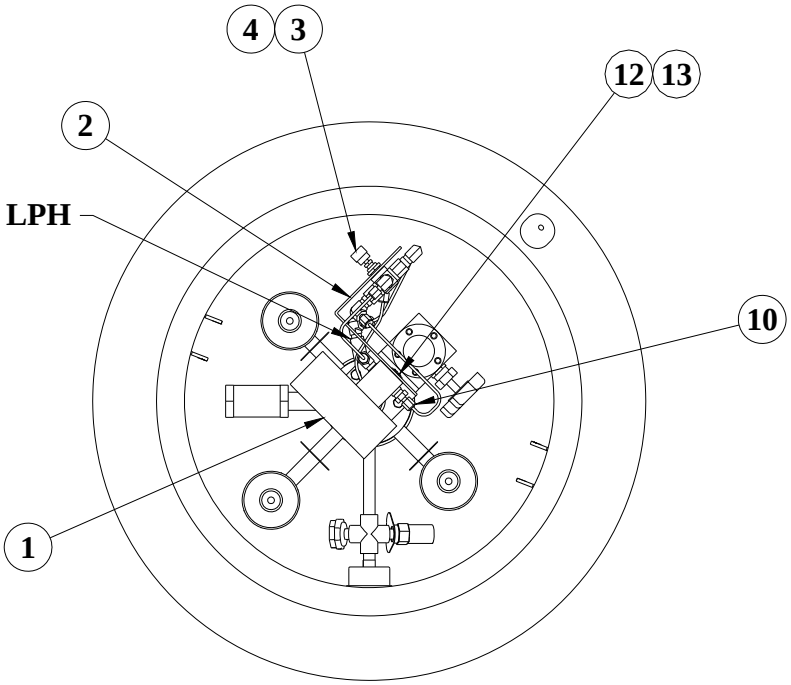
Perma-Cyl 230/265 DOT LCCM Round Base Top View



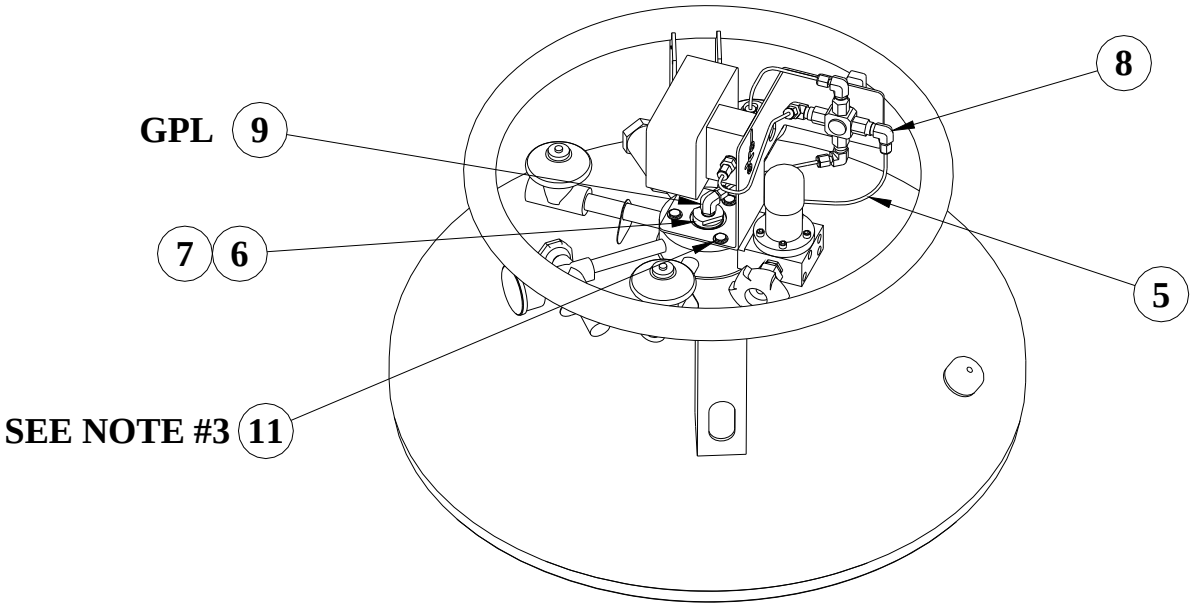
Perma-Cyl 230/265 DOT LCCM Square Base Top View



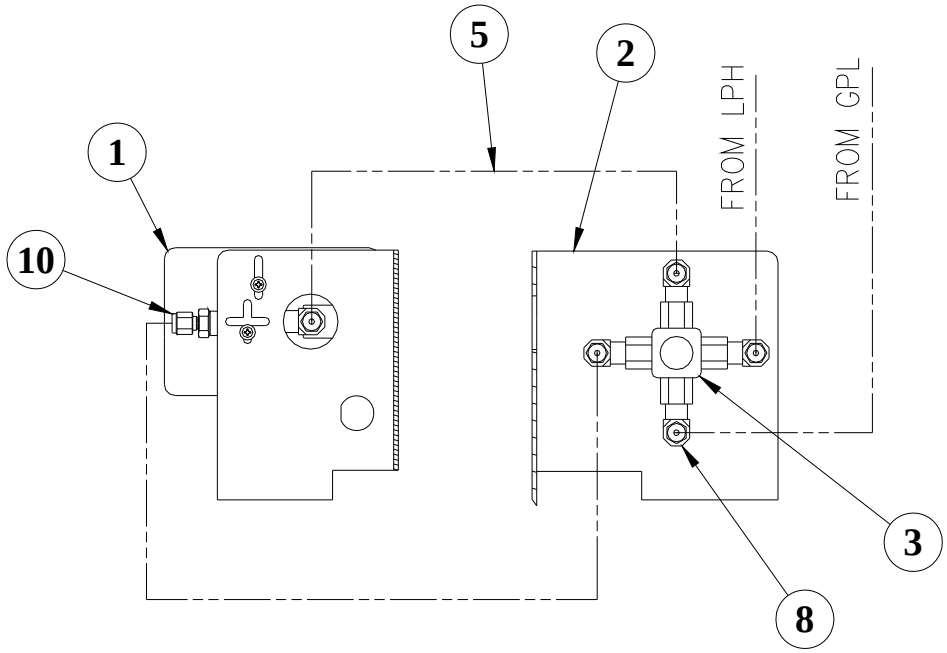
Top View: Cyl-Tel Conversion Kit



3D View: Cyl-Tel Conversion Kit



Line Connection: Cyl-Tel Conversion Kit



Parts List: Cyl-Tel Conversion Kit

Item#	Qty.	Part Number	Description
1	1	11018142	CYL-TEL GAUGE ASSY.
2	1	11823424	CYL-TEL CONVERSION BRKT.
3	1	11026353	4-WAY VALVE
4	1	11365451	4-WAY VALVE LABEL
5	3.5 FT	6910683	COPPER TUBING .125 O.D.
6	1	10680388	KNUCKLE PLUG 7/8-UNC*1/8NPT
7	1	2300094	O-RING
8	6	10501634	ELBOW BRS 90D 1/8ODT*1/4MPT
9	1	10501618	ELBOW BRS 90D 1/8ODT*1/8MPT
10	1	10501571	CONNECTOR BRS 1/8ODT*1/4MPT
11	3	2910591	FLAT WASHER SS .250
12	2	2911401	PHPNHMS SS #8-32*3/8
13	2	10740213	WASHER #8

NOTES:

1) THE VERTICAL PORTION OF THE MOUNTING BRACKET IS ORIENTED TOWARD THE LCCM REGULATOR.
2) CUT THE COPPER TUBING TO FIT BETWEEN THE TUBE FITTINGS FOR BOTH THE HIGH AND LOW PRESSURE SIDES.
3) USE THE EXISTING ROTO-CAL PROTECTOR BOLTS AND WASHERS TO SECURE THE CYL-TEL BRACKET.
4) SEAL ALL PIPE FITTING JOINTS WITH TEFLON TAPE.

The PERMA-CYL® exclusively offers the Configure to Order program that allows you to customize YOUR PERMA-CYL® specifically for YOUR application.

Option 01 – CHART Standard
Our standard offering.

Option 02 – Gauge Isolation Package
This package includes an equalization/service valve for the differential pressure gauge.

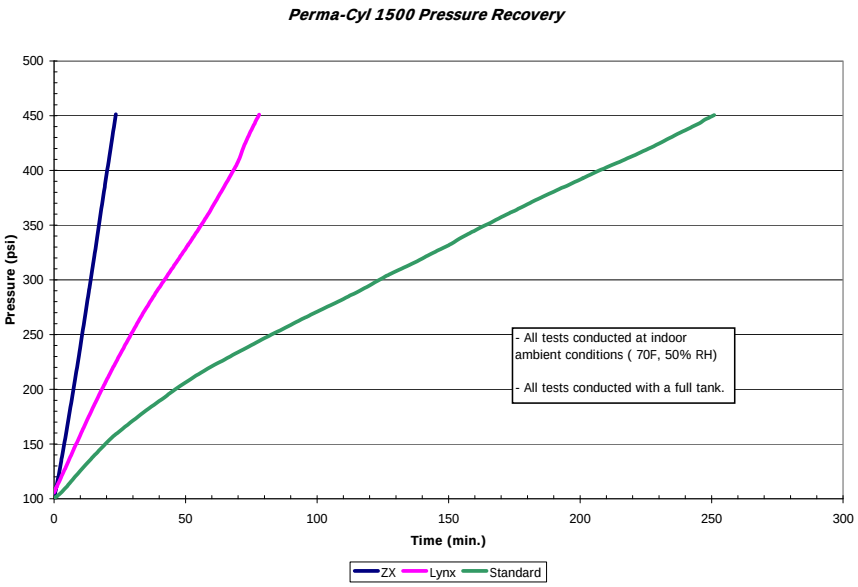
Option 03 – Component Service Valve Package
This package includes isolation valves on all serviceable components including regulators and gauges for easy service and maintenance.

Option 04 – Liquid Withdrawal Package
This package is designed with the liquid use customer in mind. A ball valve is standard on the liquid withdrawal for increased flow-rates while a valved off adjustable low pressure relief maintains low pressure in the cylinder during use.

Option 05 – CO_2 Package
This package includes all the features that are standard on CHART Beverage Cylinders. Isolation valves are included on all regulators and components. A drain valve is located on the PB circuit for easy cleanout of debris. The cylinder even has the patented Sure-Fill system and standard CO2 Fill Fitting for standardization with the existing CO2 Delivery network.

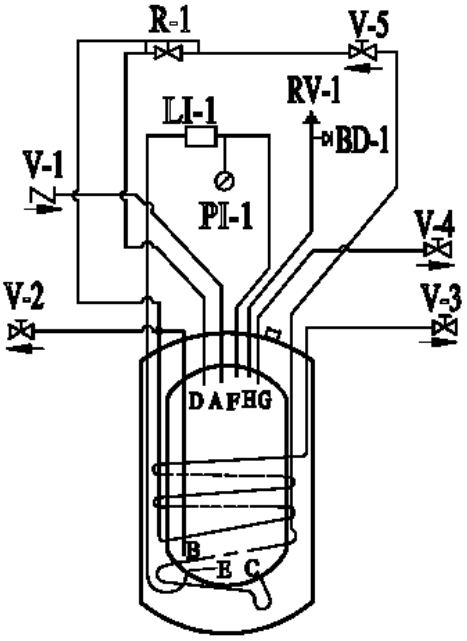
Option 06 – Lynx PB System
For increased PB recovery time and increased flow-rates up to 2500 SCFH. The Lynx System also offers isolation valves on all serviceable components.

Option 07 – ZX SUPERCHARGED PB System
For the utmost in performance in high pressure, high flow accounts the ZX Supercharger delivers. The ZX uses a high flow pressure building system to attain pressure recovery times as low as 12 minutes and can support withdrawal rates up to 7000 SCFH.



Configuration 01

Perma-Cyl 230/300/450/700/1000 MP/HP, 450/1000VHP, 1500 HP



NOMENCLATURE	
V-1	TOP FILL CHECK VALVE
V-2	LIQUID VALVE
V-3	GAS USE VALVE
V-4	VENT/FULL TRYCOCK VALVE
V-5	PRESS. BLDG. VALVE
LI-1	LEVEL INDICATOR
PI-1	PRESSURE INDICATOR
R-1	PRESS. BDLG./ ECONO REG.
RV-1	RELIEF VALVE
BD-1	BURST DISC

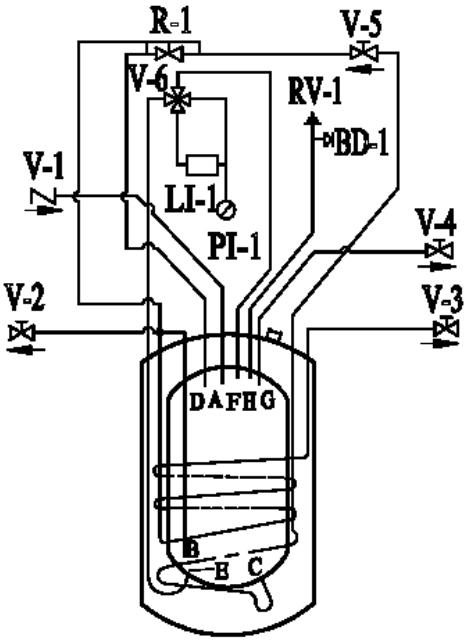
A	TOP FILL
B	LIQUID W/DRAWAL
C	PRESSURE BUILDING INLET
D	PRESSURE BUILDING OUTLET
E	LIQUID PHASE
F	VAPOR PHASE
G	VENT/FULL TRYCOCK
H	SAFETY CIRCUIT

Configuration 02

Perma-Cyl 230/300/450/700/1000 MP/HP, 450/1000VHP, 1500 HP

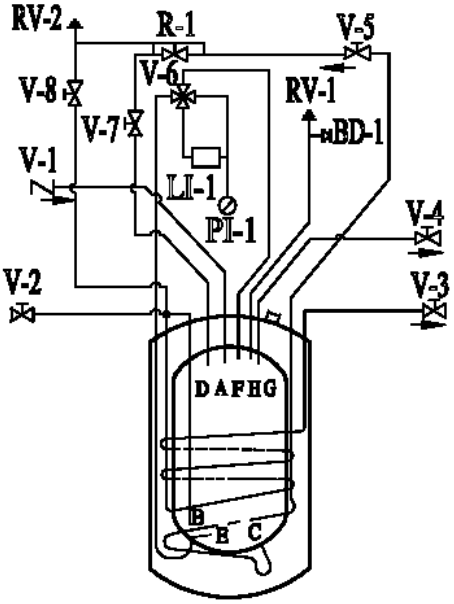
NOMENCLATURE	
V-1	TOP FILL CHECK VALVE
V-2	LIQUID VALVE
V-3	GAS USE VALVE
V-4	VENT/FULL TRYCOCK VALVE
V-5	PRESS. BLDG. VALVE
V-6	4-WAY VALVE
LI-1	LEVEL INDICATOR
PI-1	PRESSURE INDICATOR
R-1	PRESS. BDLG./ ECONO REG.
RV-1	RELIEF VALVE
BD-1	BURST DISC

A	TOP FILL
B	LIQUID W/DRAWAL
C	PRESSURE BUILDING INLET
D	PRESSURE BUILDING OUTLET
E	LIQUID PHASE
F	VAPOR PHASE
G	VENT/FULL TRYCOCK
H	SAFETY CIRCUIT



Configuration 03

Perma-Cyl 450/700/1000 MP/HP, 450/1000VHP, 1500 HP



NOMENCLATURE	
V-1	TOP FILL CHECK VALVE
V-2	LIQUID VALVE
V-3	GAS USE VALVE
V-4	VENT/FULL TRYCOCK VALVE
V-5	PRESS. BLDG. VALVE
V-6	4-WAY VALVE
V-7	REG. ISO VALVE
V-8	REG. ISO VALVE
LI-1	LEVEL INDICATOR
PI-1	PRESSURE INDICATOR
R-1	PRESS. BDLG./ ECONO REG.
RV-1	RELIEF VALVE
RV-2	LINE RELIEF
BD-1	BURST DISC

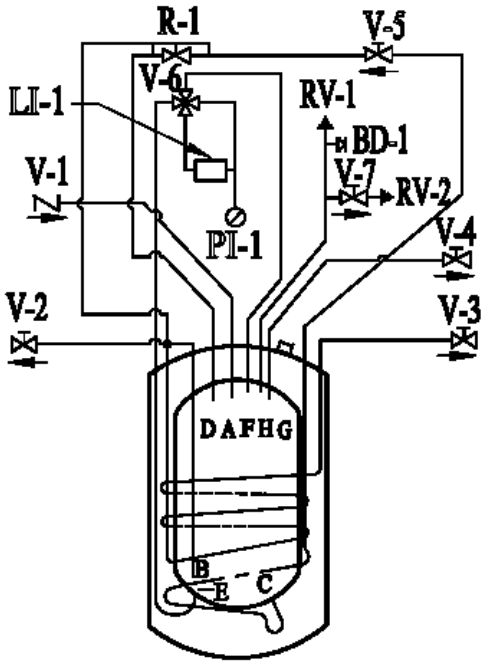
A	TOP FILL
B	LIQUID W/DRAWAL
C	PRESSURE BUILDING INLET
D	PRESSURE BUILDING OUTLET
E	LIQUID PHASE
F	VAPOR PHASE
G	VENT/FULL TRYCOCK
H	SAFETY CIRCUIT

Configuration 04

Perma-Cyl 450/700/1000 MP/HP, 450/1000VHP, 1500 HP

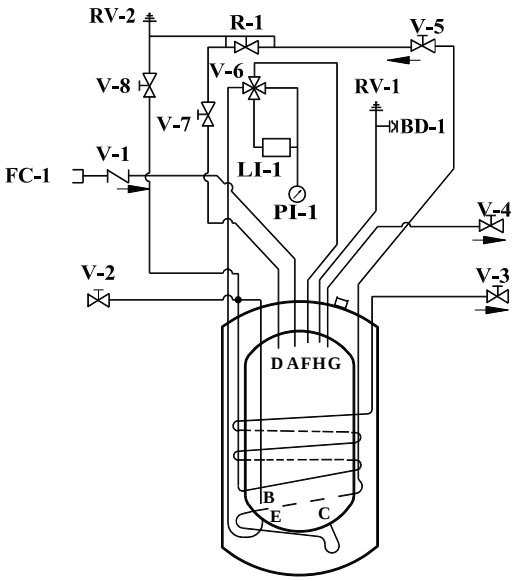
NOMENCLATURE	
V-1	TOP FILL CHECK VALVE
V-2	LIQUID VALVE
V-3	GAS USE VALVE
V-4	VENT/FULL TRYCOCK VALVE
V-5	PRESS. BLDG. VALVE
V-6	4-WAY VALVE
V-7	ISOLATION VALVE
LI-1	LEVEL INDICATOR
PI-1	PRESSURE INDICATOR
R-1	PRESS. BDLG./ ECONO REG.
RV-1	RELIEF VALVE
RV-2	RELIEF VALVE 35 PSI
BD-1	BURST DISC

A	TOP FILL
B	LIQUID W/DRAWAL
C	PRESSURE BUILDING INLET
D	PRESSURE BUILDING OUTLET
E	LIQUID PHASE
F	VAPOR PHASE
G	VENT/FULL TRYCOCK
H	SAFETY CIRCUIT



Configuration 05

Perma-Cyl 450/700/1000 MP/HP, 450/1000VHP, 1500 HP

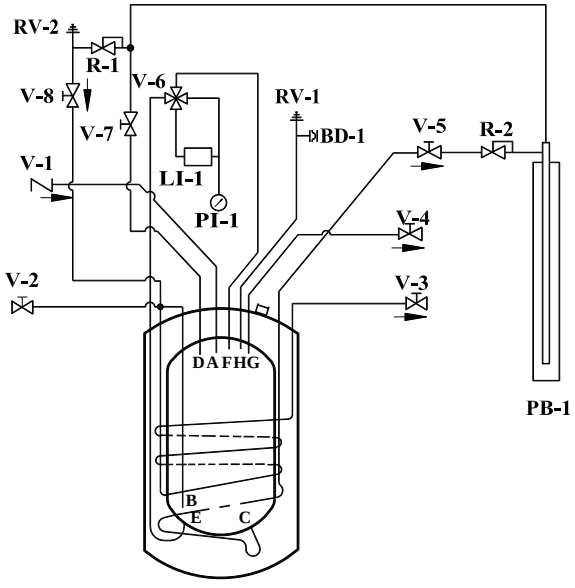


NOMENCLATURE	
V-1	TOP FILL CHECK VALVE
V-2	LIQUID VALVE
V-3	GAS USE VALVE
V-4	VENT/FULL TRYCOCK VALVE
V-5	PRESS. BLDG. VALVE
V-6	4-WAY VALVE
V-7	REG. ISO VALVE
V-8	REG. ISO VALVE
LI-1	LEVEL INDICATOR
PI-1	PRESSURE INDICATOR
R-1	PRESS. BDLG./ ECONO REG.
RV-1	RELIEF VALVE
RV-2	LINE RELIEF
BD-1	BURST DISC
FC-1	FILL CONN. CO2

A	TOP FILL
B	LIQUID W/DRAWAL
C	PRESSURE BUILDING INLET
D	PRESSURE BUILDING OUTLET
E	LIQUID PHASE
F	VAPOR PHASE
G	VENT/FULL TRYCOCK
H	SAFETY CIRCUIT

Configuration 06

Perma-Cyl 1000VHP, 1500VHP

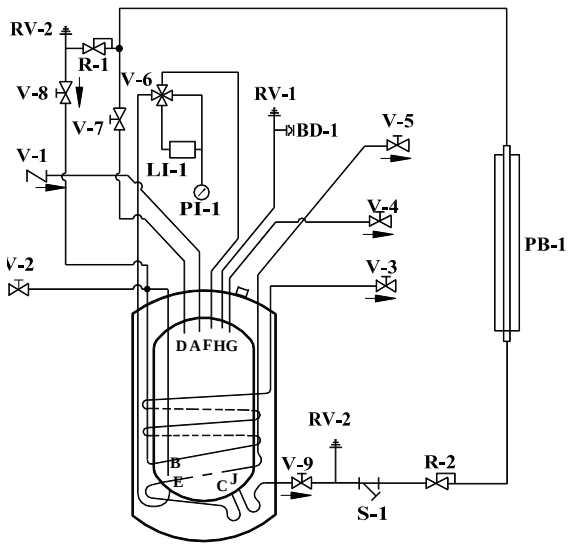


NOMENCLATURE	
V-1	TOP FILL CHECK VALVE
V-2	LIQUID VALVE
V-3	GAS USE VALVE
V-4	VENT/FULL TRYCOCK VALVE
V-5	PRESS. BLDG. VALVE
V-6	4-WAY VALVE
V-7	REG. ISO VALVE
V-8	REG. ISO VALVE
LI-1	LEVEL INDICATOR
PI-1	PRESSURE INDICATOR
PB-1	PB LYNX
R-1	ECONOMIZER REG.
R-2	PRESS. BLDG. REG
RV-1	RELIEF VALVE
RV-2	LINE RELIEF
BD-1	BURST DISC

A	TOP FILL
B	LIQUID W/DRAWAL
C	PRESSURE BUILDING INLET
D	PRESSURE BUILDING OUTLET
E	LIQUID PHASE
F	VAPOR PHASE
G	VENT/FULL TRYCOCK
H	SAFETY CIRCUIT

Configuration 07

Perma-Cyl 1000VHP, 1500VHP



NOMENCLATURE	
V-1	TOP FILL CHECK VALVE
V-2	LIQUID VALVE
V-3	GAS USE VALVE
V-4	VENT/FULL TRYCOCK VALVE
V-5	PRESS. BLDG. VALVE
V-6	4-WAY VALVE
V-7	REG. ISO VALVE
V-8	REG. ISO VALVE
V-9	AUXILARY LIQUID VALVE
LI-1	LEVEL INDICATOR
PI-1	PRESSURE INDICATOR
PB-1	EXTERNAL PRESS. BUILDER
R-1	ECONOMIZER REG.
R-2	PRESS. BLDG. REG
RV-1	RELIEF VALVE
RV-2	LINE RELIEF
BD-1	BURST DISC
S-1	STRAINER

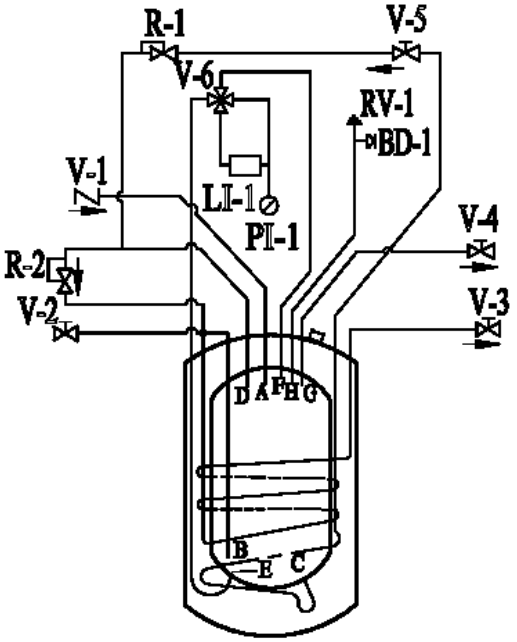
A	TOP FILL
B	LIQUID W/DRAWAL
C	PRESSURE BUILDING INLET
D	PRESSURE BUILDING OUTLET
E	LIQUID PHASE
F	VAPOR PHASE
G	VENT/FULL TRYCOCK
H	SAFETY CIRCUIT
J	AUXILARY LIQUID W/DRWL

Configuration 02

Perma-Cyl 1500 VHP

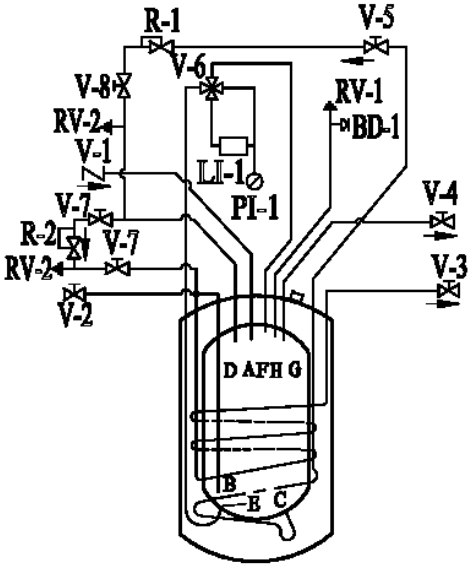
NOMENCLATURE	
V-1	TOP FILL CHECK VALVE
V-2	LIQUID VALVE
V-3	GAS USE VALVE
V-4	VENT/FULL TRYCOCK VALVE
V-5	PRESS. BLDG. VALVE
V-6	4-WAY VALVE
LI-1	LEVEL INDICATOR
PI-1	PRESSURE INDICATOR
R-1	PRESS. BLDG. REGULATOR
R-2	ECONOMIZER REGULATOR
RV-1	MAIN RELIEF VALVE
BD-1	BURST DISC

A	TOP FILL
B	LIQUID W/DRAWAL
C	PRESSURE BUILDING INLET
D	PRESSURE BUILDING OUTLET
E	LIQUID PHASE
F	VAPOR PHASE
G	VENT/FULL TRYCOCK
H	SAFETY CIRCUIT



Configuration 03

Perma-Cyl 1500 VHP

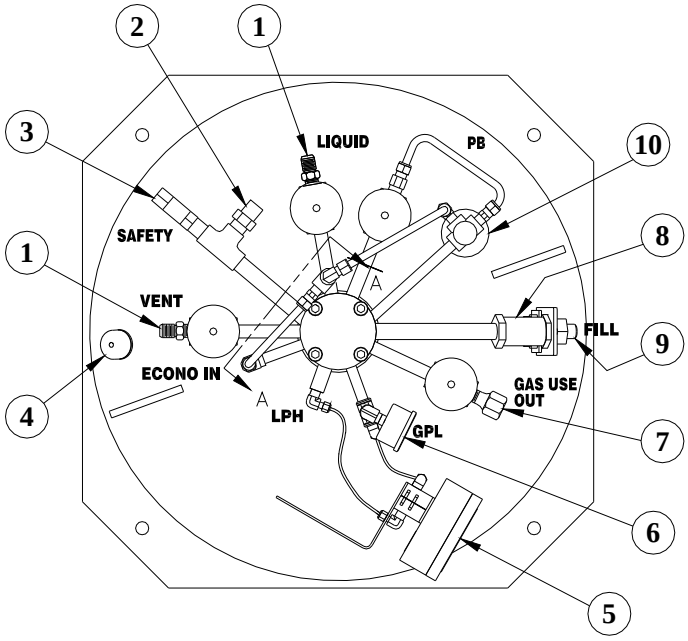


NOMENCLATURE	
V-1	TOP FILL CHECK VALVE
V-2	LIQUID VALVE
V-3	GAS USE VALVE
V-4	VENT/FULL TRYCOCK VALVE
V-5	PRESS. BLDG. VALVE
V-6	4-WAY VALVE
V-7	REG. ISO VALVE
V-8	REG. ISO VALVE
LI-1	LEVEL INDICATOR
PI-1	PRESSURE INDICATOR
R-1	PRESS. BLDG. REGULATOR
R-2	ECONOMIZER REGULATOR
RV-1	MAIN RELIEF VALVE
RV-2	LINE RELIEF VALVE
BD-1	BURST DISC

A	TOP FILL
B	LIQUID W/DRAWAL
C	PRESSURE BUILDING INLET
D	PRESSURE BUILDING OUTLET
E	LIQUID PHASE
F	VAPOR PHASE
G	VENT/FULL TRYCOCK
H	SAFETY CIRCUIT

***Customer specific configurations are available upon request.**

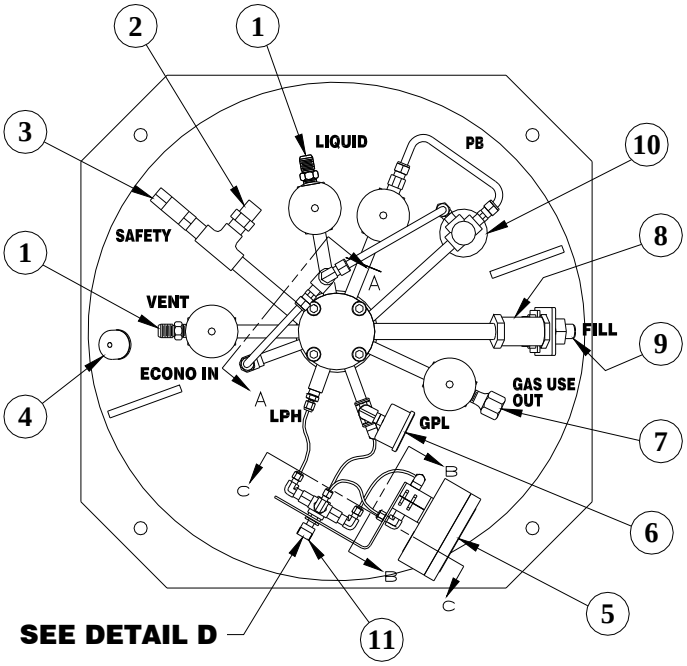
Perma-Cyl 230/300-01 Chart Standard



P/N 11560847
P/N 11560855

The Chart Standard tank configuration provides our customers with the essentials needed for a standard cryogenic vessel.

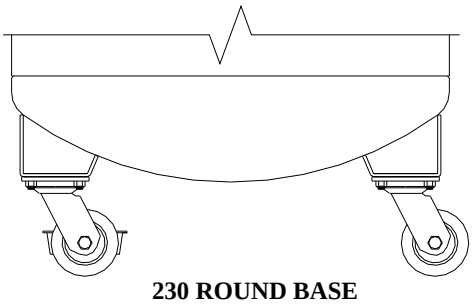
Perma-Cyl 230/300-02 Cyl-Tel Gauge Service Valve



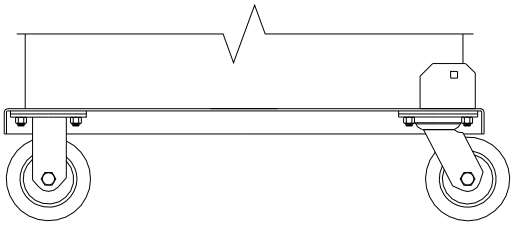
P/N 11525806
P/N 11542420

The Cyl-Tel Gauge Service Valve tank configuration provides our customers with a 4-way valve gauge isolation.

*Top View of 300 liter model w/base plate. The 230 model has optional square base w/casters or round base w/casters. See detail.

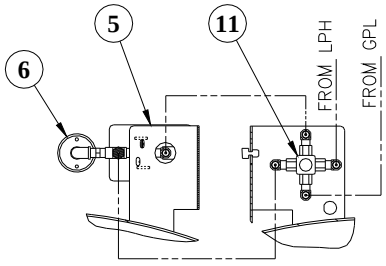


230 ROUND BASE



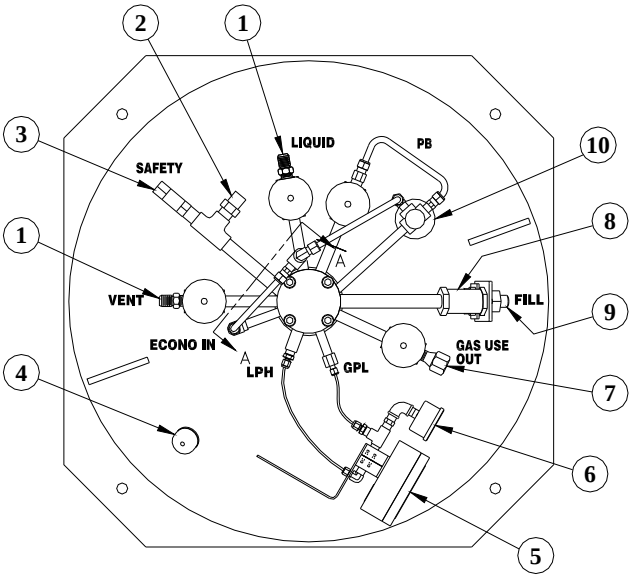
230 SQUARE BASE

SECTION A-A **DETAIL D**



SECTION B-B **SECTION C-C**

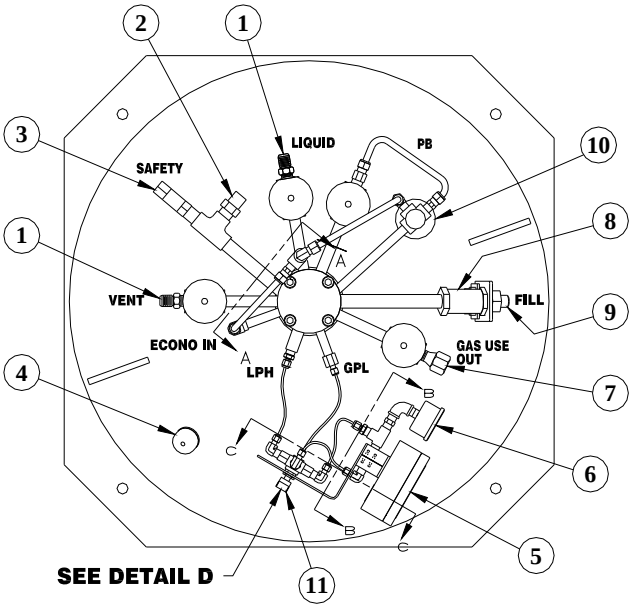
Perma-Cyl 450/700-01
Chart Standard



P/N 11560847-450 P/N 11725066-700
P/N 11560855-450 P/N 11725031-700
P/N 11560863-450

The Chart Standard tank configuration provides our customers with the essentials needed for a standard cryogenic vessel.

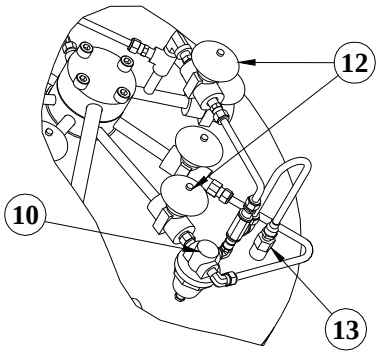
Perma-Cyl 450/700-02
Cyl-Tel Gauge Service Valve



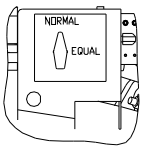
P/N 11525806-450 P/N 11725058-700
P/N 11542420-450 P/N 11684292-700
P/N 11542649-450

The Cyl-Tel Gauge Service Valve tank configuration provides our customers with a 4-way valve gauge isolation.

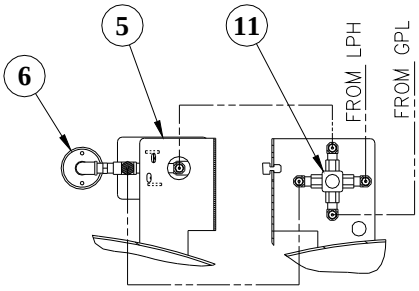
*O.D. of 450 is 30”(shown above), O.D. of 700 is 42”.



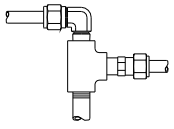
DETAIL E



DETAIL D



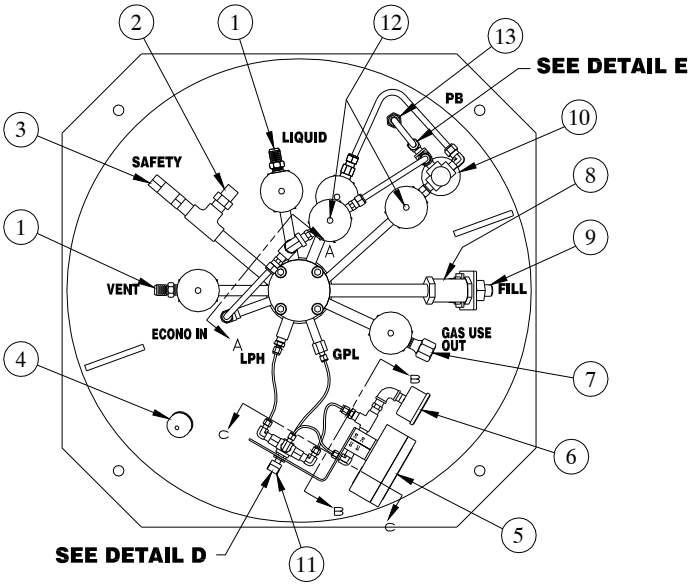
SECTION B-B **SECTION C-C**



TO ECONO IN

SECTION A-A

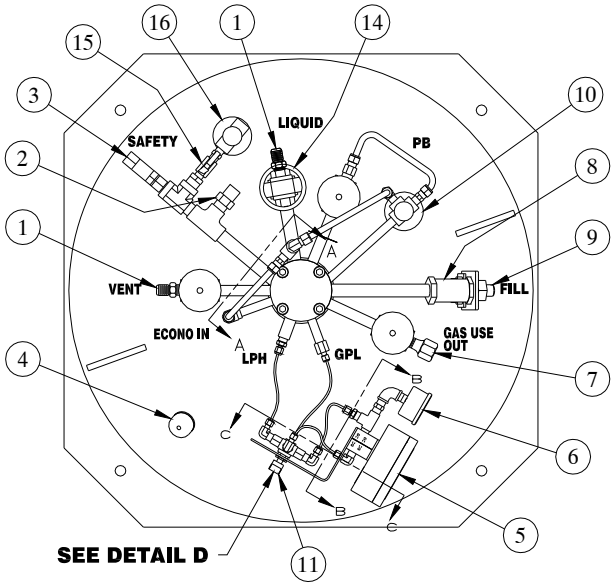
Perma-Cyl 450/700-03
Service Valves & High Pressure



P/N 11528024-450
P/N 11542411-450
P/N 11542631-450
P/N 11724936-700
P/N 11725040-700

The Service Valves & High Pressure tank configuration provides our customers with a 4-way valve gauge isolation, and regulator isolation valves.

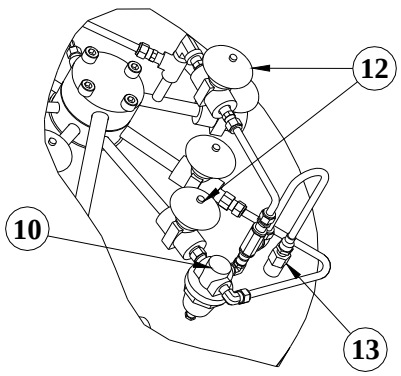
Perma-Cyl 450/700-04
Low Pressure Liquid



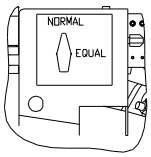
P/N 11394480-450
P/N 11725023-700

The Low Pressure Liquid tank configuration provides our customers with a 4-way valve gauge isolation, liquid withdrawal ball valve, and a valved relief regulator (15-50 psi range).

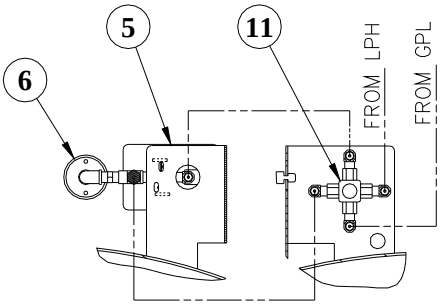
*O.D. of 450 is 30”(shown above), O.D. of 700 is 42”.



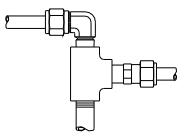
DETAIL E



DETAIL D



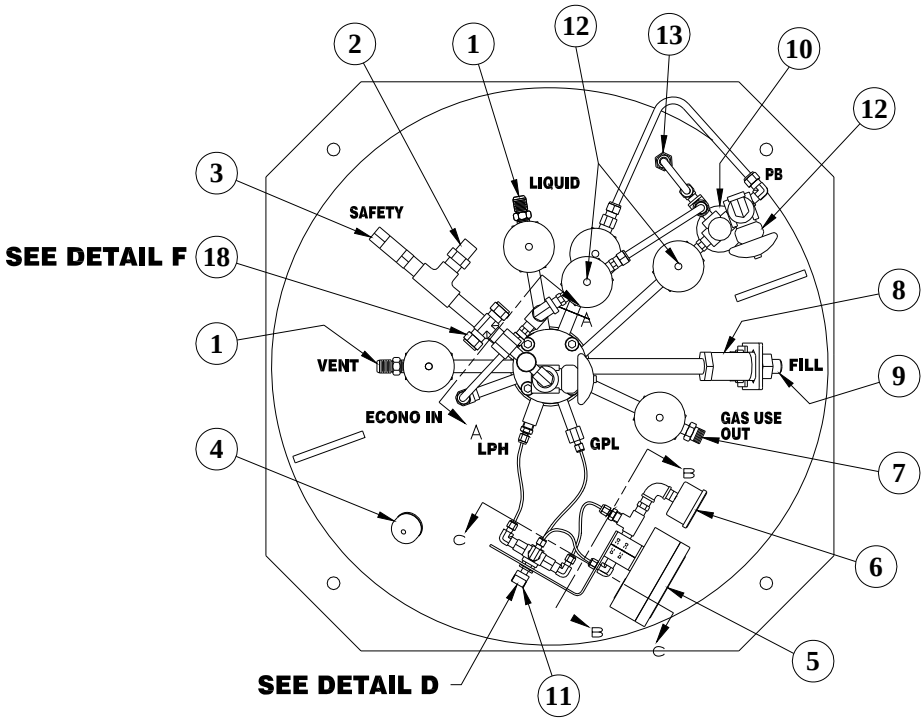
SECTION B-B **SECTION C-C**

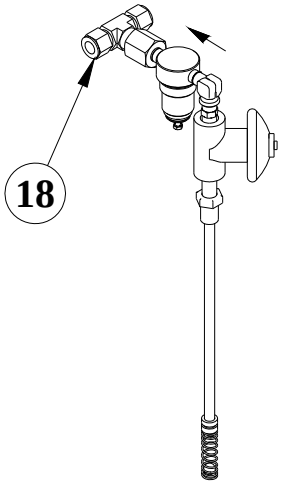


TO ECONO IN

SECTION A-A

Perma-Cyl 450/700-05 CO_2 Service



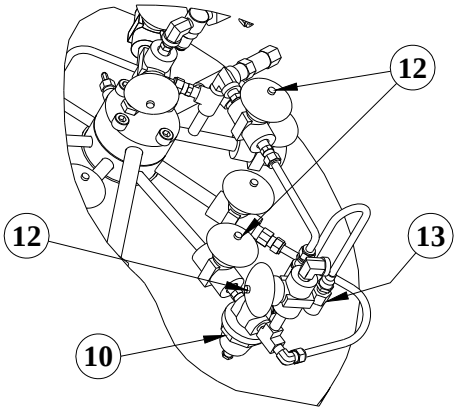


DETAIL F

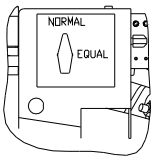
P/N 11541523-450 P/N 11700264-700

The CO_2 Service tank configuration provides our customers with a 4-way valve gauge isolation, regulator isolation valves, and a CO_2 Package, including the patented Sure-fill System.

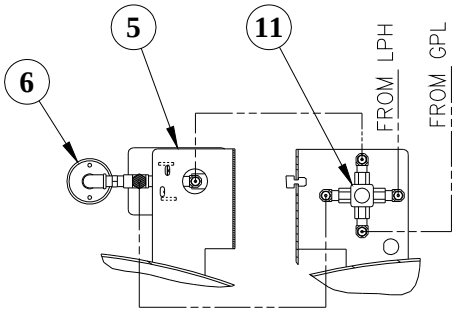
*O.D. of 450 is 30”(shown above), O.D. of 700 is 42”.



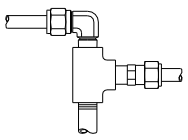
DETAIL E



DETAIL D



SECTION B-B **SECTION C-C**



TO ECONO IN

SECTION A-A

PERMA-CYL 230/300/450/700

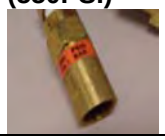
STANDARD:

ITEM	PART NO.	DESCRIPTION
1a	1110072	**Connection 1/2” ODT x 3/8” (45° Flare-Inert)** 
1b	1110112	**Connection 5/8” ODT x 3/8” (45° Flare-OXY)** 
2a	11671281	**Rupture Disk (375PSI)** 
2b	11526569	**Rupture Disk (525PSI)** 
2c	11526622	**Rupture Disk (700PSI)** 
3a	11488574	**Relief Valve (250PSI)** 
3b	11488591	**Relief Valve (350PSI)** 
3c	11385111	**Relief Valve (500PSI)** 
4	3911217	**Black Plastic Cap** 

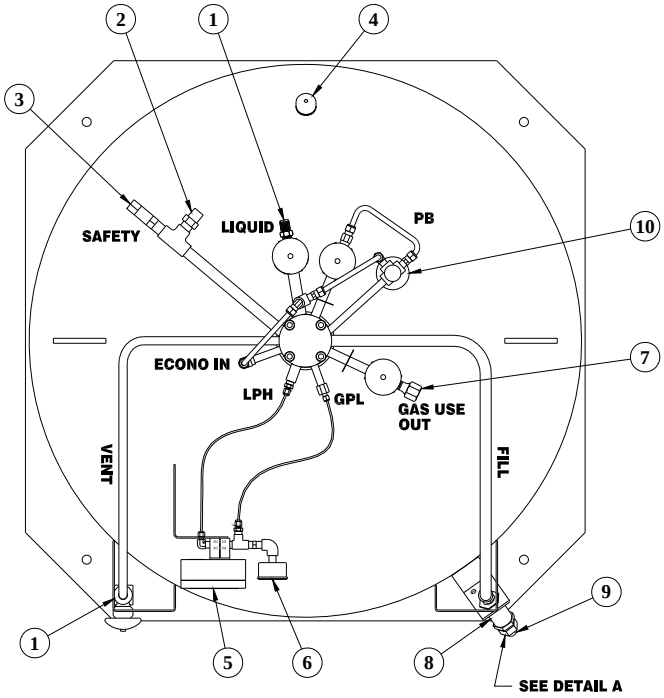
ITEM	PART NO.	DESCRIPTION
5	11018142	**Cyl-Tel Gauge** 
6a	2015179	**Pressure Gauge (0-400 PSI)** 
6b	2010064	**Pressure Gauge (0-600 PSI)** 
7a	4010022	**Outlet 3/8" MPT (INERT)** 
7b	4010012	**Outlet 3/8" MPT (OXY)** 
7c	4010562	**Outlet 3/8" MPT (CO2)** 
8	11051090	**Check Valve 1/2” FPT x 1/2” FPT** 
9.1a	10873809	**Quick Connect Fill Fitting (ARG)** 

ITEM	PART NO.	DESCRIPTION
9.1b	10873796	**Quick Connect Fill Fitting (OXY)** 
9.1c	10873817	**Quick Connect Fill Fitting (NIT)** 
9.1d	**10582833**	**Quick Connect Fill Fitting (CO2)** 
9.2a	1110122	**Connection 1/2” ODT x 1/2” (45° Flare-Inert)** 
9.2b	1110912	**Connection 5/8” ODT x 1/2” (45° Flare-OXY)** 
10a	11081336	**Combination Regulator 1/4” NPT (125 PSI)** 
10b	11081328	**Combination Regulator 1/4” NPT (300 PSI)** 
10c	11375625	**Combination Regulator 1/4” NPT (450 PSI)** 

PERMA-CYL 230/300/450/ 700 OPTIONS:

ITEM	PART NO.	DESCRIPTION
10d	10645339	**Combination Regulator 1/4” NPT (15-50PSI)** 
11	11026353	**4-Way Valve** 
12	1716702	**1/4" Isolation Valve** 
13	1812702	**Line Relief Valve (550PSI)** 
14	11539491	**1/2" Ball Valve** 
15	1716162	**1/4" Valve Iso. SUC** 
16	11696795	**Adjustable Relief Regulator (35PSI)** 
7	1716702	1/4" Drain Valve 
18	11567045	Sure Fill Assembly (See Detail F)

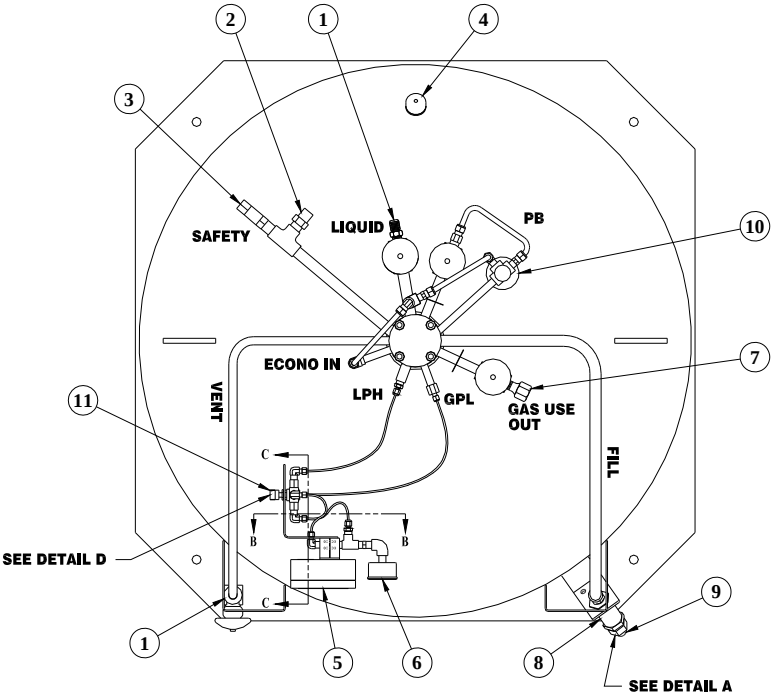
Perma-Cyl 1000-01 Chart Standard



P/N 11560898
P/N 11482017
P/N 11482050

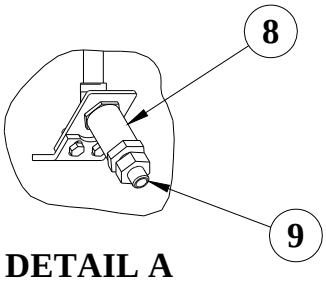
The Chart Standard tank configuration provides our customers with the essentials for a standard cryogenic vessel.

Perma-Cyl 1000-02 Cyl-Tel Gauge Service Valve

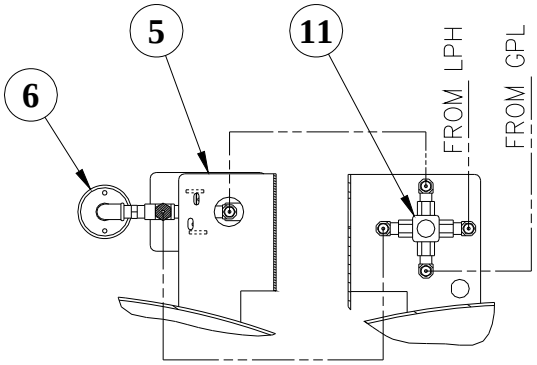


P/N 11394404
P/N 11482025
P/N 11482041

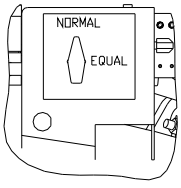
The Cyl-Tel Gauge Service Valve tank configuration provides our customers with a 4-way valve gauge isolation.



DETAIL A

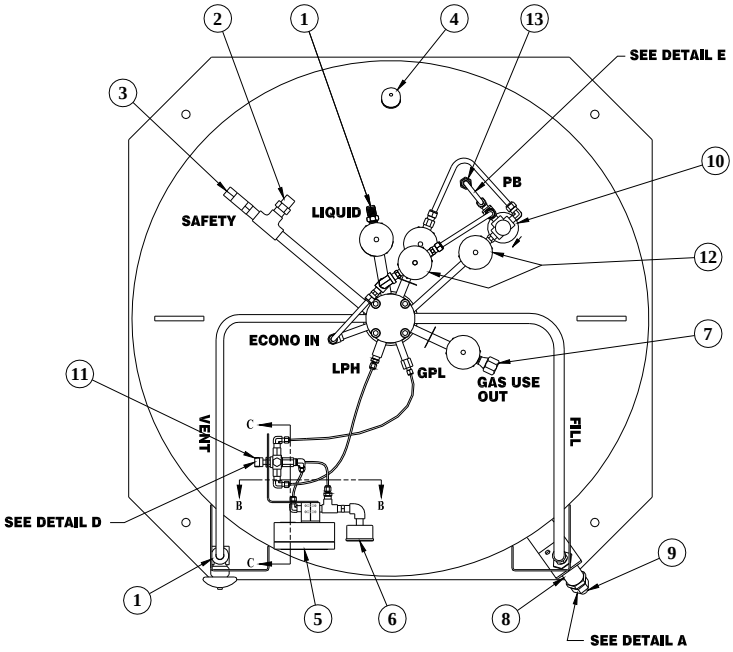


SECTION B-B SECTION C-C



DETAIL D

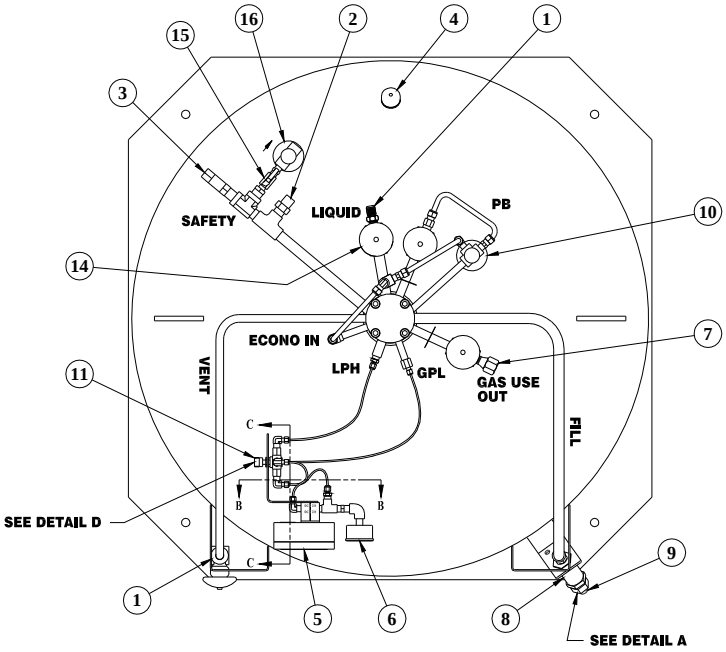
Perma-Cyl 1000-03 Service Valves & High Pressure



P/N 11394498
P/N 11482033
P/N 11482009

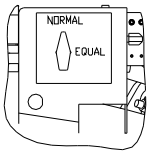
The Service Valves & High Pressure tank configuration provides our customers with a 4-way valve gauge isolation, and regulator isolation valves.

Perma-Cyl 1000-04 Low Pressure Liquid

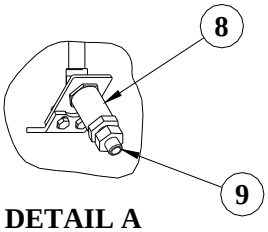


P/N 11394501

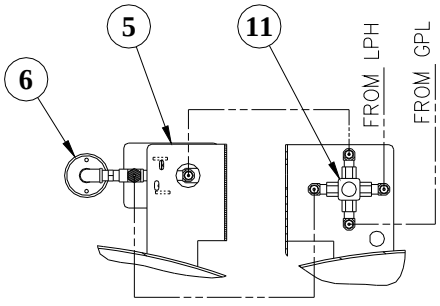
The Low Pressure Liquid tank configuration provides our customers with a 4-way valve gauge isolation, a liquid withdrawal ball valve, a valved relief regulator (15-50 psi



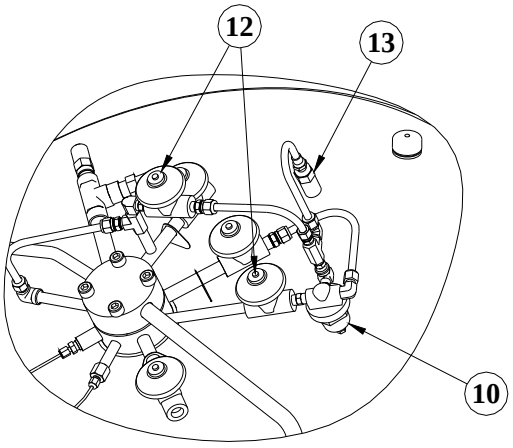
DETAIL D



DETAIL A

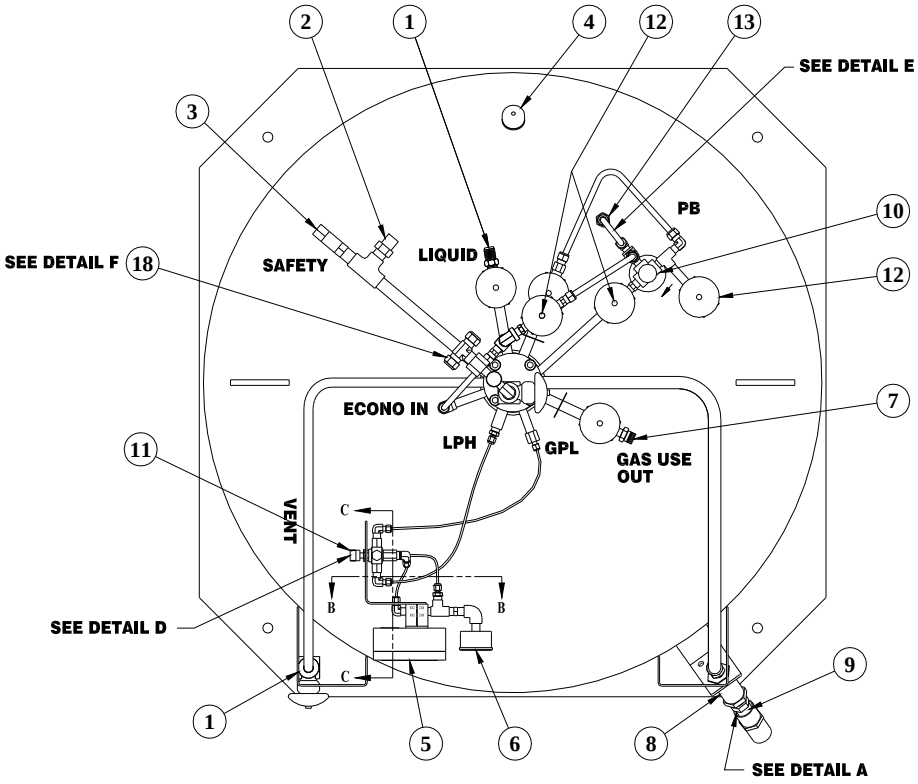


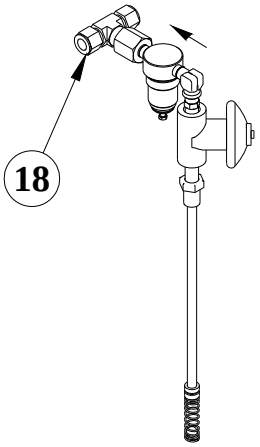
SECTION B-B SECTION C-C



DETAIL E

Perma-Cyl 1000-05 CO_2 Service

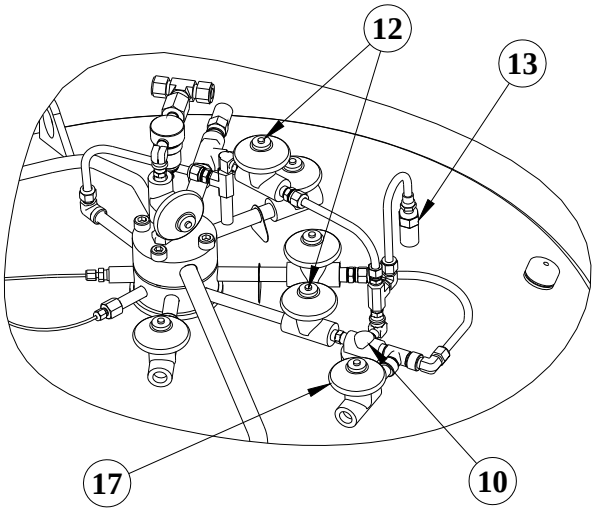




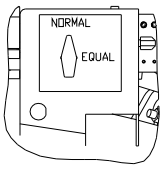
DETAIL F

P/N 11394519
P/N 11552548

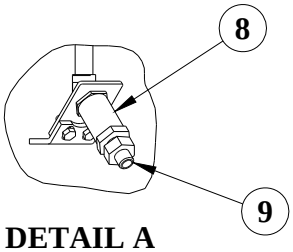
The CO_2 Service tank configuration provides our customers with a 4-way valve gauge isolation, regulator isolation valves, and a CO_2 Package, including the patented Sure-fill System.



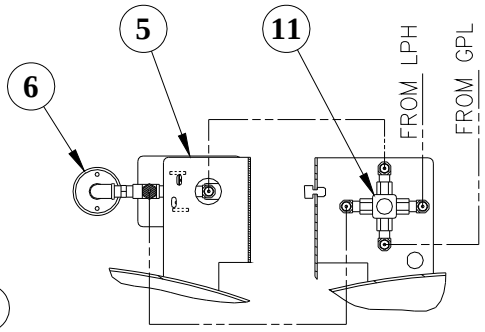
DETAIL E



DETAIL D

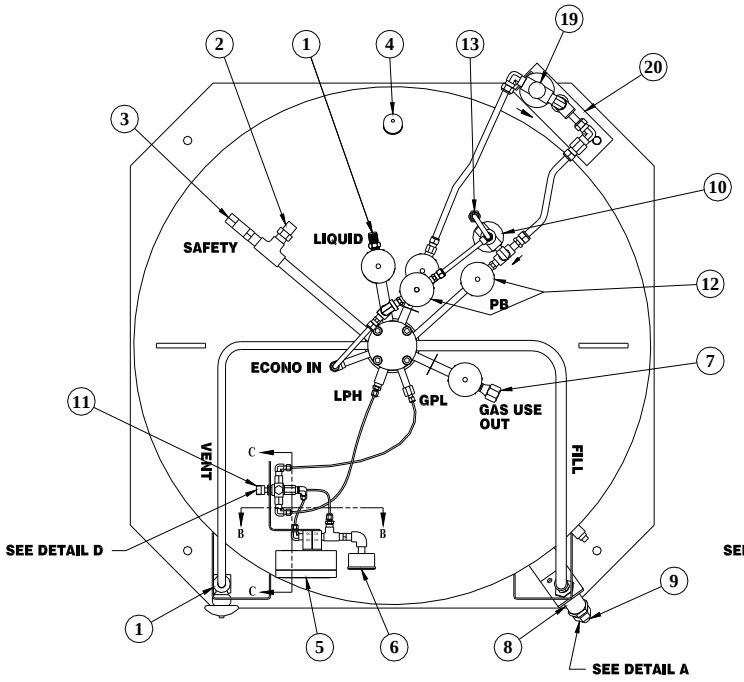


DETAIL A



SECTION B-B **SECTION C-C**

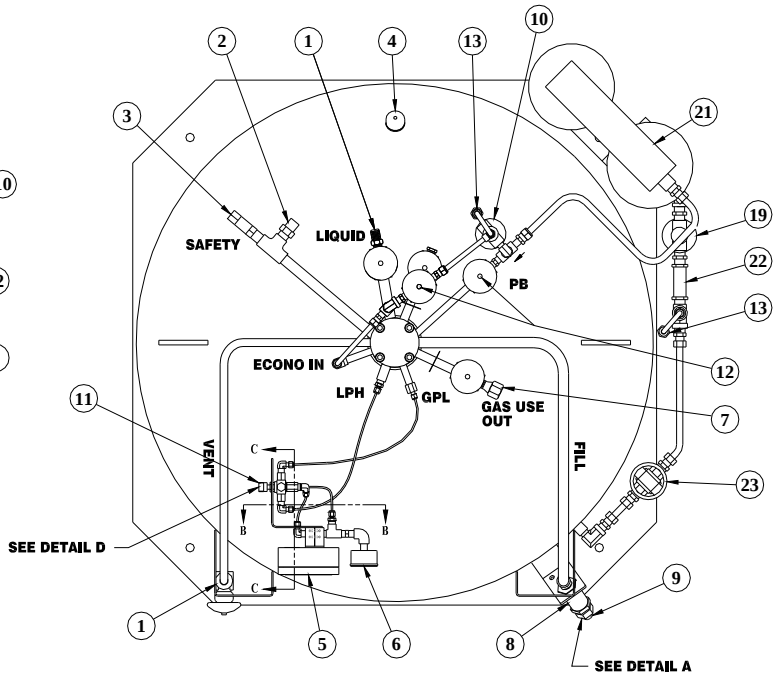
Perma-Cyl 1000 VHP-06
Lynx External PB



P/N 11717744

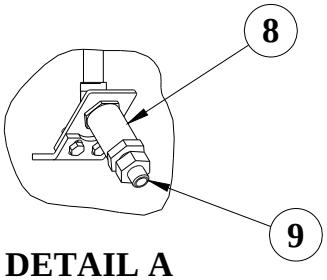
The Lynx PB option (06) adds performance benefits to the Perma-Cyl by decreasing the pressure recovery time after a fill and increasing the maximum withdrawal rate from the cylinder.

Perma-Cyl 1000-07
ZX Super-Charged PB

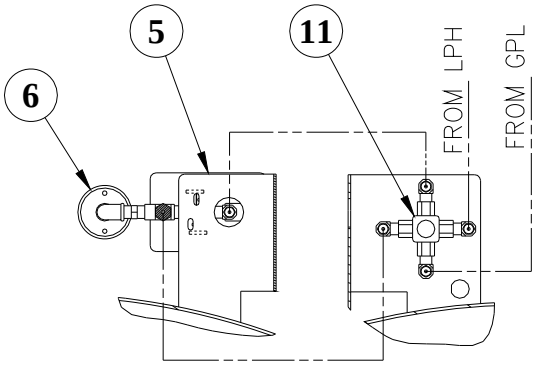


P/N 11725091

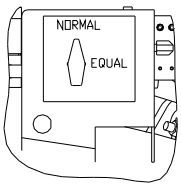
The ZX Supercharged PB (option 07) should be specified when the utmost in cylinder performance is required. This system will dramatically reduce pressure recovery time to around 15 minutes or less in most cases. When used with an external vaporizer, withdrawal rates of up to 7000 SCFH can be obtained.



DETAIL A



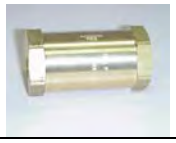
SECTION B-B SECTION C-C



DETAIL D

PERMA-CYL 1000 STANDARD:

ITEM	PART NO.	DESCRIPTION
1a	1110072	**Connection 1/2” ODT x 3/8” (45° Flare-Inert)** 
1b	1110112	**Connection 5/8” ODT x 3/8” (45° Flare-OXY)** 
2a	11671281	**Rupture Disk (375PSI)** 
2b	11526569	**Rupture Disk (525PSI)** 
2c	11526622	**Rupture Disk (700PSI)** 
3a	11488574	**Relief Valve (250PSI)** 
3b	11488591	**Relief Valve (350PSI)** 
3c	11385111	**Relief Valve (500PSI)** 
4	3911217	**Black Plastic Cap** 

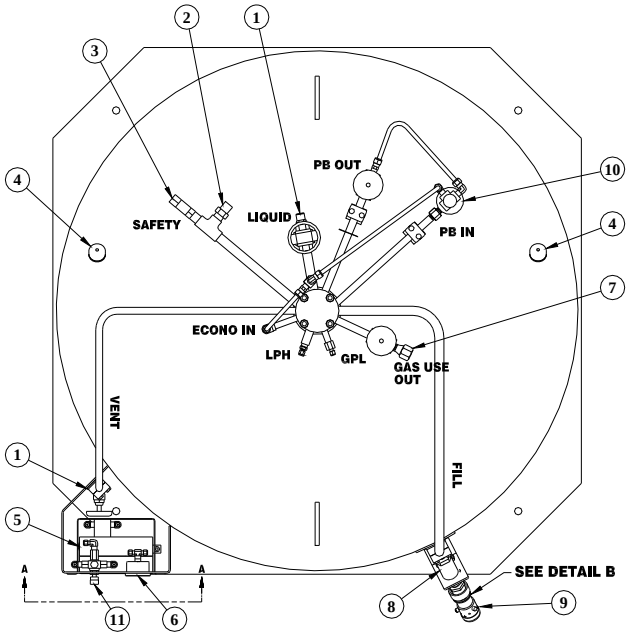
ITEM	PART NO.	DESCRIPTION
5	11018142	**Cyl-Tel Gauge** 
6a	2015179	**Pressure Gauge (0-400 PSI)** 
6b	2010064	**Pressure Gauge (0-600 PSI)** 
7a	4010022	**Outlet 3/8" MPT (INERT)** 
7b	4010012	**Outlet 3/8" MPT (OXY)** 
7c	4010562	**Outlet 3/8" MPT (CO2)** 
8	11051090	**Check Valve 1/2” FPT x 1/2” FPT** 
9.1a	10873809	**Quick Connect Fill Fitting (ARG)** 

ITEM	PART NO.	DESCRIPTION
9.1b	10873796	**Quick Connect Fill Fitting (OXY)** 
9.1c	10873817	**Quick Connect Fill Fitting (NIT)** 
9.1d	10582833	**Quick Connect Fill Fitting (CO2)** 
9.2a	1110122	**Connection 1/2” ODT x 1/2” (45° Flare-Inert)** 
9.2b	1110912	**Connection 5/8” ODT x 1/2” (45° Flare-OXY)** 
10a	11081336	**Combination Regulator 1/4” NPT (125 PSI)** 
10b	11081328	**Combination Regulator 1/4” NPT (300 PSI)** 
10c	11375625	**Combination Regulator 1/4” NPT (450 PSI)** 

PERMA-CYL 1000 OPTIONS:

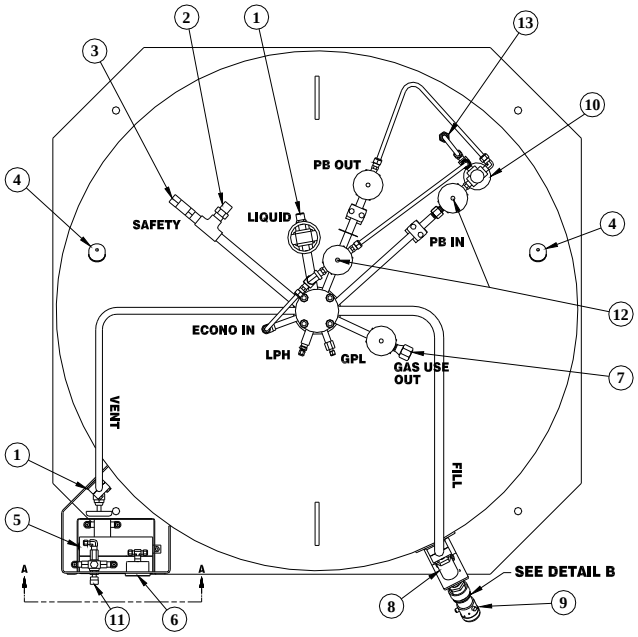
ITEM	PART NO.	DESCRIPTION
10d	10645339	**Combination Regulator 1/4” NPT (15-50PSI)** 
11	11026353	**4-Way Valve** 
12	1716702	**1/4" Isolation Valve** 
13	1812702	**Line Relief Valve (550PSI)** 
14	11539491	**1/2" Ball Valve** 
15	1716162	**1/4" Valve Iso. SUC** 
16	11696795	**Adjustable Relief Regulator (35PSI)** 
7	1716702	1/4" Drain Valve 
18	11567045	Sure Fill Assembly (See Detail F)

Perma-Cyl 1500 HP-02 Cyl-Tel Gauge Service Valve

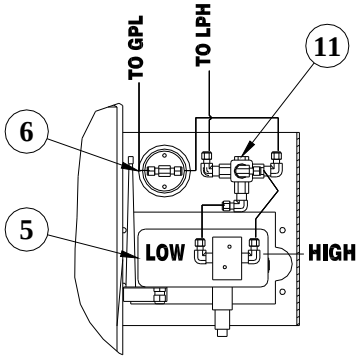


The Cyl-Tel Gauge Service Valve tank configuration provides our customers with a 4-way valve gauge isolation.

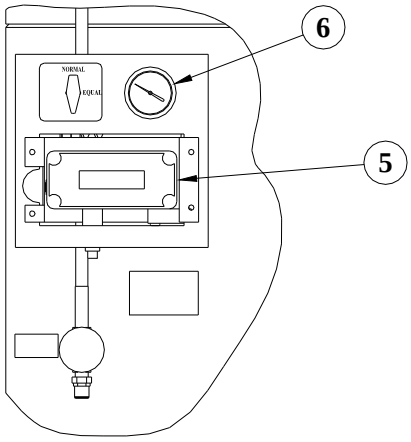
Perma-Cyl 1500 HP-03 Service Valves & High Pressure



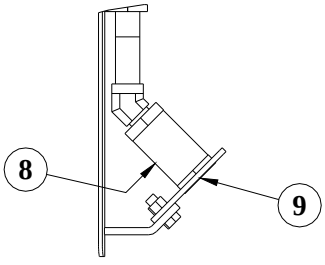
The Service Valves & High Pressure tank configuration provides our customers with a 4-way valve gauge isolation, and regulator isolation valves.



VIEW A-A

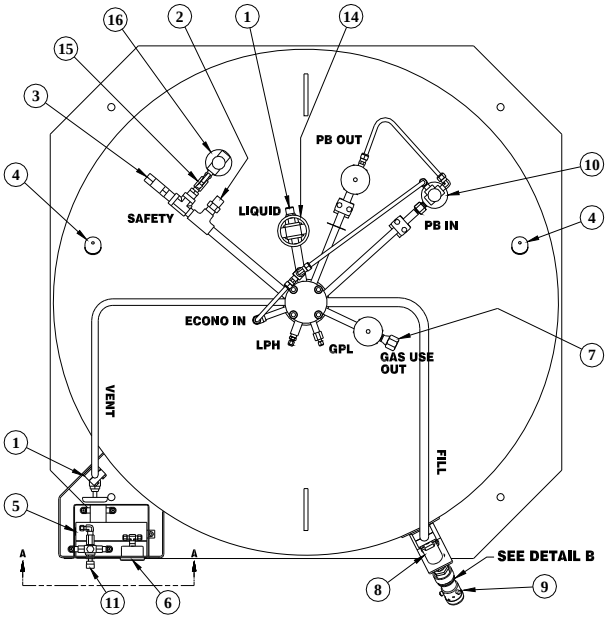


PLUMBING VIEW OF VIEW A-A



DETAIL B

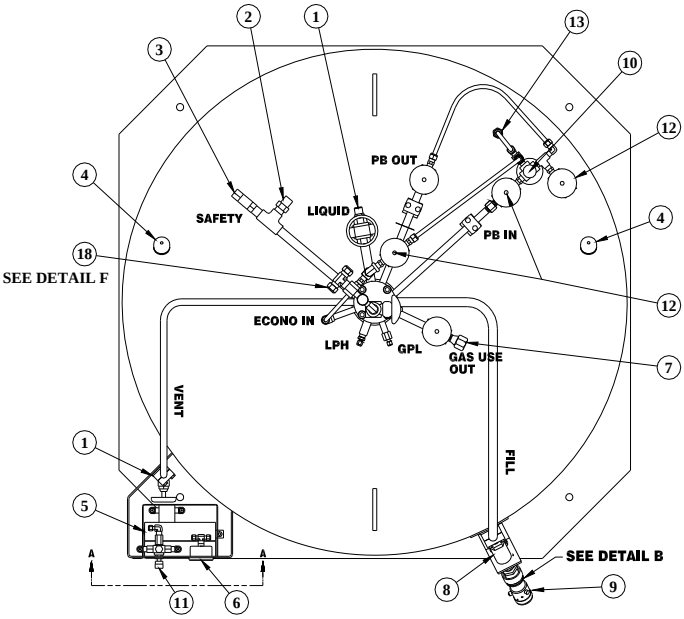
Perma-Cyl 1500 HP-04 Low Pressure Liquid



P/N1151570

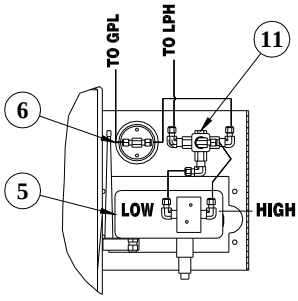
The Low Pressure Liquid tank configuration provides our customers with a 4-way valve gauge isolation, a liquid withdrawal ball valve, a valved relief regulator (15-50 psi range).

Perma-Cyl 1500 HP-05 CO_2 Service

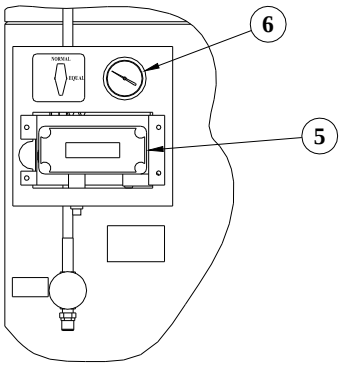


P/N 11551561
P/N 11552513

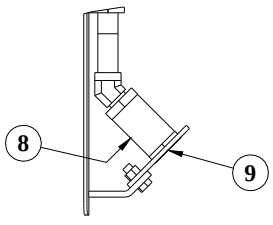
The CO_2 Service tank configuration provides our customers with a 4-way valve gauge isolation, regulator isolation valves, and a CO_2 Package, including the patented Sure-fill System.



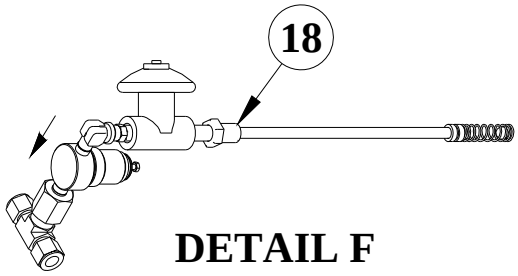
VIEW A-A



PLUMBING VIEW OF VIEW A-A



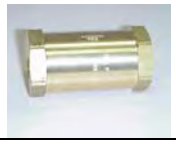
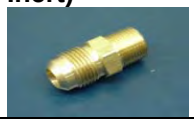
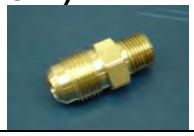
DETAIL B



DETAIL F

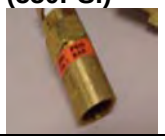
PERMA-CYL 1500 HP STANDARD:

ITEM	PART NO.	DESCRIPTION
1a	1110072	**Connection 1/2” ODT x 3/8” (45° Flare-Inert)** 
1b	1110112	**Connection 5/8” ODT x 3/8” (45° Flare-OXY)** 
2	11526569	**Rupture Disk (525PSI)** 
3	11488591	**Relief Valve (350PSI)** 
4	3911217	**Black Plastic Cap** 
5	11018142	**Cyl-Tel Gauge** 
6	2015179	**Pressure Gauge (0-400 PSI)** 
7a	4010022	**Outlet 3/8" MPT (INERT)** 
7b	4010012	**Outlet 3/8" MPT (OXY)** 

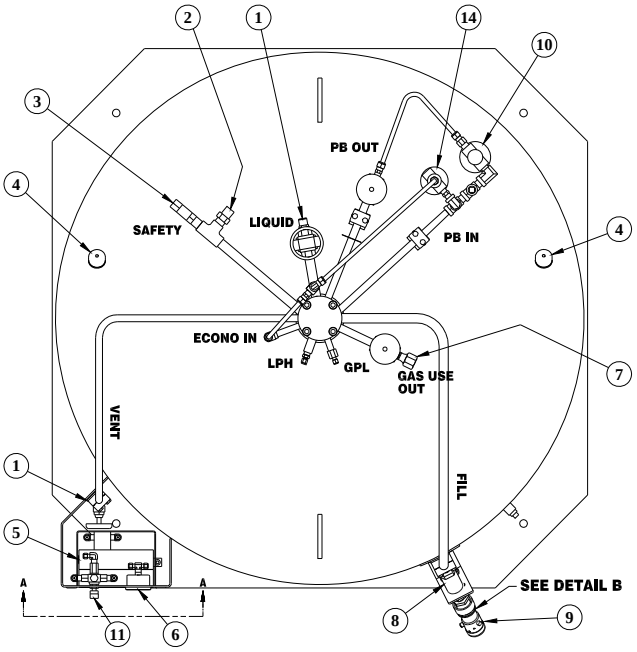
ITEM	PART NO.	DESCRIPTION
7c	4010562	**Outlet 3/8" MPT (CO2)** 
8	11051090	**Check Valve 1/2” FPT x 1/2” FPT** 
9.1a	10873809	**Quick Connect Fill Fitting (ARG)** 
9.1b	10873796	**Quick Connect Fill Fitting (OXY)** 
9.1c	10873817	**Quick Connect Fill Fitting (NIT)** 
9.1d	**10582833**	**Quick Connect Fill Fitting (CO2)** 
9.2a	1110122	**Connection 1/2” ODT x 1/2” (45° Flare-Inert)** 
9.2b	1110912	**Connection 5/8” ODT x 1/2” (45° Flare-OXY)** 

ITEM	PART NO.	DESCRIPTION
10a	11081328	**Combination Regulator 1/4” NPT (300 PSI)** 

PERMA-CYL 1500 HP OPTIONS:

ITEM	PART NO.	DESCRIPTION
10b	10645339	**Combination Regulator 1/4” NPT (15-50PSI)** 
11	11939013	**5-Way Valve** 
12	1716702	**1/4" Isolation Valve** 
13	1812702	**Line Relief Valve (550PSI)** 
14	11539491	**1/2" Ball Valve** 
15	1716162	**1/4" Valve Iso. SUC** 
16	11696795	**Adjustable Relief Regulator (35PSI)** 
17	116702	1/4" Drain Valve 
18	11567045	Sure Fill Assembly (See Detail F)

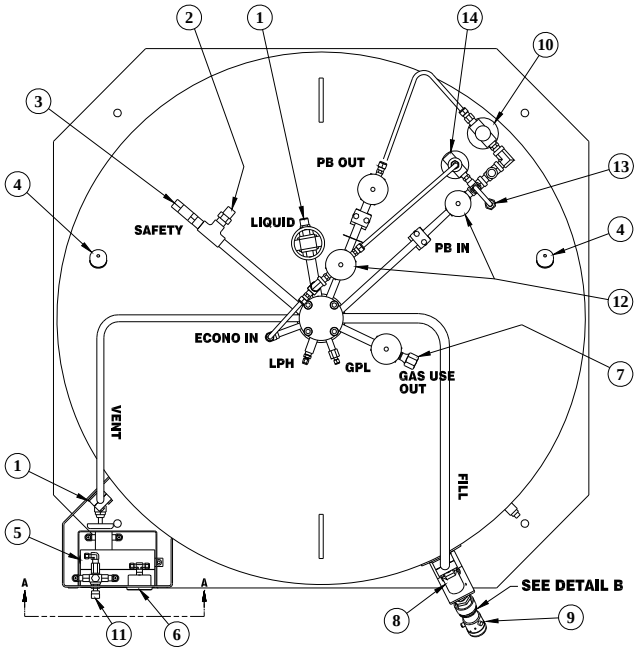
Perma-Cyl 1500 VHP-02 Cyl-Tel Gauge Service Valve



P/N 11560935

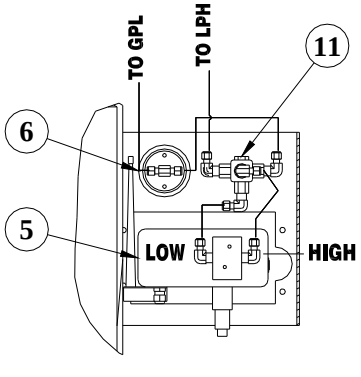
The Cyl-Tel Gauge Service Valve tank configuration provides our customers with a 4-way valve gauge isolation.

Perma-Cyl 1500 VHP-03 Service Valves & High Pressure

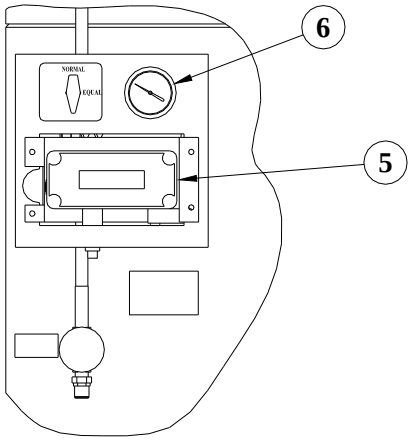


P/N 11554244

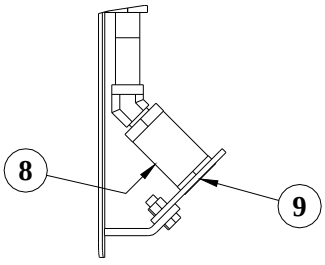
The Service Valves & High Pressure tank configuration provides our customers with a 4-way valve gauge isolation, and regulator isolation valves.



VIEW A-A

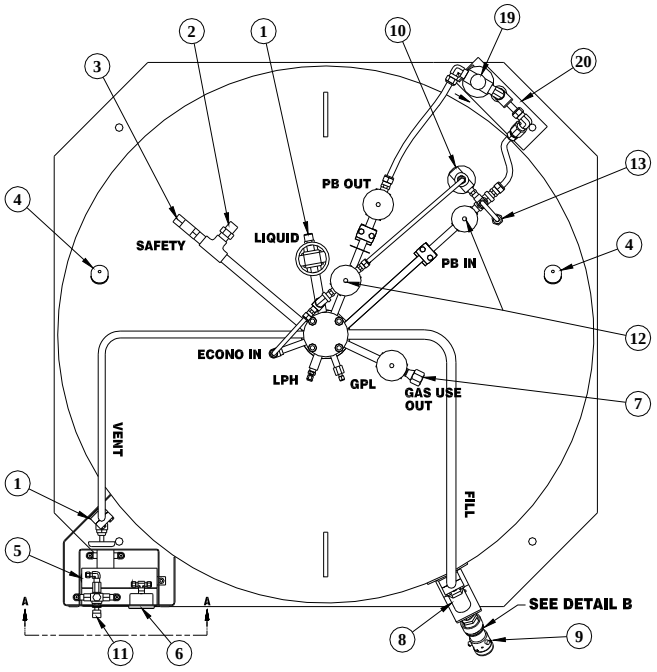


PLUMBING VIEW OF VIEW A-A



DETAIL B

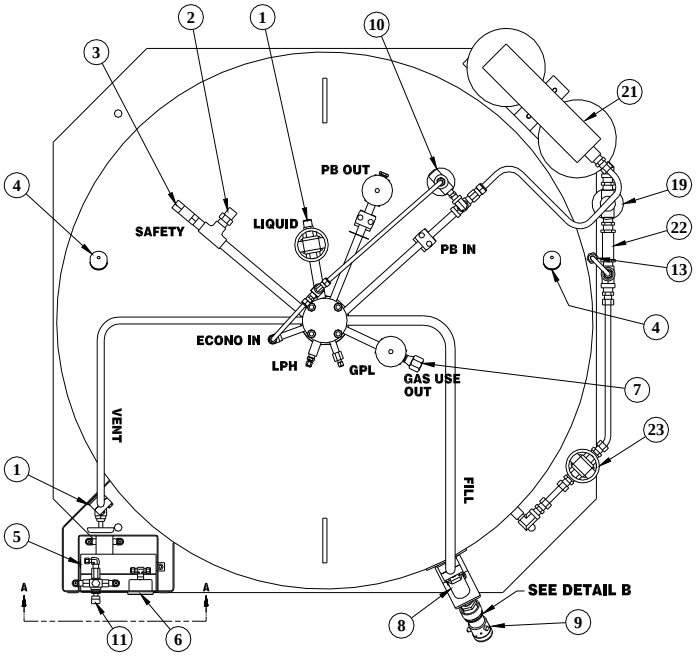
Perma-Cyl 1500 VHP-06
Lynx External PB



P/N 11717736

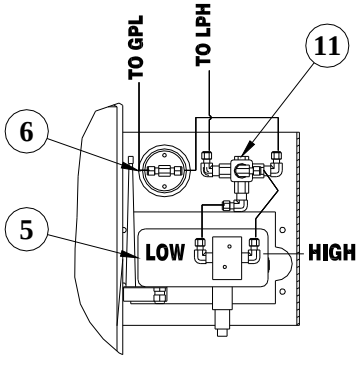
The Lynx PB option (06) adds performance benefits to the Perma-Cyl by decreasing the pressure recovery time after a fill and increasing the maximum withdrawal rate from the cylinder.

Perma-Cyl 1500 VHP-07
ZX Super-Charged PB

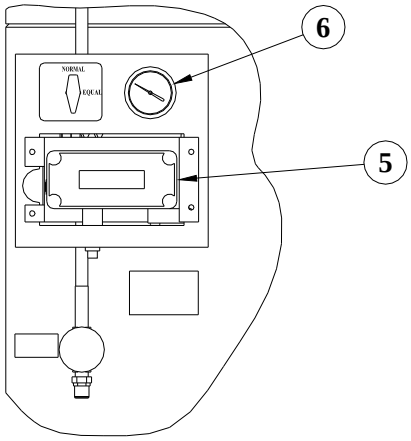


P/N 11722586

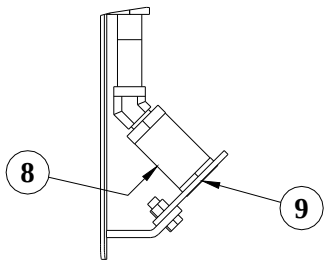
The ZX Supercharged PB (option 07) should be specified when the utmost in cylinder performance is required. This system will dramatically reduce pressure recovery time to around 15 minutes or less in most cases. When used with an external vaporizer, withdrawal rates of up to 7000 SCFH can be obtained.



VIEW A-A

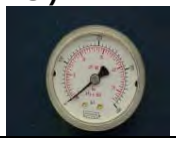


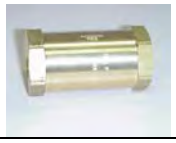
PLUMBING VIEW OF VIEW A-A

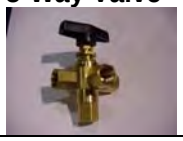


DETAIL B

PERMA-CYL 1500 VHP STANDARD:

ITEM	PART NO.	DESCRIPTION
1a	1110072	**Connection 1/2” ODT x 3/8” (45° Flare-Inert)** 
1b	1110112	**Connection 5/8” ODT x 3/8” (45° Flare-OXY)** 
2c	11526622	**Rupture Disk (700PSI)** 
3c	11385111	**Relief Valve (500PSI)** 
4	3910666	**Blue Plastic Cap** 
5	11018142	**Cyl-Tel Gauge** 
6b	2010064	**Pressure Gauge (0-600 PSI)** 
7a	4010022	**Outlet 3/8" MPT (INERT)** 
7b	4010012	**Outlet 3/8" MPT (OXY)** 

ITEM	PART NO.	DESCRIPTION
7c	4010562	**Outlet 3/8" MPT (CO2)** 
8	11051090	**Check Valve 1/2” FPT x 1/2” FPT** 
9.1a	10873809	**Quick Connect Fill Fitting (ARG)** 
9.1b	10873796	**Quick Connect Fill Fitting (OXY)** 
9.1c	10873817	**Quick Connect Fill Fitting (NIT)** 
9.1d	**10582833**	**Quick Connect Fill Fitting (CO2)** 
9.2a	1110122	**Connection 1/2” ODT x 1/2” (45° Flare-Inert)** 
9.2b	1110912	**Connection 5/8” ODT x 1/2” (45° Flare-OXY)** 

ITEM	PART NO.	DESCRIPTION
10	11061036	**Pressure Building Regulator 3/8" NPT (450PSI)** 
11	11939013	**5-Way Valve** 
14	10619675	**Econ. Regulator ¼" NPT (475PSI)** 

PERMA-CYL 1500 VHP OPTIONS:

ITEM	PART NO.	DESCRIPTION
12	1716702	**1/4" Isolation Valve** 
13	1812702	**Line Relief Valve (550PSI)** 

Chart Packaged Gas Products Warranty Policy

Warranty only applies to original purchaser of Chart equipment and does not transfer to any other party.

Materials, components and workmanship are warranted to be free of defects for 90 days from date of invoice.

Vacuum integrity as measured by conformance to Chart NER (Normal Evaporation Rate) specifications is warranted as follows:

- Perma-Cyl, Mega-Cyl or Laser-Cyl liquid cylinders – 5 years from date of invoice.
- All Chart repaired liquid cylinders – 2 years from date of invoice.

Damage or abuse caused by purchaser voids Chart warranty obligations

Freight damage incurred during shipment from Chart to purchaser must be reported immediately to Chart, and before placing equipment into service.

In the event of a valid warranty claim, Chart reserves the right to repair, replace or refund the value of the equipment at its discretion. The warranty applies only to the purchased Chart equipment and in no case is Chart obligated to reimburse the purchaser for consequential damages resulting from the operation of Chart equipment.

SPECIFICATIONS 9

Description		230 Liter C MP, LCCM Square Base w/Casters	230 Liter C MP, LCCM Round Base w/Casters	230 Liter C HP, LCCM Square Base w/Casters	230 Liter HP, LCCM Round Base w/Casters	300 Liter MP Plate Base	450 Liter MP Plate Base	450 liter HP Plate Base	450 Liter VHP Plate Base	700 Liter HP Plate Base	1000 Liter HP Plate Base	1000 Liter VHP Plate Base	1500 Liter HP Pallet Base	1500 Liter VHP Pallet Base
Capacity (liters)	Gross	240	240	240	240	330	450	450	450	688	1,056	1,056	1,550	1,550
	Net	230	230	230	230	300	420	420	420	645	950	950	1,455	1,455
MAWP	psig	235	235	350	350	250	250	350	500	350	350	500	350	500
	bar	16.2	16.2	24.1	24.1	17.2	17.2	24.1	34.5	24.1	24.1	34.5	24.1	34.5
Design Spec		DOT	DOT	DOT	DOT	ASME	ASME	ASME	ASME	ASME	ASME	ASME	ASME	ASME
Storage Capacity														
Nitrogen	SCF	5,024	5,024	4,734	4,734	7,380	10,332	10,332	10,332	15,860	23,370	23,370	35,550	35,550
	Nm3	142	142	134	134	193	272	272	272	449	615	615	935	935
Oxygen	SCF	6,244	6,244	5,930	5,930	9,100	12,760	12,760	12,760	19,600	28,861	28,861	43,900	43,900
	Nm3	177	177	168	168	239	336	336	336	554	759	759	1,155	1,155
Argon	SCF	6,073	6,073	5,763	5,763	8,850	12,478	12,478	12,478	19,160	28,225	28,225	42,950	42,950
	Nm3	172	172	163	163	234	328	328	328	542	742	742	1,130	1,130
Thermal Performance														
(NER%/Day)	N	1.80%	1.80%	1.80%	1.80%	1.20%	1.80%	1.80%	1.80%	1.00%	1%	1%	1%	1%
	O2 - Ar	1.12%	1.12%	1.12%	1.12%	0.74%	1.12%	1.12%	1.12%	0.62%	0.62%	0.62%	0.62%	0.62%
Gas Delivery Rate	SCF/H	400	400	400	400	500	575	575	575	660	960	960	1,350	1,350
	Nm3h	10.5	10.5	10.5	10.5	14.1	15.1	15.1	15.1	18.6	25.2	25.2	35.4	35.4
Dimensions														
Diameter	in	26	26	26	26	26	30	30	30	42	42	42	48	48
	mm	660	660	660	660	660	762	762	762	1067	1,067	1,067	1,219	1,219
Tare Weight	lbs	300	300	340	340	450	605	688	812	1165	1,750	2,080	2,692	3,200
	Kg	136	136	154	154	204	274	312	368	529	794	945	1,221	1,451
Height	in	54.8	52.9	54.8	52.9	68	68	68	68	66	81	81	91	91
	mm	1,392	1,344	1,392	1,344	1,727	1,727	1,727	1,727	1,676	2,058	2,058	2,311	2,311

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
No gas to gas-use equipment. OR Insufficient pressure to gas-use equipment.	Perma-Cyl tank empty.	1. Switch to emergency gas supply. 2. Call gas supplier for delivery.
	Gas Use Valve to final line regulator is closed or other valves downstream are closed.	1. Open valve or valves, as needed. 2. Insure there is no obstruction in the line or valve.
	Pressure builder is not building sufficient pressure.	1. Open pressure building regulator control valve and allow pressure to build. 2. Adjust setting on regulator to a higher pressure. 3. If tank pressure fails to rise, see section on low tank pressure.
	Final line pressure regulator set too low or malfunctioning.	1. Insure gas use valve is open and tank pressure is at least 25 psi higher than desired working pressure of final regulator. 2. Call service technician.
	Inappropriate type of regulator (high-pressure or 2-stage or too small) installed as final line regulator and is not able to supply sufficient gas flow.	1. Insure gas use valve is open and tank pressure is at least 25 psi higher than desired working pressure of final regulator. 2. Inspect final line regulator or its specifications to determine if it has a suitable flow capacity for the required inlet and outlet pressures. 3. Call appropriate equipment supplier or service technician.
	Gas supply line, hose, or network contains excessive pressure drop.	1. Check line for sufficient diameter. 2. Remove all unnecessary bends, elbows, reducers, and small diameter valves. 3. Check for leaks in the Gas Supply Line.
	Unknown	1. Call service technician.
Frost or ice on sides, bottom, top-center and/or plumbing of tank.	<u>Normal</u> condition during and following gas use, liquid use or filling.	1. NONE 2. User to check tank for frost / leaks before use.
	Tank is being used for continuous flow application and is not receiving sufficient ambient heat to melt the frost or ice. (Tank may have heavy ice build-up or continuous ice or frost.)	1. Move tank to a warmer location. 2. Add additional environmental heat and/or warm airflow to warm outer piping, components and sides of the tank. 3. Add a switchover system to allow tank to rest and warm up when not in use.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Frost or ice on sides, bottom, top-center and/or plumbing of tank. (continued)	Leak in gas supply lines, gas-use equipment, or tank plumbing. (Frost is present on tank even after an extended period with no gas or liquid use.)	1. Evacuate & ventilate room. 2. If possible, locate and correct leak. 3. User to check tank for frost / leaks each morning before starting gas use. 4. Call appropriate equipment service technician.
	Weak vacuum or failed vacuum.	1. Check if tank pressure is routinely high even during gas use and/or if tank has cold or ice spots even when not in operation as sign of vacuum problem. 2. Condensation or sweating is seen over the entire outer shell as a sign of vacuum problem. 3. Call gas service agent.
	Unknown.	1. Call gas service agent.
Routinely low pressure in tank.	PB shut-off valve is closed. (If PB is not operating, no frost ring will appear at the bottom of the tank during gas use.)	1. Open pressure building regulator control valve and allow pressure to build. 2. Call service agent to repair, replace or adjust regulator.
	Pressure builder setting is too low. (If PB is not operating, no frost ring will appear at the bottom of the tank during gas use.)	1. Adjust regulator to higher pressure and allow pressure to build. 2. Call service agent to repair, replace or adjust regulator.
	Relief valve(s) is stuck open.	1. Evacuate & ventilate the room. 2. Check exhaust of relief valve to see if gas is flowing at a pressure below the pressure stamped on the valve. 3. Tap lightly on the side of the relief valve to attempt to dislodge any obstruction holding valve open. Repeat several times, if needed. 4. Call gas service technician to replace relief valve, if necessary.
	Large gas leak from tank plumbing or from gas use system.	1. Evacuate & ventilate the room. 2. If possible, locate and repair leak or call gas equipment service technician.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Routinely low pressure in tank. (continued)	Gas or liquid withdrawal rate exceeds the tank specifications.	1. Excess usage will cause tank pressure to decrease as PB is unable maintain pressure. Decrease withdrawal rate to within design specifications. 2. Increase pressure setting on PB regulator. 3. If withdrawing gas, consider: [a] withdrawing liquid and using external vaporizer, [b] installing larger tank, [c] installing additional tank(s), or [d] splitting application. 4. If withdrawing liquid, consider: [a] installing larger tank, [b] splitting application or [c] installing additional tank(s). 5. Call gas service agent.
	Unknown	1. Switch to emergency gas cylinder. 2. Call gas service technician.
Gas supply to gas-use equipment is too cold.	Ambient temperature surrounding the Perma-Cyl is too cold.	1. Move tank to warmer location. 2. Install freestanding ambient vaporizer on gas supply line in warmer location or install in-line gas heater.
	Gas withdrawal rate from Perma-Cyl exceeds the capacity of tank's ambient vaporizer.	1. Reduce gas withdrawal rate to within specified parameters. 2. Install freestanding ambient vaporizer on gas supply line in warm location or install in-line heated vaporizer on gas supply circuit. 3. Install larger tank with greater withdrawal rate capacity.
Routinely high tank pressure.	Normal when little or no gas has been used for several days.	1. NONE – Routine use of gas will automatically reduce the tank pressure. 2. Gas usage must exceed NER of tank, if not, contact gas supplier for different tank model.
	Economizer function on regulator is malfunctioning.	1. If tank is in a mixer application and the usage is low, consider drawing gas off the vent line, as the economizer will not work completely in non-consistent draws. 2. Call gas service technician to clean, repair, or replace regulator.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Routinely high tank pressure. (continued)	Tank is over-filled.	1. If tank is filled to or beyond proper fill level, pressure builds very rapidly and relief valve may open. 2. Use gas or liquid as soon as possible to reduce tank contents. 3. Vent tank until no liquid is coming out the vent valve. 4. Follow liquid withdrawal procedures to transfer excess contents into a second tank and eliminate the over-fill situation. Avoid hazards of contact with cryogenic liquids, excess gas concentrations, or high pressure.
	Pressure building function on regulator is set too high or regulator is malfunctioning.	1. Reduce pressure setting on by turning adjustment knob counter-clockwise to the desired pressure setting and continuing normal gas use until pressure drops 2. Close PB isolation valve and carefully observe pressure to insure tank pressure does not drop too low during use. 3. Call gas service technician to adjust PB regulator.
	Weak or failed vacuum	1. Observe if condensation &/or frost are present even during periods of non-use as possible sign of vacuum problem. 2. Call gas service technician.
	Unknown.	1. Call gas service technician.
Hissing sounds or evidence of gas leaking near tank, gas lines, or gas-use equipment.	Normal for short periods of time from some regulators and relief valves.	1. Evacuate and ventilate room or area, if necessary. 2. If possible, observe leak. If leak is not large, does not last long, does not occur frequently and is in well-ventilated area, no action may be needed. If in doubt, call appropriate equipment service technician. 3. If above combined conditions do not exist, call equipment service technician and observe “Safety” precautions.
	Large leaks, leaks from elsewhere in the system, sustained leaks, or frequent leaks (**not** normal).	1. Evacuate all personnel from affected areas. Ventilate room / area. 2. If possible, locate the leak and repair it or call gas service or gas-use equipment service technician.

TROUBLESHOOTING 10

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
High gas usage.	Unrecognized increase in actual gas use.	1. NONE for Perma-Cyl or gas supplier. 2. Gas user to determine reason for increase in gas use.
	Leak in gas supply line or network or in gas-use equipment or tank plumbing, e.g. relief valve.	1. Evacuate & ventilate room, if necessary. 2. If possible, locate and repair leak or call gas-use equipment service agent. 3. User to check tank for frost / leaks before operations.
	Tank pressure routinely too high and venting.	1. See troubleshooting section on routinely high tank pressure.
	High flash or vaporization losses in liquid use application due to high pressure / temperature liquid in tank.	1. Vent tank to approximately 25 psi. Follow safety procedures. 2. In future only refill the Perma-Cyl with low-pressure cryogenic product.
	Error in gas delivery or supplier invoice.	1. Check gas usage history / pattern against supplier invoices. 2. Call gas supplier, if necessary.
Perma-Cyl cannot be filled.	Perma-Cyl is full.	1. NONE
	Fill line is blocked or inoperative.	1. Check for obstructions in the fill line. Clear if necessary. 2. Gently tap on check valve to assure proper operation. 3. Call gas service technician.
	ORCA Delivery Unit is not functioning properly.	1. Refer to ORCA Troubleshooting.
	Transfer hose is obstructed, e.g. hose is bent excessively, crimped or plugged.	1. Clear obstruction, inspect hose for damage, and, if everything is satisfactory, continue the filling.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Perma-Cyl does not shut off properly.	Fill line piping creates too much pressure drop.	1. Insure fill line is piped with ¾" Nominal Copper (or equivalent) with minimal 90 degree bends. 2. Re route fill piping.
	Improper fill procedure.	1. Review the ORCA/Perma-Cyl Filling procedure. 2. Insure that all vent and use valves of the tank are closed.
Liquid withdrawal contains high level of gas.	Saturated liquid pressure in Perma-Cyl is too high. (Temperature or energy level of contents is too high due excess pressure.)	1. Insure PB shut-off valve is closed. 2. Open vent valve to allow excess pressure to vent until desired pressure is obtained. Follow "Safety" guidelines and procedures for venting. 3. Install secondary lower pressure relief valve to reduce saturated pressure of liquid in the future. 4. In future only refill the Perma-Cyl with low-pressure cryogenic product.
Vacuum pump-out port and/or vacuum plug are open or damaged.	Pump-out plug or port have been damaged or tamper with.	1. If possible, transfer any remaining contents to another tank. 2. Call gas service technician to replace and repair tank.
	Inner vacuum space leak has dislodged safety pump-out plug.	1. If possible, transfer any remaining contents to another tank. 2. Call gas service technician to replace and repair tank.

Safety Warning and Reminder

Use only parts, which are cleaned and approved for oxygen service. Chart recommends the use of only Chart approved parts.

TROUBLESHOOTING 10

The following manuals are available for reference on related topics. All manuals are available on the MicroBulk Toolkit CD.

Description	Part Number
Perma-Cyl Installation	11630833
Cyl-Tel Operation	11076422
Cyl-Tel 2 Operation	11761841
OnSite Telemetry	11771370

All manuals are available free of charge by contacting Chart Inc. Customer Service at (800) 400-4683.

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