



230/300/450/1000/1500



Operating Manual



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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.

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

CHART Inc.
407 Seventh Street Northwest
New Prague, MN 56071 USA

You may also reach us at
Phone: 800-400-4683
Fax: 952-758-8293

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 Industries. Its purpose is to provide the users with the necessary information for the operation and the maintenance of the following tanks; Perma-Cyl 230C MP, HP DOT, Perma-Cyl 450MP, Perma-Cyl 450HP, Perma-Cyl 450VHP, Perma-Cyl 1000MP, Perma-Cyl 1000HP, Perma-Cyl 1000VHP, Perma-Cyl 1500HP and Perma-Cyl 1500VHP.

The manual is divided into following sections.

Section 2, the introduction to Perma-Cyl liquid cylinders.

Section 3, the theory of operations.

Section 4, the installation guidelines that should be followed.

Section 5, the quick-start instructions for the Cyl-Tel level gauge.

Section 6, the safety procedures needed in the operation of the tanks.

Section 7, the illustrations and the part listings.

Section 8, the calibration charts.

Section 9, the Warranty on the Perma-Cyl products.

Section 10, the specifications for the Perma-Cyl tanks.



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 manually operated pressure building circuit. A continuous liquid or gas flow can be provided from these cylinders.

CAUTION

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:

CAUTION

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 that they are attached to. 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 than 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

INSTALLATION TOOLS AND SUPPLIES

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
- ◆ 1/4" Plastic Screw Anchors
- ◆ 1/4" 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
Perma-Cyl Wall Box O2 QD	11074515

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:

- ◆ 3/4" x 21" Scaling Chisel
- ◆ 2 1/2" Core Bit
- ◆ 1" x 21: Drill Bit (Masonry)
- ◆ 1/4" x 13" Masonry Bit
- ◆ 1/2" Masonry Bit

7 1/4" 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:

- ◆ 1/4" and 3/8" Masonry Bits
- ◆ Set of Twist Drills
- ◆ 2 1/2" Hole Saw

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



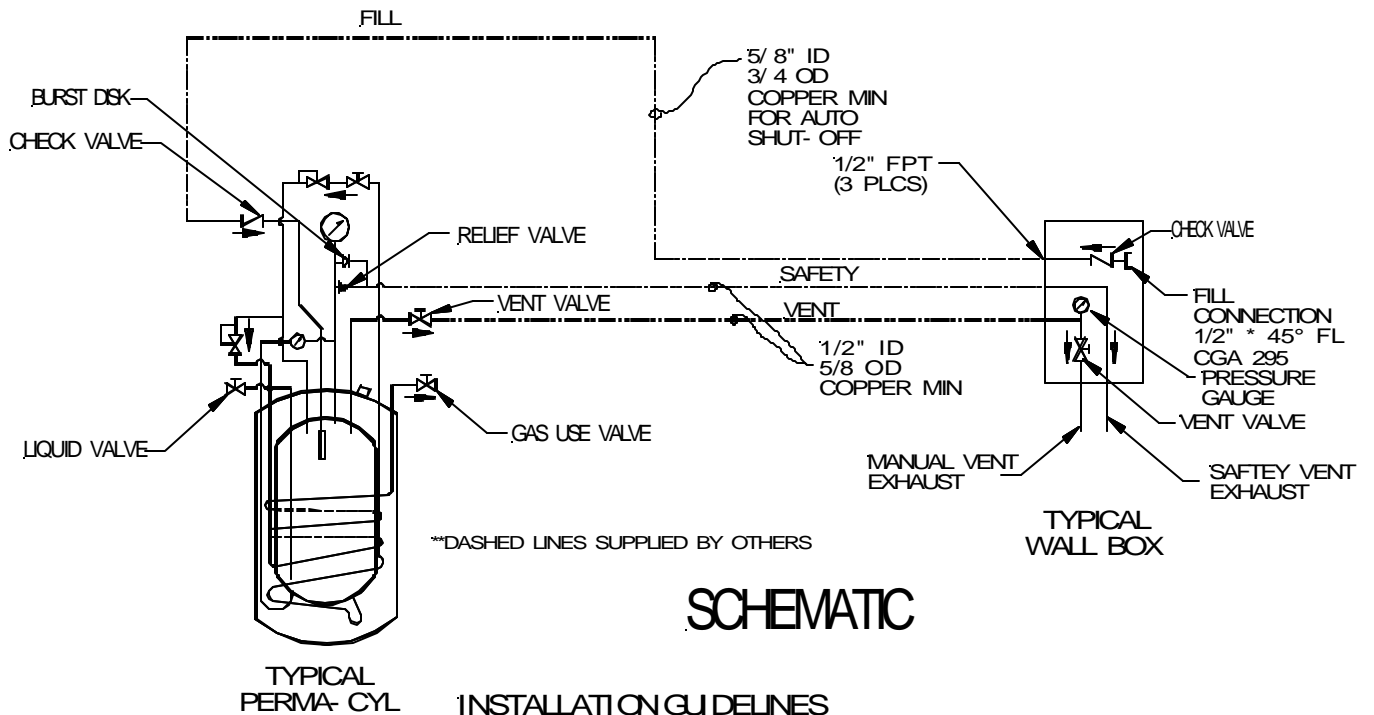
ADDITIONAL REQUIRED SUPPLIES

- ◆ 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.



- SOFT COPPER W/6" BEND RADIUS (MIN BENDS).
- 20 FT. MAX BARE PIPE FROM TANK TO WALL BOX (KEEP MINIMUM).
- INSULATE BARE PIPE W/ AIR CONDITIONING FOAM.
- FOR RUNS GREATER THAN 20 FT USE PYTHON PIPE
- 5/8" ID MIN FOR FILL LINE.
- 1/2" ID MIN FOR SAFETY AND VENT.

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

7. Run sleeving conduit to tank.
8. 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.

8.6 FILLING PROCEDURES

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

ORCA TRUCK



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 H₂O".

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.

2.1 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.

2.1 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 → 1A000 Alarm 2 → 2A000

Liquid Types: Nitrogen → dn_n2 Oxygen → dn-o2
 Argon → dn-Ar Carbon Dioxide → dnCO2 Nitrous Oxide → dnN2O

Orientations: Horizontal → Or--- Vertical → Or||||

Operating pressure: Example → P 100

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

Calibration: Example → CAL 0 (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.	<p>Battery dead, low, installed incorrectly or missing.</p> <p>Transformer not plugged in or faulty wiring.</p> <p>Electrical supply circuit breaker tripped.</p> <p>Faulty Cyl-Tel.</p>	<p>Replace battery.</p> <p>Inspect wiring and insure transformer is plugged in.</p> <p>Reset circuit breaker.</p> <p>Replace Cyl-Tel front (p/n 11520503). Call 1-800-400-4683.</p>
Cyl-Tel display is powered, but stays at zero.	<p>No product in cylinder.</p> <p>Four-way valve in "Service" position</p> <p>Four-way valve installed incorrectly</p> <p>Parameters are improperly set</p> <p>Sensor plug not on pins inside Cyl-Tel.</p> <p>Faulty Cyl-Tel.</p>	<p>Ensure there is liquid in cylinder.</p> <p>Turn valve to "Normal" position.</p> <p>See user manual to confirm proper installation</p> <p>Verify EACH parameter setting. The "P" setting as well as the inner dimensions can affect the accuracy of the gauge.</p> <p>Open Cyl-Tel and verify sensor plug is attached to pins.</p> <p>Replace (p/n 11018142). Call 1-800-400-4683.</p>
Cyl-Tel display always reads full.	<p>Parameters are improperly set.</p> <p>Faulty Cyl-Tel (Sensor may be damaged).</p>	<p>Verify EACH parameter setting. The "P" setting as well as the inner dimensions can affect the accuracy of the gauge.</p> <p>Replace (p/n 11018142). Call 1-800-400-4683.</p>
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	<p>Calibration point needs adjusting.</p> <p>Four-way valve leaks internally</p>	<p>Adjust "Cal" setting. Refer to Cyl-Tel manual.</p> <p>Replace Four-way valve (p/n 11026353)</p>
Liquid level displayed not accurate.	<p>Wrong "P" setting.</p> <p>Calibration point needs adjusting.</p>	<p>Change setting to reflect the proper saturation pressure. Refer to Cyl-Tel manual for details.</p> <p>Adjust "Cal" setting. Refer to Cyl-Tel manual.</p>

Troubleshooting the Cyl-Tel Phone Transmitter

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

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 from possible contact with oxygen; particularly oil, grease, kerosene, cloth, wood, paint, tar, coal dust, and dirt which may contain oil or grease. DO NOT permit smoking or open flames in any area where oxygen is stored, handled, or used. Failure to comply with this warning may result in serious personal injury.

WARNING

Nitrogen and argon vapors in air may dilute the concentration of oxygen necessary to support 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

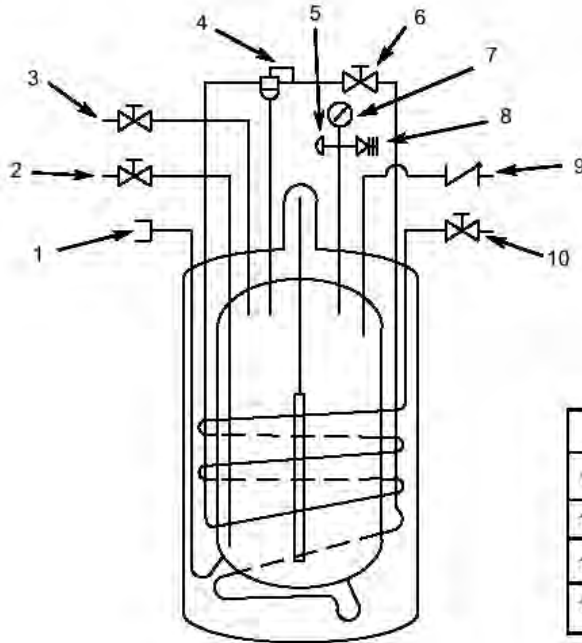
Before removing cylinder parts or loosening fittings, completely empty the liquid cylinder of liquid and release the entire vapor pressure in a safe manner. External valves and fittings can become extremely cold and may cause painful burns to personnel unless properly protected. Personnel must wear protective 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 230C SCHEMATICS

Side View



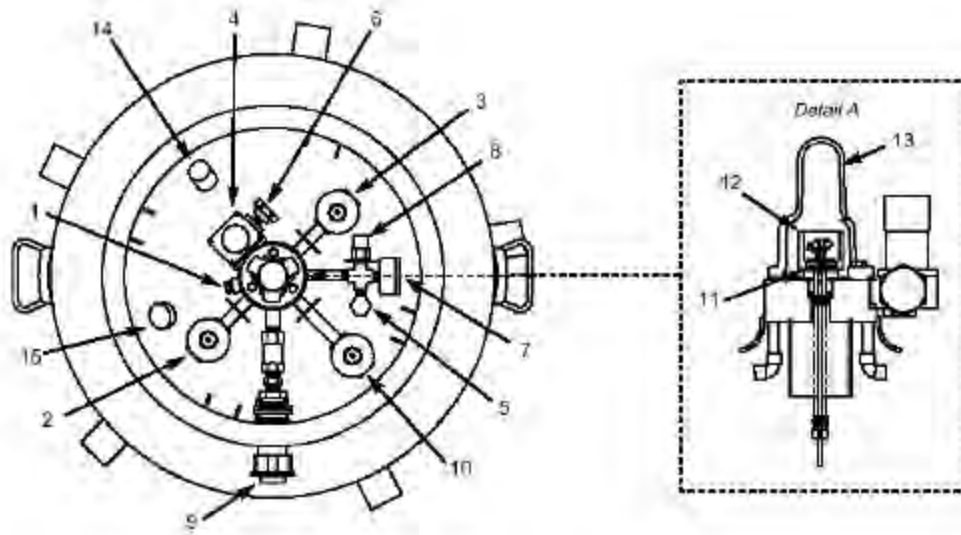
P/N	DESCRIPTION	REV
10939687	Perma-Cyl 230C MP RB TC	B
10982263	Perma-Cyl 230C HP RB TC	B
10896592	Perma-Cyl 230C MP SB TC	B
10898694	Perma-Cyl 230C HP SB TC	B

Parts List

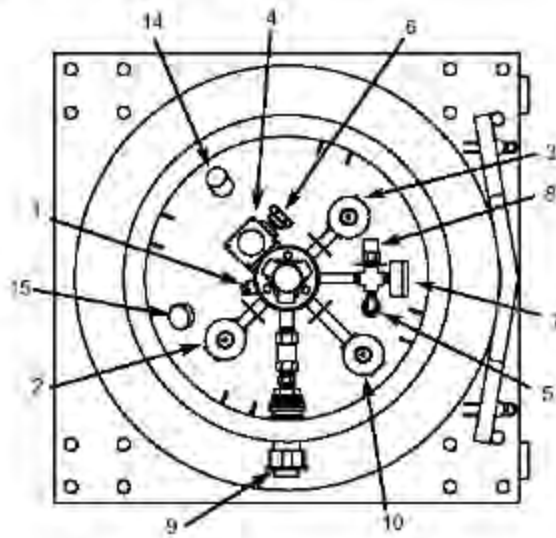
Item #*	Description	Item #*	Description
1	High Phase Port	9	Fast Fill Port
2	Liquid Use Valve	10	Gas Use Valve
3	Vent Valve	11	Roto Cal Plug/O-Ring
4	LCCM PB/ Econo Regulator	12	Roto Cal Gauge
5	Rupture Disc	13	Protective Cap
6	PB Valve	14	Pump Out Port
7	Pressure Gauge	15	Vaccum Rupture Disk (warranty seal)
8	Primary Relief		

* Item #'s correspond with all schematics. See pg 5 for Item #'s 11-15.

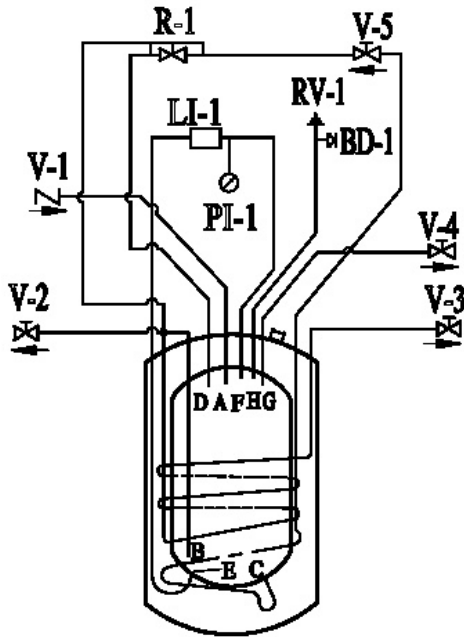
Perma-Cyl 230C Round Base Top View



Perma-Cyl 230C Square Base Top View



Perma-Cyl 450/1000 MP/HP/VHP, 1500 HP
Configuration 01



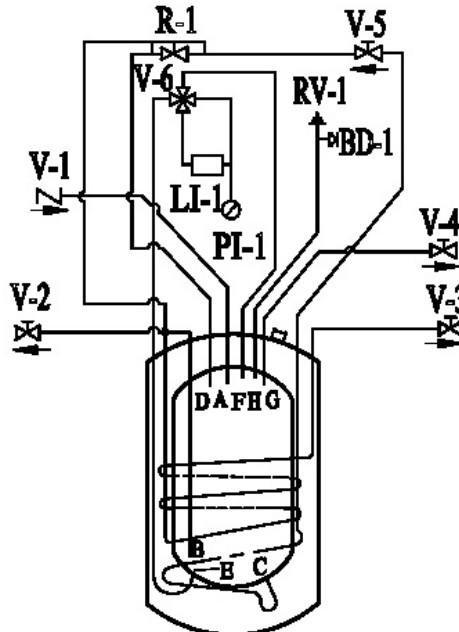
NOMENCLATURE	
V-1	TOP FILL CHECK VALVE
V-2	LIQUID VALVE
V-3	GAS USE VALVE
V-4	VENT/FULL TRYCOCK VALVE
V-5	PRESS. BLDG. VALVE
LI-1	LEVEL INDICATOR
PI-1	PRESSURE INDICATOR
R-1	PRESS. BDLG/ ECONO REG.
RV-1	RELIEF VALVE
BD-1	BURST DISC

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

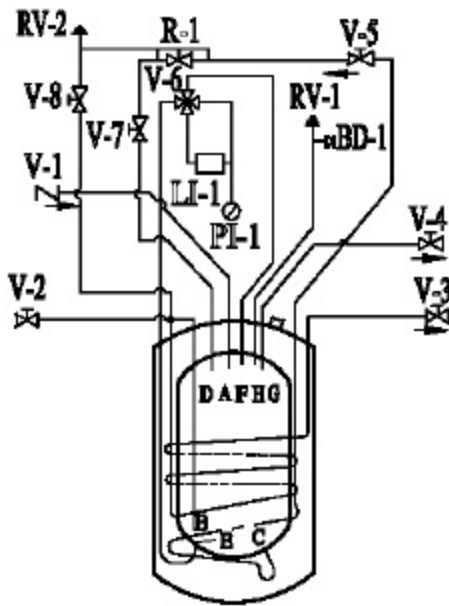
Perma-Cyl 450/1000 MP/HP/VHP, 1500 HP
Configuration 02

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



Perma-Cyl 450/1000 MP/HP/VHP, 1500 HP
Configuration 03



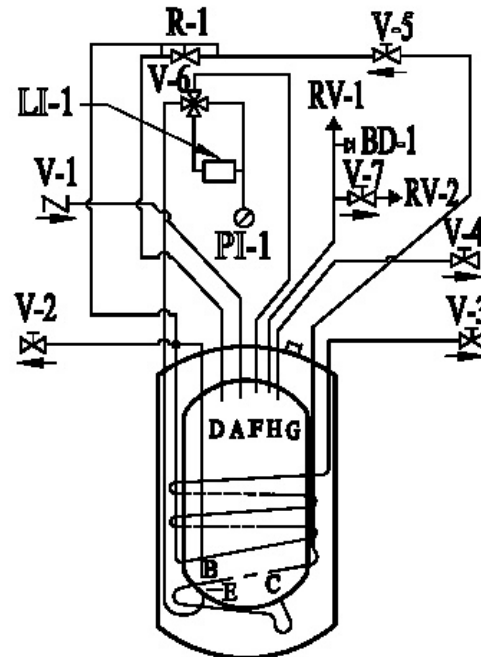
NOMENCLATURE	
V-1	TOP FILL CHECK VALVE
V-2	LIQUID VALVE
V-3	GAS USE VALVE
V-4	VENT/FULL TRYCOCK VALVE
V-5	PRESS. BLDG. VALVE
V-6	4-WAY VALVE
V-7	REG. ISO VALVE
V-8	REG. ISO VALVE
LI-1	LEVEL INDICATOR
PI-1	PRESSURE INDICATOR
R-1	PRESS. BDLG/ ECONO REG.
RV-1	RELIEF VALVE
RV-2	LINE RELIEF
BD-1	BURST DISC

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

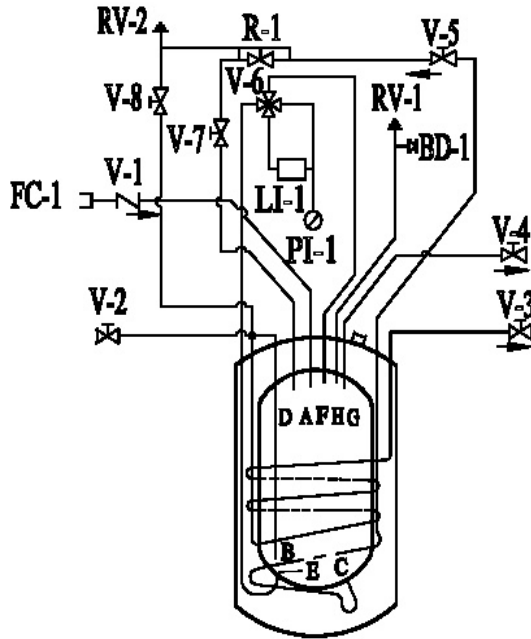
Perma-Cyl 450/1000 MP/HP/VHP, 1500 HP
Configuration 04

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



Perma-Cyl 450/1000 MP/HP/VHP, 1500 HP
Configuration 05



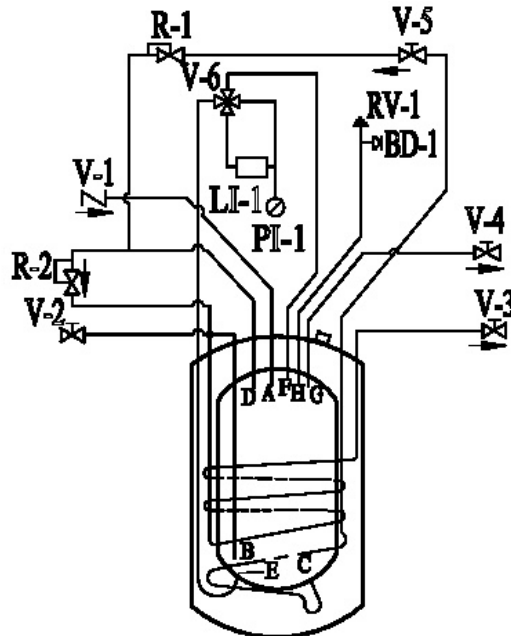
NOMENCLATURE	
V-1	TOP FILL CHECK VALVE
V-2	LIQUID VALVE
V-3	GAS USE VALVE
V-4	VENT/FULL TRYCOCK VALVE
V-5	PRESS. BLDG. VALVE
V-6	4-WAY VALVE
V-7	REG. ISO VALVE
V-8	REG. ISO VALVE
LI-1	LEVEL INDICATOR
PI-1	PRESSURE INDICATOR
R-1	PRESS. BLDG./ECONO REG.
RV-1	RELIEF VALVE
RV-2	LINE RELIEF
BD-1	BURST DISC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

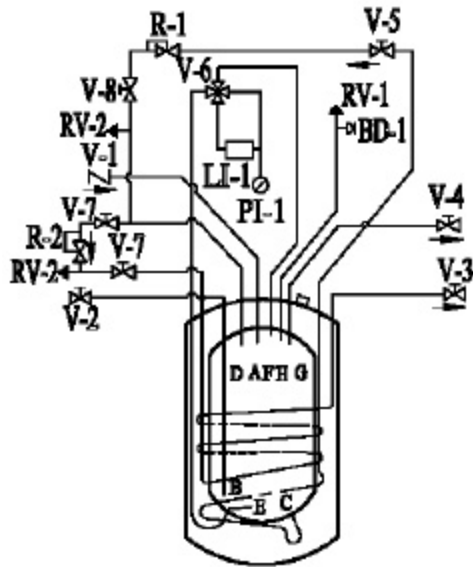
Perma-Cyl 1500 VHP
Configuration 02

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



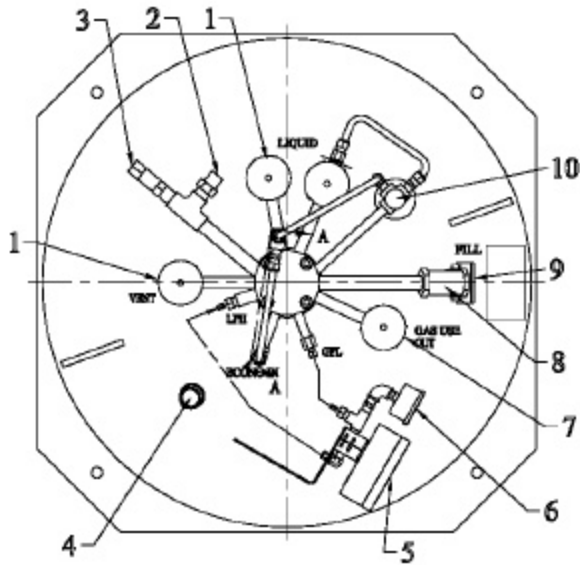
**Perma-Cyl 1500 VHP
Configuration 03**



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

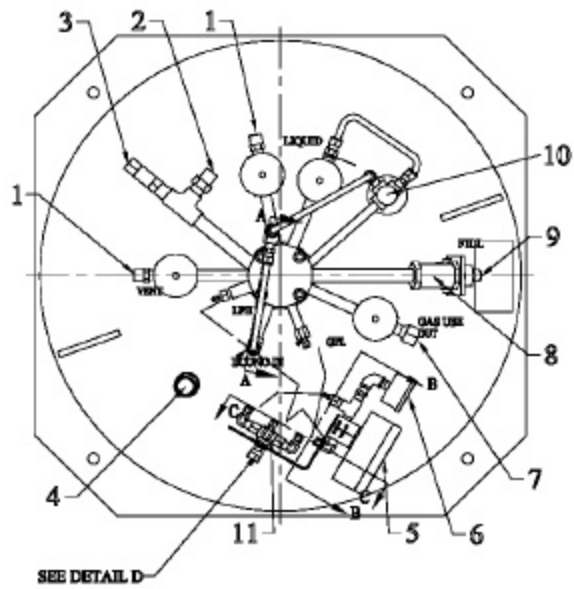
Perma-Cyl 450-01 Chart Standard



P/N 11560847
 P/N 11560855
 P/N 11560863

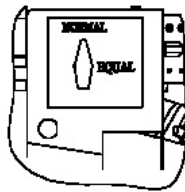
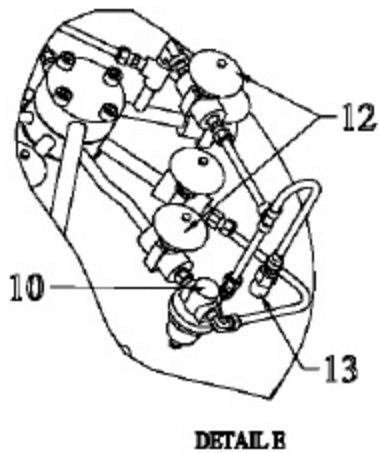
The Chart Standard tank configuration provides our customers with the essentials needed for a standard cryogenic vessel.

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

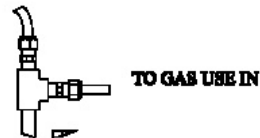


P/N 11525806
 P/N 11542420
 P/N 11542649

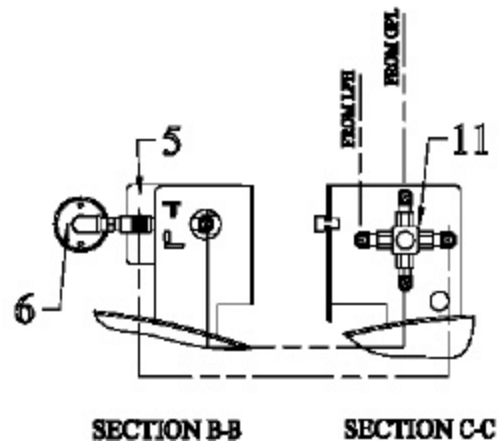
The Cyl-Tel Gauge Service Valve tank configuration provides our customers with a 4-way valve gauge isolation.



DETAIL D



SECTION A-A

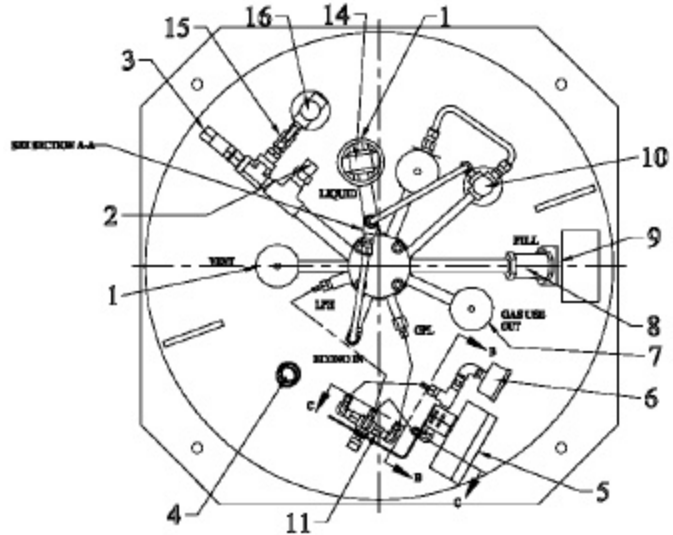
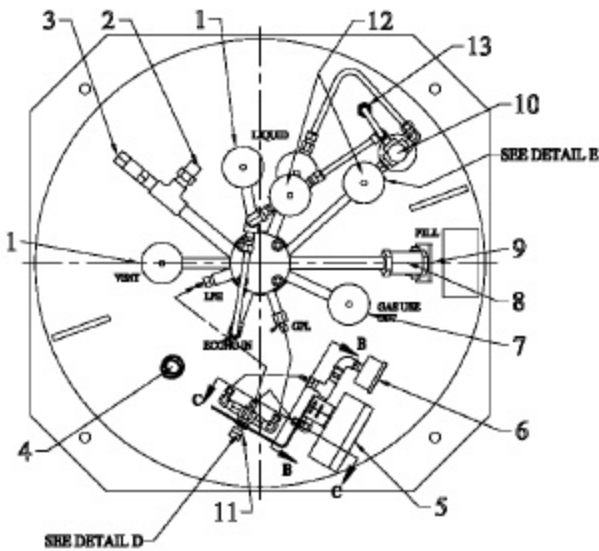


SECTION B-B

SECTION C-C

Perma-Cyl 450-03 Service Valves & High Pressure

Perma-Cyl 450-04 Low Pressure Liquid

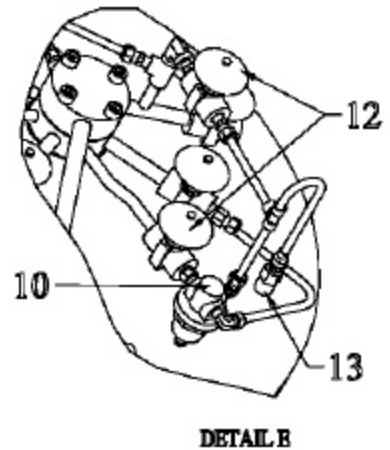
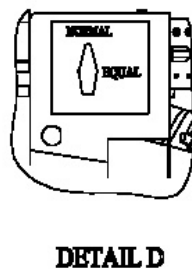
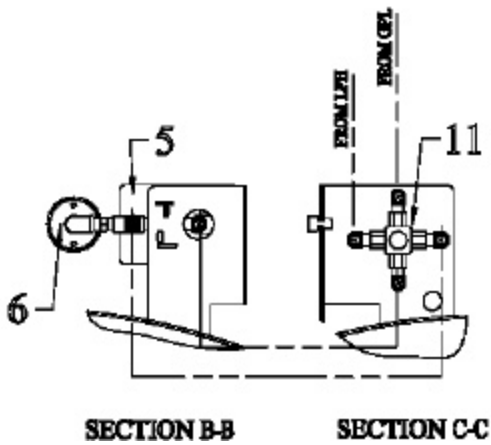


P/N 11528024
 P/N 11542411
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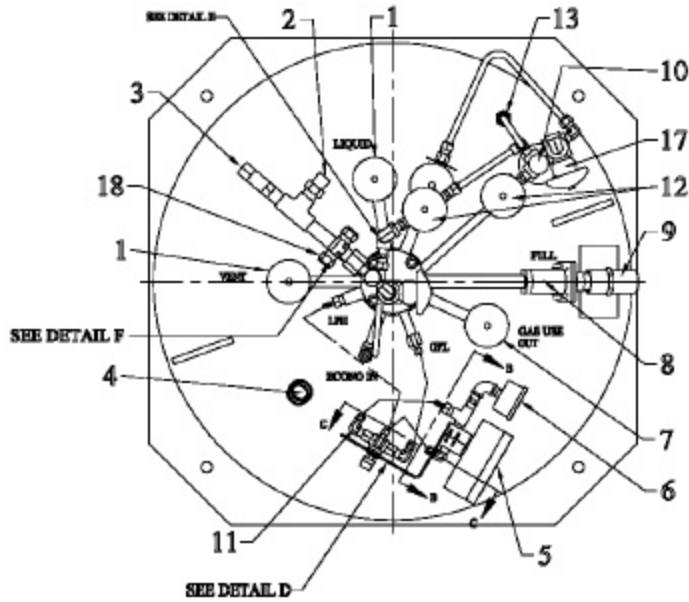
P/N 11394480

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

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).

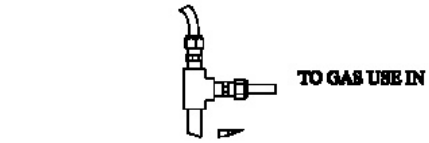


Perma-Cyl 450-05 CO₂ Service

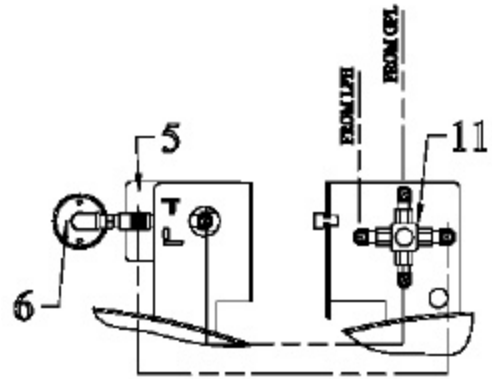


P/N 11541523

The CO₂ Service tank configuration provides our customers with a 4-way valve gauge isolation, regulator isolation valves, and a CO₂ Package, including the patented Sure-fill System.

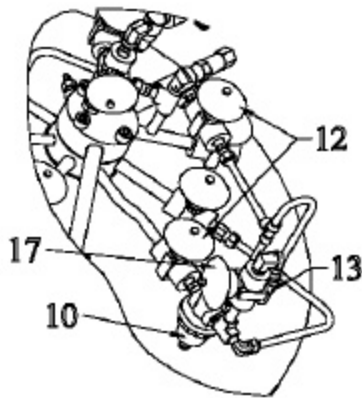


SECTION A-A



SECTION B-B

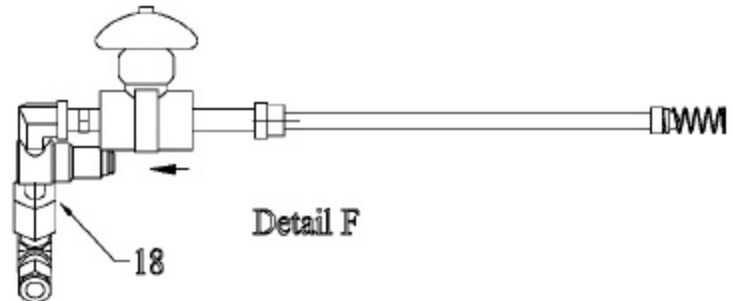
SECTION C-C



DETAIL B











DETAIL D











Detail F



PERMA-CYL 450 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	3910666	Blue Plastic Cap 

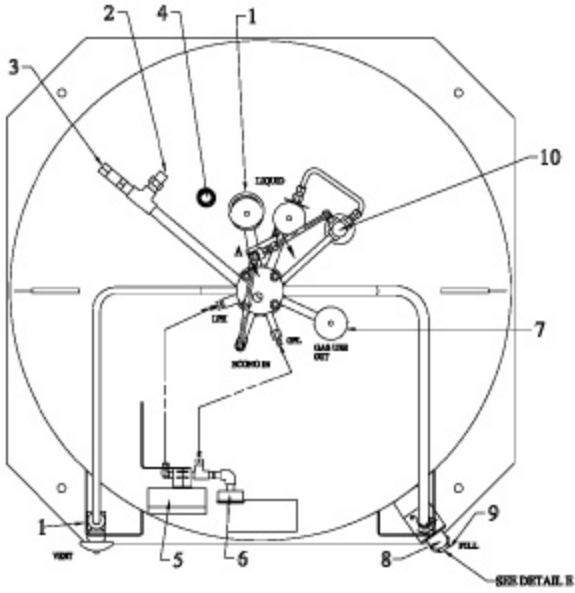
ITEM	PART NO.	DESCRIPTION
5	11018142	Cyl-Tel Gauge 
6a	2015179	Pressure Gauge (0-400 PSI) 
6b	2010064	Pressure Gauge (0-600 PSI) 
7a	4010022	Outlet 3/8" MPT (INERT) 
7b	4010012	Outlet 3/8" MPT (OXY) 
7c	4010562	Outlet 3/8" MPT (CO2) 
8	11051090	Check Valve 1/2" FPT x 1/2" FPT 
9.1a	10873809	Quick Connect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

PERMA-CYL 450 OPTIONS:

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) 

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)

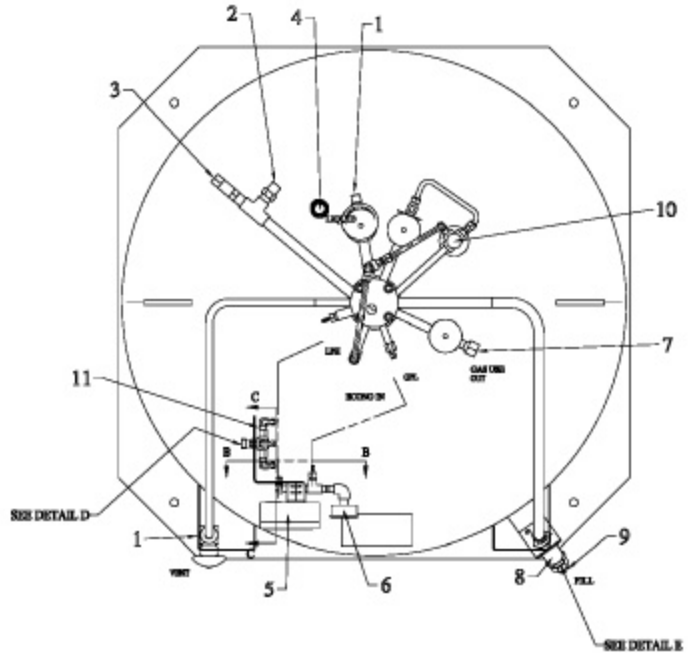
Perma-Cyl 1000-01 Chart Standard



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

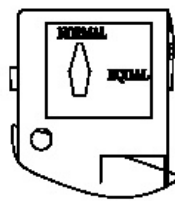
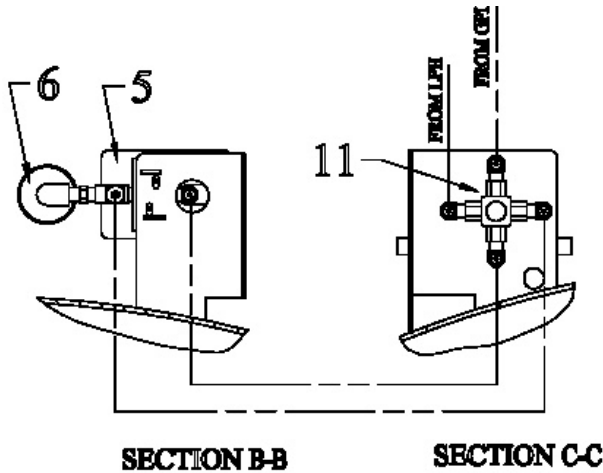
The Chart Standard tank configuration provides our customers with the essentials for a standard cryogenic vessel.

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

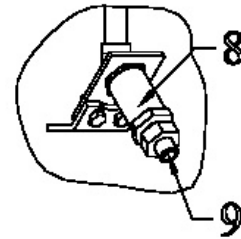


- P/N 11394404
- P/N 11482025
- P/N 11482041

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

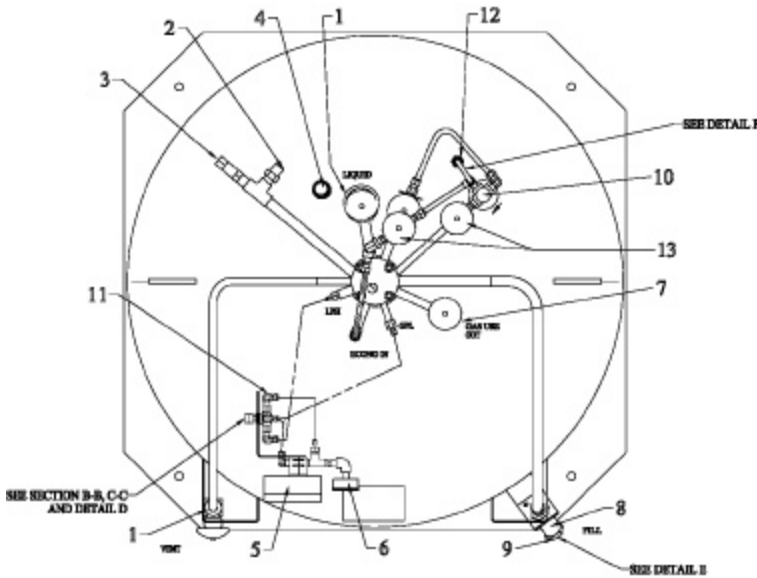


DETAIL D



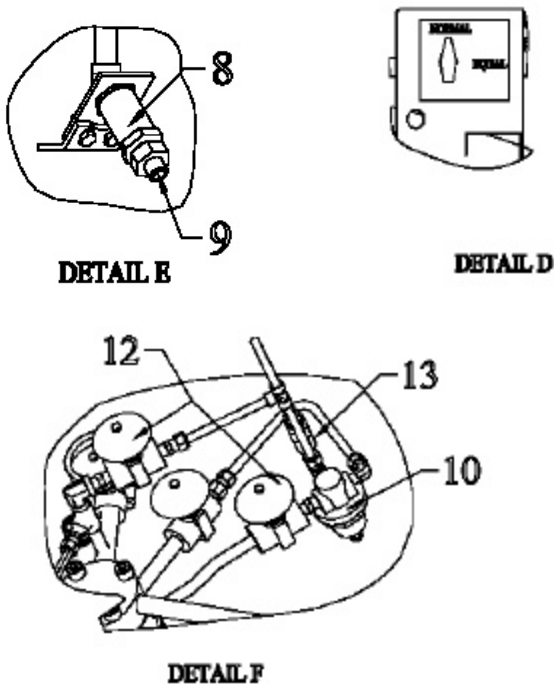
DETAIL E

Perma-Cyl 1000-03 Service Valves & High Pressure

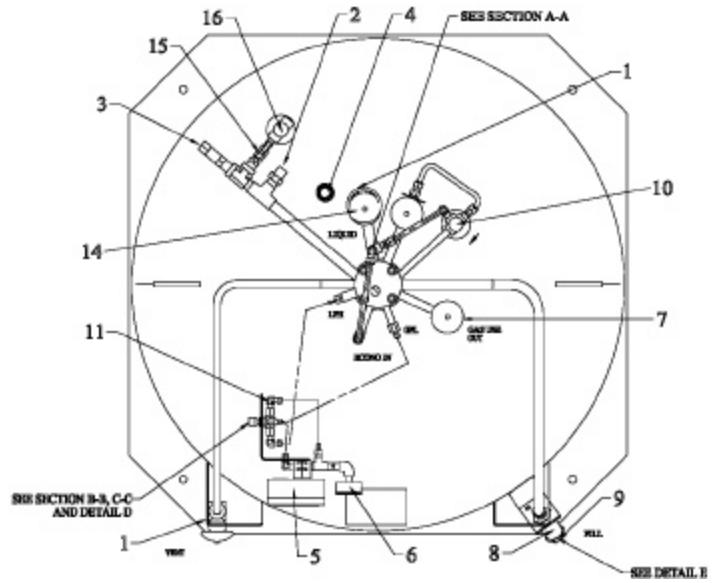


P/N 11394498
 P/N 11482033
 P/N 11482009

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

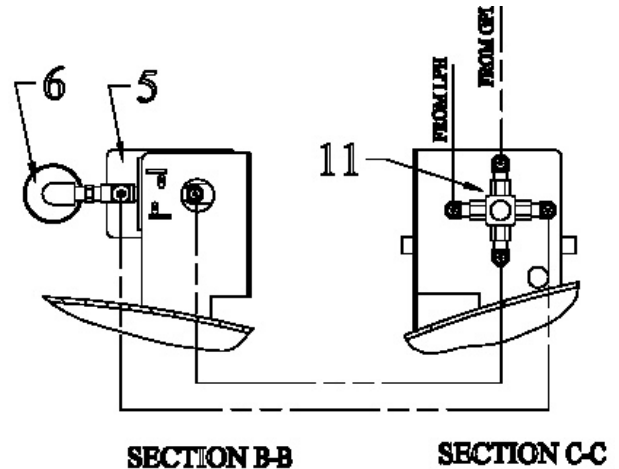


Perma-Cyl 1000-04 Low Pressure Liquid

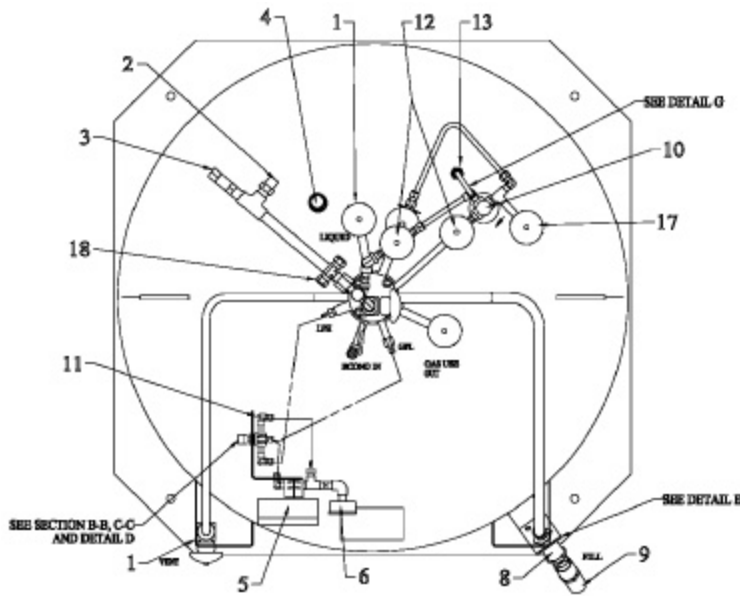


P/N 11394501

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 range).

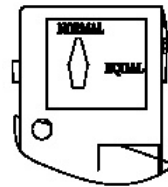
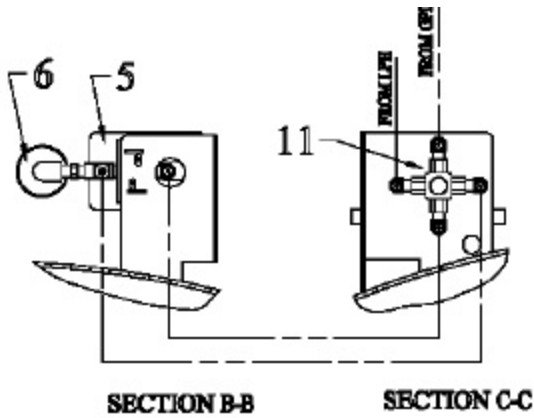


Perma-Cyl 1000-05 CO₂ Service

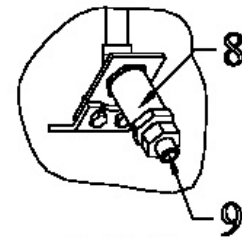


P/N 11394519
 P/N 11552548

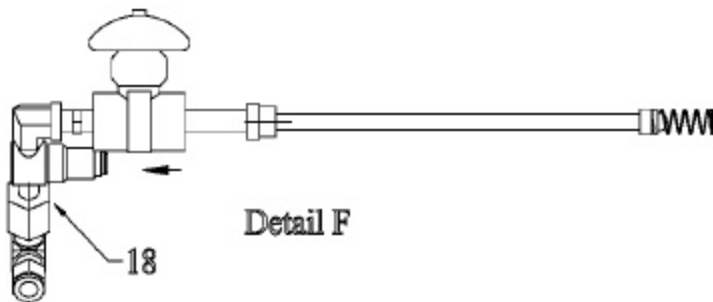
The CO₂ Service tank configuration provides our customers with a 4-way valve gauge isolation, regulator isolation valves, and a CO₂ Package, including the patented Sure-fill System.



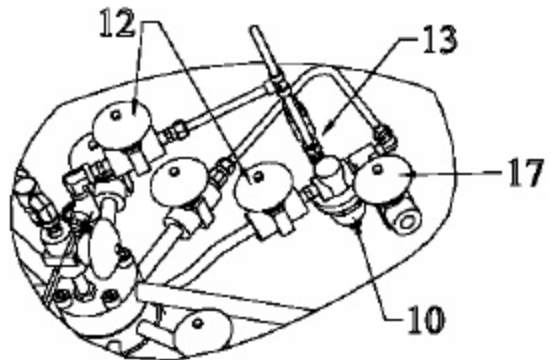
DETAIL D



DETAIL E











Detail F










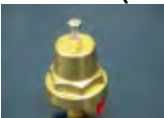
DETAIL G

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	3910666	Blue 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) 

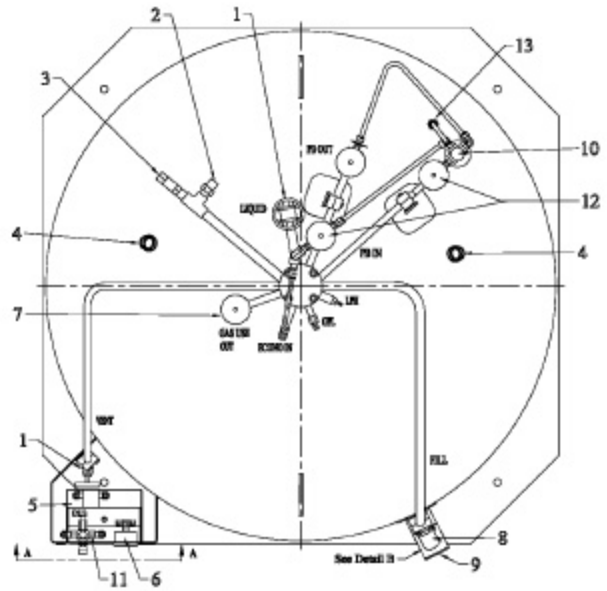
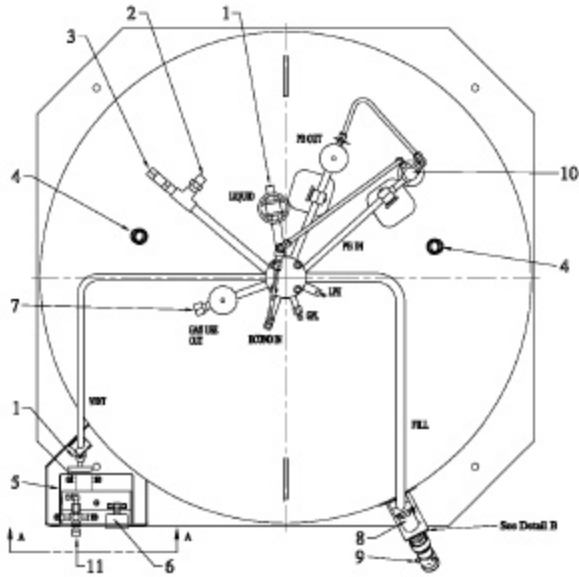
PERMA-CYL 1000 OPTIONS:

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) 

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

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

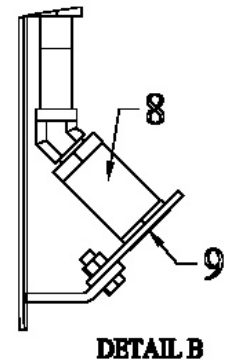
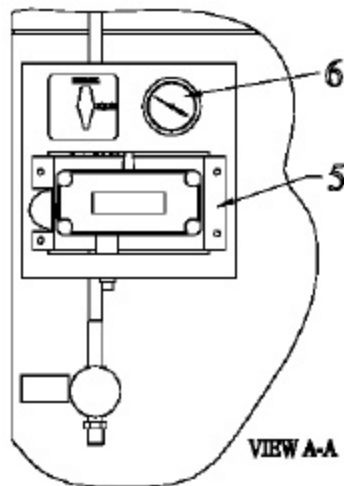
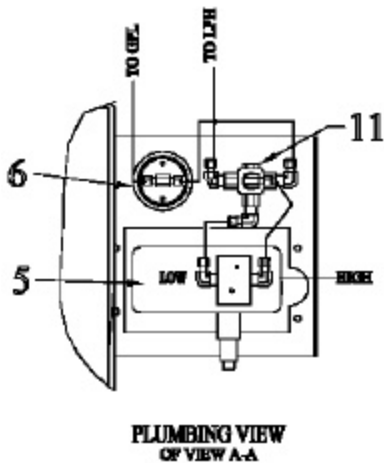


P/N 11560919
P/N 11552521

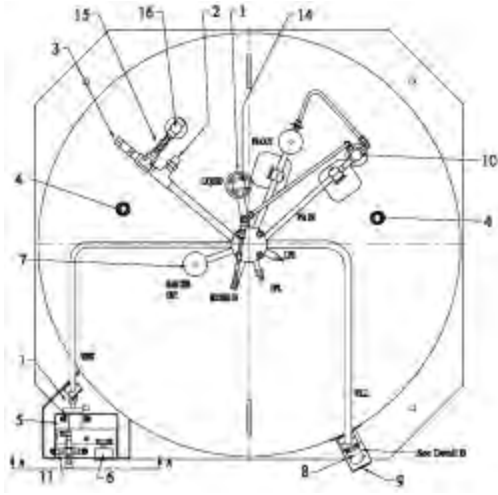
P/N 11551588
P/N 11552530

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

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



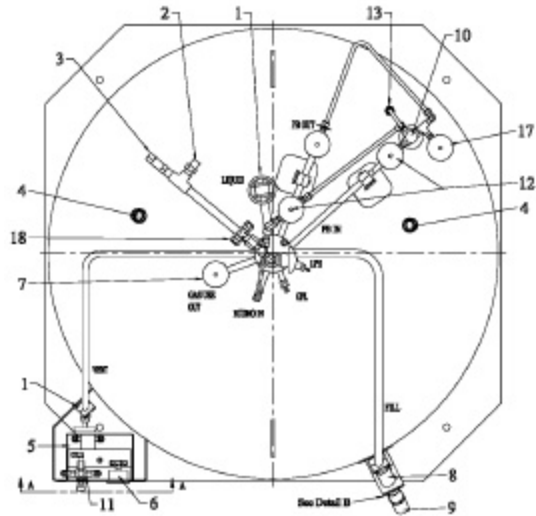
Perma-Cyl 1500 HP-04 Low Pressure Liquid



P/N1151570

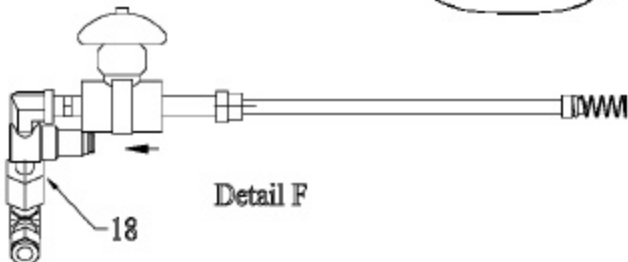
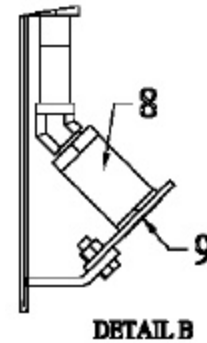
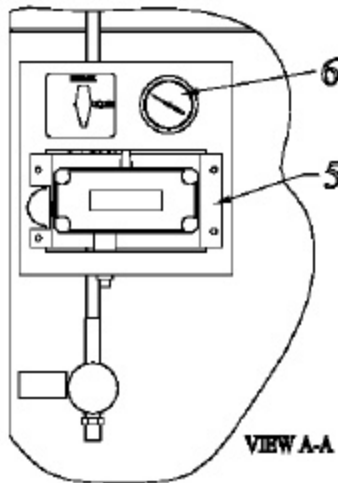
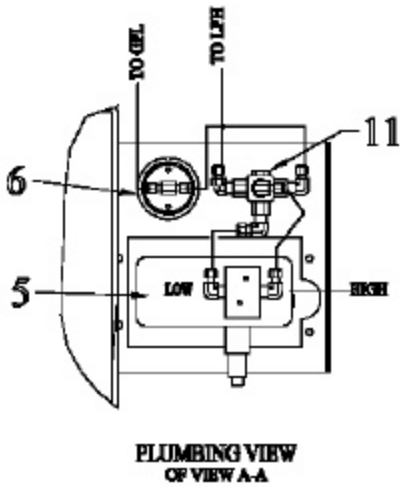
The Low Pressure Liquid tank configuration provides our customers with a 4-way valve gauge isolation, a liquid withdrawal ball valve, a valved relief regulator (15-50 psi range).

Perma-Cyl 1500 HP-05 CO₂ Service



P/N 11551561
P/N 11552513

The CO₂ Service tank configuration provides our customers with a 4-way valve gauge isolation, regulator isolation valves, and a CO₂ Package, including the patented Sure-fill System.



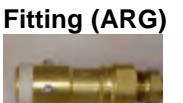
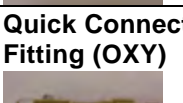
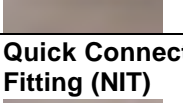
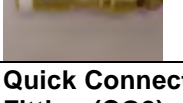




ILLUSTRATIONS & PART LISTINGS

7

PERMACYL 1500HP 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	3910666	Blue 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) 

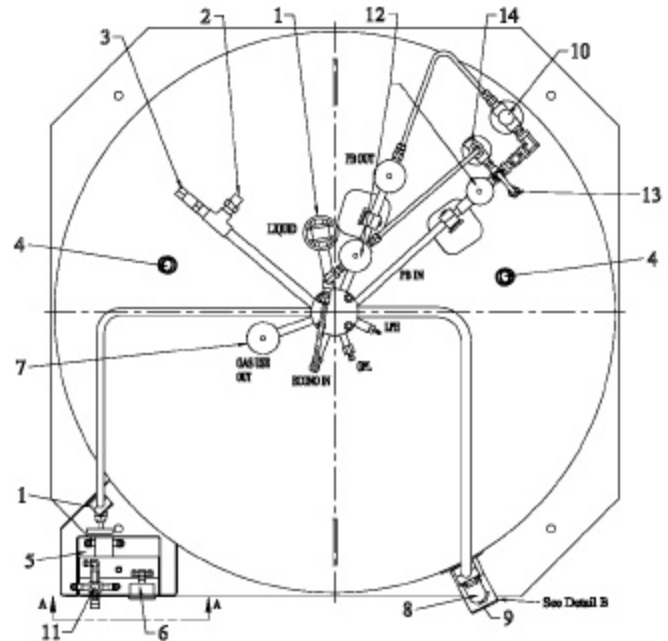
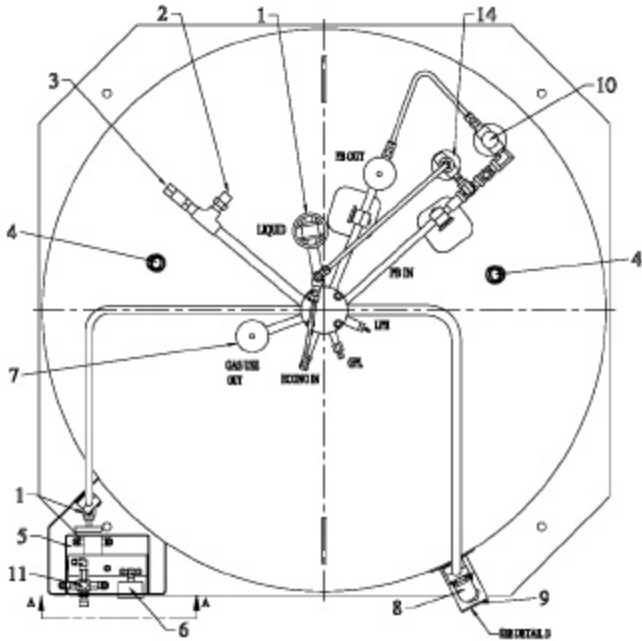
PERMA-CYL 1500 HP
OPTIONS:

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

ITEM	PART NO.	DESCRIPTION
10b	10645339	Combination Regulator 1/4" NPT (15-50PSI) 
11	11627651	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

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

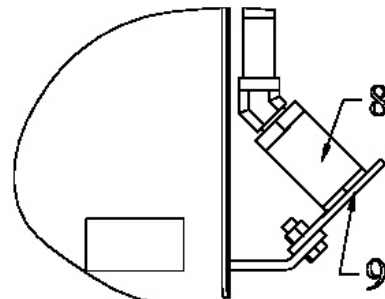
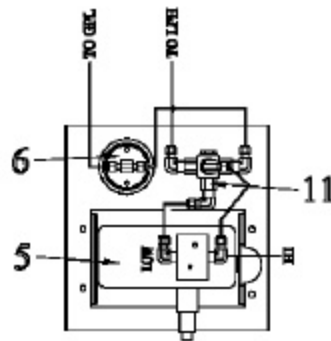
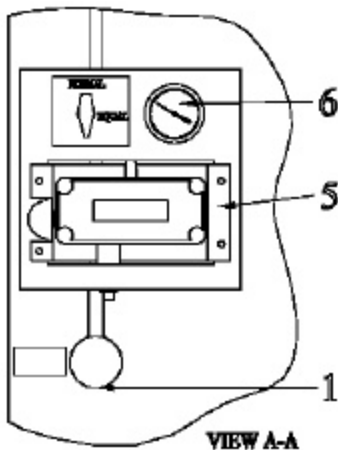


P/N 11560935

P/N 11554244

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

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











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) 

PERMA-CYL 1500 VHP
OPTIONS:

ITEM	PART NO.	DESCRIPTION
10	11061036	Pressure Building Regulator 3/8" NPT (450PSI) 
11	11627651	5-Way Valve 
14	10619675	Econ. Regulator 1/4" NPT (475PSI) 

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

English Calibration Chart															
Perma-Cyl 450MP/HP/VHP															
H ₂ O	Oxygen			Nitrogen			Argon			CO ₂			N ₂ O		
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 450MP/HP/VHP															
H ₂ O	Oxygen			Nitrogen			Argon			CO ₂			N ₂ O		
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						

English Calibration Chart												
Perma-Cyl 1000MP/HP/VHP												
H ₂ O	Oxygen			Nitrogen			Argon			CO ₂		
IN	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
2.0	1.3	3	1050	2.5	4	233	1.0	2	113	1.8	15	135
4.0	4.9	10	564	9.1	14	847	3.8	9	428	6.7	57	499
6.0	10.4	21	1197	18.5	27	1723	8.1	19	911	13.8	118	1031
8.0	17.1	35	1968	29.2	43	2719	13.6	32	1530	22.4	191	1671
10.0	24.6	51	2831	40.2	59	3743	19.8	47	2228	31.6	270	2359
12.0	32.4	67	3729	51.1	75	4758	26.5	63	2981	40.9	349	3051
14.0	40.2	83	4627	62.1	92	5782	33.4	79	3758	50.2	428	3743
16.0	48.0	99	5525	73.0	108	6797	40.2	95	4523	59.5	507	4435
18.0	55.8	115	6423	84.0	124	7821	47.0	111	5288	68.8	587	5127
20.0	63.7	131	7332	94.9	140	8836	53.9	127	6064	78.1	666	5819
22.0	71.5	147	8230	105.9	156	9860	60.7	143	6829	87.3	745	6511
24.0	79.3	163	9127	116.8	172	10875	67.6	159	7605	96.6	824	7203
26.0	87.1	180	10025	127.8	188	11899	74.4	176	8370	105.9	903	7895
28.0	94.9	196	10923	138.7	204	12914	81.3	191	9146	115.2	982	8587
30.0	102.8	212	11832	149.7	220	13939	88.1	208	9911	124.5	1062	9279
32.0	110.6	228	12730	160.6	236	14953	94.9	224	10676	133.8	1141	9971
34.0	118.4	244	13628	171.6	253	15978	101.8	240	11453	143.0	1220	10663
36.0	126.2	260	14526	182.5	269	16993	108.6	256	12218	152.3	1299	11355
38.0	134.0	276	15423	193.5	285	18017	115.5	272	12994	161.6	1378	12047
40.0	141.9	293	16333	204.4	301	19032	122.3	288	13759	170.9	1457	12739
42.0	149.7	308	17230	215.4	317	20056	129.2	304	14535	180.2	1537	13431
44.0	157.5	325	18128	226.3	333	21071	136.0	320	15300	195.5	1667	14570
46.0	165.3	341	19026	237.3	349	22095	142.8	337	16065			
48.0	173.1	357	19924	249.2	367	23203	149.7	352	16841			
50.0	181.0	373	20833				156.5	369	17606			
52.0	188.8	389	21731				163.4	385	18383			
54.0	196.6	405	22629				170.2	401	19148			
56.0	204.4	421	23526				177.1	417	19924			
58.0	212.2	438	24424				183.9	433	20689			
60.0	220.1	454	25334				190.7	449	21454			
62.0	227.9	470	26231				197.6	465	22230			
64.0	235.7	486	27129				204.4	482	22995			
66.0	249.2	514	28683				211.3	498	23771			
68.0							218.1	514	24536			
70.0							225.0	530	25313			
72.0							231.8	546	26078			
74.0							238.6	562	26843			
77.1							249.2	587	28035			

Metric Calibration Chart												
Perma-Cyl 1000MP/HP/VHP												
H ₂ O	Oxygen			Nitrogen			Argon			CO ₂		
IN	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
2.0	5.0	6	49	9.5	8	76	3.9	5	34	6.8	7	41
4.0	18.7	22	182	34.6	30	275	14.6	20	130	25.3	26	152
6.0	39.2	47	382	70.1	60	558	30.8	42	275	52.4	54	314
8.0	64.6	78	630	110.7	95	881	51.4	71	459	84.9	87	509
10.0	93.0	112	906	152.2	130	1210	75.0	103	669	119.8	122	719
12.0	122.5	147	1194	193.6	166	1540	100.4	138	895	154.9	158	930
14.0	152.1	183	1483	235.0	202	1870	126.3	173	1126	190.0	194	1141
16.0	181.7	218	1771	276.5	237	2199	152.2	209	1358	225.2	230	1352
18.0	211.3	254	2060	317.9	273	2529	178.1	244	1589	260.3	266	1563
20.0	240.9	289	2348	359.4	308	2858	204.0	280	1820	295.4	302	1774
22.0	270.5	325	2637	400.8	344	3188	229.9	315	2051	330.6	338	1984
24.0	300.1	360	2925	442.2	379	3518	255.8	351	2282	365.7	374	2195
26.0	329.7	396	3214	483.7	415	3847	281.7	387	2513	400.8	410	2406
28.0	359.3	431	3502	525.1	450	4177	307.6	422	2744	436.0	446	2617
30.0	388.9	467	3791	566.5	486	4507	333.5	458	2975	471.1	482	2828
32.0	418.6	503	4079	608.00	521	4836	359.4	493	3206	506.3	517	3039
34.0	448.1	538	4368	649.4	557	5166	385.3	529	3437	541.4	553	3250
36.0	477.7	574	4656	690.9	593	5496	411.2	564	3668	576.5	589	3461
38.0	507.3	609	4945	732.3	628	5825	437.1	600	3899	611.7	625	3672
40.0	536.9	645	5233	773.8	664	6155	462.9	635	4131	646.8	661	3882
42.0	566.5	680	5522	815.2	699	6485	488.86	671	4362	681.9	697	4094
44.0	596.1	716	5810	856.7	735	6814	514.8	706	4593	739.8	756	4441
46.0	625.7	751	6099	898.1	770	7144	540.7	742	4824			
48.0	655.3	787	6387	943.3	809	7503	566.5	777	5055			
50.0	684.9	822	6676				592.46	813	5286			
52.0	714.5	858	6964				618.4	849	5517			
54.0	744.2	894	7253				644.3	884	5748			
56.0	773.8	929	7541				670.1	920	5979			
58.0	803.4	965	7830				696.07	955	6210			
60.0	833.0	1000	8118				722.0	991	6441			
62.0	862.6	1036	8406				747.9	1026	6672			
64.0	892.2	1071	8695				773.7	1062	6904			
66.0	943.3	1133	9193				799.67	1097	7135			
68.0							825.6	1133	7366			
70.0							851.5	1168	7597			
72.0							877.3	1204	7828			
74.0							903.28	1240	8059			
77.1							943.3	1294	8416			

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

10

P/N		11042505	10979144	10896592	10939687	10898694	10982263	11529508	10914877	11196387	10907634	10923909	11075024	11501804	11195763
Description		230 Liter B	230 Liter C	230 Liter C	230 Liter C	230 Liter C	230 Liter	300 Liter	450 Liter	450 liter	450 Liter	1000 Liter	1000 Liter	1500 Liter	1500 Liter
		MP	MP	MP, LCCM	MP, LCCM	HP, LCCM	HP, LCCM	MP	MP	HP	VHP	HP	VHP	HP	VHP
		Square Base	Foot	Square Base	Round Base	Square Base	Round Base	Plate	Plate	Plate	Plate	Plate	Plate	Pallet	Pallet
		w/Casters	Ring Base	w/Casters	w/Casters	w/Casters	w/Casters	Base	Base	Base	Base	Base	Base	Base	Base
Capacity (liters)	Gross	240	240	240	240	240	240	330	450	450	450	1,056	1,056	1,550	1,550
	Net	230	230	230	230	230	230	300	420	420	420	950	950	1,455	1,455
MAWP	psig	250	250	235	235	350	350	250	250	350	500	350	500	350	500
	bar	17.2	17.2	16.2	16.2	24.1	24.1	17.2	17.2	24.1	34.5	24.1	34.5	24.1	34.5
Design Spec		ASME	ASME	DOT	DOT	DOT	DOT	ASME	ASME	ASME	ASME	ASME	ASME	ASME	ASME
Storage Capacity															
Nitrogen	SCF	5,658	5,658	5,024	5,024	4,734	4,734	7,380	10,332	10,332	10,332	23,370	23,370	35,550	35,550
	Nm3	149	149	142	142	134	134	193	272	272	272	615	615	935	935
Oxygen	SCF	6,987	6,987	6,244	6,244	5,930	5,930	9,100	12,760	12,760	12,760	28,861	28,861	43,900	43,900
	Nm3	184	184	177	177	168	168	239	336	336	336	759	759	1,155	1,155
Argon	SCF	6,833	6,833	6,073	6,073	5,763	5,763	8,850	12,478	12,478	12,478	28,225	28,225	42,950	42,950
	Nm3	180	180	172	172	163	163	234	328	328	328	742	742	1,130	1,130
Thermal Performance (NER%/Day)	N	1.20%	1.20%	1.80%	1.80%	1.80%	1.80%	1.20%	1.80%	1.80%	1.80%	1%	1%	1%	1%
	O2 - Ar	0.74%	0.74%	1.12%	1.12%	1.12%	1.12%	0.74%	1.12%	1.12%	1.12%	0.62%	0.62%	0.62%	0.62%
Gas Delivery Rate	SCF/H	400	400	400	400	400	400	500	575	575	575	960	960	1,350	1,350
	Nm3h	10.5	10.5	10.5	10.5	10.5	10.5	14.1	15.1	15.1	15.1	25.2	25.2	35.4	35.4
Dimensions	Diameter	in	26	26	26	26	26	26	30	30	30	42	42	48	48
		mm	660	660	660	660	660	660	660	762	762	762	1,067	1,067	1,219
Tare Weight	lbs	340	340	300	300	340	340	450	605	688	812	1,750	2,080	2,692	3,200
	Kg	154	154	136	136	154	154	204	274	312	368	794	945	1,221	1,451
Height	in	61	56	54.8	52.9	54.8	52.9	68	68	68	68	81	81	91	91
	mm	1,549	1,422	1,392	1,344	1,392	1,344	1,727	1,727	1,727	1,727	2,058	2,058	2,311	2,311



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CHART Inc.
Distribution & Storage Group
407 Seventh Street Northwest
New Prague, MN 56071 USA

Phone: 800-400-4683
Fax: 952-758-8215