Product Manual

Mega-Cyl® Series Liquid Cylinders

and Laser-Cyl® Liquid Cylinders

Designed and Built by:

Chart Inc.

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Contents

Revision Log

Revision Level	Date	Description
A	09/1993	First release
B	09/1995	New release with Mega-Cyl products
C	08/1999	Update manual to current design
D	03/2000	Update manual information
E	04/2000	Update manual information, incorporate Laser-Cyl 450 into manual
F	01/2002	Update for new diameter of Mega-Cyl 600
G	05/2014	Reformat
H	05/2018	Remove obsoleted Mega-Cyl 800 Model

Preface

General

The Mega-Cyl series is Chart's line of palletized cylinders designed for easy transport with capacities from 450 to 1000 liters. Engineered with the volume user in mind, these cylinders are ideal for construction sites, remote purging operations and back-up systems. Mega-Cyl cylinders are available in all services at 350 psig (24 barg) and are specifically designed to optimize distribution costs.

Laser-Cyl cylinders are designed specifically for laser applications, as a high performance option to expensive high pressure cylinder tanks. The Laser-Cyl cylinder delivers optimal pressure up to 500 psig (34.5 barg) and continuous flow rates up to 575 scfh (15.1 Nm^3/hr).

Mega-Cyl Product Highlights

- Tough, durable stainless steel construction
- High-performance Super Insulation™
- Easily accessible valves and gauges
- Spray header for pump filling on vent tube
- Accurate differential pressure contents gauge (non-electric)

Laser-Cyl Product Highlights

- Built-in vaporizer coils supply constant pressure gas at continuous flow rates up to 575 scfh (15.1 Nm^3/hr)
- Piping controls located on top for easy operation and maintenance
- Differential pressure liquid level gauge accurately displays product level (450 only)
- Insulation system provides low NER for longer holding time
- Available in 200 and 450 liter sizes with an optional pallet frame

Product Manual

This Mega-Cyl / Laser-Cyl product manual is designed to be used in conjunction with all Mega-Cyl and Laser-Cyl models provided by Chart. This manual contains information regarding the safe operation and handling of liquid nitrogen, argon, oxygen, carbon dioxide and nitrous oxide with the cylinder. It should be read and understood by anyone that operates the equipment. If there are any questions regarding the operation of the Mega-Cyl or Laser-Cyl cylinder, contact Chart Technical Service at 1-800-400-4683.

The safety requirements for operating the cylinder including the handling or transporting of cryogenic products are shown in the Safety section. Use this safety section as a "Safety Checklist" each time the equipment is being used.

The Introduction section discusses the general features of the tank along with the physical description, proper handling and responsibilities of the distributor and fillers of the liquid cylinders.

For information on how to operate the tank refer to the Operations section. This section also contains information on fill weights and calibration charts

Refer to the Maintenance section for information on how to maintain the tank and Troubleshooting issues that may arise in the daily usage of the cylinder.

The general arrangement drawings and flow schematics are available in the Specifications section along with detailed drawings and part listings.

Terms

Throughout this manual safety precautions will be designated as follows:

Warning! Description of a condition that can result in personal injury or death.

Caution! Description of a condition that can result in equipment or component damage.

Note: *A statement that contains information that is important enough to emphasize or repeat.*

Acronyms / Abbreviations

The following acronyms / abbreviations are used throughout this manual:

ASME	American Society of Mechanical Engineers
Ar	Argon
BAR	Pressure (Metric)
CGA	Compressed Gas Association
CO_2	Carbon Dioxide
DOT	Department of Transportation
FPT	Female Pipe Thread
H_2O	Water
Kg	Kilogram
MPT	Male Pipe Thread
N_2	Nitrogen
N_2O	Nitrous Oxide
NER	Nominal Evaporation Rate
NFPA	National Fire Protection Association
Nm^3/hr	Normal Cubic Meters/Hour
NPT	National Pipe Thread
O_2	Oxygen
ODT	Outside Diameter Tubing
PN	Part Number
PSI	Pounds per Square Inch
PSIG	Pounds per Square Inch (Gauge)
SCF	Standard Cubic Feet
SCFH	Standard Cubic Feet/Hour

Safety

General

All operators should have a full and complete understanding of the content of this manual before operating the equipment described. This manual is intended to describe the operation of the equipment and not intended to supersede any site-specific standards.

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

Safety Summary

Strict compliance with proper safety and handling practices is necessary when using a cryogenic system. We recommend that all our customers re-emphasize safety and safe handling practices to all their employees and customers.

While every possible safety feature has been designed into the unit and safe operations are anticipated, it is essential that the user of the cryogenic system carefully read to fully understand all WARNINGS and CAUTION notes listed in this safety summary and enumerated below.

Also read the information provided in the Safety Bulletin for oxygen and inert gases following this Safety Summary. Periodic review of the Safety Summary is recommended.

Warning! In oxygen enriched atmospheres flammable items burn vigorously and could explode.

Warning! Do not permit smoking or open flame in any area where oxygen is stored, handled, or used. Failure to comply with this warning may result in serious personal injury.

Excess accumulation of oxygen creates an oxygen-enriched atmosphere (defined by the Compressed Gas Association as an oxygen concentration above 23%). 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.

Warning! Nitrogen and argon vapors in air may dilute the concentration of oxygen necessary to support or sustain life.

Exposure to such an oxygen deficient atmosphere can lead to unconsciousness and serious injury, including death.

Caution! Before removing any parts or loosening fittings, empty the cryogenic container of liquid contents and release any 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 many result in personal injury due to the extreme cold and pressure in the tank.

Warning! Accidental contact of liquid gases with skin or eyes may cause a freezing injury similar to a burn.

Handle liquid so that it will not splash or spill. Protect your eyes and cover skin where the possibility of contact with liquid, cold pipes and equipment, or cold gas exists. Safety goggles or a face shield should be worn if liquid ejection or splashing may occur or cold gas may issue forcefully from equipment. Clean, insulated gloves that can be easily removed and long sleeves are recommended for arm protection. Cuffless trousers should be worn over the shoes to shed spilled liquid.

Warning! If clothing should be splashed with liquid oxygen it will become highly flammable and easily ignited while concentrated oxygen remains.

Such clothing must be aired out immediately, removing the clothing if possible, and should not be considered safe for at least 30 minutes.

Warning! Use only replacement parts that are compatible with liquid oxygen and have been cleaned for oxygen use.

Do not use regulators, fittings, hoses, etc., which have been previously used in a compressed air environment. And do not use oxygen equipment for compressed air. Failure to comply with these instructions may result in serious damage to the container.

Caution! Before locating oxygen equipment, become familiar with the relevant National Fire Protection Association (NFPA) standards for "Bulk Oxygen Systems at Customer Sites," and with all local safety codes.

The NFPA standard covers general principles recommended for installing bulk oxygen systems on industrial and institutional consumer premises.

Safety Bulletin

Portions of the following information is extracted from Safety Bulletin SB-2 from the Compressed Gas Association, Inc. Additional information on oxygen, nitrogen, argon, and cryogenics is available from the CGA.

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

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

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

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

Prior to reusing a damaged container, the unit must be tested, evaluated, and repaired as necessary. It is highly recommended that any damaged container be returned to Chart for repair and re-certification.

The remainder of this safety bulletin addresses those adverse environments that may be encountered when a cryogenic container has been severely damaged. These are oxygen deficient atmospheres, oxygen enriched atmospheres, and exposure to inert gases.

Oxygen Deficient Atmospheres

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

The normal oxygen content of air is approximately 21%. Depletion of oxygen content in air, either by combustion or by displacement with inert gas, is a potential hazard and users should exercise suitable precautions.

One aspect of this possible hazard is the response of humans when exposed to an atmosphere containing only 8 to 12% oxygen. In this environment, unconsciousness can be immediate with virtually no warning.

When the oxygen content of air is reduced to about 15 to 16%, the flame of ordinary combustible materials, including those commonly used as fuel for heat or light, may be extinguished. Somewhat below this concentration, an individual breathing the air is mentally incapable of diagnosing the situation because the onset of symptoms such as sleepiness, fatigue, lassitude, loss of coordination, errors in judgment and confusion can be masked by a state of "euphoria," leaving the victim with a false sense of security and well being.

Human exposure to an atmosphere containing 12% or less oxygen leads to rapid unconsciousness. Unconsciousness can occur so rapidly that the user is rendered essentially helpless. This can occur if the condition is reached by an immediate change of environment, or through the gradual depletion of oxygen.

Most individuals working in or around oxygen deficient atmospheres rely on the "buddy system" for protection - obviously the "buddy" is equally susceptible to asphyxiation if he or she enters the area to assist the unconscious partner unless equipped with a portable air supply. Best protection is obtainable by equipping all individuals with a portable supply of respirable air. Life lines are acceptable only if the area is essentially free of obstructions and individuals can assist one another without constraint.

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

1. Use the "buddy system." Use more than one "buddy" if necessary to move a fellow worker in an emergency.

2. Both the worker and "buddy" should be equipped with self-contained or airline breathing equipment.

Oxygen Enriched Atmospheres

An oxygen-enriched atmosphere occurs whenever the normal oxygen content of air is allowed to rise above 23%. While oxygen is nonflammable, ignition of combustible materials can occur more readily in an oxygen-rich atmosphere than in air; and combustion proceeds at a faster rate although no more heat is released.

It is important to locate an oxygen system in a well ventilated location since oxygen-rich atmospheres may collect temporarily in confined areas during the functioning of a safety relief device or leakage from the system.

Oxygen system components, including but not limited to, containers, valves, valve seats, lubricants, fittings, gaskets and interconnecting equipment including hoses, shall have adequate compatibility with oxygen under the conditions of temperature and pressure to which the components may be exposed in the containment and use of oxygen. Easily ignitable materials shall be avoided unless they are parts of equipment or systems that are approved, listed, or proven suitable by tests or by past experience.

Compatibility involves both combustibility and ease of ignition. Materials that burn in air may burn violently in pure oxygen at normal pressure, and explosively in pressurized oxygen. In addition, many materials that do not burn in air may do so in pure oxygen, particularly when under pressure. Metals for containers and piping must be carefully selected, depending on service conditions. The various steels are acceptable for many applications, but some service conditions may call for other materials (usually copper or its alloy) because of their greater resistance to ignition and lower rate of combustion.

Similarly, materials that can be ignited in air have lower ignition energies in oxygen. Many such materials may be ignited by friction at a valve seat or stem packing, or by adiabatic compression produced when oxygen at high pressure is rapidly introduced into a system initially at low pressure.

Nitrogen and Argon

Nitrogen and argon (inert gases) are simple asphyxiates. Neither gas will support or sustain life and can produce immediate hazardous conditions through the displacement of oxygen. Under high pressure these gases may produce narcosis even though an adequate oxygen supply sufficient for life is present.

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

Persons suffering from lack of oxygen should be immediately moved to areas with normal atmospheres. SELF-CONTAINED BREATHING APPARATUS MAY BE REQUIRED TO PREVENT ASPHYXIATION OF RESCUE WORKERS. Assisted respiration and supplemental oxygen should be given if the victim is not breathing. If cryogenic liquid or cold boil-off gas contacts worker's skin or eyes, the affected tissue should be flooded or soaked with tepid water (105-115ºF or 41-46ºC). DO NOT USE HOT WATER. Cryogenic burns that result in blistering or deeper tissue freezing should be examined promptly by a physician.

Personal Protective Equipment (PPE)

The following personal protective equipment is recommended when working around cryogenic liquid:

- Safety glasses with side shields to prevent cryogenic liquid from splashing into the eyes
- Chemical / Liquid resistant gloves to prevent cryogenic burns on exposed hands
- Long sleeve shirts to protect the arms
- Cuffless trousers worn over closed shoes

Introduction

General

The Mega-Cyl and Laser-Cyl Liquid Cylinders are vacuum insulated cylinders that are designed to furnish liquid and gaseous oxygen, nitrogen or argon on a reliable, economical basis.

The Mega-Cyl cylinders will hold 450 and 1000 liters of cryogenic product respectively. The containers have a pressure range from 0 to approximately 350 psig. The Laser-Cyl 200 & 450 cylinders have a pressure range from 0 to approximately 500 psig. The product can then be dispensed as either liquid or gas.

Physical Description

The insulation system is comprised of multiple layers of foil and paper that are incorporated with a very low vacuum. The vacuum is factory sealed and with the aid of internal molecular sieve it should remain low for the life of the container. This insulation system coupled with low heat leak support allows a small amount of heat into the inner vessel where it vaporizes liquid. If the container is left unused for a period of time the pressure will build to the safety relief valve setting. However, if the container is used in gas withdrawal service after pressure has built, the economizer system will automatically reduce the head pressure in the container without loss of product.

The design and construction of the Mega-Cyl and Laser-Cyl cylinders is aimed at building the most durable tank available today. The inner vessel is constructed of stainless steel and designed to the applicable pressure vessel code. The outer container is constructed of stainless steel to make the cylinder a maintenance free container. The cylinders can be mounted in a carbon steel pallet and frame.

The Mega-Cyl cylinder inner pressure vessel is protected from over-pressurization by a safety relief valve set at 350 psig with a rupture disc that is set at 450 psig. On the Laser-Cyl cylinder the pressure is set at 500 psig with a rupture disc set at 700 psig. The outer container of vacuum space is protected by a reverse buckling rupture disc that is set at a maximum of 25 psig.

Gas withdrawal is accomplished through a self-contained vaporizer that will provide continuous flow rates up to 880 SCFH. An internal pressure building system is provided with these containers. It is sized to maintain pressure while gas withdrawal is taking place. This system is automatically controlled by the pressure building regulator, but can be isolated by actuating the pressure building valve.

Handling the Mega-Cyl Cylinder

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

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

Responsibilities

Chart is stating below the responsibilities of the Distributor and the Filler of any Mega-Cyl / Laser-Cyl container.

1. The cylinder must be in safe condition

   The filler is responsible for confirming that any Mega-Cyl / Laser-Cyl cylinder to be filled is in its proper working condition. This includes that:

   - It has an acceptable vacuum
   - The relief system is in place and functioning
   - There is no structural damage to the cylinder
   - All warning labels are in place and legible

2. Do not overfill

   The cylinders are not to be filled beyond the recommended filling limits described in this manual.

3. Dispense only to knowledgeable users

   The filler must determine that the user is knowledgeable about the general characteristics of the product and proper safety precautions for its use. Do not allow customers to fill their own cylinders.

4. Dispose of cylinders properly

   To eliminate the risk of injury from the improper reuse of cryogenic (vacuum jacketed) cylinders, before disposal destroy the cylinder's pressure retaining capability.

   We recommend:

   - Purge the cylinder's contents.
   - Drill multiple holes through the cylinder and its vacuum casing or otherwise puncture the tank.

   Make sure the above steps are taken prior to the cylinder being taken for scrap.

Shipping the Cylinders

The transportation of the Mega-Cyl 450 and Laser-Cyl 200 & 450 is permitted at pressures up to the relief valve setting. The inner vessel is coded per DOT 4L.

The transportation of the Mega-Cyl 1000 is permitted at pressure less than 25.3 psig (reference 49 CFR 173.320 Cryogenic liquids; exception). The inner vessels of these models are coded per ASME.

Operation

Initial Inspection

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

All Mega-Cyl / Laser-Cyl cylinders are shipped with low purity nitrogen gas. For this reason any container that is to be put into oxygen or argon service should be thoroughly purged with the applicable gas.

Purging the Mega-Cyl & Laser-Cyl Cylinders

Before any operation that involves pressure or handling of cryogenic fluids, be sure that all safety precautions are taken. Refer to the Safety section for more information.

1. Open the vent valve to remove any pressure that has built in the inner vessel.
2. Open the pressure building valve to boil away any cryogenic liquid that remains in the vessel.
3. After the liquid has been boiled away and the outside of the container shows no frost, close the pressure building valve.
4. Warm the inner vessel with warm nitrogen gas through the liquid valve. Check the gas temperature as it escapes through the open vent valve.
5. Close the liquid valve, gas use and pressure building valves.
6. Attach a vacuum pump to the vent valve and evacuate the inner vessel to 26 inches of mercury.
7. Break the vacuum to 5 psig with high purity gas, either nitrogen, argon or oxygen, as required by the service of the container.
8. Repeat steps 6 and 7 twice.
9. Close all valves and remove the vacuum and gas purge lines. The container is now ready for filling.

Filling Procedures

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

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

Filling the Mega-Cyl 450 and Laser-Cyl Cylinders

The Mega-Cyl 450 and Laser-Cyl cylinders are regulated by the US DOT/Transport Canada for transporting liquid oxygen, nitrogen, or argon. The filling of these liquid cylinders must be done by product weight. This will allow enough gas space above the liquid to keep the cylinders 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 valve setting for the Mega-Cyl 450 cylinder is 350 psig and 500 psig for the Laser-Cyl cylinders. The filling procedure will show the proper way to use the filling weight table.

Filling can be accomplished by either a pressure transfer or pump fill. The following procedure should be used (reference numbers correspond with the schematics in the Specifications section).

1. Sample the residual gas that is in the cylinder. Purge the cylinder if necessary to ensure 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 liquid valve (#9). Record the weight. The difference between this weight and the initial weight is the weight of the transfer hose.

4. To determine the total filling weight add the tare weight of the cylinder, the hose weight and the proper filling weight from the table in this section. The table indicates the product across the top and the relief pressure down the side. Connect the two columns to find the proper weight. Example: Mega-Cyl 450 for oxygen at 250 psi has a product weight of 950 pounds.
5. Open the cylinders vent (#14) and liquid valves (#9). 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 (#9) on the cylinder. Close the vent valve (#14).
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: *After filling the Laser-Cyl cylinder the unit may require a 48 hour period for liquid to saturate at operating pressure.*

Filling the Mega-Cyl 1000

To fill Mega-Cyl 1000 cylinders the following procedure should be used (reference numbers used below correspond with the schematics in the Specification section).

1. Verify that the container to be filled is reasonably level to prevent over or under filling.
2. If necessary, purge the container prior to filling (refer to the section on purging).
3. Verify that the contents of the supply unit is the proper product to be transferred to the Mega-Cyl cylinder.
4. If necessary, start the pressure building system on the liquid supply source to obtain a working pressure that is sufficient enough to allow the liquid to be transferred from the source to the Mega-Cyl cylinder.
5. Verify that all container valves are closed.
6. Connect the supply unit transfer hose to liquid fill and withdraw valve (#9).
7. Open vent valve (#14).
8. Open liquid valve (#9) slowly.
9. Continue to fill the container until the proper amount of liquid has been transferred to the container. This is evident when liquid dispenses from vent valve (#14).
10. Stop the flow of liquid from the supply source.
11. Close liquid fill valve (#9), vent valve (#14).
12. Relieve fill hose pressure by loosening the hose at liquid fill and withdraw connection (#9), then disconnect the hose.
13. Check liquid pressure in the container. If pressure continues to rise as the result of a warm unit, open vent valve (#14) until thermal equilibrium in the container has been achieved. Once achieved, close the vent valve (#14).

Gas Withdrawal

The Mega-Cyl / Laser-Cyl liquid cylinders will deliver gas at various flow rates and temperatures for different applications. The flow rate is controlled by the equipment which is being supplied gas from the cylinder. The continuous flow rate indicates the flow rate that will normally provide gas at a reasonable temperature and should not be exceeded. Higher flow rates may provide very cold gas that could damage the equipment that they are attached to. To supply gaseous product follow this step-by-step procedure (reference numbers used below correspond with the schematics in the Specification section).

1. Connect the proper regulator to the liquid cylinders gas use outlet (#10).
2. Connect the proper hose between the final line regulator and the receiving equipment.
3. Open the pressure building valve (#8).
4. Allow pressure (refer to gauge) to build to the operating pressure (300 psig HP/450 psig VHP).
5. Open the gas use valve (#10).
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 Mega-Cyl / Laser-Cyl cylinder should always be kept closed to protect the inner vessel and plumbing from being contaminated.

The operator should review the safety precautions found in the Safety section before conducting a gas or liquid withdrawal operation. Protective eye glasses, and gloves should always be worn.

At low flow rates the Mega-Cyl cylinder is capable of delivering warm gas through the line regulator. As the flow rate increases, the temperature of the gas decreases. If the cold temperature becomes a problem at a desired flow rate, an external vaporizer can be added. Attach this vaporizer directly in series with the gas use connection and place the line regulator at the exit of the vaporizer.

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

Mega-Cyl Liquid Withdrawal

The Mega-Cyl 1000 series is equipped with an over the road relief valve set at 22 psig that is useful for low pressure liquid withdrawal. This relief valve can be isolated by closing the shutoff valve immediately upstream.

To transfer liquid, attach the transfer hose to the liquid connection. Slowly open the liquid valve to flow the liquid. The liquid will vaporize at first until the transfer line cools down. A phase separator on the end of the transfer line will help when transferring liquid into open dewars.

Transfer pressure should be kept to a minimum. The normal evaporation of the liquid will usually maintain enough pressure for transferring. If additional pressure is needed, the pressure building valve can be opened until the desired pressure is reached.

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

Laser-Cyl Liquid CO_2 Withdrawal

Liquid can be withdrawn from these liquid cylinders in the same manner described previously, however the transfer of liquid carbon dioxide is slightly different and should follow this procedure:

1. Connect the transfer hose to the liquid valve fitting (#22) of the high pressure liquid cylinder.
2. Connect the other end of the hose to the receiving equipment.
3. Open the pressure building valve (#8) and wait for the pressure gauge (#1) to reach the operating pressure (450 psi / 31.0 bar).
4. Refer to the receiving equipment manual for procedures to open this fill valve and vent valve of the receiving equipment.
5. Open the liquid valve on the liquid cylinder. This valve can be adjusted to obtain the proper liquid flow rate and delivery pressure.
6. Adjust the receiving equipment vent valve and the fill valve to maintain pressure in the fill hose. The equipment and the hose must maintain pressures above 70 psi (4.8 bar) during the transfer. Liquid CO_2 will turn into dry ice at lower pressures.
7. When transfer is complete, close the receiving equipment's valve. Close the liquid valve on the cylinder and relieve pressure from the hose.

Caution! ***The liquid and vent valves on high pressure liquid cylinders should always be kept closed to protect the inner vessel and plumbing from being contaminated.***

Fill Weights

The contents of the Mega-Cyl / Laser-Cyl liquid cylinders can be determined by means of a differential pressure gauge, calibrated in inches of water column, that is mounted to the left front gauge bracket. The calibration charts on the following pages show contents conversions for O_2, N_2, Ar, CO_2, and N_2O.

Filling Weight Table (Laser-Cyl 200)					
Relief Valve Setting	**Argon**	**Nitrogen**	**Oxygen**	**Carbon Dioxide**	**Nitrous Oxide**
PSIG	**LBS**	**LBS**	**LBS**	**LBS**	**LBS**
0 to 45	585	334	475	--	--
46 to 75	572	325	462	--	--
76 to 105	559	317	453	475	457
106 to 170	537	308	440	462	444
171 to 230	523	303	431	457	435
231 to 295	506	299	422	449	427
296 to 360	493	286	409	440	418
361 to 450	488	268	400	431	365
**451 to 540	471	255	387	405	383
BAR	**KG**	**KG**	**KG**	**KG**	**KG**
0 to 3.1	265	152	215	--	--
3.2 to 5.2	259	148	209	--	--
5.3 to 7.2	253	144	205	215	207
7.3 to 11.7	243	140	200	209	202
11.8 to 15.9	237	138	196	207	198
16.0 to 20.3	229	136	192	204	194
20.4 to 24.8	223	130	186	200	190
24.9 to 31.0	221	122	182	196	166
**31.1 to 37.2	213	116	176	184	174

**Normal Factory Setting

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

Filling Weight Table (Mega-Cyl 450 and Laser-Cyl 450)					
Relief Valve Setting	**Argon**	**Nitrogen**	**Oxygen**	**Carbon Dioxide**	**Nitrous Oxide**
PSIG	**LBS**	**LBS**	**LBS**	**LBS**	**LBS**
0 to 45	1316	752	1069	--	--
46 to 75	1287	732	1039	--	--
76 to 105	1257	712	1019	1069	1029
106 to 170	1207	693	990	1039	1000
171 to 230	1178	683	970	1029	980
231 to 295	1138	673	950	1009	960
*296 to 360	1118	643	921	990	941
361 to 450	1099	603	900	970	920
**451 to 540	1059	574	871	910	861
BAR	**KG**	**KG**	**KG**	**KG**	**KG**
0 to 3.1	597	341	485	--	--
3.2 to 5.2	584	332	471	--	--
5.3 to 7.2	570	323	462	485	467
7.3 to 11.7	547	314	449	471	454
11.8 to 15.9	534	310	440	467	444
16.0 to 20.3	516	305	431	458	435
*20.4 to 24.8	507	292	417	449	426
24.9 to 31.0	498	273	408	440	417
**31.1 to 37.2	480	260	395	413	390

*Normal Factory Setting for Mega-Cyl 450 HP
**Normal Factory Setting for Laser-Cyl 450

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

Note: *The Mega-Cyl 1000 can be filled to 'vent full' because they must be transported at pressures less than 25.3 psig* (reference 49 CFR 173.320 Cryogenic liquids; exception).

Calibration Charts

Mega-Cyl 450															
H_2O	Oxygen			Nitrogen			Argon			Carbon Dioxide			Nitrous Oxide		
Inches	Gallons	LB	Cubic Foot	Gallons	LB	Cub Foot	Gallon	LB	Cubic Foot	Gallon	LB	Cubic Foot	Gallons	LB	Cubic Foot
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						

Mega-Cyl 450 (Metric)															
H_2O	Oxygen			Nitrogen			Argon			CO_2			N_2O		
Inches	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						

Mega-Cyl 1000												
H_2O	Oxygen			Nitrogen			Argon			CO_2		
Inches	Gallons	LB	Cubic Foot	Gallons	LB	Cub Foot	Gallon	LB	Cubic Foot	Gallon	LB	Cubic Foot
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	7860	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	206.3	1759	15378
48.0	173.1	357	19924	249.2	367	23203	149.7	352	16841	215.5	1838	16064
50.0	181.0	373	20833				156.5	369	17606	224.7	1916	16750
52.0	188.8	389	21731				163.4	385	18383	233.9	1995	17436
54.0	196.6	405	22629				170.2	401	19148	242.7	2070	18095
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			
700							225.0	530	25313			
72.0							231.8	546	26078			
74.0							238.6	562	26843			
77.1							249.2	587	28035			

Mega-Cyl 1000 (Metric)												
H_2O	Oxygen			Nitrogen			Argon			CO_2		
Inches	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	259.3	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	608.0	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

Maintenance

Adjusting Regulator Pressure Ranges

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

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

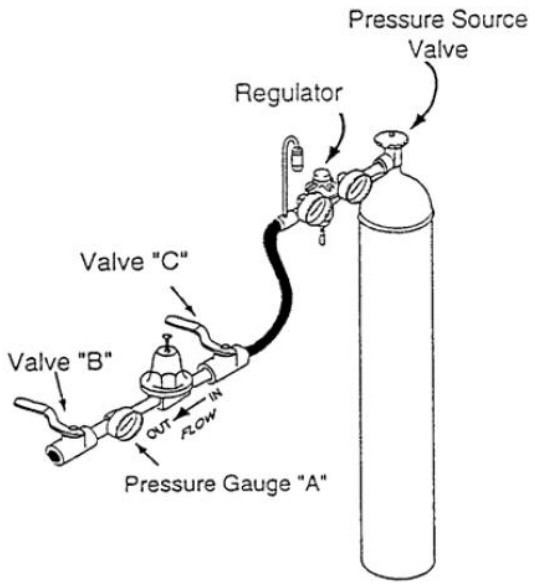


Figure 1

Bench Set-Up for Pressure Building Regulator

Alternate Regulator Springs			
Pressure Builder		Economizer	
Pressure (PSI)	Spring PN	Pressure (PSI)	Spring PN
2-25	57-1003-1	0-30	57-1024-1
15-65	57-1019-1	30-50	57-1021-1
40-100	57-1011-1	51-80	57-1015-1
100-250	57-1020-1	81-150	57-1016-1
		151-250	57-1034-1
		200-400	57-1030-1

Bench Setting a Pressure Building Regulator

1. Connect the pressure building regulator to a nitrogen pressure source as shown in Figure 1.
2. Close valve B.
3. Open pressure source valve (follow appropriate safety rules).
4. Open valve C slowly.
5. Pressure gauge A will indicate the pressure to which the regulator has been set. The pressure can be increased by turning the adjusting screw in or decreased by turning the screw out; however, after each adjustment outward it will be necessary to open and then close valve B to relieve excess pressure.
6. This procedure may be repeated as many times as necessary to obtain the proper setting.
7. After the proper setting is obtained, secure the lock nut on the adjusting screw.

Factory Settings:

Mega-Cyl 450/1000 HP	300 psig
Laser-Cyl 200/450 VHP	450 psig

Bench Setting an Economizer Regulator

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

Factory Settings:

Mega-Cyl 450/1000 HP	325 psig
Laser-Cyl 200/450 VHP	450 psig

*Not applicable for Mega-Cyl 450HP with Combo Pressure Building/ Economizer Regulator.

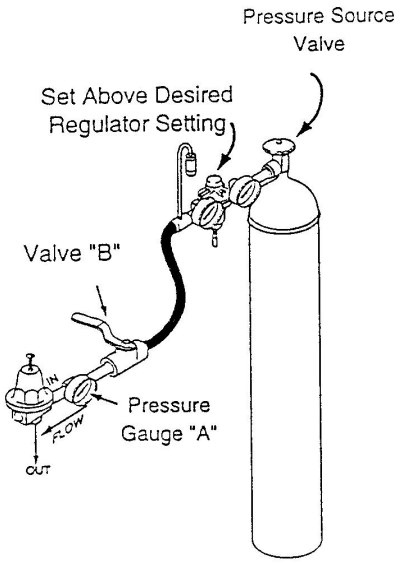


Figure 2

Procedure for Adjusting Combo Pressure Building/Economizer Regulator

1. Connect the combo regulator to a pressure source as shown in Figure 3.
2. Close Valve 2.
3. Open the pressure source valve (follow the appropriate safety rules).
4. Open Valve 1 slowly.
5. Pressure gauge A will indicate the pressure to which the regulator has been set. The pressure can be increased by turning the adjusting screw in and decreased by turning the adjusting screw out. However, after each adjustment outward it will be necessary to open and then close valve 2 to relieve excess pressure.
6. This procedure may be repeated as many times as necessary to obtain the proper setting.
7. After the proper setting is obtained, secure the lock nut on the adjusting screw.

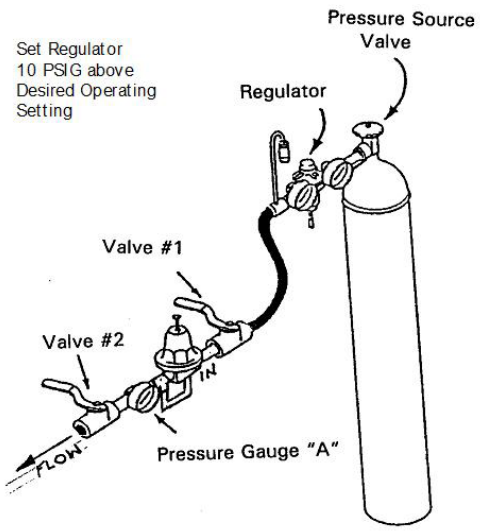


Figure 3

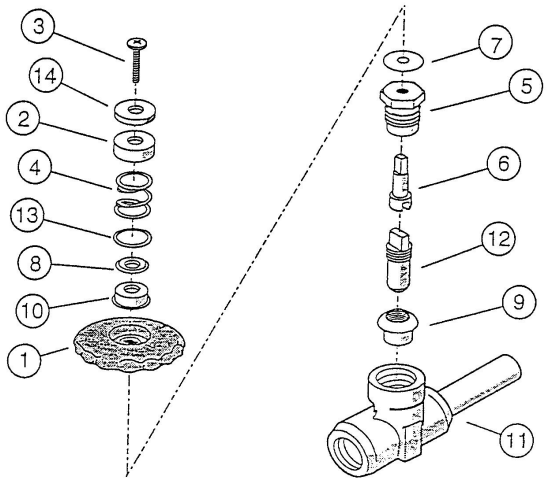
Rebuilding the Operational Valves

The valves that are used have a spring loaded rotary stem. This automatically compensates for thermal shrinkage and wear.

When a defective valve is suspected, follow this procedure to repair it (refer to the Globe Valve Components drawing and table for description and part numbers).

1. Open the vent valve and release any pressure that is in the container.
2. If the valve to be repaired is the vent valve, allow it to warm up before it is disassembled.
3. If the valve to be repaired is the pressure building valve, the container should be emptied of product and pressure.
4. Remove the valve handle screw (item 3), washer (item 14), retainer cap and spring assembly (items 2, 4, 8, 10 and 13).
5. Remove the valve handle (item 1) and Teflon thrust washer (item 7).
6. Unscrew bonnet (item 5) to remove stem (item 6) and stem seal.
7. Pick out body insert (item 12) and plug assembly (item 9).
8. Clean seat.
9. Replace parts as needed and reassemble in reverse order.

Globe Valve Components



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

*Recommended spare parts
**Parts are also available in complete packages.

Troubleshooting

The following table is arranged in a Trouble/Probable Cause/Remedy format. The probable causes for specific problems are listed in descending order of significance. That is, check out the first cause listed before proceeding to the next. Perform all procedures in order listed and exactly as stated. If you need additional assistance please contact Chart Technical Service at 1-800-400-4683.

Problem	Probable Cause	Remedy
Mega-Cyl / Laser-Cyl cylinder builds excessive pressure or builds pressure too fast.	Low usage.	If daily usage is under 1000 scf, the cylinder will build pressure. In liquid service, the cylinder should be equipped with low pressure relief valve and regulator.
	Cylinder is over filled.	If the cylinder is filled past the vent trycock or past the DOT specified fill weight, the pressure may rise rapidly after a fill.
	Pressure building regulator is set improperly or leaks.	If the pressure builds and stays at a pressure higher than desired, adjust the pressure building regulator to a new setting.
		If the pressure builds to the relief valve setting and the PB coil near the bottom of the tank is cold or frosted, replace the regulator.
	Vacuum is deteriorating.	This can be accompanied by cold or frost occurring evenly over the cylinder surface. Refer to the troubleshooting section on frost.
	Pressure building valve is open.	Close valve.
Mega-Cyl / Laser-Cyl cylinder pressure is too low.	Pressure building regulator is set too low.	Adjust the regulator as described in the Maintenance section.
	Pressure building regulator is not opening properly.	Bench test the regulator for full flow at the set pressure as described in the Maintenance section.
	Economizer regulator is set below the pressure building regulator setting.	The economizer regulator must be set 15-25 psi greater than the pressure building regulator as described in the Maintenance section.
	Usage is too high.	Refer to the Specifications section for the maximum recommended delivery rates.
	Cylinder is leaking.	Check for frost on lines or on top of head. Listen for hissing, soap test joints for leaks. Isolate leak and call Chart for repair details.
Frost occurs around the circumference of the shell 4” to 8” from the bottom.	Cylinder is building pressure with the pressure building circuit.	This is normal if the cylinder pressure is lower than the pressure regulator setting.
	Frost is residual from last fill or earlier use.	This is normal. A ring of ice or an oval shaped ice ball often remains on the cylinder for days after the last use or fill.
Frost occurs around the circumference of the shell 10” from the floor and up. Frost spots spiral up the shell.	Cylinder is vaporizing liquid into gas.	This is normal. The frost should melt within two hours after the gas use stops.
Frost occurs on head or knuckle.	Residual frost remains from last fill or recent product use.	This is normal. Ice may remain for days after a fill or heavy use.
Frost occurs evenly over the cylinder surface.	The gas withdrawal rate is high. Both the PB and gas use vaporizers are frosted.	This is normal.
	Cylinder has lost vacuum.	This is accompanied by high rate of pressure rise or high loss rate. Call Chart for return instructions.

Problem	*Probable Cause*	*Remedy*
Miscellaneous frost spots on cylinder.	Cylinder may have internal damage.	Call Chart for evaluation or repair/return instructions.
Delivery gas is too cold.	Rate exceeds recommended delivery rate.	Refer to Specifications section for recommended maximum delivery rates.
In liquid delivery, liquid is mixed with high amount of gas.	Cylinder pressure is higher than optimum for liquid withdrawal.	Reset the cylinder pressure for liquid use. Also, use a phase separator on the end of the transfer hose.
In CO_2 service, cylinder does not deliver product properly.	Possible dry ice blocks have formed in system.	Pressurize the cylinder to 100 psi or above to reliquify from CO_2 dry ice.

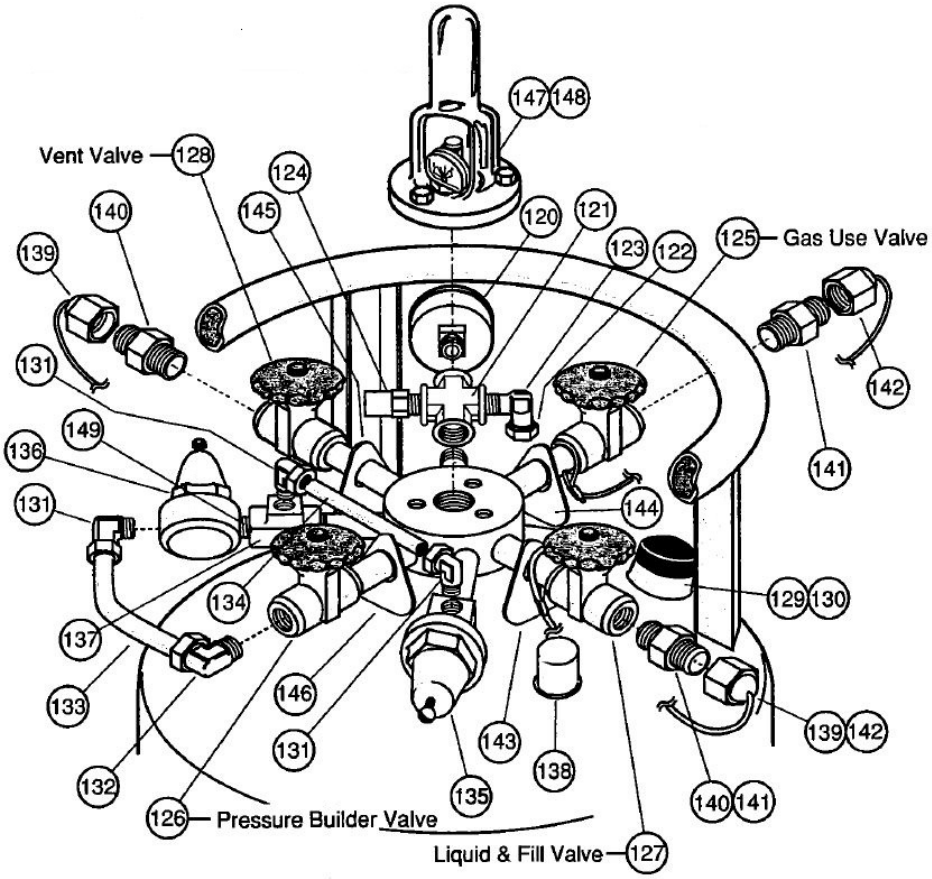
Specifications

		Mega-Cyl		Laser-Cyl	
Model		**450**	**1000**	**200**	**450**
	Pressure	HP	HP	VHP	VHP
	Part Number	10588979	10752281	10619771	10619659
Capacity					
Liquid (Gross)	(liters)	450	1056	200	450
Liquid (Net)(1)	(liters)	428	950	196	428
Gas (N_2)	ft^3 / Nm^3	8,875 / 233.2	23,363 / 614	3,521 / 93	7,922 / 208
Gas (O_2)	ft^3 / Nm^3	11,111 / 292	28,843 / 758	4,674 / 123	10,519 / 276
Gas (Ar)	ft^3 / Nm^3	10,812 / 284.1	28,234 / 742	4,552 / 120	10,241 / 269
Gas (CO_2)	ft^3 / Nm^3	8,652 / 227.4	18,580 / 488.3	3,537 / 93	7,960 / 209
Gas (N_2O)	ft^3 / Nm^3			3,333 / 88	7,516 / 197
Performance					
NER (N_2)	% per day	2.1	1.3	2.0	2.0
NER (O_2, Ar)	% per day	1.4	0.9	1.4	1.4
NER (CO_2, N_2O)	% per day	0.6	0.3	0.5	0.5
Gas Flow (N_2, O_2, Ar)	SCFH/Nm^3/hr	575 / 15.1	960 / 25.2	350 / 9.2	575 / 15.1
Gas Flow (CO_2)	SCFH/Nm^3/hr	195 / 5.1	300 / 7.9	110 / 2.9	180 / 4.7
Dimensions & Pressure Ratings					
Relief Valve Setting	psig / barg	350 / 24	350 / 24	500 / 34.5	500 / 34.5
DOT/CTC/ASME Rating		4L292	ASME Sec 8/ Div 1	4L412	4L412
Diameter (cylinder)	in / cm	30 / 76.2	42 / 106.7	20 / 50.8	30 / 76.2
Height (cylinder) (2)	in / cm	62 / 158	76 / 191	65.8 / 167.1	61.3 / 155.7
Base Width (frame)(3)	in / cm	34 / 86.4	45 / 114	--	34 / 86.4
Base Depth (frame)(3)	in / cm	34 / 86.4	45 / 114	--	34 / 86.4
Height (frame)(3)	in / cm	74 / 188	95 / 241	--	73.8 / 187.5
Tare Wt. (cyl + frame)(4)	lb / kg	1,275 / 580	2,650 / 1,205	375 / 170	1,265 / 574
Full Weight (N_2)	lb / kg	1,918 / 872	4,343 / 1,974	630 / 286	1,839 / 836
Full Weight (O_2)	lb / kg	2,195 / 998	5,038 / 2,290	762 / 346	2,136 / 971
Full Weight (Ar)	lb / kg	2,393 / 1,088	5,569 / 2,532	846 / 384	2,324 / 1,056
Full Weight (CO_2)	lb / kg	2,265 / 1,029	5,218 / 2,372	791 / 360	2,202 / 1,001

(1) CO_2 values and 450 liter models based on DOT4L fill density. N_2, O_2 and Ar values based on net volume at 0 psig.
(2) All dimensions on Laser-Cyl units are measured from the floor to the top of the sight gauge protector.
(3) Customized pallets are available upon request.
(4) Weights are approximate and vary with pallet design.

Laser-Cyl 200VHP

Parts Identification

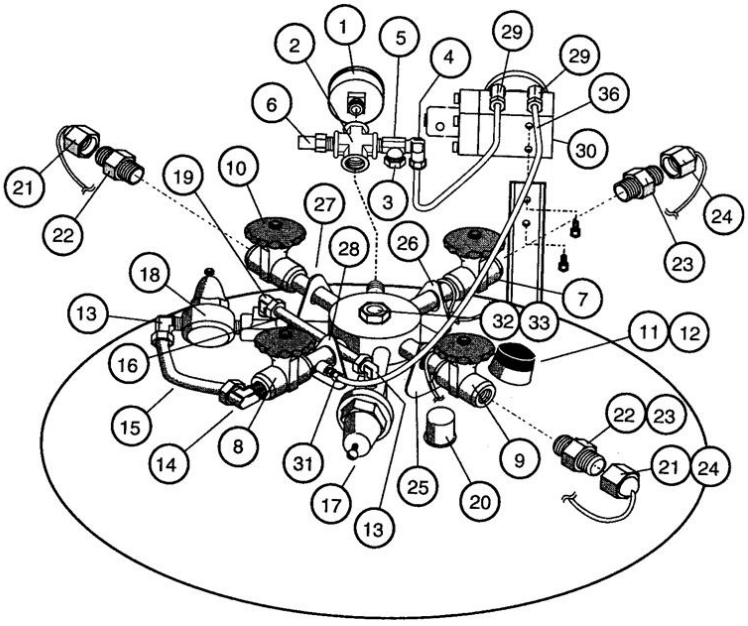


Item	PN	Qty	Description
120	20-1006-4	1	Pressure Gauge - 1/4 CBM (0-600psig/41.4barg)
121	12-1292-2	1	Cross - 1/4 FPT
122	11055525	1	Safety Rupture Disc - 1/4 MPT (700 psig/48.0 barg)
123	12-1046-2	1	Street Elbow - 1/4 NPT
124	10686878	1	Pressure Relief Valve - 1/4 MPT (500 psig/34.5 barg) CO_2 - N_2O
124	18-1271-2	1	Pressure Relief Valve - 1/4 MPT (500 psig/34.5 barg) O_2, N_2, Ar
125	17-1002-2	1	Globe Valve - 3/8 FPT (Gas Use) Green
126	17-1002-2	1	Globe Valve - 3/8 FPT (PB) Green
127	17-1599-2	1	Globe Valve - 3/8 FPT (Liquid Fill) Blue
128	17-1001-2	1	Globe Valve - 3/8 FPT (Vent) Silver
129	39-1066-6	1	Dust Cap (Vacuum Rupture Disc)
130	38-1494-5	1	Warranty Seal
131	10501685	3	Male Elbow - 3/8 OD x 1/4 MPT
132	10501706	1	Male Elbow - 3/8 OD x 3/8 MPT
133	85-1216-3	1	Copper Tubing - 3/8 ODT x 5” lg.
134	10590999	1	Copper Tubing - 3/8 ODT x 7” lg.
135	10619675	1	Economizer Regulator - 1/4 NPT (475 psig/32.8 barg)
136	10619667	1	Pressure Building Regulator - 1/4” NPT (450 psig/31.0 barg)
137	12-1062-2	1	Tee - 1/4 FPT
138	39-1069-6	1	Pumpout Cap
139	40-1663-9	2	Dust Cap - 1/2” ODT (Ar or Nit)

Item	PN	Qty	Description
139	40-1664-9	2	Dust Cap - 5/8” ODT (Oxy)
139	40-1663-9	1	Dust Cap - 1/2” ODT (CO_2 and N_2O)
140	11-1007-2	2	Male Connector - 1/2” ODT x 3/8” MPT (Ar or Nit)
140	11-1011-2	2	Male Connector - 5/8” ODT x 3/8” MPT (Oxygen)
140	11-1007-2	1	Male Connector - 1/2” ODT x 3/8” NPT (CO_2 or N_2O)
141	40-1002-2	1	Gas Outlet - 3/8” MPT x CGA-580 (Ar or Nit)
141	40-1001-2		Gas Outlet - 3/8” MPT CGA-540 (Oxy)
141	40-1056-2	2	Gas & Liquid Outlet - CGA-320 (CO_2)
141	40-1060-2	2	Gas & Liquid Outlet - CGA-326 (N_2O)
142	40-1062-9	1	Dust Cap - CGA-580 (Ar or Nit)
142	40-1051-2	1	Dust Cap - CGA-540 (Oxy)
142	40-1666-9	2	Dust Cap - CGA-320 (CO_2)
142	40-1025-9	2	Dust Cap - CGA-326 (N_2O)
143	38-1158-9	1	Metal Tag (Liquid Fill)
144	38-1159-9	1	Metal Tag (Gas Use)
145	38-1160-9	1	Metal Tag (Vent)
146	38-1161-9	1	Metal Tag (Pressure Builder)
147	10534567	1	Sight Gauge Protector (Orange)
148		1	Sight Gauge Assembly Liquid Level Gauge
149	13-1009-2	1	Brass Hex Nipple - 1/4 NPT

Laser-Cyl 400VHP

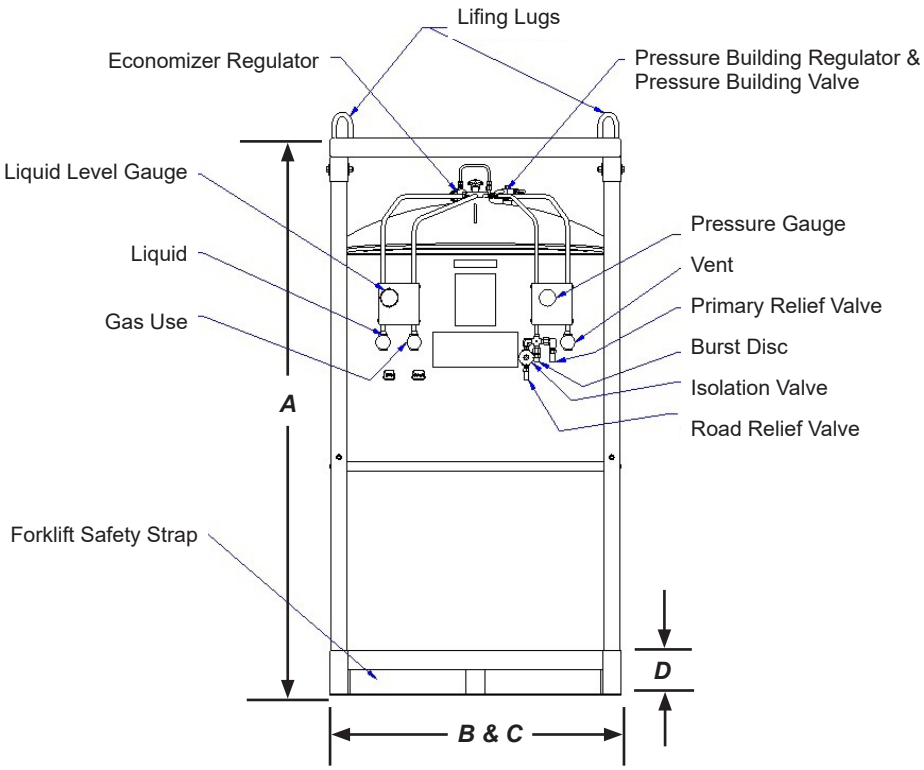
Parts Identification



Item	PN	Qty	Description
1	20-1006-4	1	Pressure Gauge - 1/4 CBM (600psig/41.4barg)
2	12-1292-2	1	Cross - 1/4 FPT
3	19-1107-2	1	Safety Rupture Disc - 1/4 MPT (700psig/48.3barg)
4	10501634	1	Elbow - 1/8” ODT x 1/4” MPT
5	12-1307-2	1	Tee - 1/4”
6	10686878	1	Pressure Relief Valve - 1/4 MPT (500psi/34.5bar) CO_2-N_2O
6	18-1271-2	1	Pressure Relief Valve - 1/4 MPT (500psi/34.5bar) O_2, N_2, Ar
7	17-1002-2	1	Globe Valve - 3/8 FPT (Gas Use)
8	17-1002-2	1	Globe Valve - 3/8 FPT (PB)
9	17-1599-2	1	Globe Valve - 3/8 FPT (Liquid Fill)
10	17-1001-2	1	Globe Valve - 3/8 FPT (Vent)
11	39-1066-6	1	Dust Cap (Vacuum Rupture Disc)
12	38-1494-5	1	Warranty Seal
13	10501685	2	Male Elbow - 3/8 ODT x 1/4 MPT
14	10501706	1	Male Elbow - 3/8 ODT x 3/8 MPT
15	10591019	1	Copper Tubing - 3/8 ODT x 5” lg.
16	10591019	1	Copper Tubing - 3/8 ODT x 7” lg.
17	10619675	1	Economizer Regulator - 1/4 NPT (475 psig/32.8 barg)
18	10619667	1	Pressure Building Regulator - 1/4 NPT (450 psig/31.0 barg)
19	10655553	1	Female Elbow - 3/8 ODT x 1/4 FPT
20	39-1069-6	1	Pump out Cap
21	40-1054-2	2	Dust Cap - 1/2” ODT (Ar or Nit)
21	39-1120-6	2	Dust Cap - 5/8” ODT (Oxy)
21	40-1054-2	1	Dust Cap - 1/2” ODT (CO_2 or N_2O)

Item	PN	Qty	Description
22	11-1007-2	2	Male Connector - 1/2” ODT x 3/8” MPT (Ar or Nit)
22	11-1011-2	2	Male Connector -5/8” ODT x 3/8” MPT (Oxy)
22	11-1007-2	1	Male Connector - 1/2” ODT x 3/8” NPT (CO_2 or N_2O)
23	40-1002-2	1	Gas Outlet - 3/8” MPT x CGA-580 (Ar or Nit)
23	40-1001-2	1	Gas Outlet - 3/8” MPT CGA-540 (Oxy)
23	40-1056-2	2	Gas and Liquid Outlet - CGA-320 (CO_2)
23	40-1060-2	2	Gas and Liquid Outlet - CGA-326 (N_2O)
24	40-1055-2	1	Dust Cap - CGA-580 (Ar or Nit)
24	39-1120-6	1	Dust Cap - CGA-540 (Oxy)
24	40-1055-2	2	Dust Cap - CGA-320 (CO_2)
24	40-1055-2	2	Dust Cap - CGA-326 (N_2O)
25	40-1055-2	1	Metal Tag (Liquid Fill)
26	38-1159-9	1	Metal Tag (Gas Use)
27	38-1160-9	1	Metal Tag (Vent)
28	38-1161-9	1	Metal Tag (Pressure Builder)
29	10501634	1	Elbow - 1/8” ODT x 1/4” MPT
30	10644862	1	Liquid Level Gauge - 2-1/2” Dial
31	10501520	1	Connector - 1/8” ODT x 1/8” MPT
32	23-0009-4	1	O-Ring
33	10676485	1	Knuckle Plug
34	29-1140-1	2	PHPNHMS #8-32 x 3/8” lg.
35	10647764	1	Calibration Chart
36	69-1068-3	1	Copper Tubing - 1/8” ODT x 2’

General Arrangement Drawing

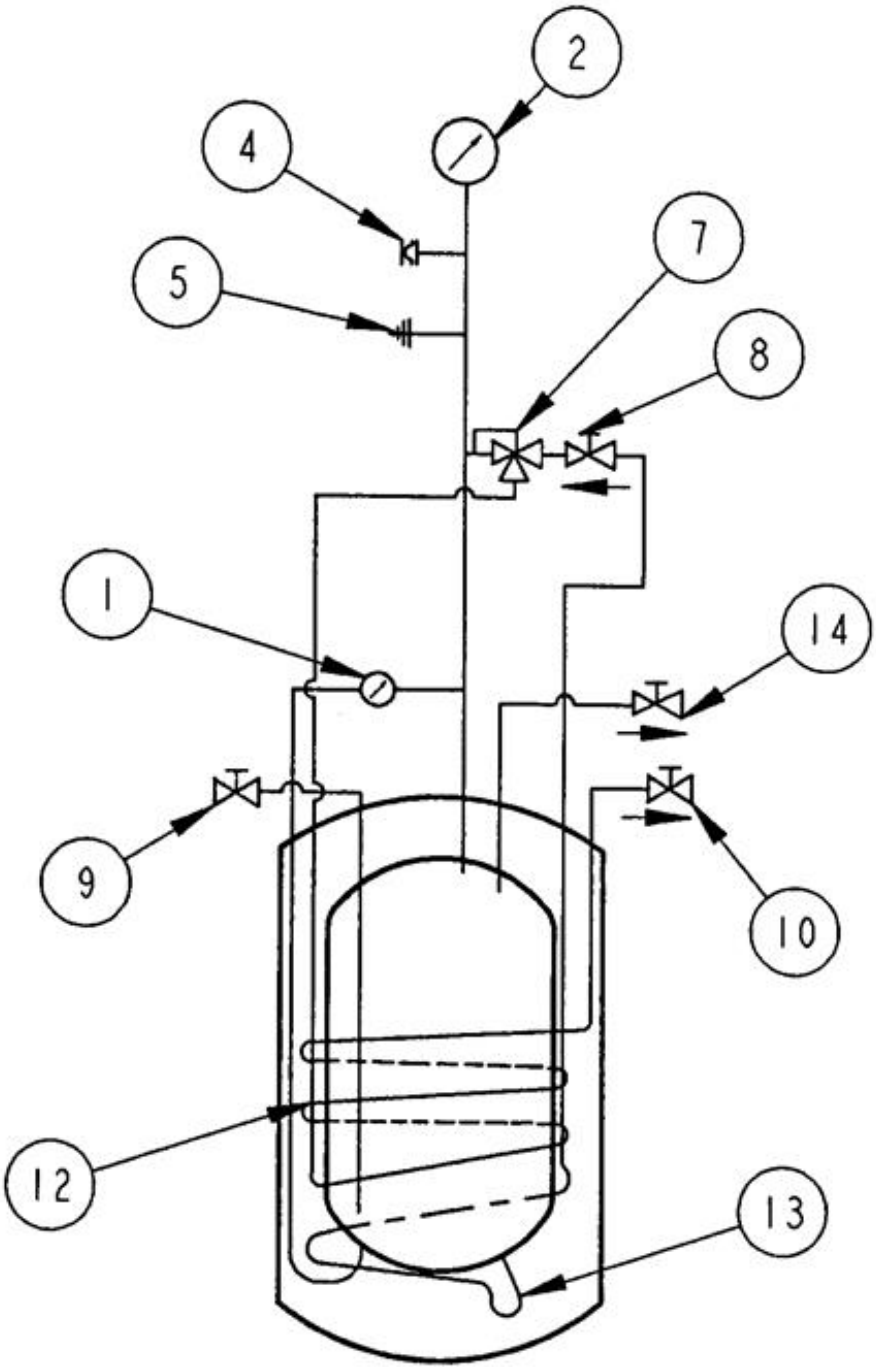


Pallet and Vessel Dimension Chart

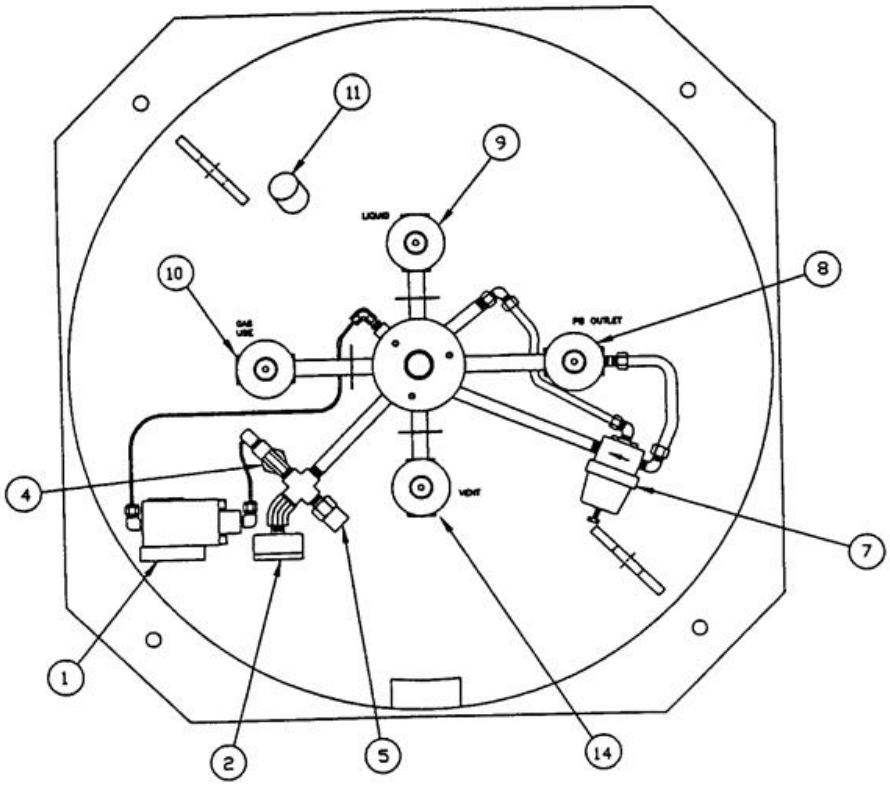
Model	Mega-Cyl 450HP	Mega-Cyl 1000HP	Laser-Cyl 450 VHP
Dimensions (cylinder)			
Diameter in. (cm)	30 (76.2)	42 (106.7)	30 (76)
Height in. (cm)	61 (155)	76 (191)	61.3 (155.7)
Dimensions (frame)*			
“A” Height in. (cm)	73.75 (187)	N/A	73.8 (187.5)
“B” Base Width in. (cm)	34 (86)		34 (86.4)
“C” Base Depth in. (cm)	34 (86)		34 (86.4)
“D” Leg Height in. (cm)	3.5 (8.9)		3.5 (8.9)

Mega-Cyl 450HP

Flow Diagram

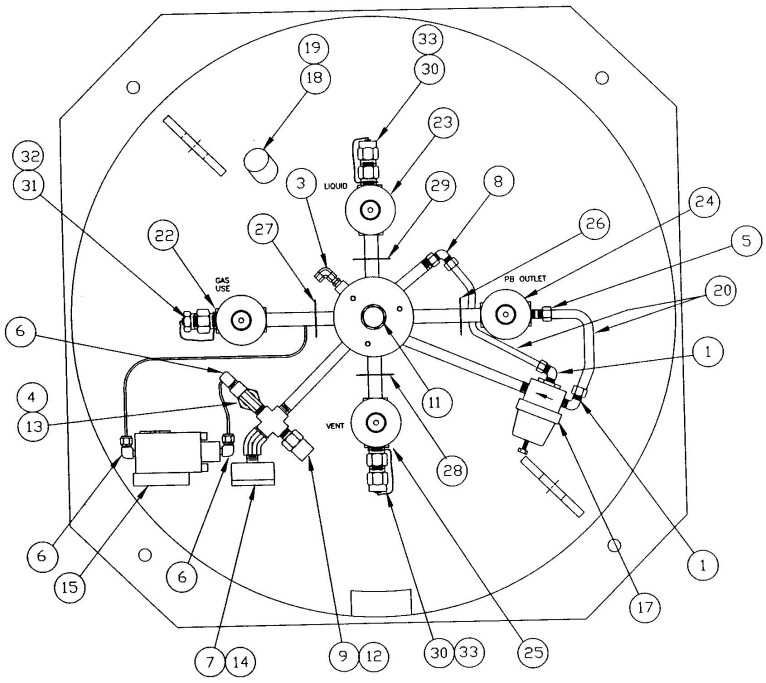


Nomenclature



Ref. #	Plumbing Controls & Function	Ref. #	Plumbing Controls & Function
1	Liquid Level Gauge - To approximate the liquid contents of the liquid cylinder.	8	Pressure Building Valve - Isolates the pressure building system.
2	Pressure Gauge - Indicates cylinder pressure.	9	Fill/Liquid Valve - Used for filling or liquid withdrawal operations.
3	Road Relief Valve - Maintains pressure below 25 psig for transport over the road.	10	Gas Use Valve - Use for gas withdrawal.
4	Burst Disc - Secondary relief device.	11	Casing Burst Disc - Protects vacuum casing from over pressurization.
5	Safety Relief Valve - Primary relief device.	12	Vaporizer - Converts liquid into gas.
6	Pressure Building/Economizer Regulator - Used to automatically build and reduce pressure as required.	13	Pressure Building Coil - Vaporizes liquid into gas.
7		14	Vent Valve - Used to vent pressure.

Parts Identification



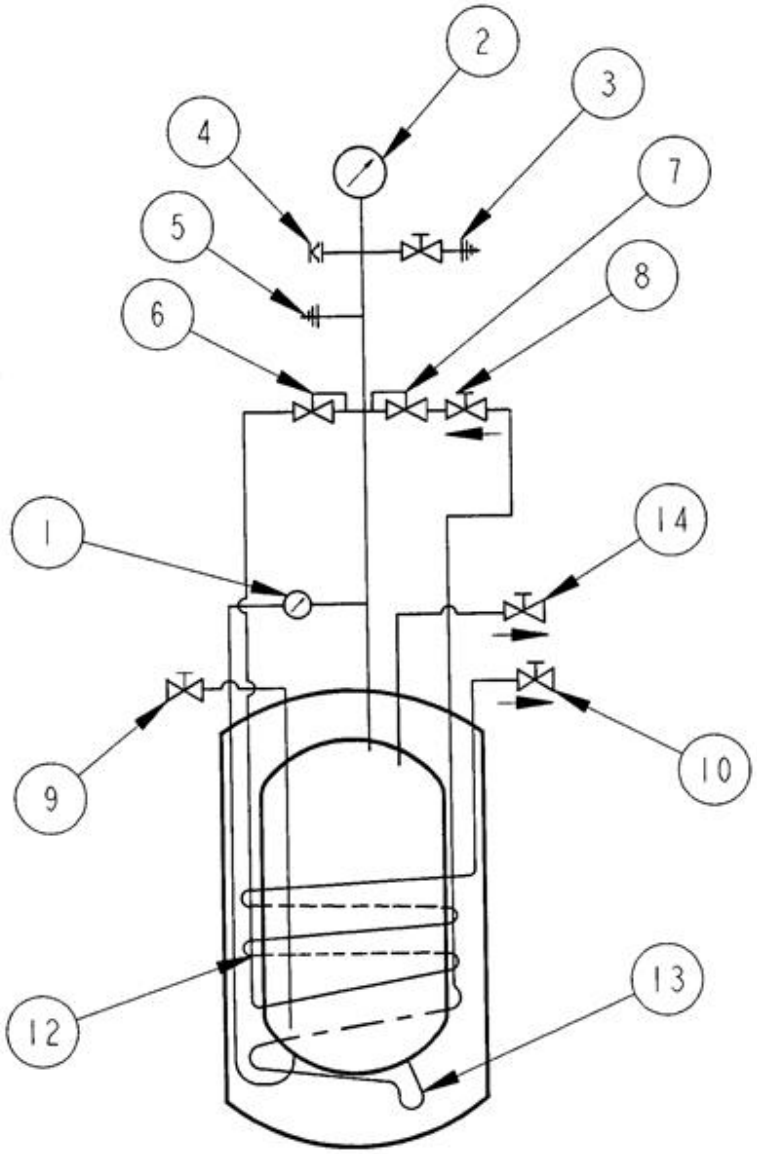
Item	PN	Qty	Description
1	10-1143-2	2	Elbow (3/8”ODT x 1/4”MPT)
2	10-1144-2	1	Elbow (3/8”ODT x 3/8”MPT)
3	10-1232-2	1	Elbow (1/8”ODT x 1/8”MPT)
4	12-1170-2	1	Brass Tee Street (1/4” NPT)
5	10501511	1	Brass Connector (3/8”ODT x 1/4”FPT)
6	10-1360-2	3	Brass Elbow (1/8”ODT x 1/4”MPT)
7	12-1047-2	1	Brass Elbow Str 45D (1/4”FPTx1/4”MPT)
8	10-1261-2	1	Brass Elbow (3/8”ODT x 1/4”FPT)
9	12-1292-2	1	Brass Cross (1/4”FPT)
11	12-1365-1	1	SS Hex Head Plug (7/8” - 14)
12	18-1216-2	1	Relief Valve (1/4” @ 250 psi)
12	18-1046-2	1	Relief Valve (1/4” MPT @ 350 psi)(all except CO_2)
13	19-1088-2	1	Rupture Disc (1/4” MPT @ 400 psi)
13	19-1163-2	1	Rupture Disc (1/4” MPT @ 600 psi)
14	20-1383-9	1	Press Gauge (2-1/2” Dial x 1/8” CBM @0-400psi)
14	20-1397-9	1	Press Gauge (2-1/2” Dial x 1/8” CBM @0-600psi)

Item	PN	Qty	Description
15	20-1425-9	1	Diff Press Gauge (5” Dial 0-60”)
17	10618939	1	Regulator PB/Econo (1/4”NPT@125psi)
17	10636302	1	Regulator PB/Econo (1/4”NPT@300psi)
18	38-1494-5	1	Warranty Seal (Rupture Disc Assy)
19	39-1066-6	1	Cap (Blue Vinyl)
20	69-1061-3	1 ft	Tube (3/8”OD x .032” wall) Cooper
21	69-1084-3	4 ft	Tube (1/8”OD) Cooper
22	17-1002-2	1	Globe Valve (3/8”FPT)(Gas Use)
23	17-1599-2	1	Globe Valve (3/8”FPT)(Liquid Fill)(Blue)
24	17-1002-2	1	Globe Valve (3/8”FPT)(PB)(Green)
25	17-1001-2	1	Globe Valve (3/8”FPT)(Vent)(Silver)
26	38-1161-9	1	Metal Tag (Pressure Building)
27	38-1159-9	1	Metal Tag (Gas Use)
28	38-1160-9	1	Metal Tag (Vent)
29	31-1158-9	1	Metal Tag (Liquid)

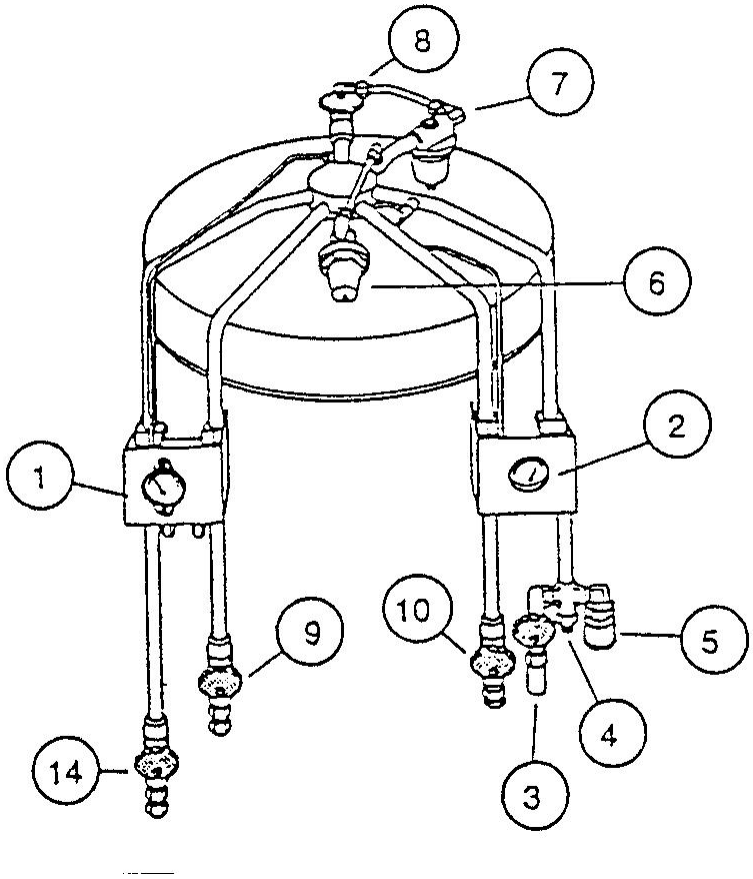
All Models							
30	11-1007-2	2	Male Conn (1/2”ODTx3/8”MPT)(Ar/Nit)	31	40-1060-2	2	Gas/Liq Conn (3/8”MPTxCGA-326)(N_2O)
30	11-1011-2	2	Male Conn (5/8”ODTx3/8”MPT)(O_2)	32	40-1062-9	1	Dust Cap (Ar/N_2) (Gas Use)
30	11-1007-2	1	Male Conn (1/2”ODTx3/8”MPT)(CO_2)	32	40-1051-2	1	Dust Cap (O_2) (Gas Use)
30	11-1007-2	1	Male Conn (1/2”ODTx3/8”MPT)(N_2O)	32	40-1666-9	2	Dust Cap (CGA-320)(CO_2)
31	40-1002-2	1	Gas Outlet (3/8”MPTxCGA-580)(Ar/Nit)	32	40-1025-2	2	Dust Cap (CGA-326)(N_2O)
31	40-1001-2	1	Gas Outlet (3/8”MPTxCGA-540)(O_2)	33	40-1663-9	2	Dust Cap (1/2”ODT)(Ar/Nit)
31	40-1056-2	2	Gas/Liq Conn(3/8”MPTxCGA-320)(CO_2)	33	40-1664-9	2	Dust Cap (5/8”ODT)(O_2)

Mega-Cyl 1000HP

Flow Diagram

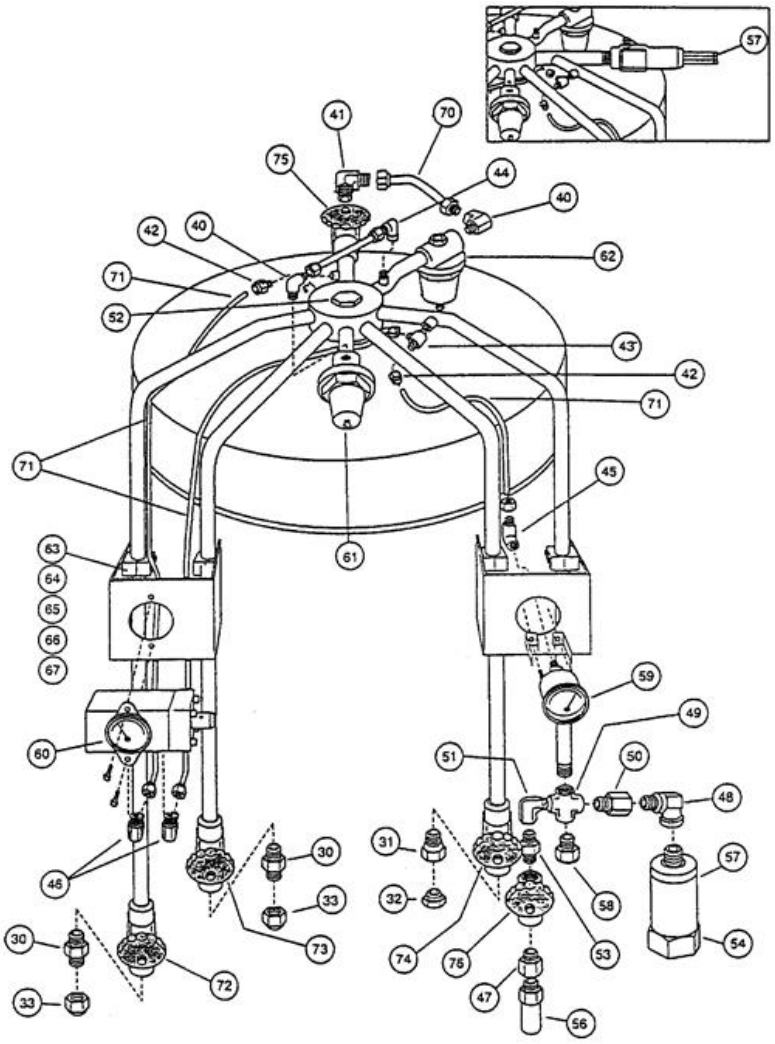


Nomenclature



Ref. #	Plumbing Controls & Function	Ref. #	Plumbing Controls & Function
1	Liquid Level Gauge - To approximate the liquid contents of the liquid cylinder.	8	Pressure Building Valve - Isolates the pressure building system.
2	Pressure Gauge - Indicates cylinder pressure.	9	Fill/Liquid Valve - Used for filling or liquid withdrawal operations.
3	Road Relief Valve - Maintains pressure below 25 psig for transport over the road.	10	Gas Use Valve - Use for gas withdrawal.
4	Burst Disc - Secondary relief device.	11	Casing Burst Disc - Protects vacuum casing from over pressurization.
5	Safety Relief Valve - Primary relief device.	12	Vaporizer - Converts liquid into gas.
6	Economizer Regulator - Used to automatically reduce pressure.	13	Pressure Building Coil - Vaporizes liquid into gas.
7	Pressure Building Regulator - Used to automatically build pressure.	14	Vent Valve - Used to vent pressure.

Parts Identification



Item	PN	Qty	Description
40	10-1143-2	2	Elbow (3/8”ODTx1/4”MPT)
41	10-1144-2	1	Elbow (3/8”ODTx3/8”MPT)
42	10-1226-2	1	Brass Conn (1/8”ODTx1/8”MPT)
43	10-1227-2	1	Brass Tee (1/8”ODTx1/8”ODTx1/8”MPT)
44	10-1261-2	1	Elbow (3/8”ODTx1/4”FPT)
45	10-1349-2	1	Brass Elbow (1/8”ODTx1/4”FPT)
46	10-1360-2	2	Brass Elbow (1/8”ODx1/4”MPT)
47	12-1002-2	1	Hex Bushing (1/4”FPTx3/8”MPT)
48	12-1050-2	1	Street Elbow (1/2”MPT)
49	12-1095-2	1	Brass Cross (3/8”FPT)
50	12-1116-2	2	Adapter (1/2”FPTx3/8”MPT)
51	12-1319-2	1	Elbow (3/8”MPTx3/8”FPT)
52	12-1326-1	1	Plug (3/4” - 16 Hex Head)
53	13-1198-2	1	Nipple Hex (3/8”)
54	16-1162-2	1	Adapter (1/2”FPT)
56	18-1001-2	1	Relief Valve (1/4”MPT@22psi)
57	18-1236-2	1	Relief Valve (1/2”MPT@250psi)
57	18-1146-2	1	Relief Valve (3/4”FPT@350psi)(Old Style)
57	10746447	1	Relief Valve (1/2”FPT@350psi)(O_2 Ar Nit)
58	19-1173-2	1	Burst Disc (400psi)
58	19-1148-2	1	Burst Disc (450psi)
59	20-1383-9	1	Press Gauge (2-1/2”Dial x 1/8”CBM@ 0-400psi)
59	20-1397-9	1	Press Gauge (2-1/2”Dial x 1/8”CBM@ 0-600psi)

Item	PN	Qty	Description
60	20-1433-9	1	DP Gauge Max Serv Press 1500 psi
61	21-1002-2	1	Econ Reg (1/4”NPT@140psi)
61	21-1075-2	1	Econ Reg (1/4”NPT@325psi)
62	21-1003-2	1	Press Build Reg (1/4”NPT@125psi)
62	21-1074-2	1	Press Build Reg (1/4”NPT@300psi)
63	29-1059-1	16	Flat Washer (1/4”)
64	29-1060-1	16	Split Lock Washer (1/4”)
65	29-1067-1	16	Hex Nut (1/4” - 20)
66	29-1403-1	16	Hex Bolt (1/4” - 20 x 1-3/4”long)
67	34-1163-6	16	Clamp (5/8”OD Tube)
68	38-1494-5	1	Warranty Seal
69	39-1066-6	1	Blue Vinyl Cap
70	69-1061-3	1 ft	Tube (3/8”ODx.032” wall) Cooper
71	69-1084-3	4 ft	Tube (1/8”) Cooper
72	17-1001-2	1	Globe Valve (3/8”)(Vent)(Silver)
73	17-1599-2	1	Globe Valve (3/8”)(Liquid)(Blue)
74	17-1002-2	1	Globe Valve (3/8”)(Gas)
75	17-1002-2	1	Globe Valve (3/8”)(Press Build)(Green)
76	17-1739-2	1	Globe Valve (3/8”) Road Relief Isolation
--	38-3058-9	1	Decal (Pressure Building)
--	38-3059-9	1	Decal (Liquid Valve)
--	38-3060-9	1	Decal (Gas Use Valve)
--	38-3061-9	1	Decal (Vent Valve)

Warranty

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:

- Mega-Cyl® and Laser-Cyl® liquid cylinders - 7 years from date of invoice (as of January 1, 2016).
- 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.