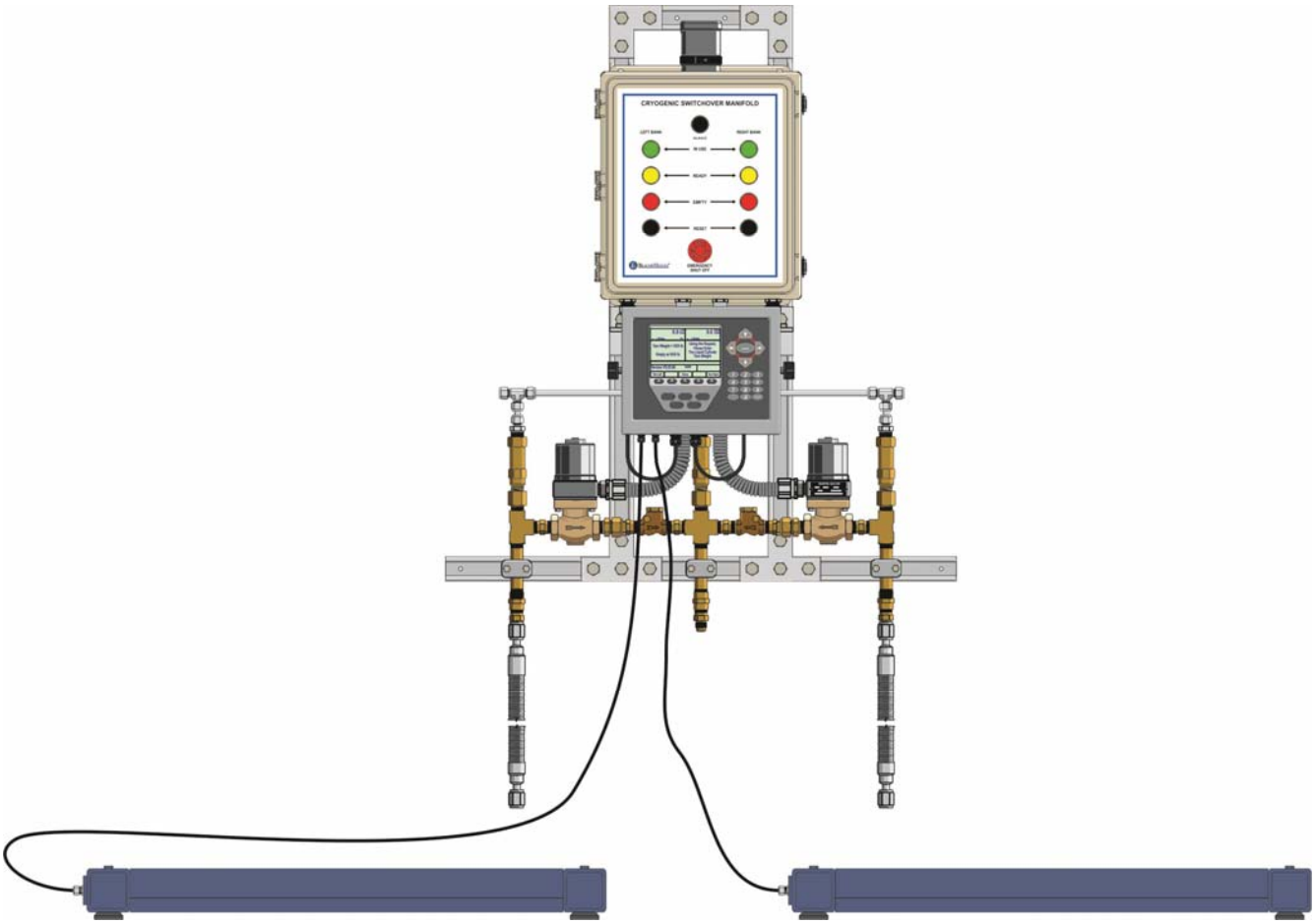


Important

These instructions are for experienced operators who know the general principles and safety precautions to be observed in handling cryogens and compressed gases. If you are not certain you fully understand the safety precautions for handling cryogenic fluids and/or gases, we urge you to obtain and read the Material Safety Data Sheet (MSDS) for each fluid/gas being used.

Do not permit untrained persons to install, operate, or maintain these manifolds. Do not attempt to install or operate these equipment until you have read and fully understand these instructions. If you do not fully understand these instructions, contact BeaconMedaes.

Be sure this information reaches the operator. Your supplier has extra copies.

1- Safety Precautions - General

In this page, unless noted otherwise, the word/term "gas(es)" applies to both compressed gas and cryogenic liquid.

Protect yourself and others. Read and understand the following instructions before attempting to use this equipment. Failure to understand and follow these instructions could result in serious personal injury and/or damage to equipment. Because of the many potential hazards associated with gases, read the Material Safety Data Sheet for each gas you will be using.

- Know and understand the physical and chemical properties of the gas being used.
- Observe general precautions for the use of gases.
- Observe safety precautions for the gas being used.
- Read and follow precautions on cylinder labels.
- Never use these manifolds with gases not compatible with the materials of construction. The use of gases not compatible with the materials of construction may cause damage to equipment or injury to personnel.
- Many gases can cause asphyxiation by displacing oxygen in the atmosphere. Make certain the area where these manifolds are operated is well ventilated. Provide a device to warn personnel of oxygen depletion in the work area.
- Use this equipment only in well ventilated areas. Vent gases to the outside atmosphere, and in an area away from personnel. Be sure that venting and disposal methods are in accordance with Federal, State, Provincial and local requirements. Locate and construct vent lines to prevent condensation or gas accumulation. Be sure the vent outlet is **NOT** obstructed by rain, snow, ice, insects, birds, etc. Do not inter-connect vent lines; if more than one vent is needed, use separate lines.
- Relief devices should be installed and properly vented in all gas handling systems to protect against equipment failure and over-pressurization.
- Never connect this equipment to a supply source having a pressure greater than the maximum rated pressure. Refer to the Equipment Specifications for maximum inlet pressure.
- Never permit oil, grease, or other combustible materials to come in contact with cylinders, equipment, and connections. Oil and grease may react and ignite when in contact with some gases – particularly oxygen and nitrous oxide.
- Cylinder, header, and master valves should always be opened very **s-l-o-w-l-y**. Heat of recompression may ignite combustible materials.
- Flexible hoses should never be kinked, twisted, or bent into a radius smaller than 3 inches. Mistreatment may cause the flexible hoses to burst.
- Do not apply heat. Some materials may react and ignite while in contact with some gases – particularly oxygen and nitrous oxide.
- Cylinders should always be secured with racks, chains, or straps. Unrestrained cylinders may fall over and damage or break off the cylinder valve which may propel the cylinder with great force.
- Oxygen manifolds and cylinders should be grounded. Static discharges and lightning may ignite materials in an oxygen enriched atmosphere, creating a fire or explosive force.
- Welding should not be performed near nitrous oxide piping. Excessive heat may cause the gas to dissociate, creating an explosive force.
- Do not use leak test solution that contains ammonia. Solutions containing ammonia may cause brass tubing to crack.
- Always use oxygen compatible leak test solution on oxygen or nitrous oxide service equipment.

2- Safety Precautions - Cryogens

Cryogenic liquids are liquids with a normal boiling point below -238ºF (-150ºC). The most commonly used industrial or medical gases that are transported, handled, and stored in the liquid state at cryogenic temperatures are oxygen, nitrogen, argon, and helium.

There are a number of general precautions and safety practices which must be observed because of the extremely low temperatures and high rates of conversion into gas of all of the cryogenic liquids. There are also specific precautions which must be followed where a particular liquid may react with contaminants or may present a hazard to life.

The user of any cryogenic liquid covered in this manual should be familiar with both the general and specific precautions outlined. The operator should also be thoroughly familiar with the instructions provided with any equipment to be used with the liquid.

GENERAL SAFETY PRECAUTIONS
Many of the safety precautions observed for gases in the gaseous state also apply to the same gases in the liquid state. However each of the liquids has properties different from those of the others. The potential hazards in handling all cryogenic liquids stem mainly from the following two important properties:

- Cryogenic burns
- Thermal expansion

INTRODUCTION
All cryogenic liquids are extremely cold. Cryogenic liquids and their cold “boil-off” vapor can rapidly freeze human tissue, and cause many common materials such as carbon steel, plastics and rubber to become brittle, or event fracture under stress. Cryogenic liquids in containers and piping at temperatures at or below the boiling point of liquefied air (-318ºF[-194ºC]) can actually condense the surrounding air to a liquid.

GENERAL SAFETY PRECAUTIONS
All cryogenic liquids produce large volumes of gas when they vaporize. For example, one volume of liquid nitrogen at atmospheric pressure vaporizes to 694 volumes of nitrogen gas at 68ºF (20ºC). If these liquids are vaporized in a sealed container, they can produce enormous pressures which could rupture vessels and/or pipes. For this reason pressurized cryogenic containers are usually protected with multiple devices for pressure relief.

Common protective devices are a pressure relief valve for primary protection and a rupture disc for secondary protection. Vaporization of cryogenic liquid, except oxygen, in an enclosed work area can cause asphyxiation, by displacing breathable air. Vaporization of liquid oxygen in an enclosed work area can cause an oxygen-rich atmosphere and could saturate a worker’s clothing which could ignite if an ignition source were present. Although oxygen is not flammable it will vigorously support and/or accelerate the combustion of other materials.

Most cryogenic liquids are odorless, colorless and tasteless when vaporized to the gaseous state. Most of them have no color as a liquid, although liquid oxygen is light blue. However, the extremely cold liquid and vapor have a built-in warning property that appears whenever they are exposed to the atmosphere. The cold “boil-off” gases condense the moisture in the air, creating a highly visible fog. The fog normally extends over a larger area than that of the vaporizing liquid.

HANDLING
Always handle cryogenic liquids carefully. At their extremely low temperatures, they can produce cryogenic burns on the skin and freeze tissues. When spilled on a surface they tend to cover it completely and therefore cool a large area. The vapors from these liquids are also extremely cold and can produce burns (i.e. freeze tissues).

Exposure to these cold gases which is too brief to affect the skin of the face or hands can affect delicate tissues, such as those of the eyes. Stand clear of boiling and splashing always occur when charging a warm container or when inserting objects into the liquid. Always perform these operations slowly to minimize boiling and splashing. Never allow any unprotected part of your body to touch un-insulated pipes or vessels containing cryogenic liquids; the extremely cold material may stick fast and tear the flesh when you attempt to withdraw it. Even nonmetallic materials are dangerous to touch at low temperatures. Use tongs to withdraw objects immersed in a cryogenic liquid. In addition to the hazards of frostbite or flesh sticking to cold materials, objects that are soft and pliable at room temperature, such as rubber or plastics, are easily broken because they become hard and brittle at these extremely low temperatures. Carbon steels become brittle at low temperatures and may easily fracture when stressed.

PROTECTIVE CLOTHING
Safety glasses are recommended during transfer and normal handling of cryogenic liquids. If severe spraying or splashing may occur, a face shield or chemical goggles should be worn for additional protection.

Dry leather gloves should always be worn when handling anything that comes in contact with cold liquids and vapor. Gloves should be loose fitting so that they can be removed quickly if cryogenic liquids are spilled onto them. Depending upon the application, special clothing may be advisable. Wear trousers on the outside of boots or work shoes.

SPECIAL INERT GAS PRECAUTIONS
The primary hazards of inert gas systems are ruptures of containers, pipelines or other systems and the potential of an inert gas to asphyxiate. A cryogenic liquid cannot be indefinitely maintained as a liquid, even in well insulated containers. Any liquid or even cold vapor trapped between valves has the potential to cause an excessive pressure build-up to the point of a violent rupture of a container or piping, hence the use of reliable pressure relief devices is mandatory.

Loss of vacuum in vacuum-jacketed tanks, valves, pipes or hoses containing cryogenic liquids will cause increased evaporation within the system. This may cause the relief devices to function and result in product venting. The vented gases should be routed to a safe outdoor location. If there are no provisions for outdoor venting, the user must assure himself that adequate ventilation is maintained. Liquid helium has the potential of solidifying air which can block safety relief devices and opening, and cause the rupture of the container. The potential for asphyxiation must be recognized when handling inert cryogenic liquids. Because of the high expansion ratios, air can be quickly displaced. Oxygen monitors are recommended whenever you handle cryogenic liquids in closed areas. Refer to the MSDS's on gaseous and liquid argon, gaseous and liquid nitrogen, and gaseous and liquid helium for additional information on properties and safe handling of these inert gases.

SPECIAL OXYGEN PRECAUTIONS
Do not permit smoking or open flames in any area where liquid oxygen is stored or handled. Do not permit liquid oxygen or oxygen-rich air atmospheres to come in contact with organic materials or flammable or combustible substances of any kind. Some of the organic materials that can react violently with oxygen when ignited by a hot spark or even a mechanical shock are oil, grease, asphalt, kerosene, cloth, tar, and dirt that may contain oil or grease. If liquid oxygen spills on asphalt or other surfaces contaminated with combustibles, do not walk on or roll equipment over the area of the spill. Keep sources of ignition away for at least 30 minutes after all frost or fog has disappeared.

Any clothing that has been splashed or soaked with liquid oxygen or exposed to high oxygen concentrations should be removed immediately and aired out for at least an hour. Personnel should stay in a well ventilated area and avoid any source of ignition until their clothing is completely free of excess oxygen. Clothing saturated with oxygen is readily ignitable and will burn vigorously. Refer to the MSDS's on gaseous and liquid oxygen for additional information on its properties and safe handling.

BUILDINGS
Test the atmosphere in confined work areas for oxygen content if a leak or abnormal condition is suspected. 19.5% oxygen concentration in the air is the minimum recommended for working without special breathing equipment. Oxygen concentration in excess of 23.5% in the air can cause clothing and other materials to burn vigorously if accidentally ignited.

3- About Cryogenic Portable Containers

INTRODUCTION

Cryogenic liquids are stored, shipped, and handled in several types of containers, depending upon the quantity required by the user. The type of containers in use are, dewars, liquid cylinders and liquid tanks. Storage quantities vary from liters to thousands of gallons. Since heat leak is always present, vaporization may be as low as 0.4% and as high as 3% of container content per day, depending upon the design of the container and the volume of the stored product. Containers are designed and manufactured according to applicable codes and specifications for the pressures and temperatures involved.

OPEN FLASK DEWARS

Above is an illustration of a typical vacuum-jacketed dewar. A dust cap over the outlet of the neck tube prevents atmospheric moisture from plugging the neck tube. This type of container is considered a non pressurized container. The unit of measure for capacity of the container is the liter. Five (5) to 200-liter containers are available. Cryogenic liquid may be removed by pouring into smaller containers. Cryogenic liquid should be removed from the 50-liter and larger capacity dewars by means of low pressurization and a transfer tube.

PORTABLE LIQUID CYLINDERS

The above picture illustrates a typical liquid cylinder. The cylinder is an insulated, vacuum-jacketed container. Safety relief valves and rupture discs protect the cylinders from over-pressurization. Since these cylinders operate at pressures up to 500 psig, their design must comply with Department of Transportation (DOT) specifications. Capacity of the cylinders vary between 100 liters and 450 liters. Cryogenic liquid may be with-drawn as a gas by passing liquid through a vaporizing coil or as a liquid under it's own vapor pressure. The CFAM series manifolds are designed to withdraw liquid from liquid cylinders and not from dewars.

4- Abbreviations

C	Common	OSHA	Occupational Safety & Health Administration
CGA	Compressed Gas Association	PSIG	Pounds per Square Inch Gauge
FT-LBS	Foot-Pounds	SCFH	Standard Cubic Feet per Hour
IN-LBS	Inch-Pounds	VAC	Voltage, Alternating Current
N/C	Normally Closed	VDC	Voltage, Direct Current
N/O	Normally Open	PCB	Printed Circuit Board
F.NPT	National Pipe Taper (Female)	M.NPT	National Pipe Taper (Male)

5- Disclaimer

BeaconMedaes shall not be liable for errors contained herein or incidental or consequential damages in connection with providing this manual or the use of material in this manual.

6- Manufacturer Statement

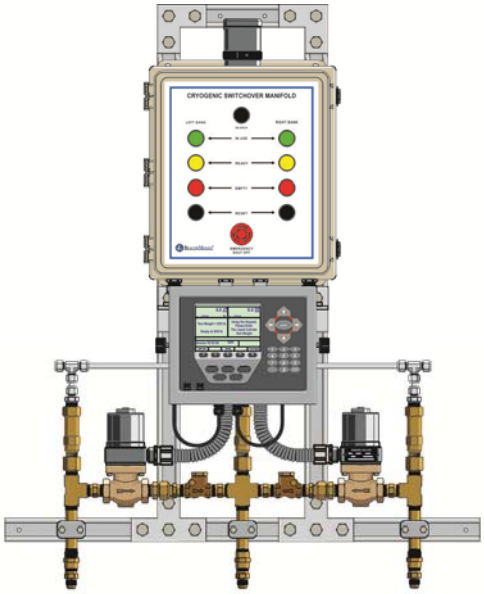
The information contained in this instruction booklet has been compiled by BeaconMedaes, from what it believes are authoritative sources, and is offered solely as a convenience to its customers. While BeaconMedaes believes that this information is accurate and factual as of the date printed, the information, including design specifications, is subject to change without prior notice.

7- Introduction

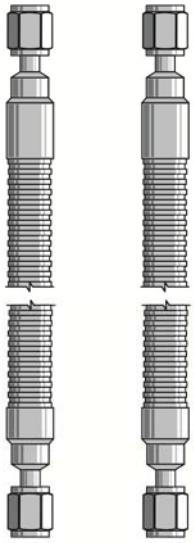
BeaconMedaes manifold systems are cleaned, tested and prepared for the indicated gas and cryogenic liquid service and are built following National Fire Protection Association and Compressed Gas Association guidelines. The manifold consists of a manifold box (aka control module) and one supply bank header (two inlets and one outlet), to provide an uninterrupted supply of gas for the specific gas application. This system is designed and built with features providing automatic switchover from the depleted “Service” supply bank to the “Reserve” supply bank. A scale controller, alarm signal connections and lights show system status and alert the need to replace depleted cylinders.

8- Components

Verify that all components below have been received. If any of these items are missing or damaged, please notify your supplier immediately.

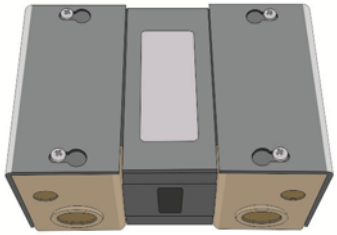


One (1)
Manifold Controller



Two (2)
Liquid Cylinder Hoses

Two (2)
Liquid Cylinder Scales



One (1)
Power Transformer

9- Description

The BeaconMedaes CFAM-WX Series Fully Automatic Switchover Manifolds assures a continuous supply of liquid cryogens or liquid carbon dioxide. It is set to transfer automatically from a depleted "In Service" supply bank to a "Stand-By" supply bank based on the net weight of cryogenic liquid (or carbon dioxide).

Visual Indicators - There are a total of six (6) lights (LEDs) indicating the status of the manifold:

-	Green Light:	Indicates which bank is "In Service"	One per bank
-	Yellow Light:	Indicates the bank is in "Stand-By" mode (Ready)	One per bank
-	Red Light:	Indicates a "Depleted" bank	One per bank

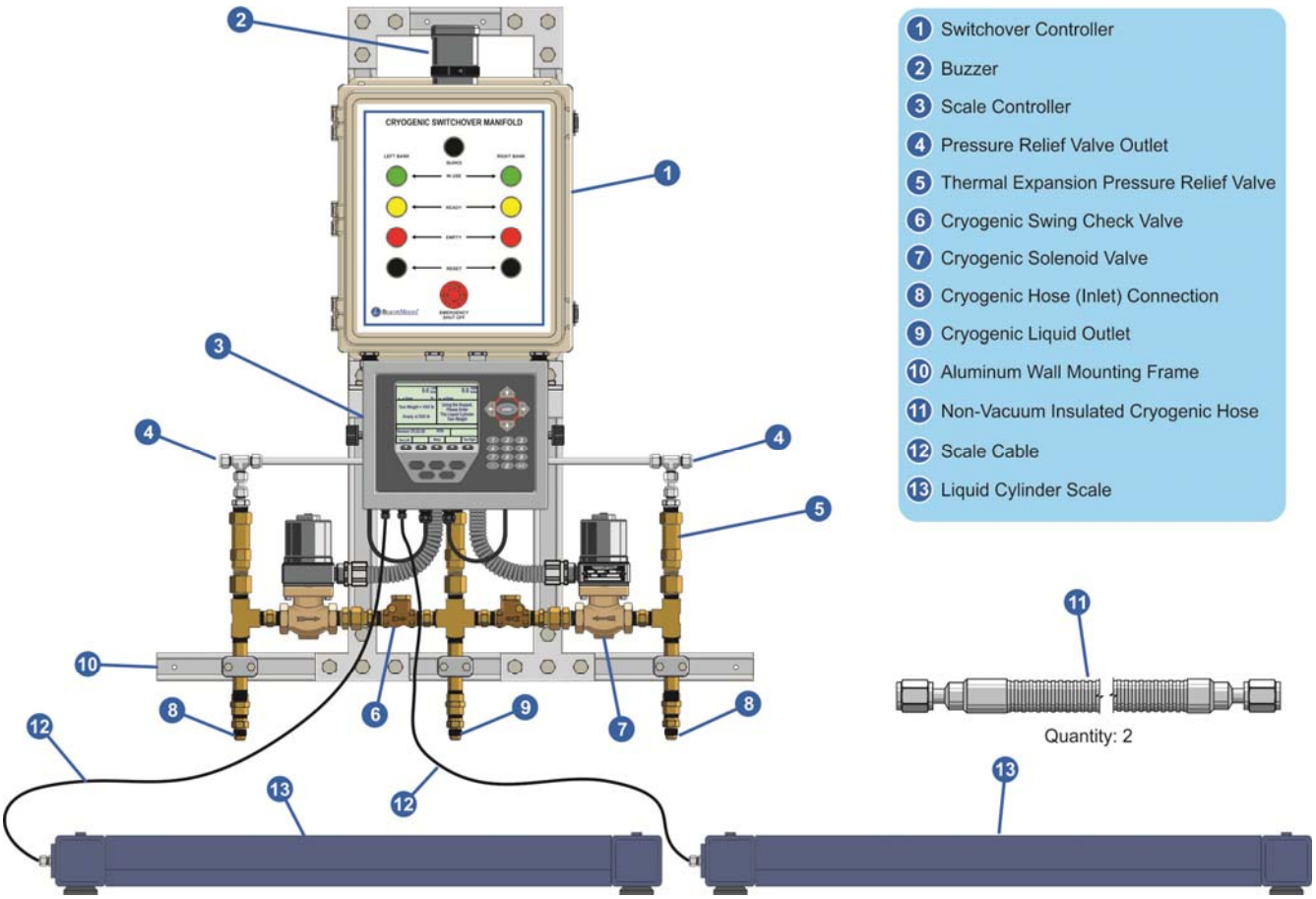
Audible Signal - The buzzer is actuated each time a bank is depleted. The silence pushbutton kills the buzzer without extinguishing its corresponding red light.

Liquid Cylinder Scales - There are two cylinder scales (one per bank). This low profile scale is one (1") from the floor and is equipped with a 4"long inclined ramp to ease cylinder loading. The scale is large enough to accept liquid cylinders up to 28" in diameter. The backstop prevents the liquid cylinder from rolling out of the scale platform.

Scale Controller - Each cylinder scale is connected to one scale controller. The scale controller indicates how much product is left in the cylinder. The operator will be requested to enter the "TARE WEIGHT" of the liquid cylinder into the scale controller right after replacing the empty cylinder by a full cylinder. The scale controller sends a signal to the manifold control box when a cylinder is empty.

Reset Push Button - The reset pushbutton needs to be pushed when an empty cylinder has been replaced by a full cylinder.

Ice and Water Management - There will be some "water management" required with this equipment. Because air is always humid and the wetted components are extremely cold, the ambient air humidity (water vapor) will freeze up on the wetted parts and ice will accumulate. When the equipment will not be in service, the ice will melt and water will drip down. The amount of water will vary upon the relative humidity of the air and the usage of the cryogenic manifold.



10- Ordering Information

CFAM-WX- ____ - ____ - ____ - ____ - ____ - ____ - ____
A B C D E F G

BeaconMedaes CFAM-WX Series Model Number Chart			
Variable	**Definition**	**Allowable Value**	**Description**
A	**Fluid**	CGA 295A CGA 622 CGA 295N CGA 440	Liquid Argon Liquid Carbon Dioxide Liquid Nitrogen Liquid Oxygen
B	**No. of Cylinders**	2	Only One Possible Configuration Possible (1 Cylinder per Side)
C	**Hoses**	SSHG VJH	Non-Vacuum Jacketed Hose (All Stainless Steel) Vacuum Jacketed Hose
D	**Relief Valves**	50 250 400 500	50 psig 250 psig 400 psig 500 psig
E	**Scale Materials**	MW SS	Painted Steel Stainless Steel
F	**Installation Hardware**	WM FS	Wall Mount Bracket Floor Stand
G	**Option**	3R	Outside Installation

11- General Instructions

Manifolds should be installed in accordance with guidelines stated by the National Fire Protection Association, the Compressed Gas Association, OSHA, and all applicable local codes. The manifolds should not be placed in a location where the temperature will exceed 120°F (49°C) or fall below 32°F (0°C). A manifold placed in an open location should be protected against weather conditions. During winter, protect the manifold from ice and snow. In summer, shade the manifold and cylinders from continuous exposure to direct rays of the sun. The manifold should be located in a clean, well ventilated area which is free of oil and combustible materials.

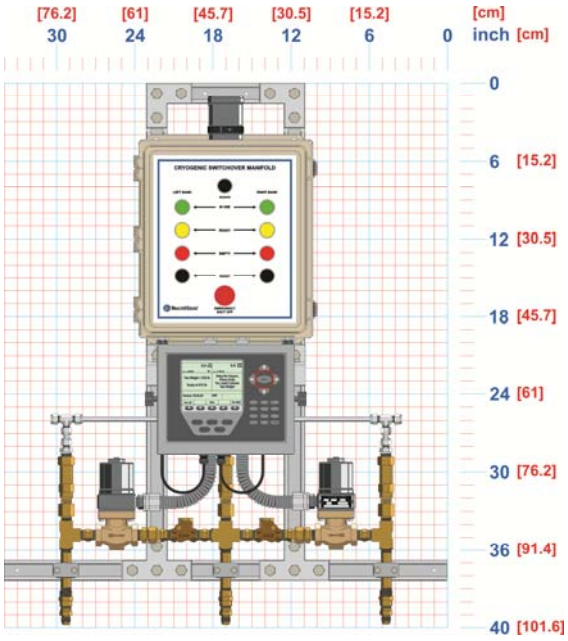
Leave all protective covers in place until their removal is required for installation. This precaution will keep moisture and debris from the piping interior, avoiding operational problems.

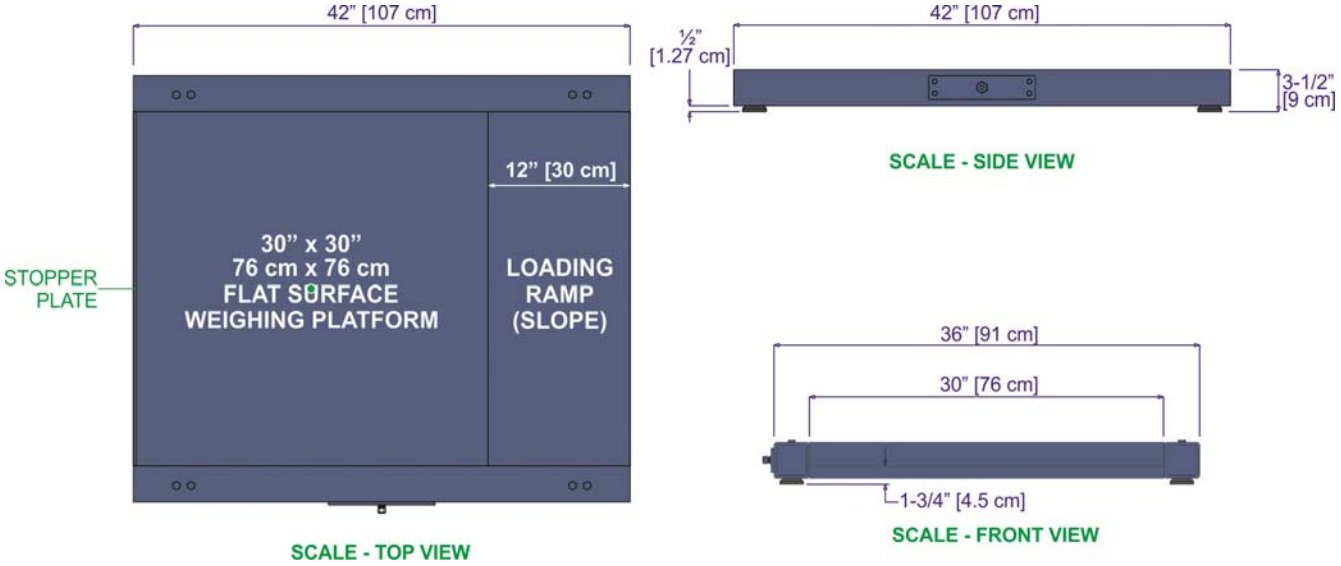
If the manifold happens to be installed indoors, all safety relief valves should be piped/vented to a safe location.

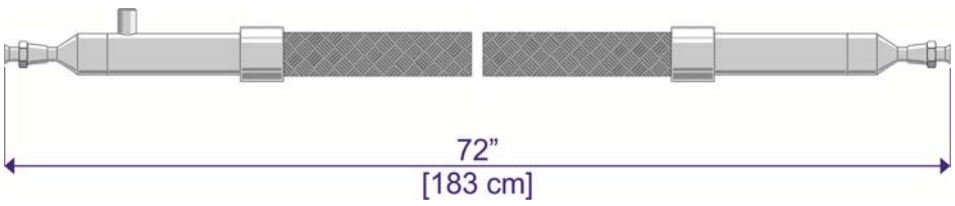
12- Technical Specifications

Specifications	
Fluid	Liquid Argon, Liquid Carbon Dioxide, Liquid Nitrogen, Liquid Oxygen
Maximum Working Pressure	Up to 500 psig [35 barg]
Operating Temperature	-325°F to 120°F [-198°C to 49°C]
Inlet and Outlet Connections	Liquid Argon Liquid Carbon Dioxide Liquid Nitrogen Liquid Oxygen
Relief Valve Outlet Connection	1/2" Compression (Stainless Steel)
Header	1/2" NPS, Brass
Solenoid Valves	Normally Closed (Power to Open)
Power Requirement - Wetted Components	Manifold Controller: 24 VAC, 6 amp.
Power Transformer for Wetted Components	Primary: 120 VAC, Secondary: 24 VAC, Single Phase, 6 Amp.
Power Requirement - Scale Controller	110 VAC, Single Phase, 1 amp. Max.
Audible Alarm	Standard, 85 dBa

13- Dimensions







14- Standard Specifications

Name Tag

Each piece of equipment bears a nametag which provides important information about:

- Fluid service
- Maximum Allowable Working Pressure (M.A.W.P.)
- Year of manufacture
- Project number
- Power requirements

15- Oxygen Service Equipment

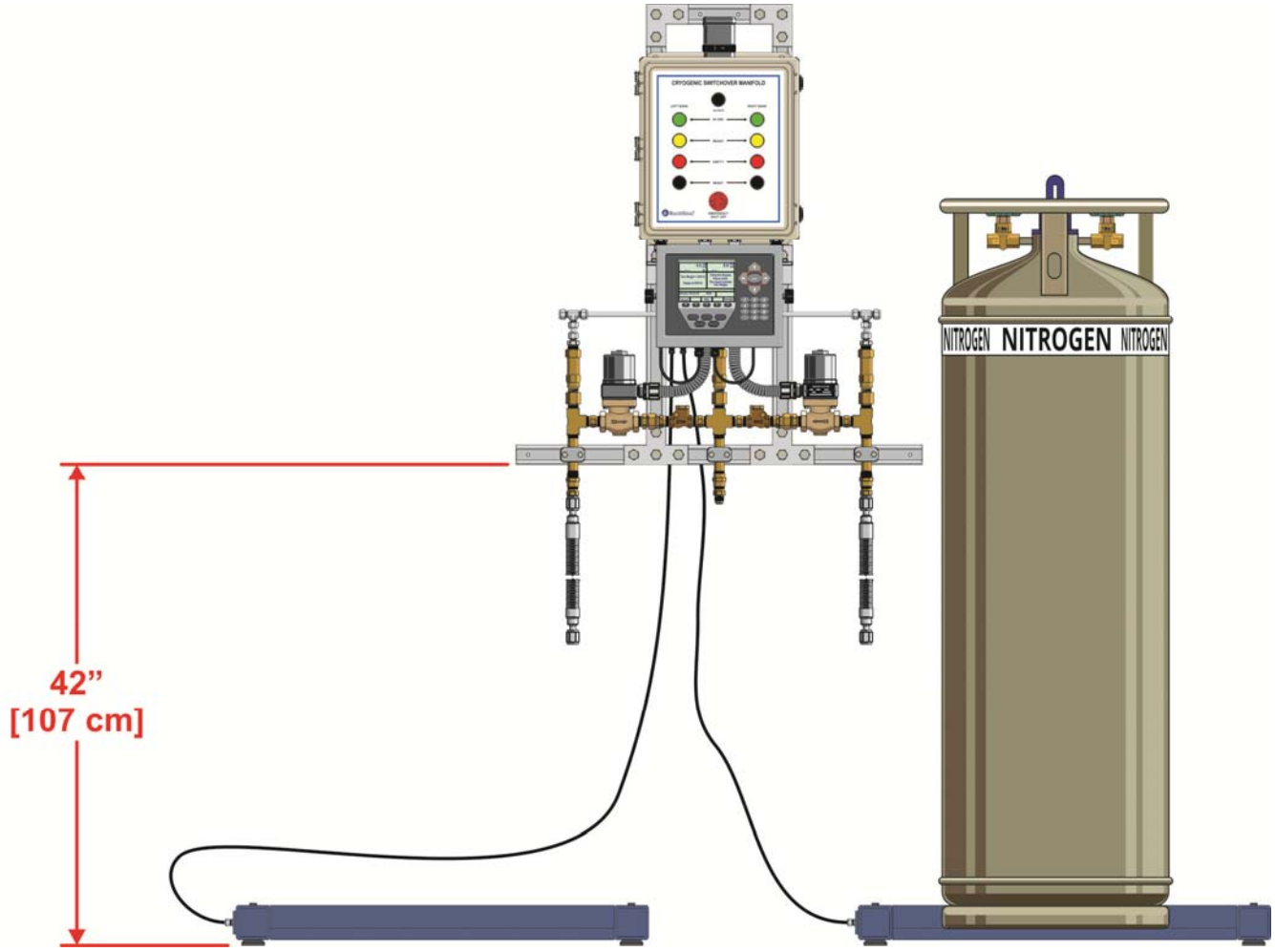
All oxygen service equipment made by BeaconMedaes is cleaned as per the requirements of CGA G-4.1-1996.

CAUTION

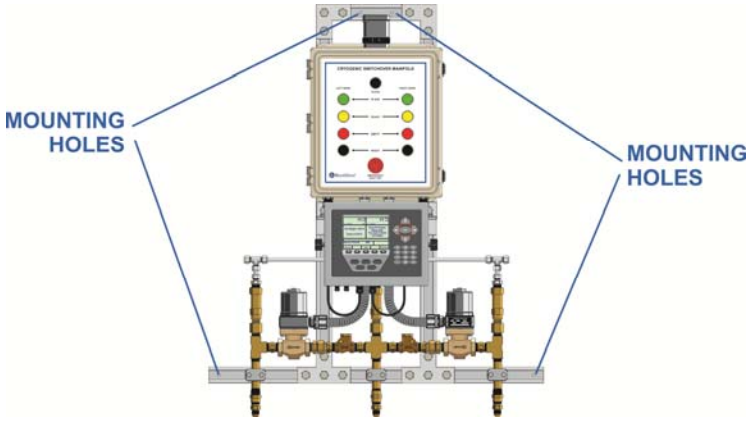
Remove all protective caps prior to assembly. The protective cap may ignite due to heat of recompression in an oxygen system.

16- Mechanical Installation

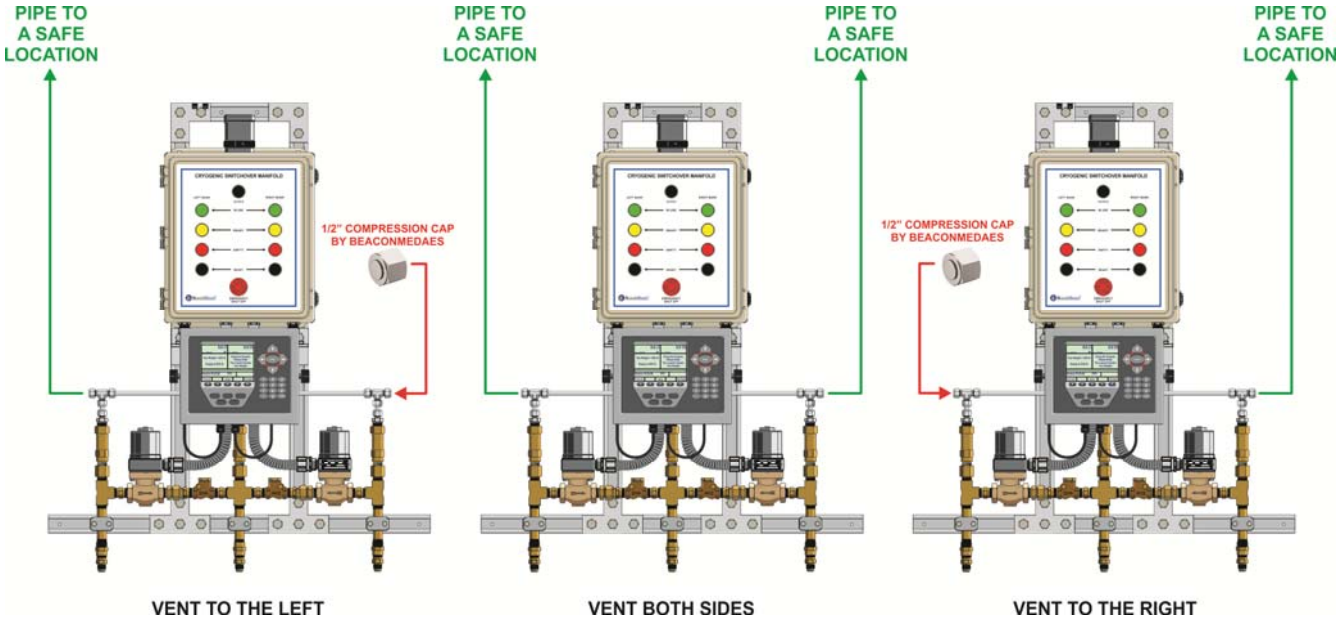
1. **Recommended Height –** The bottom of the aluminum wall frame should be at 42" from the finished floor (see figure below).



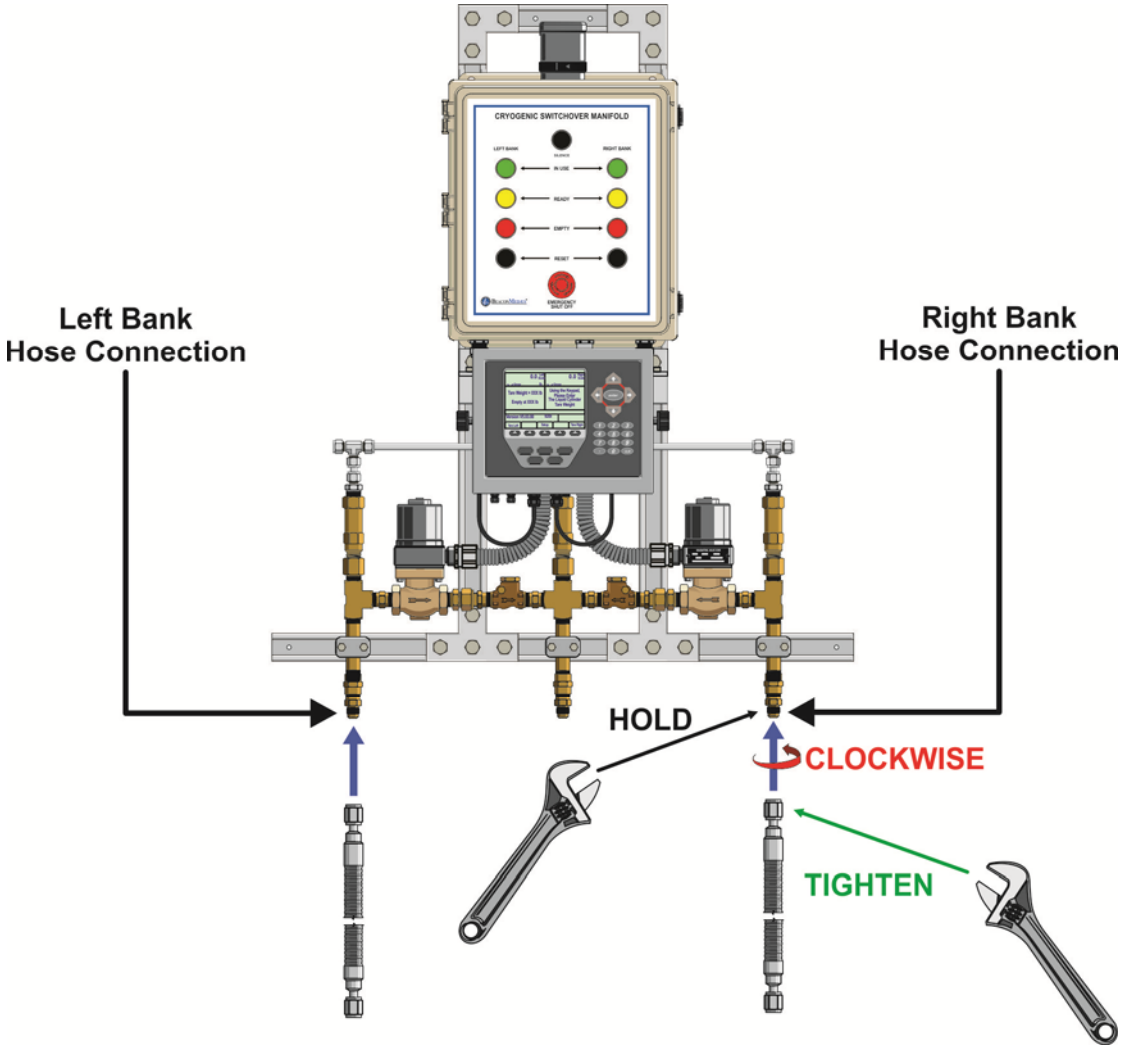
2. **Installing the manifold box** – The manifold box must be secured to a solid wall. The installer is responsible to select the proper hardware for this installation. Please note that the manifold box weighs about 60 lbs without the hoses (proper backing might be required). We do not recommend installing this manifold to walls constructed from drywall as cryogenic manifolds generate a fair amount of moisture which can damage that kind of building material. The materials supporting the manifold must be water resistant. Several holes have been made at the factory into the aluminum mounting frame for ease of installation (drill some more holes wherever it is convenient for you). Attach the manifold directly to the wall. Do not take apart any components that are attached to the mounting frame.



3. **Pressure Relief Valves –** There are three (3) thermal expansion pressure relief valves (aka PRV's) on the manifold. The three (3) pressure relief valves are manifolded together. The PRV's must be piped to a safe location. There are two (2) outlets to the PRV manifold. Each outlet connection is ½" compression in stainless steel. You can connect either outlet or both as shown below. The piping dedicated to the PRV must follow the following specification:
    a. **The vent pipeline must not create flow restriction or back pressure**
    b. **Do not install any valves downstream of the PRV outlet.**
    c. **Make sure the pipeline outlet will not collect water or cannot be obstructed by insects, debris or ice.**
    d. **The vent pipeline discharge must be located so that people and buildings in the surrounding area will not be affected in any way.**

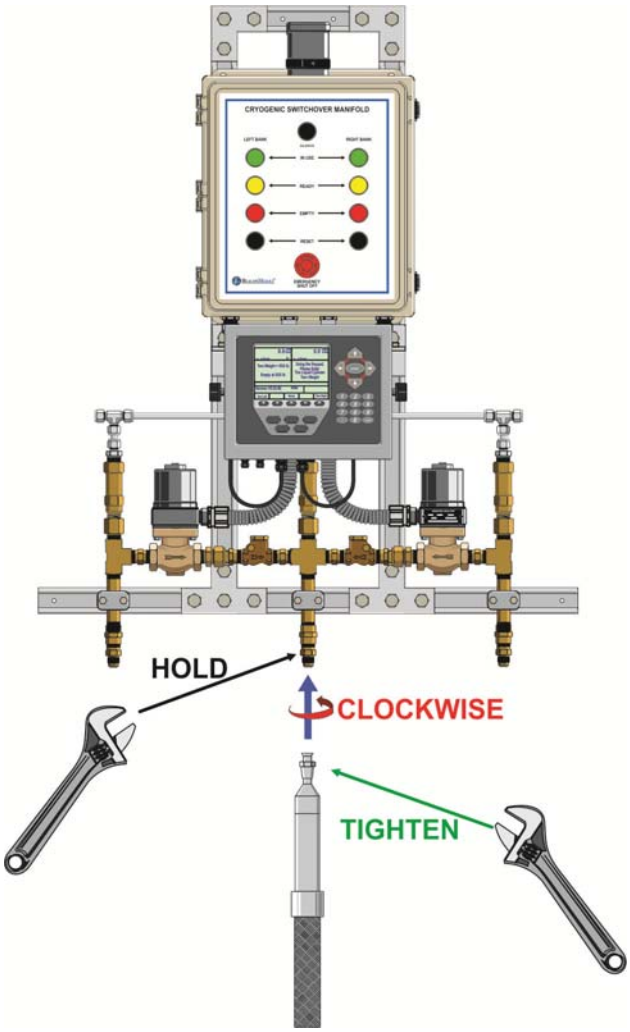


4. **Cryogenic Liquid Inlet Hoses –** Your manifold comes standard with two (2) hoses. The hoses have to be connected in the field. Unless otherwise specified, the hoses have the same inlet and outlet connection and there is no check valve (so either end can be connected to the manifold inlets). There are two (2) inlets to the manifold: left bank and right bank. The connection located in the middle of the manifold at the bottom is the outlet. The manifold inlets are flared male and the hose ends are both flared female swivel. The thread type is specific for the fluid service as specified in Section 12 of this manual. To connect the hoses to the manifold inlets, simply screw the swivel part of the hoses into the male fixed inlets of the manifold. Then, using two (2) wrenches firmly tighten the connection (see schematic below for details). THESE TWO HOSES WILL BE CONNECTED TO THE LIQUID USE VALVE OF THEIR RESPECTIVE LIQUID CYLINDER.



5. **Cryogenic Liquid Outlet Connection –** The cryogenic liquid outlet is the middle piping pointing down between the two inlets. The outlet connection is the same CGA fitting as the inlets which is either CGA 295 or CGA 440. These CGA adaptors allow for cryogenic hose installation. This fitting can be removed in the field to become ½" F.NPT for hard piping.

Hose Installation - The picture above shows the installation of a cryogenic hose as an outlet conduit. To connect the hose to the manifold outlet, simply screw the swivel part of the hose into the male fixed outlet of the manifold. Then, with two (2) wrenches, firmly tighten the connection (see schematic above for details).



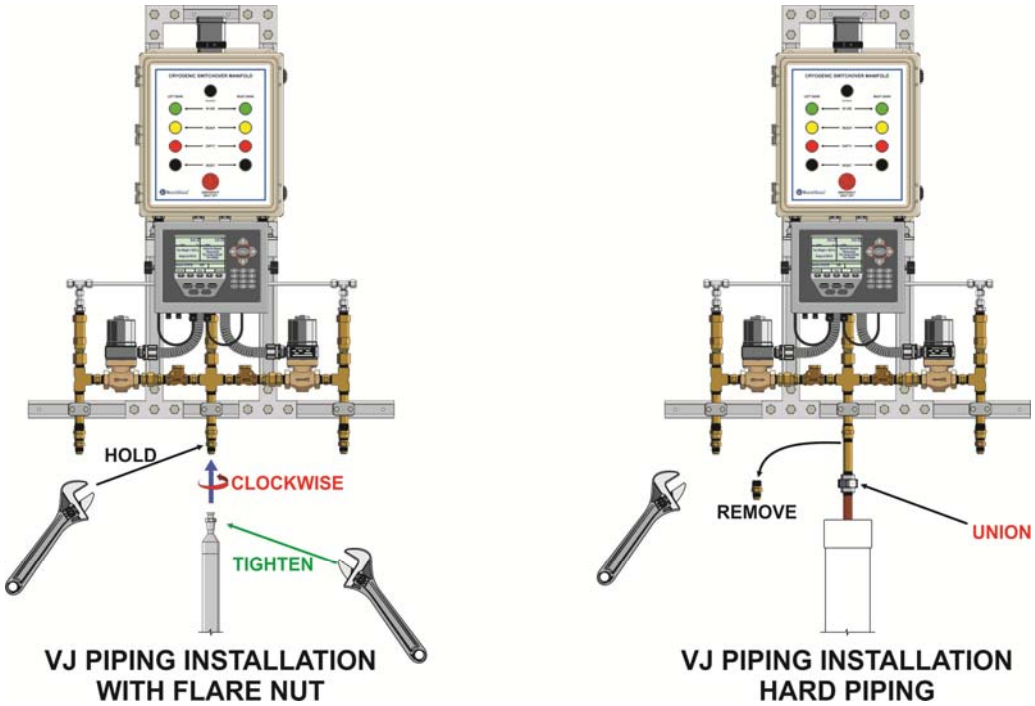
ABOUT CRYOGENIC HOSES

There are two types of cryogenic hoses: vacuum insulated and standard liquid transfer hoses (not vacuum insulated).

Vacuum Jacketed Hoses - The vacuum insulated hose is the by far the best hose to prevent heat loss and avoid ice accumulation. It consists of a corrugated metal hose surrounded by another flexible metal jacket. The space between the metal jacket and the corrugated metal hose is called the annular space. A vacuum has been pulled in the annular space which greatly minimizes the heat transfer between the cryogen in the hose and the outer ambient air.

Liquid Transfer Hoses - The non-vacuum-insulated hose is a corrugated metal hose surrounded by a braid of stainless steel. Most hoses come with a metal shroud called "armor-guard". The ends are normally flare swivel nuts that are related to the gas service. That type of hose is designed to transfer cryogens. But, because this hose is not insulated, there will be heat transfer between the hose and the ambient air resulting in ice build-up along the hose. This ice build-up is normal and cannot be prevented.

Rigid Piping Installation – Similar to hoses, rigid piping can be vacuum insulated or not vacuum insulated. Whether you install one style versus the other, it is important to have a union of some sort (either flare, compression or other style) between the manifold and the greater portion of the rigid pipe. The installer must be thoroughly trained in the installation of cryogenic piping not only for proper installation technique but also for proper material selection. This manual is not about cryogenic piping installation. This manual is about the installation and operation of the CFAM-WX fully automatic switchover manifold. The illustration below shows the minimum requirements to properly install a rigid pipe to the manifold outlet.



Vacuum Jacketed (VJ) Piping Installation - The left side of the picture above shows the installation of a VJ pipe as an outlet conduit. To connect the VJ pipe to the manifold outlet, simply screw the swivel part of the pipe into male fixed inlets of the manifold. Then, with two (2) wrenches, firmly tighten the connection (see schematic above for details).

Hard Piping Installation - The left side of the picture above shows the installation of a hard pipe as an outlet conduit. As mentioned previously, it is imperative to install a union capable of supporting both pressure and temperature of the cryogen. Furthermore, the installer is responsible to insure the cleanliness and the compatibility of the materials used for the cryogenic distribution piping. We strongly recommend insulating the piping to prevent ice build up. Field insulation is serious business and should be made only by qualified professionals.

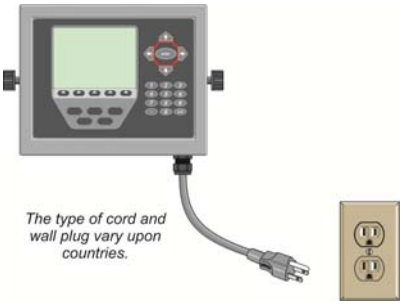
Recommendations and Technical Tips

The following recommendations apply for piping and any other parts connected to this manifold or piping system:

- Ice build-up could be very significant. It will add weight to the piping and proper support must be considered. Ice build-up can also damage the piping itself and adjacent structures such as walls, water pipes and electrical conduits. Finally, ice will melt when the piping is not in use. Water management must be considered.
- The selection of the insulating materials is important. The insulation must be capable to withstand cryogenic temperatures without cracking or breaking. The insulation must be water-tight so that moisture cannot find its way between the pipe and the insulation. The insulation itself must be protected from falling objects and mechanical impacts. Finally, and it is particularly important for oxygen service piping, the insulation material must be compatible with cryogen in service in case of a leak. For example, a foam insulated piping made out of urethane can burst into flames if it is saturated with liquid oxygen. The fire or explosion resulting from this could be deadly and/or cause serious damages to buildings and adjacent structures.
- By definition, cryogens are extremely cold and it will have a great impact on the expansion and retraction of the conduit itself. The piping material must be capable to mechanically resist to this movement. The pipe supports and clamps must allow the conduit to move.
- The selection of all materials in contact with the cryogen is of paramount importance. Carbon steel must be avoided at all cost anywhere in the system. Soft tubing even if it is in Teflon must not be used as a conduit. Rubber materials and rubber-like materials such as Viton, neoprene, Buna-N and EPDM must be avoided. For valve seals and seats, Teflon or reinforced Teflon (PCTFE) are the best materials. Finally, any valves, hoses or any other components must be rated and identified for cryogenic applications.
- DO **NOT** TRAP CRYOGENIC LIQUID IN A PIPE UNLESS PROTECTED BY A SAFETY RELIEF VALVE.

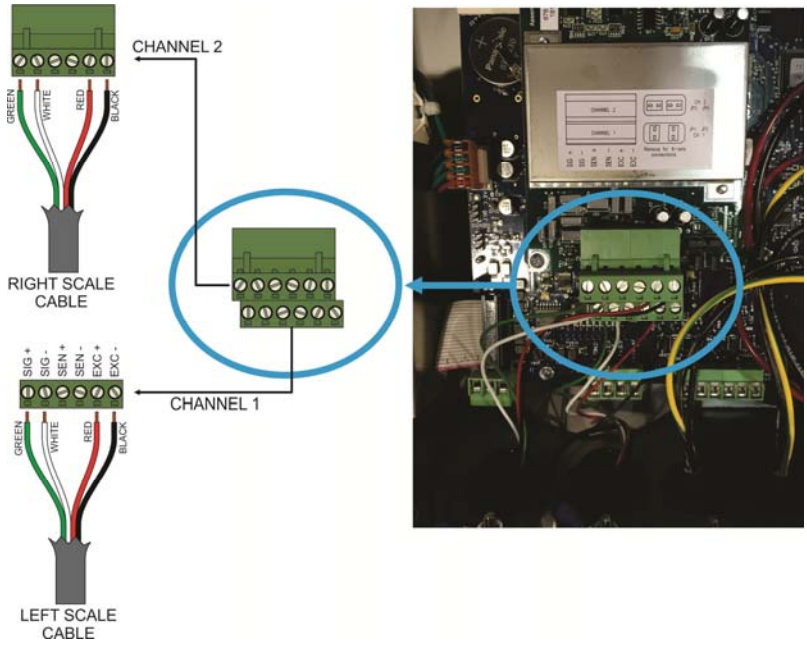
17- Electrical Installation – Scale Controller

Connecting the 115 VAC Power Supply to the Scale Controller: The scale controller requires 115 VAC to operate. The power cord is installed to the scale controller. The power cord has to be connected to a standard 3-prung 115 VAC receptacle. The power requirement for the scale controller is less than 2 Amp.

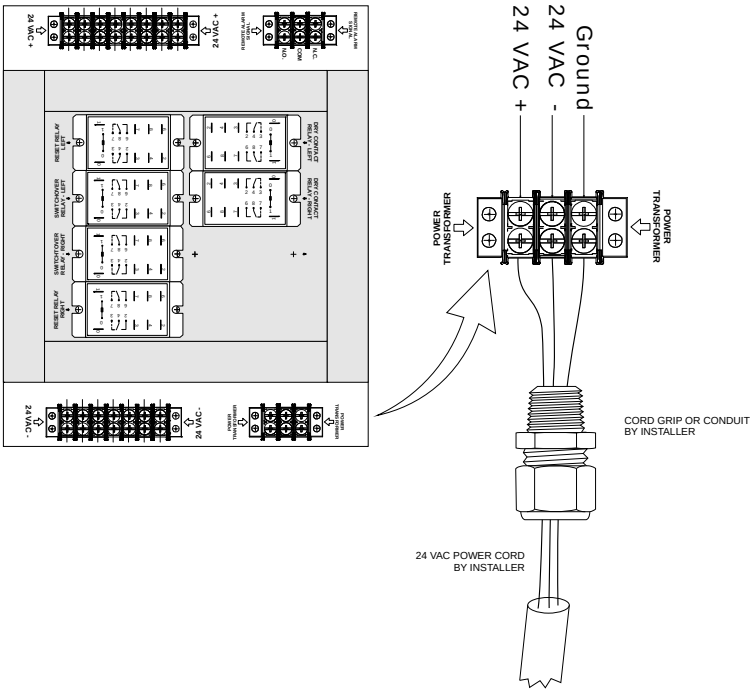


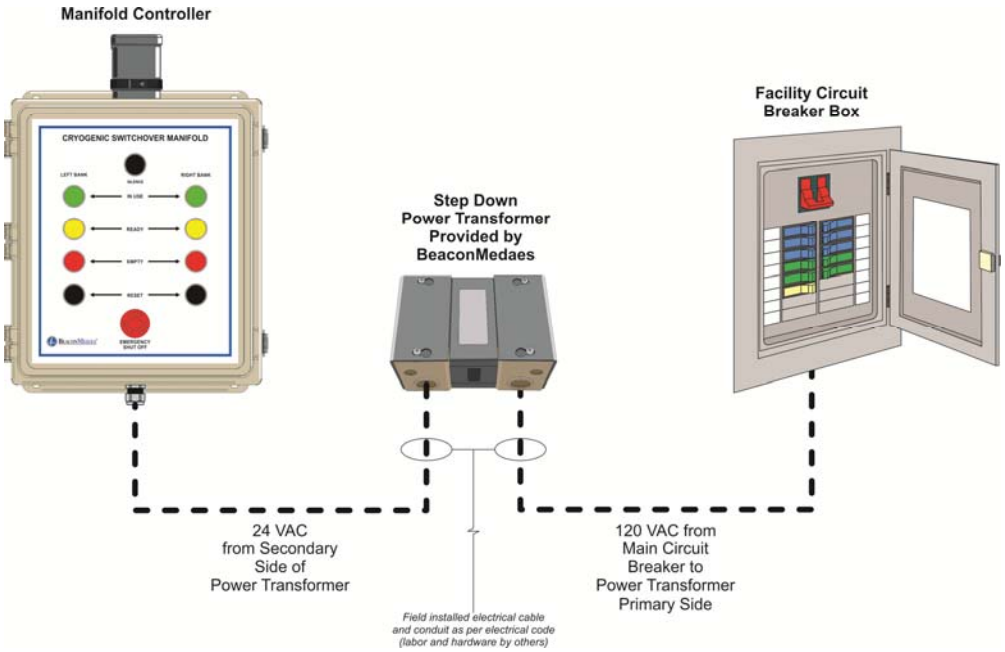
Connecting the Scales to the Scale Controller: The CFAM-WX manifold comes with two (2) scales; one (1) for the left bank and one (1) for the right bank. Each scale is provided pre-wired with a 10-ft long 4-wire scale cable. Each scale has to be wired to the scale controller in the field.

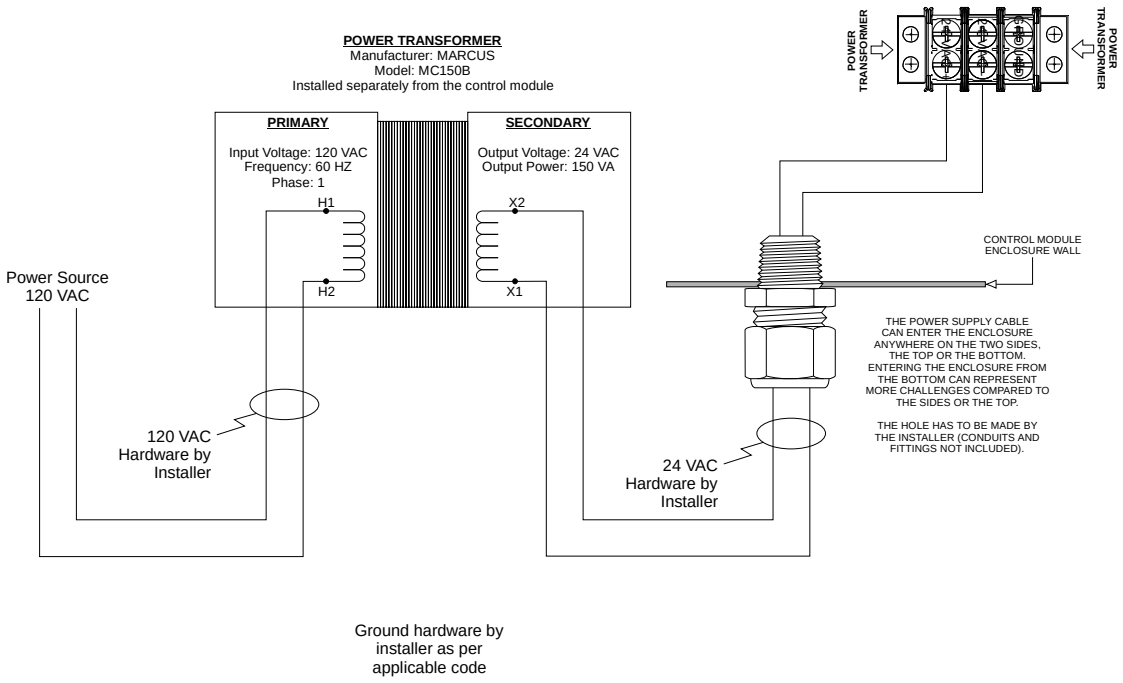
Open the back cover of the scale controller. Insert one scale cable through each one cord grip at the bottom of the scale controller. Locate the double deck green terminal strip located inside the scale controller (see picture below). The schematic below shows which scale connects to which channel. It is also showing which wire lands to which terminal.



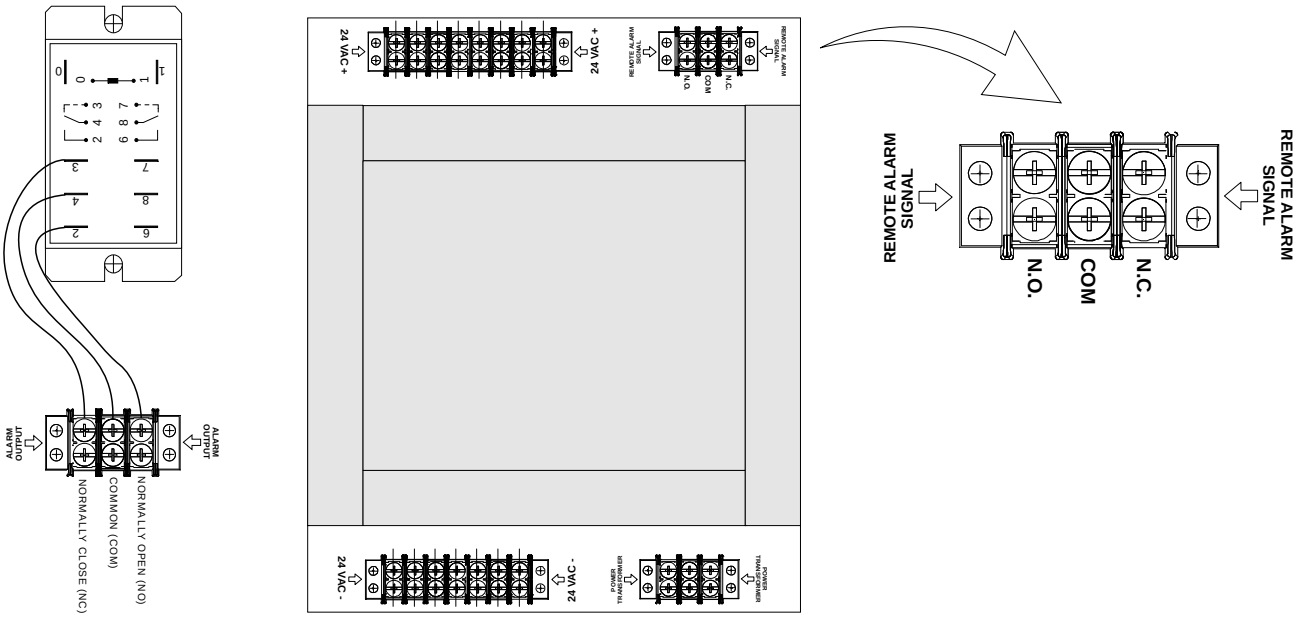
Connecting the 24 VAC Power Supply: The control module requires 24 VAC to operate. The power consumption is maximum 6 Amp. at 24 VAC. The power transformer is supplied with your manifold but it is separate from the control module itself. It has to be field installed. This power transformer must be installed inside a building (NEMA 1 rated). The terminals where the 24 VAC wires go are shown on the diagram below. The hardware required - wires, conduits and related accessories - to connect the power transformer to the control module have to be supplied by others.







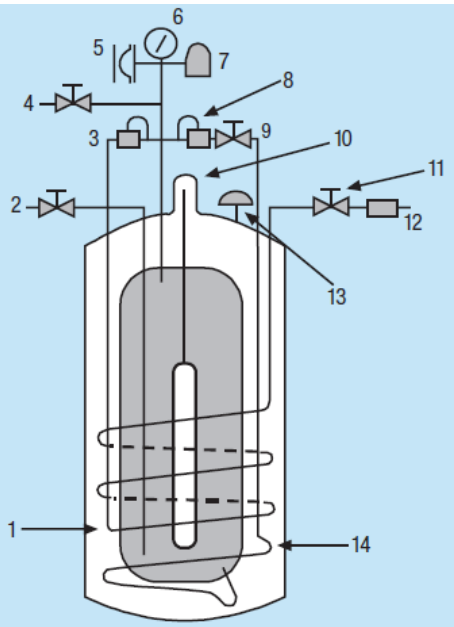
Remote Alarm Connection: The remote alarm signal (to a master alarm box for example) is a dry contact. The CFAM-WX manifold has one (1) N.O., one (1) N.C. and one (1) COM contacts (C-Shape). The SPDT relay will change position when either bank is empty (i.e. when a switchover has occurred). The terminals where the remote alarm connection has to be made are indicated below. The wire size has to be determined by the installer.

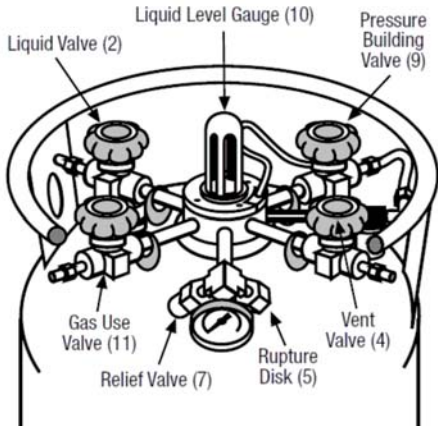


18- How a Liquid Cylinder Works

This part of the manual is dedicated to explain how a liquid cylinder works in conjunction with the CFAM-WX fully automatic cryogenic switchover manifold. Should you require more details and explanations about cryogenic liquid cylinders, please consult your gas supplier.

1. Gas withdrawal vaporizer
2. Liquid withdrawal valve
3. Economizer regulator
4. Vent valve
5. Inner tank rupture disk
6. Pressure gauge
7. Safety relief valve
8. Pressure building regulator
9. Pressure building valve
10. Liquid level gauge
11. Gas withdrawal valve and integral check valve
12. Check valve in house line
13. Outer tank rupture disk
14. Pressure building vaporizer





Liquid Withdrawal Valve (2) – Cryogenic liquid is withdrawn from the container through the connection controlled by this valve. It has a CGA connection specific for the appropriate cryogenic liquid. The cryogenic liquid feeding the CFAM-WX cryogenic switchover manifold is coming from this valve via the liquid transfer hose supplied with your manifold. It is important to understand that both the Liquid Valve and the Vent Valve have the same CGA connection.

Vent Valve (4) - This valve controls a line into the vapor space of the container. It is primarily used in the fill process to vent the vapor space while filling and can be used to vent unwanted pressure during storage and use.

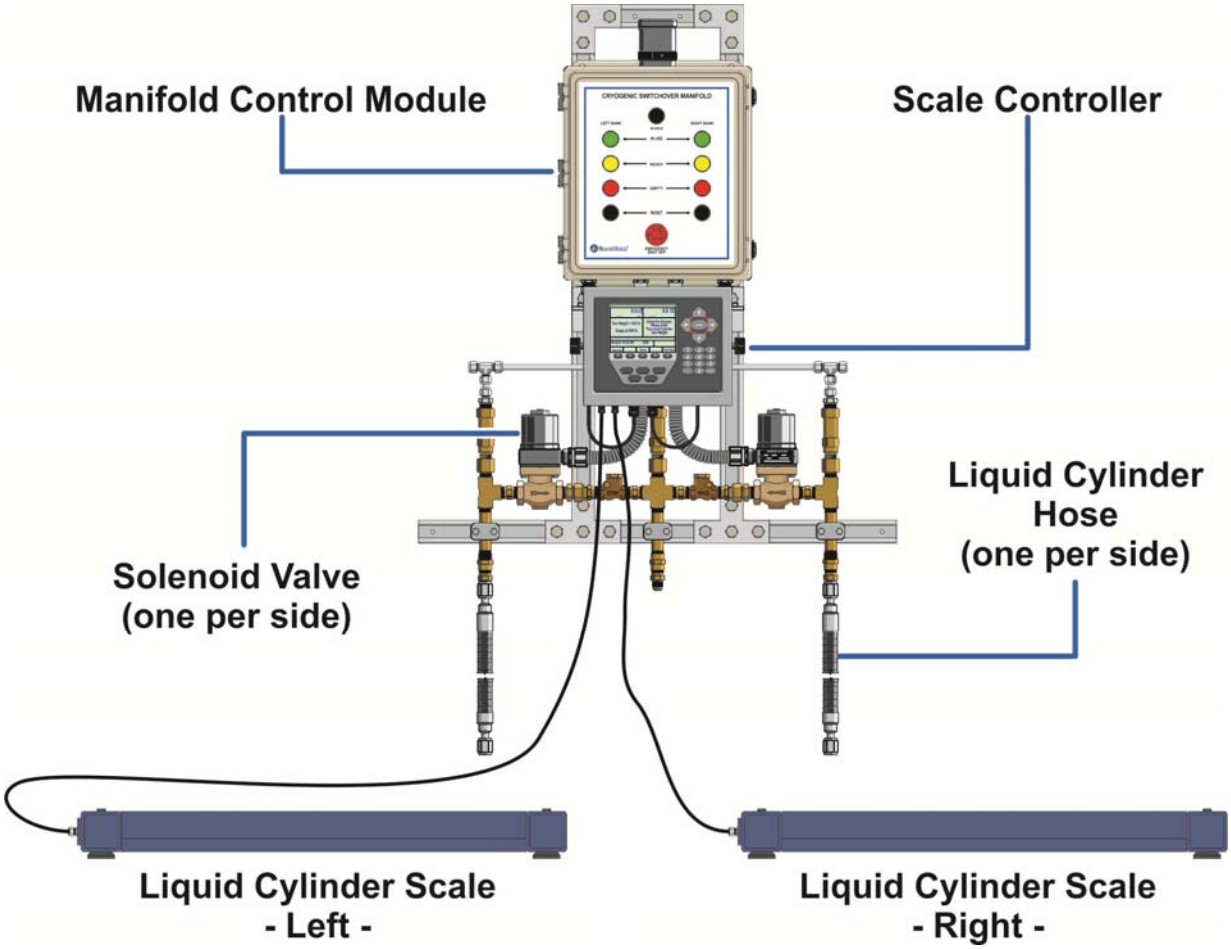
Relief Devices (5) and (7) - To protect the container from over-pressurization, it is equipped with two relief devices. The first is a reseating spring-loaded relief valve that, depending on the setting, will relieve pressure at 22 psig, 230 psig, or 350 psig. The second is a burst disk rated to protect the inner vessel. Never plug, restrict, or remove any relief device. Never attempt to cap or seal a venting relief device in any way. Notify your supplier about any container that continuously vents through any of the relief devices.

Pressure Build / Economizer Valve (9) - When the head pressure is near the relief setting, an economizer circuit preferentially directs gas from the vapor space to the gas use valve when it is open. This minimizes the loss of gas to over-pressurization and venting. Excess pressure in the vapor space of the container is relieved to the gas use valve outlet while preserving normal operating pressure. The economizer requires no operator attention and will function automatically. Reversely, the pressure building circuit is used to create sufficient operating pressure. It is controlled by a regulator that opens to allow liquid to flow from the bottom of the container, through a vaporizer, where it becomes a gas. The gas then collects in the vapor space at the top of the container. The vaporization of the liquid into gas increases the pressure in the container. In most liquid cylinders, the pressure building circuit and the economizer is open or closed by a common and single valve.

Gas Use Valve (11) – This valve allows gaseous product withdrawal through the internal vaporizer and/or the economizer. It has the recommended Compressed Gas Association (CGA) connection that matches the gas service for which the container is configured. In some applications, BeaconMedaes recommends to connect a secondary gas supply source (aka “Pusher”) that will be used to maintain the liquid cylinder gas pressure to an acceptable level in the eventuality the internal pressure build device cannot cope with the flow of cryogen coming out of the liquid cylinder. The external pusher would then be connected to the “Gas Use Valve”. In that case, a specially designed hose) is provided.

Liquid Level Gauge (10) - This is a float-type liquid level gauge. This is used to indicate the approximate amount of container contents. This indicator is often defective as it is a fairly sensitive device. Therefore, it is not always a good indication of how much liquid is left in the cylinder.

19- Manifold Operation



Before explaining how the manifold operates, it is important to provide a quick overview of the main system components. The CFAM-WX Series Fully Automatic Switchover Manifold consists primarily of one (1) scale controller, two (2) liquid cylinder scales, one (1) manifold control module, two (2) cryogenic transfer hoses, two (2) solenoid valves and related fittings.

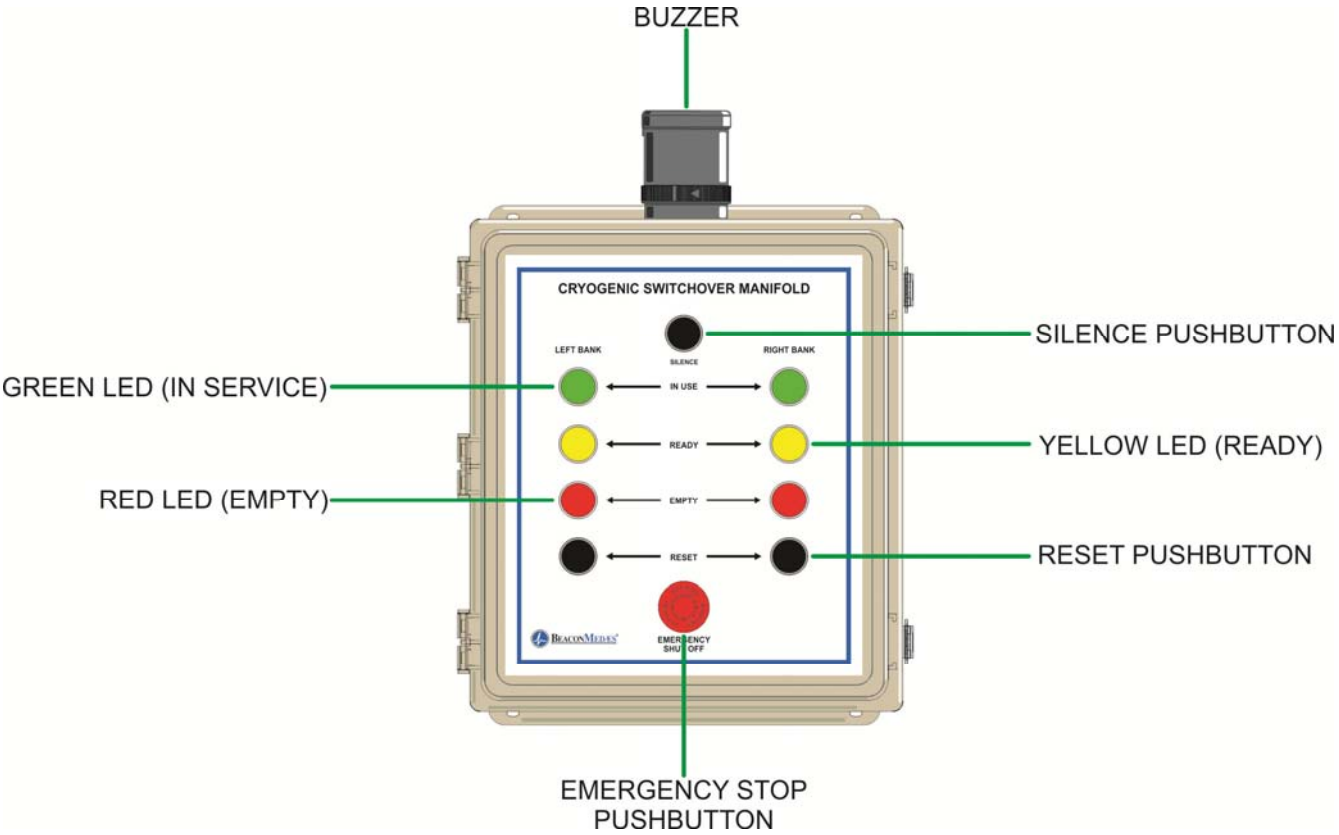
Scales – There are two (2) liquid cylinder scales: left and right. The role of the scales is simply to send a signal to the scale controller as to how much weight they carry.

Scale Controller – The scale controller reads and displays the weight of each liquid cylinder. It is also where the operator will be requested to enter the tare weight of the each liquid cylinder. Finally, the scale controller sends a signal to the control module when a liquid cylinder is empty.

Solenoid Valves – The solenoid valves are electrically opened and closed by the manifold control module. Unless otherwise specified, the solenoid valves are normally closed meaning that when there is no power to the manifold, both valves are closed. The manifold control module is designed to have either one open at a time meaning that both solenoid valves can be closed at the same time but never be both open at the same time.

Cryogenic Transfer Hoses – The cryogenic hoses transfer the cryogenic liquid from the liquid cylinders to the manifold wetted train of valves and fittings. It is very important to understand that the transfer hoses will become E-X-T-R-E-M-E-L-Y cold when the cryogen is in the hoses. The hoses will remain extremely cold long after the cryogen when through them.

Manifold Control Module – The switchover process is operated by the manifold control module. It opens and closes the solenoid valves based on the signals provided by the scale controller. The very important REST BUTTONS are located on the manifold control module. The operator will be requested to push on these buttons each time a liquid cylinder is ready to be put in service. The other function of the manifold control module is to display the system status (via the lights). This is also where all electrical connections are made.



THEORY OF OPERATION

The system is designed to work with the net content of each liquid cylinder. The operator is requested to enter the tare weight of each liquid cylinder on the scale controller while putting a liquid cylinder in service. The scale controller, which reads the entire liquid cylinder weight (gross weight), is programmed to deduct the liquid cylinder tare weight from the gross weight.

Residual Weight – As mentioned before, the scales read the entire weight of each liquid cylinder. The scales also read the weight of the hoses connected to the liquid cylinders AND the weight of the ice that will eventually build up on the liquid cylinders and hoses. It is important to factor out both the weight of the hoses and the weight of the ice. This extra weight (hoses and ice) is called the residual weight. The residual weight is factory set at 25 lbs. It can be changed in the field between 15 lbs and 65 lbs via the SETUP screen.

Reset Pushbutton – The scales send weight signal to the scale controller and nothing else. Therefore, it does not make any difference between the weight of a liquid cylinder or the weight of a person. The simple fact that the pressure builds up over time after a red light is lit will not reset the manifold automatically (only the reset pushbutton fulfills that function). The role of the reset button is to engage the switchover process. Or, in other words, the reset button is to confirm to the manifold control module the following:

a) the weight that is read by the scale controller is a liquid cylinder;
b) the liquid transfer hose has been connected to the liquid cylinder*;
c) there is enough cryogenic liquid inside the liquid cylinder so that it can be put in service;
d) the operator checked for leaks and confirmed there is no leak anywhere in the system'
e) all equipment and valves located downstream of the cryogenic manifold are ready to receive the cryogenic liquid.
f) the liquid cylinder "liquid valve" is open.

Once a reset button is pushed (considering that all other parameters are satisfied), this will open its corresponding solenoid valve and cryogenic liquid will be dispensed out of the manifold.

**The cryogenic manifold is not designed to determine if there is cryogenic liquid in the pipeline. So, if you push on the reset button and the liquid transfer hose is not connected or the "liquid use" valve is not open, the cryogenic manifold will open the corresponding solenoid valve and it will consider the liquid cylinder is in service until the liquid cylinder weight reaches the empty weight.*

Switchover Process Explained – We start the explanation with the following assumptions:

i. The system is energized.
ii. The delivery piping is properly connected.
iii. There is no liquid cylinders on any scales.
iv. There are two fresh and full liquid cylinders available.

Step 1: Connecting Both Liquid Cylinders
Simply push/roll one liquid cylinder on each scale. Connect each liquid transfer hose to their respective liquid cylinder (See Section 22 for details).

Step 2: Enter Tare Weight
The scale controller will ask the operator to enter the tare weight of each liquid cylinder. The tare weight is indicated on a tag on each liquid cylinder (normally on one of the vertical metal post linking the top ring of the liquid cylinder and the liquid cylinder itself). Once you have entered the tare weight of each cylinder, their corresponding red light will extinguish).

Step 3: Reset & Go
For this example, we are putting the left bank in service first and the right bank will be in stand-by. In order to do that, simply push the left bank reset button. Once the left bank reset button is pushed, the left bank red light will extinguish, the green light (left side) will illuminate and the solenoid valve (left side) will be energized. When pushing on the right bank reset button, the red light (right bank) will extinguish, the yellow light (right bank) will illuminate but the solenoid valve (right bank) will remain un-energized (closed). At this point, the left bank is in service and the right bank is in stand-by mode until the left bank is empty.

Usable Weight & Switchover Sequence
A liquid cylinder is considered empty when the usable weight is reached. The usable weight is the weight shown on the scale controller screen as being “Empty at XXX lb”.

Gross Weight (total weight of the liquid cylinder: container and content)
\- Tare Weight (weight of the liquid cylinder cylinder without its content)
Net Weight (content only = weight of the cryogenic liquid)
\- Residual Weight (weight of the hose and a provisional weight for ice build-up)
Usable Weight (as shown on the scale controller being “Empty at XXX lb)

In other words, when the “Net Weight” (shown on the scale controller) equals the “Empty at XXX lb”, the switchover process is engaged. Once this weight is reached, the scale controller sends a “empty cylinder” signal to the control module. The control module will:

Bank in Use	**Bank in Stand-By**
- Close the solenoid valve	- Open the solenoid valve
- Turn off the green light	- Turn on the yellow light
- Turn on the red light	- Turn on the green light

About Green Lights
Once a green light is lit, its corresponding solenoid valve is open and, therefore, the liquid cylinder is in service. This liquid cylinder will remain in service (valve open) until the liquid cylinder is empty. That means the solenoid valve will remain open even if there is no demand in the pipeline.

VERY IMPORTANT

Power Failure

The CFAM-WX manifold is mounted with two (2) normally closed solenoid valves. That means the solenoid valves require power to open. Therefore, when power goes down there is no cryogenic liquid coming out of the manifold. When the power is back on again. The solenoid valves DO NOT open automatically. An operator has to manually reset the manifold which means pressing the “Reset” pushbutton for each side/bank of the manifold.

Some facilities, primarily hospitals, are required to test their backup power generators regularly. It is frequent to see a momentary glitch/drop in power between the moment the power from the grip goes down and the power generators to kick in. This glitch can sometime be significant enough to cause the manifold to shut down and unlatch the relays that power the solenoid valves. This glitch may also cause the scale controller manifold to require a manual reset as well.

One way to overcome this situation is to install an Uninterrupted Power Supply (UPS) capable of preventing this drop in power to the manifold. The UPS does have to be powerful enough to maintain momentary power to both the CFAM controller and the scale controller.

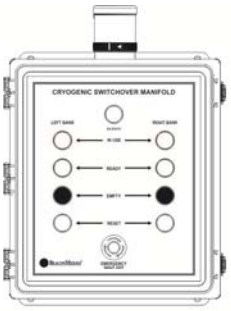
Finally, as an additional protection, the end user may require to install a low pressure switch on the cryogenic supply line to warn operators the cryogenic liquid supply is interrupted.

20- Message Center

This section of the manual shows you SOME possible "light configurations" you can see with the CFAM-WX manifold. From what we are showing below, what applies to the left bank applies to the right bank (and vice versa). Please understand that the buzzer, when energized, can be killed by the silence pushbutton without extinguishing any red light.

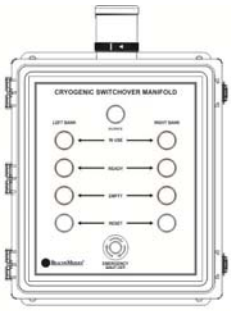
DESCRIPTION OF VISUAL AND AUDIBLE SIGNALS AND PURPOSE OF PUSHBUTTONS	
BUZZER	• The buzzer is actuated when a liquid cylinder becomes empty (ie when a red light is lit). • The buzzer can be silenced by pushing the silence pushbutton.
SILENCE PUSHBUTTON	• The silence pushbutton kills the buzzer when pressed. • The red lights do not extinguish when the pushbutton is pushed.
GREEN LIGHT (IN USE)	• A green light indicates that the liquid cylinder pressure is adequate and its respective valve is opened (cryogenic liquid is feeding from that bank). • Both green lights (one per bank) cannot be lit at the same time. • **A green light primarily means that the solenoid valve is opened.**
YELLOW LIGHT (READY)	• A yellow light indicates that the liquid cylinder net weight is adequate but the liquid cylinder on that manifold side is not in service.
RED LIGHT (EMPTY)	• A red light indicates an empty liquid cylinder. • **A red light primarily means that the solenoid valve is closed.**
RESET PUSHBUTTON	• The purpose of the reset pushbutton is to indicate to the manifold controller that a fresh liquid cylinder has been installed and it is ready to be put into service. • If the reset pushbutton is not pushed even if the hose is connected, valves are opened and the weight is satisfactory, the manifold will not use this new liquid cylinder. In that situation, all lights of that manifold side will be extinguished signifying to the operator that the reset pushbutton has to be pushed.
EMERGENCY STOP BUTTON	• The emergency stop kills the power to the **entire** manifold: - The solenoid valves close. - There will be no lights and no buzzer TO RE-ENERGIZE THE MANIFOLD, PULL AND TURN THE EMERGENCY PUSHBUTTON. The scale controller will remain energized.

MESSAGE CENTER



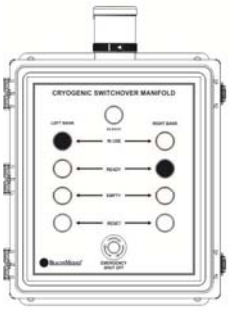
Left Bank - Red LED
EMPTY

Right Bank - Red LED
EMPTY



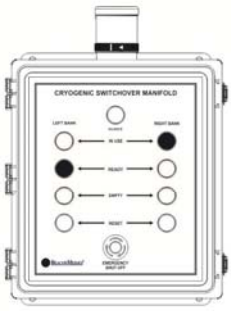
Left Bank - No Lights
NO POWER OR BANK IS READY TO BE RESET

Right Bank - No Lights
NO POWER OR BANK IS READY TO BE RESET



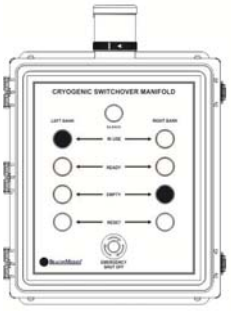
Left Bank - Green LED
IN SERVICE

Right Bank - Yellow LED
IN STAND-BY



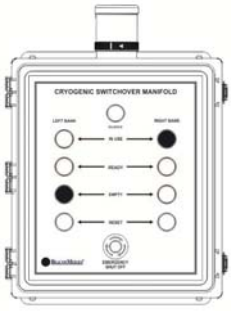
Left Bank - Green LED
IN SERVICE

Right Bank - Green LED
IN STAND-BY



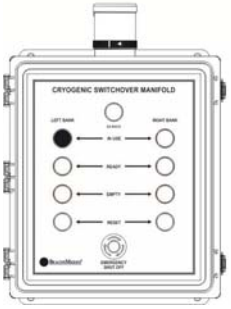
Left Bank - Green LED
IN SERVICE

Right Bank - Red LED
EMPTY



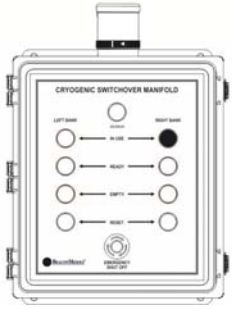
Left Bank - Red LED
EMPTY

Right Bank - Green LED
IN SERVICE



Left Bank - Green LED
IN SERVICE

Right Bank - No Lights
BANK IS READY TO BE RESET



Left Bank - No Lights
BANK IS READY TO BE RESET

Right Bank - Green LED
IN SERVICE

21- Putting a Liquid Cylinder into Service

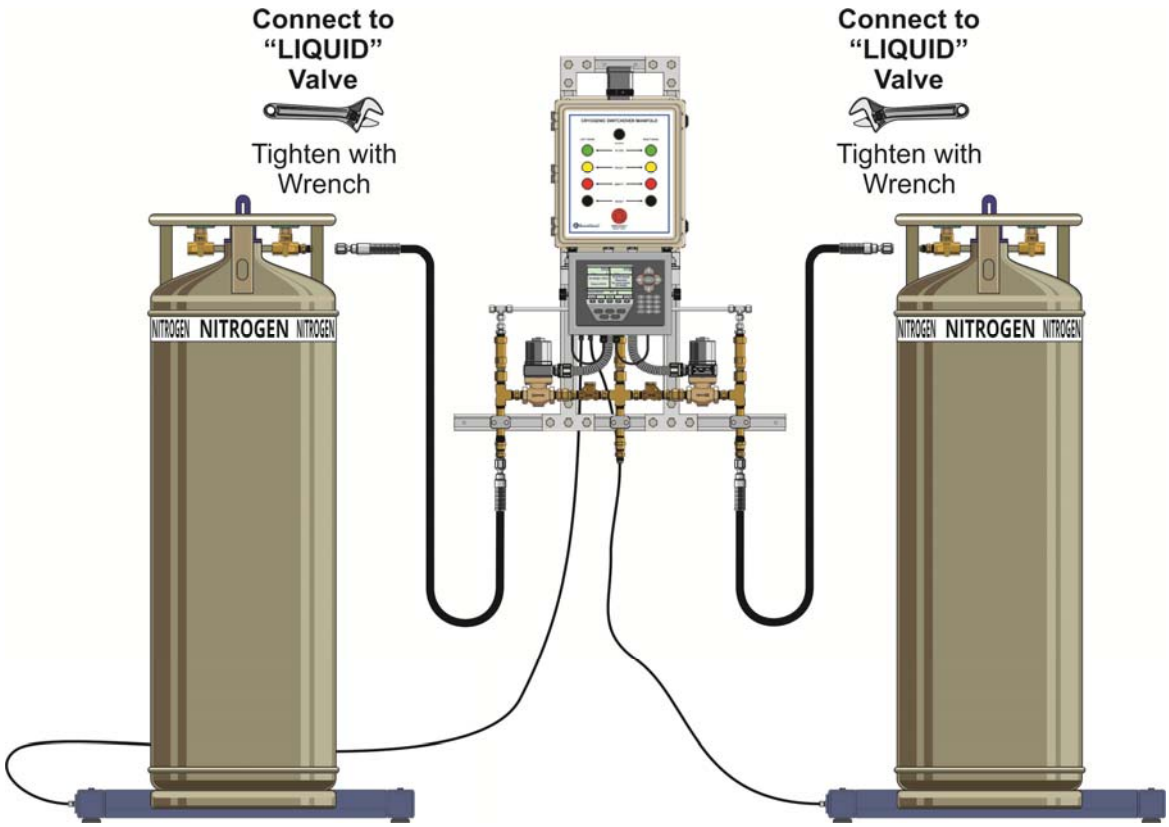
Two (2) hoses are normally provided with the CFAM-WX manifolds. This section of the manual is to provide you with the proper instructions not only on how and where to connect the hoses to the liquid cylinders but also to give you important instruction on how to put a liquid cylinder into service. This section of the instruction manual assumes that the manifold has been properly installed.

CONNECTING THE LIQUID TRANSFER HOSE

This hose has a stainless steel flare fitting female end, a stainless steel armor guard and is approximately 60"-72" long. One end of the liquid transfer hose is already connected to the inlet of the manifold located (see schematic below).

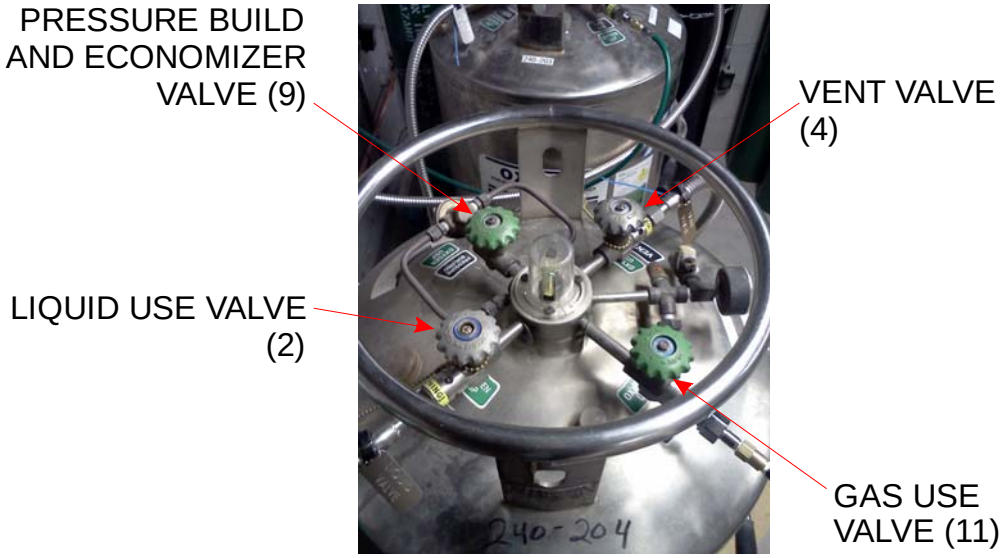
Procedure

1. Make sure that all valves on the liquid cylinder are closed (off)
2. Using gloves if the hose is cold, tighten by hand the swivel flare female end of the liquid transfer hose to the fixed male flare end of the **"LIQUID USE" valve** of the liquid cylinder.
3. Using two (2) wrenches tighten that same connection.



OPENING VALVES AND RESETTING THE MANIFOLD

At this moment, all hoses are properly connected to the liquid cylinder. It is now time to put that liquid cylinder into service.



Procedure (ALWAYS USE GLOVES – PREFERABLY CRYOGENIC GLOVES – WHEN TOUCHING COLD VALVES AND HOSES)

4. If your liquid cylinder is equipped with one, make sure the pressure building valve (9) is closed.
5. Open (turn on) the liquid use valve (2). Check for leaks with Snoop (soapy solution) and check for bubbles. Depressurize and re-tighten. Check for leaks again. If the hose or the liquid cylinder is too cold, it is possible that the Snoop will freeze and bubbles will not appear. It that case, pay attention to hissing around the connection as it may indicate a leak. If it is the case, close the valve, depressurize and remake the connection.
6. Enter the tare weight of the liquid cylinder to the scale controller.
7. Push the reset pushbutton on the manifold controller for the bank side you want to put into service.
8. The system is now ready for use.

LIQUID CYLINDER CHANGEOUT

At this point in time, we consider that a red light is lit on the manifold and the liquid cylinder has to be replaced. Hereunder are the steps to follow:

a. Close (turn off) the liquid use valve (2).
b. Using two (2) wrenches slowly disconnect the liquid transfer hose from the liquid valve. Pressure will release from the connection you are breaking. In the event there is still some cryogenic liquid left in the hose, let the hose rest in place until the pressure is down to zero before disconnecting the hose from the liquid valve. Place the hose in a safe location.
c. Remove the empty cylinder.
d. Put a fresh liquid cylinder in place and start from Step 1.

22- Is it Normal?

By definition, cryogens are extremely cold. Because of that, some facts have to be brought to the attention of the end user about what will happen when the cryogenic manifold is in service.

The Liquid Cylinder is "Singing" – When the "Liquid Use" valve is open and the pressure is building up in the system, you will hear some kind of high pitch sound coming from the liquid cylinder. It is normal as this sound will diminish and/or stop once the pressure is equalized and the cryogenic liquid is flowing in the pipeline.

Fume, Frost and Ice – As the temperature starts to drop inside the pipeline, the non insulated components in contact with the cryogen gradually transfer that cold temperature to the ambient air. The air contains moisture (water vapor) to various levels. The water vapor starts to condense in the air at first (creating a floating fume) and then creates frost on the wetted components. If the exposure to the cryogen is long enough, ice will start to build up on the parts in contact with the cryogen. The parts in contact with the cryogens are the liquid cylinder valves, the cryogenic liquid transfer hoses and the cryogenic manifold valves and piping.

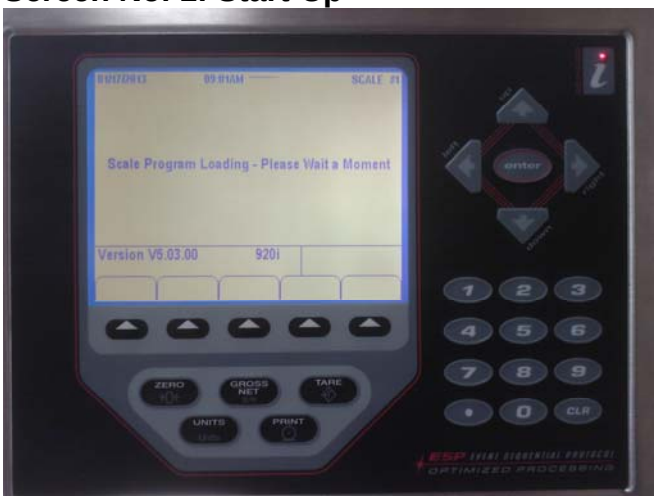
Water – When there is no demand for cryogens in the pipeline. There is no cryogen flowing and therefore, the components with ice build-ups on them will thaw. Provisions for floor drains and/or gutters must be considered.

The Pressure of the Liquid Cylinder Goes Up and Down – It is normal for the pressure to go up and down inside a liquid cylinder. As you draw liquid from the liquid cylinder, the gas headspace gets bigger. It may take a couple of minutes for the pressure building circuit to increase the pressure inside the cylinder. Reversely, when there is no demand for cryogenic liquid and the liquid cylinder sits idle for too long, the pressure inside the liquid cylinder will start to climb. The pressure relief valve will open if the pressure climbs to high (this is also normal and usual).

The Liquid Cylinder in "Stand-By/Ready" Mode is Depleting – We have explained in this earlier in this manual that a gas cannot be kept indefinitely in its cryogenic form. When the relief valve opens on a liquid cylinder, it is venting out gas that creates an excess of pressure. Consequently, the scale controller will indicate a decrease in weight for that venting liquid cylinder… it is normal and crucially suitable. The rate of venting will vary upon multiple factors such as the quality of the liquid cylinder and the time the cylinder is in ready mode (just to name a few reasons).

23- Screens

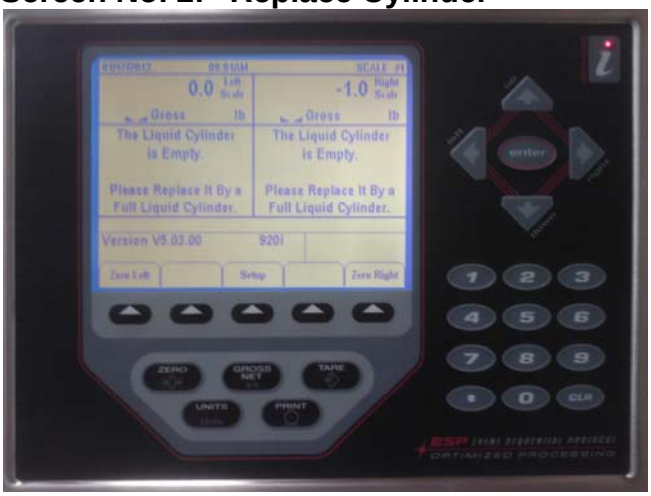
Screen No. 1: Start-Up



"Scale Program Loading – Please Wait a Moment"

- The start-up screen is the first screen the scale controller displays when the unit is energized after a power shut down.
- The scale program is being loaded. This screen will be displayed for only few seconds.

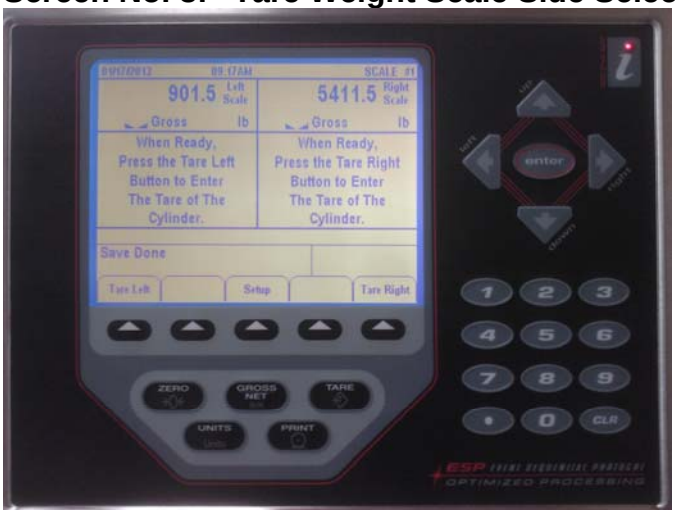
Screen No. 2: "Replace Cylinder"



"The Liquid Cylinder Is Empty – Please Replace It By a Full Cylinder"

- This screen is a "read-only" screen.
- You first have to remove the empty liquid cylinder and put a full one on the scale. Then, the scale controller will automatically display a screen asking you to enter the tare weight of the full liquid cylinder (Screen No. 3).

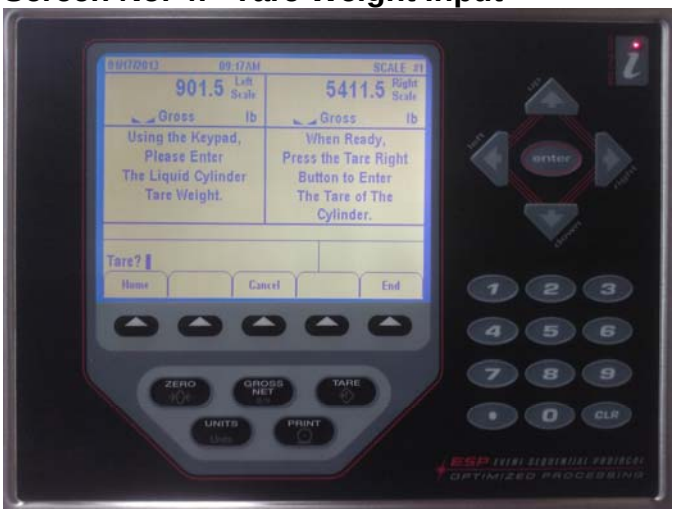
Screen No. 3: "Tare Weight Scale Side Selection"



"When Ready, Press the Tare Left Button to Enter The Tare of The Cylinder"

- This is the screen where you enter the tare weight of one or both liquid cylinders.
- You can select the side for which you want to enter the tare weight. At the very bottom of the screen, it is mentioned "Tare Left" and "Tare Right". There is an up arrow under each of them. Simply push on this up arrow to make your selection.

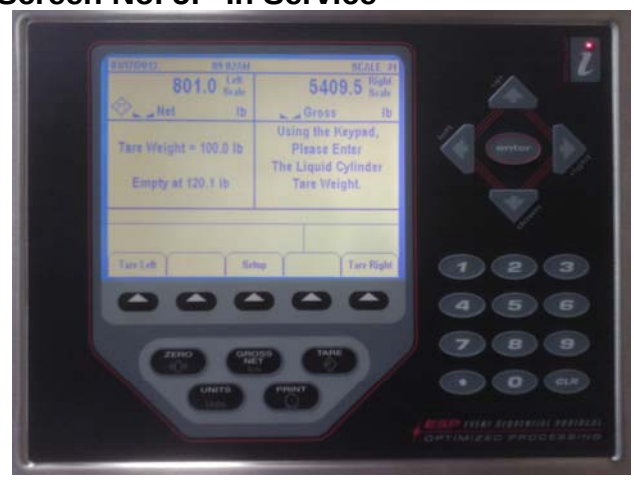
Screen No. 4: "Tare Weight Input"



"Using the keypad, enter the liquid cylinder tare weight and then press enter."

- In this example, the left bank liquid cylinder tare weight is being entered.
- The keypad is located on the bottom right portion of the scale controller fascia.
- The "enter" key is located in the middle of the four (4) arrows (top right portion of the scale controller).
- The numbers shown are not representative of a real cylinder tare weight not a real gross weight.

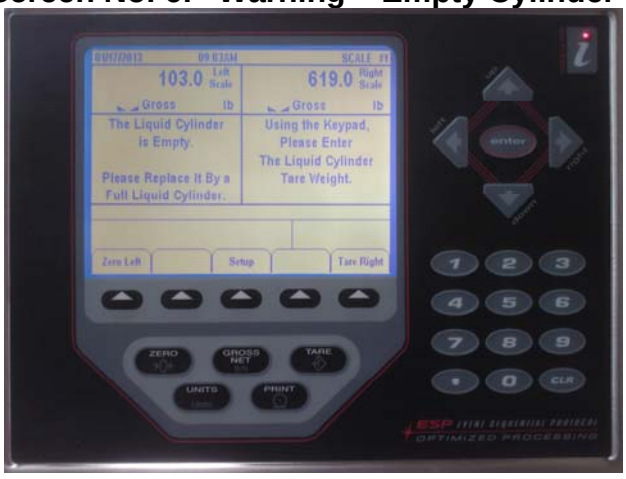
Screen No. 5: "In Service"



Once the tare weight of a liquid cylinder has been entered, the scale controller displays:

- the usable weight ("Empty at XXX lbs"… 120 lbs in this case for the left bank)
- the tare weight you just entered
- the net weight of the liquid cylinder

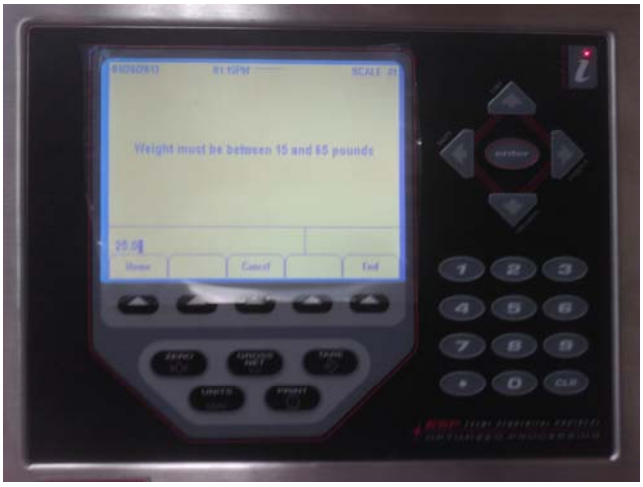
Screen No. 6: "Warning – Empty Cylinder"



The Liquid Cylinder is Empty – Please Replace It By a Full Liquid Cylinder"

- When the usable weight equals the empty weight, the red light of the corresponding bank illuminates.
- On top of the red light, the scale controller will display this message.

Screen No. 7: "Selecting Residual Weight"



Weight must be between 15 and 65 pounds

- The residual weight is field changeable between 15 lb to 65 lb.
- The residual weight screen is accessible through the set up screen.
- Using the keypad at the bottom right portion of the controller, enter the desired residual weight and press “enter”. The enter key is located at the top right portion of the scale controller (between the four arrows).

Screen No. 8: “Time & Date Change”

- This screen is accessible through the Setup screen.
- Should you require to change the time and date, simple scroll the arrow keys to the desired place (either hour, minute, day, month or year)
- Use the numbered keypad to set the desired value.
- If the value you enter is not valid (such as entering “13” as a month), the screen will display the previous value.

24- Liquid Cylinder Tare Weight

The location of the name tag containing the liquid cylinder specifications vary upon the make and model. In most cases, this information is located on a metal tag or on a plastic sticker located on the shoulder on a top ring metal post of the liquid cylinder.

25- Shutdown

WARNING:
Cryogenic fluids and gases must be discharged a safe location. Be sure to use a venting procedure that is environmentally acceptable and complies with Federal, State, Provincial and local requirements.

1. Close all liquid cylinder valves.
2. Vent the system pressure to 0 psig.
3. Close all system valves.
4. Disconnect all hoses from both liquid cylinders.

26- Repairs

If the manifold or any part of the manifold leaks or malfunctions, take it out of service immediately. Repairs should be made only by BeaconMedaes or by a factory-trained service technician with the special tools, test equipment required to make a safe repair. Tampering with the switchover manifold voids the warranty. Please contact BeaconMedaes to arrange for any necessary repairs.

Repairs to switchover manifolds done after the initial warranty period has expired are chargeable to the customer. Upon receipt at the factory, the switchover manifolds will be inspected and you will be contacted with a repair cost estimate. No item will be repaired until approval is received. There will be an evaluation charge assessed for equipment not repaired. All repairs should be arranged through your

BeaconMedaes supplier.

NOTE: All equipment being returned must be purged of all hazardous materials using a clean, dry inert gas (e.g. Dry Nitrogen) prior to return.

27- Warning

Our equipment is primarily intended for use in cryogenic systems. BeaconMedaes products are designed for use by persons technically trained in the proper use and safe handling of gas delivery systems. Due to the high pressure and cryogenic liquid employed in these processes, misapplication could result in injury or death. BeaconMedaes expressly warns against the sale to, or use of our products by, anyone other than professionally trained personnel. Do not use this equipment where pressures and temperatures can exceed those listed under the « Specifications » section.

Through misuse, age, or malfunction, components used with cryogens can fail in various modes. The system designer is warned to consider the failure modes of all component parts used with the above mentioned cryogens and to provide adequate safeguards to prevent personal injury or damage to equipment in the event of such failure modes. Adequate safeguards can be, but are not limited to:

- Pressure relief devices adequately piped to a safe location;
- Gas detection devices connected to a proper warning audible and visual alarm;
- Automatic shutoff valves and/or manual shutoff valves with an emergency stop push button;
- Self-contained breathing apparatus;
- Pipeline purge system with inert gas;
- Fire extinguishers and/or automatic sprinklers.

System designers must provide a warning to end users in the systems instructional manual if protection against a failure mode cannot be adequately provided for.

It should be recognized that warnings are valid for any equipment, regardless of manufacturer, and are not restricted to equipment manufactured by BeaconMedaes. BeaconMedaes's reputation for equipment quality performance is well established. We feel we have the additional obligation to provide information or warnings to customers to assist them in applying our equipment in a reasonable and safe manner.

28- Design Changes

In line with our commitment to continuous improvement, BeaconMedaes reserves the right to make design modifications or discontinue manufacture of any equipment without prior notice.

LIMITED WARRANTY

WARRANTY: The Seller expressly warrants that the products manufactured by it will be free from defects in material, workmanship and title at the date of shipment. This warranty is exclusive and is IN LIEU OF ALL IMPLIED OR STATUTORY WARRANTIES (INCLUDING WITHOUT LIMITATION, WARRANTIES AS TO MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, OR ARISING FROM COURSE OF DEALING OF USAGE OR TRADE) or any other express or implied warranties or representations. All claims under this warranty must be made in writing and delivered to the seller prior to the expiration of 1 year from the date of shipment from the factory, or be barred. Upon receipt of a timely claim, the seller shall inspect the item or items claimed to be defective, and seller shall, at its option, modify, repair, or replace free of charge, any item or items which the seller determines to have been defective at the time of shipment from the factory, excluding normal wear and tear. Inspection must be performed at the seller's plant and in such event, freight for returning items to the plant shall be paid by Buyer. Seller shall have no responsibility if such item has been improperly stored, installed, operated, maintained, modified and/or repaired by an organization other than the seller. Adjustment for products not manufactured by Seller shall be made to the extent of any warranty of the manufacturer or supplier thereof. The foregoing shall be the Seller's sole and exclusive liability and buyer's sole and exclusive remedy for any breach of warranty or for any other claim based on any defect in, or non-performance of, the products whether based on breach of contract or in tort, including negligence or strict liability.

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