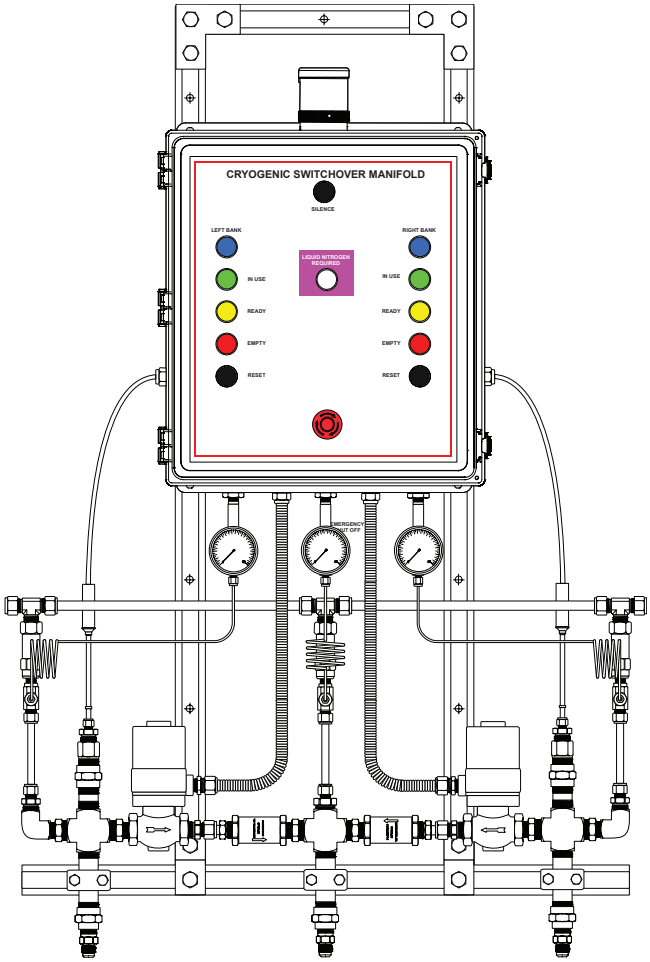
CFAM-TX Series

THIS BOOKLET CONTAINS PROPRIETARY INFORMATION OF BEACONMEDÆS AND IS PROVIDED TO THE PURCHASER SOLELY FOR USE IN CONJUNCTION WITH FULLY AUTOMATIC SWITCHOVER MANIFOLDS FOR LIQUID CYLINDERS – TEMPERATURE ACTUATED (LIQUID/WITHDRAW / LIQUID DISPENSE).



Important

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

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

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

1 - Safety Precautions

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 cannot be 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 Product Specifications for maximum inlet pressures.
- Never permit oil, grease, or other combustible materials to come in contact with cylinders, manifolds, 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 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.

1 - Safety Precautions - Cryogens

Cryogenic liquids are liquids with a normal boiling point below -238°F (-150°C). 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, hydrogen, 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. He/She 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 even fracture under stress. Cryogenic liquids in containers and piping at temperatures at or below the boiling point of liquefied air (-318°F[-194°C]) 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 68°F (20°C). If these liquids are vaporized in a sealed container, they can produce enormous pressures which could rupture the vessel. 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 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

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-to 200-liter containers are available. Product may be removed by pouring into smaller containers. Product 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 pressure build-up. Since these cylinders operate at pressures up to 500 psig, their design must comply with Department of Transportation (DOT) specifications. Capacity of the cylinders varies between 100 liters and 450 liters. Product may be with- drawn as a gas by passing liquid through a vaporizing coil or as a liquid under its 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
NPT	National Pipe Taper		

5 - Disclaimer

BeaconMedæs 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 BeaconMedæs, from what it believes are authoritative sources, and is offered solely as a convenience to its customers. While BeaconMedæs 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

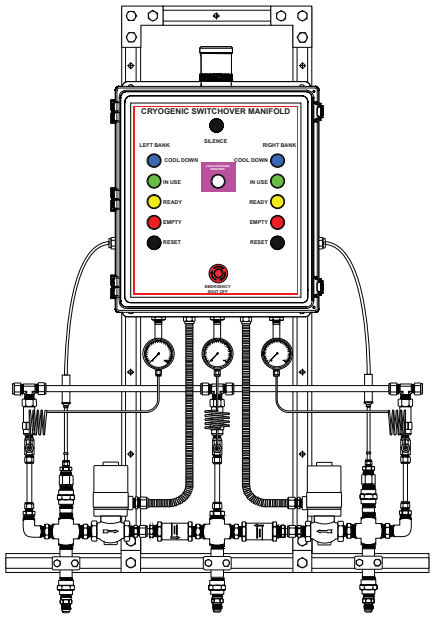
BeaconMedæs manifold systems are cleaned, tested and prepared for the indicated gas service and are built following National Fire Protection Association and Compressed Gas Association guidelines. The manifold consists of a manifold box, a control module and two supply bank headers, to provide an uninterrupted 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. Pressure switches, alarm signal connections and lights show system status and alert the need to replace depleted cylinders.

8 - Components

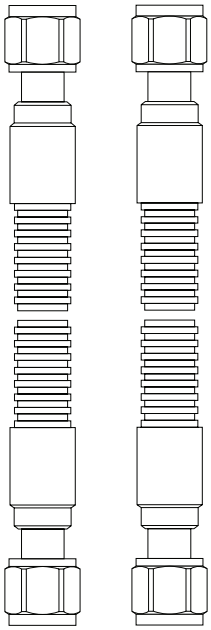
Verify that all components below have been received. If any of these items are missing or damaged, please notify your supplier immediately.

(1) POWER TRANSFORMER

(1) CFAM MANIFOLD



(2) HOSES



9 - Description

The BeaconMedæs CFAM 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 pressure of cryogenic liquid (or carbon dioxide) in the cylinder.

Visual Indicators - There are a total of ten (10) 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
Blue Light:	Indicates a bank being in “Cool Down” mode	One per bank
Pink Light: (white light in a pink rectangle)	Indicates a demand for cryogen in the pipeline	One per manifold
Clear Light:	Indicates the manifold is energized	One per manifold

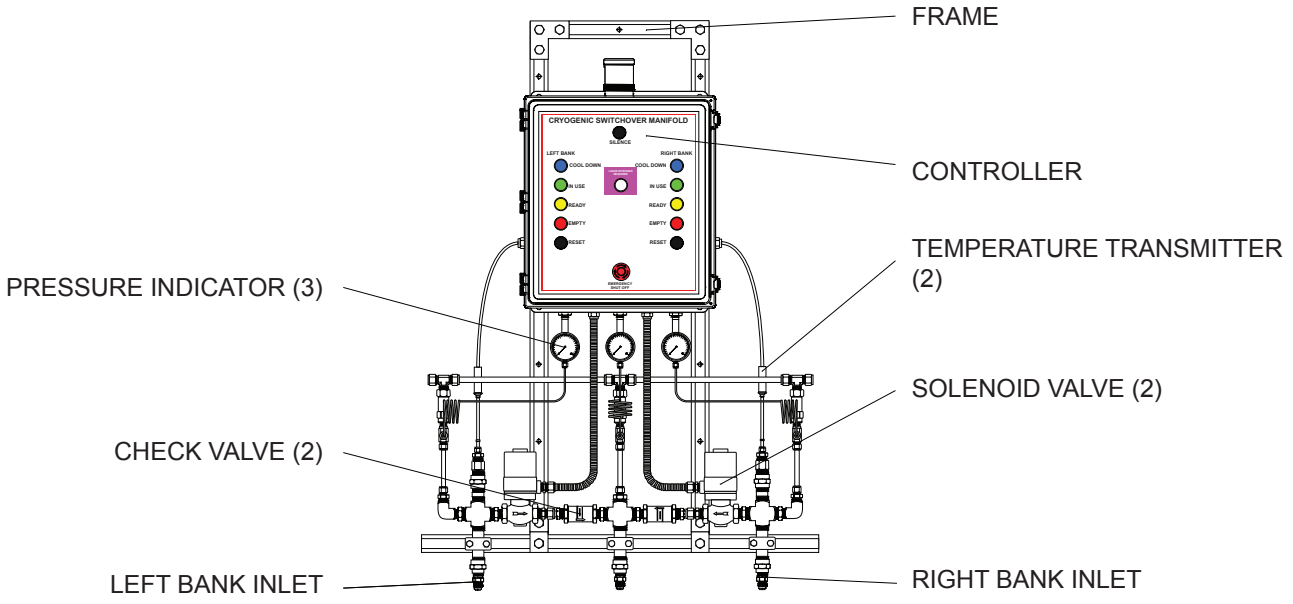
Audible Signal - The buzzer is actuated each time a bank is depleted. The silence pushbutton kills the buzzer without extinguishing its corresponding red light.

Reset Push Buttons - The reset pushbutton needs to be pushed when an empty cylinder has been replaced by a full cylinder. There is one (1) Reset Pushbutton per bank.

PLC - The CFAM-TX is driven by a Programmable Logic Controller (PLC). The PLC gets signals from the three (3) pressure transmitters and the two (2) temperature transmitters of the CFAM-TX manifold to determine when the “In Service” liquid cylinder is depleted and it is now time to switch over to the “Stand By” liquid cylinder. There is also a factor of time in the switchover process. This time factor is important primarily due to the cool down process of the different components of the system. It is very important to understand that the switchover process takes several minutes. For faster and more accurate response, the scale-actuated manifold (CFAM-WX) should be seriously considered.

LCD Screen and Keypad - Some parameters of the switchover process are field changeable to better suit your applications. Among the parameters are the switchover temperature, the switchover pressure and the cool down lag time. In normal operation mode, the LCD screen indicates the actual system conditions. The LCD and related keypad are located inside the cryogenic manifold controller.

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 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-TX – [ ] – [ ] – [ ] – [ ] – [ ] – [ ]

Fluid	Inscribe
Liquid Argon	CGA 295
Liquid Nitrogen	CGA 295
Liquid Oxygen	CGA 440

No. of Cylinders	Inscribe
Inscribe the no. of liquid cyl. per side (must be pair)	

Hoses	Inscribe
Stainless Steel	SSH
Stainless Steel with Guard	SSHG
Vacuum Jacketed	VJH

Options	Inscribe
Outside Installation	3R
Ultra High Purity Cleaning	UHP

Installation Hardware	Inscribe
Wall mount bracket	WM
Floor Stand	FS

Liquid Cylinder Used	Inscribe
22 PSIG	22
235 PSIG	235

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. Carbon dioxide and nitrous oxide manifolds must not be placed in a location where the temperature will exceed 120°F (49°C) or fall below 32°F (0°C). The manifolds for all other gases 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 - Specifications

Fluids	Liquid Nitrogen, Liquid Argon, Liquid Oxygen, Liquid Carbon Dioxide, Liquid Nitrous Oxide
Maximum Inlet Pressure	350 PSIG (Standard) – 600 PSIG (Special Order)
Operating Temperature	-300ºF to 120ºF
Pressure Gauge Size	2-1/2” Dial
Inlet Connection	Liquid Nitrogen: CGA 295 ½” Flare 45º Male Liquid Argon: CGA 295 ½” Flare 45º Male Liquid Oxygen: CGA 440 ⅝” Flare 45º Male
Outlet Connection	Liquid Nitrogen: CGA 295 ½” Flare 45º Male Liquid Argon: CGA 295 ½” Flare 45º Male Liquid Oxygen: CGA 440 ⅝” Flare 45º Male
Pressure Relief Valve Outlet Connection	½” Compression (Stainless Steel)
Audible and Visual Alarm	Standard
Header	1/2” Nominal Pipe Size
Power Requirement	Manifold Controller: 24 VAC, 6 Amp.
Alarm Signal	Dry Contact Normally Open, 30 Amp, MTBA: 5 million operations
Power Transformer	Primary: 110 VAC – Secondary: 24 VAC – Single Phase – 6 Amp.

13 - Standard Factory Settings

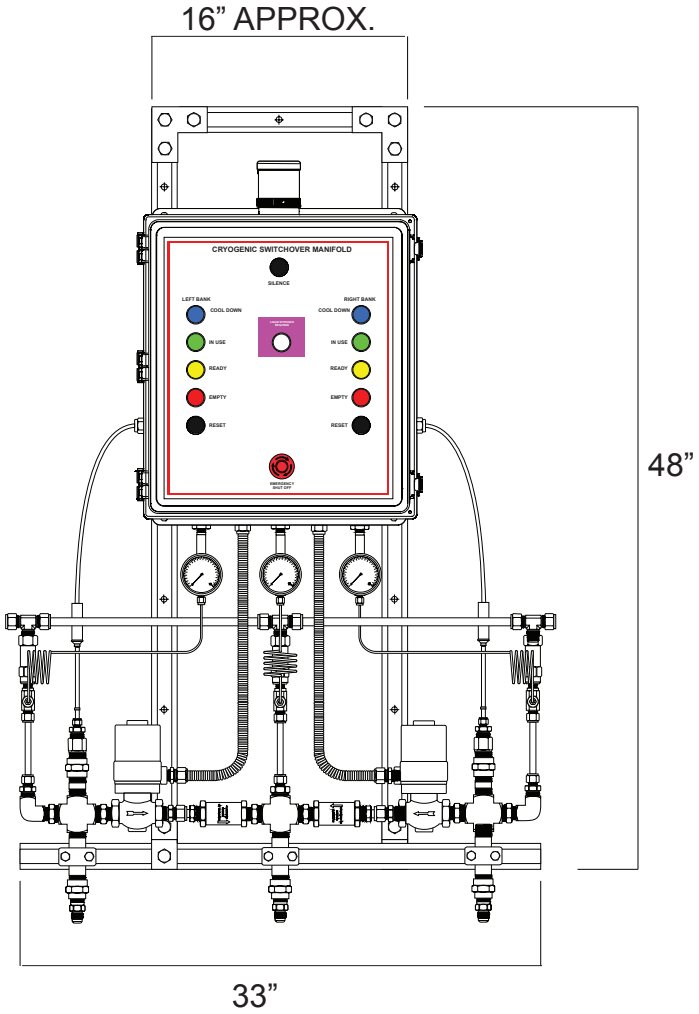
Mechanical Parts

Pressure Gauges	22-PSI Models: 30 PSI Gauges - 235-PSI Models: 300 PSI Gauges
Thermal Expansion Pressure Relief Valves	22-PSI Models: 22 PSI PRV - 235-PSI Models: 235 PSI PRV
Solenoid Valve	Normally Close (Normally Open is a special order)
Material of Construction	Brass pipes and components (Stainless steel is a special order)

Programming – 22 PSI Models Only

Cool down Timer	Field Changeable Range : Factory Setting : 90 seconds in most cases
Minimum Cylinder Pressure (Switchover Pressure)	Factory Changeable Range : 2-22 PSIG Factory Setting : 7 PSIG
Minimum Pipeline Pressure (Demand Pressure)	Factory Changeable Range : 2-22 PSIG Factory Setting : 7 PSIG

14 - Dimensions



15 - Standard Specifications

Name Tag

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

- Gas service
- Alarm set points
- Pressure settings
- Year of manufacture
- Project number

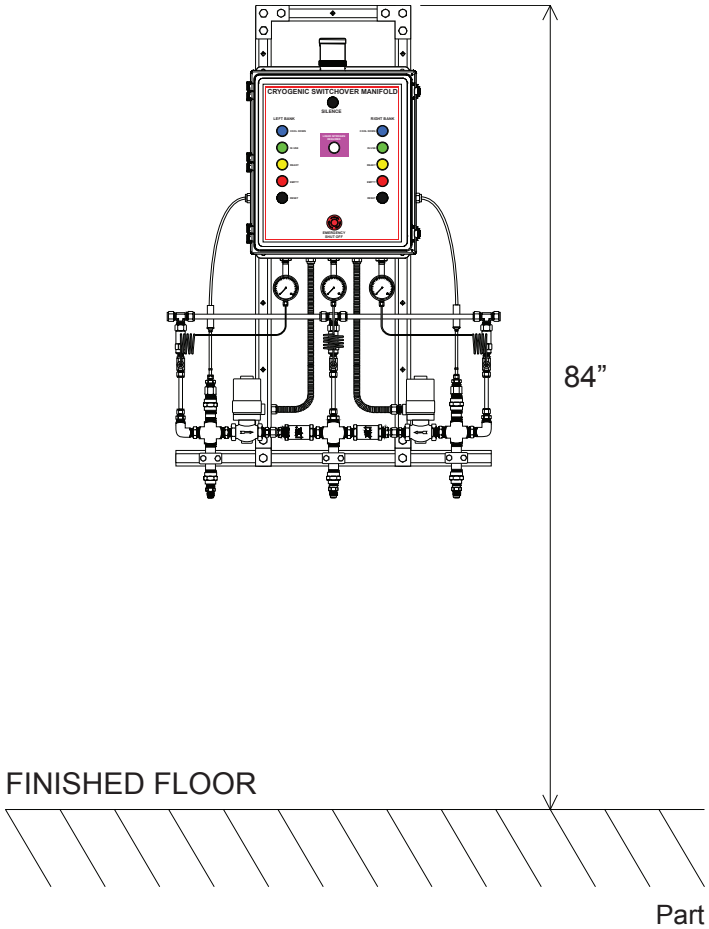
16 - Oxygen Service Equipment

All oxygen and nitrous oxide service equipment made by BeaconMedæs is cleaned as per the requirements of CGA G-4.1-1996.

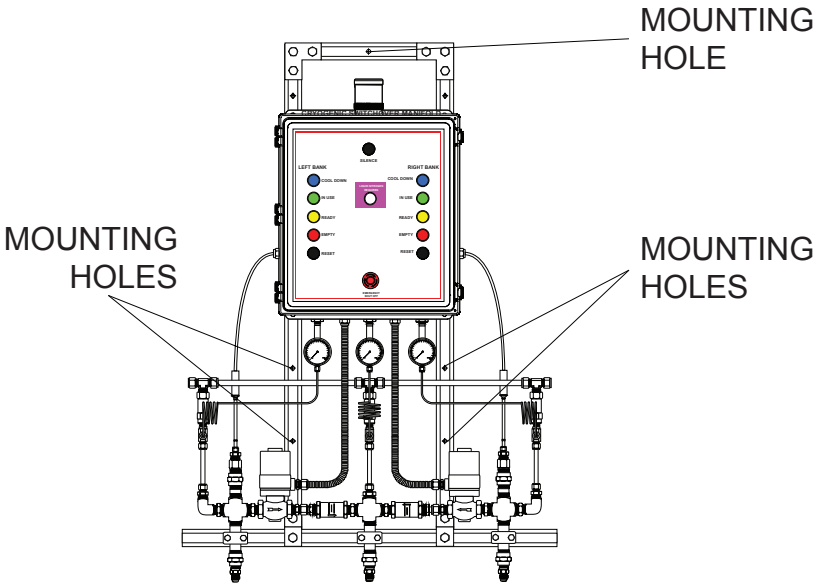
CAUTION
Remove all protective caps prior to assembly.
The protective cap may ignite due to heat of recompression in an oxygen system.

17 - Mechanical Installation

1. **Recommended Height** – The manifold box height should be such to have the top of the aluminum wall frame at 84” from the finished floor (see figure below).

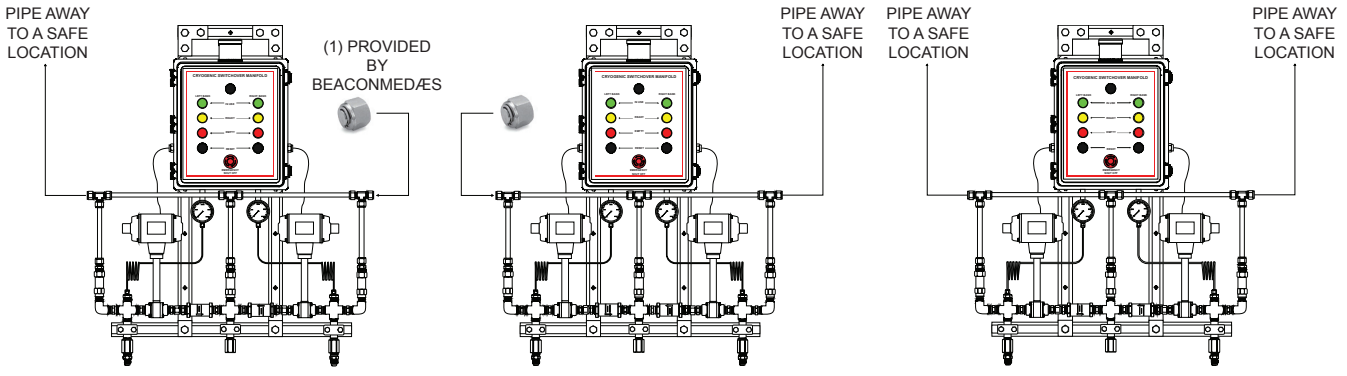


2. **Installing the manifold box** – The manifold box must be secured to a solid wall. The installer is responsible to select the proper hardware for this installation. Please note that the manifold box weighs about 60 lbs without the hoses (proper backing might be required). We do not recommend installing this manifold to walls constructed from drywall as cryogenic manifolds generate a fair amount of moisture that 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.

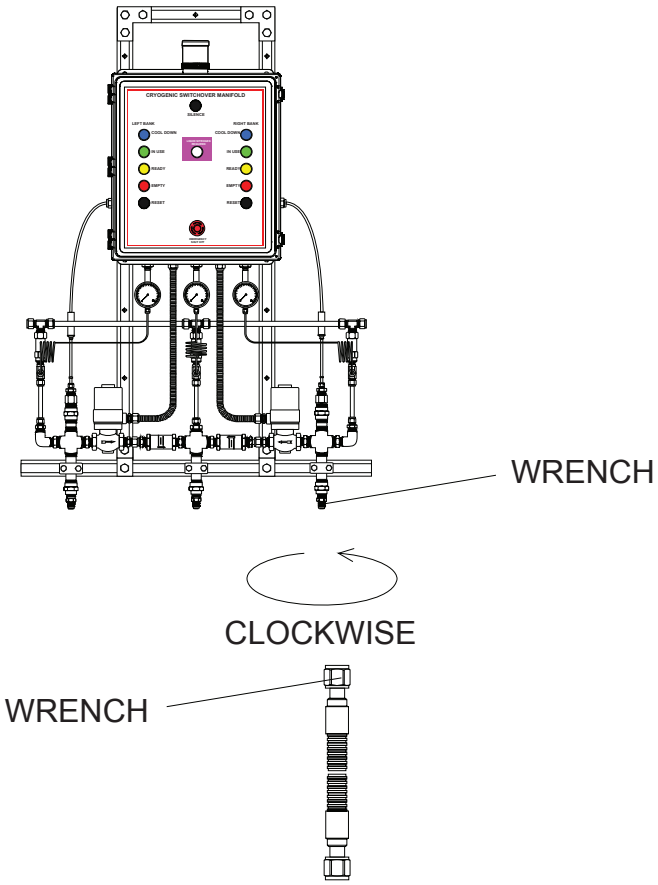


3. **Pressure Relief Valves**– There are three (3) thermal expansion pressure relief valves (aka PRV's) on the manifold. The three (3) pressure relief valves are manifolded together. The PRV's must be piped to a safe location. There are two (2) outlets to the PRV manifold. Each outlet connection is ½" 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:

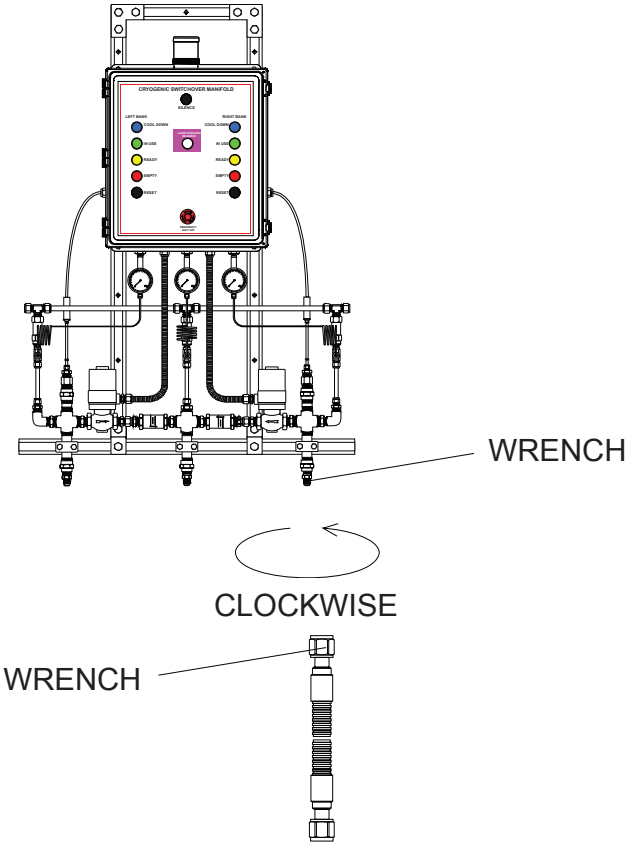
   a. The vent pipeline must not create flow restriction or back pressure
   b. Do not install any valves downstream of the PRV outlet.
   c. Make sure the pipeline outlet will not collect water or cannot be obstructed by insects, debris or ice.
   d. The vent pipeline discharge must be located so that people and buildings in the surrounding area will not be affected in any way.



4. **Cryogenic Liquid Inlet Hoses**– Your manifold comes standard with four hoses: 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 inlet). 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 inlet is flared male and the hose ends are both flared female swivel. The thread type is specific for the fluid service as specified in Section 10 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 VALVES OF THEIR RESPECTIVE LIQUID CYLINDERS.



5. **Cryogenic Liquid Outlet Connection** – The cryogenic liquid outlet is located in 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).

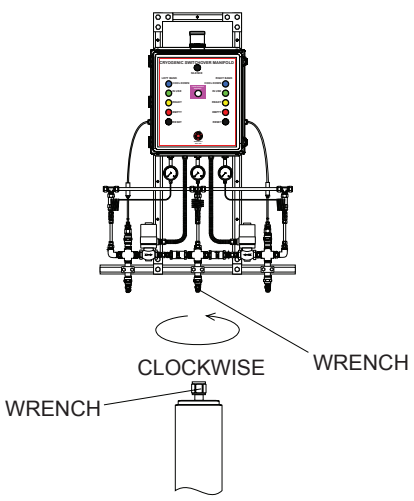
ABOUT CRYOGENIC HOSES

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

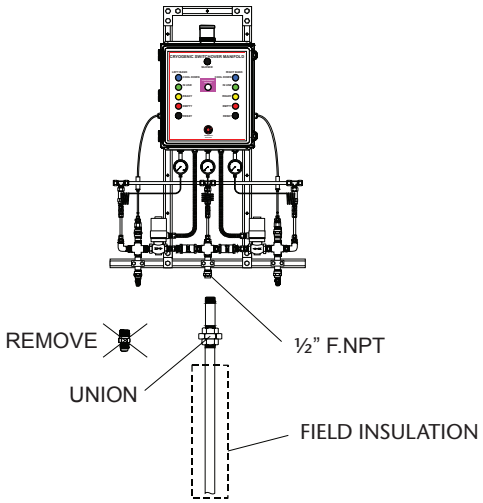
Vacuum Jacketed Hoses - The vacuum insulated hose is the by far the best hose to prevent heat loss and avoid ice accumulation. It consists of a corrugated metal hose surrounded by another flexible metal jacket. The space between the metal jacket and the corrugated metal hose is called the annular space. 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-TX fully automatic switchover manifold. The illustration below shows the minimum requirements to properly install a rigid pipe to the manifold outlet.



VJ PIPING INSTALLATION



HARD PIPING INSTALLATION

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 hoses into male fixed inlets of the manifold. Then, with two (2) wrenches, firmly tighten the connection (see schematic above for details).

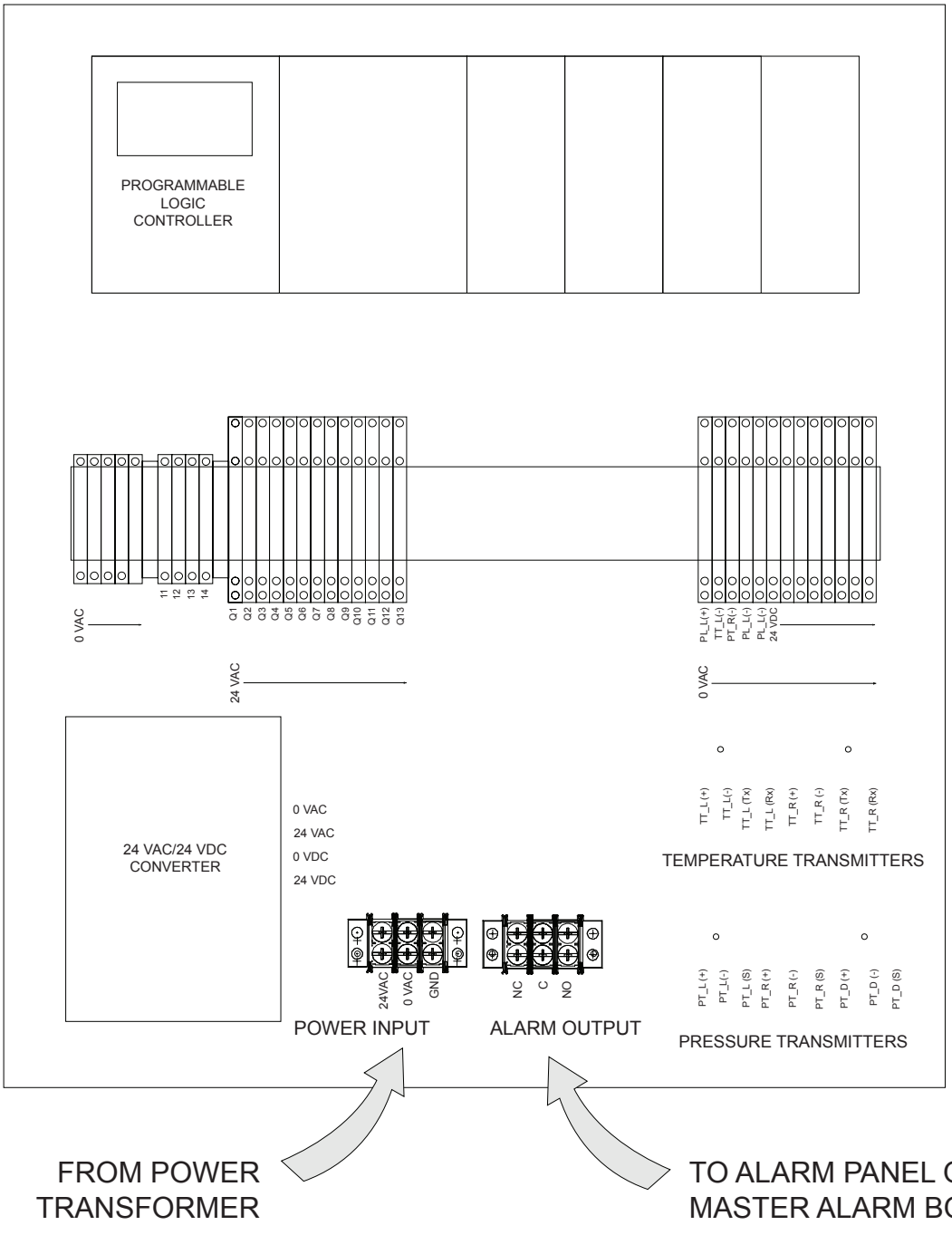
Hard Piping Installation - The left side of the picture above shows the installation of a hard pipe as an outlet conduit. As mentioned previously, it is imperative to install a union capable of supporting both pressure and temperature of the cryogen. Furthermore, the installer is responsible to insure 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:

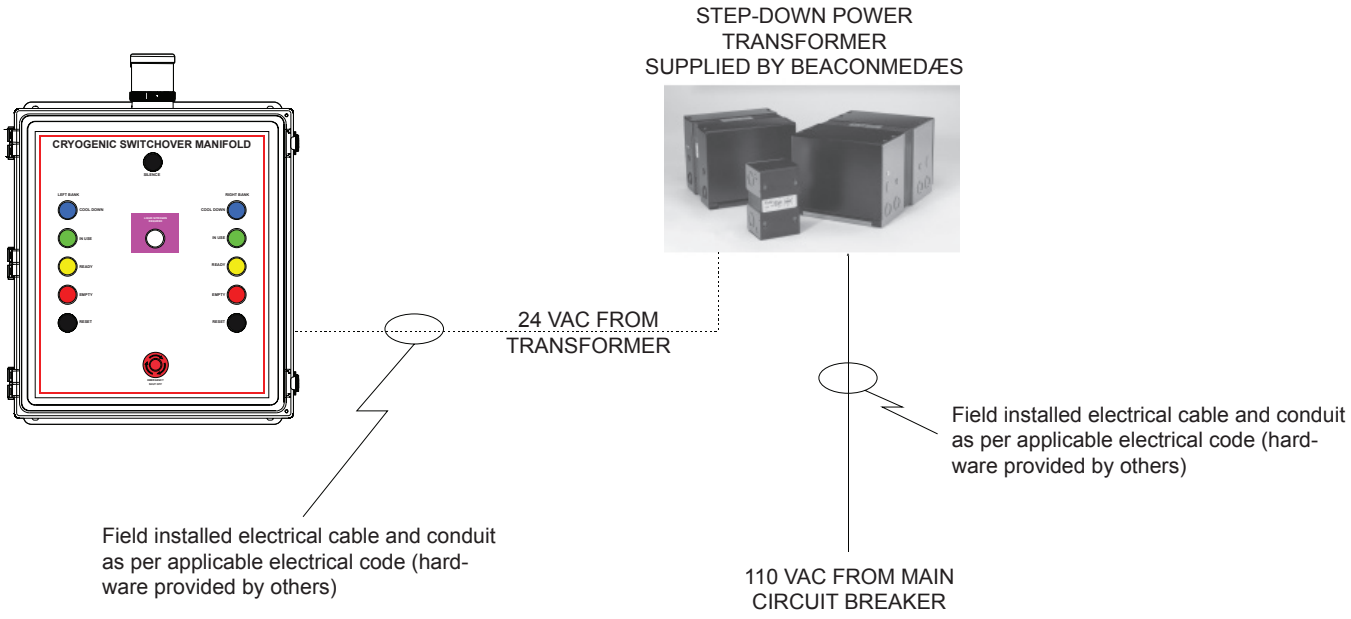
- Ice build-up could be very significant. It will add weight to the piping and proper support must be considered. Ice build-up can also damage the piping itself and adjacent structures such as walls, water pipes and electrical conduits. Finally, ice will melt when the piping is not in use. Water management must be considered.
- The selection of the insulating materials is important. The insulation must be capable of 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 foam 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.

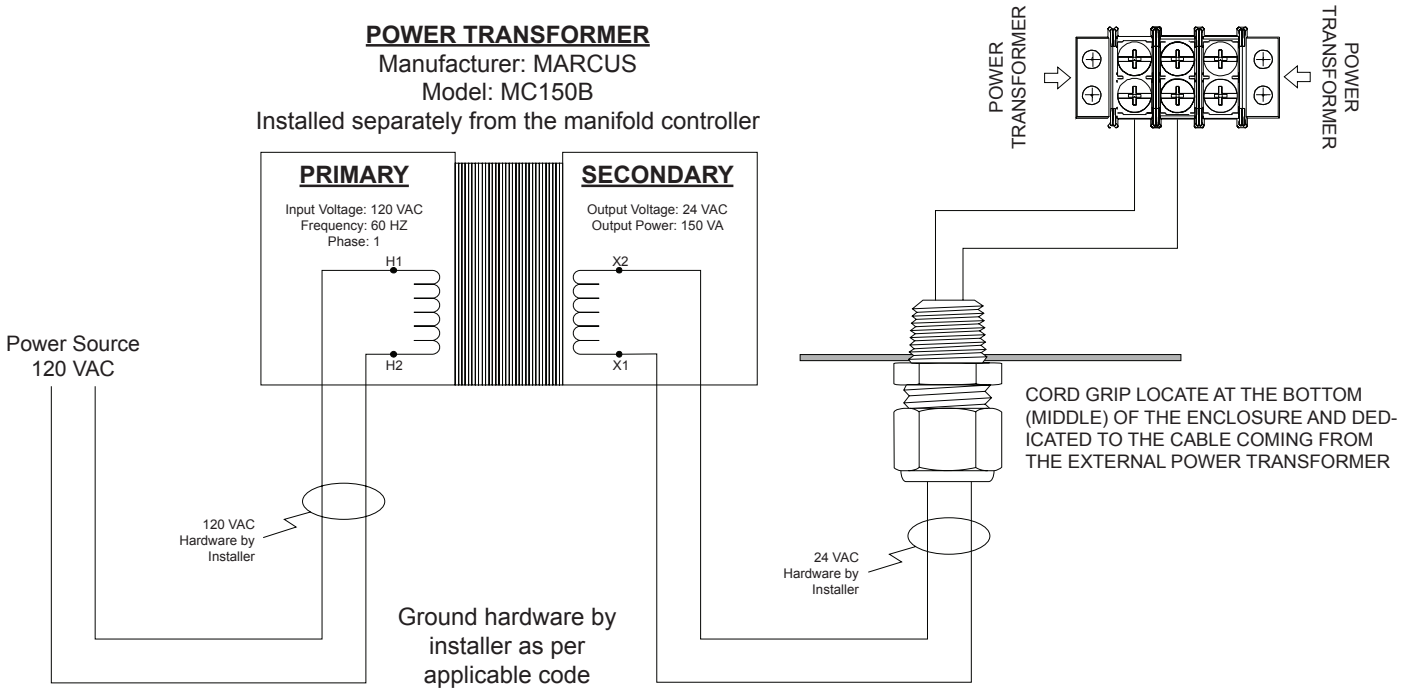
18 - Electrical Installation



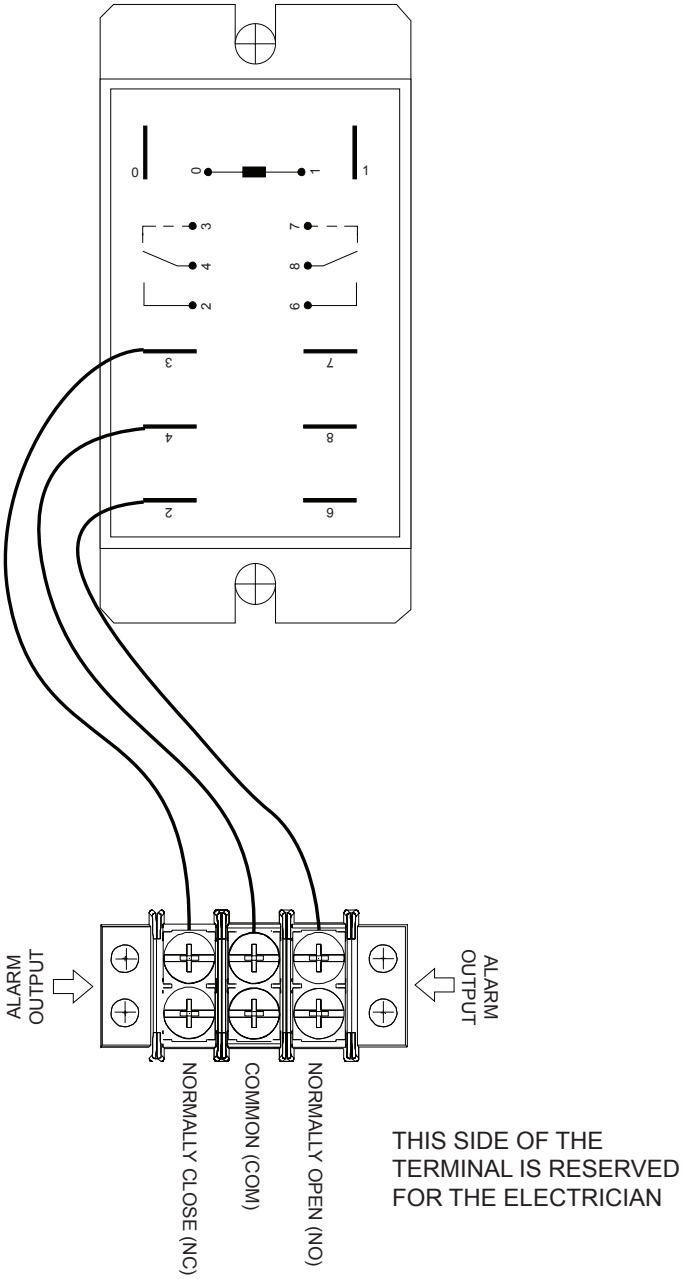
There are two (2) possible electrical connections that can be performed in the field: power supply and the remote alarm signal.

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 manifold 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 above. The hardware required - wires, conduits and related accessories - to connect the power transformer to the control module are to be supplied by others.





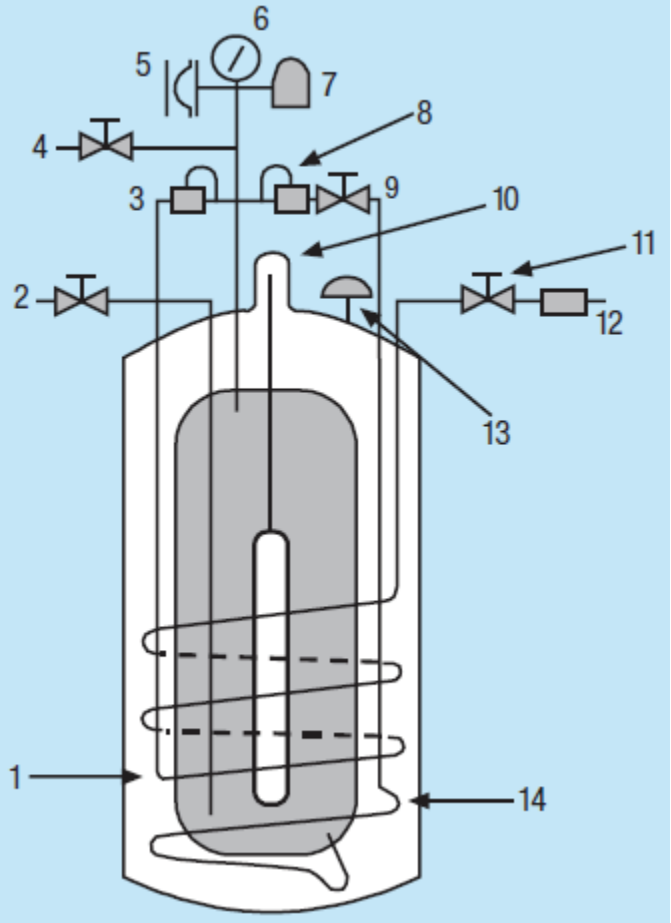
Remote Alarm Connection: The remote alarm signal (to a master alarm box for example) is a dry contact. The CFAM-TX manifold has one (1) N.O., one (1) N.C. and one (1) COM contacts (C-Shape). The SPDT relay will change position when either bank is empty (i.e. when a switchover has occurred). The terminals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

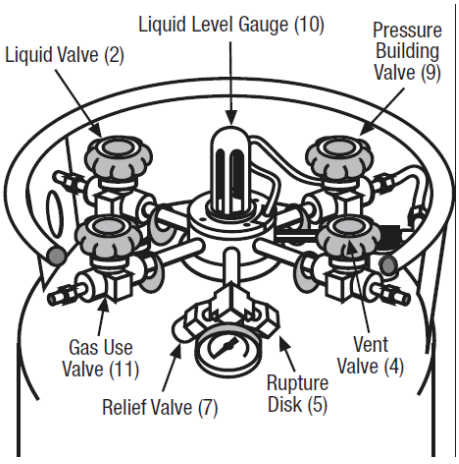


19 - How a Liquid Cylinder Works

This part of the manual is dedicated to explain how a liquid cylinder works in conjunction with the CFAM-TX 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) - Liquid product is withdrawn from the container through the connection controlled by this valve. It has a CGA connection specified for the appropriate cryogenic liquid. The cryogenic liquid feeding the CFAM-TX 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.

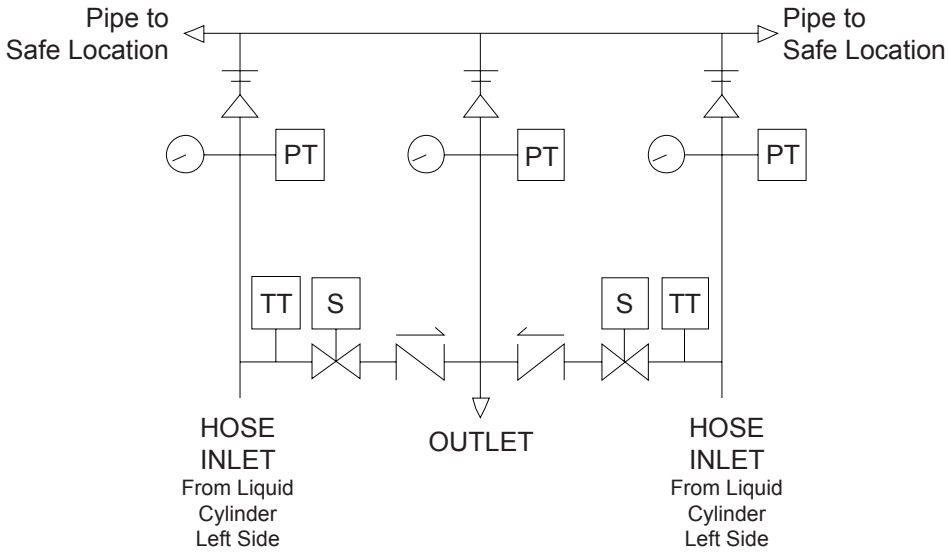
Relief Devices (5) and (7) - To protect the container from over-pressurization, it is equipped with two relief devices. The first is a reseating spring-loaded relief valve that, depending on the setting, will relieve pressure at 22 psig, 230 psig, or 350 psig. The second is a burst disk rated to protect the inner vessel. Never plug, restrict, or remove any relief device. Never attempt to cap or seal a venting relief device in anyway. 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, BeaconMedæs 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 (completely different from the “Liquid Valve” hose and “Vent Valve” 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.

20 - Theory of Operation



Legend

Wetted Parts

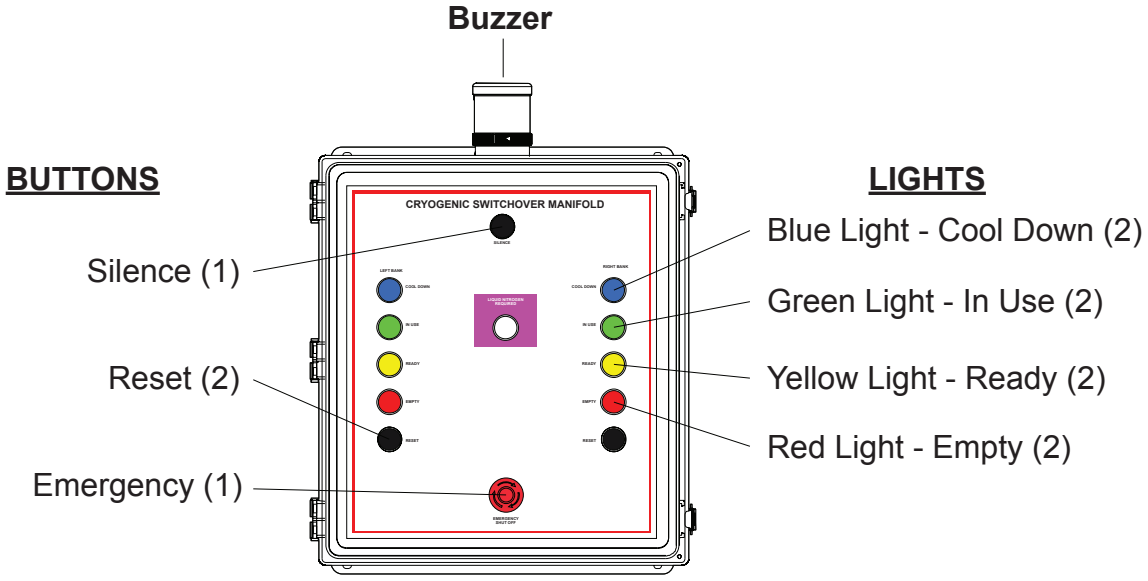
PT Pressure Transmitter

TT Temperature Transmitter

Pressure Gauge

Relief Valve

Check Valve



Audible Signal, Visual Signals and Pushbuttons – Manifold Control Box

MANIFOLD OPERATION

The automatic switchover manifold consists of a manifold box, a control module and two supply banks: one service and one reserve supply, to provide an uninterrupted supply of cryogenic liquid.

This manifold is controlled by a Programmable Logic Controller (PLC). The PLC is located inside the manifold controller enclosure. The PLC is programmed to keep a certain pressure inside the delivery pipeline. The pipeline pressure is sensed by a pressure transmitter that is also located inside the manifold controller enclosure. The pipeline transmitter is connected directly to the PLC. When the pipeline pressure falls under a minimum pipeline pressure MPP (field changeable), the PLC starts the supply cycle sub-program. When the supply cycle starts, the PLC checks the cylinder pressure on both cylinder banks. It will always start from the side that was last in use. If the side that was last in use is empty, it will switch to the other bank. For initial start up, if both sides are connected and pressure is adequate, the manifold will start the supply cycle from the left bank.

The supply cycle is controlled by the PLC. Each left and right banks have one pressure transmitter (located inside the manifold controller enclosure) and one temperature transmitter (installed directly at each manifold inlet). These transmitters relay to the PLC real-time temperature and pressure of the cryogen coming from the each liquid cylinder. Each liquid cylinder needs a minimum cylinder pressure (MCP) to be put into service. The MCP is field changeable. The supply cycle will last a certain time. The duration of the supply cycle is field changeable (factory standard: 90 seconds). During that 90 seconds period, the solenoid valve opens and the PLC will monitor pressure and temperature fluctuations of the cryogen coming from the liquid cylinder in service. At the end of the 90 seconds, the solenoid valve closes and the PLC waits 10 seconds (not field changeable) so that temperature and pressure stabilizes (this is called the cool down cycle). At the end of the cool down cycle and if the MPP is not reached, the PLC will start another supply cycle for another 90 seconds from the same liquid cylinder as long as:

a. there is enough pressure inside the liquid cylinder and;
b. the temperature inside the piping dropped or if the temperature reached -150°C (-238°F)

If neither of these two conditions is reached, the PLC will consider that the liquid cylinder is empty and it will start the other 90-second supply cycle from the other bank.

The PLC will use lights and the buzzer to tell the operator the status of the supply and demand. The best way to easily determine where the PLC is in the supply cycle is to explain the conditions under which each light and buzzer is actuated (see table on next page).

IMPORTANT TO KNOW

Reset Push button - Each time a fresh liquid cylinder has been installed and properly connected, the operator is required to push the reset Push button signifying the manifold controller that a fresh liquid cylinder has been put into service and it is ready for use. 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 Push button fulfills that function).

Minimum Cylinder Pressure (MCP) – The minimum cylinder pressure is the pressure at which the PLC considers the liquid cylinder is empty (factory set at 7 PSIG but it is field changeable). Therefore, when the pressure falls under the MCP, the corresponding red light is energized. When the pressure drops under 2 PSIG, the PLC considers there is no cylinder connected to the manifold. The PLC is programmed to turn off the red light (the liquid cylinder is not empty it is simply not connected). So, if you see no light on any given side, it is normal. Put a fresh liquid cylinder and press on the reset button.

Supply Cycle – When the supply cycle is engaged, a solenoid valve opens for the entire duration of the cycle no matter what (unless the emergency stop button is pushed). If the liquid cylinder gets empty during the supply cycle (or during the cool down cycle), the red light will be energized while either the green light or blue light is also energized. So, if you see several lights lit at the same time during the supply cycle, it is normal. Wait until the supply cycle ends before replacing an empty liquid cylinder by a full liquid cylinder.

Minimum Pipeline Pressure (MPP) – The minimum pipeline pressure is the pressure at which the PLC considers there is a demand. It is normal to see the pink light (clear light in a pink rectangle) extinguished during the supply cycle. It means the flow of cryogen is such that the pressure builds up above the MPP. If the pressure drops below the MPP during the cold down mode, the supply cycle will continue. If the supply cycle starts and you know there is no demand for liquid nitrogen in the pipeline. That means the pressure drops in the pipeline. Please seek for leaks in the pipeline, the manifold or liquid cylinder and repair rapidly (never repair a leak when the system is under pressure).

WARNING

DON'T FORGET! The PLC is programmed to keep the pressure at the minimum pipeline pressure. So, when the system is first energized during start-up, the pipeline pressure will be lower than the MPP. The manifold will lit the red lights first even if you have two liquid cylinders properly connected. As a safety feature, you will be requested to push the reset buttons. If you push on the reset buttons, the supply cycle starts and cryogenic liquid will come out of the manifold.

BE SURE THE PIPELINE IS READY TO BE PUT IN SERVICE
(cryogenic liquid will not spill on the floor or fill freezers that are not ready).

The Pressure Cascades from One Bank to the Other – It is normal primarily with 22-PSI manifolds. The materials used in cryogenic grade equipment have to be extremely resistant. The only soft material that resist to cryogenic temperature is Teflon. Teflon being a plastic, it hardens quite a bit which make the Teflon to shrink and therefore allows molecules to finds its way through check valve and solenoid valves seats. Because the leak is slow, the pressure will get to normal conditions once the supply cycle begins.

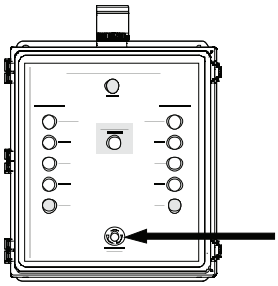
The Pressure Gauges Go Up and Down During the Supply Cycle– Unfortunately, it is normal with some 22-PSI manifolds. There might be a normal "water-hammer" effect when the gaseous/liquid nitrogen rushes through the hoses and piping and hit the thermal expansion pressure relief valves. This phenomena causes the thermal expansion pressure relief valves to momentarily open which rapidly brings the pressure down (then cycle repeat). The pressure will gradually stabilize over after a couple of seconds into the supply cycle.

DESCRIPTION OF VISUAL AND AUDIBLE SIGNALS AND PURPOSE OF PUSH BUTTONS

BUZZER	• The buzzer is actuated when a liquid cylinder becomes empty (i.e. when a red light is lit). • The buzzer can be silenced by pushing the silence pushbutton.
SILENCE PUSH BUTTON	• The silence push button kills the buzzer when pressed. • The red lights do not extinguish when the push button is pushed.
PINK LIGHT CLEAR LIGHT INSIDE A PINK RECTANGLE (CRYOGEN IN DEMAND)	• The pink light indicates that the pressure inside the pipeline is lower than the minimum pipeline • pressure (MPP). • The MPP is field changeable.
BLUE LIGHT (COOL DOWN)	• The blue light is lit when the supply cycle is in Cool Down mode. • The solenoid valve is closed • This is the time allowed to the temperature transmitter to reach the real fluid temperature. • A blue light does not mean the end of the supply cycle. • The cool down cycle is preset and not field changeable at 10 seconds.
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. • Furthermore, a green light and a yellow light cannot be lit at the same time on the same bank side. • A green light primarily means that the solenoid valve is opened.
YELLOW LIGHT (READY)	• A yellow light indicates that the liquid cylinder pressure is adequate (above the MCP) but the liquid cylinder on that manifold side is not in service. • Both yellow lights (one per bank) can be lit at the same time if there is no demand.
RED LIGHT (EMPTY)	• A red light indicates a low pressure that can be caused by one of the following conditions: - a depleted liquid cylinder - if applicable, a closed pressure building valve (the liquid cylinder may or may not be empty) - the liquid withdrawal was such that the pressure of the liquid cylinder dropped below the minimum cylinder pressure (MCP) - Between 0 and 2 PSI, the red light extinguishes signifying that there is no liquid cylinders connected to the manifold. - Between 2 and the MCP, the red lights will be energized. - Above the MCP, the red light is not energized.
RESET PUSH BUTTON	• The purpose of the reset push button 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 push button is not pushed even if the hose is connected, valves are opened and the pressure 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 push button has to be pushed. • During initial startup, both red lights will lit if the liquid cylinders are connected. Push on both reset buttons to put the liquid cylinders in service.
EMERGENCY STOP	• The emergency stop kills the power to the entire manifold: - The PLC and all the lights are un-energized - The solenoid valves close • TO RE-ENERGIZE THE MANIFOLD, PULL AND TURN THE EMERGENCY PUSH BUTTON. • Please allow few seconds for the PLC to load up the program and start running.

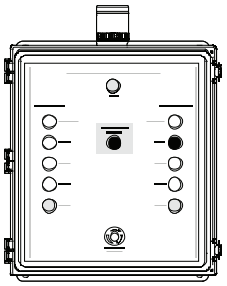
21 - Message Center

This section of the manual shows you SOME possible “light configurations” you can see with the CFAM-TX 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. To “reset” a liquid cylinder bank side, push on the reset button.



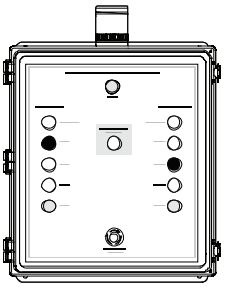
NO LIGHTS
NO BUZZER

POWER IS OFF
OR THE EMERGENCY
BUTTON HAS BEEN
PUSHED



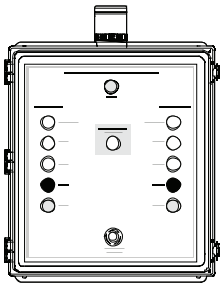
PINK LIGHT (DEMAND)
IS LIT

LEFT BANK HAS NO CYLINDER CONNECTED
RIGHT BANK IS IN USE



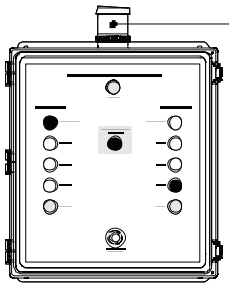
PINK LIGHT MAY OR MAY
NOT BE LIT DURING WHEN
THE GREEN LIGHT IS LIT.

LEFT BANK IN USE
RIGHT BANK READY



NO DEMAND
(NO PINK LIGHT)

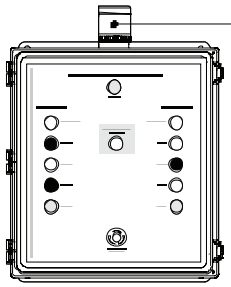
LEFT BANK EMPTY
RIGHT BANK EMPTY



BUZZER IS ACTUATED
BECAUSE RIGHT BANK IS
EMPTY

LIQUID NITROGEN IS
REQUIRED IN THE PIPELINE

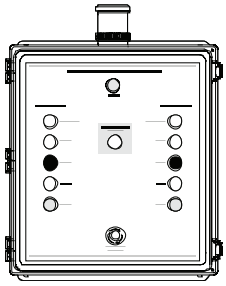
LEFT BANK IN COOL DOWN MODE
RIGHT BANK IS EMPTY



BUZZER IS ACTUATED
BECAUSE LEFT BANK IS
EMPTY

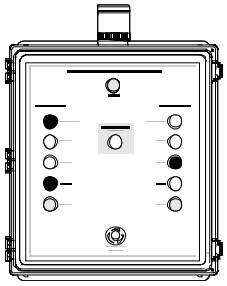
LIQUID NITROGEN IS
REQUIRED IN THE PIPELINE

LEFT BANK IS IN USE BUT EMTPY
RIGHT BANK IS READY



NO DEMAND IN THE
PIPELINE

LEFT BANK IS READY
RIGHT BANK IS READY



NO DEMAND IN THE
PIPELINE

LEFT BANK IS IN COOL DOWN MODE BUT EMPTY
RIGHT BANK IS READY

22 - Putting a Liquid Cylinder into Service

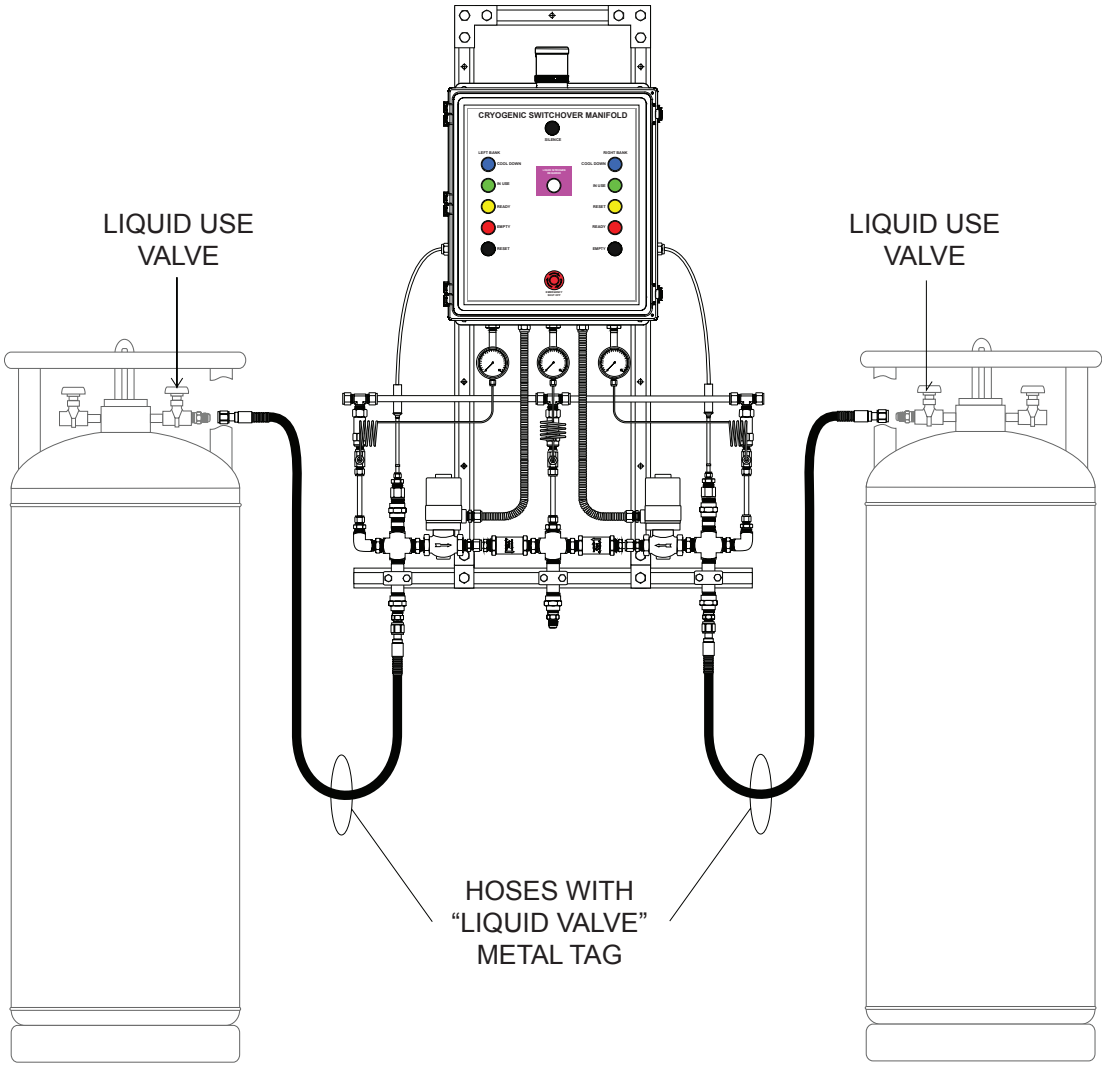
Two (2) hoses are normally provided with the CFAM-TX manifolds. This section of the manual is to provide you with the proper instructions not only on how and where to connect the hoses to the liquid cylinders but also to give you important instruction on how to put a liquid cylinder into service. This 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. The liquid transfer hoses are connected to the inlets of the manifold located (see schematic below).

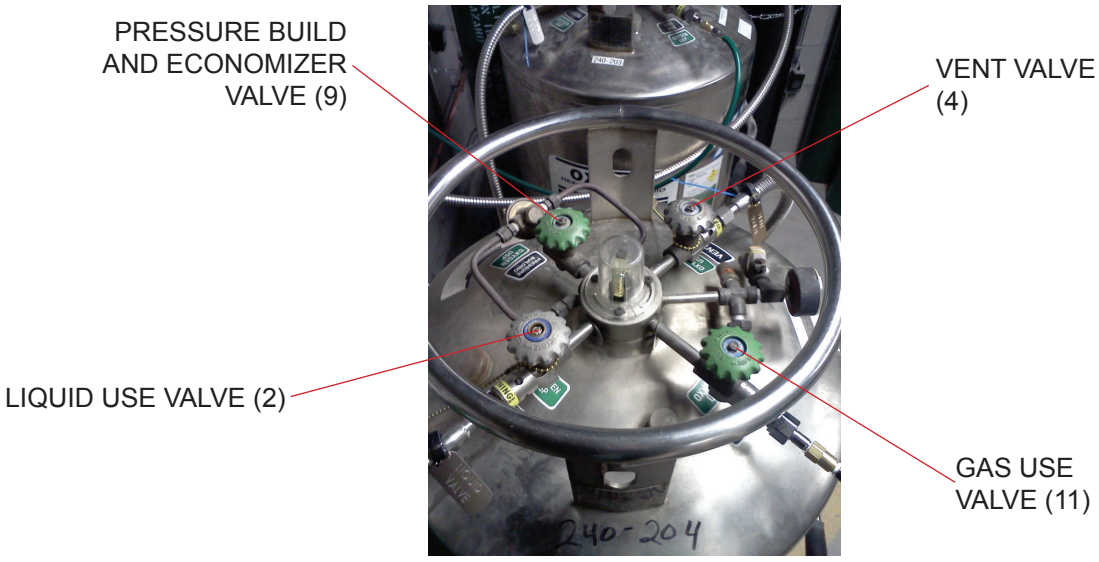
Procedure

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 Valve” 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. Push the reset pushbutton on the manifold controller for the bank side you want to put into service.
7 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 (always use cryogenic gloves when handling cold equipment and valves – a face shield is required to disconnect the liquid hose – Step 23):

8. Close (turn off) the liquid use valve (2).
9. 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 unlikely 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.
10. Remove the empty cylinder.
11. Put a fresh liquid cylinder in place and start from Step 1.

23 - 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.

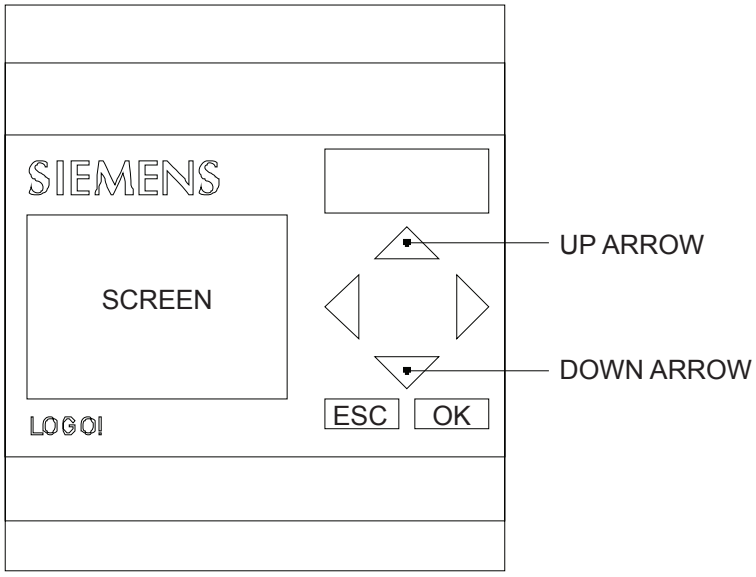
The Liquid Cylinder is "Singing" – When the "Liquid Use" valve is open and the pressure is building up in the system, you will hear some kind of high pitch sound coming from the liquid cylinder. It is normal as this sound will diminish and/or stop once the pressure is equalized and the cryogenic liquid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

24 - Adjusting Some Operating Conditions



The CFAM-TX manifold is controlled by a programmable logic controller (PLC). The PLC is located inside the manifold enclosure. Some operating conditions (parameters) that can be changed in the field:

- Minimum Pipeline Pressure
- Minimum Cylinder Pressure (Right Bank)
- Minimum Cylinder Pressure (Left Bank)
- Supply Cycle

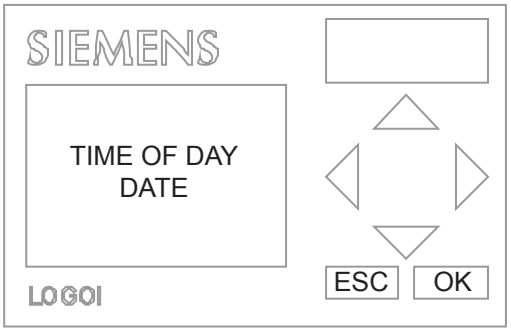
The PLC also allows you to view (only) in real-time the five (5) analog transmitters of the manifolds:

- Temperature (Right Bank)
- Temperature (Left Bank)
- Pressure (Right Bank)
- Pressure (Left Bank)
- Pressure (Pipeline)

NAVIGATING BETWEEN SCREENS

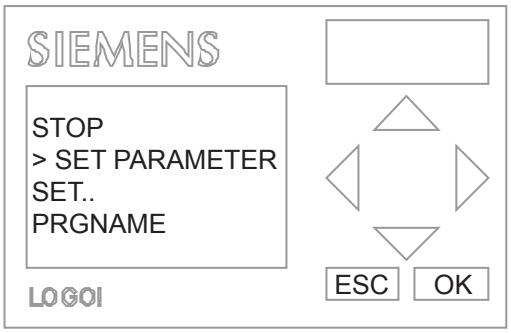
To change any parameter, select the required parameter menu and press OK. A dark arrow will appear. Move the cursor using LEFT/RIGHT arrows. Change values using UP/DOWN arrows. When the changes are made, press OK. Press ESC to exit any screen.

Main Screen



- This is the default screen when the PLC is running normally
- It displays the time of day and the date
- Press ESC to access the MENU SCREEN

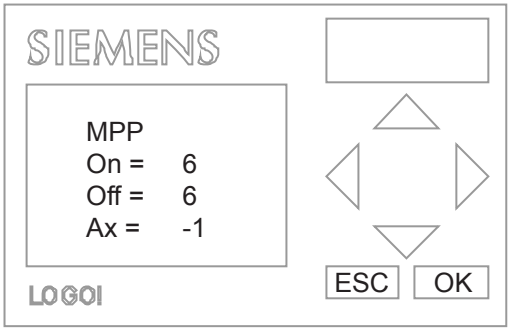
Menu Screen (Navigation Only)



- STOP = This will stop the program to run. Don't stop the program from running by yourself. Consult the factory for assistance.
- SET PARAMETERS = This is the sub menu that directs you to the parameters that can be changed in the field.
- SET = Access the menu to change time and date
- PRGNAME = Not for end user to access

To access any of the menu item, move the up or down arrows keys and press OK.

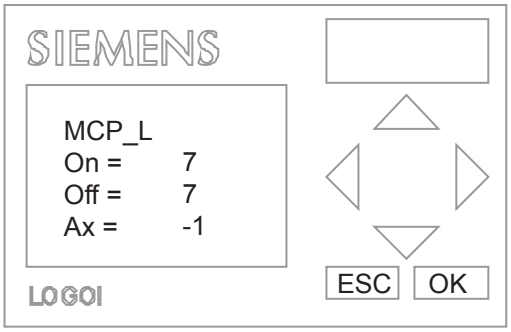
Minimum Pipeline Pressure Screen (Field Changeable Operating Condition)



- The minimum pipeline pressure is the pressure at which the supply cycle starts.
- It is field changeable from 2-22 PSIG.
- Factory setting: 6 PSI
- Make sure that both ON and OFF are the same value.
- AX must remain at -1 (DO NOT CHANGE)

Use the arrow keys to navigate. Press OK when done.
Tip: The MPP must be lower than the MCP.

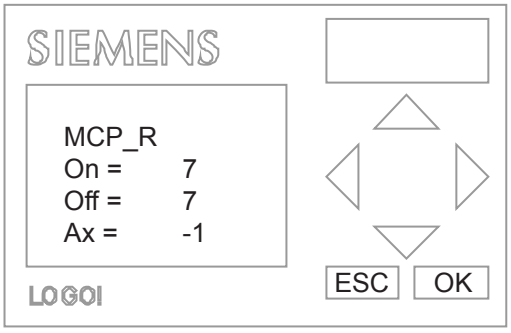
Minimum Cylinder Pressure - Left Screen (Field Changeable Operating Condition)



- The minimum liquid cylinder pressure (left bank) is the pressure at which the PLC considers a liquid cylinder is empty (or too low in pressure)
- It is field changeable from 2-22 PSIG.
- Factory setting: 7 PSI
- Make sure that both ON and OFF are the same value.
- AX must remain at -1 (DO NOT CHANGE)

Use the arrow keys to navigate. Press OK when done.
Tip: The MCP must be higher than the MPP.

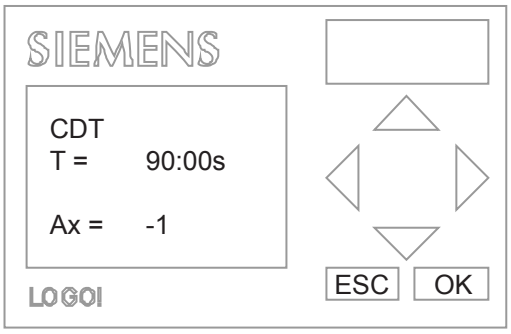
Minimum Cylinder Pressure - Right Screen (Field Changeable Operating Condition)



- The minimum liquid cylinder pressure (right bank) is the pressure at which the PLC considers a liquid cylinder is empty (or too low in pressure)
- It is field changeable from 2-22 PSIG.
- Factory setting: 7 PSI
- Make sure that both ON and OFF are the same value.
- AX must remain at -1 (DO NOT CHANGE)Use the arrow keys to navigate. Press OK when done.

Tip: The MCP must be higher than the MPP.

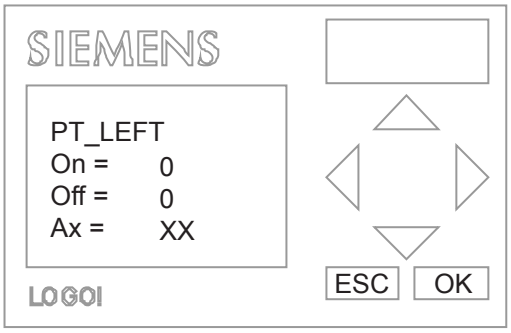
Supply Cycle / Cool Down Time Screen (Field Changeable Operating Condition)



- This screen allows you to determine the duration of the supply cycle.
- It is field changeable
- Factory setting: 90:00 seconds
- AX must remain at -1 (DO NOT CHANGE)

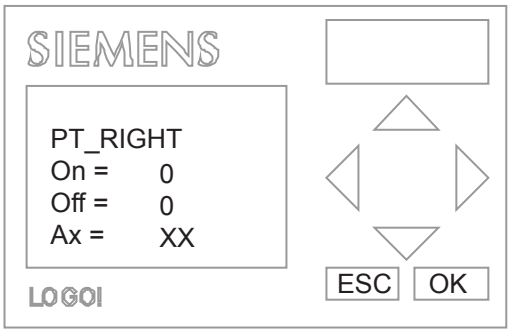
Use the arrow keys to navigate. Press OK when done.
Tip: A short cycle signifies a quicker way for the system to switchover from a depleted liquid cylinder to a full liquid cylinder. But, it can also lead to a longer supply cycle if the demand is small as it will add up several cool down cycles of 10 seconds.

Pressure Transmitter – Left (Read-Only Screen)



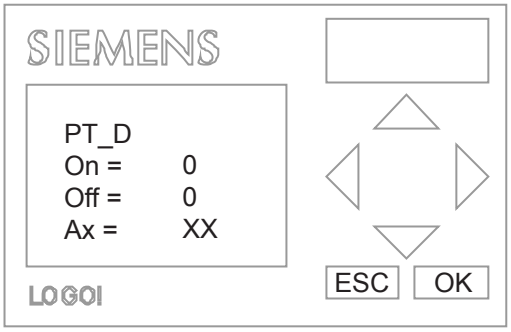
- The real-time pressure of the left bank will be displayed beside AX=
- The value is displayed in PSIG
- This value could be slightly different than the pressure you read on its corresponding pressure gauge under the manifold box. This pressure transmitter is considered being more accurate than the mechanical pressure gauge.

Pressure Transmitter – Right (Read-Only Screen)



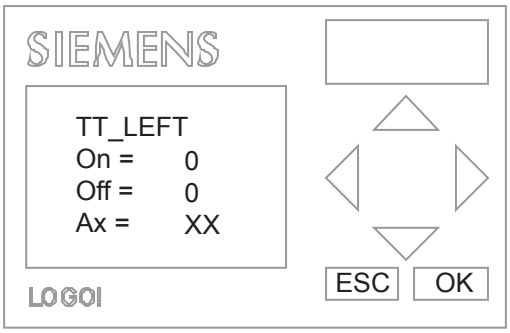
- The real-time pressure of the left bank will be displayed beside AX=
- The value is displayed in PSIG
- This value could be slightly different than the pressure you read on its corresponding pressure gauge under the manifold box. This pressure transmitter is considered being more accurate than the mechanical pressure gauge.

Pressure Transmitter – Demand (Read-Only Screen)



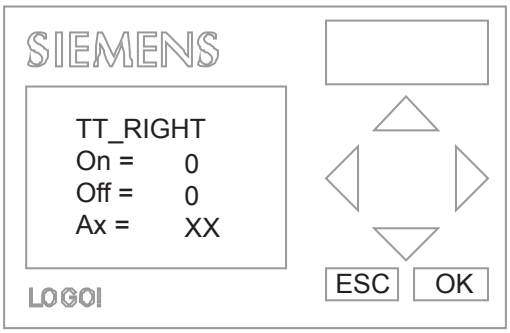
- The real-time pressure of the left bank will be displayed beside AX=
- The value is displayed in PSIG
- This value could be slightly different than the pressure you read on its corresponding pressure gauge under the manifold box. This pressure transmitter is considered being more accurate than the mechanical pressure gauge.

Temperature Transmitter – Left (Read-Only Screen)



- The real-time temperature of the left will be displayed beside AX=
- The value is displayed in degrees Fahrenheit

Temperature Transmitter – Right (Read-Only Screen)



- The real-time temperature of the left will be displayed beside AX=
- The value is displayed in degrees Fahrenheit

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 switchover leaks or malfunctions, take it out of service immediately. Repairs should be made only by BeaconMedæs with the special tools, test equipment and trained personnel required to make a safe repair. Tampering with the switchover manifold voids the warranty. Please contact BeaconMedæs 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 BeaconMedæs 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 compressed gas systems. BeaconMedæs 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 hazardous gases employed in these processes, misapplication could result in injury or death. BEACONMEDÆS 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 inert, combustible, corrosive, toxic, or oxidizing gases can fail in various modes. The system designer is warned to consider the failure modes of all component parts used with the above mentioned gases 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 BeaconMedæs. BeaconMedæs' 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, BeaconMedæs 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.

Trademarks used in our instruction manual include:

Buna-N, Delrin, Kalrez, Teflon, Tefzel, Vespel, Viton and
Viton-A are trademarks of E.I. DuPont de Nemours & Company
Monel is a trademark of Inco Alloys International, Inc.
Kynar is a trademark of Atochem North America, Inc.
Snoop is a trademark of Nupro Company
Swagelok is a trademark of Crawford Fitting Company
Hastelloy is a trademark of Union Carbide Corporation
VCR is a trademark of Cajon Company

BeaconMedæs
1800 Overview Drive
Rock Hill, SC 29730 USA
Tel.: 888.4MEDGAS (463.3427)
www.beaconmedæs.com

Printed in U.S.A.
November 2014
Instruction Manual: RB-CFAM-TX-3433