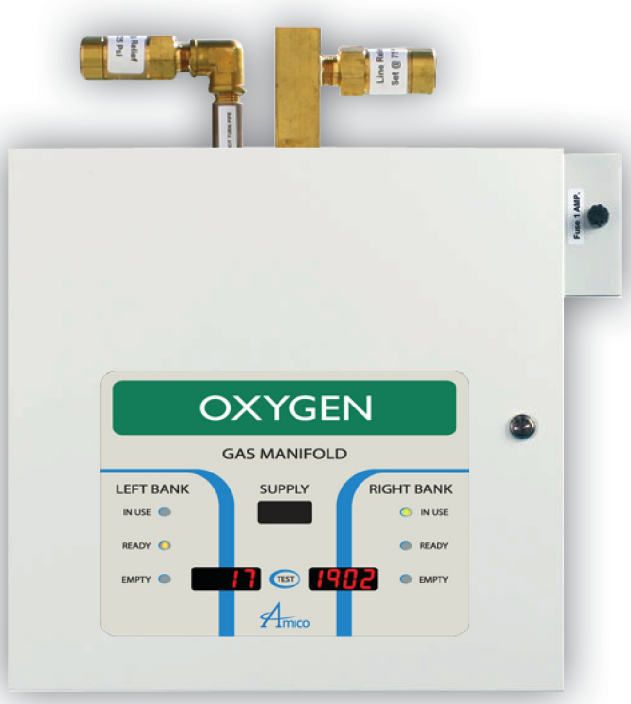
Operating & Maintenance Manual

Microprocessor Based Digital Manifold Alert-2 v6.0



Amico

www.amico.com

Contents

User Responsibility

The information contained in this Installation and Maintenance Manual, pertains only to the ALERT-2 microprocessor based digital manifold. This product will perform in conformity with the descriptions contained in this manual when assembled, operated, maintained and serviced in accordance with the installation instructions provided

The manifold MUST be checked periodically. Parts that are broken, missing, worn, distorted or contaminated, must be replaced immediately. Should such repair or replacement become necessary, please contact Amico Corporation or their distributors.

Installing CO2 and N2O manifolds outdoors. Please refer to NFPA 99C Central supply systems for nitrous oxide and carbon dioxide shall be prevented from reaching temperatures lower than the recommendations of the central supply system's manufacturer, but shall never be lower than -7°C (20°F) or greater than 54°C (130°F).

All Manifolds should not be repaired or altered without prior written approval by Amico Corporation or it's distributors. Failure to comply will void all warranty on the manifold.

Statements in this manual preceded by the words **WARNING, CAUTION, DANGER** and **NOTE** are of special significance. Please read these sections carefully.

WARNING: denotes steps which can prevent injury.

CAUTION: denotes steps which can prevent damage to equipment.

DANGER: denotes steps which can prevent electrical shock to equipment or to prevent serious injury and/or death.

Introduction

The AMICO digital medical gas manifold (ALERT-2) incorporates the latest microprocessor technology for the monitoring of medical gases. The manifold has been designed to provide user flexibility and reliability. This manual will enable the customer to install, use and maintain the manifold properly.

The amount of medical gas contained in the left or right banks is displayed on the face of the manifold cabinet. A digital display with large red LED's for clear visibility is provided to show the cylinder bank pressure in use and cylinder bank pressure in reserve at all times.

Under normal operating conditions, the green LED will be illuminated on the Primary In Use side. The Reserve bank will have an Amber LED illuminated on the Bank Ready side. If the gas cylinder pressure depletes on the primary side, an automatic switch-over will occur, rendering the reserve side in use to be illuminated and activated.

An alarm condition will occur when switch-over takes place, sending a signal to a master alarm or a remote buzzer, then causing the Red LED Bank Empty to be illuminated. This will inform the hospital personnel that the reserve side is in use and the empty cylinders need replacement

FEATURES INCLUDE:

- Fully automatic self-contained shuttle-valve, with no electrical power required for switching.
- Input power 110 VAC to 240 VAC, 50 to 60 Hz.
- Microprocessor based control panel incorporates six LED's and illuminated digital LED display readable even in poor lighting conditions.
- Error message display for ease of maintenance.
- Pressure transducer for monitoring of cylinder pressure.
- Switch for (psi / kPa / BAR).
- Two limit switches for positive indication of bank in use.
- CGA gas specific header bar with integral check valves and cylinder pigtail assemblies.
- Dual line pressure regulators.
- High pressure header isolation valves.
- Manifold complies with NFPA-99.

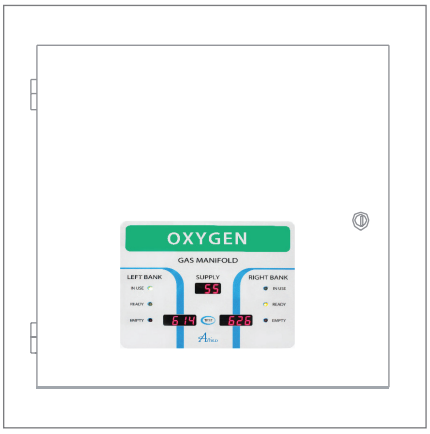
Description of Manifolds

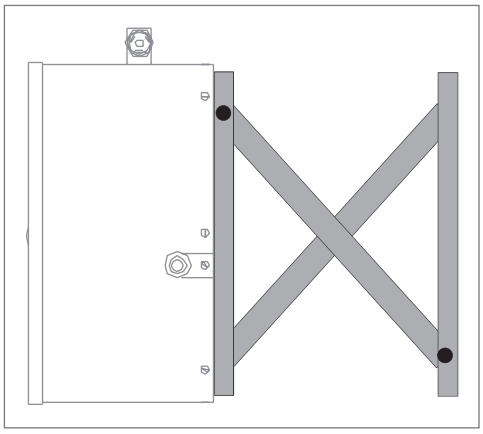
SHIPMENT DETAILS
The package consists of one fully tested Alert-2 Series Manifold and a 3/4" isolation source valve. Optional back support bracket, header bar assemblies, and pigtails are available.

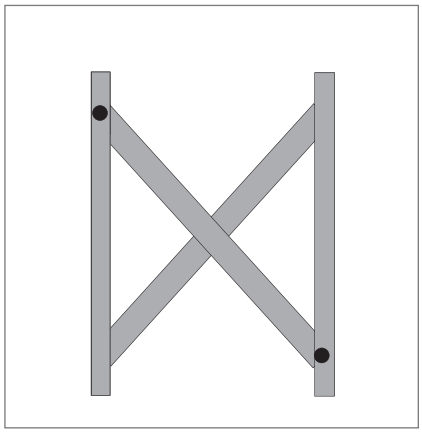
THE MANIFOLD ENCLOSURE
The Manifold enclosure contains the Switching Power Supply (110 to 240VAC) with a built-in fuse and terminal blocks. The enclosure on a standard manifold is NEMA-1 (General purpose applications only). The standard cabinet MUST NOT be mounted outdoors. An optional NEMA-4 (Water tight) enclosure must be used.

The Manifold also has a hinged door that has a pre-assembled circuit board located on the front of the enclosure. This design will reduce installation time and eliminate the risk of improper installation, since all the components of the manifold are connected and tested at the factory.

THE COLLAPSIBLE BACK BRACKET (Optional)
The collapsible back bracket is designed to take up minimal space when requested to be shipped with the manifold. The bracket will position the manifold cabinet 12" from the wall, for double cylinder spacing.

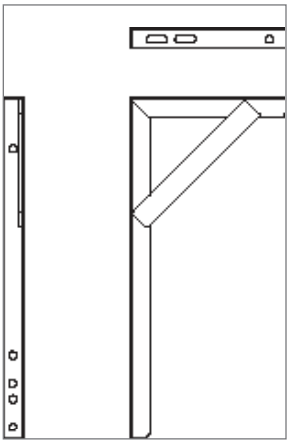






HEADER BAR WALL SUPPORT BRACKET
The manifold can support, at maximum, a 5 X 5 staggered header bar. While the straight header bar contains a wall support bracket on every second pipe in between each cylinder, a standard staggered header bar has a wall support bracket in place after every 4-5 cylinders, unless additional support is requested.

NOTE: The wall support bracket is designed to accommodate only those header bars that are directly mounted to the wall or one foot (12") away from the wall.



Description of Parts

The ALERT-2 manifold is divided into (4) main sections:

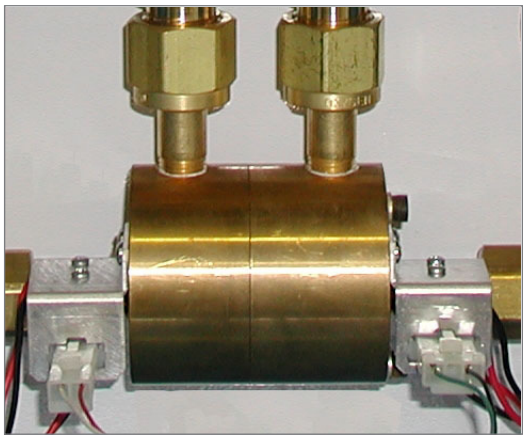
COMMON TO ALL MANIFOLDS

1. SHUTTLE VALVE ASSEMBLY

The shuttle valve assembly has been designed to facilitate the automatic switch-over from bank to bank. The shuttle valve is the heart of the manifold and forms the centre of the control apparatus to ensure uninterrupted flow of gas without change in the delivery pressure.

When the operating bank pressure falls to a predetermined level, the difference in pressures acting on either side of the shuttle valve causes change-over to the reserve cylinder bank.

Amico has two different types of shuttle valves:



Diaphragm type (LOW Pressure)
This shuttle valve consists of a machined brass body, in two halves. There are two threaded inlet connections and two outlet connections (nut and nipple CGA-540).

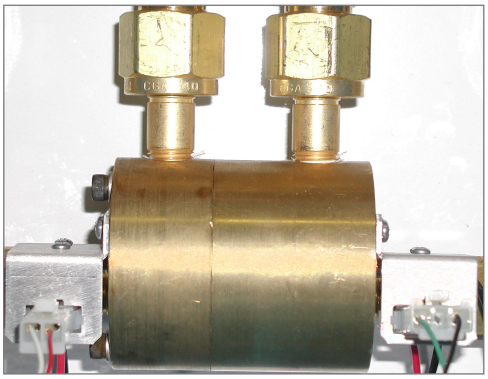
The shaft assembly consists of a stainless steel shaft and a nylon reinforced neoprene diaphragm, which is sandwiched between two seat plates. Neoprene seats are held against these plates by seat washers secured by nuts. The shaft assembly fits into the chamber formed by the body halves, which bolt together and squeeze the diaphragm sealing one side from the other.

The shaft is free to move from side to side with the diaphragm flexing back and forth. When pressure is introduced from one side, the shaft assembly takes up it's initial position with the pressurized side open. As the same pressure is allowed into the closed side, the shaft remains in the same position since the pressure acts on a reduced diaphragm area, which does not provide sufficient force to cause switch-over.

When the operating side pressure falls to a specific pressure, the force on the closed side overcomes the force on the open side and the shuttling occurs changing the supply from one bank to the other. The change in shaft positions is detected by limit switches, which signals the microprocessor that change-over has occurred.

Piston Type (HIGH Pressure)

The high pressure shuttle valve used for Nitrogen service is basically the same as the low pressure one, except for the replacement of the diaphragm shaft assembly by a piston shaft assembly.



Instead of squeezing a diaphragm between the two body halves to form the two pressure chambers, the sides are separated by an O-RING seal around the circumference of a piston. The piston shaft assembly slides back and forth in the cylinder bore, as shuttling occurs.

In both types of shuttle valves, the gas is delivered to them from one of the two operating pressure regulators upstream. Once passing through the shuttle valve, the gas goes to one of the line pressure regulators, which is capable of maintaining a constant delivery pressure despite the fluctuating inlet pressure caused as one bank becomes empty and the next takes over.

2. PRESSURE REGULATORS

There are two types of regulators in the Amico manifold: The Operating pressure regulator and the Line pressure regulator. Both types conform to NFPA 99.

Operating (Source) Regulators

There are two operating regulators on every manifold, one for the left bank and one for the right bank. The regulators are factory preset for Oxygen, Nitrous Oxide, Carbon Dioxide and Medical Air service @ 150psig [1034 kpa]. For Nitrogen service, the regulators are set at 275 psig [1896 kPa].

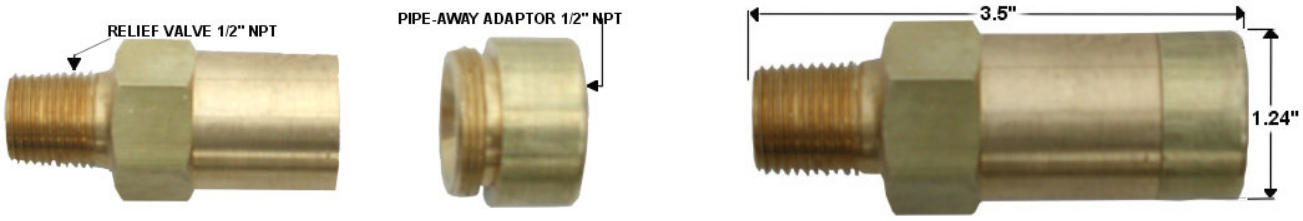
Line Regulators

There are also two line regulators on every manifold (unless a single line manifold is specified at the time of order the line regulator is capable of maintaining a constant dynamic delivery pressure at the maximum designed flow rate of the system. The regulators are factory preset for Oxygen, Nitrous Oxide, Carbon Dioxide and Medical Air service at 55psig [379kpa]. For Nitrogen service, the regulators are set at 170psi [1172 kpa].

3. PRESSURE RELIEF VALVES

Pressure relief valves are installed downstream of all pressure regulators and are set at no more than 50% above the setting of the pressure regulator located immediately upstream. All pressure relief valves are capable of fully relieving the pressure at the set point and are upstream of any shut-off valve.

All pressure relief valves in the manifold have piping connections to allow for connection of vent lines to the outside of the facility.



Relief pressure settings vary with gas service as follows:

	Oxygen	Carbon Dioxide	Nitrous Oxide	Medical Air	Nitrogen	Liquid by Liquid Oxygen	Liquid by Liquid Nitrogen
Line Pressure Relief Valve	75 psi [517 kPa]	75 psi [517 kPa]	75 psi [517 kPa]	75 psi [517 kPa]	225 psi [1551 kPa]	75 psi [517 kPa]	225 psi [1551 kPa]
Operating Pressure Relief Valve	225 psi [1551 kPa]	225 psi [1551 kPa]	225 psi [1551 kPa]	225 psi [1551 kPa]	375 psi [2586 kPa]	375 psi [2586 kPa]	375 psi [2586 kPa]

4. PRESSURE TRANSDUCER

Pressure transducers monitor the supply pressure of a gas coming into the manifold cabinet. The gas pressure is converted into a signal that is transferred onto the digital LED front display. There are two transducers in the manifold cabinet, one for the left and one for the right pressure bank.

CONTROL COMPONENTS

The Amico manifold qualifies as a "Cylinder System Without Reserve Supply" as classified in NFPA 99. This is one category of the broader classification "Central Supply System" which encompasses many types of sources of supply to non-flammable medical gas piping systems. As such, the Amico manifold is comprised of two banks of cylinders which alternately supply the pipeline, each having various control components. When the primary bank is exhausted, the secondary takes over automatically.

WARNING SYSTEM COMPONENTS

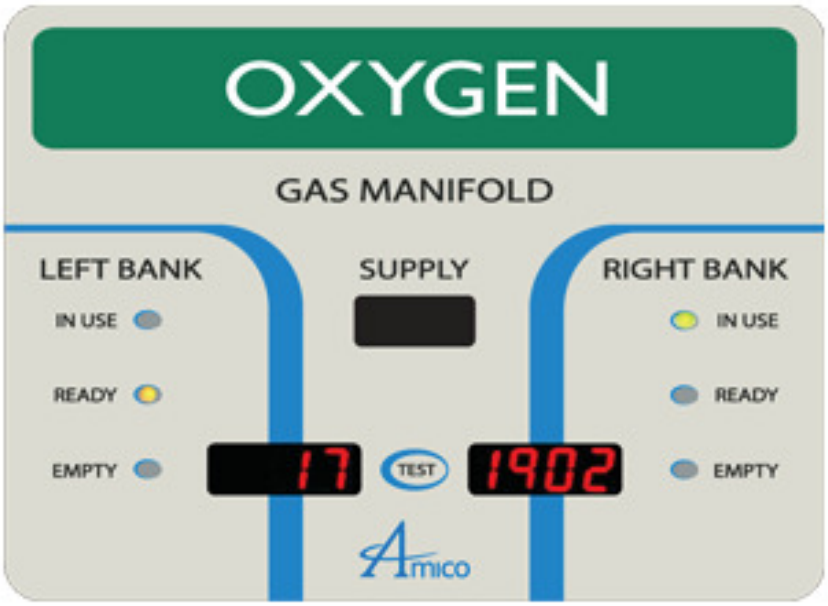
Forming an integral part of the Amico manifold control cabinet are a number of components whose function is to give continuous visual information as to the state of operation of the system.

1. **Bank Change-Over Indicators**

LED's on the face of the manifold are controlled by the microprocessor. The microprocessor interprets the various input signals (pressure in gas cylinders and bank switch-over), converting the information into a digital display.

The pressure coming into the manifold is measured by the pressure transducer. The transducer sends a signal to the microprocessor which then converts the signal to a digital display on the left or right bank.

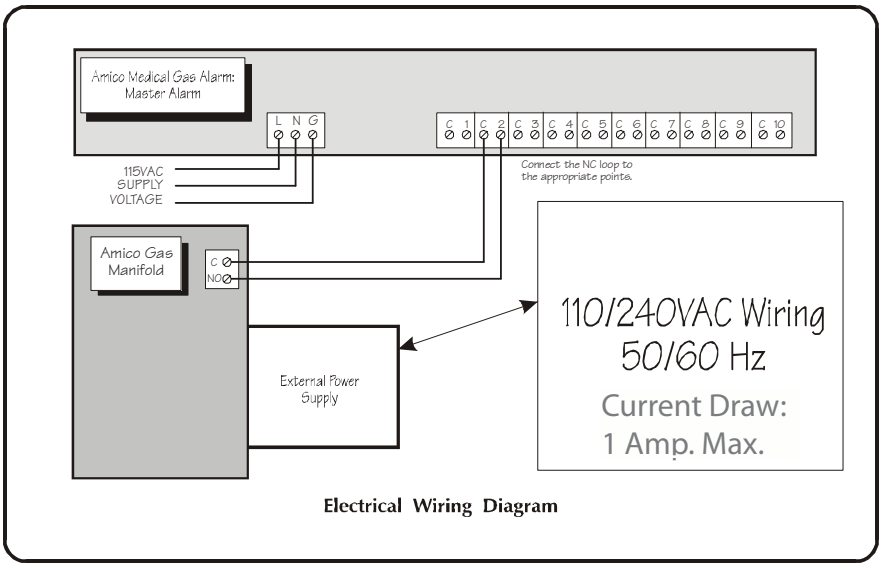
As the shuttle valve changes position (pressure controlled, not microprocessor controlled) from left bank to right bank, the limit switch is activated. This causes a signal to be sent from the limit switch to the microprocessor. The signal controls the status LED's of the left or right bank (in use, ready, empty) and relay for remote monitoring.



OPERATING ALARM SYSTEMS

Operating alarm systems are mandatory according to NFPA 99. Amico supplies a complete range of operating alarm units which can be used in conjunction with the Amico manifold to provide the required visual and audible signals, in suitable locations, when change-over from the primary supply to the secondary supply occurs.

The manifold control cabinet contains the required circuitry to send a dry contact signal to the alarm unit when a bank is empty and change-over occurs. The normally closed internal circuitry is designed to alarm when there is an open circuit. The depletion of a bank triggers a relay, which renders the alarm circuit open and initiates the alarm signal.



Electrical Wiring Diagram

SAFETY FEATURES

Gas Service Identification

Amico manifolds are clearly labelled for the gas that they are intended to be used for. A large nameplate, indicating the appropriate gas is attached on the cabinet door. The two pipes extending from the top of the cabinet, one for main line pressure and one for the operating pressure relief, are labelled.

Function Identification

The indicator LED's on the door are clearly marked to explain their function.

Cylinder Connections

The Amico manifold is designed to assure that only cylinders containing the proper gas, can be connected to it. All cylinder extension bar connections as well as pigtail hose assemblies, comply with CGA Standard B96, "Compressed Gas Cylinder Valve Outlet and Inlet Connections".

UL Listing

The Amico manifold is cULus Listed (UL SA9906).

Installation

RECEIPT AND LOCATION

The Amico manifold should be carefully examined upon receipt. If any damages are found, a claim should be filed with the transport company and Amico Corporation.

Any authorized dealers and distributors should also be notified immediately.

ASSEMBLY INSTRUCTIONS

Wall Mounting Instructions

The Amico manifold is shipped in a semi-assembled condition to facilitate packaging and installation.

Position the collapsible manifold support wall bracket (optional) onto the wall.

Mark the holes, drill and attach suitable anchors (not supplied by Amico) into the supporting wall (refer to "**Appendix K**"). Bolt the manifold support into position.

Attach the manifold control cabinet to the support using supplied bolts. The cabinet attaches to the front of the wall bracket.

Cylinder Bank Installation Instructions

CAUTION: This section contains important information necessary for proper installation of the cylinder banks. Read it carefully before installing cylinder banks.

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osition the wall brackets, if required, to support the extension bars and bolt in place.

Connect the two high pressure inlet valve / header bar assemblies to the inlet blocks on either side of the cabinet.

Secure the cylinder extension bar to the support using the U-bolts supplied as part of the assembly.

Remove the plug and chain assembly on each outlet connection on the cylinder extension bar. Attach the cylinder pigtails to the header bar connections, while ensuring the check valves are operating in the proper direction.

WARNING: To avoid contamination with particles or other potential hazardous materials, keep pigtails in plastic wrapping until such time as connection to gas cylinder is planned.

When the medical gas piping system has been tested in accordance with **NFPA 99**, the manifold can then be connected to it.

The outlet pipes leading from the Amico control cabinet should be connected to their respective pipeline system connections. The connection to the relief valves should be made with a union (supplied by others) to facilitate change, if required.

An appropriate sealing compound that is suitable for the gas being transmitted shall be used for threaded connections.

WARNING: If downstream joints near the cabinet outlet are to be silver brazed, special attention must be given not to overheat the copper tubing, since this may alter the sealing compound used in the threaded joints leading from the control cabinet.

Testing for Leakage

The following instructions apply to leak testing to be preformed on the joints made during assembly and connection of the Amico manifold and not to tests previously made on the piping system.

The connections inside the Amico control cabinet have been inspected at the manufacturing plant and DO NOT require leak testing. In order to determine whether any leaks exist between cylinder extension bar sections or at the pipeline connections, the system must be pressurized using either oil-free dry air or oil-free dry nitrogen.

In the case of medical Oxygen, Nitrous Oxide or Carbon Dioxide Amico manifolds, the actual service gases **ARE NOT** suitable for leak testing due to their inherent dangerous properties. Leak testing must be performed using either oil-free dry air or oil-free dry nitrogen. In the case of either a Medical Air or a Nitrogen Amico manifold, the actual service gas may be used to perform the leak tests as follows:

1. Connect a cylinder of the manifold service gas to the end connection on each end of the cylinder extension bar using the copper cylinder connection hose assemblies (pigtails) supplied.

2. Make sure all other outlets are capped with the plug and chain assemblies supplied.

3. Make sure that the high pressure inlet valves of each bank are fully **OPEN**.

4. "Slowly" open the two cylinder valves closest to the cabinet, one at a time, to pressurize the cylinder extension bar and to pressurize the pipeline.

5. All outlets from the pipeline, downstream of the manifold, should be closed and thus there should be no flow from the manifold.

6. Check for leaks at all cylinder extension joints and at the joints where the pipes were connected to the pipeline, using a commercial leak detector, which is compatible with oxygen.

7. If any leaks are found, the system must be depressurized by bleeding through a convenient pipeline outlet and the faulty connections must be repaired.

8. The threaded pipe cylinder extension bar connections may be tightened one more turn, maintaining the horizontal location of the cylinder adapters or a further application of an oxygen service threaded sealant may be required.

9. If the brazed pipeline connections leak, they must be removed, cleaned and then re-brazed following the proper technique. All repaired joints must be pressure tested as previously.

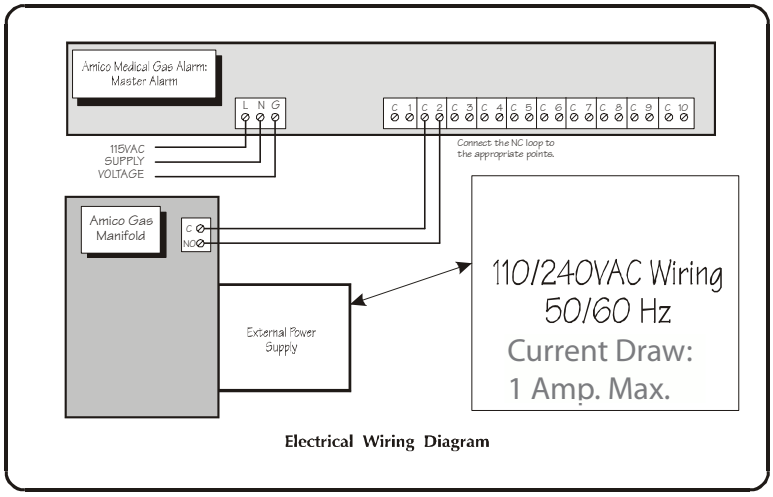
FINAL TESTING

Purging and analyzing of the complete medical gas piping system shall be carried out in accordance with **NFPA 99**.

ELECTRICAL HOOK-UP TO CLOSED CIRCUIT ALARMS

Once the Amico manifold has been installed and the source of supply for the medical gas piping is completed, the electrical connections can be made. The input power to the Amico manifold is 110-240VAC, 50-60Hz.

Connections from the Amico manifold to the Amico Master Alarm must be made from terminals marked **C** and **NO**, to the appropriate terminals (RESERVE IN USE) on the Master Alarm.



Electrical Wiring Diagram

DANGER: Electrical shock hazard. Ensure that the main power source is turned off during the connection of the exterior power supply.

CHECK-OUT OF INDICATOR FUNCTIONS

Introduce power to the Amico control cabinet. Ensure that all regulator handles have been backed off. With the high pressure inlet valves outside the cabinet both OPENED, S-L-O-W-L-Y open the cylinder valves on the cylinders closest to the control cabinet. After one minute, S-L-O-W-L-Y open all other cylinder valves. A pipeline outlet downstream of the manifold cabinet, such as a purge valve or terminal valve, should be opened and vented safely, to produce a dynamic flow condition for the indicator function check-out.

After opening the cylinder valves, set the operating regulators to 150 psig [1034kPa] for all gases, except for Nitrogen, 275 psig [1896 kPa]. Note that the operating regulator set first determines the "In Use" bank. When both banks are open, check the pressure to ensure that the correct pressure is indicated. The left hand and right hand Bank Pressures should both read full cylinder pressure while the line pressure should now be set at 55 psig [379 kPa] for all manifolds except for Nitrogen, 170 psig [1172 kPa].

Check the indicator LED for proper functioning. Only one Green LED, on the side which had it's operating regulator set first, should be lit and the other side should have an Amber LED lit.

Close the cylinder valve on the primary bank and watch the indicator LED to ensure proper functioning. The primary bank pressure should fall, while the secondary and line pressures stay constant. When the primary pressure falls to approximately 90 psig [621 kPa] for all gases except Nitrogen, 190 psig [1310 kPa], there should be a distinct sound of the shuttle valve switching over to the secondary supply. When the switching occurs, the line pressure will remain constant and the Green LED should reverse, with only one of them lit. The Red LED "Bank Empty" will become lit on the bank empty side.

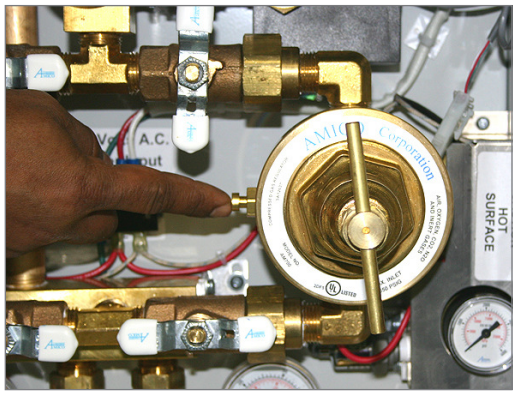
With the Amico manifold wired up to the Amico Master Alarm, the change over from primary to secondary supply will cause an audible alarm buzzer and the appropriate indicator LED on the Master Alarm to illuminate.

MANIFOLD SET-UP

The manifold comes with the regulators preset from the factory and ready for use but should the regulators require set –up after servicing follow the steps below:

1. Attach the gas specific pigtails to the CGA connections on the header bars and then ensure that full Cylinders are connected to the manifold.

2. With both operating regulator handles backed off fully, open the cylinder on any one side of the manifold. Make sure that the emergency shut-off valves on either side of the manifold are fully open, these valves should only be closed in case of an emergency.



3. Set the operating pressure to 150 psi (Oxygen, Nitrous Oxide, Carbon Dioxide, Medical Air) and 275 psi for (Nitrogen). After setting up the operating pressure set the Line pressure to 55 psi for most gases except for Nitrogen which is 170 psi by isolating one Line regulator at a time.

4. Open the cylinder on the other side of the manifold and set the remaining Operating Regulator as mentioned above. **NOTE:** Operating regulators once set up, should not be reset at any time.

NOTE: **The operating regulator should be set up using full gas/liquid cylinders for the gas specified.**

The operating regulator, once set up, should not be reset at any time.

There is an over-shoot of between 10-30 psi once the "In Use" side has depleted and a full cylinder is connected.

Also, when the "In Use" side is being depleted, just before the bank can switch-over, there is an increase in pressure on the "In Use" side.

(Example: Operating regulator set @ 150 psi would show an increase in pressure indicating 160-180 psi).

This is normal in both cases, when full and when depleting, as once the "In Use" side is depleted, a full cylinder is connected and after it switches back into "In Use" mode, it resets itself and feeds at 150 psi.

To replace the empty cylinders with full ones, keep the high pressure inlet valve open throughout this procedure. Close all empty cylinder valves and remove them. Attach full cylinders in their place, then S-L-O-W-L-Y open the cylinder valve nearest the inlet valve and wait for at least one full minute before S-L-O-W-L-Y opening the remaining cylinder valves, one at a time.

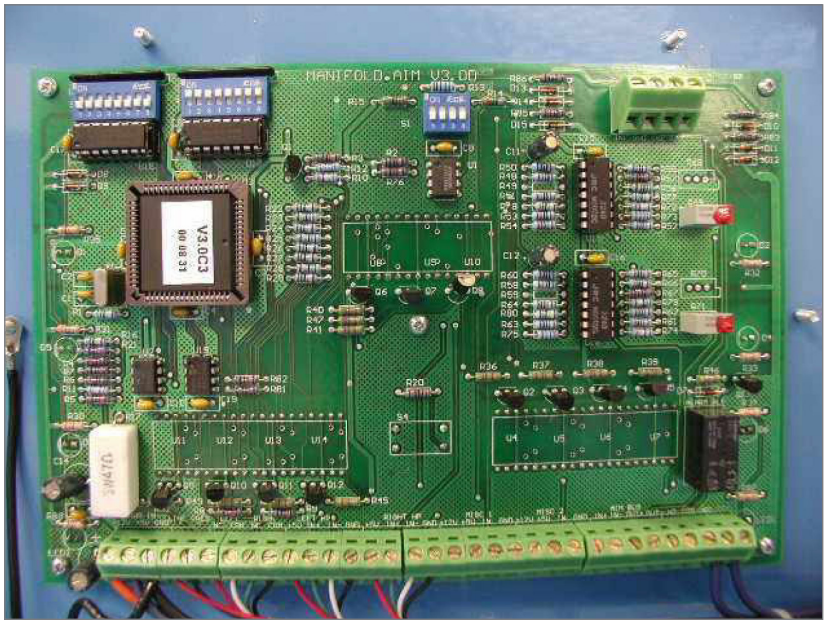
The introduction of full cylinder pressure into the cabinet's main bar, energizes the appropriate control pressure switch which causes the Red LED "Bank Empty" to go out. The Amico manifold is then ready for the next switch-over. **Please note for *Liquid by Liquid* manifolds the "Test or Reset" button must be pressed to switch from "Empty" mode to "Ready" mode after changing the cylinders.**

NOTE: **At the instant shuttling occurs, a small amount of gas will leak from the shuttle valve, shaft end. This is normal and should stop when the shaft reaches the full extent of its travel. If leakage persists at the shaft ends, it could indicate a leaking check valve at the shuttle valve outlet. It could also indicate a leaking shaft O-ring or a leaking seat.**

The cylinders and the operating pressure regulators of a nitrous oxide or a carbon dioxide supply system shall be observed daily during peak demand periods to determine whether they show frosting or condensation on the surface.

WARNING: Fire Hazard. DO NOT permit smoking or any other source of ignition in the area where the manifold is located or near the relief valve vent outlet. Be certain that all connections are free of dirt, grease and oil. These substances burn with great intensity in air, enriched with oxygen or nitrous oxide and some gas mixtures.

Field Adjustments



Units of Measure Dip Switches

Dip Switch S3 is used to identify the units of measure on the manifold (psi/bar/kPa).

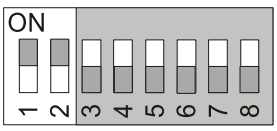
PSI mode:
Set Dip switches # 1 & 2 to the **ON** position.

BAR mode:
Set Dip switches # 1 & 2 to the **OFF** position.

KPA mode:
Set Dip switch # 1 to the **OFF** position and # 2 to the **ON** position.

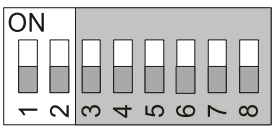
Set Dip switch # 1 to the **OFF** position and # 2 to the **ON** position.

PSI



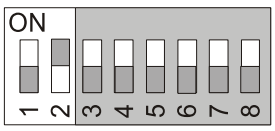
S3

BAR



S3

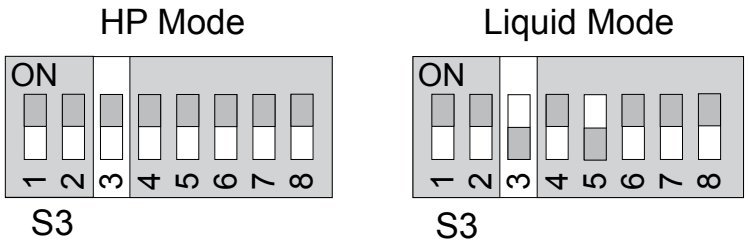
KPA



S3

DIP SWITCH SETTINGS FOR LEFT & RIGHT BANK

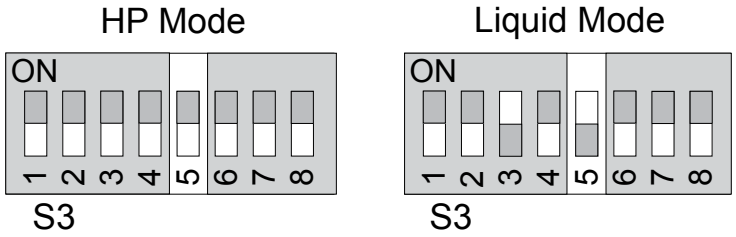
Left Bank Select



High Pressure mode for Amico Model #: M2-X-MAN-07B (2500 Psi)
Set Dip switch # 3 to the **ON** position.
This will enable gas cylinders to be attached to the **left** bank of the manifold.

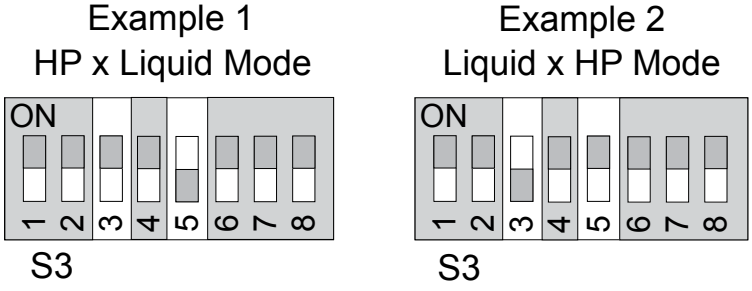
Liquid Mode for Amico Model #: M2-X-MAN-07C (500 Psi)
Set Dip switch # 3 to the **OFF** position.
This will enable liquid cylinders to be attached to the **left** bank of the manifold

Right Bank Select



High Pressure mode for Amico Model #: M2-X-MAN-07B (2500 Psi)
Set Dip switch # 5 to the **ON** position.
This will enable gas cylinders to be attached to the **right** bank of the manifold.

Liquid Mode for Amico Model #: M2-X-MAN-07C (500 Psi)
Set Dip switch # 5 to the **OFF** position.
This will enable liquid cylinders to be attached to the **right** bank of the manifold



Dip Switches # 4, 6 & 7 are not used. Leave in the **ON** position.
Dip Switch # 8 should remain in the **ON** position and should **never** be tampered with.

DIP SWITCH SETTINGS FOR AIMS ADDRESS

Device = Manifold and Alarm

Dip Switch S1 is used for Manifold Identification Address (used with interfacing the manifold to a PC [AIMS]).

NOTE: Each device must have a unique address. Choose from the following list below.

Dip Switch Settings S1

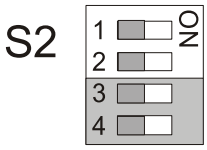
	8	7	6	5	4	3	2	1
Do Not Use	on	on	on	on	on	on	on	on
Device #1	on	on	on	on	on	on	on	***off***
Device #2	on	on	on	on	on	on	***off***	on
Device #3	on	on	on	on	on	on	***off***	***off***
Device #4	on	on	on	on	on	***off***	on	on
Device #5	on	on	on	on	on	***off***	on	***off***
Device #6	on	on	on	on	on	***off***	***off***	on
Device #7	on	on	on	on	on	***off***	***off***	***off***
Device #8	on	on	on	on	***off***	on	on	on
Device #9	on	on	on	on	***off***	on	on	***off***
Device #10	on	on	on	on	***off***	on	***off***	on
Device #11	on	on	on	on	***off***	on	***off***	***off***
Device #12	on	on	on	on	***off***	***off***	on	on
Device #13	on	on	on	on	***off***	***off***	on	***off***
Device #14	on	on	on	on	***off***	***off***	***off***	on
Device #15	on	on	on	on	***off***	***off***	***off***	***off***
Device #16	on	on	on	***off***	on	on	on	on
Device #17	on	on	on	***off***	on	on	on	***off***
Device #18	on	on	on	***off***	on	on	***off***	on
Device #19	on	on	on	***off***	on	on	***off***	***off***
Device #20	on	on	on	***off***	on	***off***	on	on
Device #21	on	on	on	***off***	on	***off***	on	***off***
Device #22	on	on	on	***off***	on	***off***	***off***	on
Device #23	on	on	on	***off***	on	***off***	***off***	***off***
Device #24	on	on	on	***off***	***off***	on	on	on
Device #25	on	on	on	***off***	***off***	on	on	***off***
Device #26	on	on	on	***off***	***off***	on	***off***	on
Device #27	on	on	on	***off***	***off***	on	***off***	***off***
Device #28	on	on	on	***off***	***off***	***off***	on	on
Device #29	on	on	on	***off***	***off***	***off***	on	***off***

Dip Switch Settings S1

	8	7	6	5	4	3	2	1
Device #30	on	on	on	***off***	***off***	***off***	***off***	on
Device #31	on	on	on	***off***	***off***	***off***	***off***	***off***
Device #32	on	on	***off***	on	on	on	***off***	on
Device #33	on	on	***off***	on	on	on	***off***	***off***
Device #34	on	on	***off***	on	on	on	on	on
Device #35	on	on	***off***	on	on	on	on	***off***
Device #36	on	on	***off***	on	on	***off***	***off***	on
Device #37	on	on	***off***	on	on	***off***	***off***	***off***
Device #38	on	on	***off***	on	on	***off***	on	on
Device #39	on	on	***off***	on	on	***off***	on	***off***
Device #40	on	on	***off***	on	***off***	on	***off***	on
Device #41	on	on	***off***	on	***off***	on	***off***	***off***
Device #42	on	on	***off***	on	***off***	on	on	on
Device #43	on	on	***off***	on	***off***	***off***	on	***off***
Device #44	on	on	***off***	on	***off***	***off***	***off***	on
Device #45	on	on	***off***	on	***off***	***off***	***off***	***off***
Device #46	on	on	***off***	on	***off***	on	on	on
Device #47	on	on	***off***	on	***off***	on	on	***off***
Device #48	on	on	***off***	***off***	on	on	***off***	on
Device #49	on	on	***off***	***off***	on	on	***off***	***off***
Device #50	on	on	***off***	***off***	on	***off***	on	on
Device #51	on	on	***off***	***off***	on	***off***	on	***off***
Device #52	on	on	***off***	***off***	on	***off***	***off***	on
Device #53	on	on	***off***	***off***	on	***off***	***off***	***off***
Device #54	on	on	***off***	***off***	on	on	on	on
Device #55	on	on	***off***	***off***	on	on	on	***off***
Device #56	on	on	***off***	***off***	***off***	on	***off***	on
Device #57	on	on	***off***	***off***	***off***	on	***off***	***off***
Device #58	on	on	***off***	***off***	***off***	***off***	on	on
Device #59	on	on	***off***	***off***	***off***	***off***	on	***off***

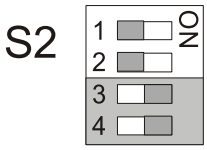
TERMINATION for AIMS

The S2 Dip Switch needs to be as follows:



Set Dip Switch # 1 to the OFF position.
Set Dip Switch # 2 to the OFF position.
Set Dip Switch # 3 to the OFF position.
Set Dip Switch # 4 to the OFF position.

The last device needs to be terminated. Set S2 as follows:



The last device in the link should be set as:
Set Dip Switch # 1 to the OFF position.
Set Dip Switch # 2 to the OFF position.
Set Dip Switch # 3 to the ON position.
Set Dip Switch # 4 to the ON position.

Maintenance

GENERAL

The tests and inspections specified below apply only to the Amico manifold and not to the medical gas pipeline system as a whole. They are intended to help ensure the proper operation of the manifold and are not to be interpreted as repair instructions. Fault finding and repair procedures are given in the Trouble Shooting section of this manual.

AMICO CONTROL CABINET

Control equipment should be inspected and tested according to the following schedule:

1. Pressure Regulator:
- a. Observe and record line pressure periodically.
- b. Test for external leaks at least semi-annually.
- c. Switch line regulators monthly.

2. High Pressure Inlet Valves (Manifold Hand Valves):
- a. Inspect semi-annually and test for external leakage and tightness of shut-off.

3. Pressure Transducers:
- a. Inspect annually and test for external leakage.

4. Ensure that all electrical switches and LED's are maintained in proper working condition.
Inspect Inlet Filters every 6 months.

CYLINDER EXTENSION BARS

The following components shall be inspected semi-annually as indicated:

1. Test check valves of pigtail assemblies for proper closure.

2. Inspect pigtail assemblies for apparent damage and thread damage to cylinder connections.
Replace all damaged pigtails immediately.

NOTE: Replace ALL pigtails after 5 years of service.
The cylinders and the operating pressure regulators of a nitrous oxide or a carbon dioxide supply system shall be observed daily during peak demand periods to determine whether they show frosting or condensation on the surface.

Where this is evident, the system shall be further inspected for evidence of leaks. Should excessive condensation or frosting occur, it may be necessary to increase manifold capacity by adding additional cylinders or installing or replacing the manifold with a manifold with built in heaters.

PERIODIC STANDING PRESSURE TEST

At intervals of not more than 5 years, a 1-hour standing pressure test shall be made on each medical gas system to check for leakage.

SHUTTLE VALVE PREVENTATIVE MAINTENANCE

Shuttle valves should be inspected for any leaks annually.

Removing the Shuttle Valve
Turn off the gas supply. Disconnect the left and right hand supply lines from the shuttle valve. Disconnect the shuttle valve outlets from the main bar connections to remove the shuttle valve from the cabinet. Loosen the round head screws holding the limit switches in place and remove the switches from the shuttle valve.

Installing the Shuttle Valve
Install limit switches and tighten the round head screws to secure the switches in place. Install the replacement (or re-conditioned) shuttle valve by tightening its outlet connections to the center bar. Connect the left hand supply lines between the left hand operating pressure regulator outlet and the shuttle valve. (Repeat for right hand side) S-L-O-W-L-Y open the high pressure inlet valve on the left hand header bar.

NOTE: The manifold should now be operating on the left hand cylinder bank via the shuttle valve. Line pressure should remain at its normal setting.

S-L-O-W-L-Y open the high pressure inlet valve on the right hand header bar. Inspect all connections previously dismantled for leaks using a commercially available leak detector solution compatible with oxygen.

WARNING: DO NOT UNDER ANY CIRCUMSTANCES USE HYDROCARBON BASED LUBRICANTS ON SHUTTLE VALVE PARTS. ONLY USE THE LUBRICANTS SUPPLIED, OR USE A SUITABLE EQUIVALENT, SPECIFICALLY APPROVED FOR MEDICAL USE AND FOR OXYGEN SERVICE.

WARNING: Fire Hazard. DO NOT permit smoking, or any other source of ignition in area where the manifold is located, or near the relief valve vent outlet. Be certain that all connections are free of dirt, grease and oil. These substances burn with great intensity in air, enriched with oxygen, or nitrous oxide and some gas mixtures.

Reconditioning of Shuttle Valves

Two replacement parts are available to permit the reconditioning of shuttle valves. They include all the seats and seals required.

M2-X-LPV-RK kit is used to recondition low pressure shuttle valves M2-SHUTV-LP, used in Oxygen, Nitrous Oxide, Carbon Dioxide and Medical Air Service.

M2-X-HPV-RK kit is used to recondition high pressure shuttle valves M2-SHUTV-HP, used only in Nitrogen Service, Liquid *Liquid and Liquid* High Pressure.

Detailed instructions for dismantling, assembling and testing of the shuttle valves are supplied with the replacement parts and kits are shown in Appendix B, C, D & E.

Troubleshooting

This section is intended to serve as a general guide for identifying the potential functional problems which may occur during the operation of Amico manifolds.

Components removed for maintenance, must be serviced, repaired and tested only by personnel qualified to work on equipment used in medical service. Only original manufacturer's parts as supplied by Amico may be used.

ELECTRICAL FAULTS

SYMPTOM	CAUSE	CORRECTIVE ACTION
No indicator LED's on front panel illuminated when gas is flowing	a. Power input.	1. Check for 110 to 240 VAC.
	b. Fuse Blown.	2. Replace fuse (1 amp).
	c. Power present at manifold circuit board. Check that orange wire is 12V and blue wire is 5V.	3. Replace the circuit board.
	d. Power not present at manifold circuit board.	4. Replace the power supply.
Both Red LED's are flashing, but both banks are full	a. All cylinder valves on both banks are closed.	1. Slowly open the cylinder valves on either side and make sure that both emergency valves on either side of the manifold are open.

OPERATING PRESSURE REGULATOR FAULTS

SYMPTOM	CAUSE	CORRECTIVE ACTION
Gas leakage around operating pressure regulator bonnet	a. Loose bonnet. b. Diaphragm leak.	1. Tighten bonnet. 2. Replace regulator with substitue unit and change diaphragm.
Shuttle valve shuttles before operating bank is empty	a. Idle operating pressure regulator creeping due to seal leakage.	1. Reset regulator and change seal.
Venting at operating relief valve	a. Over pressure due to creeping or faulty regulation by operating pressure regulator	1. Set operating regulator to value specified on page 8 (Operating Regulators)

LINE PRESSURE REGULATOR FAULTS

SYMPTOM	CAUSE	CORRECTIVE ACTION
Pipeline not at desired pressure	a. Line regulator not set correctly.	1. Set line regulator to valve specified on page 8 (Line Regulators).
Required gas flow not available	a. Line regulator not set correctly.	

LINE PRESSURE REGULATOR FAULTS

SYMPTOM	CAUSE	CORRECTIVE ACTION
Low pressure relief valve venting	a. Line regulator set at too high a delivery pressure.	1. Set line regulator to valve specified on page 8 (Line Regulators).
	b. Relief valve set at too low a pressure.	2. Replace the relief valve with a new set in accordance with page 9 (Pressure Relief Valves).
	c. Creep in line regulator.	3. Replace Line Regulator that creeps and change seal.

SHUTTLE VALVE FAULTS

SYMPTOM	CAUSE	CORRECTIVE ACTION
Gas leakage	a. Body halves not joined tightly enough.	1. Tighten screws.
	b. Body "O" ring leaking.	2. Replace "O" ring kit, use repair kit.
	c. Gas bleeding out of shaft of shuttle valve, (i.e.: left side and feeding from the right high pressure side).	3. Replace check-valve(s).
	d. Shaft "O" ring leaking, (i.e.: left side, and feeding from the left high pressure side).	4. Use shuttle valve repair kit.
Both banks feeding	a. Shuttle valve seat leaking.	1. Replace shuttle valve seal, use repair kit.
	b. Shuttle valve shaft hung up.	2. Bleed gas, reset operating regulators.

ERROR CODE MESSAGES ON THE MANIFOLD DISPLAY

SYMPTOM	CAUSE	CORRECTIVE ACTION
E01	Sensor not connected	Check sensor wiring. Reconnect wire properly.
E06	Sensor wires between the manifold module, shorted out on reversed polarity.	Reverse polarity or replace defective wire.
E10	Shuttle valve shaft hung up or not shuttled-fully. Operating regulators not set up properly, limit switch wiring connector.	Under Low Flow conditions, E10 could happen during switchover. This is normal under this Low Flow condition. When the shuttle has fully shuttled over the E10 error will clear. Reset operating regulators to specified setting, make sure connections are properly connected to switches.

Cylinder Changing Procedures

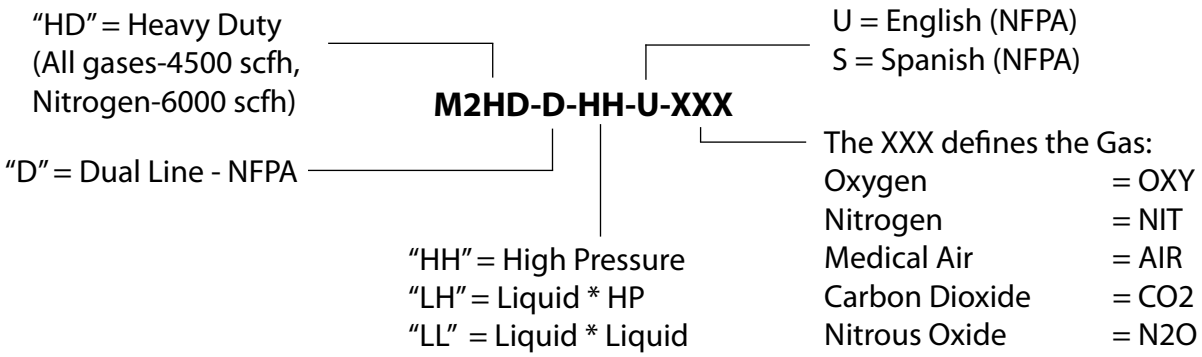
1. KEEP THE MAIN BANK VALVE OPEN THROUGHOUT THESE PROCEDURES.
2. CLOSE CYLINDER VALVES ON ALL EMPTY CYLINDERS.
3. DISCONNECT PIGTAILS FROM CYLINDER VALVE OUTLETS, USING AN APPROPRIATE WRENCH.
4. PLACE PROTECTIVE CAPS OVER THE CYLINDER VALVES OF THE EMPTY CYLINDERS AND MOVE THEM ASIDE.
5. REMOVE PROTECTIVE CAPS OF THE FULL CYLINDERS. VISUALLY INSPECT THE CYLINDER VALVES FOR DUST, GREASE OR OIL.
6. USING A CLEAN (LINT FREE) CLOTH, WIPE EACH CYLINDER VALVE OUTLET CLEAN. DO NOT USE YOUR FINGERS.
7. STANDING TO ONE SIDE, "CRACK" THE CYLINDER VALVE BY BRIEFLY OPENING AND CLOSING THEM TO BLOW OUT ANY DUST. MAKE SURE THEY ARE POINTING AWAY FROM YOU AND OTHER PERSONNEL.
8. CONNECT THE PIGTAILS TO THE CYLINDER VALVE OUTLETS AND TIGHTEN THE NUT WITH AN APPROPRIATE WRENCH.
9. VERY S-L-O-W-L-Y OPEN THE CYLINDER VALVE ON THE CYLINDER CLOSEST TO THE CONTROL CABINET. WATCH THE BANK PRESSURE DISPLAY ON THE FRONT OF THE CABINET, TO MAKE SURE THE PRESSURE RISES SLOWLY TO THE FULL CYLINDER PRESSURE READING.
10. WAIT ONE FULL MINUTE.
11. PROCEED TO S-L-O-W-L-Y OPEN THE REMAINING CYLINDER VALVES ONE AT A TIME.

WARNING: High Pressure oxygen systems must be handled with CAUTION. Spontaneous combustion may occur if oxygen comes into contact with grease or oil. Ensure that hands, gloves, clothing and tools are kept clean and free of oil and grease. Be careful not to introduce dust or other contaminants into the system when changing cylinders. Failure to comply with this procedure may be hazardous.

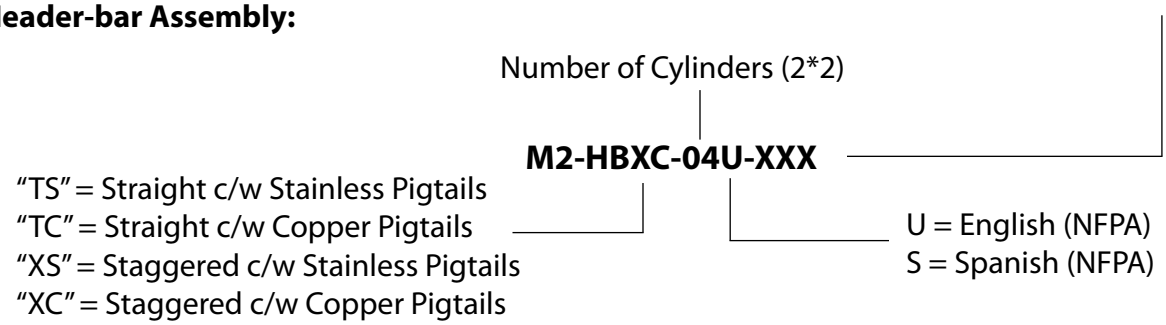
WARNING: Fire Hazard. NO NOT permit smoking, or any other source of ignition in area where the manifold is located, or near the relief valve vent outlet. Be certain that all connections are free of dirt, grease and oil. These substances burn with great intensity in air, enriched with oxygen, or nitrous oxide and some gas mixtures.

Ordering Information

Manifold Cabinet:



Header-bar Assembly:



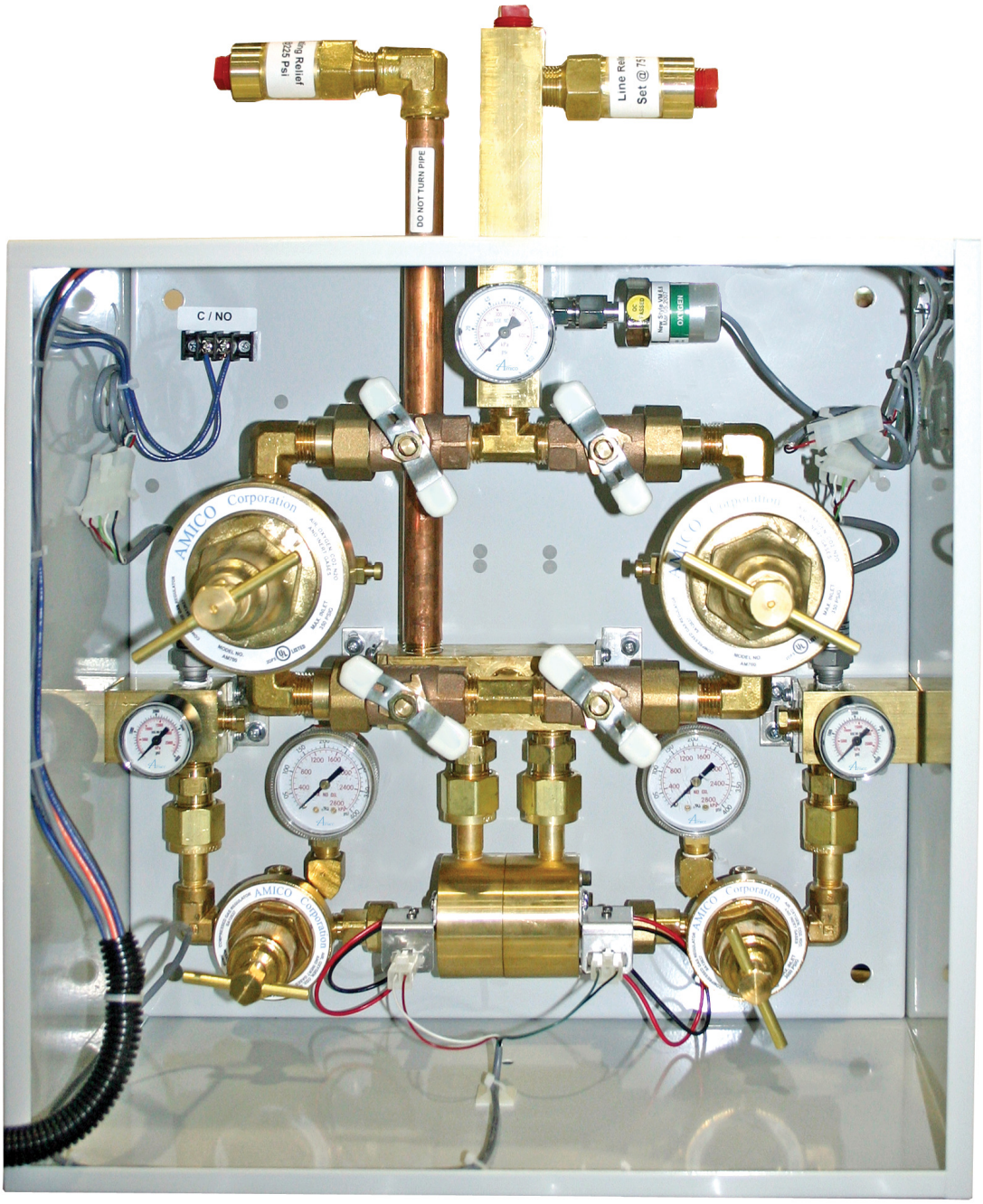
CONTROL CABINET PARTS LIST

DESCRIPTION	MODEL NUMBER
Pressure transducer for Oxy, N2O, Air, CO2, & Nit	M2-X-MAN-07B
Pressure transducer for Liquid Manifolds	M2-X-MAN-07C
Line pressure regulator for Heavy Duty Manifolds	M2-X-MAN-42E-L
	M2-X-MAN-42E-R
For Nit	M2-X-MAN-42E-LN
	M2-X-MAN-42E-RN
Operating pressure regulator for HD Manifolds	M2-X-MAN-18L
	M2-X-MAN-18R
For Nit	M2-X-MAN-18-N2L
	M2-X-MAN-18-N2R
Repair Kit Line pressure regulator - HD	M2-REG700-RK
Repair Kit Operating pressure regulator	
For Nit	M2-REG250-RK-HP
For Oxy, N2O, Air, & CO2	M2-REG250-RK-LP

DESCRIPTION	MODEL NUMBER
Shuttle Valve assembly for Nitrogen	M2-SHUTV-HP
Shuttle Valve assembly for Oxy, N2O, Air, & CO2	M2-SHUTV-LP
Shuttle Valve repair kit for Nitrogen & Liquid	M2-X-HPV-RK
Shuttle Valve repair kit for Oxy, N2O, Air & CO2	M2-X-LPV-RK
Intermediate check valve for all gases	M-X-MAN-33B
Operating pressure relief valve Nitrogen	M-X-MAN-72W-300
Operating pressure relief valve Oxy, N2O, Air & CO2	M-X-MAN-72W-200
Line Pressure relief valve for Nitrogen	M-X-MAN-72W-200
Line pressure relief valve for Oxy, N2O, Air & CO2	M-X-MAN-72W-075
Plug & Chain assembly - Air	M-X-HB-NUT-AIR
Plug & Chain assembly - CO2	M-X-HB-NUT-CO2
Plug & Chain assembly - N2O	M-X-HB-NUT-N2O
Plug & Chain assembly - Nit	M-X-HB-NUT-NIT
Plug & Chain assembly - Oxy	M-X-MAN-36
Copper pigtail c/w Check valve - Air	M-X-HB-PTC-AIR
Copper pigtail c/w Check valve - CO2	M-X-HB-PTC-CO2
Copper pigtail c/w Check valve - N2O	M-X-HB-PTC-N2O
Copper pigtail c/w Check valve - Nit	M-X-HB-PTC-NIT
Copper pigtail c/w Check valve - Oxy	M-X-HB-PTC-OXY
Stainless pigtail c/w Check valve - Air	M-X-HB-PTS-AIR
Stainless pigtail c/w Check valve - CO2	M-X-HB-PTS-CO2
Stainless pigtail c/w Check valve - N2O	M-X-HB-PTS-N2O
Stainless pigtail c/w Check valve - Nit	M-X-HB-PTS-NIT
Collapsible wall bracket	M2-X-MAN-SUP
Extension wall support	M-X-HB-WLBRKIT
High pressure inlet valve	M-X-HB-HPVLV-A
ALERT-2 LED circuit board assembly	M3-LED-CB
ALERT-2 Complete Retro-Fit Kit	M2-X-RETRO-V3
Manifold Power Supply	M2-X-POWER

Appendix A

Manifold Internal Layout



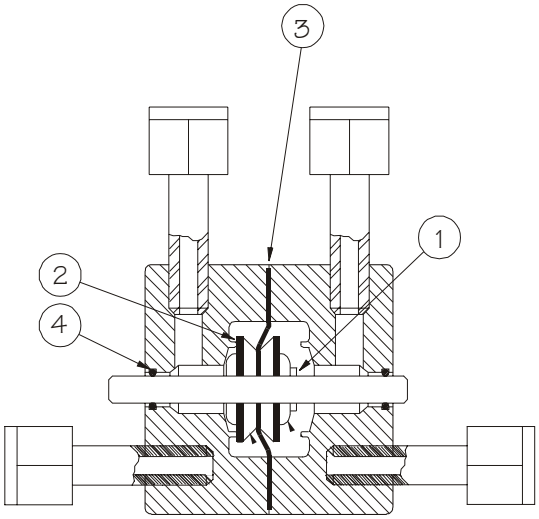
Appendix B

Low Pressure Shuttle Valve Maintenance

Low pressure shuttle valves M2-SHUTV-LP are used in Oxygen, Nitrous Oxide, Carbon Dioxide and compressed Medical Air manifolds.

A repair kit is comprised of:	1 diaphragm	M2-X-LPV-DIAPHR
	2 seats	M2-X-LPV-SEAT
	2 O-rings	M2-X-LPV-08
	Lubricant	Krytox Grease

MAINTENANCE PROCEDURE
Dismantling the Shuttle Valve



1. Remove the three socket head cap screws from the body.

2. Gently separate the two body halves.

3. Remove the shaft and diaphragm assembly.

4. Unscrew the lock nut (Item #1) from the shaft assembly. Remove the seats (Item #2) and diaphragm (Item #3).

ASSEMBLING THE SHUTTLE VALVE

1. Replace the seats and diaphragm with those supplied in the repair kit.

2. Tighten the diaphragm to the shaft using the brass lock nut.

3. Insert the two new o-rings into the grooves of the brass body halves.

4. Apply a very light coating of the lubricant supplied in the repair kit (Krytox Grease, manufactured by DUPONT), to each end of the shaft, about one inch from each end.

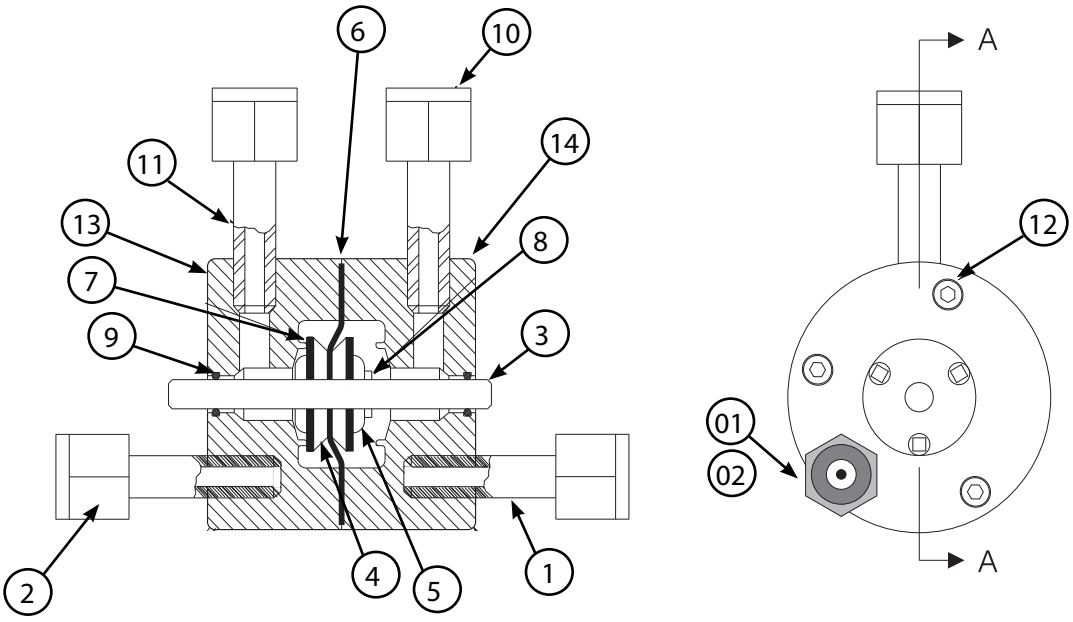
5. Insert the shaft and diaphragm assembly into the brass body halves.

6. Replace the three socket head cap screws into the body and tighten.

Appendix C

Low Pressure Shuttle Valve Assembly

1.	M2-X-LPV-01V	Shuttle Low Press. Union Nipple
2.	M2-X-LPV-02	Shuttle Low Press. Union Nut
3.	M2-X-LPV-SHAFT	Shuttle Low Press. Shaft
4.	M2-X-LPV-05	Shuttle Low Press. Large Holder
5.	M2-X-LPV-07	Shuttle Low Press. Small Holder
6.	M2-X-LPV-DIAPHR	Shuttle Low Press. Diaphragm
7.	M2-X-LPV-SEAT	Shuttle Low Press. Seat
8.	M2-X-LPV-NUT	Shuttle Low Press. Shaft Nut
9.	M2-X-LPV-08	Shuttle Low Press. Shaft O-ring
10.	M-X-MAN-09	Shuttle Low Press. Nut CGA-540
11.	M-X-MAN-08	Nipple CGA-540 * 1/4″-2-1/16″
12.	H-HEXSOCK-1024	Machine Screw 1/4-20-*2″
13.	M2-X-LPV-04L	Shuttle Valve Low Press. Left body
14.	M2-X-LPV-04R	Shuttle Valve Low Press. Right body
	M2-SHUTV-LP	Shuttle Valve for all gases (excluding Nitrogen)
	M2-X-LPV-RK	Shuttle Valve Reapir Kit



Appendix D

High Pressure Shuttle Valve Maintenance

High pressure shuttle valves M2-SHUTV-HP are used only in Nitrogen and Liquid manifolds.

A repair kit is comprised of:	1 O-ring	M2-X-HPV-05
	2 O-rings	M2-X-LPV-08
	1 O-ring	M2-X-HPV-08
	2 Seats	M2-X-LPV-SEAT
	Lubricant	Krytox Grease
	1 O-ring	M2-X-HPV-03

MAINTENANCE PROCEDURE

Dismantling the Shuttle Valve

1. Remove the three socket head cap screws from the body.

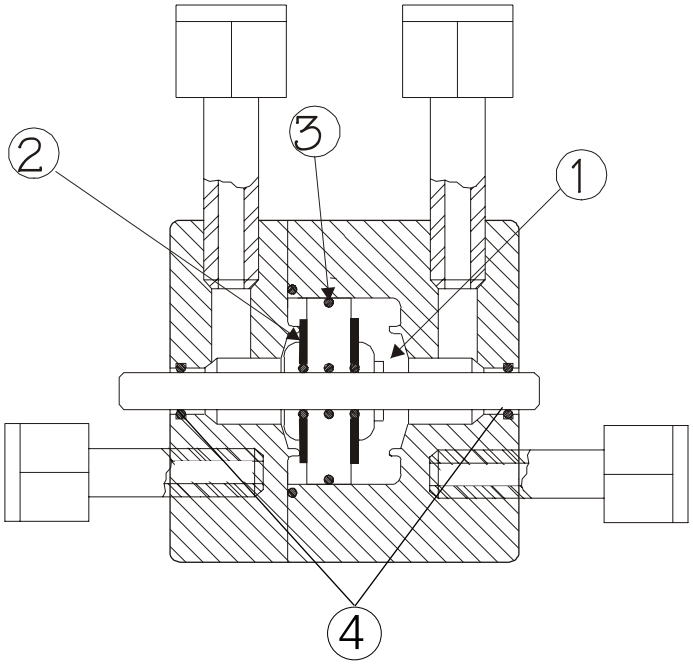
2. Gently separate the two body halves.

3. Remove the piston shaft assembly.

4. Unscrew the lock nut (Item #1) from the shaft assembly. Remove the seats (Item #2) and valve (Item #3) piston.

5. Extract o-rings from their grooves using a fine pointed instrument (needle), being careful not to scratch the brass body halves.

6. Discard the o-rings and seats.



Appendix E

High Pressure Shuttle Valve Assembly

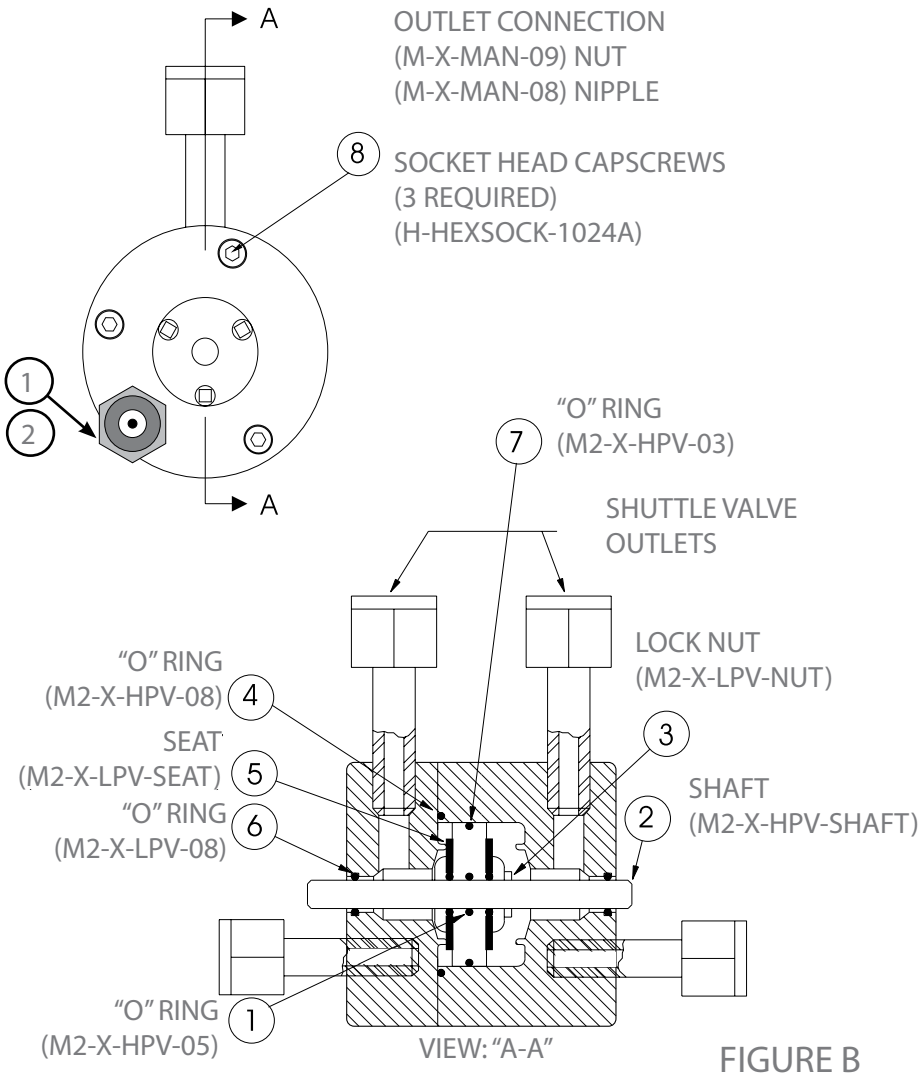


FIGURE B

SHUTTLE VALVE MAINENANCE KIT
(M2-X-HPV-RK) INCLUDES:

2 - M2-X-LPV-SEAT	SEATS
1 - M2-X-LPV-03	"O" RING
1 - M2-X-HPV-05	"O" RING
2 - M2-X-LPV-08	"O" RING
1 - M2-X-HPV-08	"O" RING

SHUTTLE VALVE FOR M2-SHUTV-HP:
- NITROGEN AND LIQUID MANIFOLDS

ASSEMBLING THE HP SHUTTLE VALVE

1. Using the parts supplied, re-assemble the piston shaft assembly and tighten the lock nut securely.

2. Install the 2 new O-rings (item #14) into the grooves in the valve body halves.

3. Apply a very light coating of the lubricant supplied in the repair kit (Krytox Grease, manufactured by DUPONT), to each end of the shaft, about one inch from each end.

4. Apply a very light coating of the lubricant to the piston bore of the larger of the two valve body halves. This lubricant serves to reduce friction at the shaft O-ring seals, to permit easy shutting of the shaft assembly.

WARNING: DO NOT UNDER ANY CIRCUMSTANCES USE HYDROCARBON BASED LUBRICANTS ON SHUTTLE VALVE PARTS. USE ONLY THE LUBRICANTS SUPPLIED OR USE A SUITABLE EQUIVALENT, SPECIFICALLY APPROVED FOR MEDICAL USE AND FOR OXYGEN SERVICE.

5. Gently insert the piston shaft assembly into the larger valve body half.

6. Place O-ring into grove in valve body.

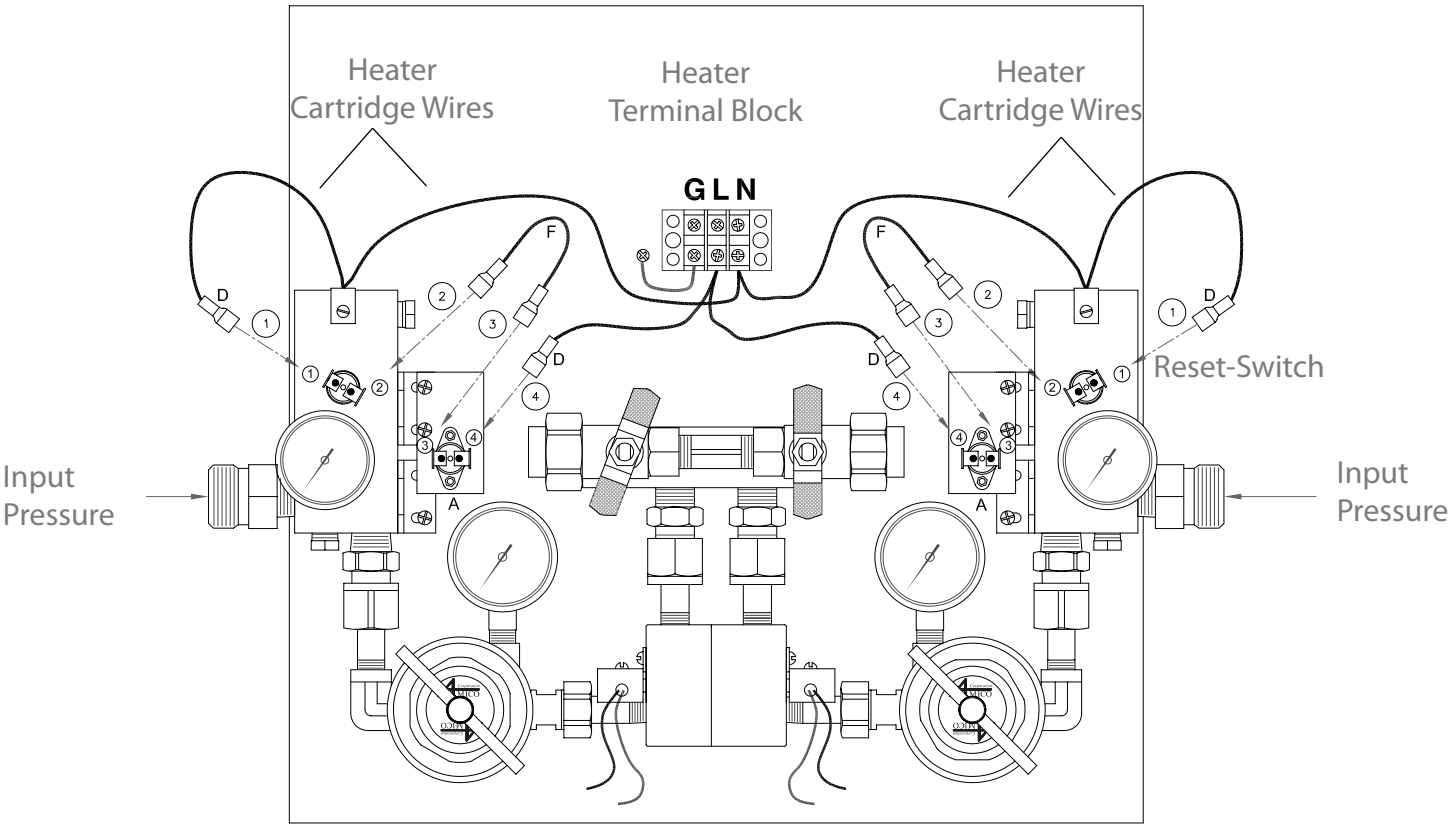
7. Gently slide the other valve body half onto the shaft and align the bolt holes.

8. Insert the three socket head cap screws and tighten them a turn at a time, alternating the screws, to apply an even clamping pressure on the O-ring, until all three screws are tightened.

9. Ensure that the piston shaft assembly moves freely back and forth in the valve body by alternately applying finger pressure to the shaft ends.

Appendix F

Wiring Schematic Heater Units



The Heaters are wired to our main Power Supply. If the facility requires a separate circuit breaker for the Heaters, separate wires are required to be connected to the heater terminal block and the existing wiring from the heater terminal block to the power supply should be removed.

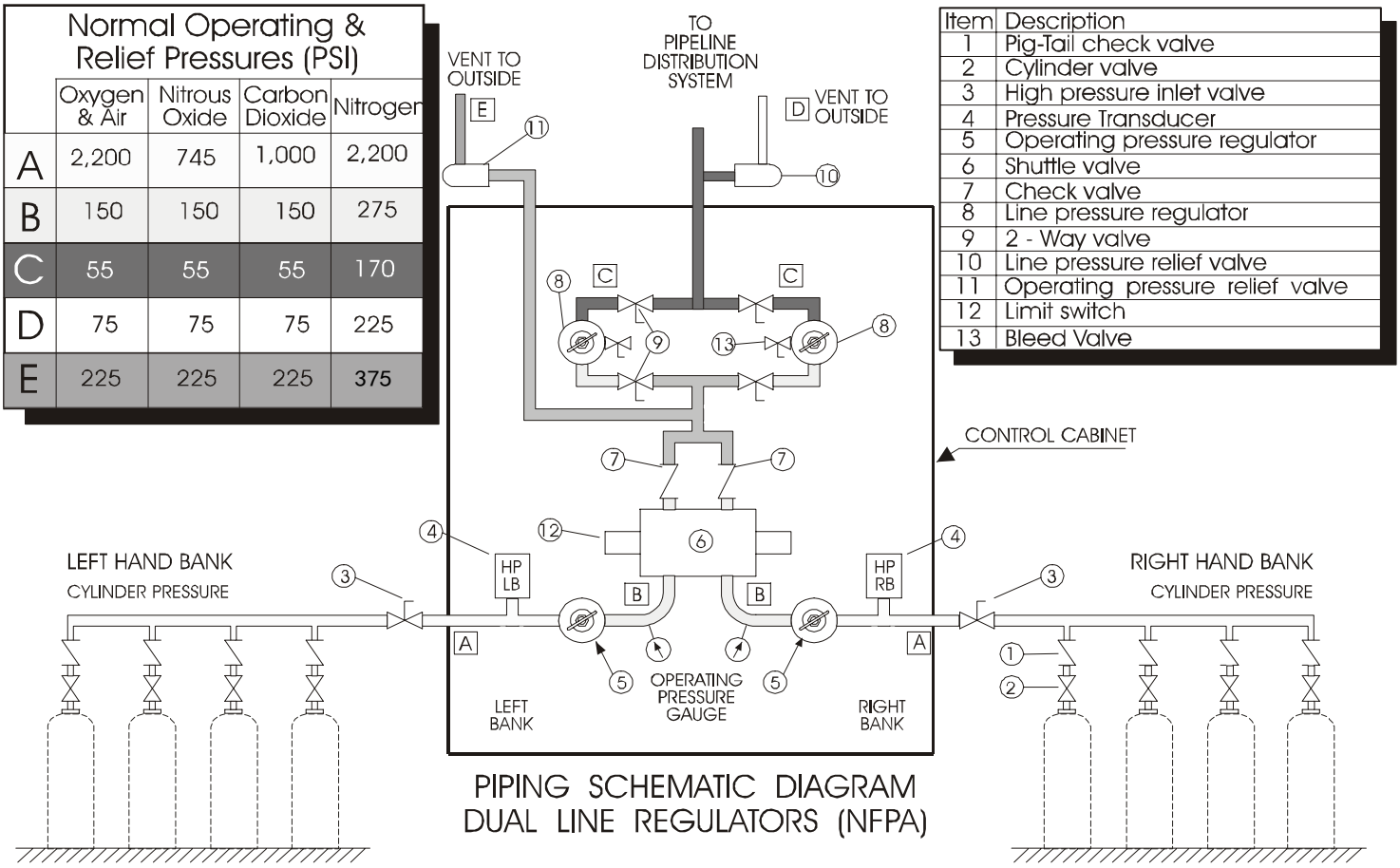
The Heaters normally switch on when the temperature drops below 24°C or 75°F. If the temperature exceeds 65-75°C or 160-175°F, the Heater re-set switch will trip and the heaters will automatically switch off. To re-set the Heaters, remove the heater covers & press the red button on the re-set switch to activate. When the Heaters are in use or switched on, it will draw up to 3 amps of current. The Heater Cartridge is 200Watts (each side), normally both sides do not switch on together. It depends on the flow of gas or climatic conditions. Heaters are available in 120V & 240V.

Appendix G

Piping Schematic Diagram - NFPA

Normal Operating & Relief Pressures (PSI)				
	Oxygen & Air	Nitrous Oxide	Carbon Dioxide	Nitrogen
A	2,200	745	1,000	2,200
B	150	150	150	275
C	55	55	55	170
D	75	75	75	225
E	225	225	225	375

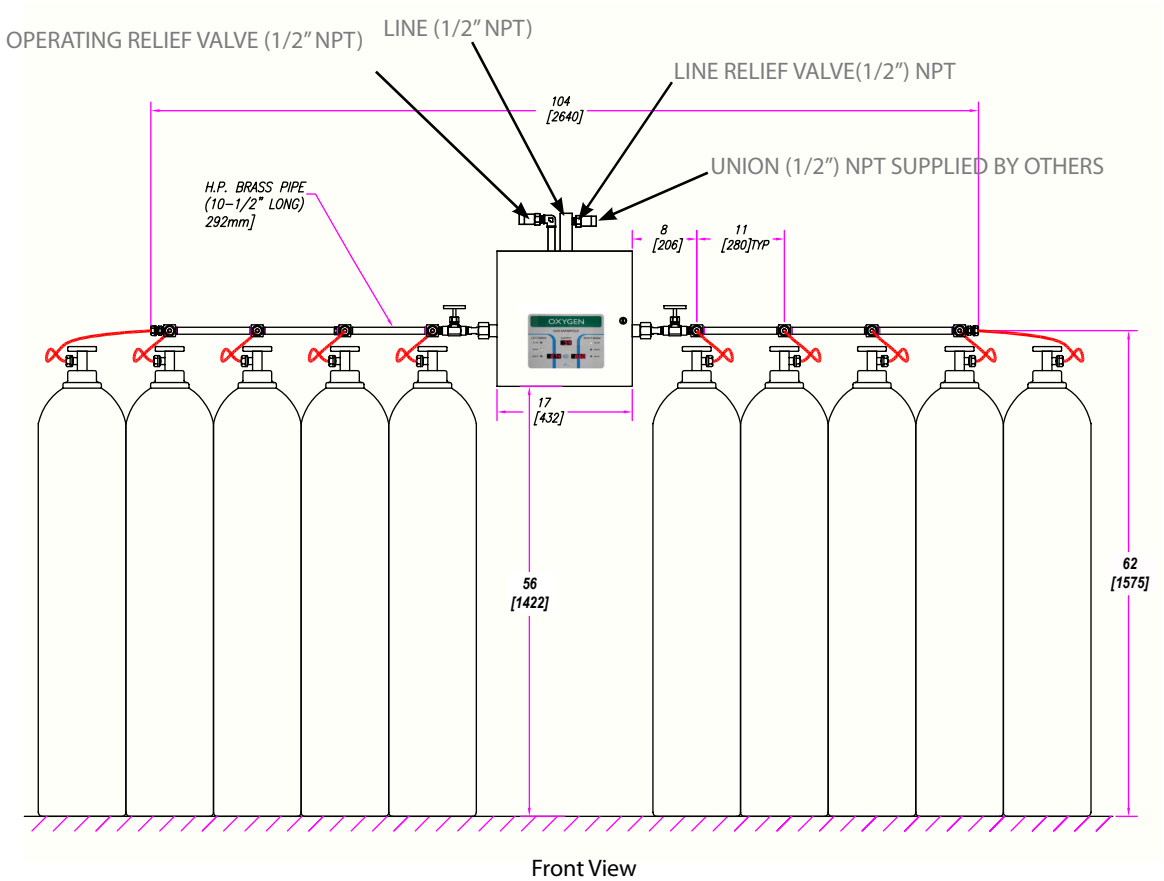
Item	Description
1	Pig-Tail check valve
2	Cylinder valve
3	High pressure inlet valve
4	Pressure Transducer
5	Operating pressure regulator
6	Shuttle valve
7	Check valve
8	Line pressure regulator
9	2 - Way valve
10	Line pressure relief valve
11	Operating pressure relief valve
12	Limit switch
13	Bleed Valve



PIPING SCHEMATIC DIAGRAM
DUAL LINE REGULATORS (NFPA)

Appendix H

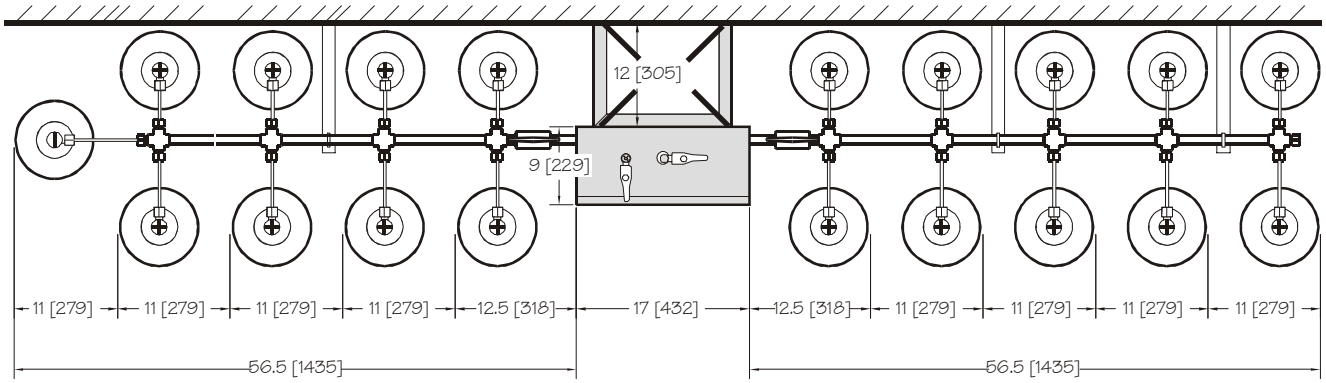
Staggered Header-Bar Front View



Front View

Appendix I

Staggered Header-Bar Top View



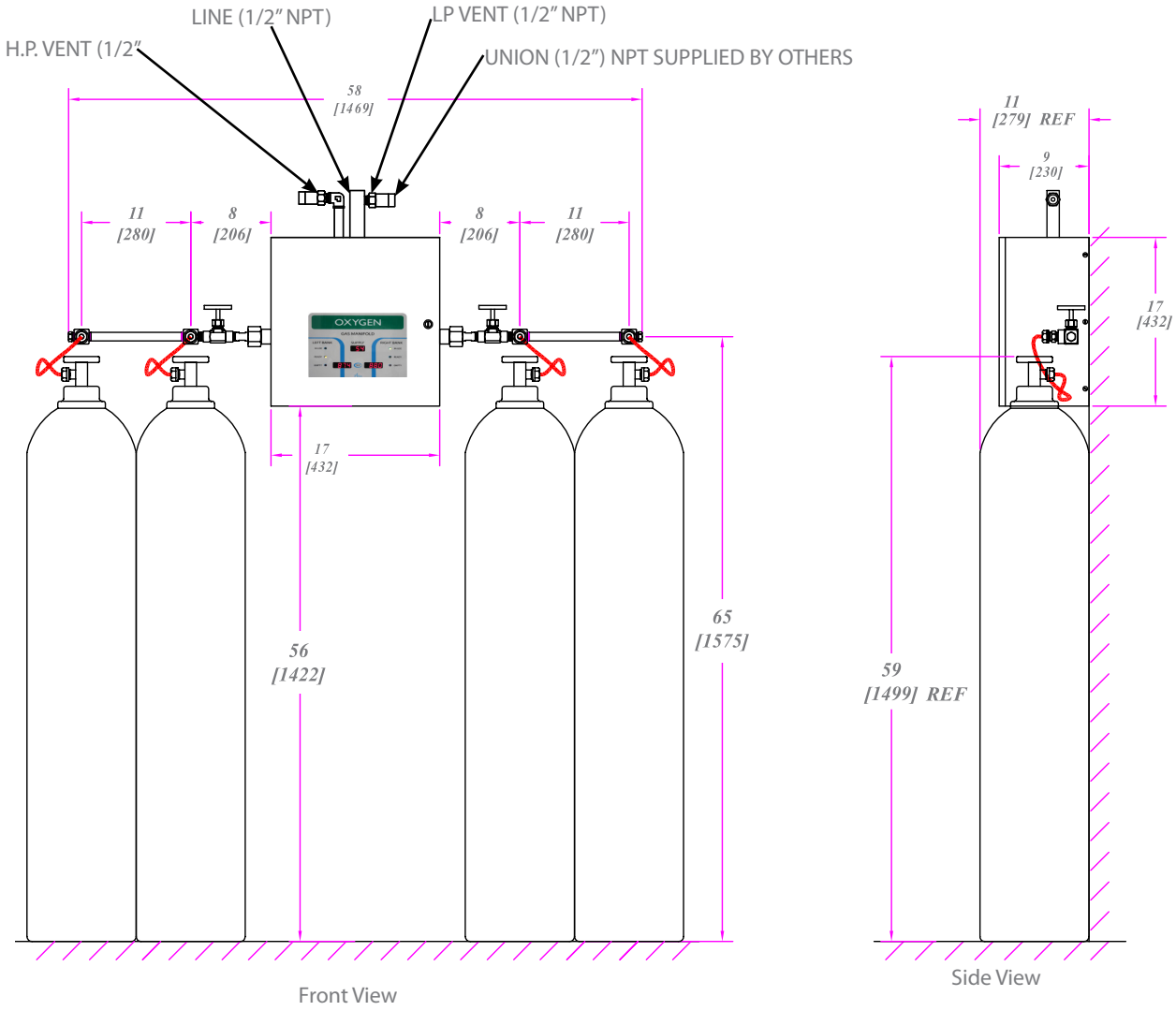
No. of Cylinders	Overall Length
2	42 [1067]
4	42 [1067]
6	64 [1626]
8	64 [1626]
10	86 [2184]

No. of Cylinders	Overall Length
12	86 [2184]
14	108 [2743]
16	108 [2743]
18	130 [3302]
20	130 [3302]

Top View

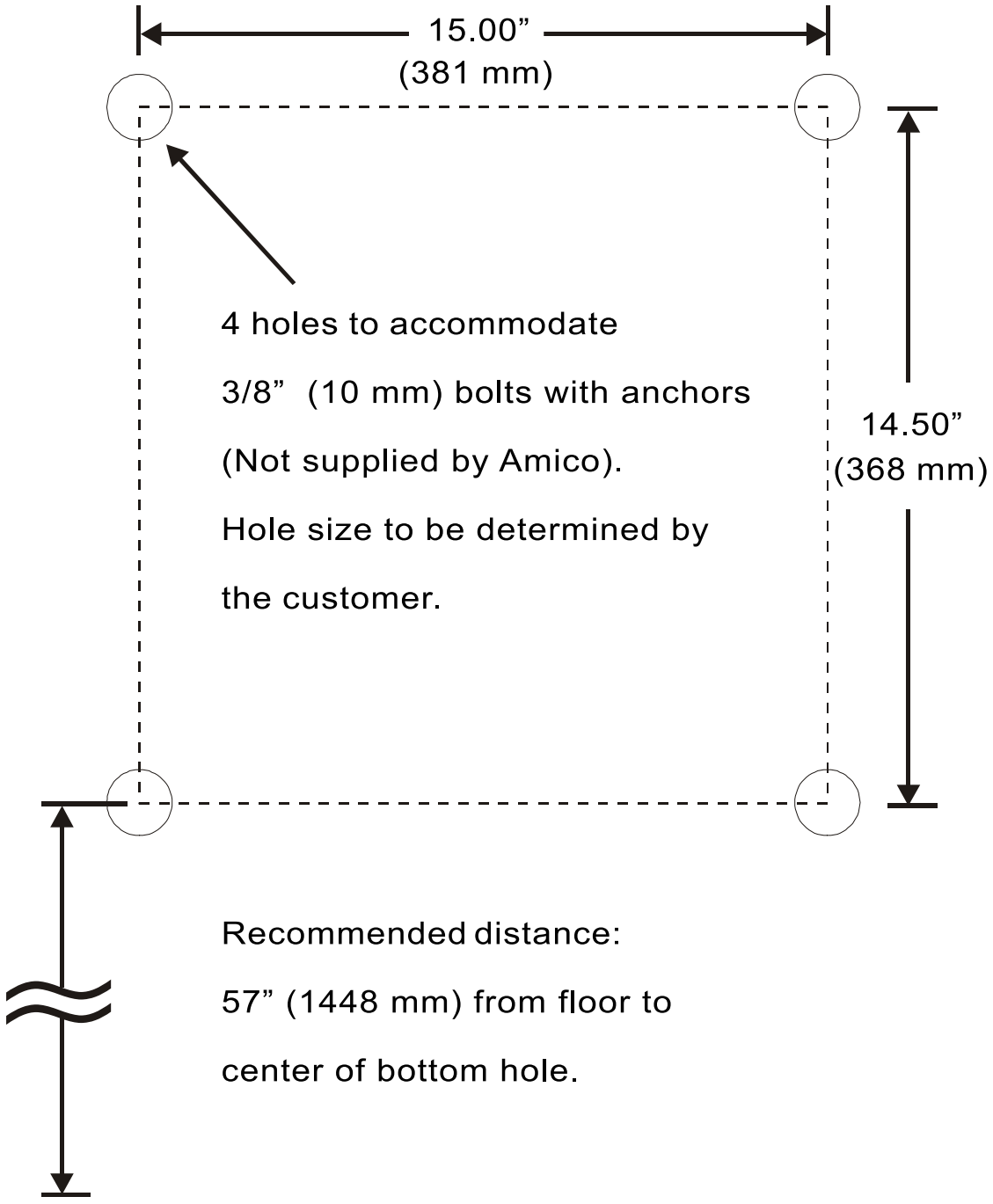
Appendix J

2 Cylinder Straight Header-Bars



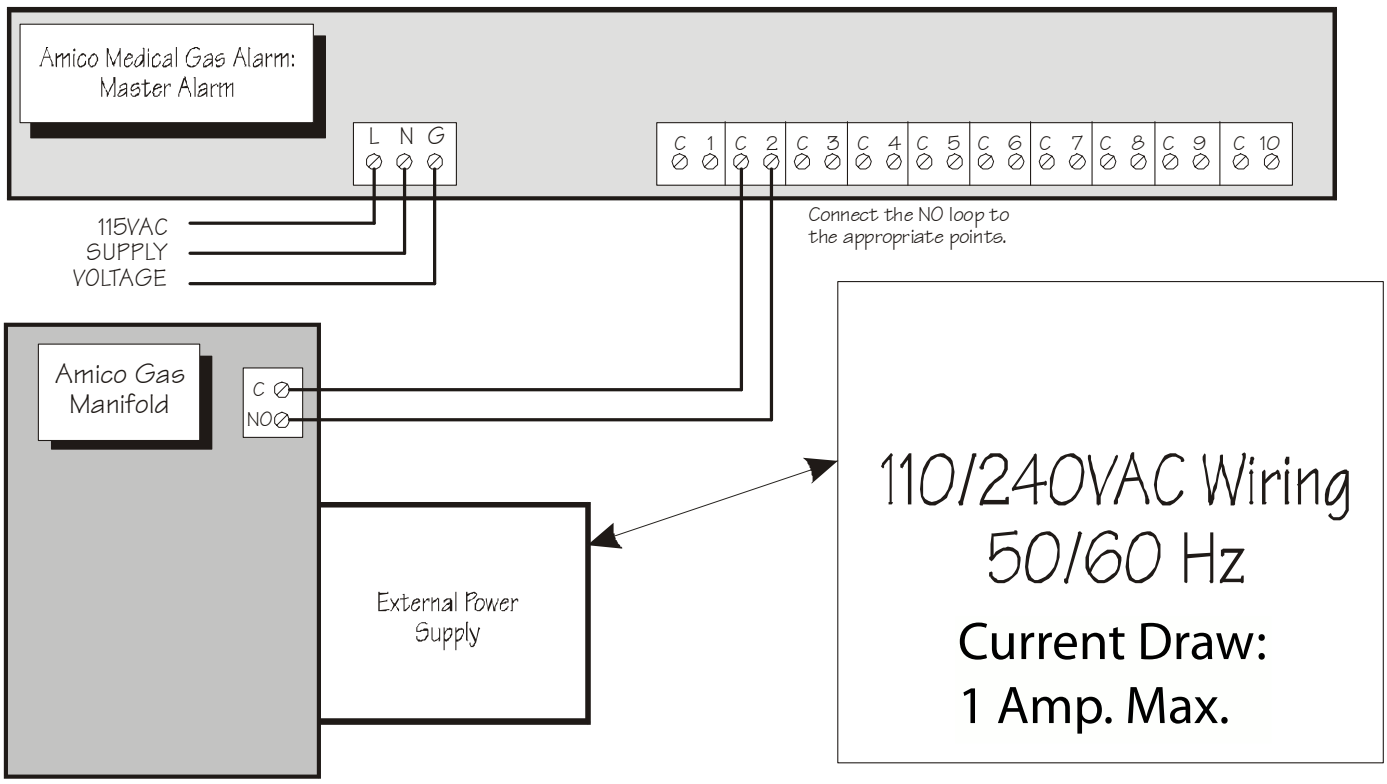
Appendix K

Support Bracket Hole Pattern Layout



Appendix L

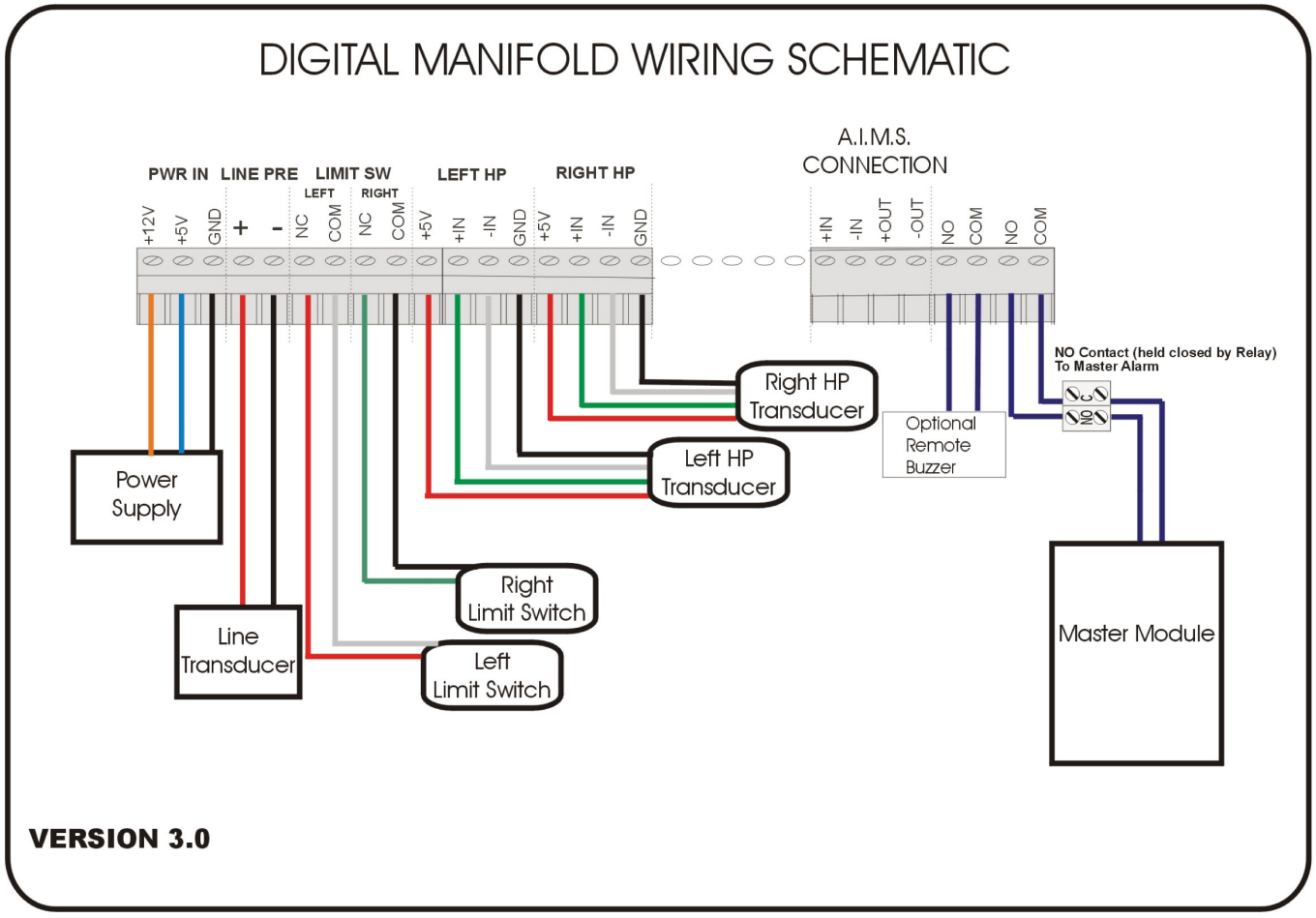
Electrical Wiring Diagram



Electrical Wiring Diagram

Appendix M

Control Cabinet Wiring Diagram



Appendix N

Standard Manifold Flow Rates - All

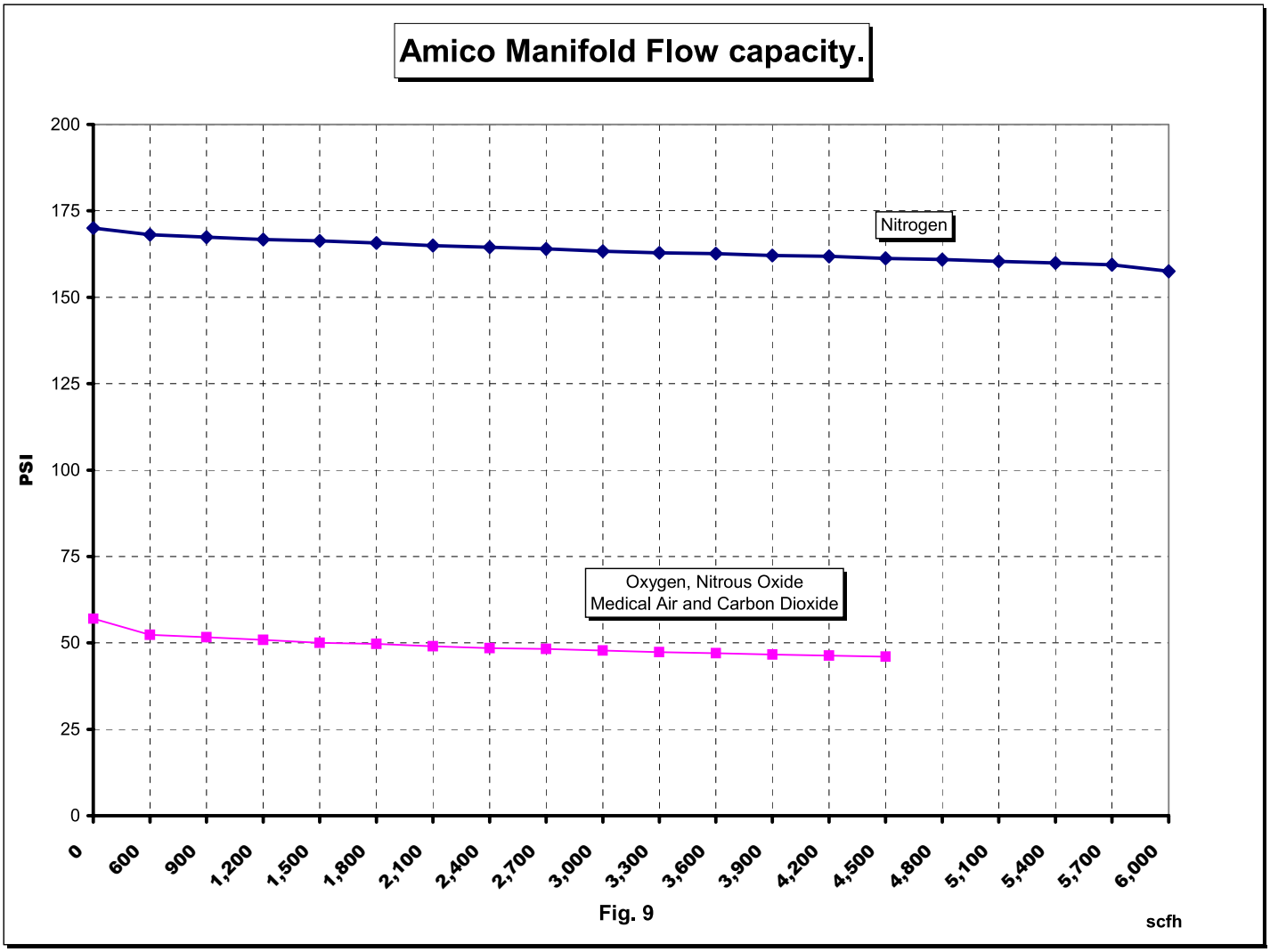
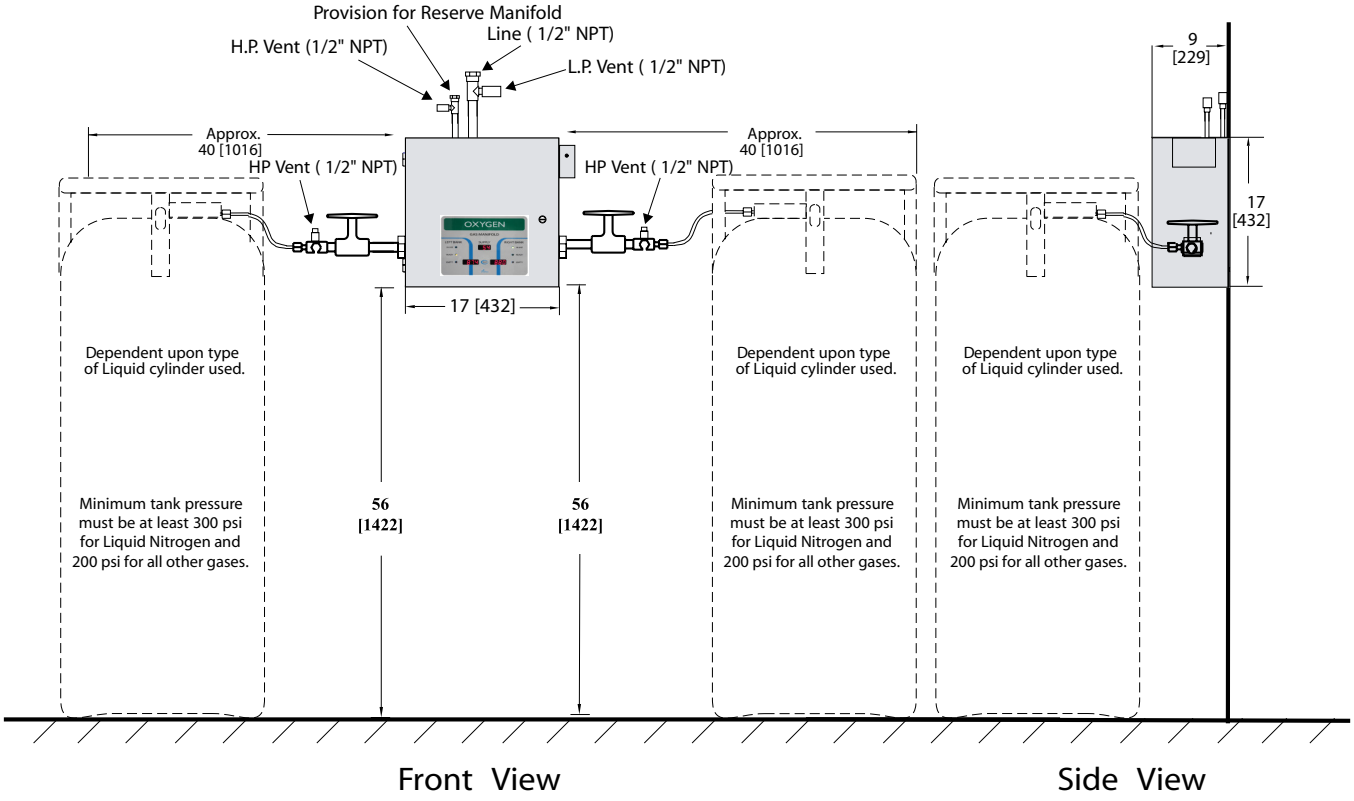


Fig. 9

Appendix O

Liquid Cylinder Applications

The Liquid by Liquid manifold is specifically designed to regulate and monitor vaporized gas from cryogenic liquid cylinders. The manifold incorporates special cryogenic regulators to prevent regulator freeze up under high-flow conditions. To prevent the loss of useful gas into the atmosphere, an economizer circuit is included to utilize the accumulated excess pressure from the secondary supply bank. The economizer circuit re-routes the excess pressure into the line via check valves inserted into the main inlet blocks, then passes through the 0.007" orifice which goes into the main center section of the manifold.



The Manifold shall be a digital, fully automatic type and shall switch from "Bank In Use" to "Reserve" bank without fluctuation in the supply line pressure and without the need for external power. After the switch-over, the "Reserve" bank shall then become the "Bank in Use" and the "Bank in Use" shall become the "Reserve" bank. After replacing the depleted cylinder with a new one, the **'Push to Test'** button on the front of the cabinet must be pressed to re-set the manifold into "Ready" mode.

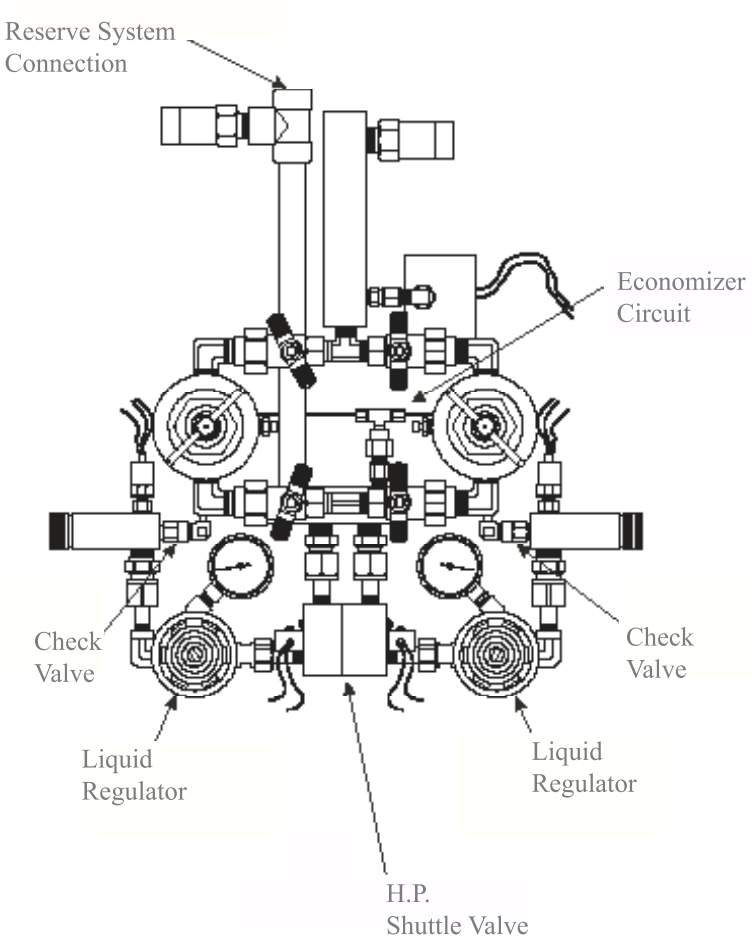
NOTE: Flow Capacity depends on the amount of cylinder(s) and type of cylinder(s) used. For Oxygen the average flow per liquid container/cylinder is 350scfh. Flow capacity is increased with additional containers, for higher flow requirements an external vaporizer (supplied by others) is necessary. For the manifold, the maximum flow rate is approximately 1000scfh. Manifold not recommended to be used for hyperbaric chambers.

Appendix P

Liquid Manifold Settings

Normal Operating Pressure PSI (kPA)
For Gas Services

	Oxygen & Air	Nitrous Oxide	Carbon Dioxide	Nitrogen
Input Pressure	230 (1586)	230 (1586)	230 (1586)	330 (2276)
Operating Regulator	150 (1034)	150 (1034)	150 (1034)	275 (1896)
Line Regulator	55 (379)	55 (379)	55 (379)	170 (1172)
Line Relief Valve	75 (517)	75 (517)	75 (517)	225 (1550)
Operating Relief	375 (2585)	375 (2585)	375 (2585)	375 (2585)



Warranty Policy

Amico Corporation warrants its Medical Gas Pipeline Equipment to be free from defects in material and workmanship for a period of twelve (12) months from the date of shipment. Within this period Amico will repair or replace any part on site, or at the factory, which is proven to be defective at Amico's cost.

Furthermore, Amico will warrant its material to be free from defect for an additional period of four (4) years (five (5) years from the date of shipment). Within this period, Amico will replace any part, at no charge, which is proven to be defective. Shipping and Installation costs after the 1st twelve (12) months will be borne by the Customer.

This warranty is valid only when the product has been properly installed according to Amico specifications, used in a normal manner and serviced according to factory recommendations. It does not cover failures due to damage which occurs in shipments or failures which resulted from accidents, misuse, abuse, neglect, mishandling, alteration, misapplication or damage that may be attributable to acts of God.

Amico shall not be liable for incidental or consequential damages resulting from the use of the equipment.

All claims for warranty must first be approved by Amico's Service Department (service@amico.com or 1-877-462-6426). A valid Return Goods Authorization (RGA) number must be obtained from Amico prior to commencement of any service work. Warranty work, which has not been pre-authorized by Amico, will not be reimbursed.

Notes

Notes

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