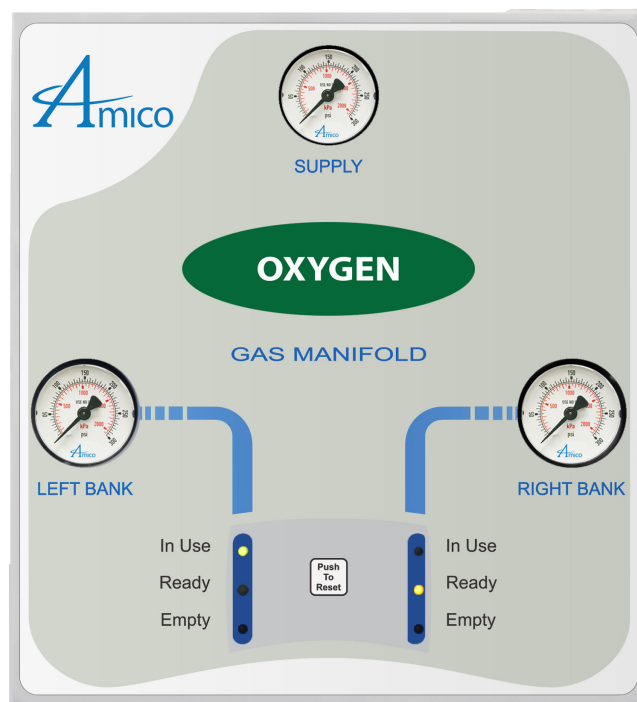


# Operating & Maintenance Manual

## Automatic Cryogenic Liquid Solenoid Manifold NFPA v1.1



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# User Responsibility

The information contained in this Installation and Maintenance Manual pertains only to the Amico Automatic 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.

**All Manifolds should not be repaired or altered without prior written approval by Amico Corporation or its 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 Automatic Cryogenic Liquid Solenoid Manifold is designed to provide a reliable, uninterrupted supply of gas to a hospital or other medical facility. The manifold accommodates multiple cryogenic containers divided into two equal banks. One bank is designated as a "Primary" source of gas while the other bank stands in reserve as a "Secondary" source.

A display of LED's on the front of the manifold indicates the status of the gas supply. Each bank has a green (IN USE), yellow (READY) and red (EMPTY) LED. When the primary bank of cylinders are depleted, the manifold will automatically switch to the secondary bank of cylinders without interruption of gas flow to the facility. The red LED will illuminate when a bank is depleted and two normally closed dry contacts for the reserve In-Use alarm will open. One or both sets of contacts may be wired to an external alarm, remote buzzer and/or a building management system.

When the empty Liquid tanks / Dewar's are replaced with full ones, the manifold will need to be reset by pressing the "PUSH TO RESET" button on the front of the cabinet. At this time the status is changed from EMPTY to READY mode as indicated on the LED display that the bank is now the secondary bank.

Note: the "PUSH TO RESET" button should not be pressed until the empty Liquid tank / Dewar has been replaced with a full one.

The power supply is connected to the top right hand corner of the manifold. Connections from the manifold to the Amico master alarm must be made from terminals marked C/Signal to the appropriate terminals (Reserve In-Use) on the master alarm or a remote buzzer.

The Manifold is designed in accordance with the National Fire Protection Association (NFPA 99)

## **FEATURES INCLUDE:**

- Input power to the manifold is 110-240 VAC, 50-60Hz
- Incorporates six LED's display - readable in poor lighting conditions
- Dual line pressure regulators
- 3/4" Isolation valve for supply line
- Wall mounting bracket attached to manifold for easy installation
- Manifold complies with NFPA 99
- Economizer circuit

# Description of the Manifold

## SHIPMENT DETAILS

The Manifold system may be shipped in more than one carton, depending on the number of cylinder connections. The main carton contains the following items:

- Manifold control panel (with power supply assembly)
- Wall mounting bracket (attached to manifold control panel)
- 3/4" (19.05mm) source shut-off valve
- Installation, Operation and Service manual

Additional cartons may contain appropriate number of headers and cylinder pigtail assemblies. Cylinder inlets closest to the manifold control panel are intended for cylinders placed directly beneath the manifold control panel. Pigtails for all gases are 72" (1,828.8mm) flexible type. The manifold is designed to be mounted directly to a wall.

## THE MANIFOLD ENCLOSURE

The manifold contains a switch mode power supply that can handle voltage from 110-240 VAC with a built-in fuse and terminal block. The enclosure on this manifold is NEMA-1 (general purpose applications only). This cabinet must **not** be mounted outdoors. For outdoor use, a NEMA- 4 enclosure is recommended.

The manifold also has a latched enclosure that is easy to remove. The pre-assembled circuit board is located on the center of the enclosure with a hinged mounting bracket. 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.

## MANIFOLD DISPLAY BOARD

The LED's on the front of the Manifold indicate the status of the gas supply. The primary bank will indicate (In-Use, with the Green LED turned on) and the reserve / secondary indicating (Ready, with the Yellow LED turned on) or (Empty, Red LED turned on) depending on the status of gas. When the primary bank of cylinders are depleted, the manifold will automatically switch to the secondary bank of cylinders without interruption of gas flow to the facility. The Red LED will illuminate when a bank is depleted and two normally closed dry contacts will open. One or both sets of contacts may be wired to an external alarm, remote buzzer and/or a building management system.

When replacement cylinders are attached to the depleted bank and the reset button pressed, the red LED goes out and the yellow LED illuminates indicating that the bank has been automatically designated as the secondary supply. No other user interaction is required. Both sets of dry contacts close to cancel any external alarm conditions.

## ECONOMIZER CIRCUIT

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.

# Description of the Manifold

## LIQUID TANKS

Liquid cylinders contain the product in a liquid state inside of the container. The liquid has to be converted to gas before entering the manifold. This can be done by the container VIA the internal vaporizers, or in a high or low flow situation with an external vaporizer. The contents of the liquid container can only be measured by weight. A gauge on the tank, or simply rocking the tank to determine its weight. The contents of the tanks cannot be measured by the pressure output. The gauges on the manifold for bank pressure do not indicate the amount of product inside the liquid tanks.

## GAS FLOW THROUGH THE MANIFOLD

The liquid containers are divided into two banks. One bank will be the "In-Use" and the other bank will be "Ready" or secondary bank. The bank In-Use can be either bank with the other bank as secondary, depending on the current status. As the "In-Use" bank depletes (liquid is gone and pressure drops in that bank) the manifold will switch to the secondary bank. Indicator LEDs will change to indicate the "In-Use" now as "Empty" and the "Ready" bank will become "In-Use".

### NOTE:

It is common for the pressure on the empty bank to increase and give the false indication that the tank is full. Always check contents of tanks via weight and float gauge on the tank.

The "Empty" tank can then be replaced with a full one. The manifold will not reset until the "Empty" bank is replaced and the "Push to Reset" button is pressed. At this time the status is changed from "Empty" to "Ready". That bank is now the secondary bank. The "Push to Test" reset should not be pressed until the empty tank has been replaced with a full one.

During normal operation this sequence of alternation will change, the "In-Use" and "Ready" banks from right hand to left hand banks back and forth as tanks get depleted.

Depending on the amount of gas usage the pressure building valve on the tank "In-Use" may need to be left open. This allows the tank to convert adequate liquid to gas for the higher flow needed. This will depend on the facility's usage. This will normally cause frosting on the outside of the container indicating the proper operation of the pressure builder. Occasional venting of gas on the tank to relieve excessive pressure is normal and can be expected.

## RESERVE (HIGH PRESSURE) BANK

The high pressure reserve bank is used to back up the liquid tanks. The reason is that sometimes the liquid tanks (both banks) could run empty and the personnel using the system does not know how to determine the amount of liquid content inside the tanks.

When the liquid tanks run empty, the pressure inside the manifold will drop (in the case of OXY, CO<sub>2</sub> & N<sub>2</sub>O below 150 PSI and NIT below 275 PSI). At 80 PSI for OXY, CO<sub>2</sub> & N<sub>2</sub>O and 180 PSI for NIT, the High Pressure Reserve manifold will start to supply gas. An alarm from the Reserve In-Use pressure switch (set at 85 PSI for OXY, N<sub>2</sub>O & CO<sub>2</sub> and 190 psi for NIT) will be activated. The Reserve header has a reserve low pressure switch (to be set at 1100 PSI for OXY, NIT & AIR and 500 PSI for CO<sub>2</sub> & N<sub>2</sub>O) that will ensure the Reserve Header has adequate volume to supply the facility until the liquid tanks are replenished. The reserve high-pressure tank when full is usually around 2300 psi for OXY, NIT & AIR and 800 PSI for CO<sub>2</sub> & N<sub>2</sub>O.

# Description of the Manifold

## RESERVE (HIGH PRESSURE) BANK

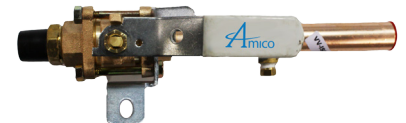
### NOTE:

Flow capacity depends on the amount of liquid containers and type of tanks/containers used. For Oxygen the average flow per liquid tank/container is 350scfh. Flow capacity is increased with additional containers. For higher flow requirements an external vaporizer (supplied by others) is necessary.

## Description of Parts

### MAIN LINE SOURCE VALVE

A 3/4" (19.05mm) isolation valve with a locking handle, supplied with the manifold should be installed on top of the manifold connecting to the main supply line.



### SOLENOID VALVE

The Solenoid valve is 12 VDC, normally open and is located between the Liquid tank/ Dewar and the Line regulator. The Solenoid is logically controlled by the micro display board with the bank In-Use being normally opened and the reserve/secondary being held normally closed.



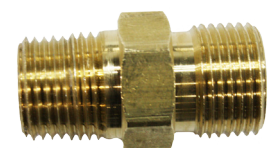
### PRESSURE TRANSDUCERS

The Pressure Transducer senses the bank pressure and transfers information to the display board to indicate the In-Use, Reserve & Empty mode. There are two transducers in the manifold cabinet, one for the left bank cylinder and one for the right bank cylinder.



### CHECK VALVE

A Check valve is provided upstream of each solenoid to prevent back flow while servicing a bank.

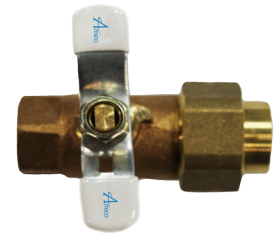




# Description of Parts

## LINE REGULATOR BALL VALVE

Quarter-turn ball valves are provided upstream and downstream of each line regulator. These valves allow for removal and servicing of one of the line regulators while the other is in use. All four ball valves are normally in the open position.



## DUAL LINE REGULATOR

On every Amico Automatic Gas Manifold the line regulator is capable of maintaining a constant dynamic delivery of pressure at the maximum designed flow rate of the system. For Oxygen, Nitrous Oxide and Carbon Dioxide service, the line regulators are factory preset at 55psi and for Nitrogen at 170psi.



## PRESSURE RELIEF VALVE

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. Relief valves are capable of fully relieving the pressure at the set point. All pressure relief valves in the manifold have piping connections to allow for connection of a vent line to the outside of the facility.



## FRONT PANEL INDICATORS

Six front panel indicators monitor the status of the manifold.



# Description of Parts

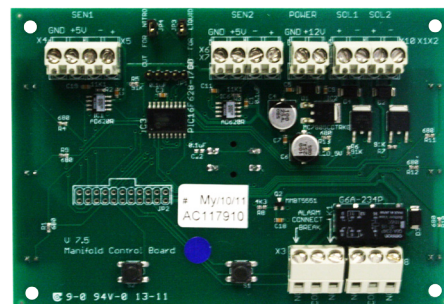
## POWER SUPPLY

The power supply is 110 - 240 VAC, 50-60 Hz. It is mounted on the top right hand side of the manifold and has a 1 amp fuse.



## CONTROL BOARD

The Control Board is an electronic circuit board which controls the bank switch-over. It monitors the pressure with the help of the bank transducers and controls the solenoid valve in order to initiate the bank switch or changeover. The control board illuminates the appropriate front panel LED indicators and also provides dry contacts for connections to a remote buzzer or an external master alarm. Power to the control board is provided by the external power supply.



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

## GAS SERVICE IDENTIFICATION

Amico manifolds are clearly labeled for the intended gas use. The appropriate gas label is attached on the cabinet door. There are two pipes extending from the top of the cabinet, one is for the main line pressure and the other is the vent for the pressure relief valve, which is also labeled accordingly.

## HEADER BAR CONNECTIONS

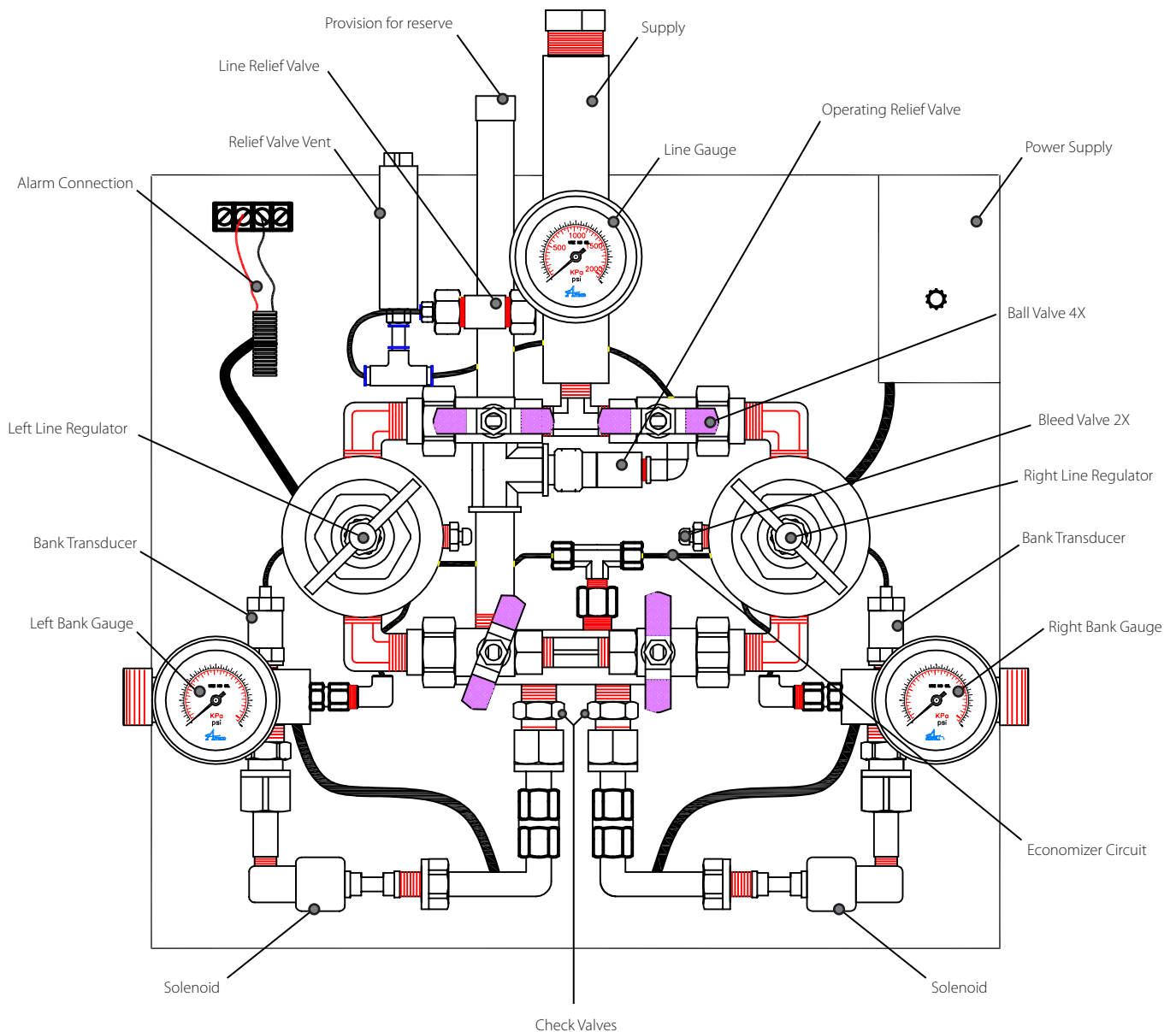
The gas-specific header bar should be attached to the inlet block on either side of the manifold. The inlet block is provided with a sintered bronze filter and a "C" clip to secure it. The header bar should contain the proper gas connections and all cylinder connections; as well the pigtail (hose) assemblies should comply with CGA standard B96, Compressed Gas Cylinder Valve outlet and inlet connections.

# Description of Parts

## OPERATING ALARM SYSTEMS

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.

## PARTS LAYOUT



# Display Functions

1. Introduce power to the control cabinet
2. Follow Cylinder Changing Procedures on the side of the cabinet to ensure that all tanks and fittings are secure and properly connected to the header bar.
3. Check the indicator LED for proper functioning.
4. Open the Liquid Tanks one side at a time and press the "Push to Reset" button between the LED displays. One Green LED, on the side which had the tanks opened first should be lit for In Use and the other side should have a Yellow LED lit for Ready.
5. Close the Liquid tank valves on the primary (In Use) bank and watch the indicator LED to ensure proper functioning. The primary bank pressure should decrease, while the secondary and line pressures stay constant.
6. When the primary bank pressure falls to approximately 100psi for all gases except Nitrogen which is 200psi, the bank switch-over occurs. The line pressure will remain constant with the LED illuminating, indicating the In Use and Empty banks. After replacing the depleted gas cylinders, open the liquid tank valves on the depleted side and press the "Push to Reset" button and the Empty bank should become Ready.
7. With the Manifold wired to the Amico Master Alarm, the change-over from primary to secondary bank will cause an audible alarm. The appropriate indicator LED on the Master Alarm will illuminate. This can also be achieved by using the switch-over test button located on the back of the control board.

The Amico Automatic Manifolds are designed in accordance with the current revision of NFPA 99.

There are two categories of the Amico Manifolds. Depending upon the delivery pressure, the following gas types are available.

## **55psi Delivery Pressure**

- Oxygen, Nitrous Oxide, Carbon Dioxide

## **170psi Delivery Pressure**

- Nitrogen

## **NOTE:**

In the event of a power fluctuation or failure, a switch over alarm will be activated on the master alarm panels.

- Both the solenoid valves will open and supply pressure until both the banks are depleted.
- The solenoid will not prevent the flow from being supplied no matter which side is In-Use and until the system is completely out of gas.

# Installation Precautions

Tampering with gas specific connections shall be prohibited. Do not alter, remove or modify gas specific connections.

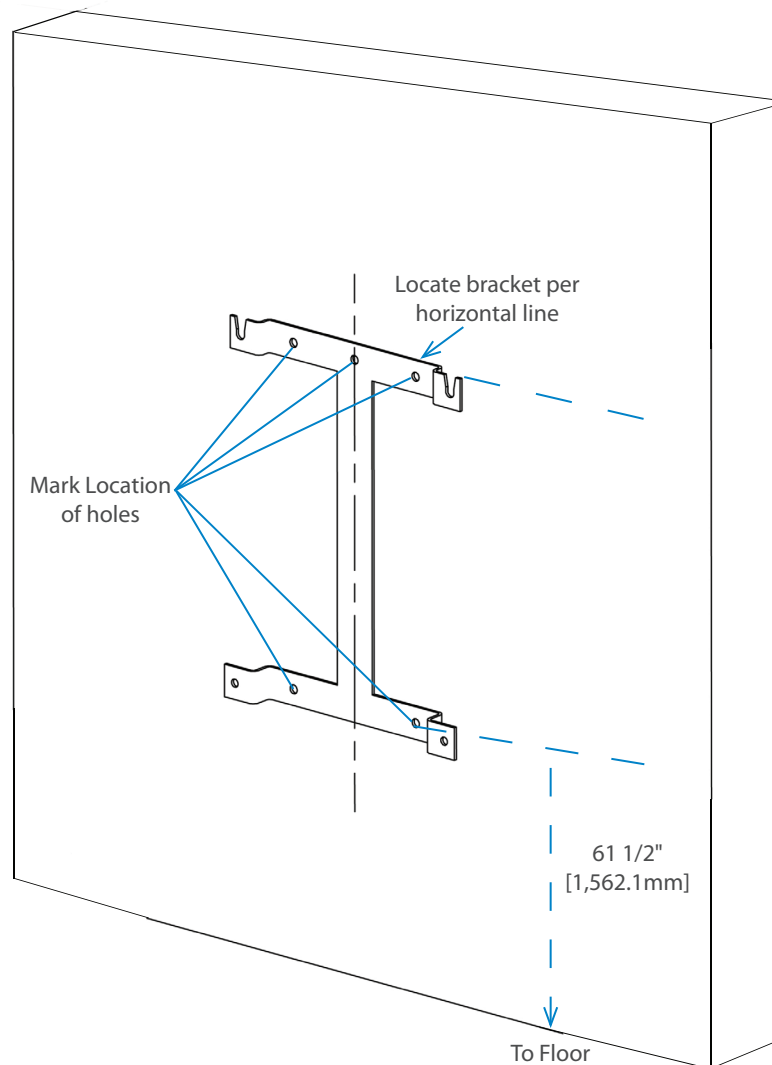
Keep all manifold parts, tools and work surfaces free of oil, grease and dirt. These and other flammable materials may ignite when exposed to high pressure oxygen or nitrous oxide.

- Do not use chemicals, lubricants or sealants unless specified in these instructions
- Before connecting the Liquid tank / Dewar to the manifold, ensure the tank valve is free of dirt and debris
- After connecting the tank to manifold, open the tank valve S-L-O-W-L-Y to allow heat of compression to dissipate
- Do not use flame or "sniff" tests for leaks
- Do not apply heat to any part of the manifold system
- Always ensure Liquid tanks / Dewar's are secure and on level floor
- Do not repeatedly bend, sharply bend, or twist pigtails as damage to tubing may occur
- After the manifold wall bracket has been mounted, at least two people should lift and hang the manifold cabinet, one should not do this alone
- Do not put the manifold into operation until verified by a qualified person as per NFPA 99 or other local standards

# Wall Mounting Instructions

1. Remove manifold control panel from the shipping carton and ensure it is in upright position on the foam packaging insert.
2. Using the back support bracket as a template, place on the flat wall, align top of the bracket with the level horizontal line. The vertical center line of the bracket will be the vertical center line of the installed manifold. The support bracket should be mounted 61-1/2" [1,562.1 mm] from the finished floor to the bottom hole on the bracket as shown in **Figure 1**.
3. Mark locations of mounting holes. Remove the bracket and drill mounting holes. Attach the bracket to the wall with appropriate anchors (supplied by others). 3/8" [9.525 mm] diameter anchors are recommended.

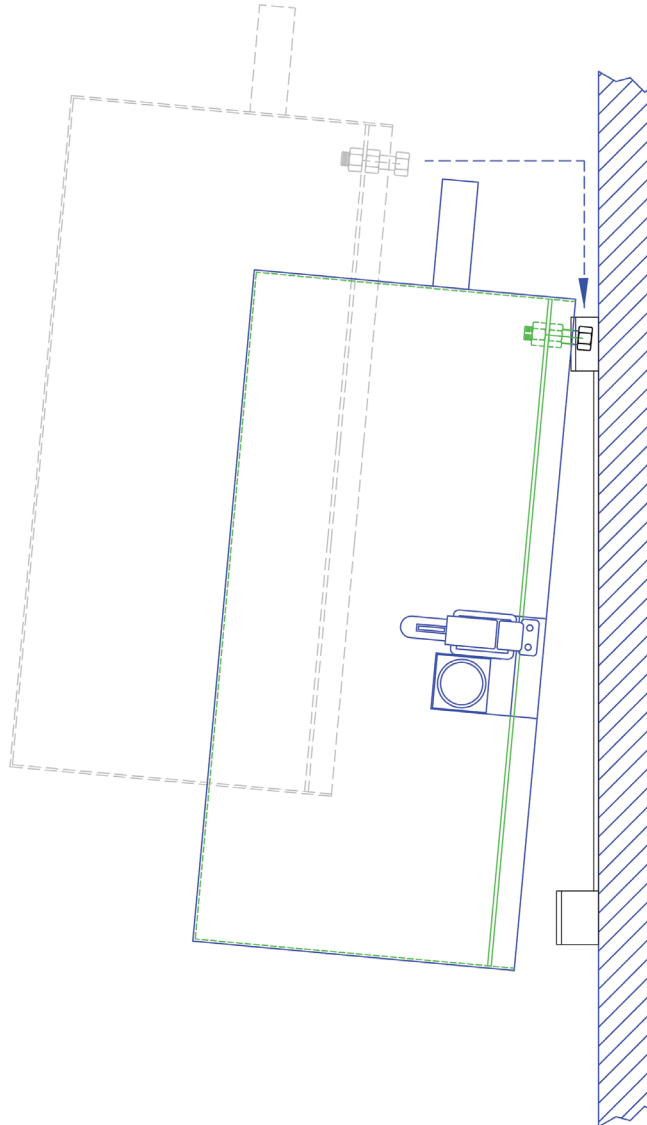
**Figure 1**



# Wall Mounting Instructions

4. Hang the manifold control panel on the mounting bracket. The top two control panel mounting bolts will slide into slots of the bracket. The bottom of the manifold control panel should be angled away from the bracket until the top two bolts have been inserted as shown in **Figure 2**.

**Figure 2**



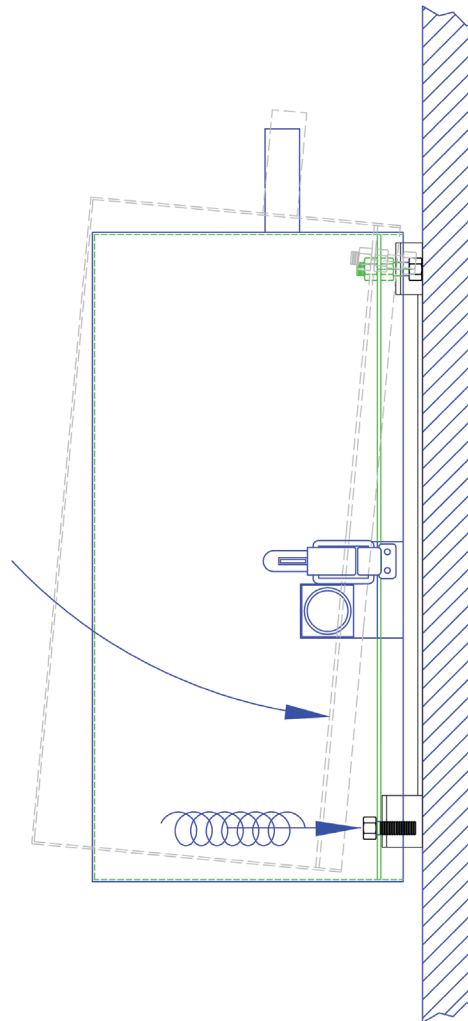
**NOTE:**

A bracket mounting height of 61-1/2" [1,562.1 mm] from the finished floor to the bottom hole on the support bracket allows for adequate clearance beneath the manifold when utilizing standard "H" size or slightly taller cylinders.

# Wall Mounting Instructions

5. The bottom of the control panel can then be positioned so that the holes at the bottom of the panel align with the holes in the hanging bracket. Use 3/8" [9.525 mm] bolts to secure the cabinet to the bracket as shown in **Figure 3**.

**Figure 3**



**WARNING:** Do not attempt to lift manifold alone. Two people are recommended for hanging the manifold onto wall mounting bracket



**CAUTION:** Do not use thread sealant on header bar or pigtail connections



# Tank Installation Instructions



**CAUTION:** This section contains important information necessary for proper installation. Read it carefully before installing Header bars

- Position the wall brackets
- Connect the two header bar assemblies to the inlet blocks on either side of the cabinet
- Secure the Header bar assembly by tightening the union nuts onto the inlet blocks
- Remove the plug and chain assembly on each of the outlet connections on the header bar
- Attach the 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 potentially hazardous materials, keep pigtails in plastic wrapping until such time as connection to gas cylinder is planned

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 Leaks

The following instructions apply for performing a leak test on the joints made during assembly and connection of the Amico manifold.

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 the tank and header bar sections or at the pipeline connections, the systems 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.

- Connect a Liquid tank of the manifold service gas to the header bars on each side of the manifold using the proper tank connection hose assemblies (pigtailed) supplied
- Make sure all other outlets are capped with the plug and chain assemblies supplied
- Make sure that the pressure inlet valves of each bank are fully **OPEN**
- “S-L-O-W-L-Y” open the tank valves on each side of the cabinet, one side at a time, to pressurize the header bar and pipeline
- All outlets from the pipeline, downstream of the manifold, should be closed and thus there should be no flow from the manifold
- Check for leaks at all tank extension joints and at the joints where the pipes are connected to the pipeline, using a commercial leak detector which is compatible with oxygen
- If any leaks are found the system must be depressurized by bleeding through a convenient pipeline outlet and the faulty connections must be repaired
- The Header bar connections may be tightened one more turn maintaining the horizontal location of the tank adapters, or a further application of an oxygen service threaded sealant may be required
- 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 mentioned previously

# Initial Power-Up

1. Release the two latches on either side of the manifold control panel and remove the cover.
2. Verify the following:
  - Both master valves located on both header bars are open
  - All four line regulator isolation valves are open (handles in horizontal position)
  - Power supply has been connected
  - Both Red "Empty" indicators on the front of the manifold are illuminated
  - If connected to a master alarm panel, "Secondary Supply" alarm is activated
3. Close 3/4" source shut-off valve.
4. Slowly open one tank on the right side of the manifold and press the "Push to Reset" button between the bank LED indicators.
5. Verify the following:
  - Right bank Red "Empty" LED goes out
  - Right bank Green "In Use" LED illuminates
  - Right bank cylinder contents gauge reads cylinder pressure
6. Slowly open one tank on the left side of the manifold and press the "Push to reset" button between the bank indicators.
7. Verify the following:
  - Left bank Red "Empty" LED goes out
  - Left bank Yellow "Ready" LED illuminates
  - Left bank cylinder contents gauge reads cylinder pressure
  - If connected to a master alarm panel, "secondary supply" alarm is not activated
8. Close right bank cylinder. Slightly depress bleed valve located on the side of the regulator. Verify the following:
  - Right bank cylinder contents gauge drops slowly
  - As the right cylinder contents gauge is nearly depleted, the manifold changes over to the left bank
  - After change-over, the right bank Green "In Use" LED goes out and the Red "Empty" LED illuminates
  - After change-over, the left bank Yellow "Ready" LED goes out and the Green "In Use" LED illuminates
9. Verify the "line pressure" gauge reading is acceptable.
10. Slowly open one cylinder on the right side of the manifold and press the "Push to Reset" button.

# Initial Power-Up

11. Verify the following:
  - Right bank Red "Empty" LED goes out
  - Right bank Yellow "Ready" LED illuminates
  - Right bank tank contents gauge reads cylinder pressure
12. Close left bank tank. Slightly press bleed valve located on the side of the line regulator. Verify the following:
  - Left bank tank contents gauge drops slowly
  - As left cylinder contents gauge is nearly depleted, the manifold changes over to the right bank
  - After change-over, the left bank Green "In Use" LED goes out and Red "Empty" LED illuminates
  - After change-over, the right bank Yellow "Ready" LED goes out and Green "In Use" LED illuminates
13. Slowly open one cylinder on the left side of the manifold and press the "Push to Reset" button
14. Verify the following:
  - Left bank Red "Empty" LED goes out
  - Left bank Yellow "Ready" LED illuminates
  - Left bank cylinder contents gauge reads tank pressure
  - If connected to a master alarm panel, "secondary supply" alarm is not activated
15. Close left and right side cylinders.
16. Record pressure readings of left and right bank tank contents gauges.
17. Wait 15 minutes.
18. Compare current readings of the left and right bank tank contents gauges to those recorded in step 16. If there is a noticeable pressure change on either gauge, perform leak testing described in Testing For Leaks (page 20).
19. Reinstall manifold control panel cover.
20. Slowly open all tanks on both banks of the manifold.
21. Open 3/4" (19.05mm) source valve.

# Line Regulator Pressure Adjustment

This procedure should be performed if the line regulator pressure is not within acceptable limits during performance verification procedure or after installation of a new line regulator.

1. With both the banks supplying pressure, open ball valves on the inlet and outlet on only one side of the line regulator to be adjusted.
2. Slightly press the bleed valve on the side of the regulator to create a small flow of gas through the manifold.
3. Using the handle on the bonnet of the regulator, turn to adjust the pressure to the specified setting, as mentioned on the cabinet door by observing the line gauge.
4. Repeat (steps 1-3) to adjust the other line regulator.
5. After adjusting the pressure to the specified setting open all ball valves and ensure the supply line remains open.

# Line Regulator Replacement

If necessary, the line regulator replacement can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment.

1. Close the two ball valves on inlet and outlet of line regulator to be replaced.
2. Loosen union nuts on two closed isolation valves.
3. Vent pressure from the bank, which was shut off in step 2, by pressing the bleed valve on side of the regulator.
4. Ensure the orientation of fittings (direction of gas flow) is the same on the replacement regulator. Install fittings on new regulator.
5. Inspect O-ring removed from the ball valve union. If damaged, replace O-ring.
6. Verify the correct orientation of fittings on the regulator; some slight adjustment may be required to align with the ball valves without causing stress to the fittings.
7. Hand-tighten the two ball valve union nuts and then with a wrench snug lightly to ensure the fittings are secure.

**NOTE:** do not over tighten unions, as it is an o-ring seal.

8. Open ball valves and set the line regulator's output pressure as described in Line Regulator Pressure Adjustment procedure.

# Control Board Replacement

If necessary, the control board replacement can be performed while the manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment.

1. Remove two top screws at the base of the display board bracket and tilt the display board assembly back.
2. Disconnect power supply.
3. Remove the screws located on the circuit board, which detaches it from the front plate. Note orientation of the old circuit board and remove wiring one at a time and connect each wire to the appropriate terminal on the new board.
4. Install the circuit board and fasten the screws to secure it. Return bracket to its original position and then fasten the two screws at the base.
5. Reconnect power supply to the manifold cabinet.
6. Check the correct operation of the circuit board by simulating a bank switch over a couple of times.

# Solenoid Replacement

1. Ensure the Solenoid that needs to be replaced is **not** the side that is In-use.
2. Disconnect power supply if manifold is not in service.
3. Remove two top screws at the base of the display board bracket and tilt the display board assembly back and with the help of a small flat screw driver, disconnect the solenoid wires labeled L for left and R for right to indicate the side of the solenoid from the terminal block on the circuit board.
4. Remove the two union nuts on either side of the solenoid, one located at the inlet side and the other at the output side of the solenoid.
5. Install the replacement solenoid and tightened the union nuts on either side to ensure the solenoid is secure.
6. Connect the solenoid wires to the appropriate terminal on the circuit board.
7. Return the circuit board bracket back to upright position and then fasten the two screws at the base.
8. Reconnect power supply to the manifold cabinet.
9. Check the correct operation of the solenoid by simulating a bank switch over a couple of times.

# Tank Changing Procedures

1. Keep the main bank valve open throughout these procedures.
2. Close tank valves on all empty tanks.
3. Disconnect hose / pigtails from tank valve outlets using an appropriate wrench.
4. Place protective caps over the tank valves of the empty tanks and move them aside.
5. Visually inspect the tank valves for dust, grease or oil.
6. Using a clean (lint free) cloth, wipe each tank valve outlet clean. Do not use your fingers.
7. Connect the hose / pigtails to the tank valve outlets and tighten the nut with an appropriate wrench.
8. Very S-L-O-W-L-Y open the valve on the tank closest to the control cabinet. Watch the bank pressure display on the front of the cabinet to make sure the pressure rises slowly.
9. S-L-O-W-L-Y open the remaining tank valves one at a time.



**WARNING:** 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 tanks. Failure to comply with the procedure may be hazardous



**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

# Ordering Information

Manifold Cabinet:

**M3A-DS-LL-L-XXX**

A = Analog

DS = Dual Solenoid

LL = Liquid

The Letter "L" Defines  
the Language:

U = English (NFPA)  
S = Spanish (NFPA)

The Letters "XXX"  
Define the Gas:

OXY = Oxygen  
N2O = Nitrous Oxide  
CO2 = Carbon Dioxide  
NIT = Nitrogen

Header-Bar Assembly:

**M2-HBLQ-XXL-XXX**

Number of Cylinders:

(1\*1 = 02)  
(2\*2 = 04)

LQ = Straight c/w Cryogenic Pigtailes

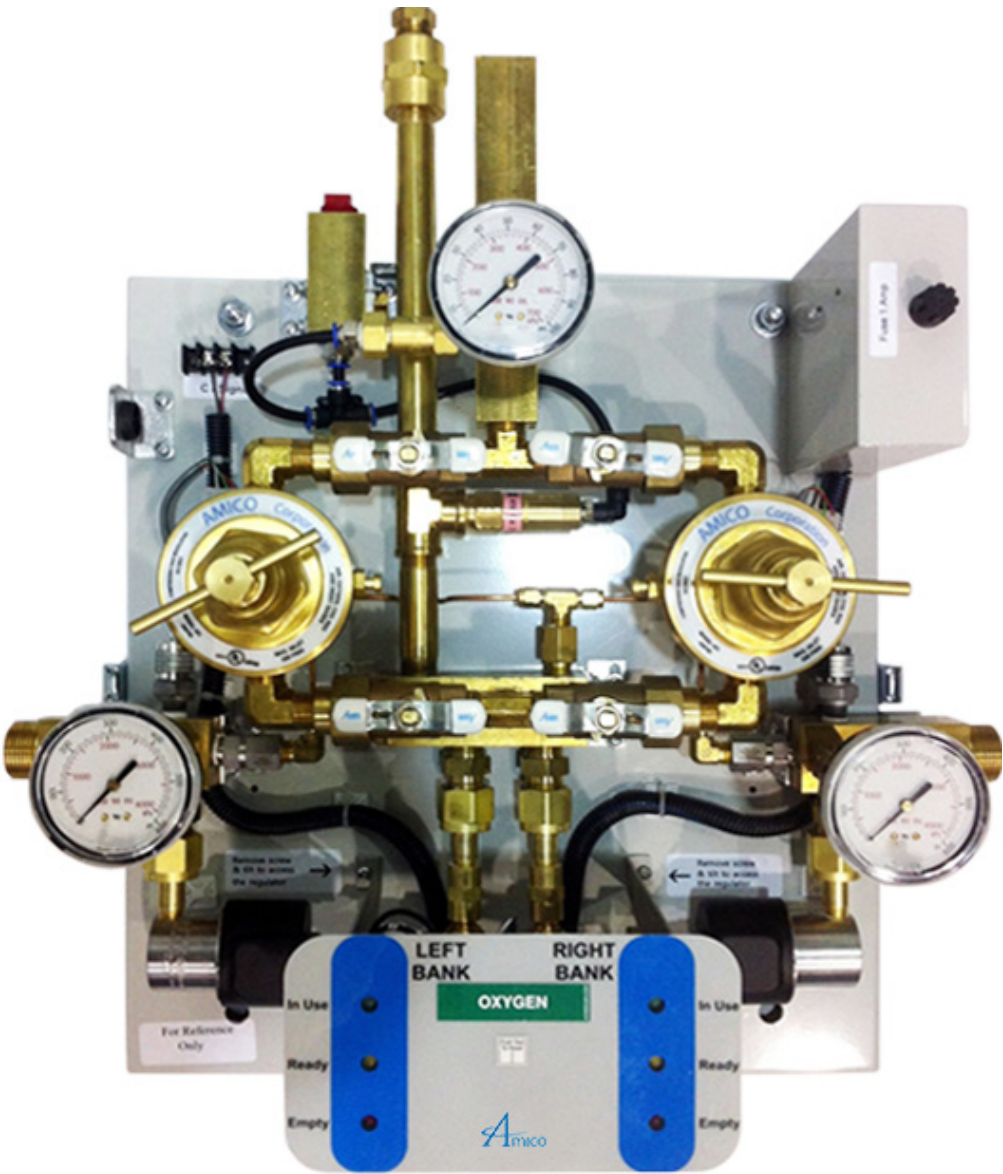


# Control Cabinet Parts List

DESCRIPTION	MODEL NUMBER
Pressure transducer for Oxy, N2O, CO2, & Nit	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
Repair Kit - Line pressure regulator	M2-REG700-RK
Intermediate check valve for all gases	M-X-MAN-33B
Operating pressure relief valve	M-X-MAN-72W-500
Pipe away adaptor	M-X-PIPEAWAY-GNT
Line Pressure relief valve for Nitrogen	M-X-IN-72W-225
Line pressure relief valve for Oxy, N2O, & CO2	M-X-IN-72W-075
Pigtail c/w Check valve – Cryogenic	M-X-HB-CRYO-GAS
	GAS= OXY, N2O, NIT & CO2
ALERT-2.1 LED circuit board	M3-LED-DLCB
Manifold Power Supply Board	M2-X-POWER
Solenoid Valve	M3-X-LIQ-SOLVLV
Economizer check valve	M2-X-MAN-31

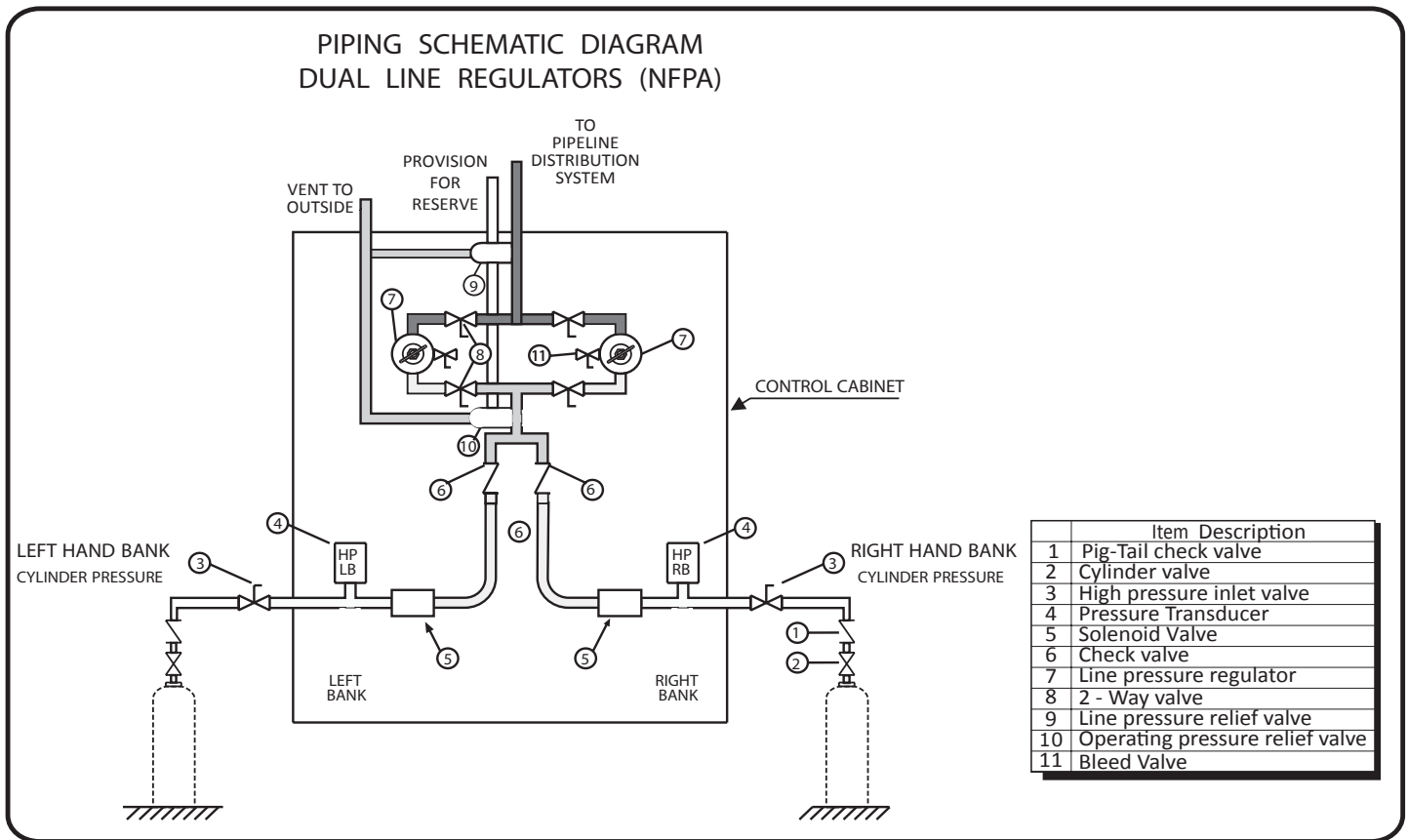
# Appendix A

## Manifold Internal Layout



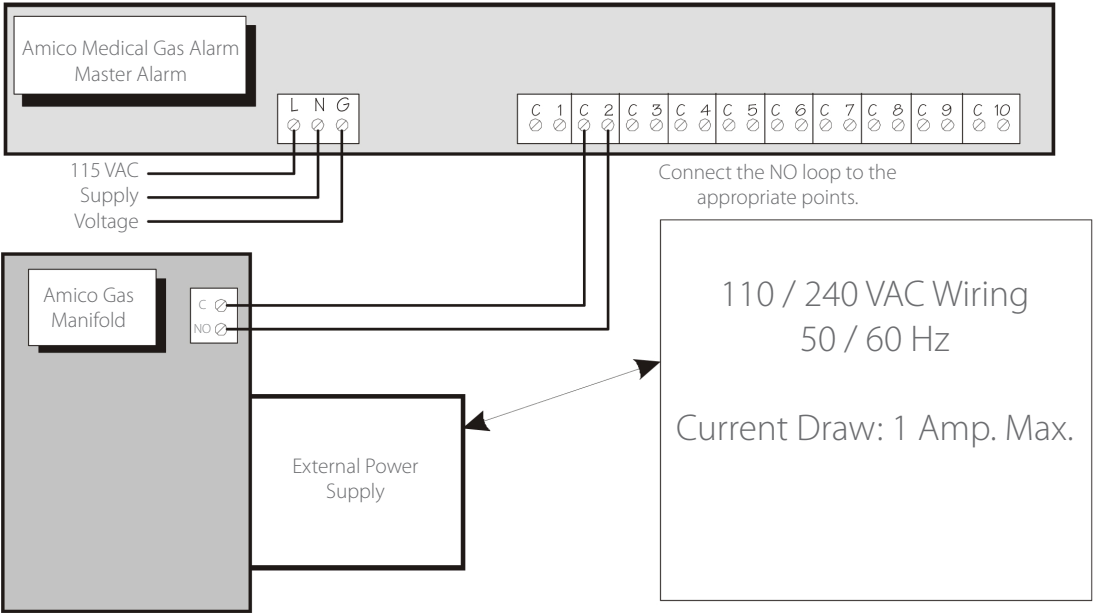
# Appendix B

## Piping Schematic Diagram



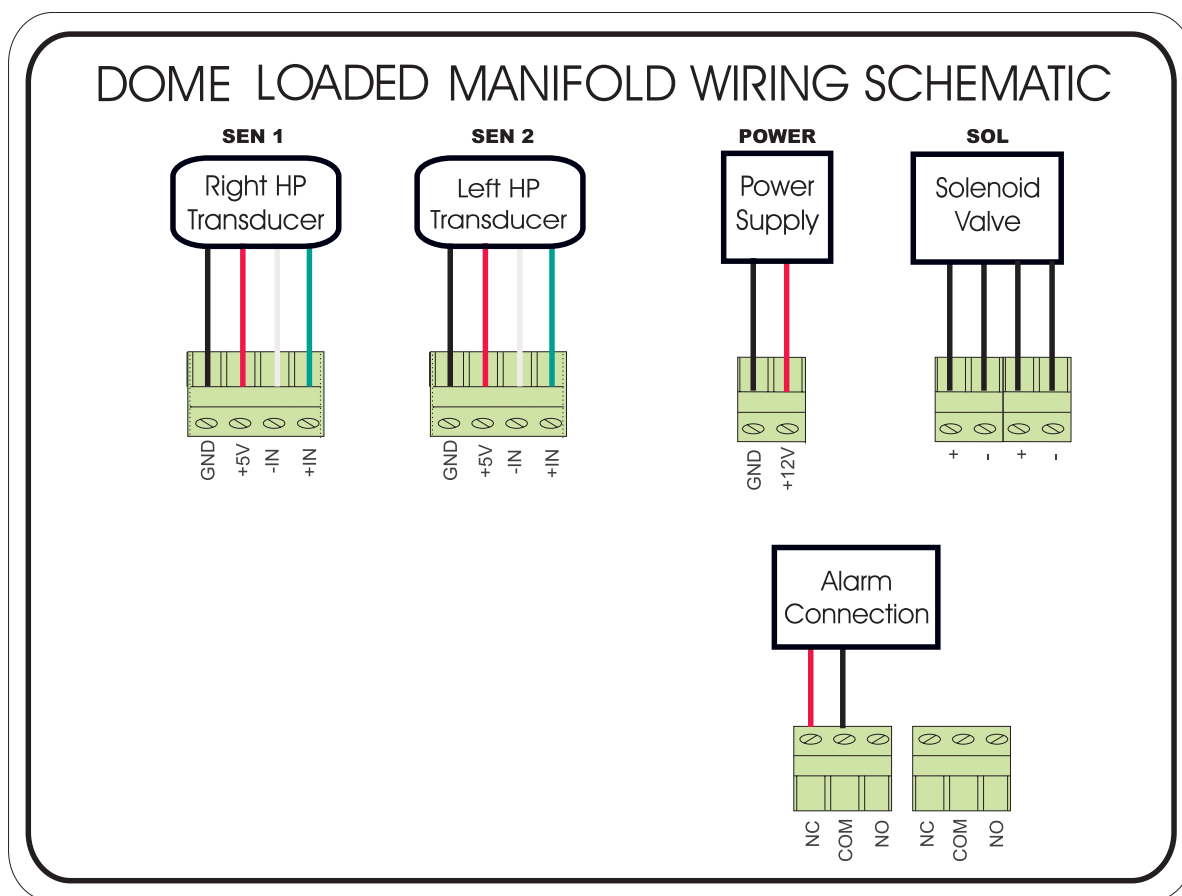
# Appendix C

## Electrical Wiring Diagram



# Appendix D

## Control Cabinet Wiring Diagram

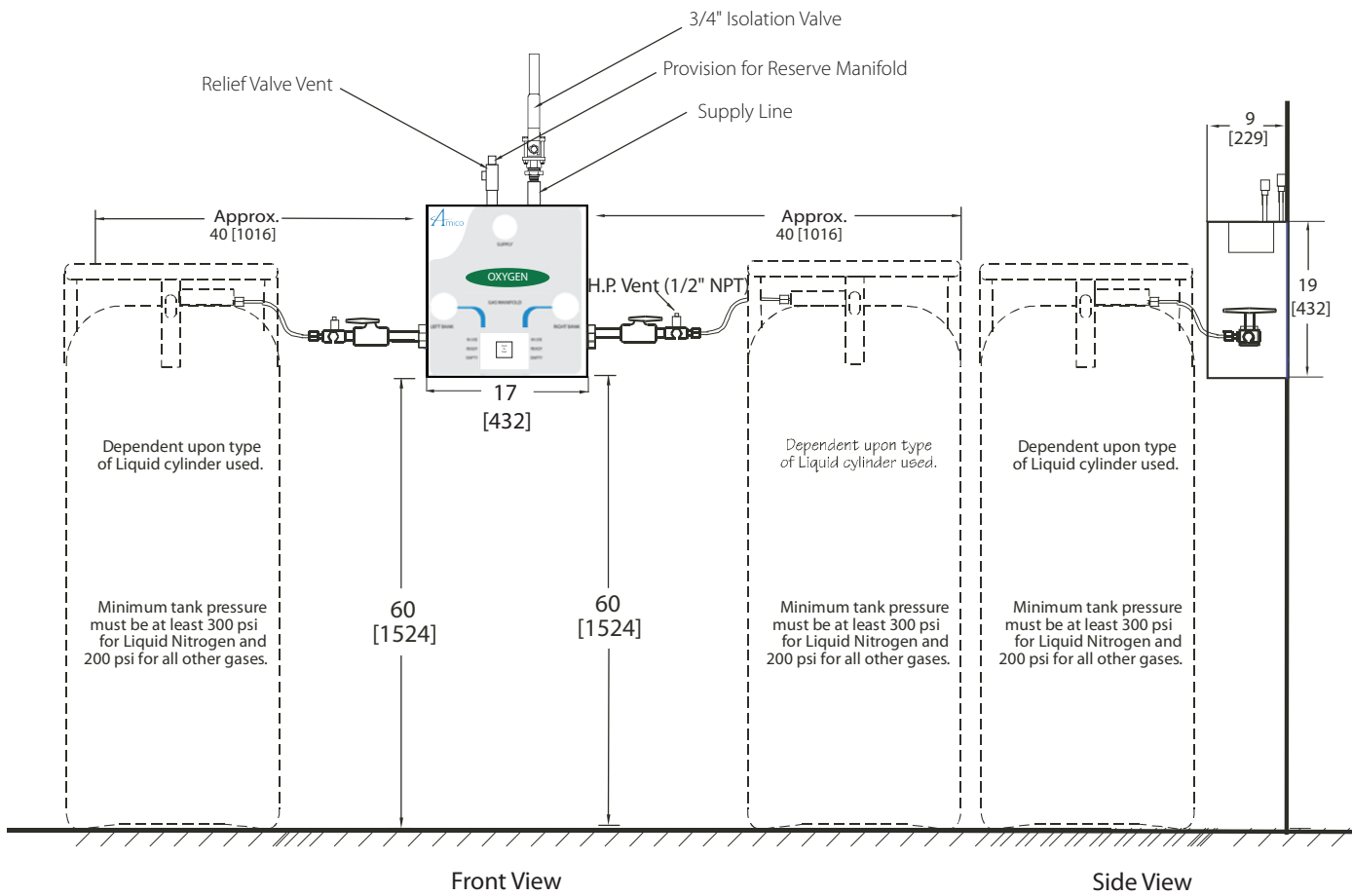


# Appendix E

## Liquid Setup with Header Bars

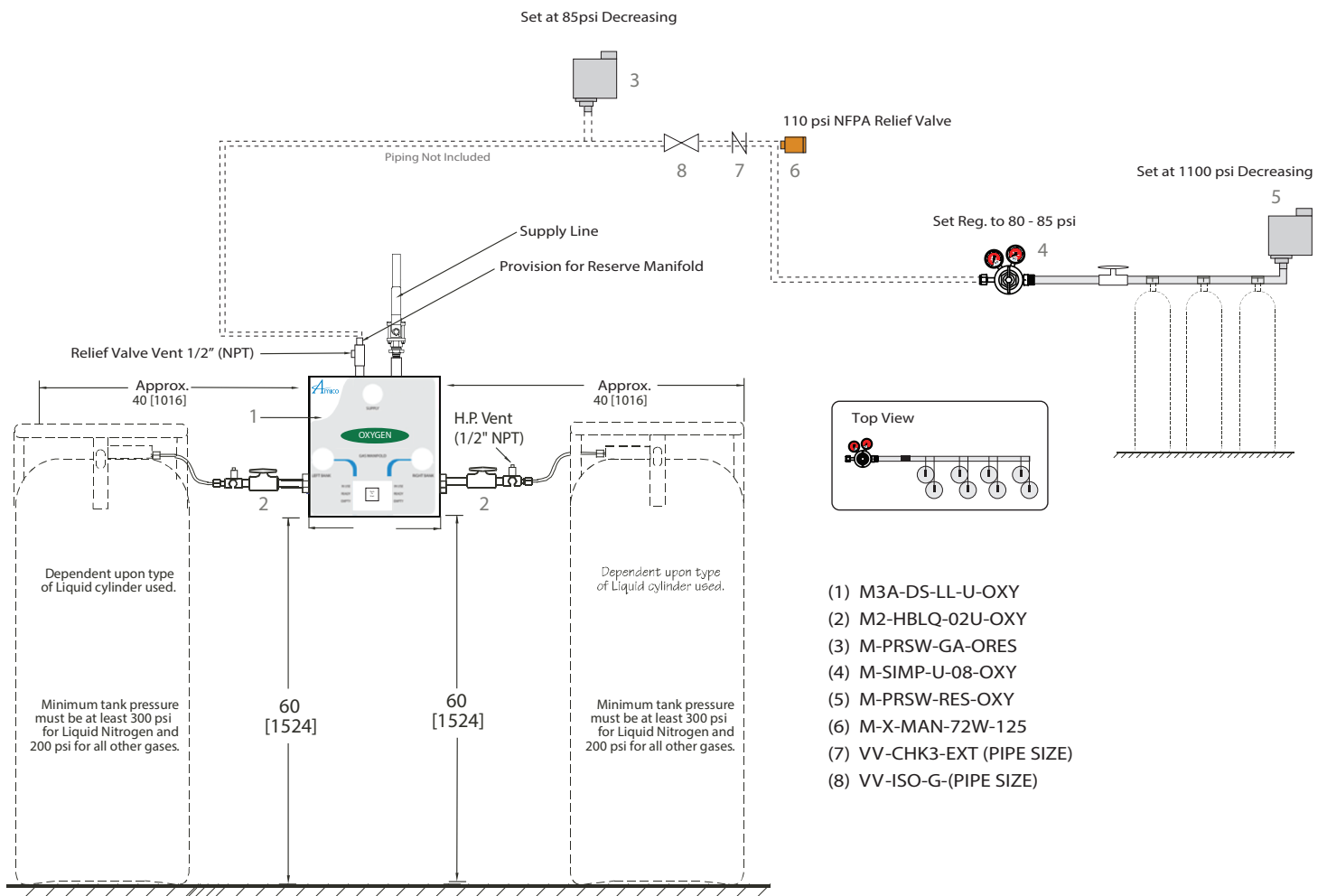
**NOTE:** A standard 450psi relief valve is provided on the header.

Inch [mm]



# Appendix F

## Liquid Manifold with High Pressure Reserve



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