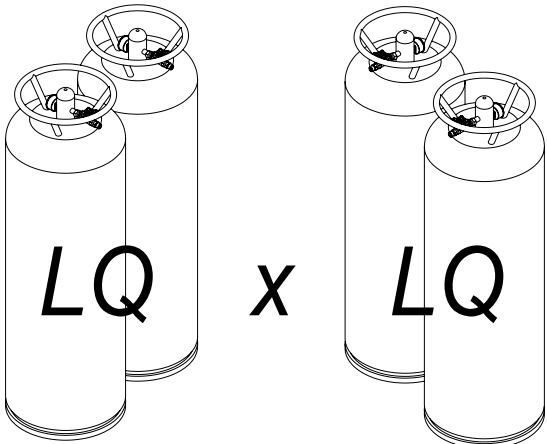
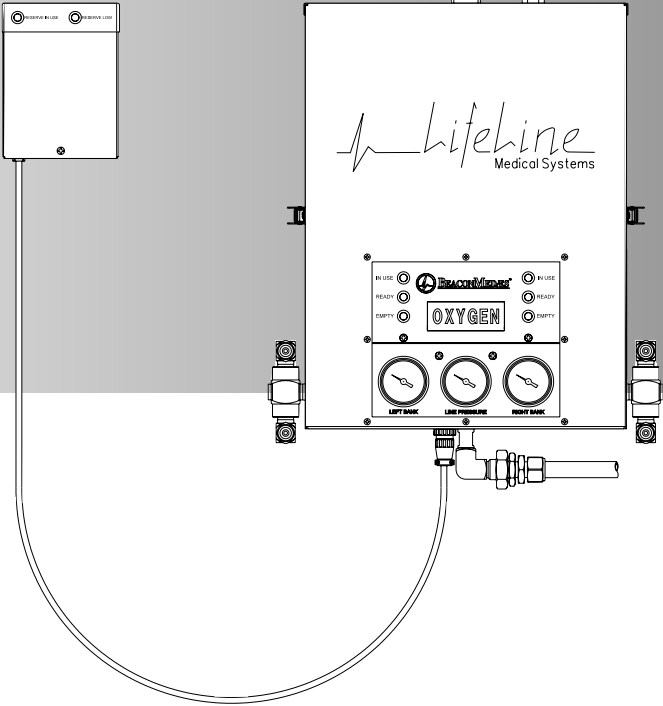


# Lifeline Medical Systems

## Fully-Automatic Manifold

For Use With Liquid Cylinders



*Liquid x Liquid Models*



# Introduction

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## Audience

This manual provides information related to installation and operation of liquid container Lifeline manifold systems manufactured by BeaconMedæS. Service information contained in this manual is intended for use by technicians or personnel qualified to repair and service medical equipment.

## Abbreviations

AR	Argon
CGA	Compressed Gas Association
CO2	Carbon Dioxide
N2	Nitrogen
N2O	Nitrous Oxide
NPTF	National Pipe Thread Female
NPTM	National Pipe Thread Male
NER	Normal Evaporation Rate
O2	Oxygen
PSI	Pounds Per Square Inch
scfm	Standard Cubic Feet Per Minute
scfh	Standard Cubic Feet Per Hour
VAC	Voltage, Alternating Current
VDC	Voltage, Direct Current

## Introduction

### Definition of Statements

Statements in this manual preceded by following words are of special significance.

**⚠ WARNING:** Means there is a possibility of injury or death to yourself or others.

**⚠ CAUTION:** Means there is a possibility of damage to unit or other property.

**NOTE:** Indicates points of particular interest for more efficient and convenient operation.

### Product Description

Lifeline automatic changeover manifold system is designed to provide a reliable, uninterrupted supply of gas to a hospital or other medical facility. A typical manifold system consists of a manifold control panel with two banks of liquid containers and a separate high-pressure reserve header assembly.

Manifold control panel utilizes multiple liquid containers divided into two equal banks and is often referred to as "liquid x liquid" or "LQ x LQ". One bank is designated as "Primary" source of gas while other bank stands in reserve as "Secondary" source.

Manifold control panel is connected to an external high pressure reserve header assembly consisting of multiple high-pressure cylinders.

Lights on front of manifold control panel and power supply enclosure indicate status of gas supply. Each manifold bank has a green (IN USE), yellow (READY), and red (EMPTY) light. The power supply enclosure has a red (RESERVE IN USE) and red (RESERVE LOW) light.

When manifold's primary bank of liquid containers is depleted, system will automatically switch to secondary bank of liquid containers. If secondary bank of containers should become depleted, manifold system will automatically

switch to external high-pressure reserve header assembly.

Normally-closed dry switch contacts are supplied for each alarm condition listed below. Switch contacts are typically wired to external master alarm panels and will open when alarm condition occurs.

- Secondary Supply
- Reserve In Use
- Reserve Low

An external power supply converts 120 VAC to 24 VAC to power manifold. Power supply is connected to bottom of manifold control via a 48" cable.

Lifeline manifold system is designed in accordance with National Fire Protection Association (NFPA) 99.

### Environmental Considerations

Manifolds are to be installed in accordance with requirements stated by NFPA 99, CGA and all applicable local codes.

Manifold components are designed to work best over a temperature range of 32° F (0° C) through 130° F (54° C). Wider temperature variations may cause manifold malfunctions to occur.

BeaconMedæS recommends manifold control panel be located with its power supply at an installation site protected from moisture, continuous exposure to direct sun rays, ice and snow.

Installing a nitrous oxide or carbon dioxide manifold and high-pressure reserve header assembly in a location that exposes it to ambient temperatures below 32° F (0° C) is not recommended.

## Installation

### Precautions

#### **⚠ WARNING:**

- 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 cylinder to manifold, momentarily open and close cylinder valve to blow out dirt and debris.
- After connecting cylinder to manifold, open cylinder 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 secure high-pressure cylinders with racks, straps, or chains. Unrestrained cylinders may fall over and damage or break off cylinder valve.
- Do not repeatedly bend, sharply bend, or twist copper pigtailed as damage to tubing may occur.
- Do not bend flexible pigtailed into a radius smaller than 3”.
- After manifold wall bracket has been mounted, one person alone should not attempt to lift and hang the manifold cabinet.
- Do not put manifold into operation until verified by a qualified person per NFPA 99 or other local standard.

### Manifold System Components

Manifold system will be shipped in more than one carton. Total number of cartons will depend upon number of cylinder connections. Main carton contains the following items:

- Manifold control panel
- Wall mounting bracket (attached to manifold control panel)
- Power supply assembly
- 3/4" source shut-off valve
- High-pressure reserve header inlet fittings
- Installation, Operation, and Service Manual

Additional cartons contain high-pressure reserve header assembly and appropriate number of high-pressure cylinder pigtail assemblies. As a standard, reserve header cylinder inlets are on 5-inch centers. High-pressure cylinders must be placed in a double row "staggered" configuration. High-pressure pigtailed for gases other than oxygen are 24" length stainless-steel flexible type. Oxygen pigtailed are rigid copper, preformed to approximate shape for connection to cylinders. Pigtailed for all liquid containers are 72" length flexible type. The manifold is designed to mount directly to a wall, or be freestanding floor mounted with addition of a manifold control panel floor stand kit and an appropriate number of header floor stand kits for reserve header assembly (sold separately).

## Installation

### Wall Mounting Manifold Control

1. Remove manifold control panel from shipping carton and place face down on foam packaging insert.
2. Mounting bracket is shipped attached to back of manifold control panel. Remove lower 3/8" mounting nut as shown in Figure 1. Pull bottom of bracket away from manifold control panel and slide bracket off two upper control panel mounting bolts.
3. Mark wall 79-3/4" from finished floor in location where manifold will be mounted. Convert mark to level horizontal line approximately 8" long.
4. Place bracket flat against wall as shown in Figure 2 and align top of bracket with level horizontal line. Vertical center line of bracket will be vertical center line of installed manifold. Mounting top of bracket at 79-3/4" height will net a 61" height from center of manifold control inlets to finished floor.

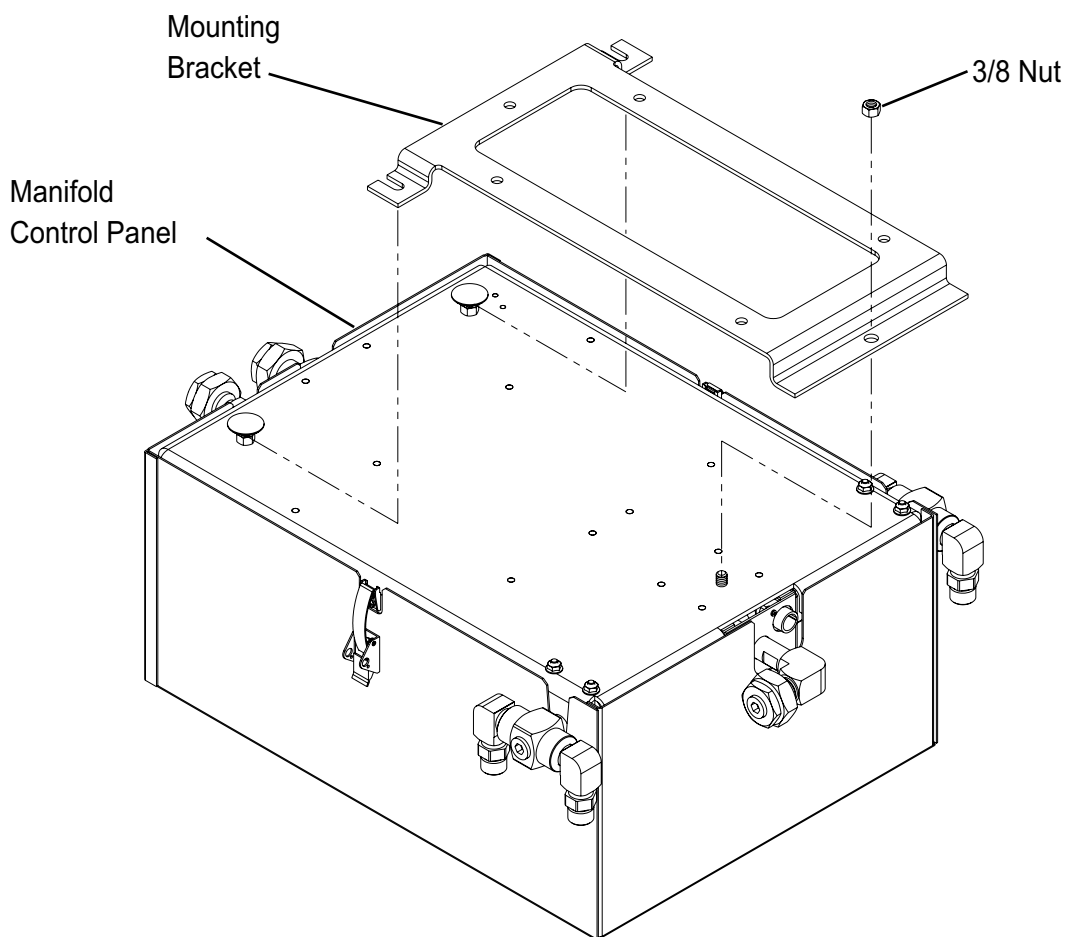


Figure 1

## Installation

### Wall Mounting Manifold Control

5. Mark locations of mounting holes. Remove bracket and drill mounting holes. Attach bracket to wall with appropriate anchors (by others). 3/8" diameter anchors are recommended.
6. Hang manifold control panel on mounting bracket. Top two control panel mounting bolts will slide into slots of bracket. Bottom of manifold control panel should be angled away from bracket until top two bolts have been inserted as shown in Figure 3. Bottom of control panel can then be positioned toward bracket so 3/8" mounting stud passes through

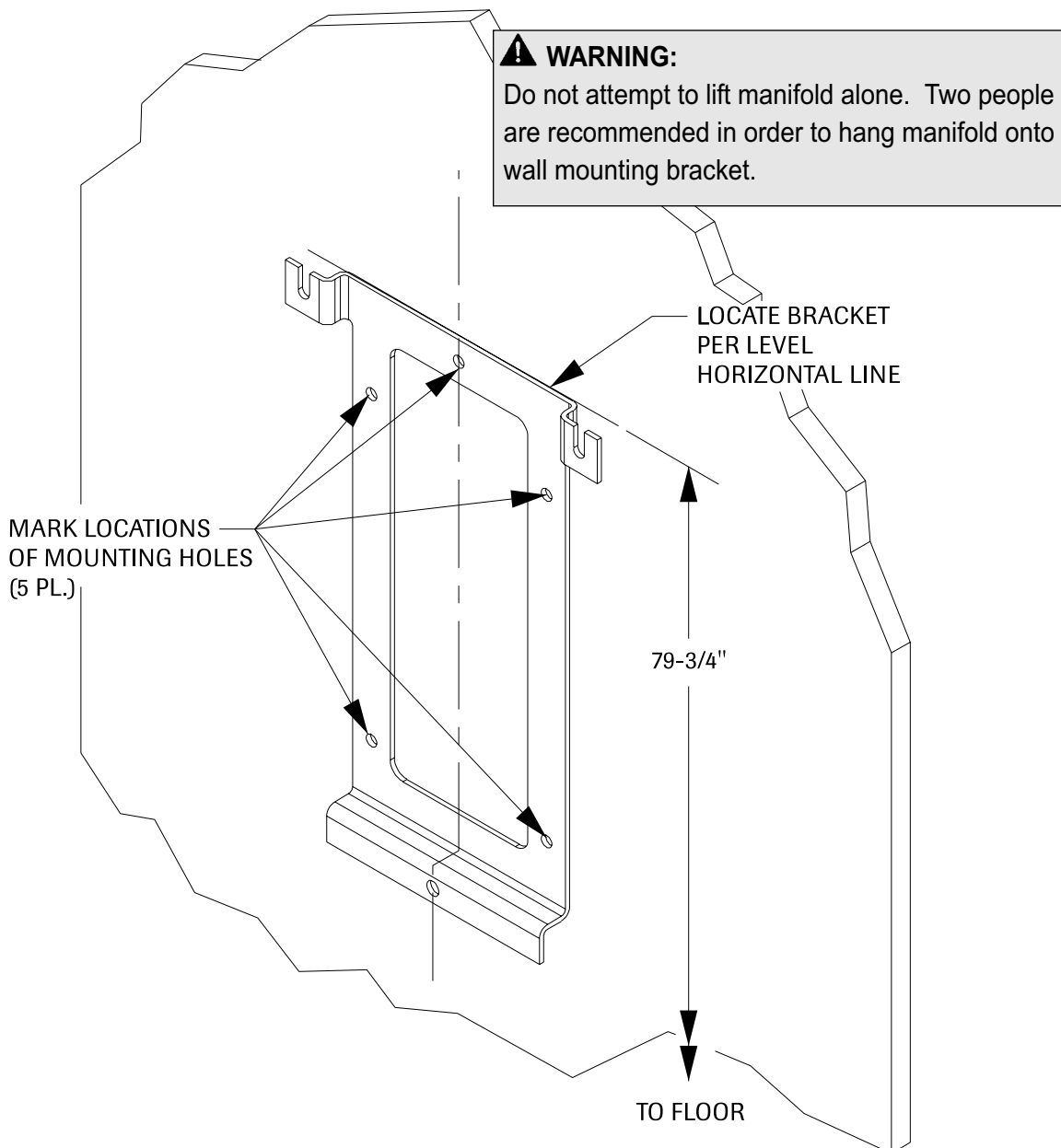


Figure 2

# Installation

## Wall Mounting Manifold Control

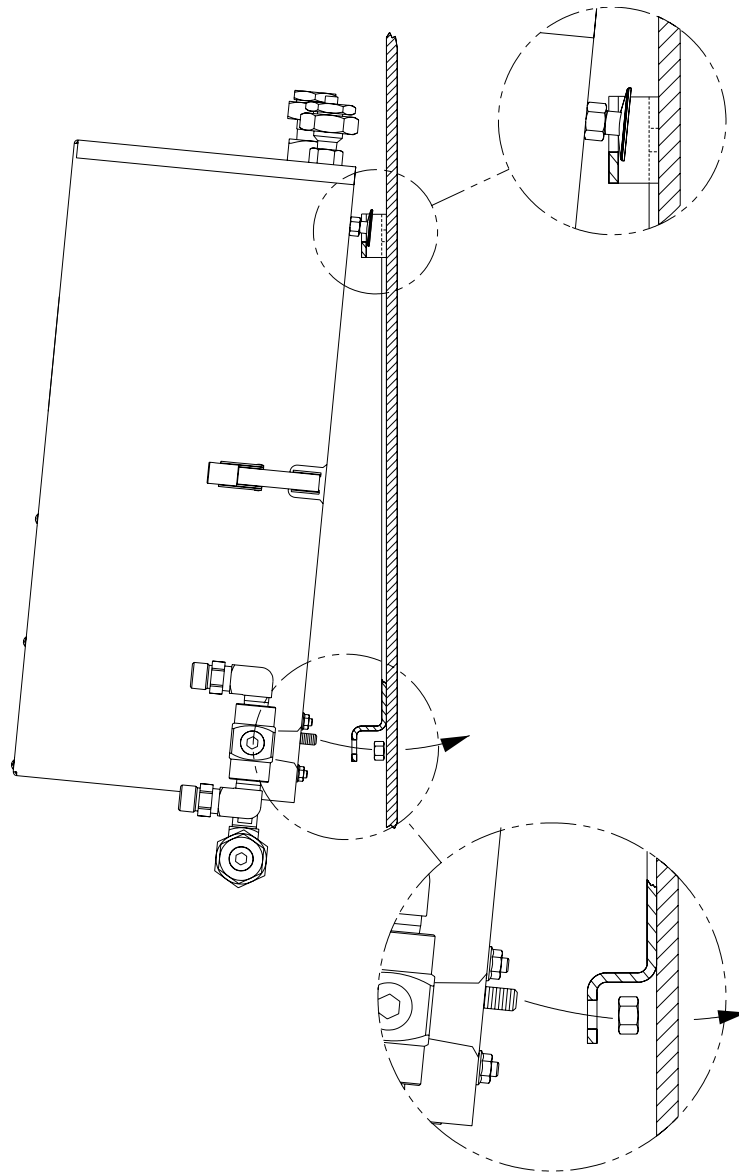


Figure 3

### Wall Mounting HP Reserve Header

High pressure reserve header components may be shipped in several cartons. One carton will contain control section assembly consisting of master valve, regulator assembly, and reserve low pressure switch as shown in Figure 4.

Additional shipping cartons contain header extensions, cylinder pigtails, and header wall brackets. Depending on number of cylinders, header extensions are configured with two or three cylinder inlets. Large reserve headers may also include combinations and multiples of each type of header extension.

1. Remove large nut and plug from right side of control section. Attach appropriate header extension to control section. Position cylinder inlet connections of each header extension so they are pointing out. Additional header extensions may be attached end to end if required. Install large nut and plug previously removed on end of last header extension (Figure 5).
2. Mark wall 60-1/2" from finished floor in location where high-pressure reserve header will be mounted. Convert mark to level horizontal line approximately as long as assembled high-pressure reserve header.

**NOTE:**

A mounting height of 60-1/2" allows for adequate clearance beneath reserve header assembly when utilizing standard "H" size cylinders (55" tall overall). Bracket mounting height should be increased proportionally if taller cylinders are to be used.

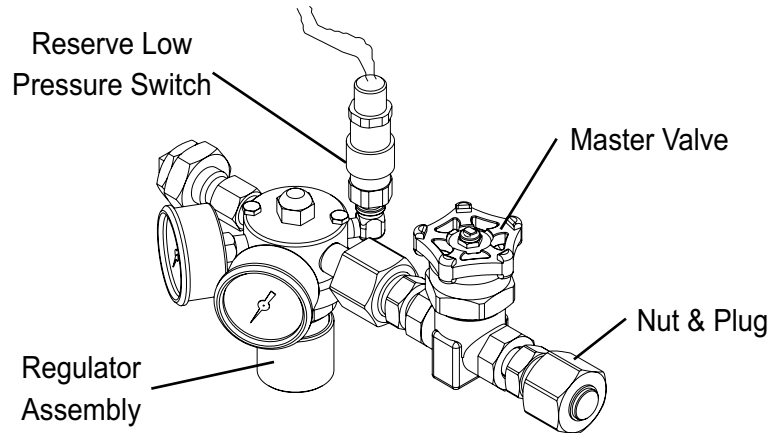
3. Depending upon number of header extensions, two or more header brackets will be provided. Header brackets should be positioned along length of high-pressure reserve header assembly and should contact header directly between cylinder connections.

A header bracket will typically be provided for each header extension. Measure centerline distance between header brackets and transfer those measurements to horizontal line described in step 2 as shown in Figure 6.

4. Position header bracket against wall and align top of bracket with horizontal line. Center brackets with centerline marks from step 3. Attach brackets to wall using appropriate anchors (by others). 3/8" diameter anchors are recommended.
5. Set complete reserve header on top of wall brackets and assemble u-bolt and bracket hardware as shown. Tighten u-bolt nuts.
6. One more wall bracket should be installed to support left side of reserve header assembly as shown in Figure 7. Bracket will be slightly lower than others and should be attached to reserve header in order to mark mounting hole location on wall.
7. Tighten all header extension unions and plugs. Ensure all cylinder connections point away from wall.

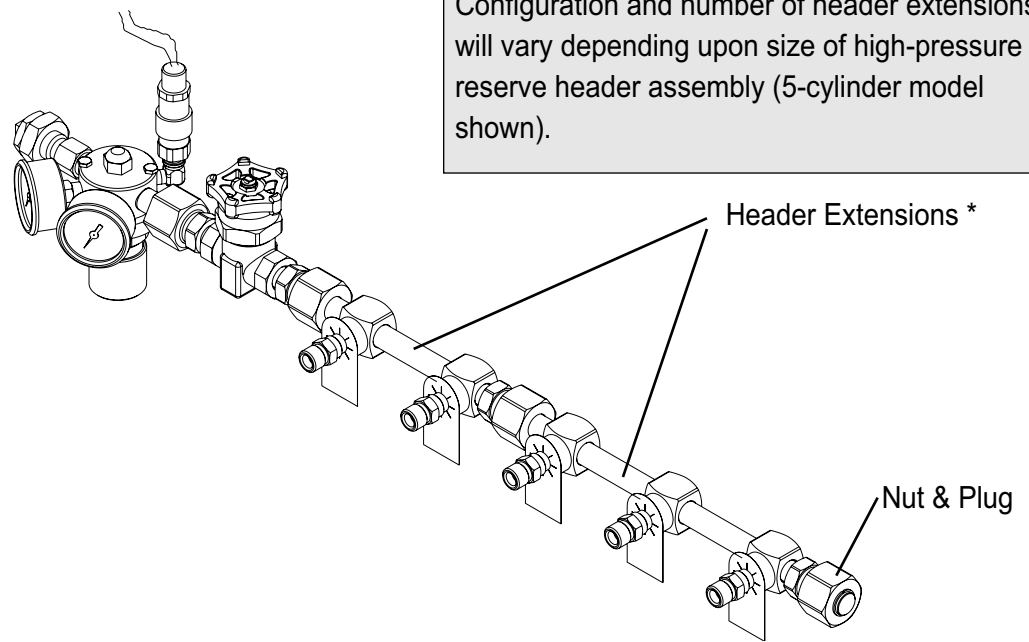


**Wall Mounting HP Reserve Header**



**Figure 4**

**\* NOTE:**  
Configuration and number of header extensions will vary depending upon size of high-pressure reserve header assembly (5-cylinder model shown).

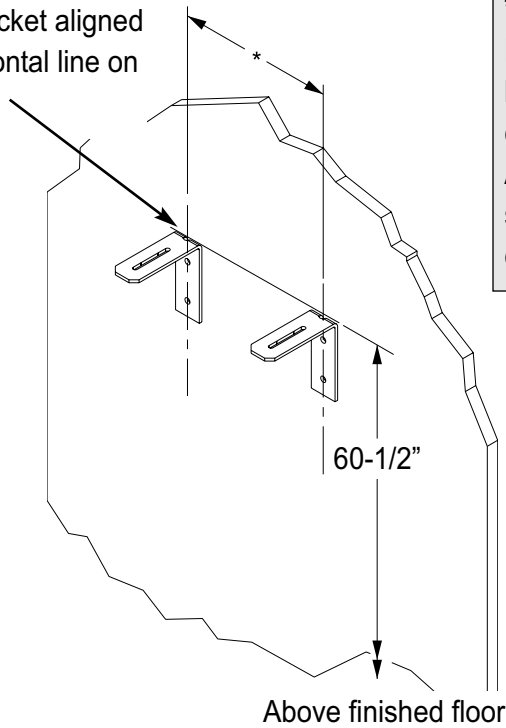


**Figure 5**

## Installation

### Wall Mounting HP Reserve Header

Top of bracket aligned with horizontal line on wall.



**\* NOTE:**

Distance between wall brackets to be determined by installer. Depending upon reserve header configuration, multiple brackets may be required. A bracket is provided for each header segment and should contact header between cylinder connections as shown in Figure 7.

Figure 6

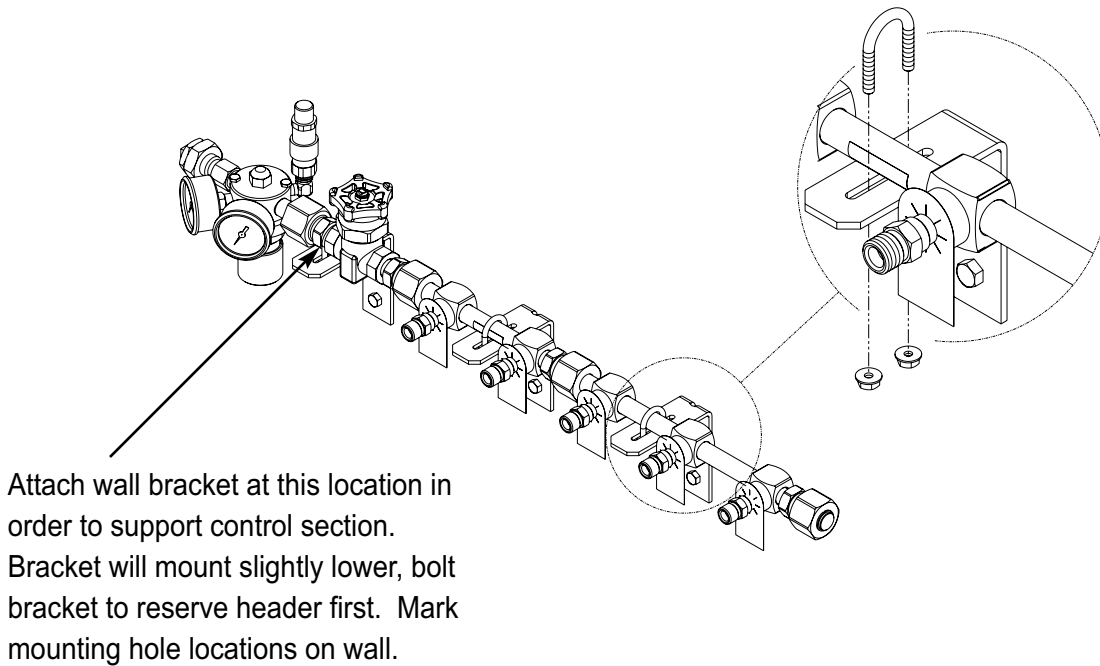


Figure 7

## Installation

### Floor Mounting Manifold Control

For floor mounting manifold control panel, a manifold control stand kit should be ordered separately. One manifold control panel stand kit contains all items needed to mount control panel.

Verify contents of manifold control stand kit (Figure 8):

1. Remove manifold control panel from shipping carton and place face down on foam packaging insert.
2. Mounting bracket is shipped attached to back of manifold control panel. Remove lower 3/8" mounting nut as shown in Figure 1. Pull bottom of bracket away from manifold control panel and slide bracket off two upper control panel mounting bolts.
3. Only bracket will be needed at this time. Set manifold control panel aside for installation later.

#### NOTE:

Return manifold control panel to shipping carton if necessary to protect and keep it clean.

4. Attach post base to one end of each 80-inch channel as shown in Figure 10, Detail A. Use two each 3/8" bolts, flat washers and channel nuts per base. Tighten all four bolts.
5. Stand each channel / base side by side. Attach manifold mounting bracket to both bases as shown in Figure 10, Detail B. Use four each 3/8" bolts, flat washers and channel nuts per base. Top of bracket should be level and positioned 79 3/4" above floor. Tighten all four bolts.

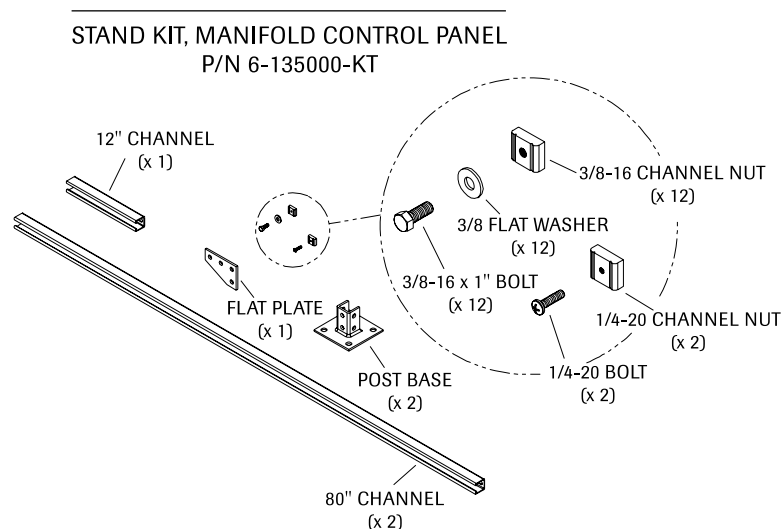


Figure 8

#### STAND KIT, MANIFOLD HEADER P/N 6-135001-KT

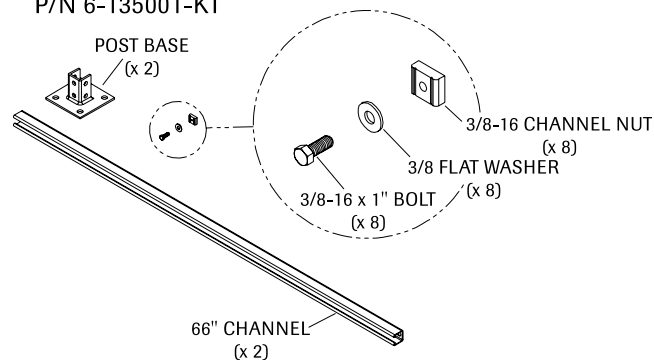


Figure 9

## Installation

### Floor Mounting Manifold Control

6. Position entire assembly in desired manifold mounting location. Mark location of eight base mounting holes. Move assembly aside and drill holes. Minimum 3/8" diameter mounting bolts are recommended (by others).
7. Reposition assembly over holes and install mounting hardware (by others). Tighten all mounting bolts.
8. Attach 12-inch channel to top of one vertical channel as shown in Figure 10, Detail D. 12-inch channel is used to mount power supply and may be located on either side of manifold control panel. Use flat plate, four each 3/8" bolts, flat washers and channel nuts. Unlike other hardware shown in Figure 10, 3/8 bolts will pass through elongated holes in back of channel and will be secured with channel nuts inside. Tighten all four bolts.
9. Hang manifold control panel on mounting bracket. Top two control panel mounting bolts

will slide into the slots of bracket. Bottom of control panel should be angled away from bracket until top two bolts have been inserted as shown in Figure 3. Bottom of manifold control panel can then be positioned toward bracket so 3/8" mounting stud passes through lower hole in mounting bracket. Install and tighten 3/8" nut removed in step 2.

#### **CAUTION:**

In order to prevent damage to manifold piping connections, vertical stands must be securely braced to permanent structure to prevent movement.

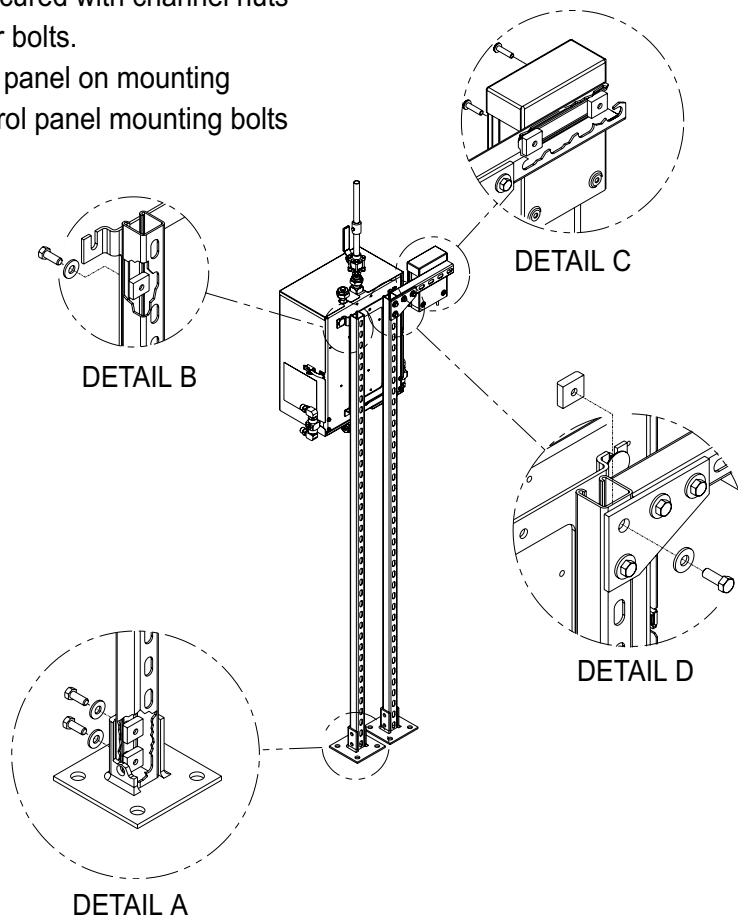


Figure 10

## Installation

### Floor Mounting HP Reserve Header

High pressure reserve header components will be shipped in one or more cartons. One carton will contain control section assembly consisting of master valve, regulator assembly, and reserve low pressure switch as shown in Figure 4. Additional cartons contain header extensions, cylinder pigtails, and header wall brackets.

Header extensions are configured with two or three cylinder inlets. Large reserve headers may include combinations and multiples of each type of header extension.

For floor mounting reserve header assembly, an appropriate number of manifold header stand kits should be ordered separately. Depending on size of high-pressure reserve header assembly, one or more manifold header stand kits are required. A vertical stand is required for each header extension. One vertical stand is required to support control section of reserve header assembly. Each header stand kit contains two vertical stands.

Verify contents of header stand kit (Figure 9).

1. Remove large nut and plug from right side of control section. Attach appropriate header extension to control section. Position cylinder inlet connections of each header extension so they are pointing out. Additional header extensions may be attached end to end if required. Install large nut and plug previously removed on end of last header extension (Figure 5).



#### **CAUTION:**

Do not use thread sealant on header connections.

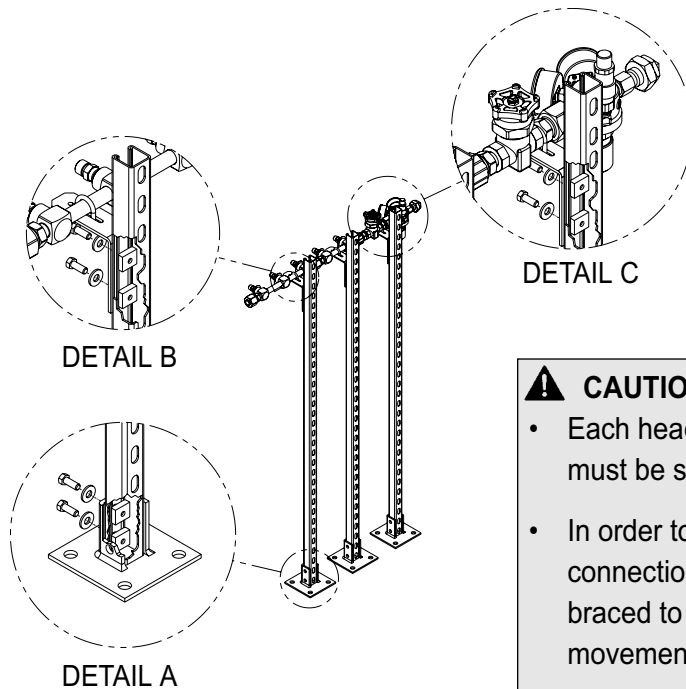
2. A header bracket is provided for each header extension. Another header bracket is provided to support control section of reserve header. Actual position of header brackets on reserve header to be determined by installer.

Header brackets should be positioned along length of high-pressure reserve header assembly and should contact header directly between cylinder connections. Bracket to support control section must be located as shown in Figure 11, Detail C. After each bracket position has been determined, measure centerline distance between the header brackets and record measurements for later use. Set assembled reserve header aside for later use.

3. Each header bracket should be attached to a header stand. Assemble each header stand by attaching a post base to one end of 66-inch channel as shown in Figure 11, Detail A. Use two each 3/8" bolts, flat washers and channel nuts. Tighten all bolts.
4. Set header stands in a vertical position. Align all stands and set center to center spacing to match header bracket spacing recorded in step 2. Mark locations of all four base mounting holes on each header stand. Move header stands aside and drill holes. Minimum 3/8" diameter mounting bolts are recommended (by others).
5. Reposition header stands over holes and install mounting hardware (by others). Tighten all mounting bolts.
6. Mark all header stands, (except control section stand), 60-1/2" from finished floor. Align top of header bracket with mark and attach header brackets to channels as shown in Figure 11, Detail B. Use two each 3/8" bolts, flat washers and channel nuts. Tighten all bolts. Control section bracket will be attached later.
7. Set assembled reserve header on header brackets and assemble u-bolt hardware as shown in Figure 7. Tighten u-bolt nuts.
8. Verify reserve header assembly is level. Adjust height of brackets as necessary.
9. Attach control section bracket to header stand as shown in Figure 11, Detail C. assemble u-bolt hardware. Tighten u-bolt nuts.

## Installation

### Floor Mounting HP Reserve Header



#### ⚠ CAUTION:

- Each header segment and control section must be supported by a header bracket.
- In order to prevent damage to manifold piping connections, vertical stands must be securely braced to permanent structure to prevent movement.

Figure 11

### Main Outlet and Relief Valve Connection

Manifold's main outlet and relief valve outlet are supplied with zero clearance, o-ring sealed unions. Main outlet connection is 3/4 NPTF and relief valve is 1/2 NPTF. A 3/4" source shut-off valve is also supplied with manifold control panel. Inlet side of source shut-off valve is 3/4 NPTM for connection directly to main outlet union. Outlet side is a 3/4" nominal copper. A plugged, 1/8 NPTF port is provided on outlet side of valve to aid in purging.

#### ⚠ CAUTION:

- Close 3/4" source shut-off valve to prevent debris from falling into manifold during brazing procedure.
- To prevent damage to internal o-ring, do not apply heat to relief valve union. Braze male sweat adapter to relief piping prior to attaching to union.

### HP Reserve Header Connection

High-pressure reserve header must be piped to inlet on bottom of manifold control panel. Both outlet of reserve header and manifold inlet are supplied with zero clearance, o-ring sealed unions. Both unions have 1/2 NPTF threads. Piping type and installation must be in accordance with current NFPA requirements.

#### ⚠ CAUTION:

To prevent damage to internal o-ring, do not apply heat to reserve header or manifold inlet zero clearance unions. Braze male sweat adapters to interconnecting piping prior to attaching to unions.

## Installation

### Power Supply Installation

A separate power supply assembly is provided with manifold control panel. Power supply assembly should be mounted to wall on either right or left side of manifold with top of power supply roughly in alignment with top of manifold control panel. 1/4" diameter mounting holes are provided in back of power supply box (wall mounting hardware by others).

If floor mounting manifold control panel, mount power supply assembly to 12-inch channel as shown in Figure 10, Detail C. Use two each 1/4" bolts and channel nuts. Tighten all bolts.

Power supply shall be connected to a building installed circuit breaker. Circuit breaker shall be marked as disconnecting means for manifold. It is recommended that circuit breaker be in close proximity to manifold power supply.

Power supply assembly houses a 24 VAC transformer and terminal blocks for AC input power, reserve low pressure switch and remote alarm connection (Figure 12). A 48" long cable connects power supply to a six-pin connector on bottom of manifold control panel.

Holes for 1/2" conduit are located on bottom of power supply box for 120 VAC power, reserve low pressure switch and remote alarm wiring.

#### **NOTE:**

All wiring shall be protected from physical damage by raceways or conduit in accordance with NFPA 70, National Electric Code.

120 VAC current draw will be less than 100 milliamperes. Primary of 24 VAC transformer contains a 0.25 Amp time-delay fuse. The fuse type is 5 x 20 mm, GMD-250mA (240 VAC models use 0.125 Amp time-delay, type 5 x 20 mm, GMD-125mA).

### Reserve Low Switch Wiring

The reserve low pressure switch is located on high pressure reserve header assembly (Figure 4) and must be wired to appropriate terminals inside power supply (Figure 12). The pressure switch is equipped with 20" wire leads and a 1/2 NPTM conduit connection. Stranded wire of at least 22 gauge is recommended. Maximum recommended wire size is 14 gauge.

### Remote Alarm Connection

For connection to a remote alarm or building automation system, three sets of dry, normally closed alarm contacts are available inside power supply assembly. One of three sets is designated for each alarm condition listed below.

- Secondary Supply
- Reserve In Use
- Reserve Low

All three sets of contacts are independent of each other and will be closed whenever manifold is powered and operating normally (no alarm condition). If any alarm condition above occurs, the appropriate set of contacts will open. If AC power to manifold is removed, all three sets of contacts will open. Contacts are rated for 2 A @ 30 VDC / 0.6 A @ 110 VDC / 0.6 A @ 125 VAC.

Power supply also includes a red RESERVE IN USE and red RESERVE LOW light that will illuminate upon activation of corresponding alarm condition.

Refer to Figure 12 for power supply connections.

# Installation

## Power Supply Wiring

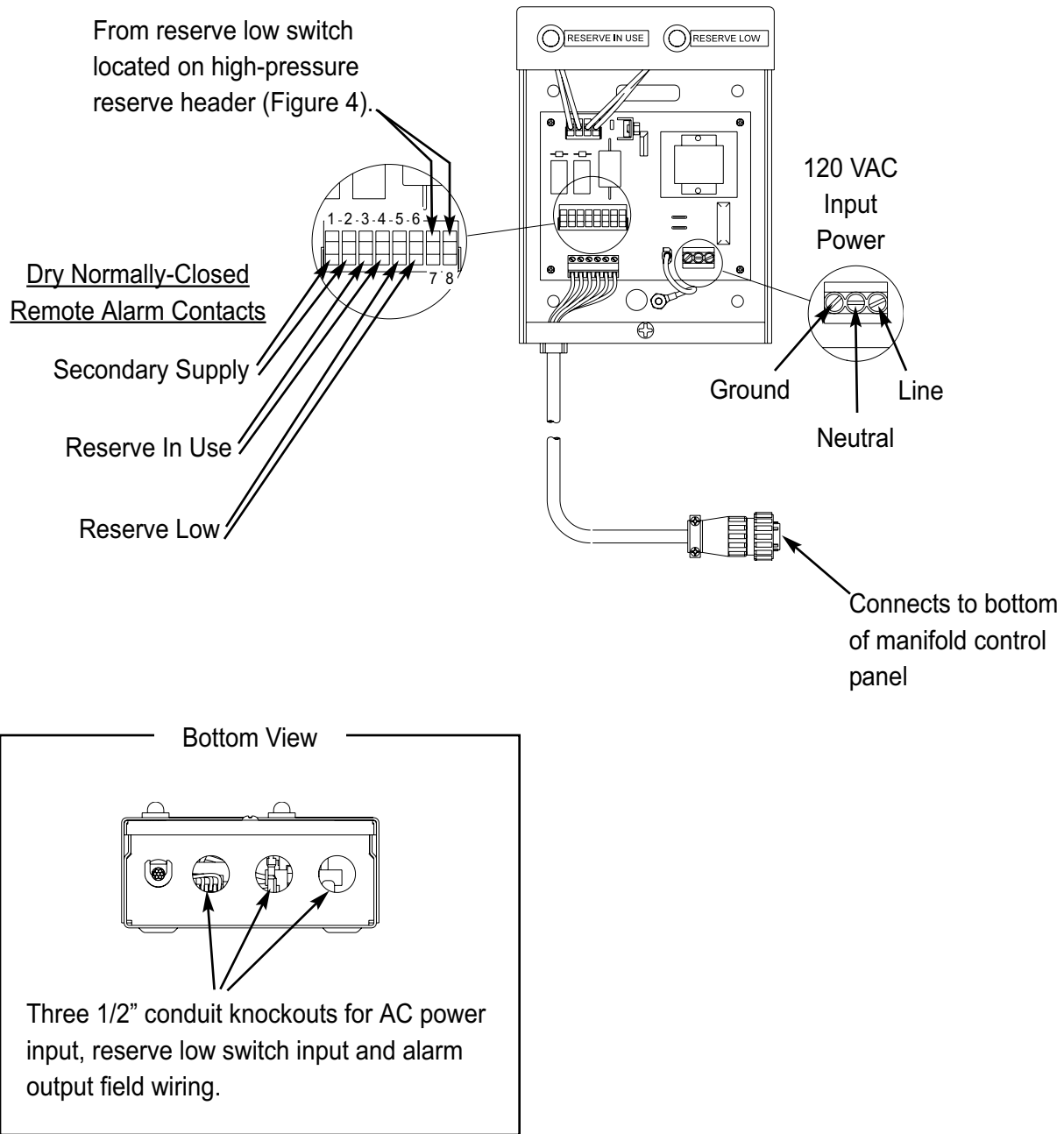


Figure 12



## Installation

### Pigtail / Cylinder Connection

72" black flex pigtails are connected between manifold control panel and liquid containers (Figure 13). Remove plastic shipping caps from manifold control panel inlets. Connect either end of 72" black flex pigtail to manifold inlet. Connect other end of pigtail to gas outlet of liquid container.

All high-pressure reserve header assemblies other than oxygen utilize 24" length flexible stainless-steel braided pigtails. Figure 14 illustrates a typical 5 cylinder high-pressure reserve header assembly utilizing flexible pigtails.

Oxygen high-pressure reserve header assemblies are supplied with pre-formed rigid copper pigtails. Figure 15 illustrates a typical 5 cylinder high-pressure reserve header assembly utilizing pre-formed rigid copper pigtails.

To install high-pressure reserve header pigtails:

1. Remove plastic shipping caps from reserve header pigtail connections.
2. Connect one end of pigtail assembly to reserve header connection. Coiled end of rigid copper pigtails attaches to reserve header connection.
3. Position gas cylinders as shown in Figures 14 and 15. Secure each cylinder to wall or floor stand with chains or straps.
4. Connect pigtails to each cylinder. Rigid copper pigtails used on oxygen reserve headers are pre-formed to approximate required shape. Lower end of rigid copper pigtails must be bent 90° toward cylinder outlets.
5. Tighten all pigtail connections firmly. Do not over-tighten.

#### **⚠ WARNING:**

- All pigtail assemblies are shipped in sealed bags and are cleaned as if for oxygen use. Manifold control panel and reserve header connections are clean and capped. Do not unpackage or remove any cap until ready to install. During installation use care to maintain cleanliness.
- Do not connect 72" black flex pigtail to high pressure reserve header assembly. This type of pigtail must only be connected between manifold control panel and liquid containers.
- Do not repeatedly bend, sharply bend, or twist copper pigtails as damage to tubing may occur.
- Do not bend high-pressure flexible pigtails into a radius smaller than 3".
- Always secure high-pressure cylinders with racks, straps, or chains. Unrestrained cylinders may fall over and damage or break off cylinder valve.

#### **⚠ CAUTION:**

- Do not use thread sealant on header or pigtail connections.
- Prior to connecting pigtail to cylinder, slightly open and close each cylinder valve to blow out dirt and debris.

#### **NOTE:**

Both ends of flexible pigtails are the same. Either end may be connected to manifold header. Rigid copper pigtails on oxygen manifolds are pre-formed and must be connected as shown in Figure 15.

Pigtail / Cylinder Connection

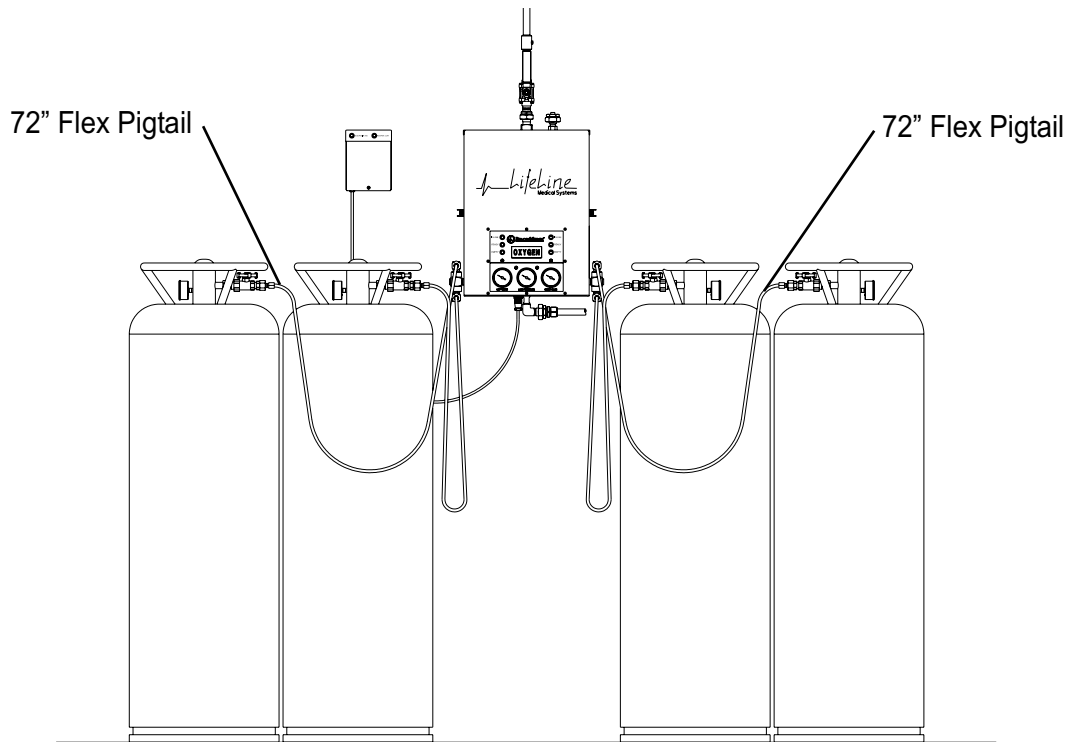


Figure 13

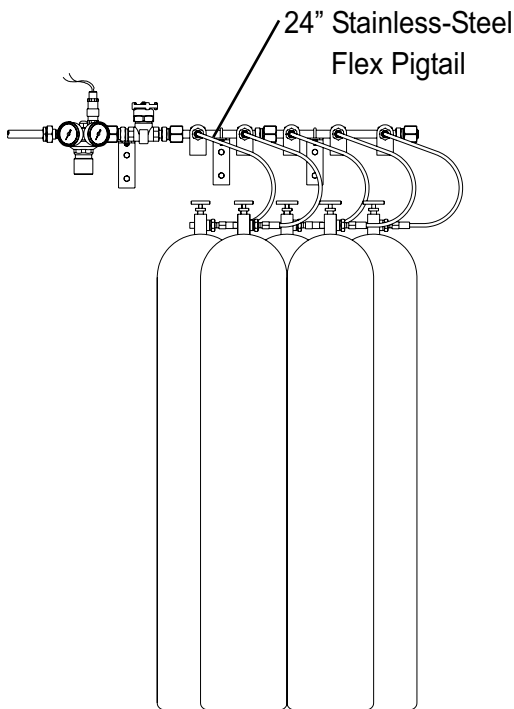


Figure 14

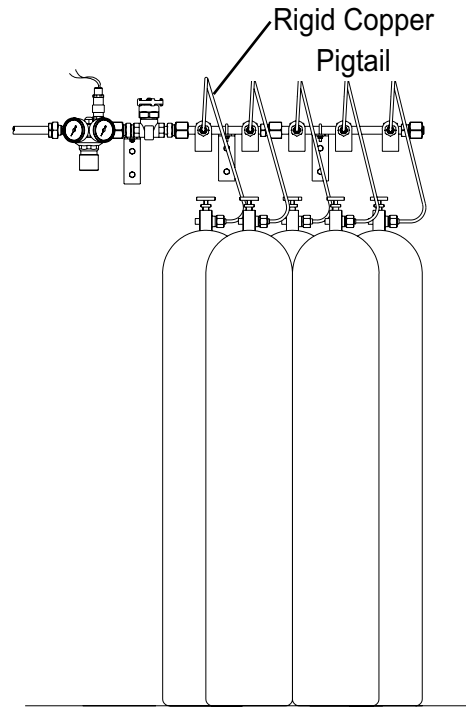


Figure 15

## Installation

### Initial Power-Up and Operational Testing

1. Release two latches on sides of manifold cover (one on each side). Remove cover as shown in Figure 16.
2. Verify following: (Refer to Figures 17 for component location).
  - Both manifold master valves are turned fully counterclockwise (open)
  - All four manifold line regulator isolation valves are open (handles horizontal).
  - Power supply cable has been attached to connector on bottom of manifold .
- Reserve header master valve is turned fully counterclockwise(open).
- Both red "EMPTY" lights on front of manifold and both red lights on front of power supply ("RESERVE IN USE" and "RESERVE LOW") are illuminated.
- If connected to a master alarm panel, "SECONDARY SUPPLY", "RESERVE IN USE", and "RESERVE LOW" alarms are activated.
3. Close 3/4" source shut-off valve.
4. Slowly open one cylinder on high-pressure reserve header assembly.

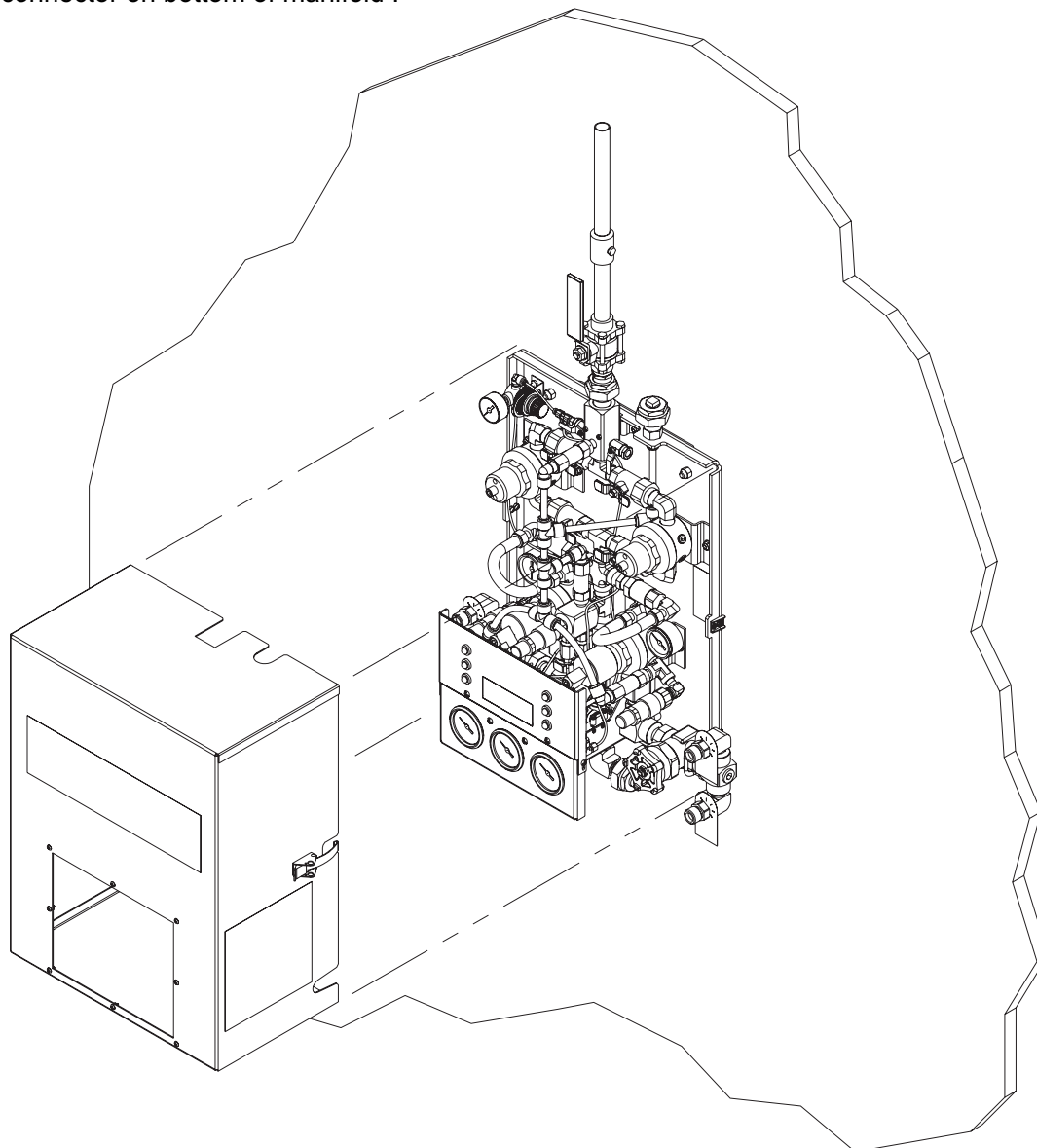


Figure 16

## Installation

### Initial Power-Up and Operational Testing

5. Verify following:
    - Power supply "RESERVE LOW" light turns off.
    - If connected to a master alarm panel, "RESERVE LOW" alarm cancels.
    - Contents gauge on reserve header regulator reads cylinder pressure (approx. 2200 PSI for O<sub>2</sub>, N<sub>2</sub>, and AR. / approx. 1000 PSI for N<sub>2</sub>O and CO<sub>2</sub>).
  6. Slowly open one liquid container on right side of manifold.
  7. Verify following:
    - Manifold right bank red "EMPTY" light turns off.
    - Manifold right bank green "IN USE" light illuminates.
    - Manifold right bank contents gauge reads liquid container pressure.
    - Power supply red "RESERVE IN USE" light turns off.
    - If connected to a master alarm panel, "RESERVE IN USE" alarm cancels.
  8. Slowly open one liquid container on left side of manifold.
  9. Verify following:
    - Manifold left bank red "EMPTY" light turns off.
    - Manifold left bank yellow "READY" light illuminates.
    - Manifold left bank contents gauge reads liquid container pressure.
    - If connected to a master alarm panel, "SECONDARY SUPPLY" alarm cancels.
  10. Close manifold right liquid container. Slightly open vent valve (Figure 17). Verify following:
    - Right bank contents gauge drops slowly.
    - As right contents gauge is nearly depleted, manifold changes over to left bank.
    - After change-over, right bank green "IN USE" light turns off and red "EMPTY" light illuminates.
    - After change-over, left bank yellow "READY" light turns off and the green "IN USE" light illuminates.
- NOTE:**  
If pressure in liquid containers on left bank of manifold is greater than approx. 175 PSI (liquid containers with 230 PSI relief valves) or greater than approx. 300 PSI (liquid containers with 350 PSI relief valves), manifold's economizer circuit will draw a small amount of flow from left side. If right bank contents gauge does not drop when vent valve is slightly opened, vent valve must be opened further in order to exceed economizer circuit flow limits.
11. Close vent valve.
  12. Verify "Line Pressure" gauge reading is acceptable.
  13. Slowly open one liquid container on right side of manifold.
  14. Verify following:
    - Right bank red "EMPTY" light turns off.
    - Right bank yellow "READY" light illuminates.
    - Right bank contents gauge reads liquid container pressure.
  15. Close left liquid container. Slightly open vent valve. Verify following:
    - Left bank contents gauge drops slowly.
    - As left contents gauge is nearly depleted, manifold changes over to right bank.
    - After change-over, left bank green "IN USE" light turns off and red "EMPTY" light illuminates.
    - After change-over, right bank yellow "READY" light turns off and green "IN USE" light illuminates.

### Initial Power-Up and Operational Testing

**NOTE:**

If pressure in liquid containers on right bank of manifold is greater than approx. 175 PSI (liquid containers with 230 PSI relief valves) or greater than approx. 300 PSI (liquid containers with 350 PSI relief valves), manifold's economizer circuit will draw a small amount of flow from right side. If left bank contents gauge does not drop when vent valve is slightly opened, vent valve must be opened further in order to exceed economizer circuit flow limits.

16. Close vent valve.
17. Close right liquid container. Slightly open vent valve. Verify following:
  - Right bank contents gauge drops slowly. As right cylinder contents gauge is nearly depleted, right bank green "IN USE" light goes out and red "EMPTY" light illuminates.
  - Shortly after illumination of right bank red "EMPTY" light, power supply "RESERVE IN USE" light illuminates. If connected to a master alarm panel, "RESERVE IN USE" alarm is activated.
18. Close vent valve.
19. Close cylinder on high pressure reserve header. Slightly open vent valve. Verify following:
  - Reserve header cylinder contents gauge drops slowly.
  - As reserve header cylinder contents gauge drops to approximately 1500 PSI (400 PSI for N<sub>2</sub>O and CO<sub>2</sub> systems), power supply red "RESERVE LOW" light illuminates.
  - If connected to a master alarm panel, "RESERVE LOW" alarm is activated.
20. Close vent valve.
21. Slowly open one high-pressure cylinder on reserve header.
22. Slowly open one liquid container on each side of manifold.
23. Record pressure readings of manifold's left and right contents gauges.
24. Record pressure reading of reserve header contents gauge.
25. Close left and right liquid containers and high-pressure reserve header cylinder.
26. Wait 15 minutes.
27. Compare current readings of manifold left and right gauges and reserve header contents gauge to those recorded in step 23 and 24. If there is a noticeable pressure change on either gauge, perform leak testing described in the next section.
28. Reinstall manifold cover.
29. Slowly open all liquid containers on manifold and high-pressure cylinders on reserve header.
30. Open 3/4" source shut-off valve.

# Installation

## Initial Power-Up and Operational Testing

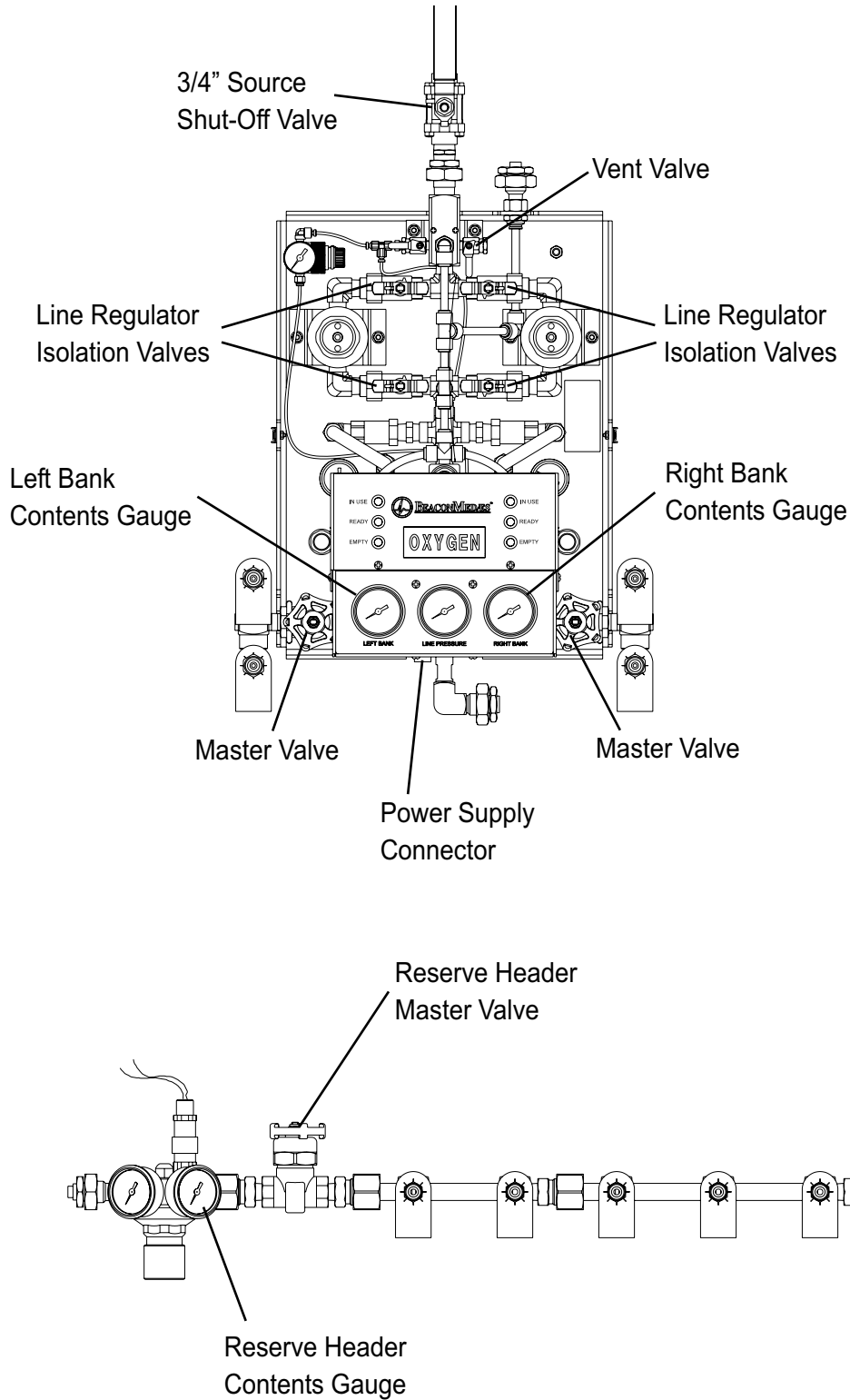


Figure 17

## Installation

### Leak Testing

The following leak testing is recommended if a leak is observed during previous Initial Power-Up and Operational Testing procedure. If a noticeable drop in any pressure gauge reading was not detected, this leak testing is not required.

1. Release two latches on sides of manifold cover (one on each side). Remove cover as shown in Figure 16.
2. Close 3/4" source shut-off valve.
3. Verify isolation valves on inlets and outlets of line regulators are open.
4. Slowly open one liquid container on left and right bank of manifold.
5. Slowly open one high-pressure cylinder on reserve header assembly.
6. Close two internal isolation valves on INLETS (lower valves) of line regulators. (Refer to Figure 17 for component location).
7. Close left and right liquid containers. Close high-pressure cylinder on reserve header assembly.
8. Record pressure readings of manifold left and right bank contents gauges, manifold line pressure gauge, and reserve header contents gauge.
9. Wait 15 minutes.
10. Compare current readings of all four gauges to those recorded in step 8.
11. If a loss of pressure is noted on any gauge, leak location may be further narrowed as follows:
  - A loss of pressure on manifold line pressure gauge indicates a leak downstream of closed line regulator inlet isolation valves.
  - A loss of pressure on left manifold contents gauges indicates a leak in components on left side of manifold

upstream of left line regulator inlet isolation valve.

- A loss of pressure on right manifold contents gauges indicates a leak in components on right side of manifold upstream of right line regulator inlet isolation valve.
- A loss of pressure on reserve header cylinder contents gauge indicates a leak within reserve header assembly or piping connecting reserve header to bottom of manifold.

#### CAUTION:

Avoid getting leak detector solution onto electrical components. Wipe off excess leak detector solution after testing.

12. Locate leak by applying a small amount of an oxygen compatible leak detector solution while manifold is under pressure. Formation of bubbles indicates a leak. Since manifold is factory leak tested, suspect those items first that were added during installation process. For example, main outlet union fitting, reserve header piping and union fitting, etc.
13. Eliminate leaks by tightening or replacing connections or tubing. Retest and verify all leaks have been eliminated.
14. Open line regulator isolation valves.
15. Reinstall manifold control panel cover.
16. Slowly open all manifold liquid containers and reserve header high-pressure cylinders.
17. Open 3/4" source shut-off valve.

## Operation

### Precautions

#### **⚠ WARNING:**

- Tampering with gas-specific connections shall be prohibited. Do not alter, remove or modify gas-specific connections.
- Before connecting liquid container to manifold or high-pressure cylinder to reserve header, momentarily open and close container/cylinder valve to blow out dirt and debris.
- After connecting container/cylinder to manifold, open container/cylinder valve s-l-o-w-l-y to allow heat of compression to dissipate.
- Always secure high-pressure cylinders with racks, straps, or chains. Unrestrained cylinders may fall over and damage or break off cylinder valve.
- Do not repeatedly bend, sharply bend, or twist copper pigtailed as damage to tubing may occur.
- Do not bend flexible pigtailed into a radius smaller than 3".
- Service to be performed by qualified medical equipment technician.

### Manifold Specifications

All Lifeline Manifold systems are designed in accordance with current revision of NFPA 99. There are three categories of Lifeline manifolds for liquid containers depending upon delivery pressure.

Following gas types are available for each delivery pressure:

#### 55 PSI Delivery Pressure

- Oxygen
- Nitrous Oxide
- Carbon Dioxide
- Argon

#### 100 PSI Delivery Pressure

- Oxygen

#### 180 PSI Delivery Pressure

- Nitrogen

Refer to Table 1, page 25 for manifold specifications.



**Manifold Specifications**

**NOTE:**

In order to ensure proper manifold switchover operation, do not set delivery pressure (line regulator) less than 40 PSI.

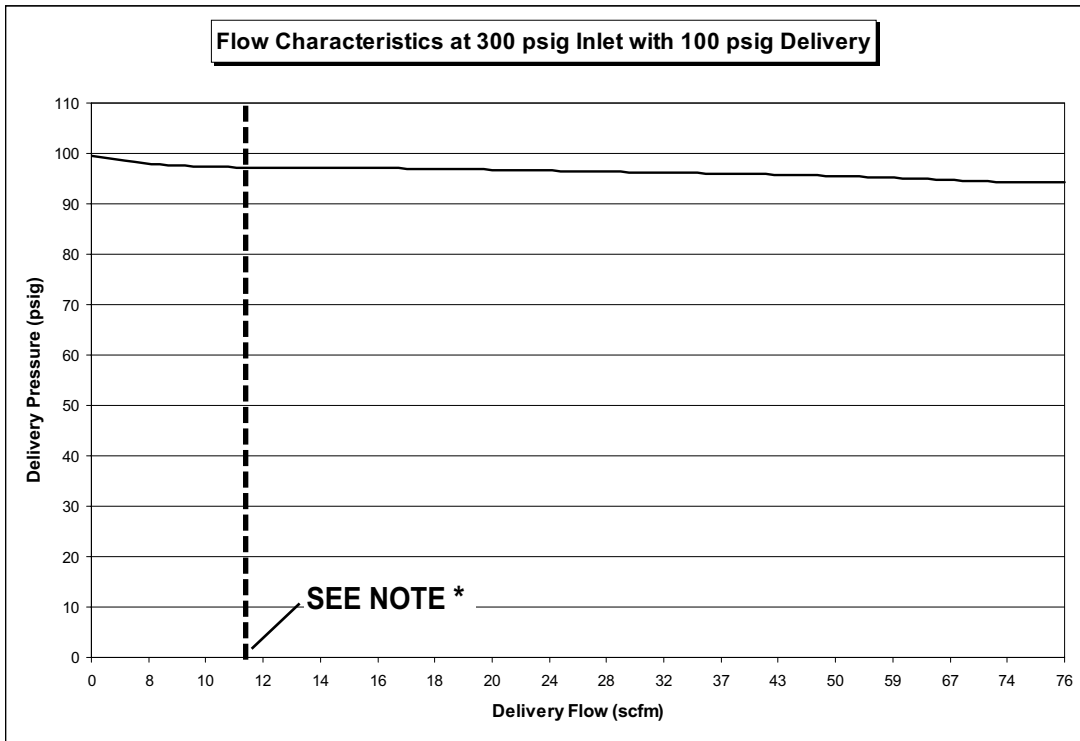
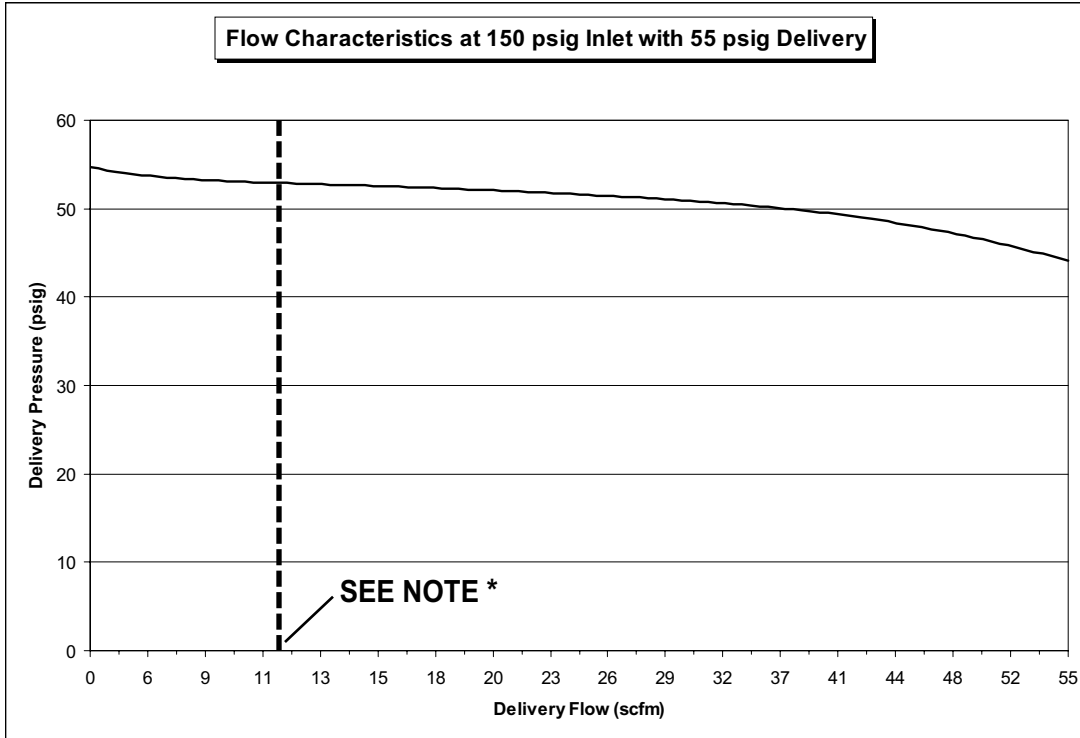
<b>Parameter</b>	<b>OXYGEN ARGON</b> 55 PSI Delivery Pressure	<b>N2O CO2</b> 55 PSI Delivery Pressure	<b>OXYGEN</b> 100 PSI Delivery Pressure	<b>NITROGEN</b> 180 PSI Delivery Pressure
Recommended Liquid Container Relief Valve	230	350	350	350
Manifold Inlet Relief Valve	400	400	400	400
Sec. Bank Inlet Pressure - Economizer Operation	> 175	> 300	> 300	> 300
Intermediate Pressure - Ready Bank	70	210	210	210
Dome Bias Pressure	55 **	40	40	40
Intermediate Pressure - In Use Bank	125 *	250	250	250
Intermediate Relief Valve	350	350	350	350
Line Regulator	55	55	100	180
Line Regulator Relief Valve	75	75	150	250
Secondary Supply Switch (on pressure drop)	100 ± 5	250 ± 10	250 ± 10	250 ± 10
Reserve In Use Switch (on pressure drop)	80 ± 5	210 ± 5	210 ± 5	210 ± 5
Reserve Low Switch (on pressure drop)	1500 ± 25	400 ± 25	1500 ± 25	1500 ± 25
Reserve Header Regulator	70	200	200	200

\* Intermediate pressure value of "In Use" bank is dependent upon dome bias pressure. Variations from 55 PSI delivery pressure will affect intermediate pressure reading.

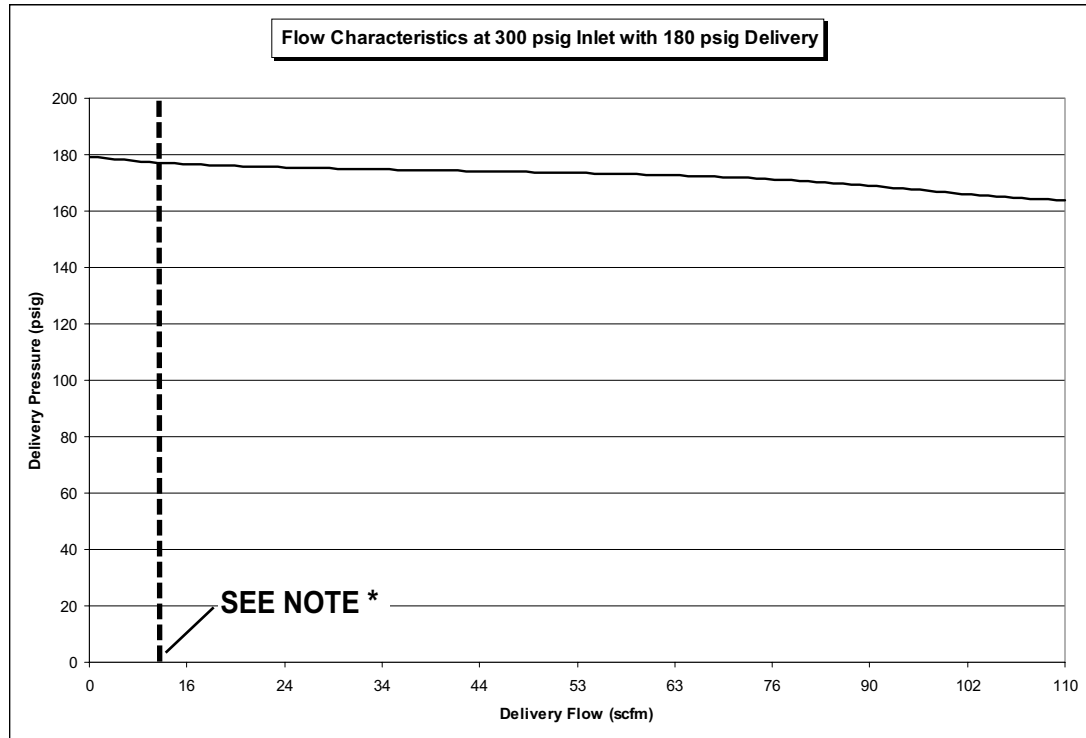
\*\*Same as delivery pressure.

**Table 1**

Manifold Specifications



Manifold Specifications



**\* NOTE:**

Manifold system flow will be limited by flow capacity of liquid container(s).

**Approximate maximum continuous gaseous flow** of liquid containers are listed below:

<u>Gas Type</u>	<u>Flow (per container)</u>
Oxygen	5.8 scfm (350 scfh)
Nitrous Oxide	1.8 scfm (110 scfh)
Carbon Dioxide	2.5 scfm (150 scfh)
Nitrogen	5.8 scfm (350 scfh)
Argon	5.8 scfm (350 scfh)

Dotted line represents approximate maximum flow of **two** oxygen, nitrogen or argon liquid containers connected to each manifold bank, 11.6 scfm (700 scfh).

### Manifold System Components

Refer to Figures 18 through 22.

**Master Valve** Multi-turn high-pressure valves allow flow from liquid containers to be shut off. Master valves use metallic seating surfaces. Both master valves should always be turned to fully open, maximum counterclockwise position.

**Bank Regulator** A dome loaded, single stage, diaphragm type regulator. Used to reduce incoming liquid container pressure to a lower intermediate pressure. Bank regulator (one for each bank) has an internal adjusting spring used to set a "base" pressure of approximately 70 PSI (210 PSI on some models). The "dome" (i.e. bonnet or bell) of regulator is a pressure tight chamber. When pressure is applied to dome, amount of force applied is added to force of adjusting spring. For example, when 55 PSI of pressure is applied to dome, 70 PSI base pressure setting is raised to approximately 125 PSI.

**Secondary Supply Pressure Switch** An adjustable, single pole, normally open pressure switch. A pressure switch is connected to high pressure port of each bank regulator in order to monitor pressure in each bank of liquid containers. When adequate pressure is applied, switch contacts are held closed. When liquid container pressure drops to switch setting of 100 PSI (250 PSI for some models), switch contacts will open.

**Check Valve** Soft-seal check valves are provided downstream of each bank regulator and on high-pressure reserve header inlet to allow service of upstream components while the manifold is in use.

**Intermediate Relief Valve** Protects components between bank regulators and line regulators in event of an overpressure condition caused by bank regulator or high-pressure reserve header

regulator failure. Outlet of relief valve is piped to a common relief valve port on top of manifold.

**Economizer Valve** Spring-loaded check valve (one for each bank) connected between manifold inlet (from liquid container) and intermediate pressure space upstream of line regulator. Economizer will open when liquid container pressure exceeds intermediate pressure by approximately 50 PSI. Flow through economizer valve is restricted by an orifice in brass block where economizer valve is mounted. Economizer circuit is designed to entrain gas from liquid containers not in use (Secondary Supply) that would otherwise be vented as a result of NER (normal evaporation rate).

**Reserve In Use Pressure Switch** An adjustable, single pole, normally open pressure switch. Monitors intermediate pressure. When adequate pressure is applied, the switch contacts are held closed. When intermediate pressure drops to the switch setting of 80 PSI (210 PSI for some models), switch contacts will open. Activation of switch indicates both banks of liquid containers have been depleted and flow is being provided by high-pressure reserve header assembly.

**Line Regulator Isolation Valve** Quarter-turn ball valves are provided upstream and downstream of each line regulator. These valves allow for removal and servicing of one line regulator while other is in use. All four isolation valves are normally in open position.

**Line Regulator** A single stage, diaphragm type regulator used to reduce manifold's intermediate pressure to normal hospital line pressure. Two line regulators are provided per NFPA 99 requirements to allow for isolation and service of one while other is in use.

### Manifold System Components

Line Relief Valve A relief valve to prevent over-pressurization of hospital piping system by failure of a line regulator. Outlet of relief valve is piped to a common relief valve port on top of manifold.

Dome Regulator A single stage, diaphragm type, relieving regulator used to limit amount of pressure provided to domes of bank regulators. Dome regulator is not used on oxygen manifolds with 55 PSI delivery pressures.

Solenoid Valve A 24 VDC, solenoid assembly, used to direct dome bias pressure to one of bank regulators. As dome bias pressure is directed to one of bank regulator, dome of other bank regulator is vented through solenoid valve.

Front Panel Indicators Six front panel indicators monitor status of manifold. Indicators are 24 VDC LED (Light Emitting Diode) type.

Control Board An electronic circuit board that controls manifold switchover. Control board monitors pressure switches and controls solenoid valve in order to initiate manifold switchover. Control board illuminates appropriate front panel indicators and provides dry contacts for activation of external master alarms. Power to control board is provided by external power supply.

Power Supply (Not Shown) An external NEMA 3R rated enclosure contains a 120 VAC to 24 VAC transformer. 24 VAC is routed to manifold control board via a detachable six-conductor cable and connector. An in-line 0.25 amp slow-blow fuse is provided in 120 VAC power line (0.125 amp for 240 VAC models). Terminal blocks inside power supply allow for connection of AC input power, reserve low switch input and master alarm panel normally closed dry contact outputs. Refer to Figure 12 for power supply wiring.

Reserve Header Master Valve Multi-turn high pressure valve allows flow from high-pressure cylinders to be shut off. Master valve uses metallic seating surfaces. Master valve should always be turned to fully open, maximum counterclockwise position.

Reserve Header High-Pressure Regulator A single stage, diaphragm type regulator. Used to reduce incoming cylinder pressure to 70 PSI (200 PSI for some models). Two gauges are mounted on regulator body. 3000 PSI gauge reads high-pressure cylinder contents pressure, 300 PSI gauge reads regulator outlet pressure.

Reserve Low Pressure Switch An adjustable, single pole, normally open pressure switch. Monitors contents pressure of high-pressure cylinders connected to reserve header. When adequate pressure is applied, switch contacts are held closed. When cylinder contents pressure drops to switch setting of 1500 PSI (300 PSI for some models), switch contacts will open. Activation of switch indicates that contents of high-pressure cylinders has been partially depleted either by use or leakage.

Manifold System Components

**NOTE:**  
Some components not shown for clarity.

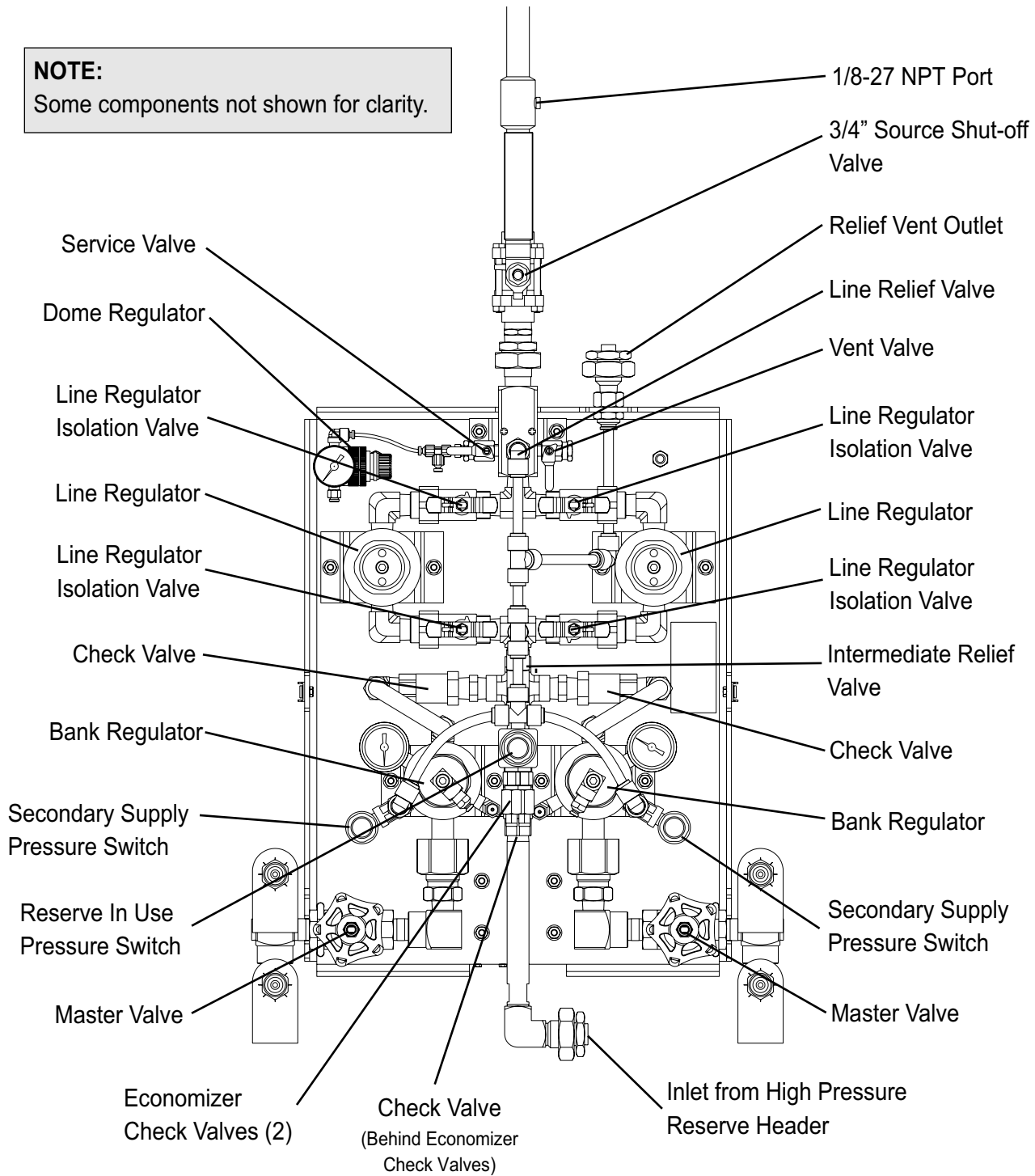


Figure 18

# Operation

## Manifold System Components

**NOTE:**

Some components not shown for clarity.

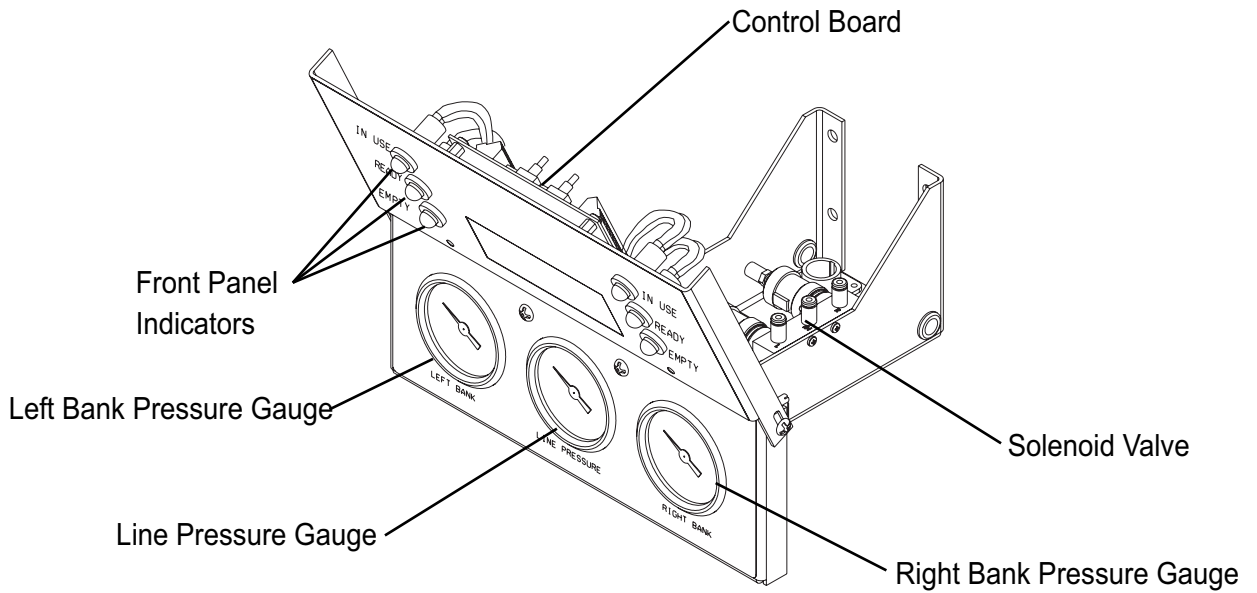


Figure 19

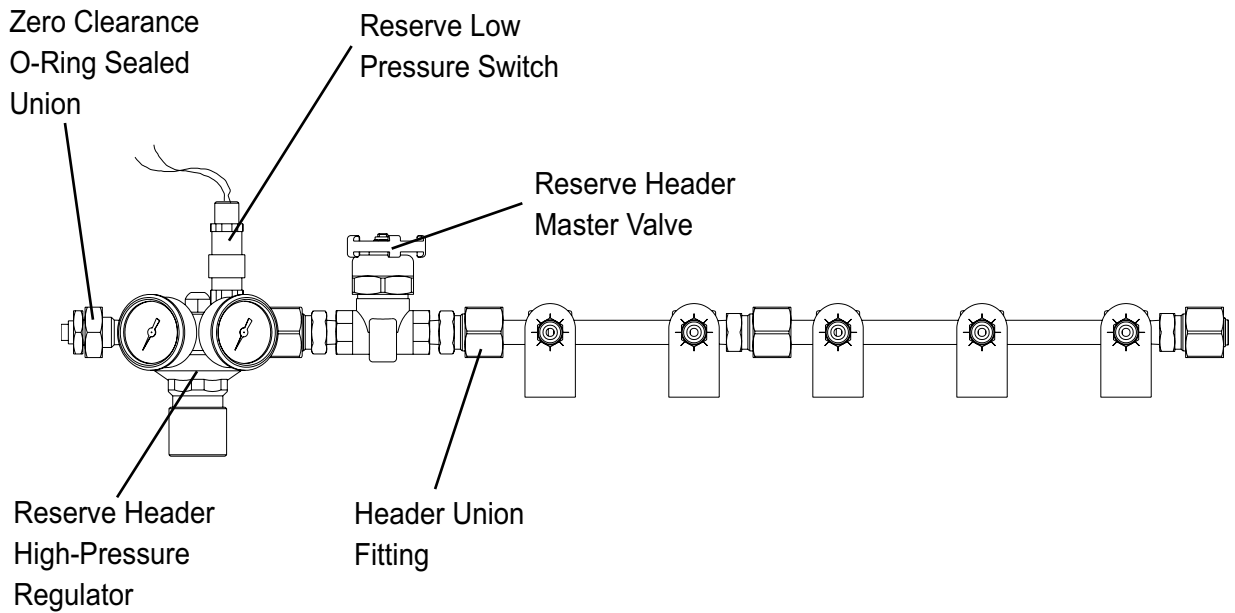


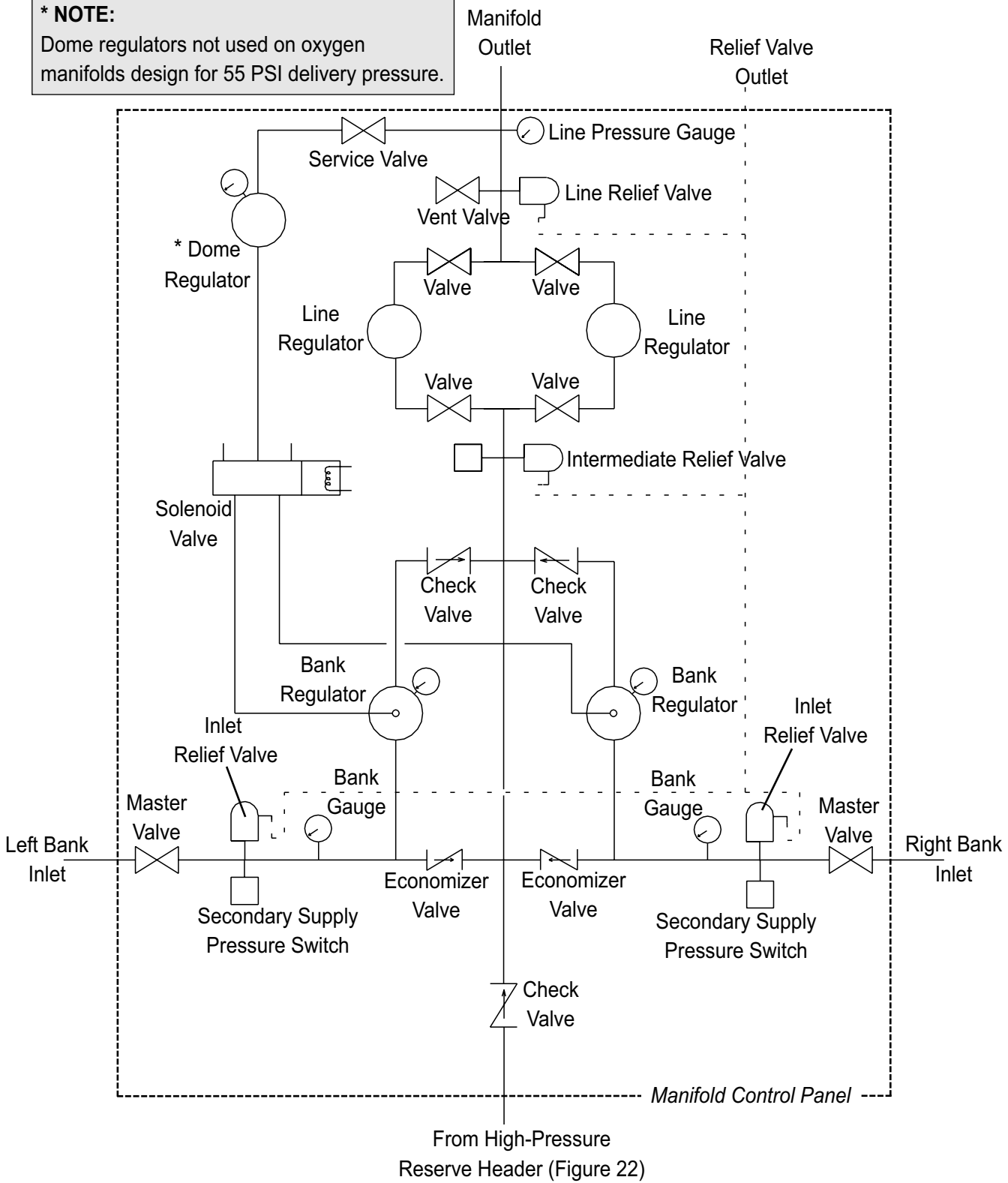
Figure 20

# Operation

## Manifold System Components

**\* NOTE:**

Dome regulators not used on oxygen manifolds design for 55 PSI delivery pressure.



**Figure 21**



High-Pressure Reserve Header Assembly

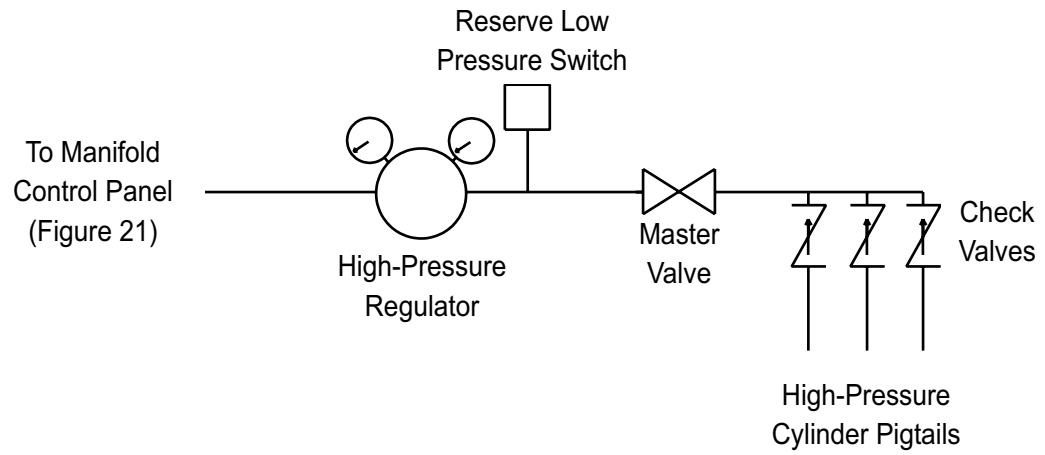


Figure 22

### Gas Flow Through Manifold

Refer to Figures 21 and 22.

Gas is provided to left and right manifold bank inlets via liquid cylinders and pigtailed. Flow of gas through left and right side of manifold is exactly the same, each passing through a master valve and then directly to a bank regulator. Liquid cylinder pressure is also applied to a normally open pressure switch (closes when pressure is applied), a front panel pressure gauge, a 400 PSI relief valve and an economizer valve.

Bank regulators reduce incoming cylinder pressures to an intermediate pressure. Bank regulators are referred to as a "dome loaded" type of regulator. These regulators have an internal adjusting spring that is manually set at a specific pressure similar to other diaphragm type pressure regulators. In addition to internal adjusting spring, bias pressure may be applied to dome of regulator (adjusting spring side of diaphragm) thus boosting pressure above what is manually set by adjusting spring. This output pressure boost will be approximately equal to amount of bias pressure.

For example, if a bank regulator is manually adjusted to 70 PSI via internal adjusting spring, and a dome bias pressure of 55 PSI is applied, output pressure will increase to approximately 125 PSI (70 + 55). When bias pressure is removed, output pressure setting will return to 70 PSI.

Outputs of both left and right bank regulators each pass through check valves and connect together upstream of a dual line regulator assembly. An intermediate relief valve protects components between bank and line regulators in event of a bank regulator seat failure.

Dual line regulator assembly consists of two line regulators plumbed in parallel with upstream and downstream isolation 1/4-turn ball valves. Output of both line regulators tee together and exit at manifold's main outlet. A line relief valve and line pressure gauge are connected to manifold's main outlet.

Outlet pressure is routed to a dome regulator reducing pressure to 40 PSI at solenoid valve. Solenoid valve switches 40 PSI (dome bias pressure) to one of bank regulators. When one bank regulator is supplied bias pressure, other bank regulator's dome is vented to atmosphere. An electronic circuit board controls solenoid valve based upon input from right and left pressure switches. Solenoid valve directs bias pressure to bank designated as primary.

Oxygen manifolds designed for 55 PSI nominal output pressure do not incorporate a dome regulator. Full line pressure (55 PSI) is routed directly to solenoid valve and is used as dome bias.

In addition to left and right liquid cylinder inlets, manifold is equipped with an input from a high-pressure reserve header assembly. This input is located on bottom of manifold cabinet.

Refer to Figure 22 for high-pressure reserve header assembly components.

Gas flows from high-pressure cylinders through a master valve to a regulator, high-pressure gauge and reserve low pressure switch. Regulator output enters manifold, flows through a check valve and into manifold piping just upstream of line regulators.

## Operation

### Manifold Switch-Over

After electrical power has been applied to manifold, side that is pressurized first is designated primary or "IN USE" bank. In order to simplify following explanation, we will arbitrarily select right side of manifold as primary bank. Green "IN USE" light on right side is illuminated. Yellow "READY" light is illuminated on left (secondary) bank.

Solenoid valve directs dome bias pressure to bank regulator on right side. If we use a 55 PSI oxygen manifold as an example, output of right bank pressure regulator is approximately 125 PSI (70 PSI base pressure + 55 PSI bias pressure). Output of left bank regulator is 70 PSI (base pressure only, no bias pressure). Since right bank regulator has highest pressure, all flow is supplied by right bank of liquid containers.

After right side liquid containers have been depleted, pressure falls to pressure switch setting (100 PSI). Right side pressure switch opens signaling circuit board to switch solenoid valve. Solenoid valve vents dome bias pressure from right bank regulator and directs bias pressure to left bank regulator. Green "IN USE" light on right side goes out and red "EMPTY" light illuminates. Yellow "READY" light on left side goes out and green "IN USE" light illuminates. A set of normally-closed dry switch contacts, available inside power supply, will open in order to signal master alarm panel (Secondary Supply).

Since left bank regulator has dome bias pressure applied, its output pressure is boosted to approximately 125 PSI. Right bank regulator has no dome bias pressure and its output pressure is controlled only by base pressure (70 PSI). All flow is supplied by left bank of cylinders.

When liquid containers on right side are replaced and pressure is restored, right pressure

switch closes and signals circuit board. Circuit board will in turn, cancel remote switchover alarm, turn off right side red "EMPTY" light and illuminate right side yellow "READY" light.

All flow is supplied by left bank of liquid containers until pressure in left bank drops to left pressure switch setting (100 PSI). Left pressure switch then opens, causing switchover to right side in same fashion as previously described.

In event of a power failure, unpowered solenoid valve will direct dome bias pressure to left bank regulator. A switchover alarm will be activated on master alarm panels. All flow will be supplied by left bank of liquid containers until depleted. Right bank of liquid containers will then automatically begin to supply flow.

If a situation occurs where both banks of liquid containers are depleted, intermediate pressure will begin to drop from 125 PSI to the "RESERVE IN USE" pressure switch setting of 80 PSI. At 80 PSI, normally-closed switch will open and red "RESERVE IN USE" light on front of power supply will illuminate. A set of normally-closed dry switch contacts, available inside power supply, will open in order to signal master alarm panel.

Intermediate pressure will continue to drop until reaching reserve header regulator setting of 70 PSI. At this point, all flow will be supplied by high pressure cylinders connected to reserve header assembly.

When pressure in reserve header high-pressure cylinders drop to 1500 PSI, reserve low normally-closed pressure switch will open. A set of normally-closed dry switch contacts, available inside power supply, will open in order to signal master alarm panel.

## Testing and Adjustments

### Performance Verification

#### **⚠ WARNING:**

If necessary, most service, adjustment, and testing can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment. Servicing and testing manifold while not in use, with 3/4" source shut-off valve closed, is preferred. Following test procedure assumes that manifold is not in service.

Use following test steps to verify manifold system's functional performance.

1. Remove manifold cover.
2. Before beginning test, verify the following:
  - Both left and right side manifold master valves are turned to full counterclockwise open position.
  - Master valve on high-pressure reserve header is turned to full counterclockwise open position.
  - Liquid containers are attached to both sides of manifold and left and right bank contents gauges indicate pressure greater than "Secondary Supply Switch" settings. Refer to Rable 1, page 25.
  - High-pressure cylinders are attached to high-pressure reserve header and cylinder contents pressure gauge indicates at least 1800 PSI (at least 600 PSI for Nitrous Oxide or Carbon Dioxide).
  - Power is applied to manifold.
3. If manifold is not in use, close 3/4" source shut-off valve.
4. Verify two right-side line regulator isolation valves are open and two left-side line regulator isolation valves are closed.
5. As a starting point for this procedure, set

manifold so that right bank is in use. If right bank green light is illuminated, proceed to next step. If left bank green light is illuminated, manually switch manifold to right side by pressing left switch on control board (Figure 24).

6. Verify the following:
  - Only right bank green "IN USE" and left bank yellow "READY" lights are illuminated.
  - Red "RESERVE IN USE" and "RESERVE LOW" lights on power supply box are NOT illuminated.
  - If manifold is connected to a master alarm panel, "SECONDARY SUPPLY", "RESERVE IN USE" and "RESERVE LOW" alarms are not activated.
7. If manifold is equipped with a dome regulator, verify dome regulator's gauge reads 40-45 PSI. If manifold does not have a dome regulator, proceed to next step.

#### **NOTE:**

Dome regulator's red locking ring must be pulled out away from regulator body before adjustment knob can be turned. After adjustment, push locking ring inward to lock knob. Since dome regulator is self-relieving, it is recommended that dome regulator always be increased to desired pressure. For example, if dome regulator pressure is too high, first lower pressure to approximately 30 PSI. Then raise pressure to between 40-45 PSI.

8. Open vent valve to create a small flow of gas through manifold. Vent valve must be opened wide enough so that right side bank regulator gauge (attached to right dome regulator body), just begins to slightly drop.
9. Verify pressure gauge reading on right-side bank regulator is as indicated in Table 1 (intermediate pressure - in use bank). If pressure is not correct, refer to Bank Regulator Adjustment procedure.
10. Verify front panel line pressure gauge reading

## Testing and Adjustments

### Performance Verification

is as indicated in Table 1 (line regulator). If pressure is not correct, refer to Line Regulator Adjustment procedure. Note reading for later use.

11. Close vent valve. Watch pressure gauge

**NOTE:**

Line regulator values listed in Table 1 are nominal factory settings. Actual customer settings may vary.

readings of right side bank regulator and front panel line pressure gauge for at least five minutes. Readings may be slightly higher without vent flow. Verify readings do not continue to increase.

12. Close all liquid containers on right side of manifold. Open vent valve slightly so that front panel right bank pressure gauge drops slowly. Verify manifold switches to left bank when right bank contents gauge drops to value indicated in Table 1 (Secondary Supply Switch). If pressure value is not correct, right secondary supply pressure switch needs

**NOTE:**

If pressure in liquid containers on left bank of manifold is greater than approx. 175 PSI (liquid containers with 230 PSI relief valves) or greater than approx. 300 PSI (liquid containers with 350 PSI relief valves), manifold's economizer circuit will draw a small amount of flow from left side. If right bank contents gauge does not drop when vent valve is slightly opened, vent valve must be opened further in order to exceed economizer circuit flow limits.

adjustment. Refer to Secondary Supply Switch Adjustment procedure.

13. Close vent valve. Verify the following:
  - Only left bank green "IN USE" and right bank red "EMPTY" lights are illuminated.

- If manifold is connected to a master alarm panel, only manifold "SECONDARY SUPPLY" alarm is activated.
14. Slowly open one liquid container on right side. Verify right bank red "EMPTY" light turns off and right bank yellow "READY" light illuminates.
  15. Close two right-side line regulator isolation valves and open two left-side line regulator isolation valves.
  16. Open vent valve to create a small flow of gas through manifold. Vent valve must be opened wide enough so that left side bank regulator gauge (attached to left dome regulator body), just begins to slightly drop.
  17. Verify pressure gauge reading on left-side bank regulator is as indicated in Table 1 (intermediate pressure - in use bank). If pressure is not correct, refer to Bank Regulator Adjustment procedure.
  18. Verify front panel line pressure gauge reading is the same as in step 10. If pressure is not correct, refer to Line Regulator Adjustment procedure.
  19. Close vent valve. Watch pressure gauge readings of left side bank regulator and front panel line pressure gauge for at least five minutes. Readings may be slightly higher without vent flow. Verify readings do not continue to increase.
  20. Close all liquid containers on left side of manifold. Open vent valve slightly so that front panel left bank contents gauge drops slowly (vent flow must exceed economizer limits - see previous note). Verify manifold switches to right bank when left bank pressure gauge drops to the value indicated in Table 1 (Secondary Supply Switch). If pressure value is not correct, left pressure switch needs adjustment. Refer to Secondary Supply Switch Adjustment procedure.
  21. Close vent valve. Verify that only right bank green "IN USE" and left bank red "EMPTY" lights are illuminated.

### Performance Verification

22. Close all liquid containers on right side of manifold. Open vent valve so that front panel right bank pressure gauge drops slowly. As right bank pressure is nearly depleted, right bank regulator intermediate pressure gauge will also begin to drop. Verify that power supply red "RESERVE IN USE" light illuminates when right bank intermediate pressure gauge drops to value listed in Table 1 (Reserve In Use Switch). If pressure is not correct, refer to Reserve In Use Switch Adjustment procedure.
23. Close vent valve. If manifold is connected to a master alarm panel, verify "SECONDARY SUPPLY" and "RESERVE IN USE" alarms are activated.
24. Open vent valve to create a small flow of gas through manifold. Verify output pressure gauge reading of reserve header regulator is as indicated in Table 1 (Reserve Header Regulator). If pressure value is not correct, refer to Reserve Header Regulator Adjustment procedure.
25. Close vent valve. Watch reserve header regulator output pressure gauge for at least five minutes. Reading may be slightly higher without vent flow. Verify readings do not continue to increase.
26. Close all high-pressure cylinders connected to reserve header. Open vent valve slightly so that cylinder contents pressure gauge on reserve header regulator drops slowly. Verify power supply red "RESERVE LOW" light illuminates when pressure drops to value listed in Table 1 (Reserve Low Switch). If pressure is not correct, refer to Reserve Low Switch Adjustment procedure.
27. Close vent valve. If manifold is connected to a master alarm panel, verify "SECONDARY SUPPLY", "RESERVE IN USE" and "RESERVE LOW" alarms are activated.
28. Slowly open one cylinder on high-pressure reserve header. Verify the following:
  - Power supply red "RESERVE LOW" light turns off.
  - If connected to a master alarm panel, "RESERVE LOW" alarm cancels.
  - If connected to a master alarm panel, "SECONDARY SUPPLY" and "RESERVE IN USE" alarms remain activated.
29. Slowly open one liquid container on right side of manifold. Verify the following:
  - Power supply red "RESERVE IN USE" light cancels.
  - Right bank red "EMPTY" light cancels
  - Right bank green "IN USE" light illuminates.
  - If connected to a master alarm panel, "RESERVE IN USE" alarm cancels.
  - If connected to a master alarm panel, "SECONDARY SUPPLY" alarm remains activated.
30. Slowly open one liquid container on left side. Verify the following:
  - Left bank red "EMPTY" light turns off.
  - Left bank yellow "READY" light illuminates.
  - If connected to a master alarm panel, "SECONDARY SUPPLY" alarm cancels.
31. Open two right side line regulator isolation valves.
32. Close all left and right liquid containers. Close all cylinders on high-pressure reserve header.
33. Record pressure readings of manifold's left and right bank contents gauges. Record pressure reading of reserve header cylinder contents gauge.
34. Verify that after 15 minutes, all three pressure gauge readings have not changed.
35. Slowly open all liquid containers on both banks of manifold and cylinders on high-pressure reserve header.
36. Using circuit board switches, switch manifold to bank of cylinders with least pressure.
37. Reinstall manifold control panel cover.
38. Open 3/4" source shut-off valve.

## Testing and Adjustments

### Bank Regulator Adjustment

The following procedure describes process of setting bank regulator's "base" pressure. This procedure should only need to be performed if bank regulator pressures were not within acceptable limits during performance verification procedure or after installation of a new bank pressure regulator.

Base pressure setting is a mechanical adjustment controlled by regulator's internal adjusting spring and is regulator's output pressure without any dome bias. After base pressure has been set, pressure will be increased by amount of dome bias pressure that is applied. Refer to Figure 18 for location of components called out in this procedure.

1. Remove two front panel screws A (Figure 23). Loosen two hinge screws B. Fold front panel down to service position as shown in Figure 24. Lightly tighten two hinge screws.
2. Close service valve.

**NOTE:**

By closing service valve, manifold's outlet pressure gauge is also isolated. Cycling manifold to vent residual dome bias pressure will also vent pressure shown on manifold's outlet pressure gauge. Actual outlet pressure supplied by manifold is not affected by following procedure.

3. Using control board switches, cycle manifold from bank to bank to vent residual dome bias pressure.
4. Using 1/4" Allen wrench, remove pipe plug from dome of bank regulator(s) to be adjusted.
5. Shut off all liquid containers on both banks of manifold.
6. Shut off all high-pressure cylinders connected to high-pressure reserve header.
7. Open vent valve to vent all pressure from manifold.
8. Close vent valve and slowly open one liquid container on side of manifold that needs adjustment. For example, if right bank regulator needs adjustment, open one liquid container on right side of manifold.
9. Slightly open vent valve to create a small flow of gas through manifold.
10. Using 1/4" Allen wrench, set bank regulator to the value specified in Table 1, page 25 (Intermediate Pressure - Ready Bank).
11. Close vent valve and cylinder.
12. If other bank regulator also needs to be adjusted, repeat steps 7 through 11.
13. Apply Teflon tape and reinstall pipe plug in dome of bank regulator(s).
14. Loosen front panel hinge screws and return front panel to its upright position. Reinstall two front panel screws and tighten hinge screws.
15. Slowly open all liquid containers on both manifold banks.
16. Slowly open all high-pressure cylinders on reserve header.
17. Open service valve.

# Testing and Adjustments

## Bank Regulator Adjustment

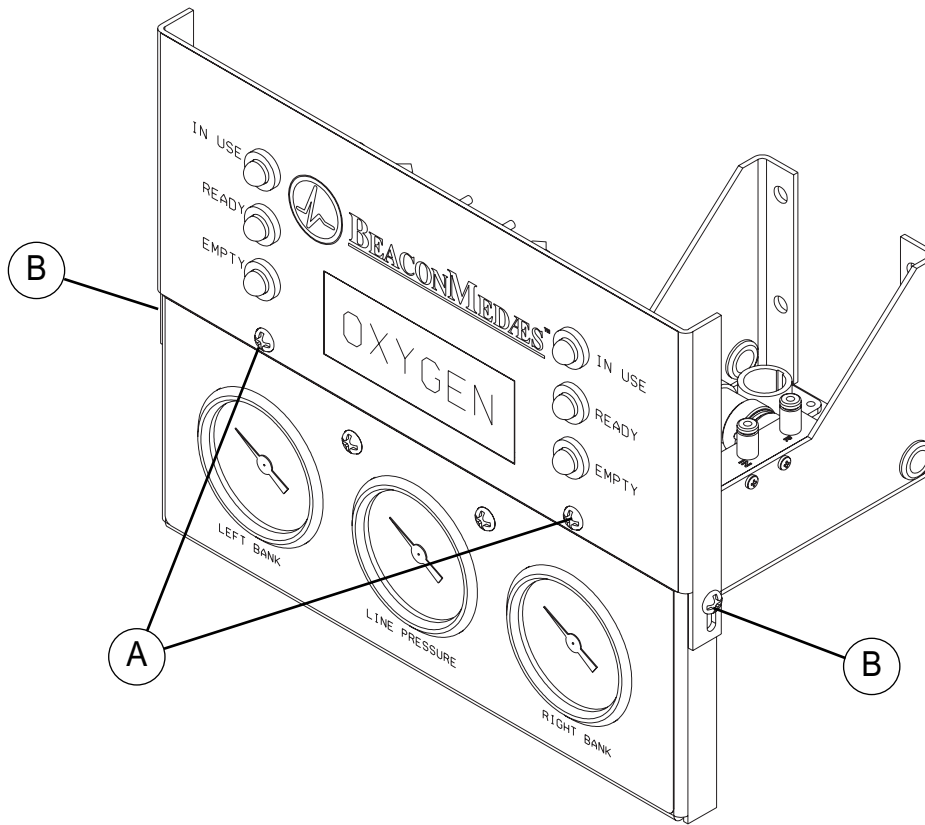


Figure 23

**NOTE:**  
Some components not shown for clarity.

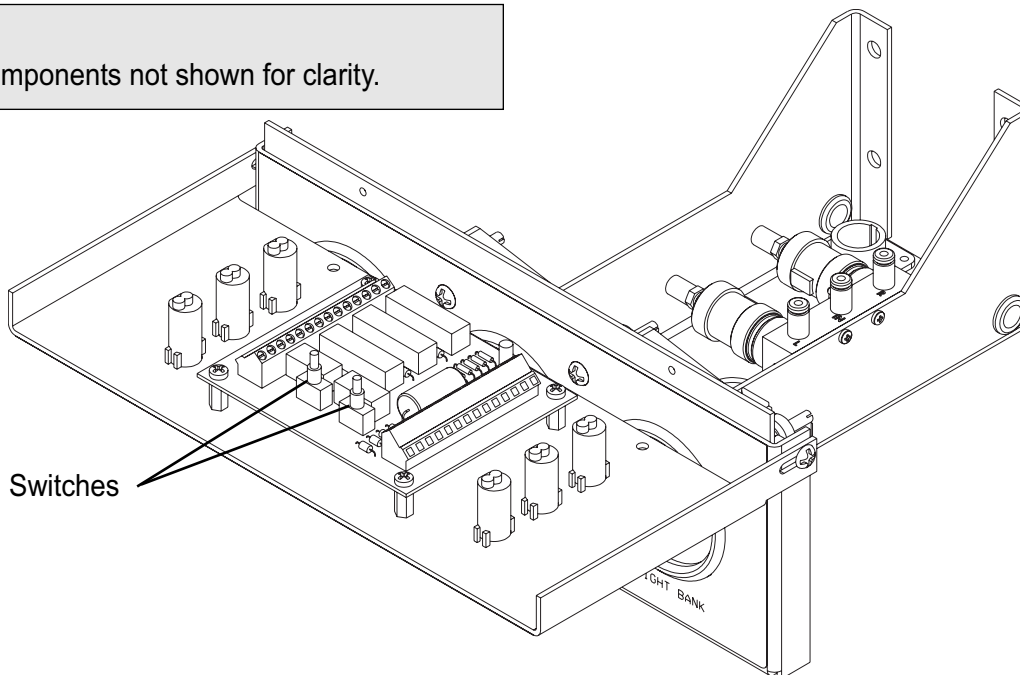


Figure 24



## Testing and Adjustments

### Line Regulator Adjustment

The following procedure describes process of setting line regulator pressure. This procedure should only need to be performed if line regulator pressures were not within acceptable limits during Performance Verification procedure or after installation of a new line pressure regulator.

When shipped from factory, inlet and outlet isolation valves to both line regulators are in open position. Refer to Figure 18 for location of components called out in this procedure.

**NOTE:**

If inlet and outlet isolation valves for both line regulators are open, manifold's outlet pressure gauge will indicate pressure of line regulator with highest setting. Verify setting of each regulator individually as described in following procedure.

1. Open two right-side line regulator isolation valves and close two left-side line regulator isolation valves.
2. Slightly open vent valve to create a small flow of gas through manifold.
3. Using 6mm Allen wrench, turn right line regulator adjusting screw for an appropriate front panel output pressure gauge reading. Note reading for later use. Recommended settings are listed in Table 1, page 25 (Line Regulator).
4. Open two left-side line regulator isolation valves and close two right-side line regulator isolation valves.
5. Using 6mm Allen wrench, turn left line regulator adjusting screw for same outlet pressure gauge reading noted in step 3.
6. Close vent valve.
7. Open two right-side line regulator isolation valves. Verify all four line regulator isolation valves are open.

### Secondary Supply Switch Adjustment

The following procedure describes process of setting secondary supply pressure switches. This procedure should only need to be performed if manifold switchover pressures were not within acceptable limits during the performance verification procedure.

Secondary supply pressure switches are normally open type that close when pressure in excess of switch setting is applied. When pressure is applied to both banks of manifold, both pressure switches are closed. When pressure of "IN USE" bank drops to switch setting, manifold will switch to opposite bank. Switches should always be adjusted as pressure decreases. If pressure switch can not be set, switch must be replaced. Pressure switches are not repairable. Refer to Figure 18 for location of components called out in this procedure.

1. Verify at least one liquid container is open on each bank of manifold.
2. Using circuit board switches (Figure 24), switch manifold to bank whose pressure switch is to be adjusted. For example, if pressure switch on right side is to be adjusted, press left circuit board switch so that green "IN USE" light on right bank is illuminated.
3. Close liquid container on "IN USE" bank.
4. Slightly open vent valve to create a small flow of gas through manifold. Front panel contents gauge for "IN USE" bank should begin to drop. Adjust vent valve so that gauge drops very slowly.
5. Note gauge reading when manifold switchover takes place. Recommended settings are listed in Table 1, page 25 (Secondary Supply Switch).
6. Close vent valve.

## Testing and Adjustments

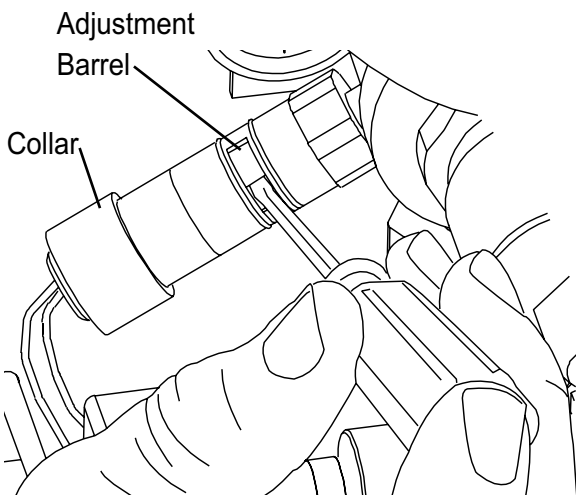
### Secondary Supply Switch Adjustment

7. If switch adjustment is necessary, slide collar of switch toward wires to access internal adjustment barrel. Insert tip of small screwdriver into adjustment barrel and rotate barrel (Figure 25).

**NOTE:**

When viewing switch from wire end, rotating barrel clockwise will raise switch setting. A counterclockwise rotation will lower switch setting. Make small adjustments and retest as follows:

8. Slowly open one liquid container on bank of manifold that was just tested.
9. Using circuit board switches, switch manifold back to bank that was just tested.
10. Repeat steps 3 through 9 until pressure switch has been set within acceptable limits.
11. Slide pressure switch collar back to original position.



**Figure 25**

### Reserve In Use Switch Adjustment

The following procedure describes process of setting reserve in use pressure switch. This procedure should only need to be performed if reserve in use switch setting was not within acceptable limits during the performance verification procedure.

Reserve in use pressure switch is a normally open type that closes when pressure in excess of switch setting is applied. When pressure is applied to either bank of manifold, pressure switch is closed. When both banks of liquid containers have been depleted, intermediate pressure drops to switch setting, power supply red “RESERVE IN USE” light illuminates. Switches should always be adjusted as pressure decreases. If pressure switch can not be set, switch must be replaced. Pressure switches are not repairable. Refer to Figure 18 for location of components called out in this procedure.

1. Verify following:
  - At least one liquid container is open on each bank of manifold.
  - Red “RESERVE IN USE” light on power supply is not illuminated.
  - At least one high-pressure cylinder is open on high-pressure reserve header.
2. Use circuit board switches (Figure 24) to set right bank as primary “IN USE” bank.
3. Close liquid containers on both banks of manifold.
4. Slightly open vent valve to create a small flow of gas through manifold. Right bank front panel contents gauge should begin to drop. Adjust vent valve so that gauge drops very slowly.
5. As right bank is depleted, manifold should switch to left bank. Left bank front panel contents gauge should drop very slowly.

## Testing and Adjustments

### Reserve In Use Switch Adjustment

6. As left bank front panel contents gauge reading drops below 125 PSI (250 PSI on some models), intermediate pressure gauge located on left bank regulator begins to drop.
7. Note intermediate pressure reading (as indicated on pressure gauge mounted to left bank regulator body) when power supply red "RESERVE IN USE" light illuminates (as indicated on left bank regulator gauge). Recommended settings are listed in Table 1, page 25 (Reserve In Use Switch).
8. Close vent valve.
9. If switch adjustment is necessary, slide collar of switch toward wires to access internal adjustment barrel. Insert tip of small screwdriver into adjustment barrel and rotate barrel (Figure 25).

#### **NOTE:**

When viewing switch from wire end, rotating barrel clockwise will raise switch setting. A counterclockwise rotation will lower switch setting. Make small adjustments and retest as follows:

10. Slowly open one liquid container on left bank of manifold.
11. Close liquid container on left side of manifold and slightly open vent valve to create a small flow of gas through manifold. Left bank front panel contents gauge should begin to drop. Adjust vent valve so that gauge drops very slowly.
12. Repeat steps 7 through 11 until pressure switch has been set within acceptable limits.
13. Slide pressure switch collar back to original position.

### Reserve Header Regulator Adjustment

The following procedure describes process of setting reserve header high-pressure regulator. This procedure should only need to be performed if regulator setting was not within acceptable limits during performance verification procedure. Refer to Figure 19 and 20 for location of components called out in this procedure.

1. Verify only one high-pressure cylinder is open on high-pressure reserve header.
2. Close liquid containers on both banks of manifold.
3. Slightly open vent valve to create a small flow of gas through manifold. Flow gas through manifold until pressure on both manifold banks has been depleted and red "RESERVE IN USE" light on power supply illuminates.
4. Using 6mm Allen wrench, turn reserve header regulator adjusting screw for an appropriate output pressure gauge reading. Recommended settings are listed in Table 1, page 25 (Reserve Header Regulator).
5. Close vent valve.

### Reserve Low Switch Adjustment

The following procedure describes process of setting reserve low pressure switch. This procedure should only need to be performed if reserve low switch setting was not within acceptable limits during performance verification procedure. Refer to Figure 18 and 19 for location of components called out in this procedure.

1. Verify at least one high-pressure cylinder is open on high-pressure reserve header.
2. Verify red "RESERVE LOW" light on power supply is not illuminated.
3. Close liquid containers on both banks of manifold.

## Testing and Adjustments

### Reserve Low Switch Adjustment

4. Slightly open vent valve to create a small flow of gas through manifold. Flow gas through manifold until pressure on both manifold banks has been depleted and red "RESERVE IN USE" light on power supply illuminates.
5. Close high-pressure cylinder on reserve header and adjust vent valve so that high-pressure gauge on reserve header regulator drops very slowly.
6. Note high-pressure gauge reading when red "RESERVE LOW" light on power supply illuminates. Recommended settings are listed in Table 1, page 25 (Reserve Low Switch).
7. Close vent valve.
8. If switch adjustment is necessary, slide collar of switch toward wires to access internal adjustment barrel. Insert tip of small screwdriver into adjustment barrel and rotate barrel (Figure 25).

**NOTE:**

When viewing switch from wire end, rotating barrel clockwise will raise switch setting. A counterclockwise rotation will lower switch setting. Make small adjustments and retest as follows:

9. Slowly open one high-pressure on reserve header.
10. Repeat steps 3 through 8 until pressure switch has been set within acceptable limits.
11. Slide pressure switch collar back to original position.

## Service Procedures

### Precautions

#### **⚠ WARNING:**

- 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.
- Use only proper repair tools and parts. Use only approved repair parts provided by BeaconMedæx.
- Do not use chemicals, lubricants or sealants unless specified in these instructions.
- Before connecting liquid containers to manifold and high-pressure cylinders to reserve header, momentarily open and close container/cylinder valves to blow out dirt and debris.
- After connecting liquid containers and high-pressure cylinders, open container/cylinder s-l-o-w-l-y to allow heat of compression to dissipate.
- Do not use flame or "sniff" test for leaks.
- Do not apply heat to any part of the manifold system.
- Always secure high-pressure cylinders with racks, straps, or chains. Unrestrained cylinders may fall over and damage or break off cylinder valve.
- Do not repeatedly bend, sharply bend, or twist the copper pigtailed as damage to the tubing may occur.
- Do not bend flexible pigtailed into a radius smaller than 3".

### Routine Maintenance

#### Daily:

- Visually inspect manifold for normal operation. Record front panel indicator status (e.g. left bank "IN USE", right bank "READY").
- Record left and right bank pressure gauge readings.
- Record line pressure gauge reading.
- Record reserve header cylinder contents and output pressure gauge readings

#### At container/cylinder replacement:

- Visually inspect each pigtail for cleanliness, and damage. Do not use and immediately replace dirty or damaged pigtailed.
- Check for leaks at pigtail connection using oxygen compatible leak detector solution.

#### Annually:

- Verify manifold operation using Performance Verification procedure.

#### Every 3-5 years:

- Replace pigtailed.

### Techniques For Leak-Tight Connections

Lifeline manifolds utilize four different types of connections between internal components.

- Threaded pipe fittings.
- Parker brand "A-Lok" fittings.
- Parker brand "Prestolock" fittings.
- O-ring face seal fittings.

Threaded pipe fittings should be sealed with Teflon tape. Remove old Teflon tape from both male and female threads. Use care so that all fragments are removed from threads and interior of fittings. Apply Teflon tape to male pipe threads. Approximately 2 to 3 turns should be sufficient. Do not cover first thread with tape. Assemble fittings and tighten.

Parker brand "A-Lok" fittings are a type of compression fitting. Mark nut and fitting prior to disassembly. Before retightening, make sure ferrule assembly has been completely inserted into fitting. Retighten nut by hand. Torque nut with wrench until marks line up, which indicates that fitting has been tightened to its original position. A noticeable increase in mechanical resistance will be felt indicating ferrule is being resprung into sealing position. Then, tighten nut 1/12 of a turn (1/2 of a wrench flat) past original position. If tightening a fitting for first time, make sure tube has been inserted completely into fitting and tighten nut by hand. Wrench tighten nut an additional 1-1/4 turns.

Parker brand "Prestolock" fittings are used throughout manifold to attach each end of black nylon tubes. To release tube from fitting, press fitting's release button against body while pulling tube out. If you experience difficulty, open a Crescent wrench so that it just slides over outside of nylon tube. Push side of Crescent wrench against fitting's release button while pulling out on tube. Verify end of the tube is cut square and free of burrs and debris. Insert tube into fitting until it bottoms. Pull on tubing to verify it is properly retained in fitting.

O-ring face seal fittings are used on main outlet and relief valve vent outlet unions as well as four line regulator isolation valve unions. Leaks at these connections can be caused by damaged o-rings or scratches / nicks in brass fittings where o-rings contact. Replace either o-ring or fitting as necessary to correct leak. Lubrication of o-ring is not required.

## Service Procedures

### Secondary Supply Switch Replacement

The following procedure describes process of replacing secondary supply pressure switch. If necessary, pressure switch replacement can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment.

1. Remove two front panel screws A (Figure 23). Loosen two hinge screws B. Fold front panel down to service position as shown in Figure 24. Lightly tighten two hinge screws.
  2. Disconnect power supply connector from bottom of manifold cabinet.
  3. Close all liquid containers on side of manifold where pressure switch will be replaced.
  4. Vent pressure from bank that was shut off in step 3 by slightly loosening compression nut on back of front panel bank contents gauge.
  5. Using small blade screwdriver, remove violet and blue pressure switch wires from control board terminals. Note location of each wire.
  6. Cut cable ties and remove pressure switch wires from manifold's harness.
  7. Verify all pressure has been vented. Remove old pressure switch.
- ⚠ CAUTION:**  
Bank regulator high-pressure ports incorporate filter material between inner and outer wire screens. Take care not to dislodge filter or screens when removing and reinstalling pressure switch.
8. Apply Teflon tape to threads of new switch and install into bank regulator body. Tighten switch so that switch adjustment opening (Figure 25) is facing outward.
  9. Route switch wires and attach them to appropriate control board terminals. Secure wires with cable ties.

10. Tighten compression nut on back of front panel bank contents gauge.
11. Slowly open each liquid container on side of manifold where pressure switch was replaced.
12. Reconnect power supply connector to bottom of manifold cabinet.
13. Verify new switch is set correctly by performing appropriate steps of Performance Verification procedure.
14. Loosen front panel hinge screws and return front panel to upright position. Reinstall two front panel screws and tighten hinge screws.

### Bank Regulator Replacement

The following procedure describes process of replacing bank regulator. If necessary, bank regulator replacement can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment. Internal repair of bank regulator is not recommended.

1. Remove two front panel screws A (Figure 23). Loosen two hinge screws B. Fold front panel down to service position as shown in Figure 24. Lightly tighten two hinge screws.
2. Close all cylinders on side of manifold where bank regulator will be replaced.
3. Vent pressure from bank that was shut off in step 2 by slightly loosening compression nut on back of front panel bank pressure gauge.
4. Remove 5/8" OD copper tube from outlet of bank regulator.
5. Remove pressure switch from bank regulator fitting.

#### **⚠ CAUTION:**

Bank regulator high-pressure ports incorporate filter material between inner and outer wire screens. Take care not to dislodge filter or screens when removing and reinstalling pressure switch.

### Bank Regulator Replacement

6. Disconnect black plastic vent tubing from inlet relief valve.
7. Remove 1/8" copper tube between bank regulator elbow fitting and front panel bank pressure gauge.
8. Loosen large union nut on inlet of bank regulator.
9. Remove nylon tube from regulator dome.
10. Remove two bank regulator bracket mounting nuts.
11. Remove regulator and bracket from manifold.
12. Remove pressure gauge and remaining fittings from old regulator.
13. Noting regulator/bracket alignment, remove regulator bracket from old regulator.
14. Install regulator bracket on new regulator. Align bracket as noted above.
15. Using Teflon tape, reinstall pressure gauge and fittings into new regulator body.
16. Attach new regulator and bracket to manifold's base plate. Hand-tighten mounting nuts.
17. Tighten large nut on inlet of new bank regulator.
18. Install 5/8" OD copper tube.
19. Tighten regulator bracket mounting nuts.
20. Install secondary supply pressure switch. Remember to pre-twist pressure switch wires. Tighten switch so that switch adjustment opening (Figure 25) is facing outward.
21. Install 1/8" copper tube between regulator fitting and front panel bank pressure gauge.
22. Reinstall nylon vent and dome tubing.
23. Slowly open liquid cylinders and set bank regulator's output pressure as described in Bank Regulator Adjustment procedure.
24. Check all joints for leaks using an oxygen compatible leak detector solution.
25. Loosen front panel hinge screws and return front panel to upright position. Reinstall two front panel screws and tighten hinge screws.

#### NOTE:

- Replacement bank regulator is supplied with inlet nut and tailpiece. All other fittings, pressure gauge and pressure switch must be removed from old regulator and reused.
- Refer to Techniques For Leak-Tight Fittings for recommendations concerning removal and reassembly of fittings.
- Some pressure ports in new regulator body will be shipped with pipe plugs. Remove plugs where applicable.
- Check valves downstream of line regulators will prevent back flow. These check valves are intended to prevent gross leaks during service and may not be bubble tight.
- Secondary supply pressure switch may be separated from bank regulator without disconnecting pressure switch wires from control board. Carefully unscrew pressure switch and allow wires to twist. Removal of switch typically requires 4 - 5 revolutions. When reinstalling switch, twist wires 4 - 5 revolutions in a counterclockwise direction so that when tightened, wires will return to approximate original position.



## Service Procedures

### Line Regulator Replacement

The Following procedure describes process of replacing line regulator. If necessary, 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. Internal repair of line regulator is not recommended.

#### NOTE:

- Before removing fittings from old regulator note orientation and depth of fitting in regulator body. In order to align with isolation ball valves, fittings must be installed into new regulator at approximately same depth.
- The unused pressure ports in the new line regulator body will be shipped with pipe plugs.
- Refer to Techniques For Leak-Tight Fittings for recommendations concerning removal and reassembly of fittings.

1. Close two isolation valves on inlet and outlet of line regulator to be replaced.
2. Loosen union nuts on two closed isolation valves.
3. Remove two line regulator bracket mounting nuts.
4. Remove line regulator and bracket from manifold.
5. Noting regulator/bracket alignment, remove regulator bracket from old regulator.
6. Install regulator bracket on new regulator. Align bracket as noted above.
7. Noting orientation of fittings, remove fittings from old regulator.
8. Install fittings on new regulator. Verify correct orientation of fittings.
9. Inspect o-ring removed from each isolation valve union. If damaged, replace o-ring.

10. Insert o-ring into each isolation valve and attach new regulator and bracket to manifold's base plate. Hand-tighten mounting nuts.
11. Tighten two isolation valve union nuts.
12. Tighten line regulator bracket mounting nuts.
13. Open line regulator isolation valves and set line regulator's output pressure as described in Line Regulator Pressure Adjustment procedure.
14. Check all joints for leaks using an oxygen compatible leak detector solution.

### Reserve In Use Switch Replacement

The following procedure describes process of replacing reserve in use pressure switch.

#### **⚠ WARNING:**

Do not attempt to replace reserve in use pressure switch while manifold is in use. Manifold must be depressurized before switch can be removed.

1. Remove two front panel screws A (Figure 23). Loosen two hinge screws B. Fold front panel down to service position as shown in Figure 24. Lightly tighten two hinge screws.
2. Close 3/4" source shut-off valve above manifold.
3. Disconnect power supply connector from bottom of manifold cabinet.
4. Close all liquid containers on both banks of manifold.
5. Close all high-pressure cylinders on high-pressure reserve header.
6. Open vent valve and vent all pressure from manifold system.
7. Using small blade screwdriver, remove violet and blue pressure switch wires from control board terminals. Note location of each wire.
8. Cut cable ties and remove pressure switch wires from manifold's harness.

### Reserve In Use Switch Replacement

9. Verify all pressure has been vented. Remove old pressure switch.
10. Apply Teflon tape to threads of new switch and reinstall. Tighten switch so that switch adjustment opening (Figure 25) is facing toward right or left side of manifold.
11. Route switch wires and attach them to appropriate control board terminals. Secure wires with cable ties.

**NOTE:**

Replacement switches are not factory set. Set switch to appropriate value per Reserve In Use Switch Adjustment procedure in this manual.

12. After switch has been adjusted, loosen front panel hinge screws and return front panel to upright position. Reinstall two front panel screws and tighten hinge screws.
13. Close vent valve.
14. Slowly open all liquid containers on both sides of manifold.
15. Slowly open all high-pressure cylinders connected to high-pressure reserve header.
16. Reconnect power supply connector to bottom of manifold cabinet.
17. Check switch threads for leaks using an oxygen compatible leak detector solution.
18. Open 3/4" source valve above manifold.

### Reserve Header Regulator Replacement

Following procedure describes process of replacing high-pressure reserve header regulator. If necessary, reserve header regulator replacement can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment. Internal repair of reserve header regulator is not recommended. Refer to Figure 20 for component identification.

1. Close all high-pressure cylinders connected to reserve header.

2. Disconnect reserve low switch wires from electrical junction box. Disconnect any conduit connected to switch.
3. Vent pressure from reserve header by loosening zero clearance o-ring sealed union on output side of reserve header regulator.
4. After all pressure has been vented, remove reserve low pressure switch from elbow fitting on regulator body.
5. Remove regulator by disconnecting zero-clearance union on output side and header union on inlet side of regulator.
6. Remove pressure gauges and remaining fittings from old regulator.

**CAUTION:**

Reserve header regulator's high-pressure ports incorporate filter material between inner and outer wire screens. Take care not to dislodge filter or screens when removing plugs and reinstalling gauges or fittings.

**NOTE:**

- Replacement reserve header regulator is supplied with inlet nut and tailpiece. All other fittings and pressure gauges must be removed from old regulator and reused.
- Refer to Techniques For Leak-Tight Fittings for recommendations concerning removal and reassembly of fittings.
- Some pressure ports in new regulator body will be shipped with pipe plugs. Remove plugs where applicable.

7. Using Teflon tape, reinstall pressure gauges and fittings into new regulator body.
8. Reinstall regulator on reserve header and tighten zero clearance and header unions.
9. Using Teflon tape, reinstall reserve low pressure switch. Tighten switch so that switch adjustment opening (Figure 25) is facing outward.

## Service Procedures

### Reserve In Use Switch Replacement

10. Reconnect reserve low switch electrical conduit and wiring.
11. Slowly open high-pressure cylinders connected to reserve header.
12. Check all joints for leaks using an oxygen compatible leak detector solution.
13. Adjust regulator per reserve header regulator adjustment procedure in this manual.

### Reserve Low Switch Replacement

The following procedure describes process of replacing high-pressure reserve header, reserve low switch. If necessary, reserve low switch replacement can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment. Refer to Figure 20 for component identification.

1. Close all high-pressure cylinders connected to reserve header.
2. Disconnect reserve low switch wires from electrical junction box. Disconnect any conduit connected to switch.
3. Vent pressure from reserve header by loosening zero clearance o-ring sealed union on output side of reserve header regulator.
4. After all pressure has been vented, remove reserve low pressure switch from elbow fitting on regulator body.
5. Using Teflon tape, reinstall reserve low pressure switch. Tighten switch so that switch adjustment opening (Figure 25) is facing outward.
6. Reconnect reserve low switch electrical conduit and wiring.
7. Tighten zero clearance union on output of regulator.
8. Slowly open high-pressure cylinders connected to reserve header.

9. Check switch threads for leaks using an oxygen compatible leak detector solution.
10. Adjust pressure switch per reserve low switch adjustment procedure in this manual.

### Control Board Replacement

The following procedure describes process of replacing manifold's electronic control circuit board. If necessary, control board replacement can be performed while manifold is in service. However, this should only be done by qualified technicians experienced in servicing medical equipment. Repair of control board is not recommended.

1. Remove two front panel screws A (Figure 23). Loosen two hinge screws B (Figure 24). Fold front panel down to service position as shown in Figure 18. Lightly tighten two hinge screws.
2. Disconnect power supply connector from bottom of manifold cabinet.
3. Using small blade screwdriver, remove each wire from control board terminals.
4. Remove four control board screws. Note orientation of old control board and remove from manifold.
5. Install new control board and secure with four screws.
6. Connect each wire to appropriate terminal. Refer to wiring diagram, Figure 20 for wire locations.
7. Loosen front panel hinge screws and return front panel to upright position. Reinstall two front panel screws and tighten hinge screws.
8. Reconnect power supply connector to bottom of manifold cabinet.
9. Verify correct operation of new control board by performing Performance Verification.

Wiring Diagram

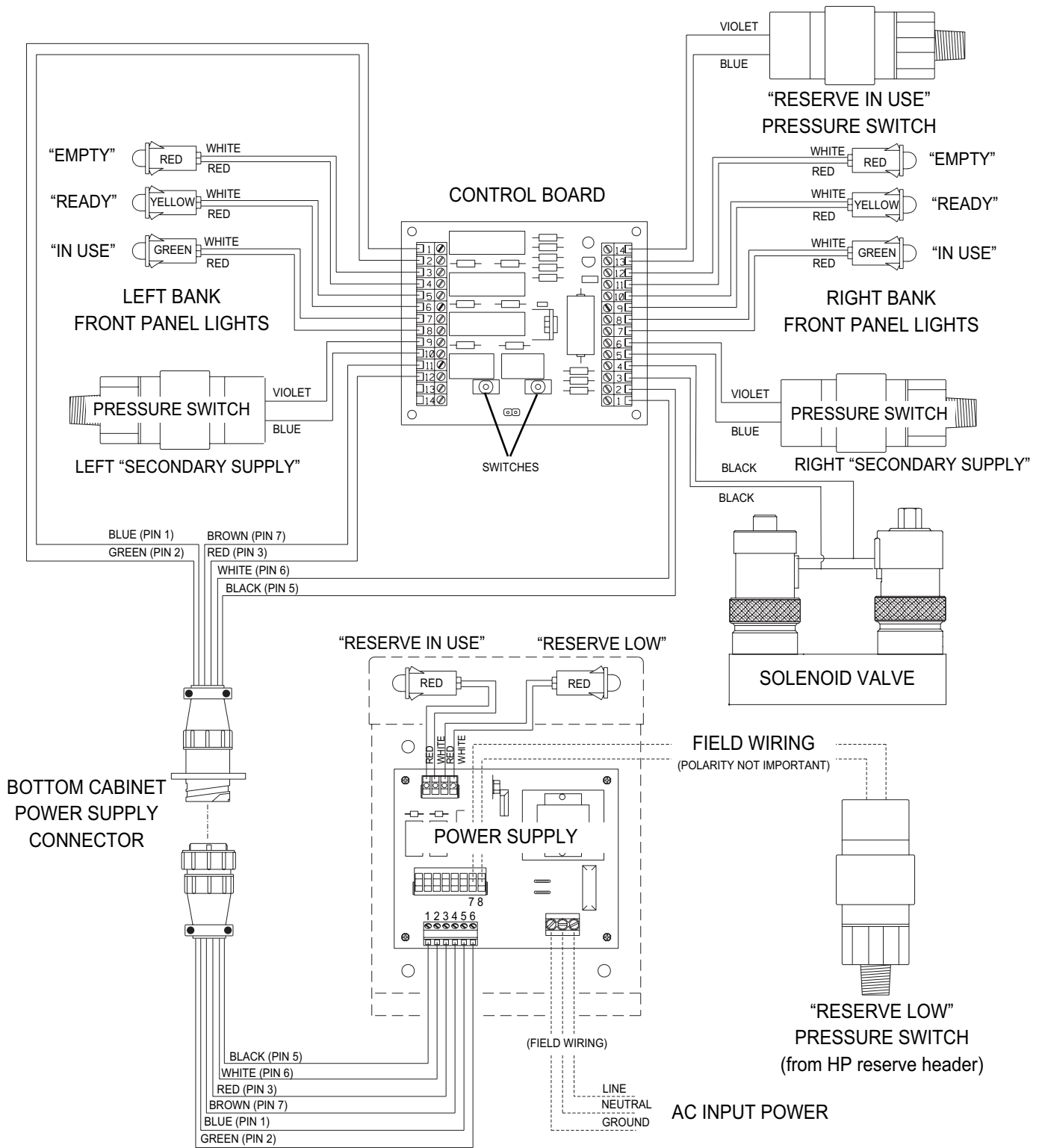
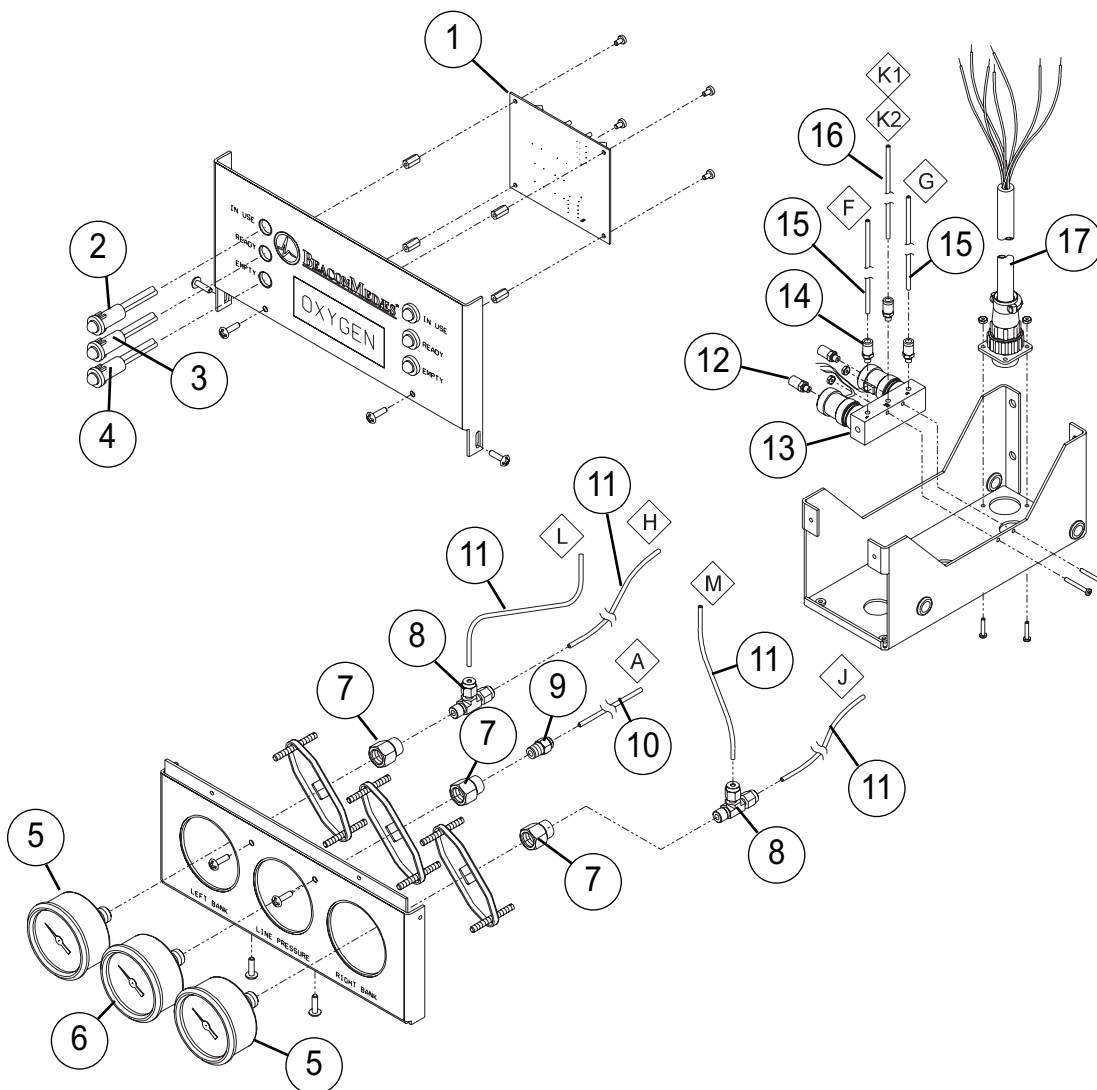


Figure 26

# Illustrated Parts List

## Control Panel Components



**Item Part No. Description**

- 1 6-231940-00 Control Board Assembly
- 2 6-867268-GR Panel Mount LED, Green
- 3 6-867268-YW Panel Mount LED, Yellow
- 4 6-867268-RD Panel Mount LED, Red
- 5 6-130114-00 Bank Pressure Gauge, 400 PSI
- 6 6-130115-00 Line Pressure Gauge, 100 PSI
- 6-130116-00 Line Pressure Gauge, 300 PSI
- 7 6-513011-00 Reducing Coupler, 1/8 NPT x 1/4 NPT
- 8 6-515642-00 Male Run Tee, 1/8 Tube x 1/8 NPT
- 9 6-515602-00 Male Connector, 1/8 Tube x 1/8 NPT
- 10 6-611645-01\* Nylon Tube, 22"
- 11 6-355003-00 1/8 Copper Tube
- 12 6-645025-00 Muffler
- 13 6-103805-00 Solenoid Valve
- 14 6-515600-00 Fitting, 1/8 Tube x 10-32 UNF

**Item Part No. Description**

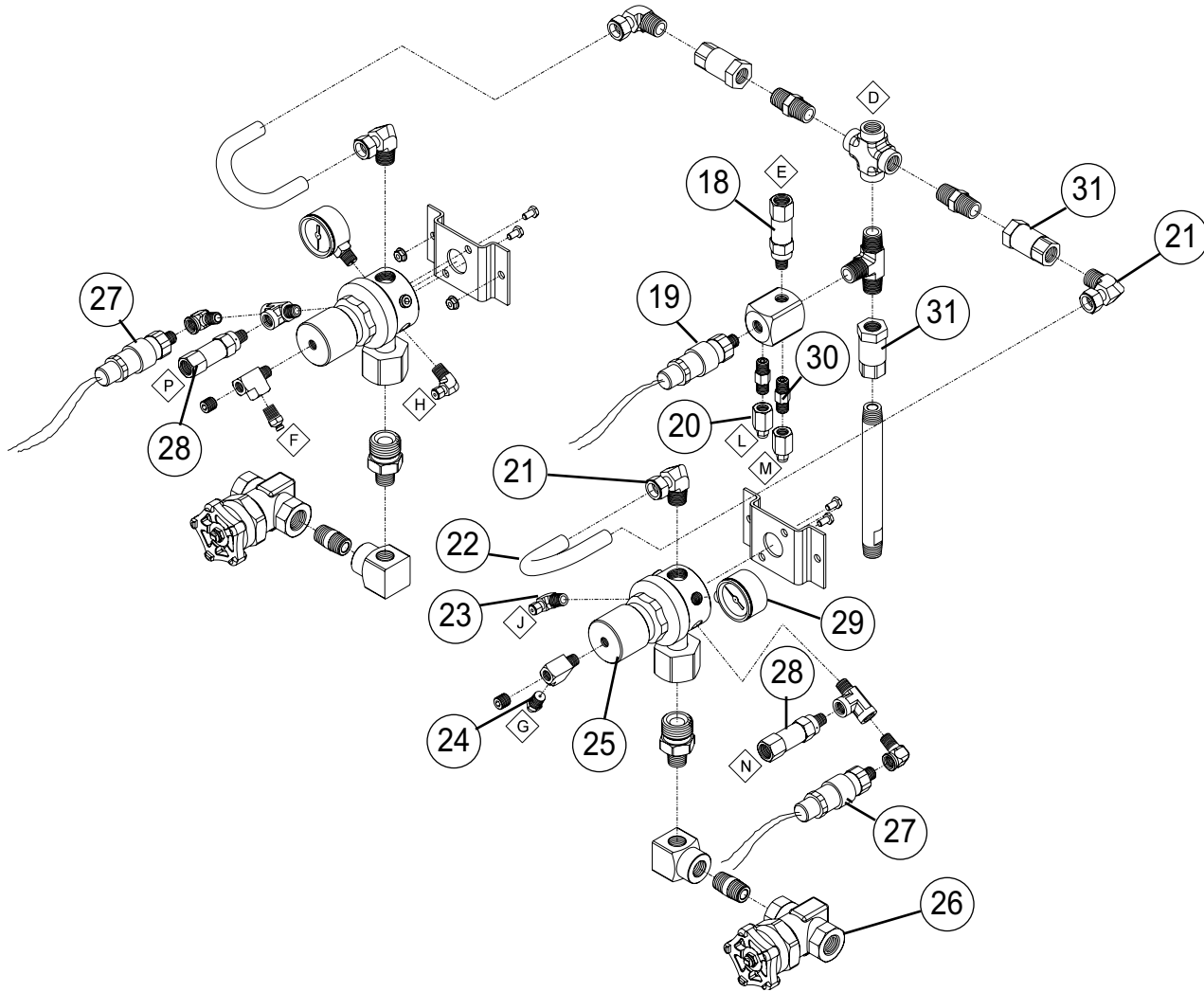
- 15 6-611645-01\* Nylon Tube, 8.5"
- 16 6-611645-01\* Nylon Tube, 25"
- 17 6-290830-00 Wire Harness Assembly, Control Cabinet

\*Tubing sold per foot.

◇ Denotes connections to other illustrated parts lists.

# Illustrated Parts List

## Bank Regulator Components



### Item   Part No.   Description

18	6-230763-50	Intermediate Relief Valve, 350 PSI
19	6-868008-00	Pressure Switch (not factory set)
20	6-515601-00	Female Connector, 1/8 Tube x 1/4 NPT
21	6-515631-00	Male Elbow, 5/8 Tube x 1/2 NPT
22	6-355010-UB	Copper U-Tube 5/8 OD
23	6-515629-00	Male Elbow, 1/8 Tube x 1/4 NPT
24	6-515605-00	Male Connector, 1/8 Tube x 1/4 NPT
25	6-122010-00	Bank Regulator (all except N2O & CO2)
	6-122011-00	Bank Regulator (N2O & CO2 only)
26	6-120005-00	Master Valve
27	6-868008-00	Pressure Switch, Preset at 250 PSI

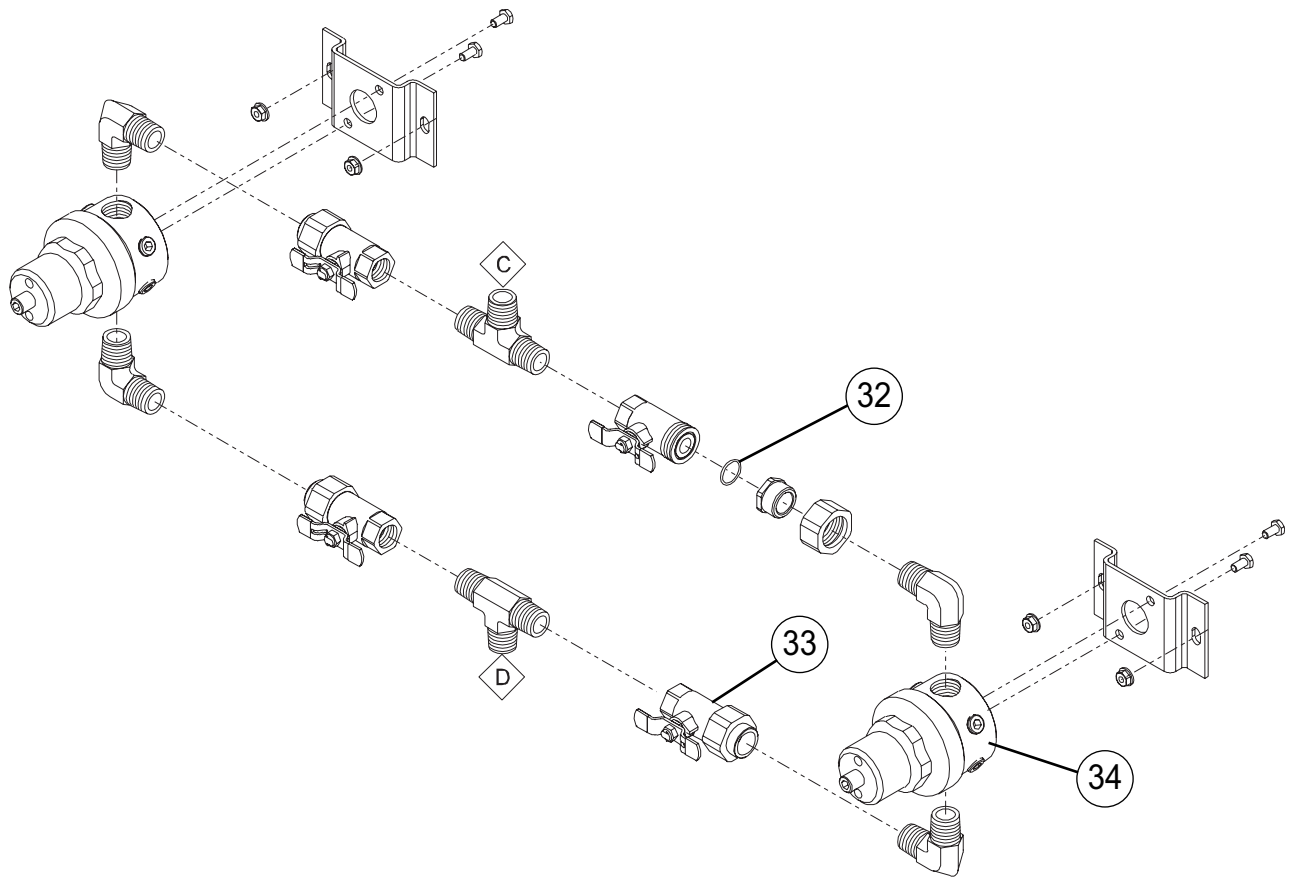
### Item   Part No.   Description

28	6-230764-00	Inlet Relief Valve, 400 PSI
29	6-130118-00	Bank Regulator Gauge, 300 PSI
30	6-513600-00	Economizer Check Valve
31	6-230772-00	Check Valve, 1/2 NPT

◊ Denotes connections to other illustrated parts lists.

# Illustrated Parts List

## Line Regulator Components



<u>Item</u>	<u>Part No.</u>	<u>Description</u>
32	6-622610-00	O-Ring, Line Regulator Ball Valve
33	6-230783-00	Ball Valve, 1/2 NPT
34	6-122012-00	Line Regulator

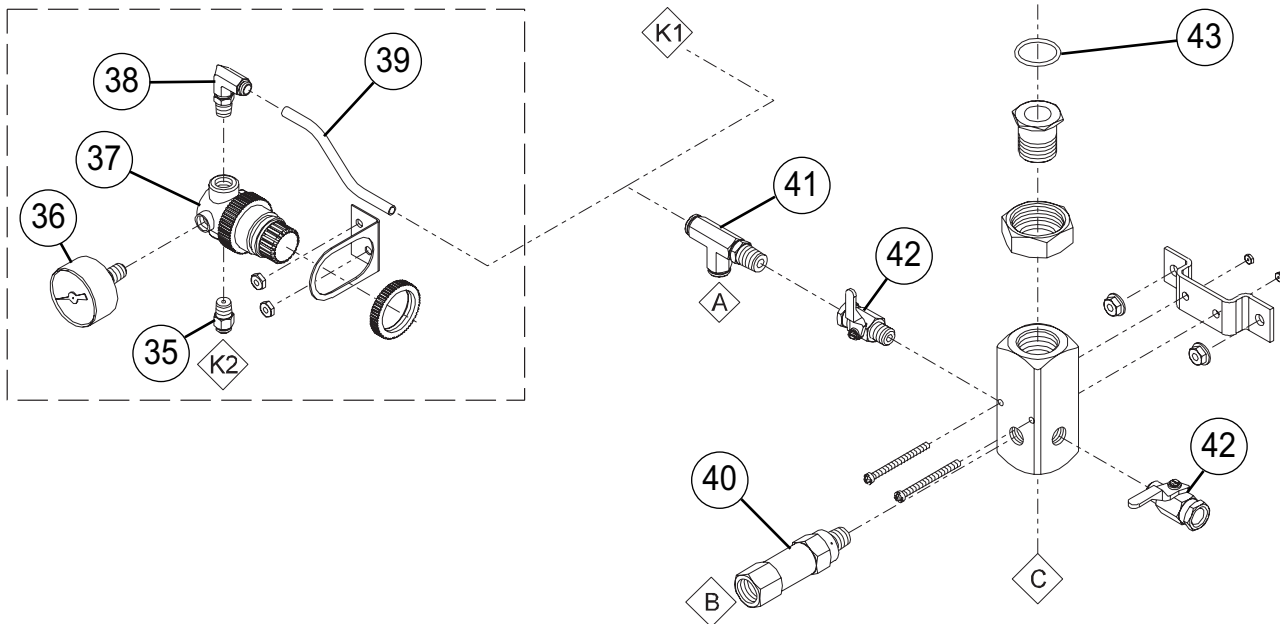
◇ Denotes connections to other illustrated parts lists.

# Illustrated Parts List

## Outlet / Dome Regulator Components

Item	Part No.	Description
35	6-515602-00	Male Connector, 1/8 Tube x 1/8 NPT
36	6-130119-00	Dome Pressure Gauge, 60 PSI
37	6-122013-00	Dome Pressure Regulator
38	6-515632-00	Male Elbow, 1/8 Tube x 1/8 NPT
39	6-611645-01*	1/8 Nylon Tube, 5.5"
40	6-230760-75	Line Relief Valve, 75 PSI
	6-230761-50	Line Relief Valve, 150 PSI
	6-230762-50	Line Relief Valve, 250 PSI
41	6-515641-00	Male Run Tee, 1/8 Tube x 1/8 NPT
42	6-230194-03	Ball Valve, 1/8 NPT
43	6-622611-00	O-Ring, Main Outlet Zero Clearance Fitting
44	6-230784-00	3/4" Ball Valve
44a	6-290566-00	Repair Kit, 3/4" Ball Valve (not shown)

\*Tubing sold per foot.



◇ Denotes connections to other illustrated parts lists.

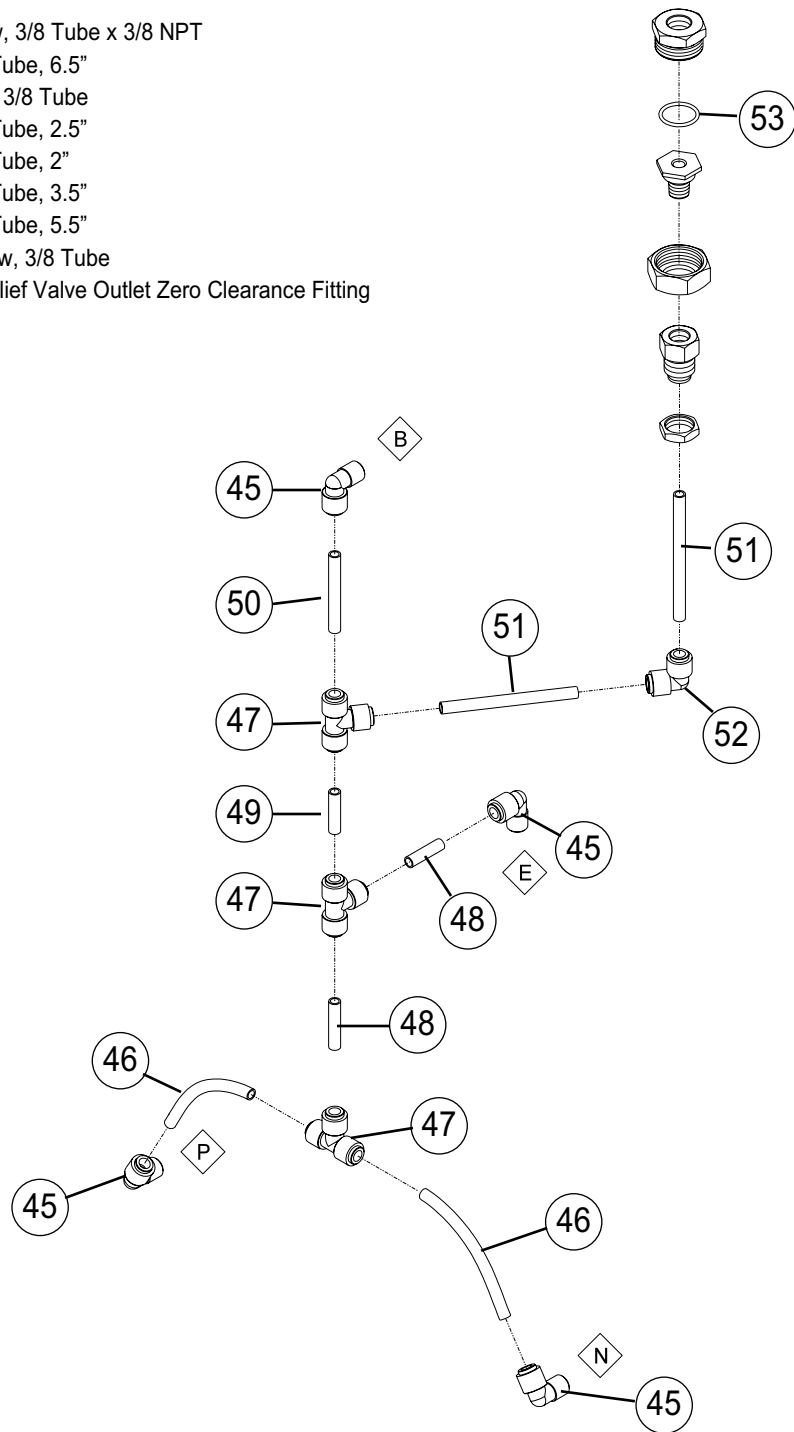


# Illustrated Parts List

## Relief Vent Components

Item	Part No.	Description
45	6-616590-00	Male Elbow, 3/8 Tube x 3/8 NPT
46	6-611645-03*	3/8 Nylon Tube, 6.5"
47	6-616592-00	Union Tee, 3/8 Tube
48	6-611645-03*	3/8 Nylon Tube, 2.5"
49	6-611645-03*	3/8 Nylon Tube, 2"
50	6-611645-03*	3/8 Nylon Tube, 3.5"
51	6-611645-03*	3/8 Nylon Tube, 5.5"
52	6-616591-00	Union Elbow, 3/8 Tube
53	6-622611-00	O-Ring, Relief Valve Outlet Zero Clearance Fitting

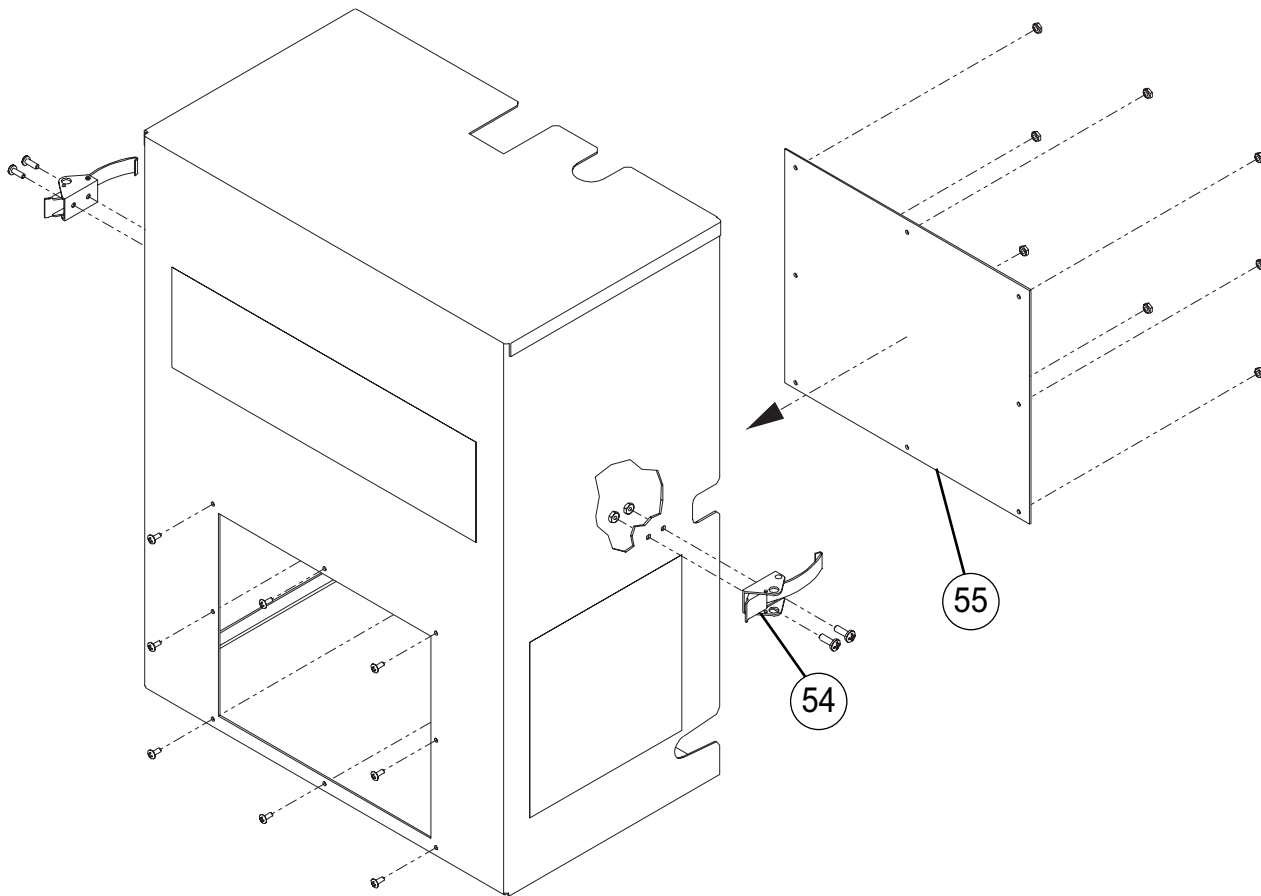
\*Tubing sold per foot.



◇ Denotes connections to other illustrated parts lists.

# Illustrated Parts List

## Cabinet Cover Components

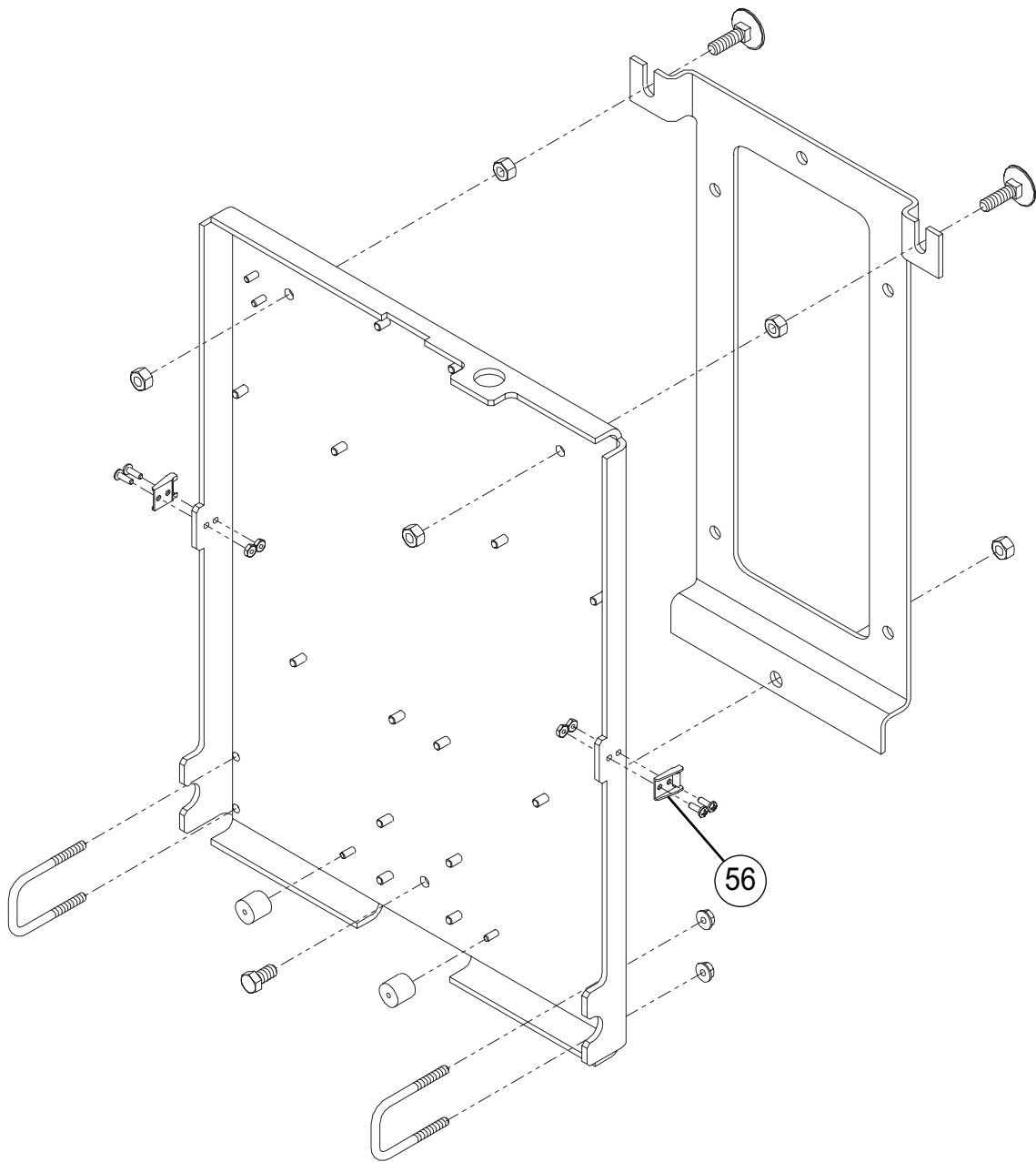


<u>Item</u>	<u>Part No.</u>	<u>Description</u>
-------------	-----------------	--------------------

- |    |             |  |
|----|-------------|--|
| 54 | 6-838153-00 | Manifold Cover Draw Latch (includes item 56) |
| 55 | 6-616505-00 | Front Cover Window                           |

# Illustrated Parts List

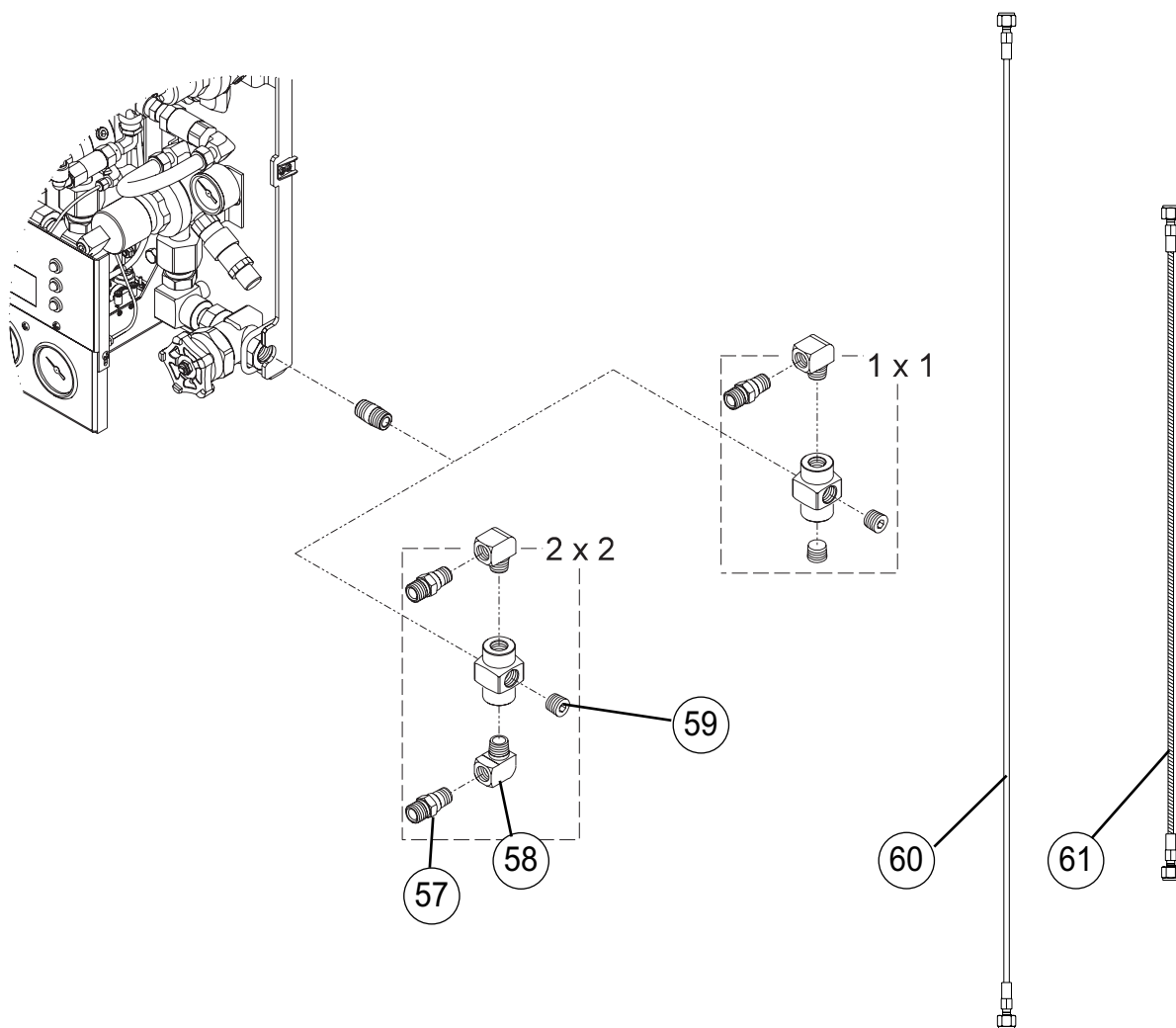
## Cabinet Base Plate Components



<u>Item</u>	<u>Part No.</u>	<u>Description</u>
56	6-838153-00	Manifold Base Latch (Includes item 54)

# Illustrated Parts List

## Manifold Inlet Components



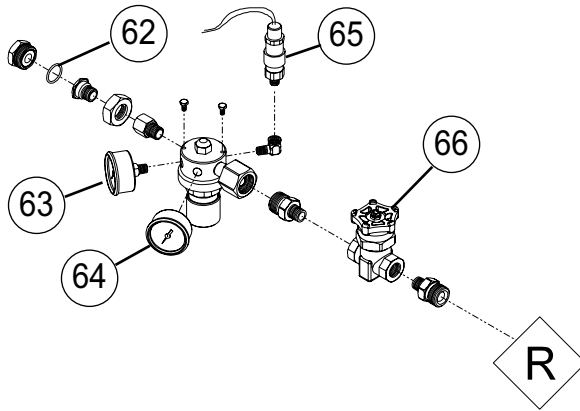
Item	Part No.	Description
57		Check Valve Spud x 1/2 NPT (high flow - 350 PSI Maximum Pressure)
	6-511618-10	Oxygen (CGA 540)
	6-511618-11	Nitrous Oxide (CGA 326)
	6-511618-14	Nitrogen or Argon (CGA 580)
	6-511618-20	CO2 (CGA 320)
58	6-515724-00	90° Street Elbow, 1/2 NPT
59	6-515700-00	Plug, 1/2" NPT
60		72" Flex Pigtail (for liquid cylinders)
	6-290910-72	Oxygen (CGA 540)
	6-290911-72	Nitrous Oxide (CGA 326)
	6-290914-72	Nitrogen or Argon (CGA 580)
	6-290920-72	CO2 (CGA 320)
61		48" Liquid Cylinder Vent Hose
	6-290840-48	Oxygen (CGA 440)
	6-290841-48	N2O, N2, CO2, or Argon (CGA 295)

### **⚠ WARNING:**

Check valve spuds for liquid containers (item 57), have a maximum operating pressure of 350 PSI. Although similar in appearance to high-pressure check valve spuds (items 69 and 71, page 61), care must be taken not to interchange the two types. Check valve spuds for liquid containers are labeled "350 PSI MAX."

# Illustrated Parts List

## HP Reserve Header Components



Item	Part No.	Description
62	6-622611-00	O-Ring, Zero Clearance Fitting
63	6-130116-00	Pressure Gauge, 300 PSI
64	6-130117-00	Pressure Gauge, 3000 PSI
65	6-868009-00	Pressure Switch (not factory set)
66	6-120005-00	Master Valve

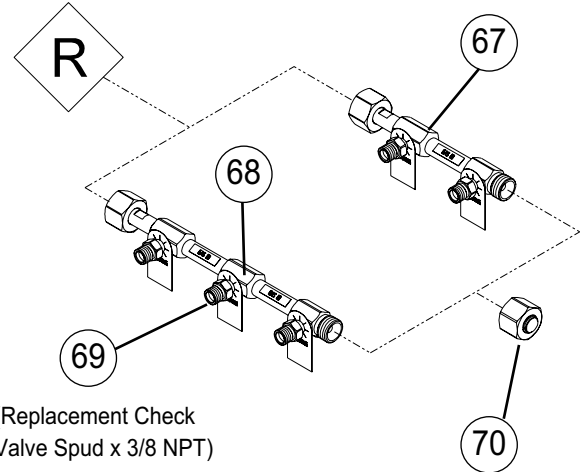
Item	Part No.	Description
67		2 Cylinder Header Segment
	6-136002-10	Oxygen (CGA 540)
	6-136002-11	Nitrous Oxide (CGA 326)
	6-136002-14	Nitrogen (CGA 580)
	6-136002-20	CO2 (CGA 320)
	6-136002-26	Argon (CGA 580)
68		3 Cylinder Header Segment
	6-136003-10	Oxygen (CGA 540)
	6-136003-11	Nitrous Oxide (CGA 326)
	6-136003-14	Nitrogen (CGA 580)
	6-136003-20	CO2 (CGA 320)
	6-136003-26	Argon (CGA 580)

Item	Part No.	Description
69		Check Valve Spud (HP) x 3/8 NPT
	6-511619-10	Oxygen (CGA 540)
	6-511619-11	Nitrous Oxide (CGA 326)
	6-511619-14	Nitrogen or Argon (CGA 580)
	6-511619-20	CO2 (CGA 320)
70	6-515763-00	Header Plug and Nut Assembly
71		Check Valve Spud (HP) x 1/2 NPT
	6-511615-10	Oxygen (CGA 540)
	6-511615-11	Nitrous Oxide (CGA 326)
	6-511615-14	Nitrogen or Argon (CGA 580)
	6-511615-20	CO2 (CGA 320)

◊ Denotes connections to other illustrated parts lists.

Lifeline Manifolds manufactured after October 2006 use check valves with 3/8" NPT connections on header segments.

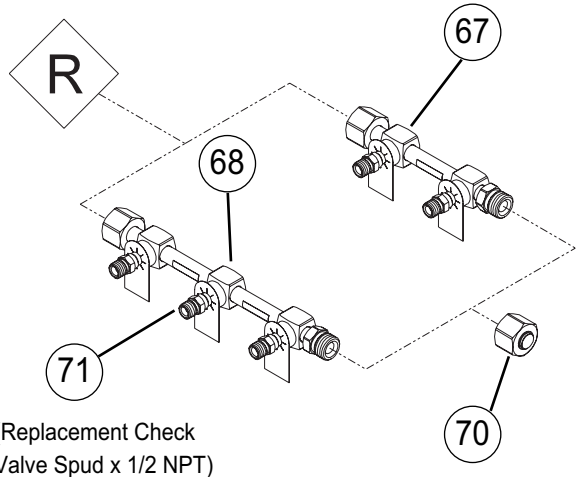
**Note hexagonal block sections where check spuds thread into header segments.**



(Replacement Check Valve Spud x 3/8 NPT)

Lifeline Manifolds manufactured prior to October 2006 used check valves with 1/2" NPT connections on header segments.

**Note square block sections where check spuds thread into header segments.**



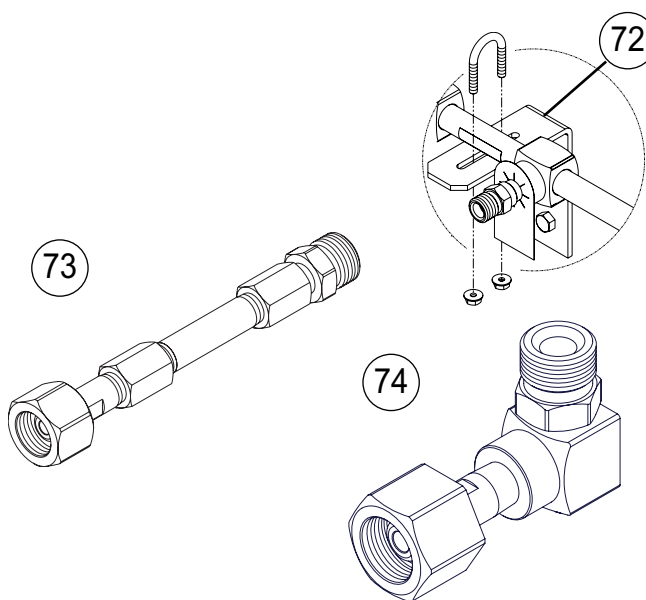
(Replacement Check Valve Spud x 1/2 NPT)

**⚠ WARNING:**  
Check valve spuds for liquid containers (item 57, page 60), have a maximum operating pressure of 350 PSI. Although similar in appearance to high-pressure check valve spuds (items 69 and 71), care must be taken not to interchange the two types. Check valve spuds for liquid containers are labeled "350 PSI MAX."

## Illustrated Parts List

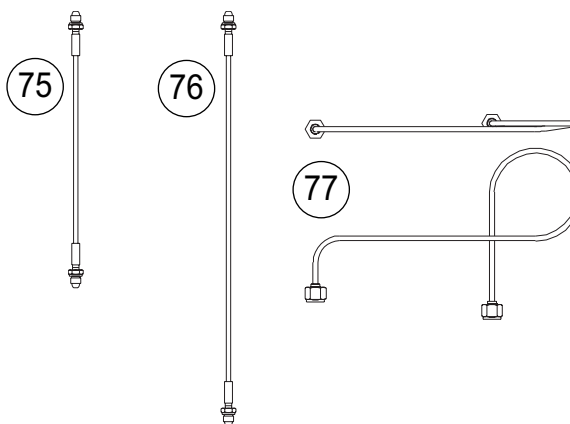
### HP Reserve Header Components

Item	Part No.	Description
72	6-425564-KT	Header Wall Bracket (includes hardware)
73		Header Extension
	6-136000-10	10" Length
	6-136000-12	12" Length
	6-136000-16	16" Length
74		Header Elbow, 90°
	6-290657-01	3-3/4" Length



### Pigtails

Item	Part No.	Description
75		24" Flexible Pigtail Assembly
	6-290811-24	Nitrous Oxide (CGA 326)
	6-290814-24	Nitrogen or Argon (CGA 580)
	6-290820-24	CO2 (CGA 320)
76		36" Flexible Pigtail Assembly
	6-290811-36	Nitrous Oxide (CGA 326)
	6-290814-36	Nitrogen or Argon (CGA 580)
	6-290820-36	CO2 (CGA 320)
77	6-290810-00	Rigid Copper Pigtail, Oxygen (CGA 540)



### Replacement Pigtail O-Rings / Washers

Item	Part No.	Description
--		Replacement O-rings - (Pkg of 10) (not shown)
	6-622612-PG	Oxygen (CGA 540)
	6-622613-PG	Nitrous Oxide (CGA 326)
	6-622614-PG	Nitrogen or Argon (CGA 580)
--		Replacement Washers - (Pkg of 10) (not shown)
	6-621600-PG	Carbon Dioxide (CGA 320)

### Manifold Stand Kits

Item	Part No.	Description
--	6-135000-KT	Control Panel Stand Kit (shown on Pg. 11)
--	6-135001-KT	Header Stand Kit (shown on Pg. 11)

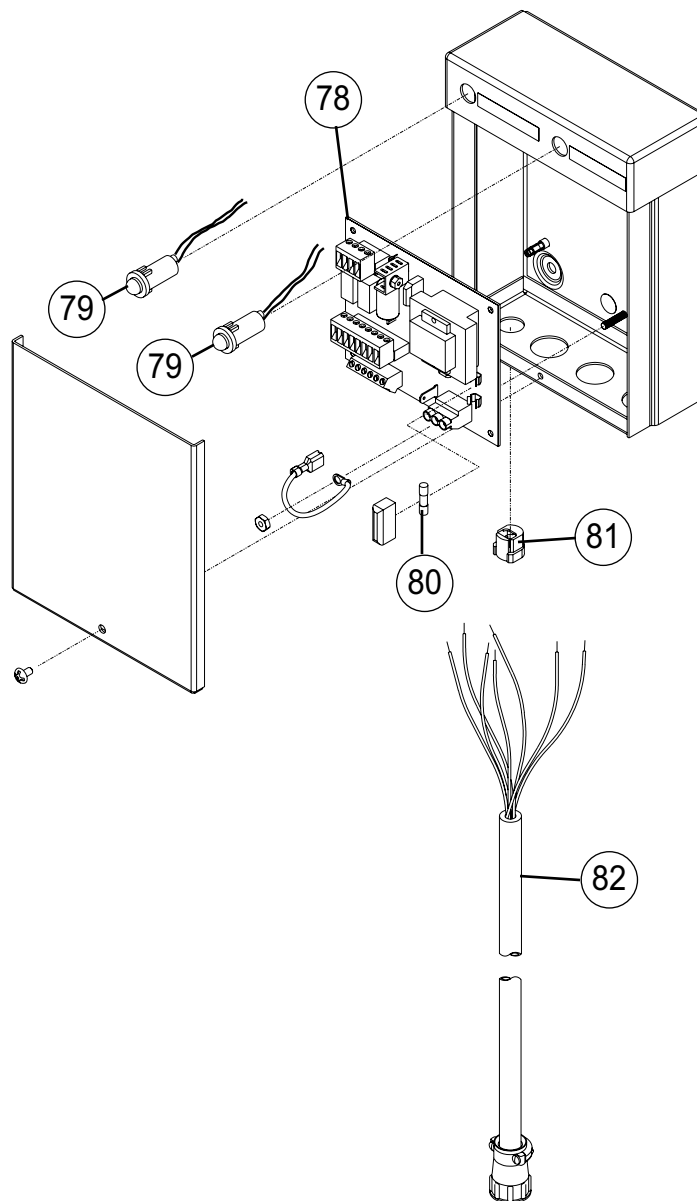
### Manifold Accessories

Item	Part No.	Description
--		Nut & Blind Gland for Header Check (not shown)
	6804-2000-001	Oxygen (CGA 540)
	0204-6668-300	Nitrous Oxide (CGA 326)
	0204-6669-300	Nitrogen or Argon (CGA 580)
	0204-6662-300	Carbon Dioxide (CGA 320)
--		Wall Mount Cylinder Bracket (not shown)
	6-290641-01	Single
	6-290641-04	Double
--	*6-515725-00	90° Street Elbow, 3/4 NPT (not shown)

\*Note: 90° Elbow used between zero clearance fitting and source valve to redirect direction due to low ceiling height.

## Illustrated Parts List

### Power Supply Components



<u>Item</u>	<u>Part No.</u>	<u>Description</u>
78	6-231985-LQ	Power Supply Circuit Board, 120 VAC
	6-231984-LQ	Power Supply Circuit Board, 240 VAC
79	6-867268-RD	Panel Mount LED, Red
80	6-865549-00	1/4 Amp Fuse, 5 x 20 mm, (GMD-250mA)
	6-865542-00	1/8 Amp Fuse, 5 x 20 mm (GMD-125mA)
81	6-865100-00	Strain Relief
82	6-290831-00	Wire Harness Assembly, Power Supply

## Warranty

BeaconMedæ's warrants the equipment it manufactures to be free of defect in materials or workmanship when installed and operated in accordance with instructions for the following periods. All of the periods commence upon shipment or at start up, whichever period terminates earlier.

This warranty covers all necessary parts and labor required for correction of the defect whether by any or all of repair, replacement, or credit, which election shall be made by BeaconMedæ's at its sole discretion.

This warranty requires the owner to ensure that the equipment is 1) started up or placed in service by an authorized representative of BeaconMedæ's, which includes the completion and forwarding to BeaconMedæ's of an appropriate start-up checklist, 2) certified in accordance with NFPA 99, most recent edition, by a properly qualified verification agency, and 3) maintained in strict accordance with Operation and Maintenance instructions provided with the product.

Warranty claims will be honored only after examination by BeaconMedæ's and only when such examination shall disclose to BeaconMedæ's' reasonable satisfaction that such equipment has not been damaged

in shipment or installation, improperly installed, operated outside of any published operating limits (including but not limited to temperature, pressure, humidity, or ventilation), improperly or inadequately maintained, field modified in any way, improperly repaired, or in any other way improperly applied or used.

All claims against this warranty require prompt notification, within the warranty period, of any seeming defect. Failure to promptly notify BeaconMedæ's of the seeming defect will invalidate all warranties. This warranty excludes damage or defect caused by shipping, acts of God, fire, war, labor difficulties, action of government, or other cause beyond the reasonable control of BeaconMedæ's.

This warranty is given in lieu of all other warranties, expressed or implied, including implied warranties of fitness for a particular purpose and merchantability.

In no event shall BeaconMedæ's be liable for damages in excess of the value of the defective product, nor shall BeaconMedæ's be liable for any direct, special or consequential damages, loss of profit of any kind, or for loss of use of the products.

	Standard Warranty Periods		Limitation:
	From Shipment	From Startup	
LifeLine Medical Air Systems	30 months	24 months	Bare Compressor as below. Normal consumables warranted as below.
LifeLine Bare Compressors	36 months	30 months	
Compressor Head valves	12,000 operating hours or 4 years		The "441 Valve" in all LifeLine dryers is warranted for 10 (Ten)Years  Vane Life varies with horsepower. Vane Replacement may be required within this interval. Refer to manual for detail.
Compressor Rings and Bearings	8,000 operating hours or 3 years		
LifeLine Desiccant Dryer Systems	30 months	24 months	
LifeLine Lubricated Vane Vacuum	30 months	24 months	
LifeLine Oilless Vane Vacuum	30 months	24 months	
LifeLine Liquid Ring Vacuum	30 months	24 months	
LifeLine Dynamic Vacuum	30 months	24 months	
Lifeline Claw (standard lubricant)	30 months	24 months	
Lifeline Claw (O2 Assured)	30 months	24 months	
Pipeline products	30 months	24 months	



*Corporate Headquarters:*

BeaconMedæ's  
1800 Overview Dr.  
Rock Hill, SC 29730  
Phone (803) 817-5600  
Fax (803) 817-5750

**For technical support or to place an order call:**

1 888 4 MEDGAS  
(1-888-463-3427)  
Fax (866) 635-3296

[www.beaconmedaes.com](http://www.beaconmedaes.com)