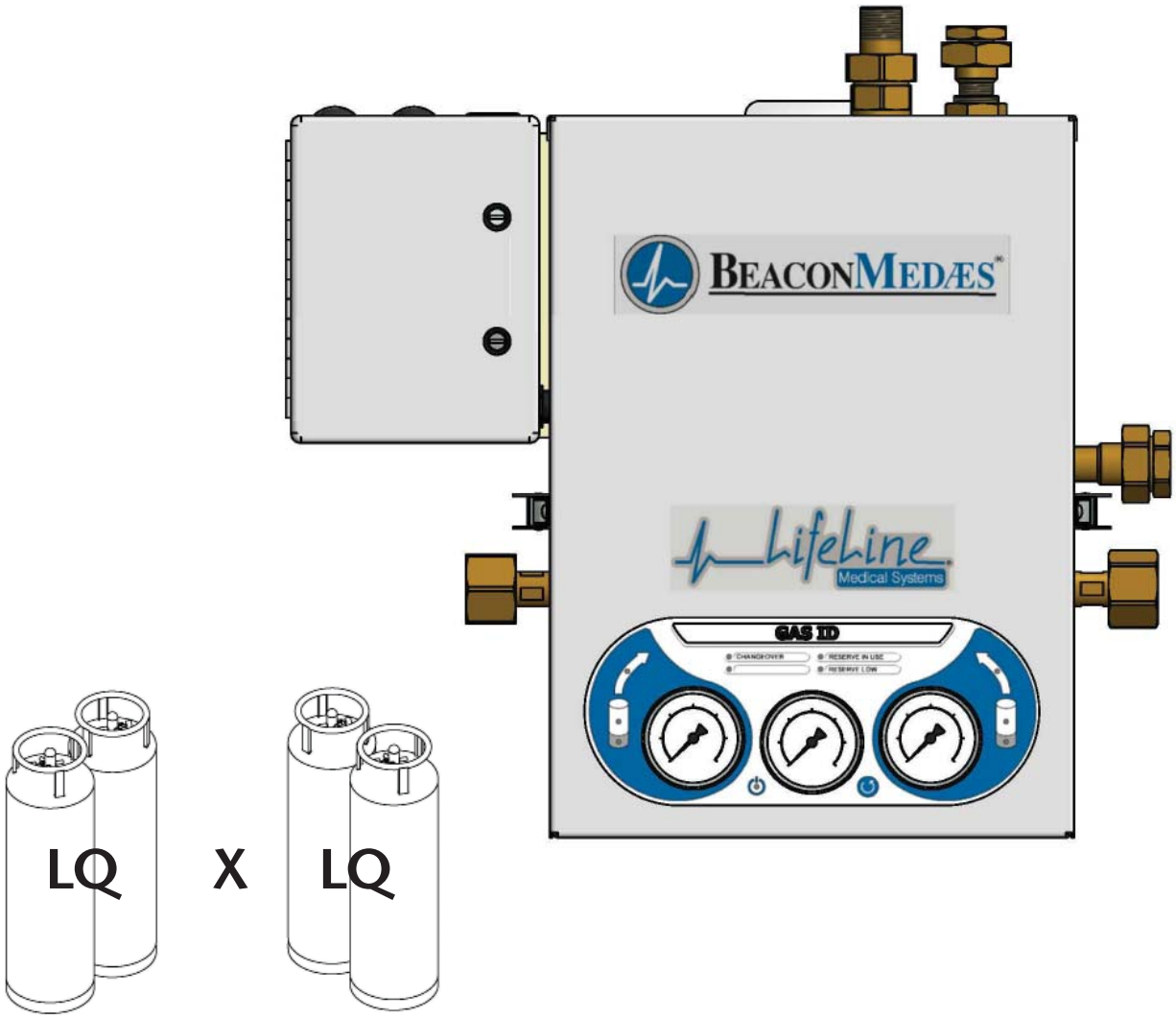
Installation, Operation and Maintenance Instructions



Liquid x Liquid Models

Lifeline Medical Systems

Liquid Pressure Fully-Automatic Manifold

Basic/TAE

NFPA/ISO

Part number 4107 9013 94
Revision 04
14 November 2019

U.S. Design Patent No. D734,854

BeaconMedæs®

Lifeline
Medical Systems

Installation, Operation and Maintenance Manual

Lifeline Medical Systems
Liquid by Liquid Fully-Automatic Manifold

This unit is purchased from: _____

Date purchased: _____

Model number: _____

Serial number: _____

Option(s) included: _____

Any information, service or spare parts requests should include the machine serial number and be directed to:

BeaconMedæs
1059 Paragon Way
Rock Hill, SC 29730

Telephone: (888) 463-3427
Fax: (803) 817-5750

BeaconMedæs reserves the right to make changes and improvements to update products sold previously without notice or obligation.

Part number 4107 9013 94
Revision 04
14 November 2019

Table of Contents

Table of Contents (continued)

1.0 Introduction

1.1 Audience

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

1.2 Abbreviations

AR	Argon
CGA	Compressed Gas Association
CO_2	Carbon Dioxide
N_2	Nitrogen
N_2O	Nitrous Oxide
NPTF	National Pipe Thread Female
NPTM	National Pipe Thread Male
NER	Normal Evaporation Rate
O_2	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

1.3 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.

1.4 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.

The 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 the “Primary” source of gas while other bank stands in reserve as the “Secondary” source.

The manifold control module is connected to an external high pressure reserve header assembly consisting of multiple high-pressure cylinders.

Lights on the front of the manifold control module indicate the status of gas supply. Each manifold bank has a green (IN USE), green (READY), and red (EMPTY) light, a yellow (RESERVE IN USE) and red (RESERVE LOW) light also located on the manifold.

When the manifold’s primary bank of liquid containers is depleted, the system will automatically switch to the secondary bank of liquid cylinders. When the liquid containers are replenished, the manifold will automatically switch back to the primary (left) bank. If the primary bank of liquid containers and the secondary bank of liquid cylinders are depleted, the manifold system will automatically switch to the 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 the external master alarm panels and will open when an alarm condition occurs.

- Changeover
- Reserve In Use
- Reserve Low

Product Description (Cont.)

A power supply converts 100-250 VAC to 24 VDC to power the manifold. Two sets of dry normally closed alarm contacts can be accessed inside the manifold control module.

The Lifeline manifold is designed in accordance with the National Fire Protection Association (NFPA) 99 and International Organization for Standardization (ISO) 7396-1.

1.5 Environmental Considerations

Manifolds are to be installed in accordance with requirements stated by NFPA 99, ISO 7396-1, CGA and all applicable local codes.

The BeaconMedaes Lifeline manifold has been environmentally tested to MIL STD 810F. The power supply and control board is fully contained inside a NEMA 4 enclosure, allowing for outdoor installations. The manifold can be used in high humidity conditions and was successfully tested at 86°F (30°C) - 140°F (60°C) with 95% relative humidity, per MIL STD 810F.

The power supply and electrical components have a pollution degree 1 classification. The manifold components will be used in a pollution degree 4 environment.

The manifold components are designed to work best over a temperature range of 0° F (-18° C) through 130° F (54° C). Wider temperature variations may cause manifold malfunctions to occur. The manifold is designed to be used below 2,000 meters, for higher elevations contact the factory.

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.

1.6 Environmental Declarations

Disposal

General

When developing products and services, BeaconMedæs tries to understand, address, and minimize the negative environmental effects that the products and services may have, when being manufactured, distributed, and used, as well as at their disposal.

Recycling and disposal policies are part of the development of all BeaconMedæs products. BeaconMedæs company standards determine strict requirements.

When selecting materials the substancial recycability, the disassembly possibilities and the separability of the materials and assemblies are considered as well as the environmental perils and dangers to health during the recycling and disposal of the unavoidable rates of non-recycable materials.

BeaconMedæs products for the most part consist of metallic materials that can be remelted in steelworks and smelting works and that is therefore almost infinitely recyclable. The plastic use is labeled; sorting and fractioning of the materials for recycling in the future is foreseen.

Disposal of Materials

Dispose contaminated substances and materials separately, according to local applicable environmental legislations.

NOTE:

This concept can only succeed with your help.

Support us by disposing professionally.

By assuring a correct disposal of the product you help to prevent possible negative consequences for environment and health that can occur with inappropriate waste handling.

Recycling and re-usage of materials helps to preserve natural resources.

2.0 Installation

2.1 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 pigtails as damage to tubing may occur.
- Do not bend flexible pigtails 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 ISO 7396-1

2.2 Manifold System Components

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

- Manifold control module
- Wall mounting bracket (attached to manifold control panel)
- ¾" source shut-off valve
- High-pressure reserve header inlet fittings (attached to manifold on NFPA model only)
- Installation, Operation, and Service Manual

Additional cartons contain the appropriate number of header extensions and cylinder pigtail assemblies. High Pressure cylinders for reserve header (NFPA) must be placed in a double row "staggered" configuration. High Pressure pigtails for gases other than oxygen and N_2O are 24" length stainless-steel flexible type.

Pigtails 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 module floor stand kit and an appropriate number of header floor stand kits for reserve header assembly (sold separately).

2.3 Wall Mounting Instructions

1. Remove manifold control module from shipping carton and place face up on cardboard packaging insert.

2. Remove the control module enclosure by releasing the two latches on each side and set the cover aside.

3. Remove the four M8 hex head bolts from the mounting bracket as shown in Figure Lift the manifold away from the mounting bracket and set aside.

4. Mark wall 77-½" from finished floor in location where manifold will be mounted. Convert mark to level horizontal line approximately 8" long.

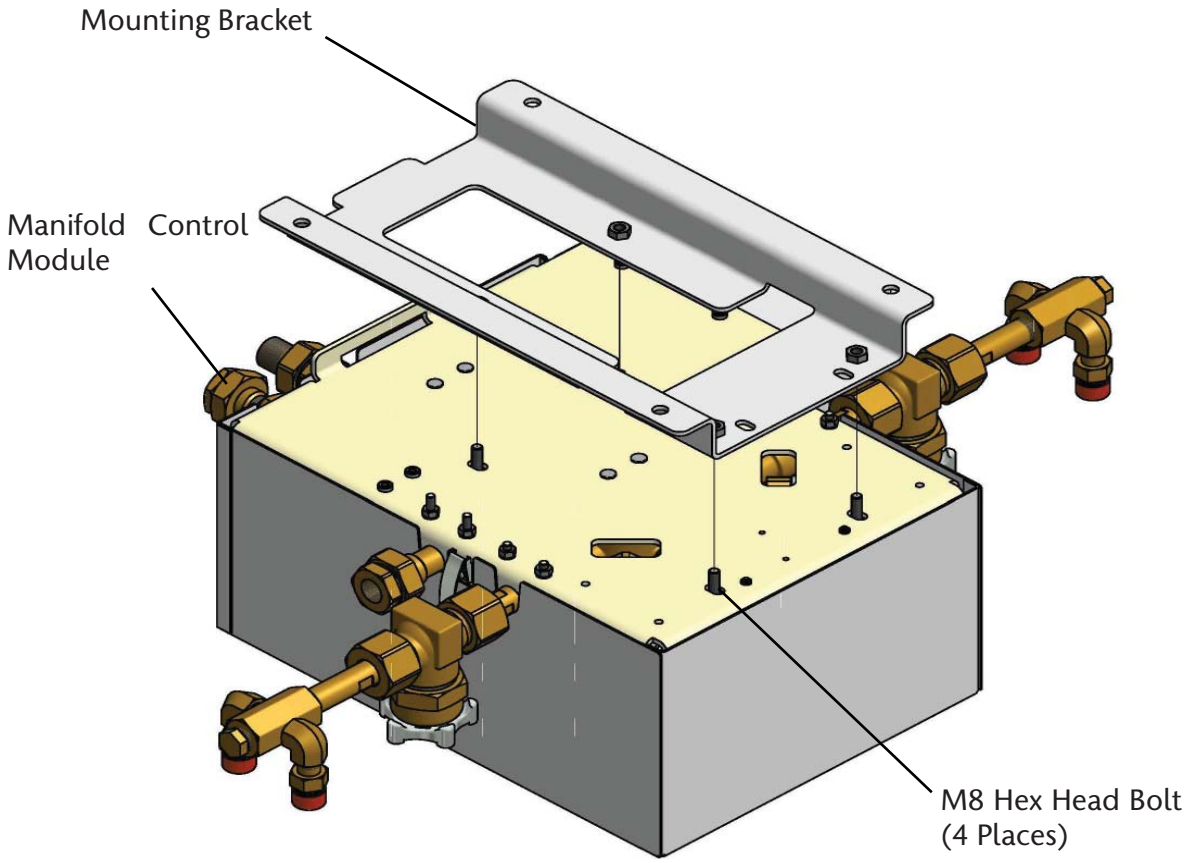


Figure 1

Wall Mounting Instructions (cont.)

5. 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 77-½" height will net a 65-¾" height from center of header to finished floor.
6. Mark locations of mounting holes. Remove bracket and drill mounting holes. Attach bracket to wall with appropriate anchors (by others). ⅜" diameter anchors are recommended.

> **⚠ WARNING:**
>
> Do not attempt to lift manifold alone. Two people are recommended in order to hang manifold onto wall mounting bracket.

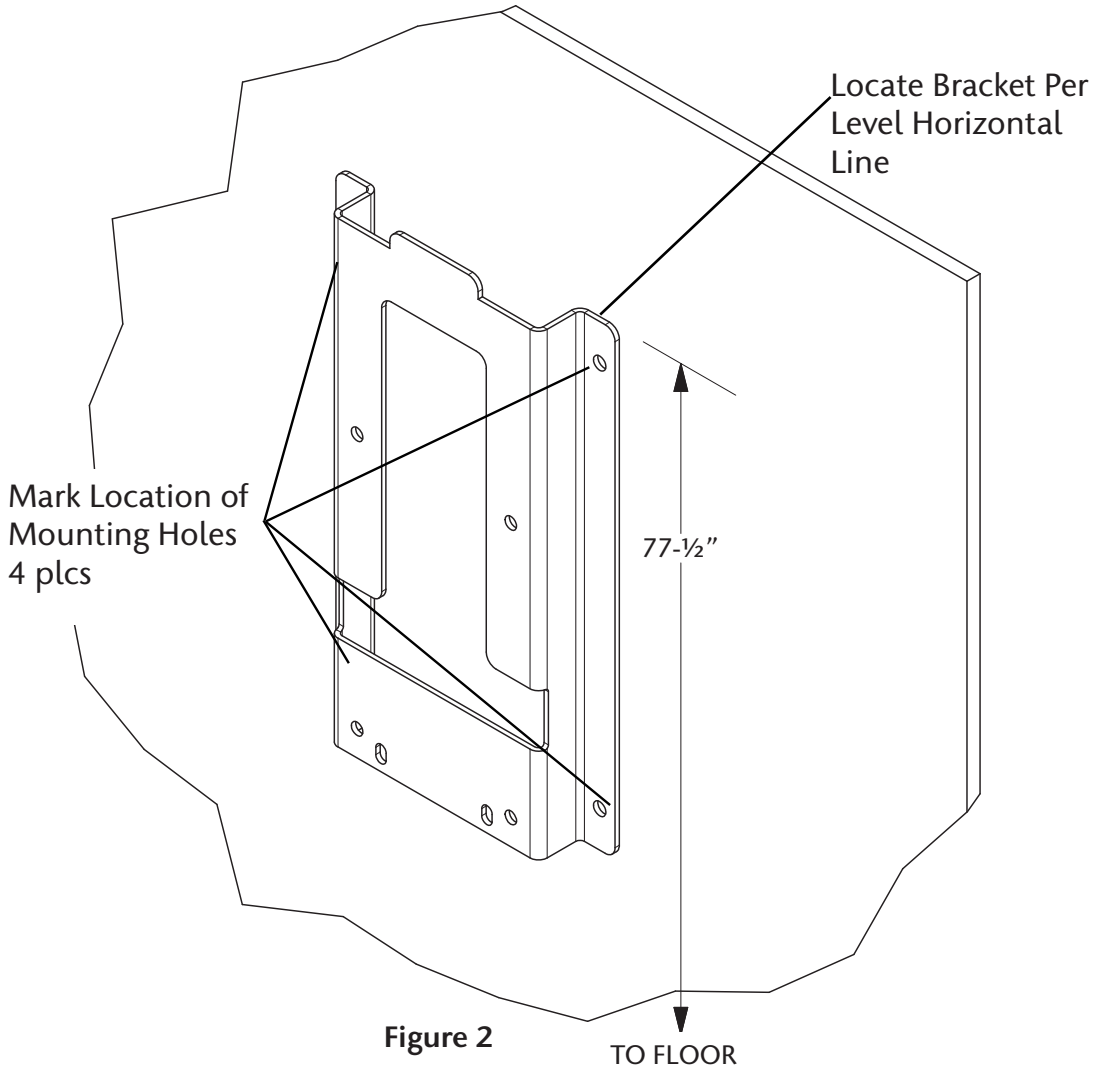


Figure 2

Wall Mounting Instructions (cont.)

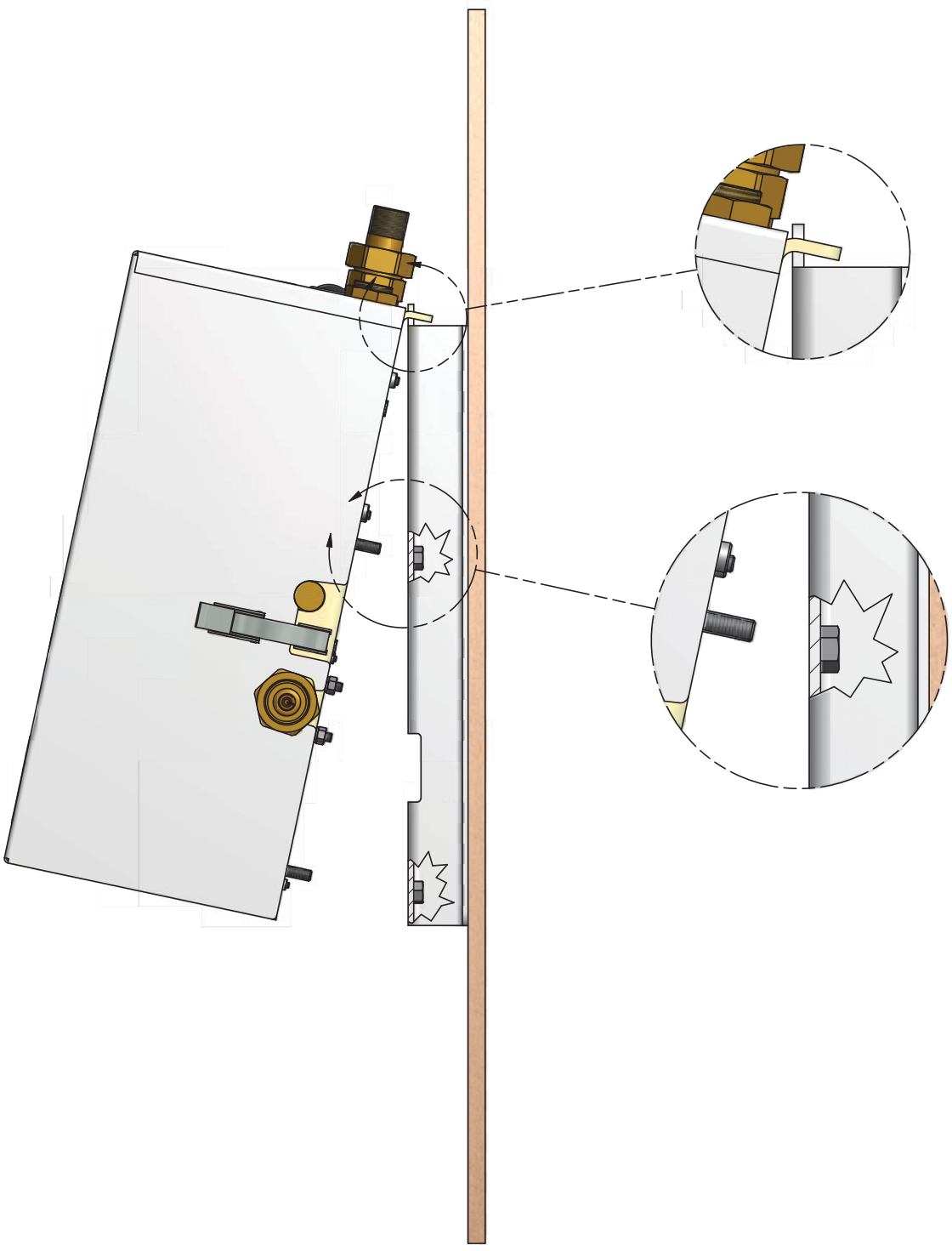


Figure 3

Wall Mounting Instructions (cont.)

7. Hang manifold control panel on tab of mounting bracket (Figure 3). Using M8 hex bolt, attach manifold to wall bracket through slots in black plate (4 places).

> **⚠ CAUTION:**
>
> Do not use thread sealant on header or pigtail connections.

8. For all manifolds, additional shipping cartons contain extension headers and master valves. Attach master valve and appropriate header extension to manifold control panel. Position cylinder inlet connections of each header extension so they are pointing out (away from the wall) and tighten header extension (Figure 4).

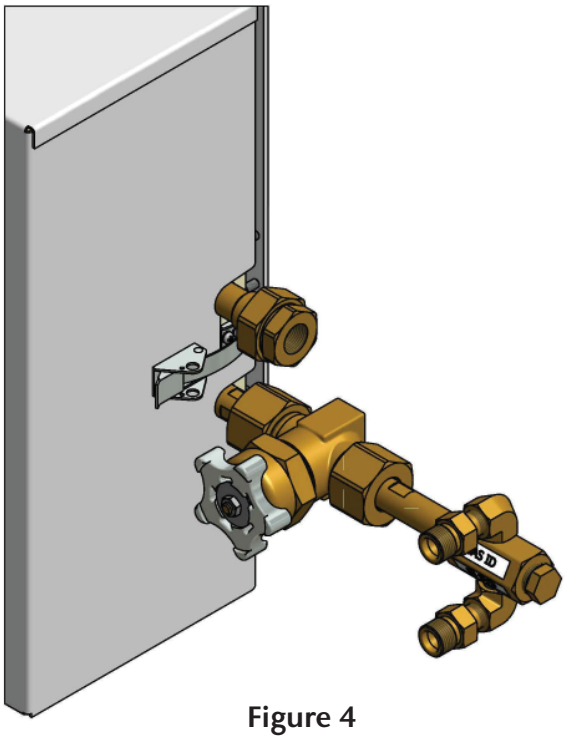


Figure 4

> **NOTE:**
>
> A mounting height of 65-¾" 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.

2.4 Floor Mounting Instructions

For floor mounting the manifold control panel and headers, a manifold control panel stand kit and an appropriate number of manifold header stand kits should have been ordered separately. One manifold control panel stand kit contains all items needed to mount the control panel. Depending on the number of header segments, one or more header stand kits are required. A header stand is required for each header segment. Each header stand kit contains two vertical stands and all necessary items to support one 2-cylinder or 3-cylinder header segment on each side of the manifold. Verify contents of stand kits (Figures 6 and 7):

1. Remove manifold control module from shipping carton and place face up on cardboard packaging insert.

2. Remove the control module enclosure by releasing the two latches on each side and set the cover aside.

3. Remove the four M8 hex head bolts from the mounting bracket as shown in Figure 1.

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

4. Only bracket will be needed at this time. Set manifold control panel aside for installationlater.

5. Attach post base to one end of each 80-inch channel as shown in Figure 8, Detail A. Use two each ⅜" bolts, flat washers and channel nuts per base. Tighten all four bolts.

6. Stand each channel / base side by side. Attach manifold mounting bracket to both bases as shown in Figure 8, Detail C. Use four each ⅜" bolts, flat washers and channel nuts perbase. Top of bracket should be level and positioned 77 ½" above floor. Tighten all fourbolts.

7. Position entire assembly in desired manifold mounting location. Mark location of eight base mounting holes. Move assembly aside and drill holes. Minimum ⅜" diameter mounting boltsare recommended (by others).

8. Reposition assembly over holes and install mounting hardware (by others). Tighten all mounting bolts.

9. Hang manifold control module on tab of mounting bracket (Figure 3). Using M8 hex bolt, attach manifold to wall bracket through slots in black plate (4 places).

10. Additional cartons containing mastervalves and header assemblies will be shipled loose. Attach the master valves and appropriate header extensions to the manifold control panel.Position cylinder inlet connections of each header extension so they are pointing out (away from the wall) and tighten header extension (Figure 4).

11. Set header stand in a vertical position roughly in alignment with two vertical control panel stands. Position header bracket against channel and on bottom side of header as shown in Figure 5. Attach bracket to channel as shown in Figure 8, Detail B. Use two each ⅜" bolts, flat washers and channel nuts. Tighten all bolts.

12. Align header stand with two control panel vertical stands, centering the header bracket between two pigtail connections. Mark locations of all four base mounting holes. Move header stand aside and drill holes. Minimum ⅜" diameter mounting bolts are recommended (by others).

13. Reposition header stand over holes and install mounting hardware (by others). Tighten all mounting bolts.

2.4 Floor Mounting Instructions Cont.

14. Assemble u-bolt and bracket hardware asshown in Figure 6. Tighten u-bolt nuts.

15. Additional header extensions may be attached end to end if required.

16. Install large nut and plug on end of last header extension. Tighten large nut.

⚠ CAUTION:

Do not use thread sealant on header or pigtail connections.

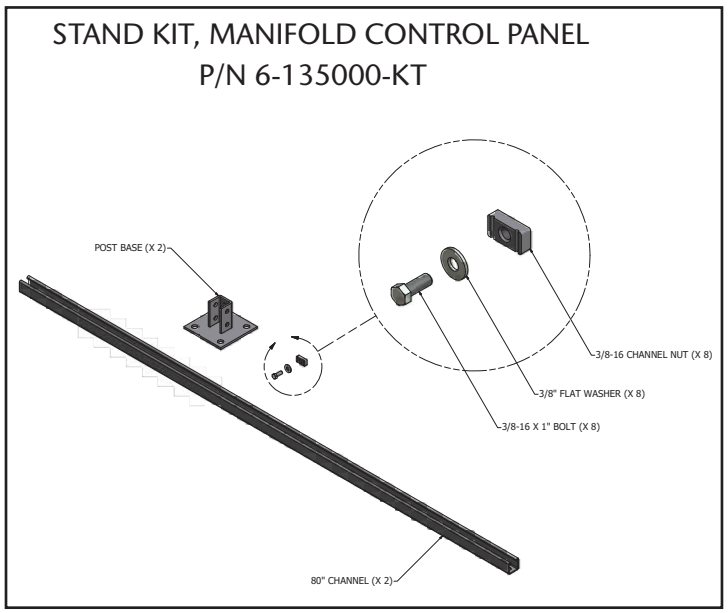


Figure 5

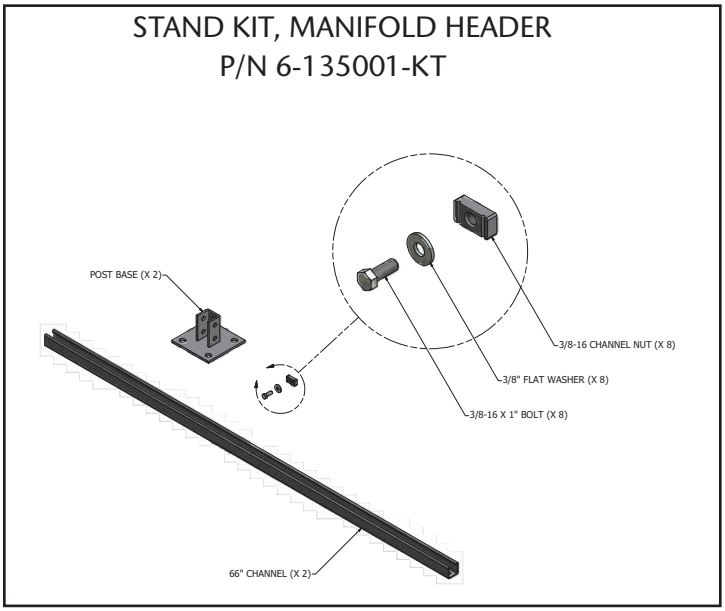


Figure 6

⚠ CAUTION:

Each header segment must be supported by a header bracket before additional header segments are added.

MANIFOLD CONTROL AND
HEADER STAND KIT ASSEMBLY

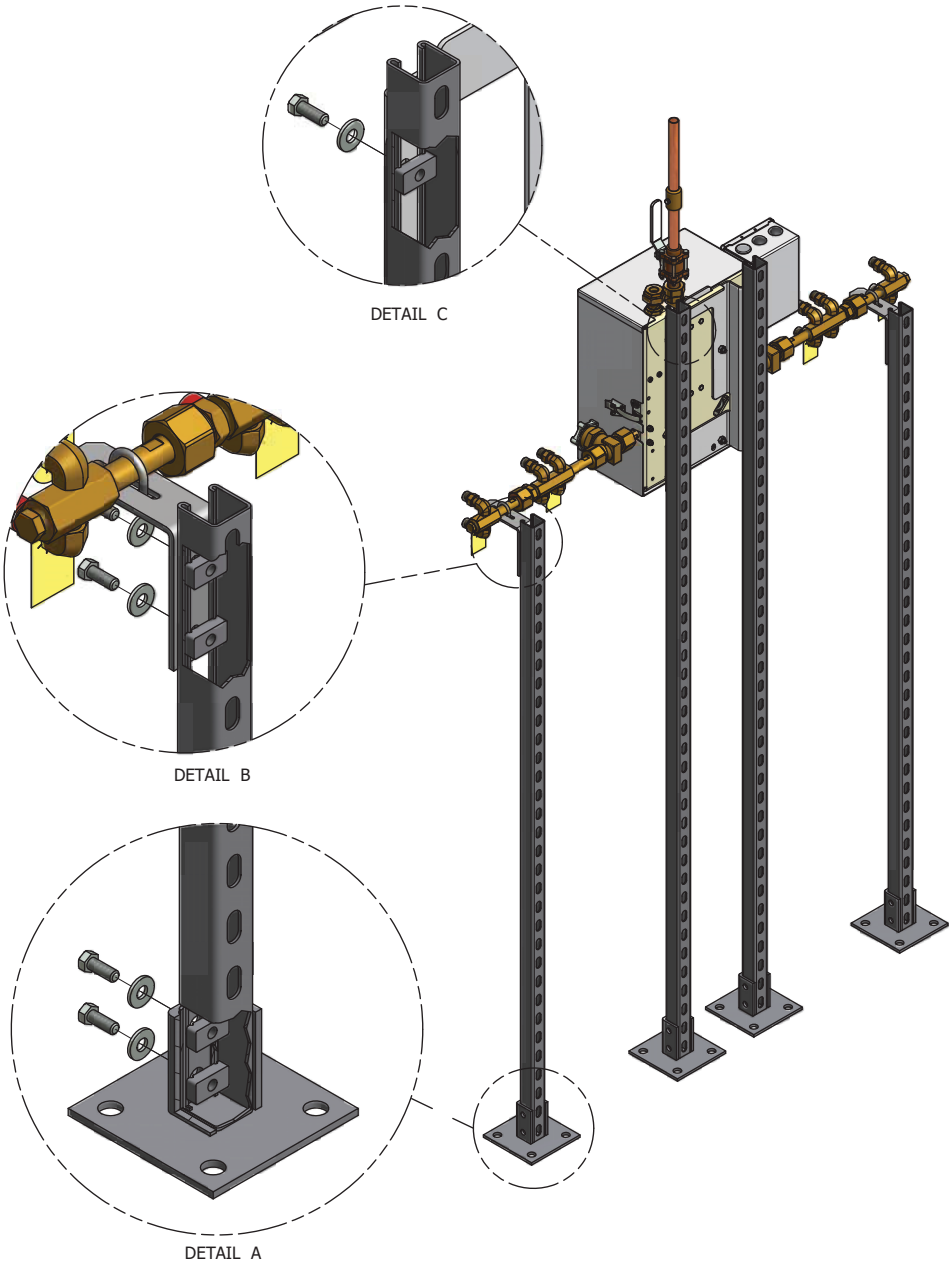


Figure 7

2.5 Wall Mounting HP Reserve Header (If Equippped)

High pressure reserve header components may be shipped in several cartons. One carton will contain the control section assembly consisting of regulator assembly, and reserve low pressure switch as shown in Figure 8. Additional shipping cartons contain header extensions, cylinder pigtails, header wall brackets, master valve, and plug and nut. Depending on the 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. Attach master valve to the control assembly. 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 on end of last header extension (Figure 10).

2. Mark wall 65-¾" 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.

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 10.

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). ⅜" 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 10.

7. Tighten all header extension unions and plugs. Ensure all cylinder connections point away from wall.

Wall Mounting HP Reserve Header (cont.)

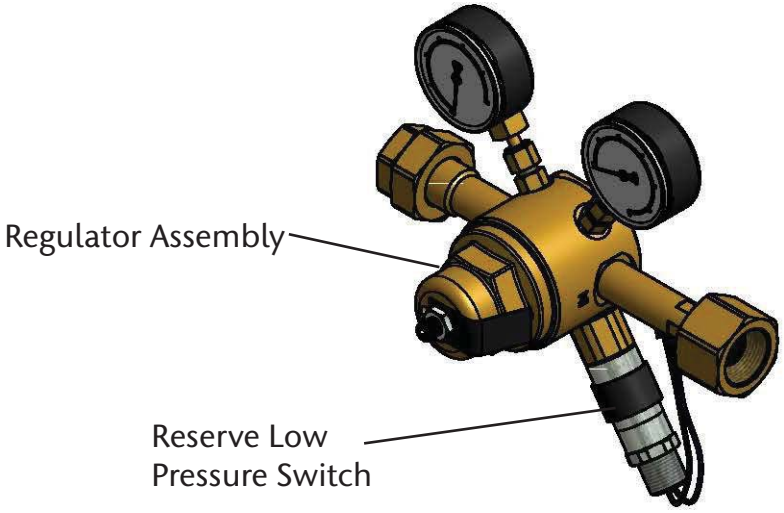


Figure 8

NOTE:

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

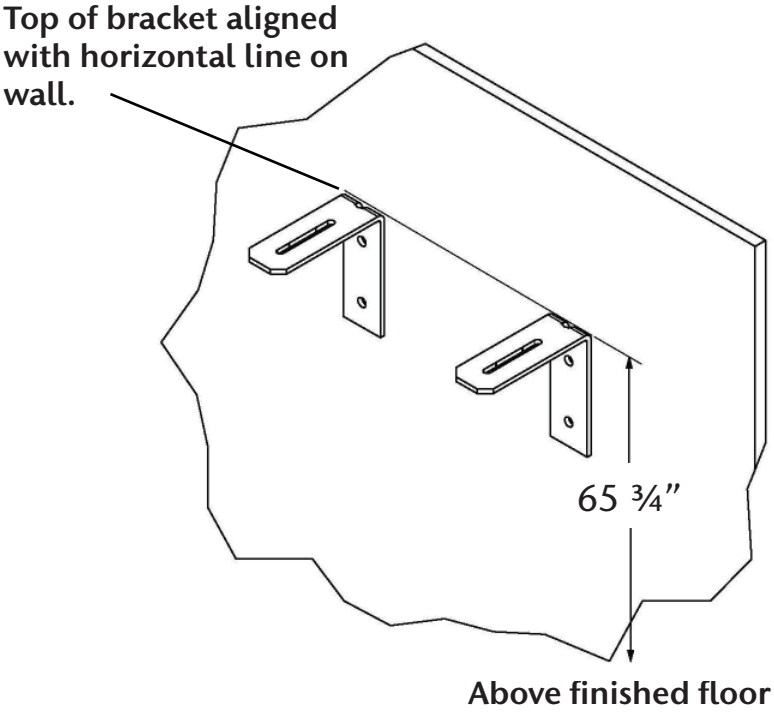


Figure 9

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 10.

Wall Mounting HP Reserve Header (cont.)

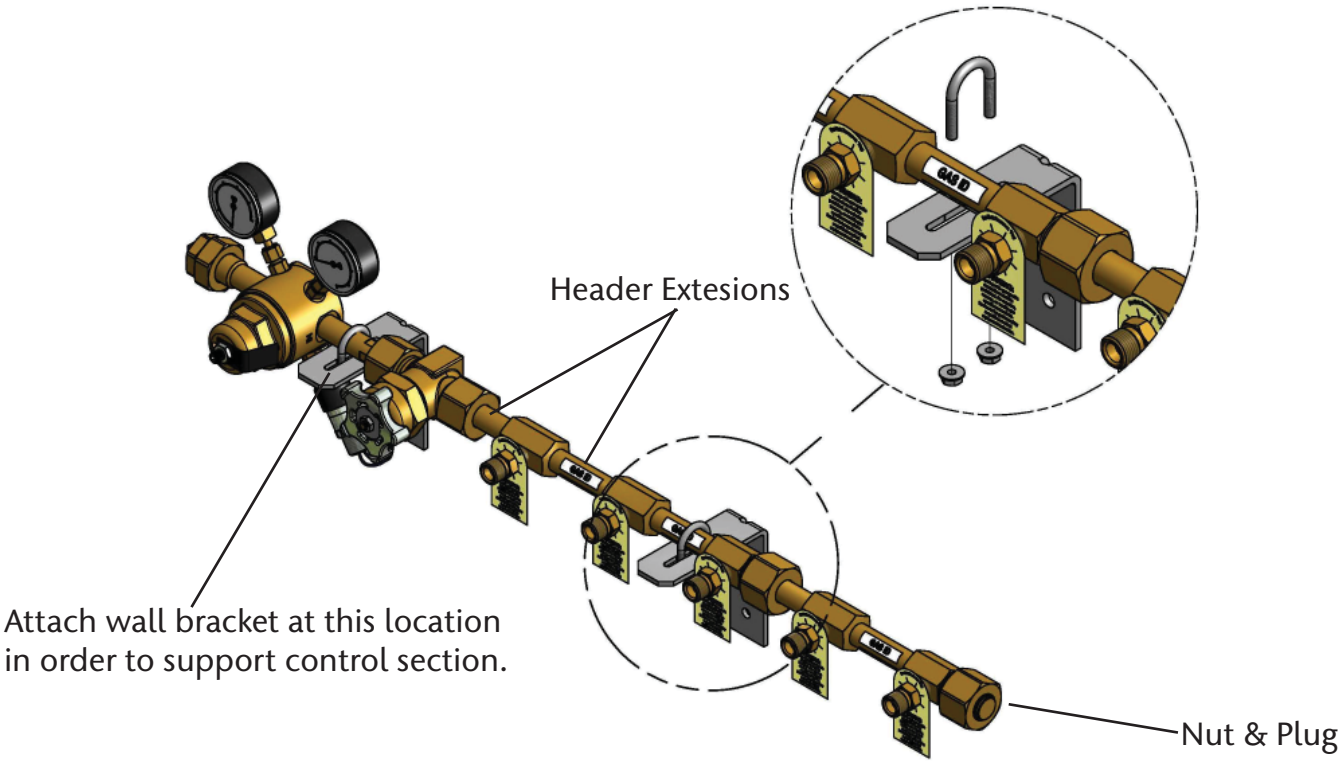


Figure 10

2.6 Main Outlet and Relief Valve Connection

The manifold's main outlet and the relief valve outlet are supplied with zero clearance, O-ring sealed unions. The main outlet connection is ¾" MNPT and relief valve is ½" FNPT. A ¾" source shut-off valve is also supplied with a manifold control module. The inlet side of the source shut-off valve is ¾" MNPT for connection directly to the main outlet union. The outlet side is a ¾" nominal copper. A plugged, ⅛" FNPT port is provided on the outlet side of the valve and may be removed to aid in purging.

2.7 HP reserve Header Connection (If Equipped)

High-pressure reserve header must be piped to inlet on right side of manifold control panel. The outlet of the reserve header is supplied with a zero clearance, O-ring sealed union with ½" NPTF connection.

NFPA models include a zero clearance, O-ring sealed union with a ½" NPTF connection for the reserve header on the manifold. This connection must be ordered separately for ISO models.

Piping type and installation must be in accordance with current NFPA 99 and ISO 7396-1 requirements.

2.8 Power Supply

A power supply assembly is provided with manifold control module. The installer must use 12-14 AWG copper supply wiring when connecting to the manifold. Power supply shall be connected to a building installed circuit breaker. Circuit breaker shall be a maximum 15 amps and marked as disconnecting means for manifold. It is recommended that circuit breaker be in close proximity to manifold power supply and properly sized according to local and national regulations. The manifold has a category II overvoltage rating.

The Power supply box contains a 24 VDC power supply and terminal blocks for AC input power and remote alarm connection. Holes for ½" conduit are located on top of power supply box for 100 to 250 VAC, 50/60 Hz power and remote alarm wiring.

Current draw will be less than 250 milliamperes. Fuse type is 5 x 20 mm, GMD-250mA.

Chassis grounding for manifold provided by included wiring to back plate and enclosure door. Only ground wire required is through incoming power terminal.

2.9 Reserve Low Pressure Switch Wiring (If Equipped)

The reserve low pressure switch is located on high pressure reserve header assembly (Figure 8) and must be wired to appropriate terminals inside power supply (Figure 11). See wiring diagram (Figures 32 and 33) for proper connection points. The pressure switch is equipped with 20" wire leads and a ½ NPTM conduit connection. Stranded wire of at least 22 gauge is recommended. Maximum recommended wire size is 14 gauge.

2.10 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.

- Changeover
- 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.

2.10 Remote Alarm Connection Cont.

Refer to Figure 11 for power supply connections.

Power Supply Wiring Control

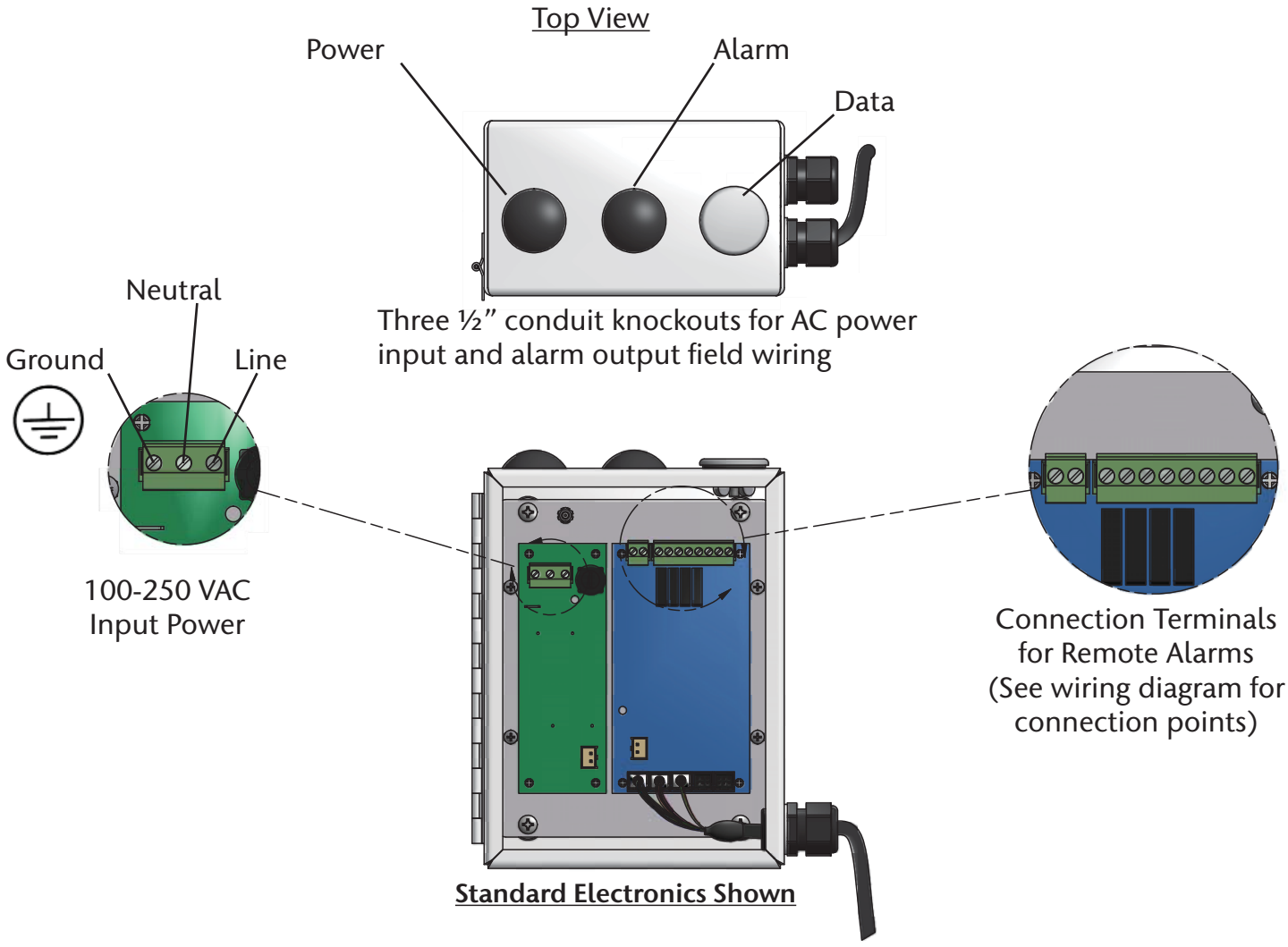


Figure 11

2.11 Pigtail/Cylinder Connection

72" black flex pigtails are connected between manifold control panel and liquid containers (Figure 12). 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 13 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 14 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 13 and 14. Secure each cylinder to wall or floor stand with chains or straps.

4. Connect pigtails to each cylinder. Rigid copper pigtails used on oxygen systems 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 14.

Pigtail/Cylinder Connection (Cont.)

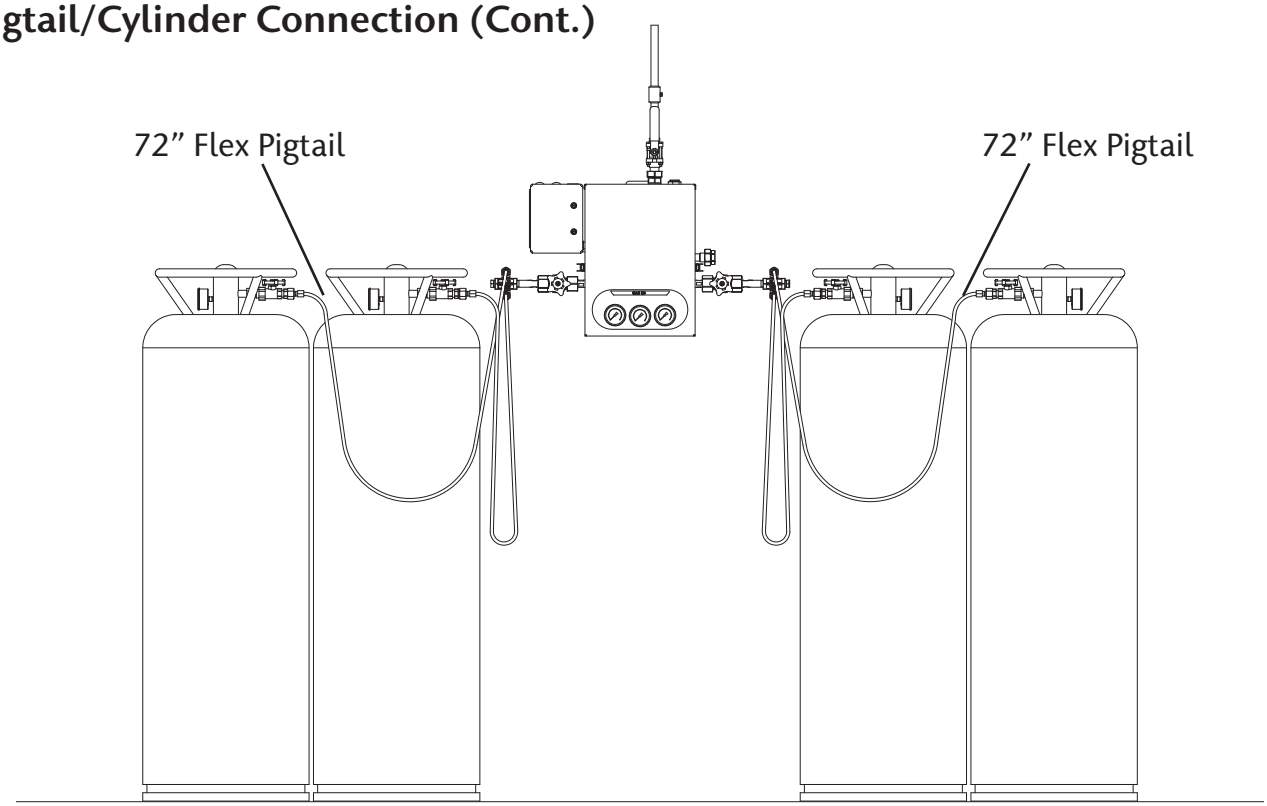


Figure 12

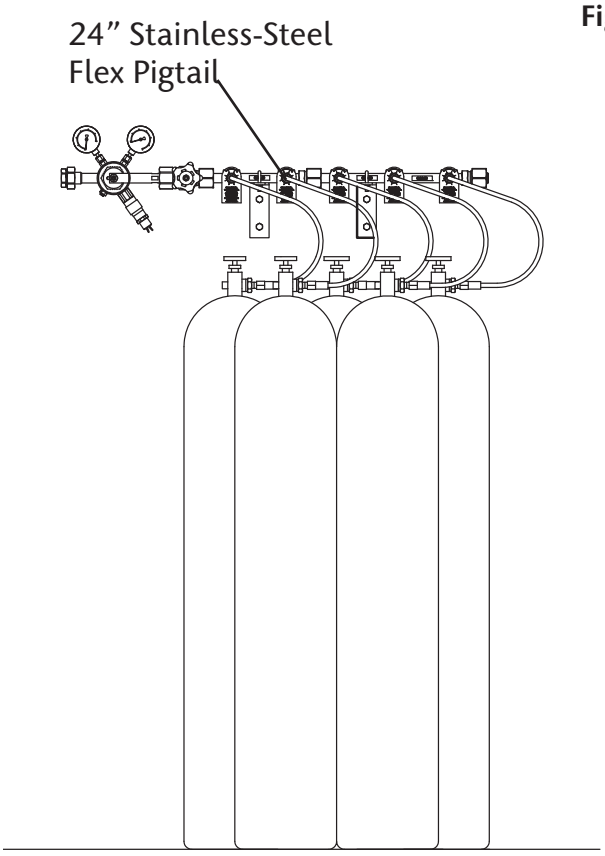


Figure 13

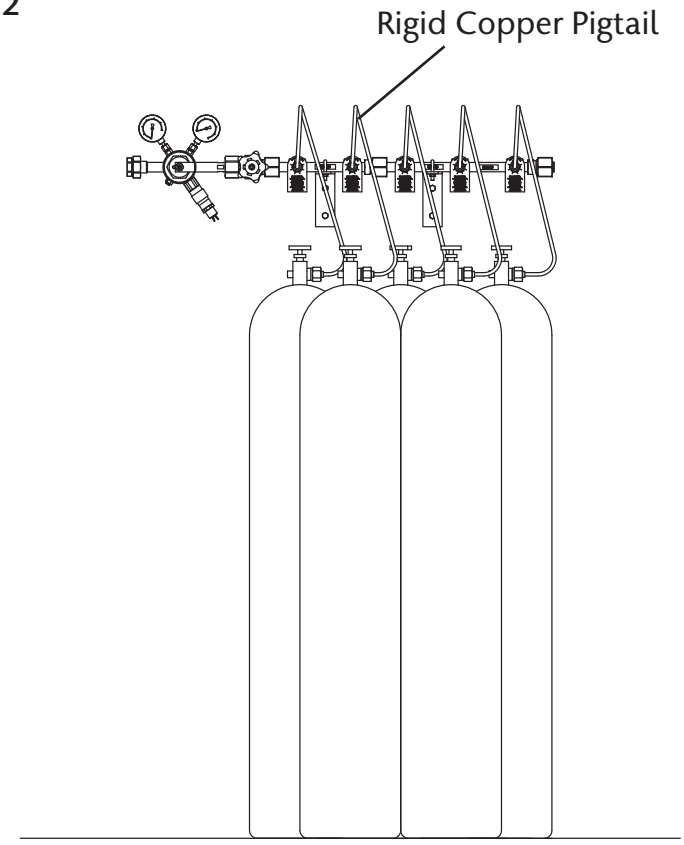


Figure 14

2.12 Initial Power-Up and Operational Testing

See Figures 15, 16, 17, and 18.

1. Release two latches on sides of manifold control module cover (one on each side). Remove cover.
2. Verify the following:
   - Both manifold master valves are turned fully counterclockwise (open).
   - All isolation valves to be open. (handles vertical)
   - Reserve header master valve is turned fully counterclockwise (open).
   - Both red "EMPTY" lights on front of manifold and yellow "RESERVE IN USE" and red "RESERVE LOW" are illuminated.
   - If connected to a master alarm panel, "CHANGEOVER", "RESERVE IN USE", and "RESERVE LOW" alarms are activated.
3. Close ¾" source shut-off valve.
4. Slowly open one cylinder on high-pressure reserve header assembly.
5. Verify the following:
   - "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_2, N_2, and AR. / approx. 1000 PSI for N_2O and CO_2).
6. Slowly open one liquid cylinder on right side of manifold.
7. Verify following:
   - Manifold right bank red "EMPTY" light turns off.
   - Manifold right bank green "READY" and "IN USE" light illuminates.
   - Manifold right bank contents gauge reads liquid container pressure.
   - Manifold yellow "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 green "READY" light illuminates.
   - Manifold left bank contents gauge reads liquid container pressure.
   - If connected to a master alarm panel, "CHANGEOVER" alarm cancels.
10. Close manifold right liquid container. Slightly open vent valve. Verify following:
    - Right bank contents gauge drops slowly.
    - As right contents gauge is nearly depleted, manifold changes over to left bank.
    - After changeover, right bank green "READY" and "IN USE" light turns off and red "EMPTY" light illuminates.
    - After changeover, left bank green "IN USE" light illuminates, yellow "CHANGEOVER" light illuminates and changeover alarm sounds.
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 green "READY" light illuminates and"Yellow "CHANGEOVER" light turns off.
    - 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 changeover, left bank green "IN USE" light turns off and red "EMPTY" light illuminates.
    - After changeover, right bank green "IN USE" light illuminates and yellow "CHANGEOVER" light illuminates.

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, "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_2O and CO_2 systems), 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.

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.

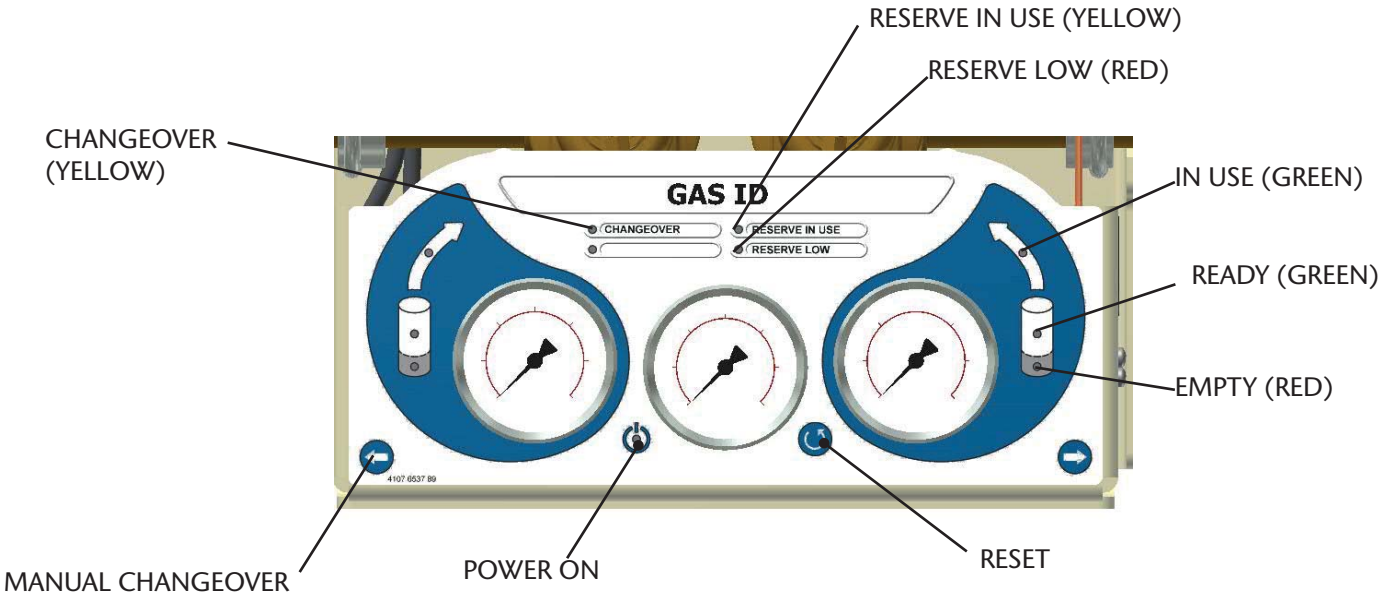


Figure 15

27. Compare curent reading of left and right bank cylinder contents gauges to those recorded in step 23. If there is a noticeable pressure change on either gauge, perform leak testing described in the next section.

28. Reinstall manifold control panel cover.

29. Slowly open all cylinders on both banks of manifold.

30. Open ¾" source shut-off valve.

2.13 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.

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.

1 Release two latches on sides of manifold cover (one on each side).

2 Close ¾" source shut-off valve.

3. Verify isolation valves on inlets 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 Figures 16 & 18 for component Location).

7. Close liquid container on left and right bank of manifold. 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.

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 ¾" source shut-off valve.

⚠ CAUTION:

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

NFPA Version Shown

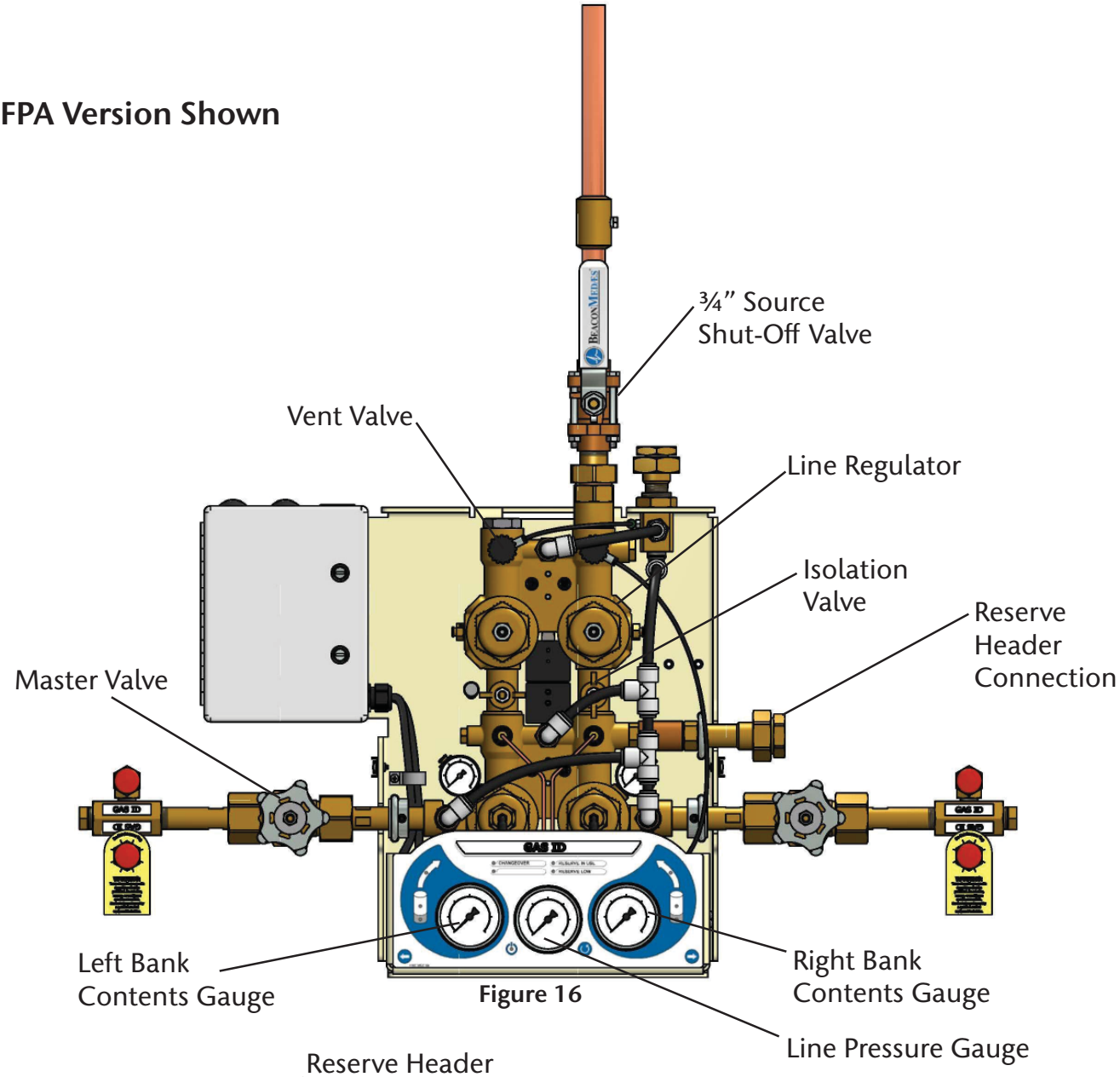


Figure 16

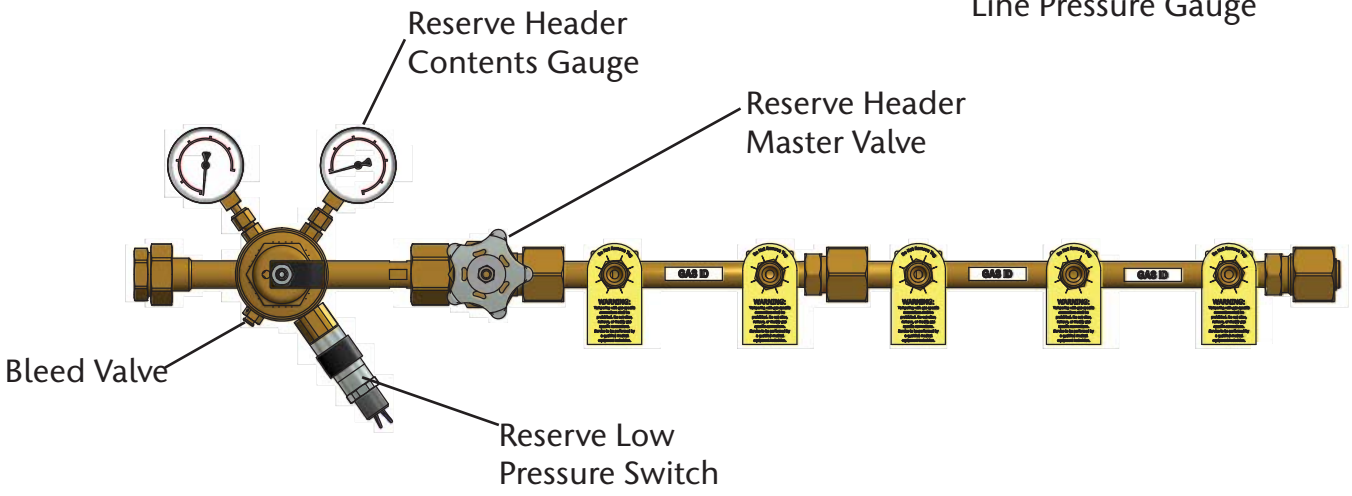


Figure 17

ISO Version Shown

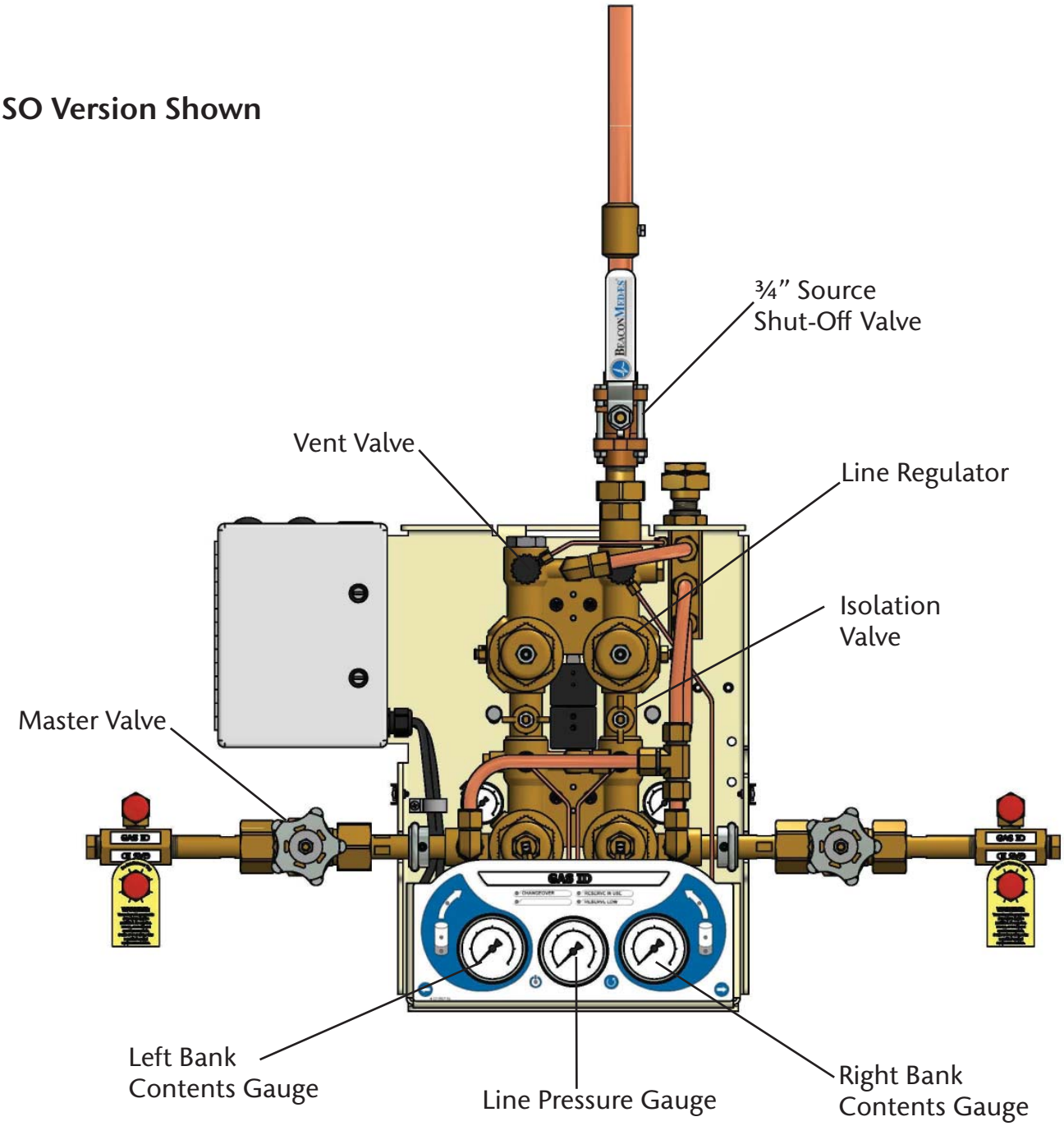


Figure 18

3.0 Operation

3.1 Precautions

⚠ WARNING:

- Tampering with gas-specific connections shall be prohibited. Do not alter, remove or modify gas-specific connections.
- Before connecting liquid container to left bank of manifold or high-pressure cylinder to right bank of manifold and 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 pigtails as damage to tubing may occur.
- Do not bend flexible pigtails into a radius smaller than 3".
- Service to be performed by qualified medical equipment technician.

NOTE:

Manifolds for Oxygen and Argon with 55 PSI delivery pressure are designed for use with 230 psi relief valve liquid containers, set for a minimum operating pressure of 200 psi. Liquid containers for other gases with a 350 psi relief valve must have a minimum operating pressure of 300 psi.

3.2 Manifold Specifications

All Lifeline Manifold systems are designed in accordance with the current revision of NFPA 99 and ISO 7396-1. There are three categories of Lifeline manifolds depending upon the delivery pressure.

The 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 for the manifold's specifications.

Manifold Specifications (cont.)

NOTE:

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

Parameter (psi)	OXYGEN ARGON 55 PSI Delivery Pressure	OXYGEN ARGON 55 PSI Delivery Pressure	N_2O CO_2 55 PSI Delivery Pressure	OXYGEN 100 PSI Delivery Pressure	NITROGEN 180 PSI Delivery Pressure
Recommended Liquid Container Relief Valve	230	350	350	350	350
Manifold Inlet Relief Valve	400	400	400	400	400
Sec. Bank Inlet Pressure - Economizer Option	>175	>300	>300	>300	>300
Intermediate Pressure - Ready Bank	70	195	210	210	210
Dome Bias Pressure	55**	55**	40	40	40
Intermediate Pressure - In Use Bank	125 ± 10*	250 ± 10*	250	250	250
Intermediate Relief Valve	350	350	350	350	350
Line Regulator	55	55	55	100	180
Line Regulator Relief Valve	75	75	75	150	250
Changeover Switch (on pressure drop)	100 ± 5	250 ± 10	250 ± 10	250 ± 10	250 ± 10
Reserve in Use Activation ***	100 ± 5	250 ± 10	250 ± 10	250 ± 10	250 ± 10
Reserve Low Pressure Switch (on pressure drop)	1500 ± 25	1500 ± 25	400 ± 25	1500 ± 25	1500 ± 25
Reserve Header Regulator Setpoint	70	200	200	200	200

* The intermediate pressure value of the "IN USE" bank is dependent upon the dome bias pressure. Variations from the 55 PSI delivery pressure will affect the intermediate pressure reading.

** Same as delivery pressure.

*** This activation point happens when both changeover pressure switches open

Table 1

3.3 Flow Characteristics

*** 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:

Gas Type	Flow (per container)
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)

3.4 Manifold System Components

Refer to Figures 15, 19, 20, 21 and 22.

Master Valve Multi-turn high pressure valves allow flow from cylinders 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, piston diaphragm type regulator. Used to reduce incoming cylinder contents pressure to a lower intermediate pressure. Bank regulator (one for each bank of cylinders) has an internal adjusting spring used to set a "base" pressure of approximately 70 PSI (210 PSI on nitrogen manifolds). "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.

Changeover 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 cylinder pressure drops to switch setting of 100 PSI (250 PSI for some models), switch contacts will open.

Pressure Transducer (TAE Version Only) A 4-20mA Pressure Transducers are used on the TAE version of the Manifold to monitor pressures in place of the switches used on the standard manifold. A Pressure Transducer is connected to the high pressure port of each bank regulator to monitor pressures in each bank of cylinders. Bank Pressure Transducers have a pressure range of 0-3000 psi. Another Pressure Transducer is connected downstream of the Line Regulators to monitor delivery pressure. Delivery Pressure Transudcer have a range of 0-300 psi. Transducers are NOT adjustable.

Check Valve Soft-seal check valves (not shown) are provided downstream of each bank regulator to allow service of upstream components while the other side of the manifold is in use.

Intermediate Relief Valve The intermediate relief valve protects the components between the bank regulators and the line regulators in the event of an overpressure condition caused by bank regulator failure. The outlet of the relief valve is piped to a common relief valve port on top of the 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).

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

Line Regulator A single-stage, piston diaphragm type regulator used to reduce manifold's intermediate pressure to normal hospital line pressure. Two line regulators are provided per NFPA 99 and ISO 7396-1 requirements to allow for isolation and service of one while other is in use.

Line Relief Valve A relief valve to prevent overpressurization of the 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, piston diaphragm type, relieving regulator used to limit amount of pressure provided to domes of bank regulator. 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 the bank regulators. As dome bias pressure is directed to one of the bank regulators, dome of the other bank regulator is vented through the solenoid valve.

Control Board Installed in NEMA 4, enclosure pre-mounted to the back bracket. The electronic circuit board that controls manifold changeover. The control board monitors the pressure switches/ transducers and controls the solenoid valve in order to initiate manifold changeover. The control board illuminates the appropriate front panel indicators and also provides dry contacts for activation of the external master alarms.

Power Supply The power supply is 100-250 VAC to 24 VDC. The 24 VDC is connected to the manifold control board via a two conductor cable and connector. An in-line .25 amp slow-blow fuse is provided in 120 VAC power line. Terminal blocks on power supply allow for connection of AC input power.

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 highpressure 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 (400 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. Reserve Low pressure tranducer has a 0-3000 psi range. (TAE version only)

Source Shutoff Valve, ¼ turn valve used to isolate manifold from hospital piping for repair.

Manifold System Components (cont.)

NOTE:

NFPA 99 Basic Version Shown

Some components not shown for clarity.

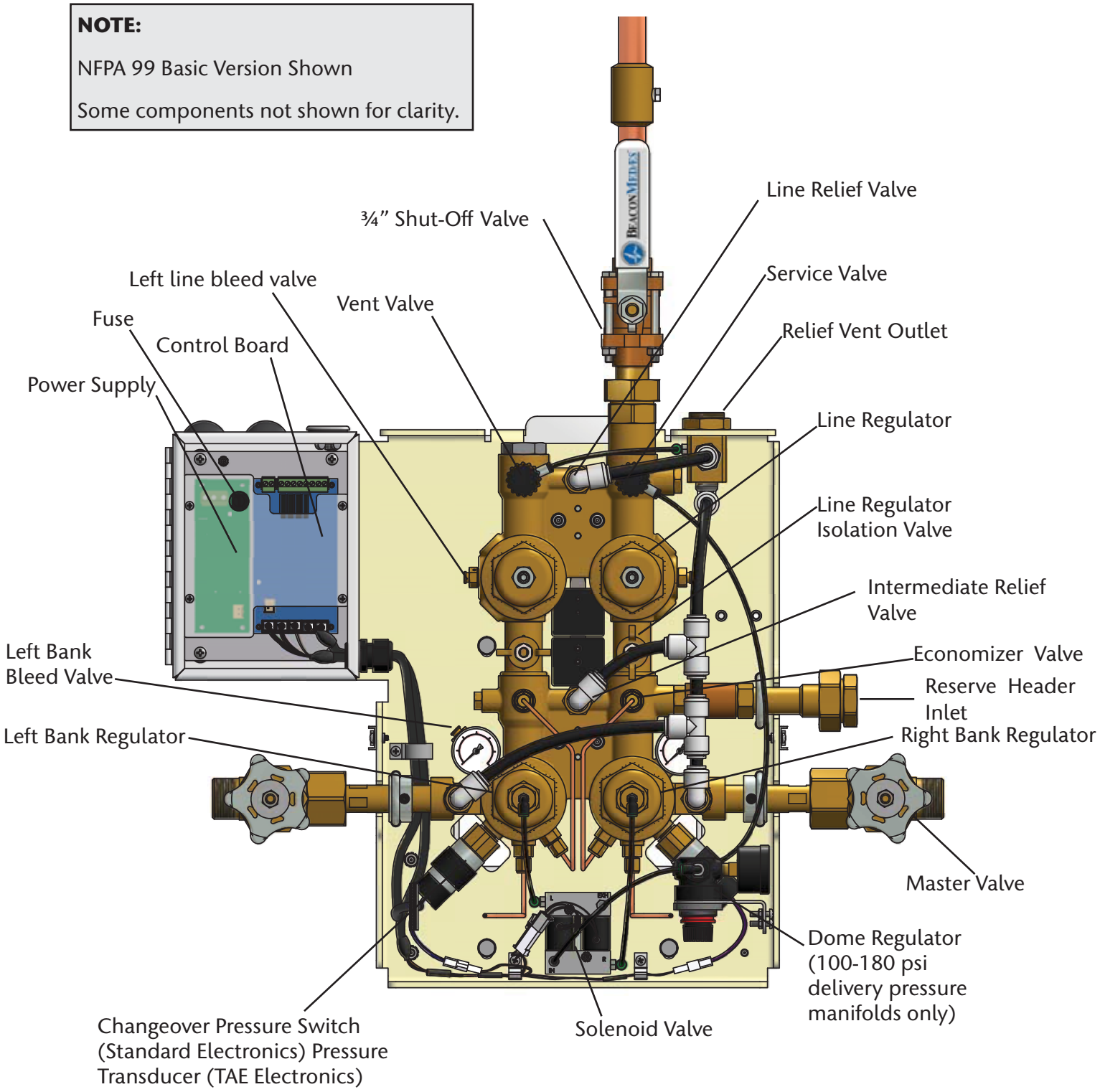


Figure 19: NFPA Version Shown

Manifold System Components (cont.)

NOTE:

ISO 7396-1 Basic Version Shown

Some components not shown for clarity.

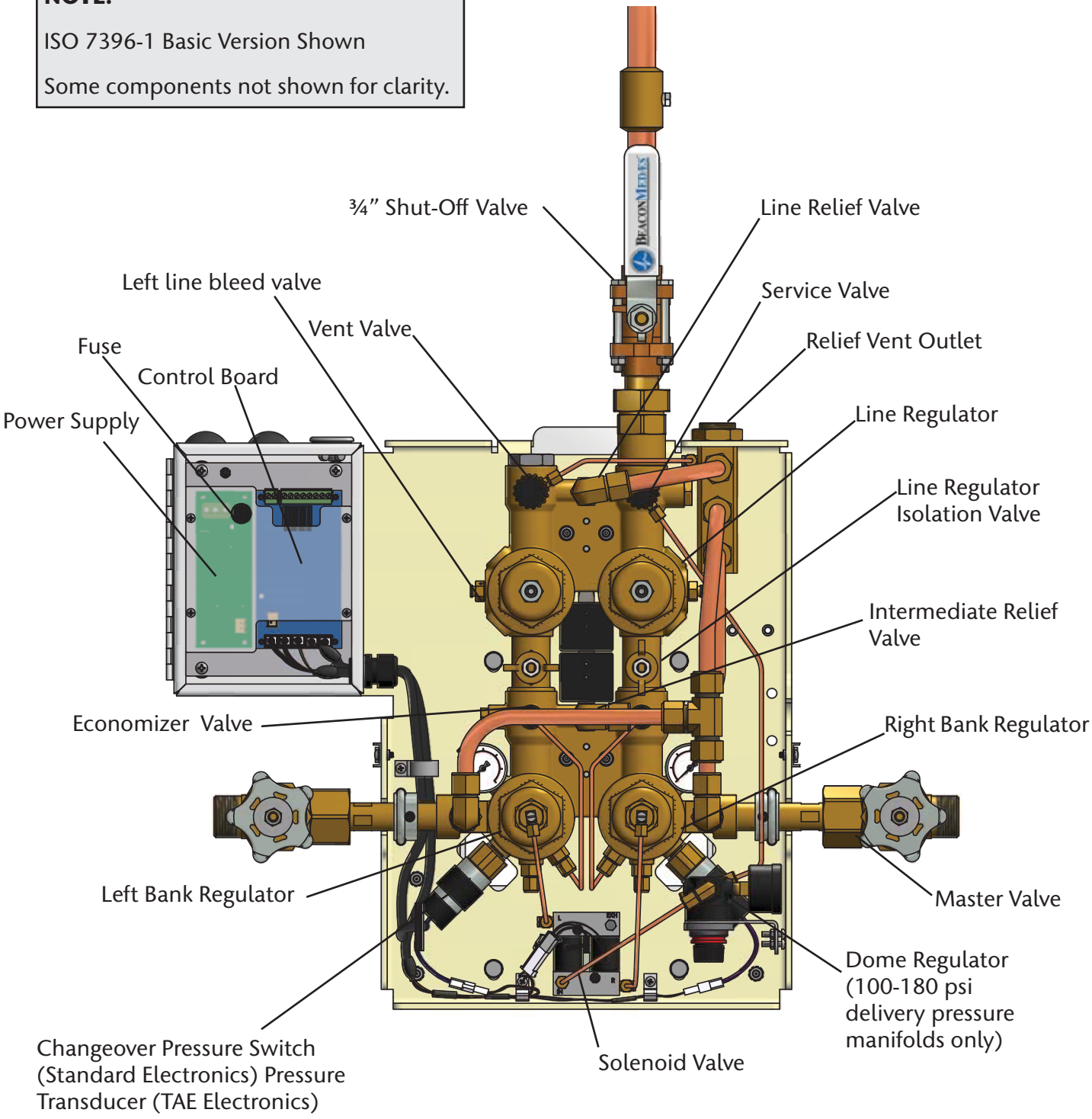


Figure 20: ISO Version Shown

Manifold System Components (cont.)

NOTE:

Some components not shown for clarity.

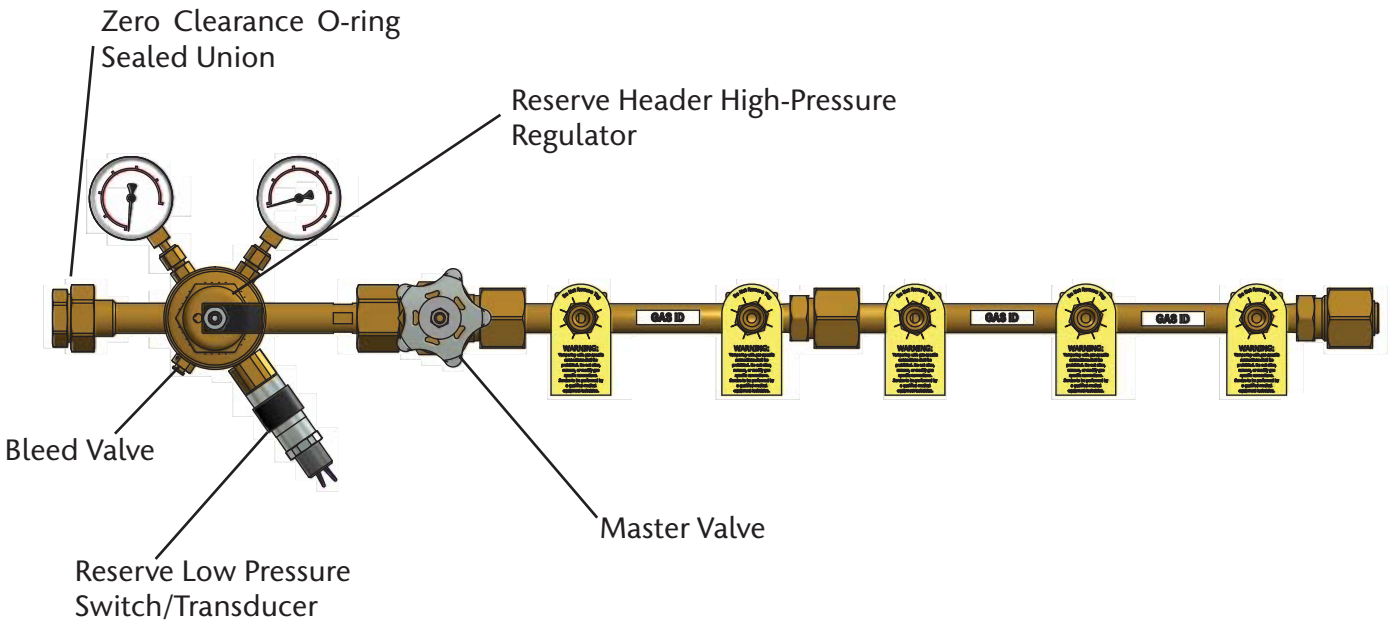
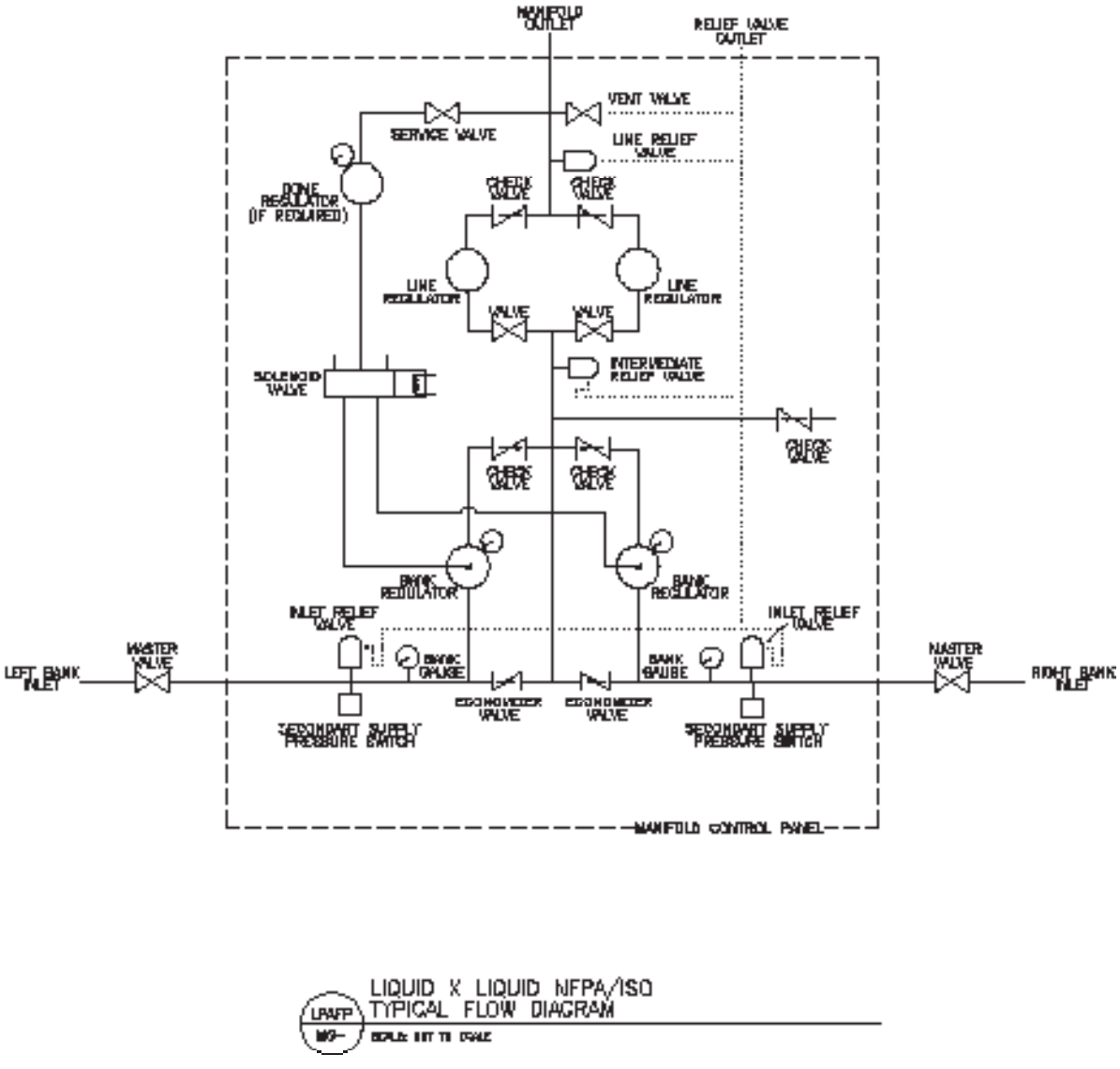


Figure 21

Manifold System Components (cont.)

NOTE:

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



LIQUID X LIQUID NFPA/ISO
TYPICAL FLOW DIAGRAM

Figure 22

Manifold System Components (cont.)

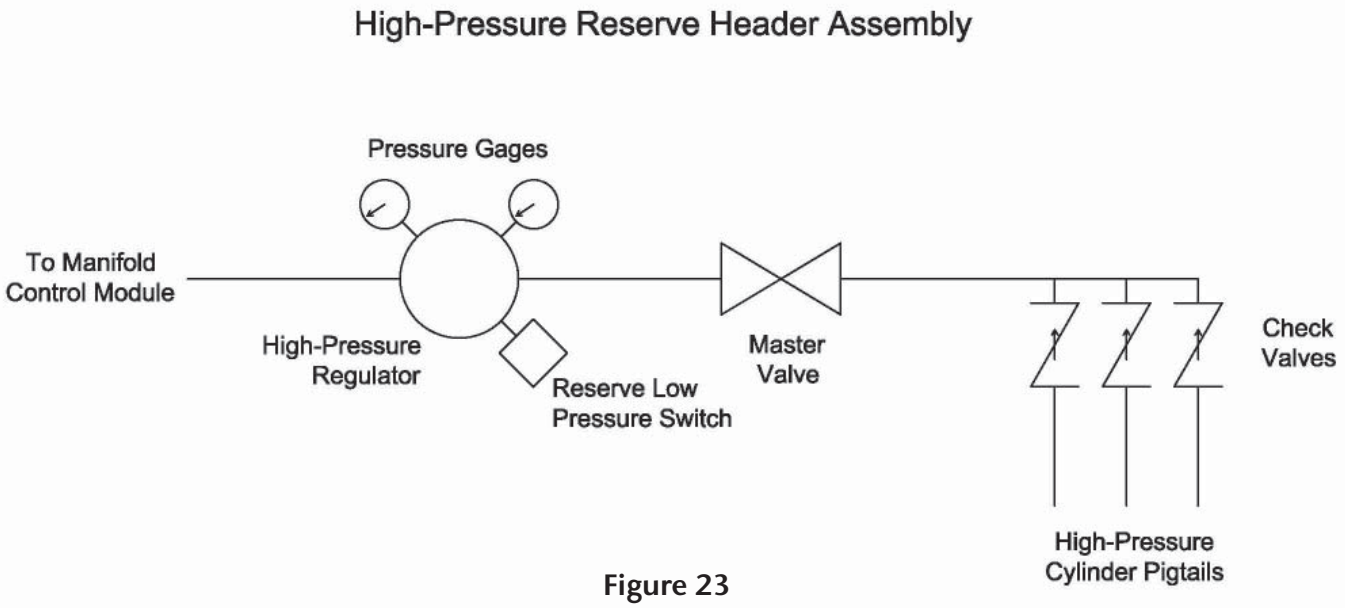


Figure 23

3.5 Gas Flow Through the Manifold

Refer to Figure 22 and 23.

Gas is provided to left and right manifold bank inlet via liquid cylinders and pigtails. 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 applied to a normally open pressure switch (closes when pressure is applied) front panel pressure gauge, 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 ¼ 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 "IN USE" bank.

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 container inlets, manifold is equipped with an input from a high-pressure reserve header assembly. This input is located on side of manifold.

Refer to Figure 23 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.

3.6 Manifold Changeover

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. Green "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. Green "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 changeover alarm, turn off right side red "EMPTY" light and illuminate right side green "READY" light.

All flow is supplied by left bank of liquid containers until pressure in left bank drops to left pressure switch setting. Left pressure switch then opens, causing changeover to the 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 changeover 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 to the "RESERVE IN USE" pressure switch setting. A normally-closed switch will open and yellow "RESERVE IN USE" light will illuminate. A set of normally-closed dry switch contacts, 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 (400 PSI for N_2O/CO_2), reserve low normally-closed pressure switch will open. A set of normally-closed dry switch contacts, will open in order to signal master alarm panel.

Reset Button (See Figure 15)

The reset button by default is inactive. It can be made active by activating the Latching Option (on standard control manifolds only). See "Latching Option" for activation instructions.

Manual Changeover Buttons (See Figure 15)

The Manual Changeover Buttons allow the user to manually change banks for servicing and/or inspection. Press the left arrow to change the Left Bank to Primary/In Use. Press the right arrow to change the Right Bank to Primary/In Use.

Latching Option (Standard control models only) (See Figure 24)

The Latching Option prevents and helps identify seeking (rapidly switching back and forth between liquid containers due to overdraw). When activated, the manifold will Latch when Changeover occurs and will not be allowed to automatically switch back to that bank when pressure returns. The reset button must be pressed to reset a Latched condition. On standard control models only, this option can be turned on by placing jumper JP6 on the control board on the 1-2 position (manifold is shipped with JP6 on pins 2-3). This option is not available on Total Alert control models, as seeking can be evidenced by the Trend Log.

NOTE: The Latching Feature will NOT prevent the manifold from delivering available gas from either bank or the reserve.

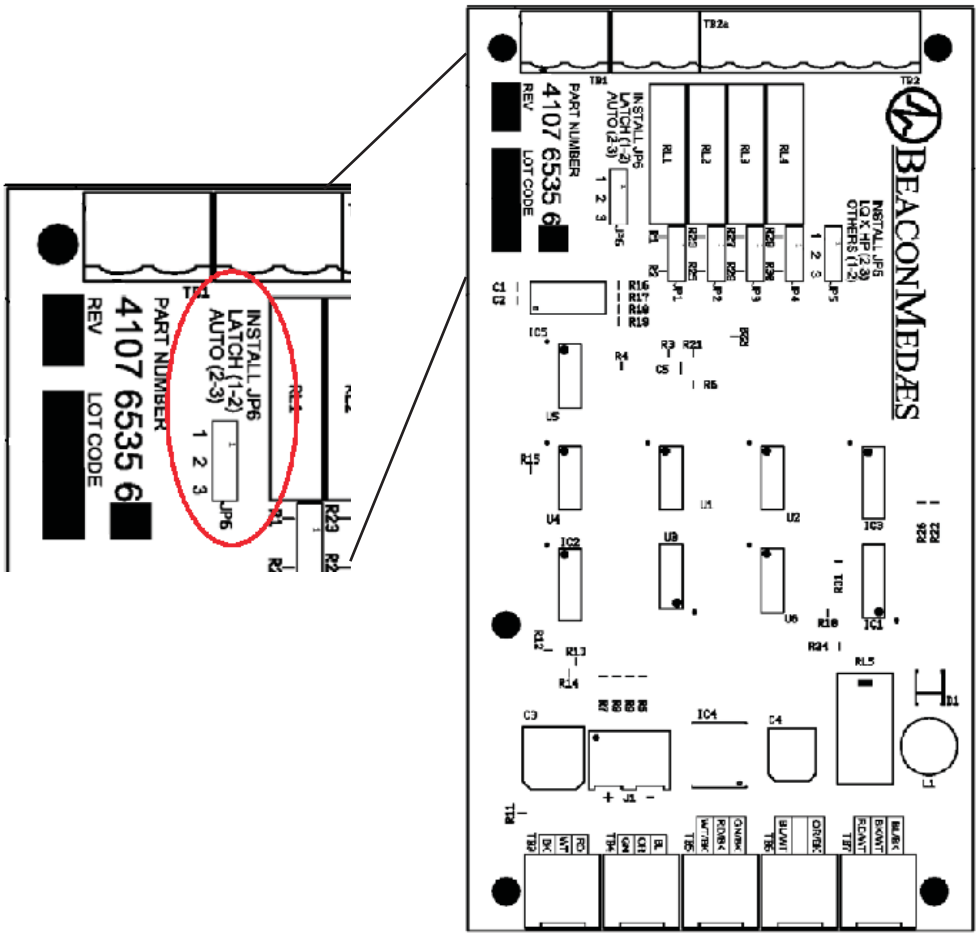


Figure 24

4.0 Testing and Adjustments

4.1 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 ¾" source shutoff valve closed, is preferred. Following test procedure assumes manifold is not in service.

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

1. Remove manifold cover.

2. Before beginning test, verify 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 left and right sides of manifold and left/right bank contents gauge indicates pressure greater than "Changeover Pressure Setting" setting. Refer to Table 1.

   - 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 ¾" source shutoff valve.

4. Verify right-side line regulator isolation valves are open and left-side line regulator isolation valves are closed.

5. As a starting point for this procedure, set manifold so right bank is in use. If right bank green light "IN USE" is illuminated, proceed to next step. If left bank green "IN USE" light is illuminated, manually switch manifold to right side by pressing left arrow button on overlay (See Figure 15).

6. Verify the following:

   - Only right bank green "IN USE" and left bank green "READY" lights are illuminated.

   - Yellow "RESERVE IN USE" and red "RESERVE LOW" lights are NOT illuminated.

   - If manifold is connected to a master alarm panel, "CHANGEOVER", "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.

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 readingis 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 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.

NOTE:

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

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 (Changeover Pressure Setting). If pressure value is not correct, right secondary supply pressure switch needs adjustment. Refer to Secondary Supply Switch Adjustment procedure.

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.

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 "CHANGEOVER" alarm is activated.

14. Slowly open one liquid container on right side. Verify right bank red "EMPTY" light turns off and right bank green "READY" light illuminates.

15. Close right-side line regulator isolation valves and open left-side line regulator isolation valves.

16. Open vent valve to create a small flow of gas through manifold.

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 previouse note). Verify manifold switches to right bank when left bank pressure gauge drops to the value indicated in Table 1 (Changeover Pressure Setting). 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.

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 yellow “RESERVE IN USE” light illuminates when right bank intermediate pressure gauge drops to value listed in Table 1 (Reserve In Use Pressure Setting).

23. Close vent valve. If manifold is connected to a master alarm panel, verify “CHANGEOVER” 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 red “RESERVE LOW” light illuminates when pressure drops to value listed in Table 1 (Reserve Low Pressure Setting). 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 “CHANGEOVER”, “RESERVE IN USE” and “RESERVE LOW” alarms are activated.

28. Slowly open one cylinder on high-pressure reserve header. Verify the following:

    - Red “RESERVE LOW” light turns off.
    - If connected to a master alarm panel, “RESERVE LOW” alarm cancels.
    - If connected to a master alarm panel, “CHANGEOVER” and “RESERVE IN USE” alarms remain activated.

29. Slowly open one liquid container on right side of manifold. Verify the following:

    - Yellow “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, “CHANGEOVER” alarm remains activated.

30. Slowly open one liquid container on left side. Verify the following:

    - Left bank red “EMPTY” light turns off.
    - Left bank green “READY” light illuminates.
    - If connected to a master alarm panel, “CHANGEOVER” alarm cancels.

31. Using changeover buttons on overlay, switch manifold to bank of cylinders with least pressure.

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 changeover button on overlay, switch to bank of cylinders with least pressure.

37. Reinstall manifold control panel cover.

38. Open ¾" source shut-off valve.

4.2 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 servicing 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. Recommended settings are listed in Table 1 under heading of "Intermediate Pressure - Ready Bank". After base pressure has been set, pressure will be increased by amount of dome bias pressure applied. Refer to Figures 19,20, and 21 for location of components called out in this procedure..

1. Remove front cover to expose changeover buttons located on the overlay.

2. Close service valve (see NOTE).

3. Using manual changeover buttons on overlay, cycle manifold from bank to bank to vent residual dome bias pressure.

4. Shut off all liquid containers on the bank opposite of the regulator to be adjusted.

5. Shut off all high pressure cylinders connected to the high pressure reserve header.

6. Slightly open vent valve (less than 1/4 turn) to create a small flow of gas through manifold.

7. Using a 1" wrench, loosen Bank Regulator Locknut.

8. Using ¾ " wrench, set bank regulator to the value specified in Table 1 (Intermediate Pressure - Ready Bank).

9. Tighten the Bank Regulator Locknut.

10. Close vent valve.

11. If other bank regulator also needs to be adjusted, repeat steps 4 through 9.

12. Slowly open all liquid containers on both manifold banks.

13. Slowly open all high pressure cylinders connected to the high pressure reserve header.

14. Open service valve and reset dome regulator to 40 PSI (if app).

15. Verify manifold operation.

16. Install and secure front cover using the two latch hinges.

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.

4.3 Line Regulator Adjustment

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 repair of a line pressure regulator.

When shipped from factory, inlet isolation valves to both line regulators are in open position. Refer to Figure 19, 20, and 21 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 the following procedure.

1. Remove the front cover.
2. Open the right-side Line Regulator Isolation Valve and close the left-side Line Regulator Valve.
3. Slightly open vent valve (less than 1/4 turn) to create a small flow of gas through manifold.
4. Using a 16mm wrench, loosen the right Line Regulator Locknut.
5. Using 5mm Hex Key wrench, turn the Right Line Regulator Adjusting Screw to achieve an appropriate output pressure gauge reading. Note reading for later use. Refer to Table 1 (delivery pressure) for factory settings.
6. Tighten the Right Line Regulator Lock Nut.
7. Open left-side Line Regulator Isolation Valve and close the right-side Line Regulator Isolation Valve.
8. Using a 16mm wrench, loosen Line Regulator Locknut.
9. Using 5mm Allen wrench, turn left-side Line Regulator Adjusting Screw to achieve the same outlet pressure gauge reading as noted in step 4.
10. Tighten the left Line Regulator Lock Nut.
11. Close Vent Valve.
12. Open right-side Line Regulator Isolation Valve.
13. Verify manifold operation.
14. Install and secure front cover using the two latch hinges.

4.4 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 21 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 yellow "RESERVE IN USE" light illuminates.
4. Using 16 mm wrench, loosen the Regulator Locknut
5. Using 5mm Allen wrench, turn reserve header regulator adjusting screw to achieve the desired output pressure gauge reading. Recommended settings are listed in Table 1 (Reserve Header Regulator).
6. Tighten the Regulator Locknut.
7. Close vent valve

8. Slowly open all liquid containers on both banks of manifold

9. Slowly open all cylinders on the high pressure reserve header.

4.5 Changeover Pressure Switch Adjustment

The following procedure describes process of setting "changeover" pressure switches. This procedure should only need to be performed if the pressure switches were not within acceptable limits during the performance verification procedure.

Changeover 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 19,20, and 21 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 manual changeover buttons located on overlay, switch manifold to bank whose pressure switch is to be adjusted. For example, if pressure switch on right side is to be adjusted, press right arrow located on overlay 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 changeover takes place. Recommended settings are listed in Table 1, (Changeover Pressure Switch Setting).

6. Close vent valve.

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 24).

8. Slowly open one liquid container on bank of manifold that was just tested.

9. Using manual changeover buttons located on the overlay, 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.

12. Slowly open all containers connected to both banks of manifold.

4.6 Reserve Low Pressure 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 17 for location of components called out in this procedure.

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:

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

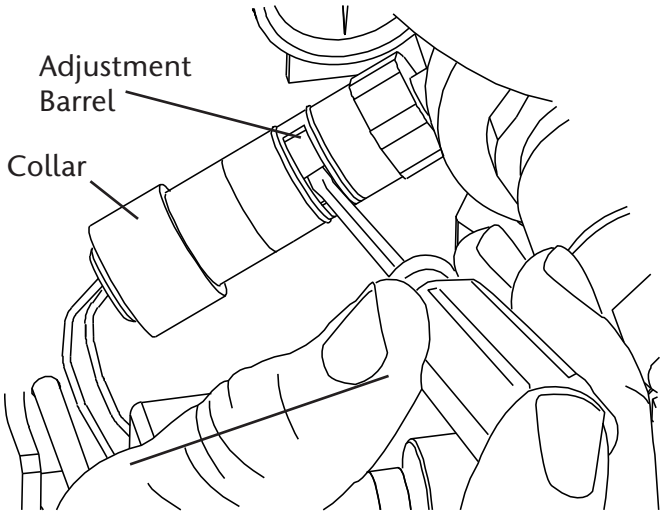


Figure 25

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 yellow "RESERVE IN USE" light illuminates.
5. Close high-pressure cylinder on reserve header and adjust vent valve so that highpressure gauge on reserve header regulator drops very slowly.
6. Note high-pressure gauge reading when red "RESERVE LOW" light illuminates. Recommended settings are listed in Table 1 (Reserve Low Pressure 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).
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.
12. Slowly open all liquid containers on both banks of manifold.
13. Slowly open all cylinders on high pressure reserve header.

5.0 Service Procedures

5.1 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 BeaconMedæs.
- Do not use chemicals, lubricants or sealants unless specified in these instructions.
- Before connecting liquid containers or highpressure cylinders to manifold or reserve header, momentarily open and close container/cylinder valves to blow out dirt and debris.
- After connecting cylinder to manifold, open 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 manifold system.
- Always secure 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 pigtails as damage to tubing may occur.
- Do not bend flexible pigtails into a radius smaller than 3".

5.2 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 pigtails.
- Check for leaks at pigtail connection using oxygen compatible leak detector solution.

Annually:

- Verify manifold operation using performance verification process.

Every 3-5 Years:

- Replace pigtails.

5.3 Techniques for Leak-Tight Connections

Lifeline manifold utilizes three different types of connection between internal components.

- Parker brand “A-Lok” fittings.
- Parker brand “Prestolock” fittings.
- O-ring face seal fittings.

Parker brand “A-Lok” fittings are a type of compression fitting. Mark nut and fitting prior to disassembly. Before retightening, make sure assembly has been inserted into fitting until ferrule seats in 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 (½ 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 1-¼ turns.

Parker brand “Prestolock” fittings are used throughout manifold to attach each end of black nylon tubes (NFPA 99 version only). 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 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 and 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.

5.4 Changeover Pressure Switch/ Transducer Replacement

Following procedure describes process of replacing pressure switch/ transducer. 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. Close all cylinders on side of manifold where pressure switch will be replaced.

2. Vent pressure from bank that was shut off in step 1 by pushing pressure relief valve located near the bank pressure gauge (Figures 19, 20).

3. Disconnect pressure switch/transducer wires at white connector.

4. Verify all pressure has been vented. Remove old pressure switch/transducer from bank regulator body.

> **⚠ 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.

5. Install new pressure/transducer and tighten to snug fit. Do not overtighten.

6. Route switch wires and reconnect switch to white connector. Secure wires with cable ties.

7. S-l-o-w-l-y open each cylinder on side of manifold where pressure switch was replaced.

8. Verify new switch/transducer is set correctly by performing appropriate steps of Performance Verification procedure.

5.5 Bank Regulator Maintenance

See Figure 26

IMPORTANT: Vent all inlet pressure and outlet pressure to 0 psig prior to servicing the regulator. Make sure assembly is performed in a clean environment free of any oils and grease (hydrocarbons). Use care as not to damage the regulator's sealing surfaces. Scratches or other damage to certain surfaces may render regulator non-repairable.

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. Close all cylinders on side of manifold where bank regulator will be replaced.

2. Vent pressure from bank that was shut off in Step 1 by pressing the bleed valve (Figures 19, 20).

3. Disconnect tubing from bank regulator by depressing ring on fitting.

4. Using a 1" Wrench, loosen Bank Regulator Locknut.

5. Using a ¾" Wrench, turn the Bank Regulator Adjustment Screw counter-clockwise to release all spring tension. Remove Adjustment Screw/ Locknut and set aside in clean area.

> **⚠ 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..

6. Using a 2" Socket, remove the Spring Chamber.

7. Using a Screwdriver, insert into top of Spring Chamber past Adjustment Screw threads and push on the Spring Button to push out Piston Diaphragm, Spring and Spring Button. Set components aside in a clean area.

8. Remove Pusher Post Button and set aside.

9. Using a Plastic Pick, remove the Regulator/Body O-ring. Discard O-ring.

10. Using a ⅞" Socket, remove the Seat Ring by turning counter-clockwise.

11. Discard Seat Ring w/O-ring.

12. Remove Piston Sub-Assembly and discard.

13. Verify the Piston Spring remains in place within regulator body.

14. Insert new Piston Sub-Assembly.

15. Insert new Seat Ring, remove spring pressure from seat ring during installation by pressing on piston sub-assembly while screwing in the seat ring, and torque to 30 ft-lbs.

16. Assemble Pusher Post Button.

17. Insert new Regulator/Body O-ring. Use care to place uniformly in groove.

18. Using Plastic pick, remove old O-ring from Piston Diaphragm and install new one included in kit.

19. Stack Piston Diaphragm, Spring and then the Spring Button together.

20. Place Spring Chamber on top of these components to capture them. The O-ring on the Piston Diaphragm should hold all the components in the Spring Chamber.

21. Assemble Spring Chamber to the Regulator Body. Tighten to 50 ft-lbs.

22. Using a Plastic Pick, remove the Adjustment Screw O-ring. Discard O-ring.

23. Assemble new Adjustment Screw O-ring.

24. Put Locknut on Adjustment Screw and assemble to Spring Chamber.

25. Turn Adjustment Screw until desired set pressure is reached.

26. Tighten Locknut.

27. Verify manifold operation.

NOTE:

Refer to Techniques For Leak-Tight Fittings for recommendations concerning removal and reassembly of fittings.

NOTE:

Check valves downstream of bank regulators will prevent back flow. Check valves are intended to prevent gross leaks during service and may not be bubble tight.

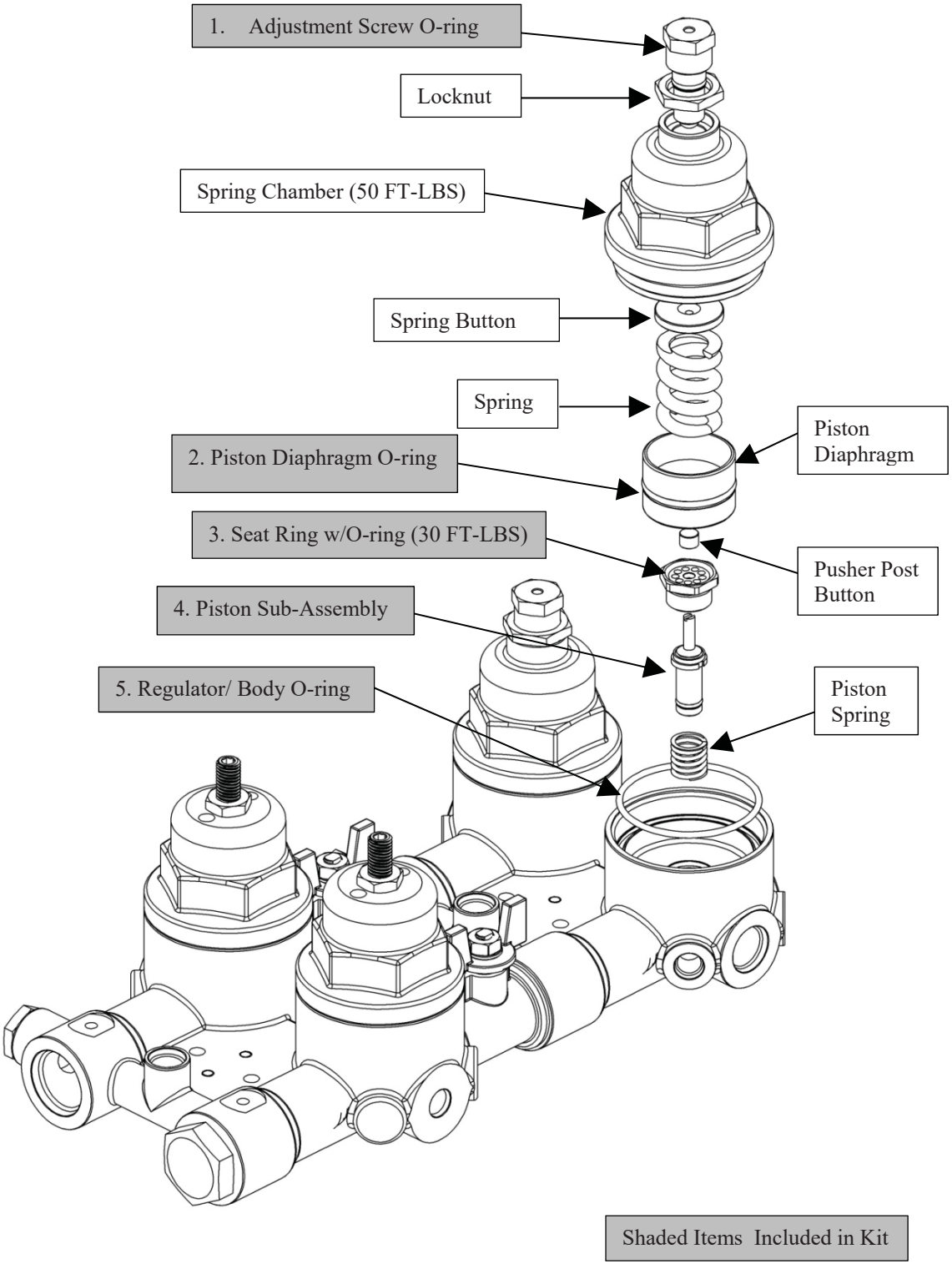


Figure 26: NFPA/ISO version HPxHP Manifold Shown.

5.6 Line Regulator Maintenance

See Figure 27.

IMPORTANT: Vent all inlet pressure and outlet pressure to 0 psig prior to servicing the regulator. Make sure assembly is performed in a clean environment free of any oils and grease (hydrocarbons). Use care as not to damage the regulator's sealing surfaces. Scratches or other damage to certain surfaces may render regulator non-repairable.

1. Close line regulator isolation valve upstream of the regulator being repaired.
2. Vent all inlet and outlet pressure of lineregulator to 0 psi by pressing the bleed valve. (Figure 15 & 16)
3. Using a 16mm Wrench, loosen Line Regulator Locknut.
4. Using a 5mm Hex Key Wrench, turn Line Regulator Adjustment Screw counterclockwise to release all spring tension. Remove Adjustment Screw/Locknut andset aside in clean area.
5. Using a 2" Socket, remove Spring Chamber.
6. Using a Screwdriver, insert into top of Spring Chamber past Adjustment Screw threads and push on Spring Button to push out Piston Diaphragm, Spring and Spring Buttons. Set components aside in a clean area.
7. Remove Pusher Post Button and set aside.
8. Using a Plastic Pick, remove Regulator/Body O-ring. Discard O-ring.
9. Using the ⅞" Socket, remove Seat Ring by turning counter-clockwise.
10. Discard Seat Ring w/O-ring.
11. Remove Piston Sub-Assembly and discard.
12. Verify Seat Spring and O-ring remains in place within regulator's body.
13. Insert new Piston Sub-Assembly.
14. Insert new Seat Ring and remove spring pressure from seat ring during installation by pressing on piston sub-assembly while screwing in the seat ring.
15. Assemble Pusher Post Button.
16. Insert new Regulator/Body O-ring. Use care to place uniformly in groove.
17. Using Plastic Pick, remove old O-ring from Piston Diaphragm and install new one included in kit.
18. Stack Piston Diaphragm, Spring and Spring Buttons together.
19. Place Spring Chamber on top of these components to capture them. The O-ring on Piston Diaphragm should hold all components in Spring Chamber.
20. Assemble Spring Chamber to the Manifold Body. Tighten to 50 ft-lbs.
21. Put Locknut on Adjusting Screw and assemble to Spring Chamber.
22. Turn Adjustment Screw until desired set pressure is reached.
23. Tighten Locknut.
24. Verify manifold operation.

NOTE:

Refer to Techniques For Leak-Tight Fittings for recommendations concerning removal and reassembly of fittings.

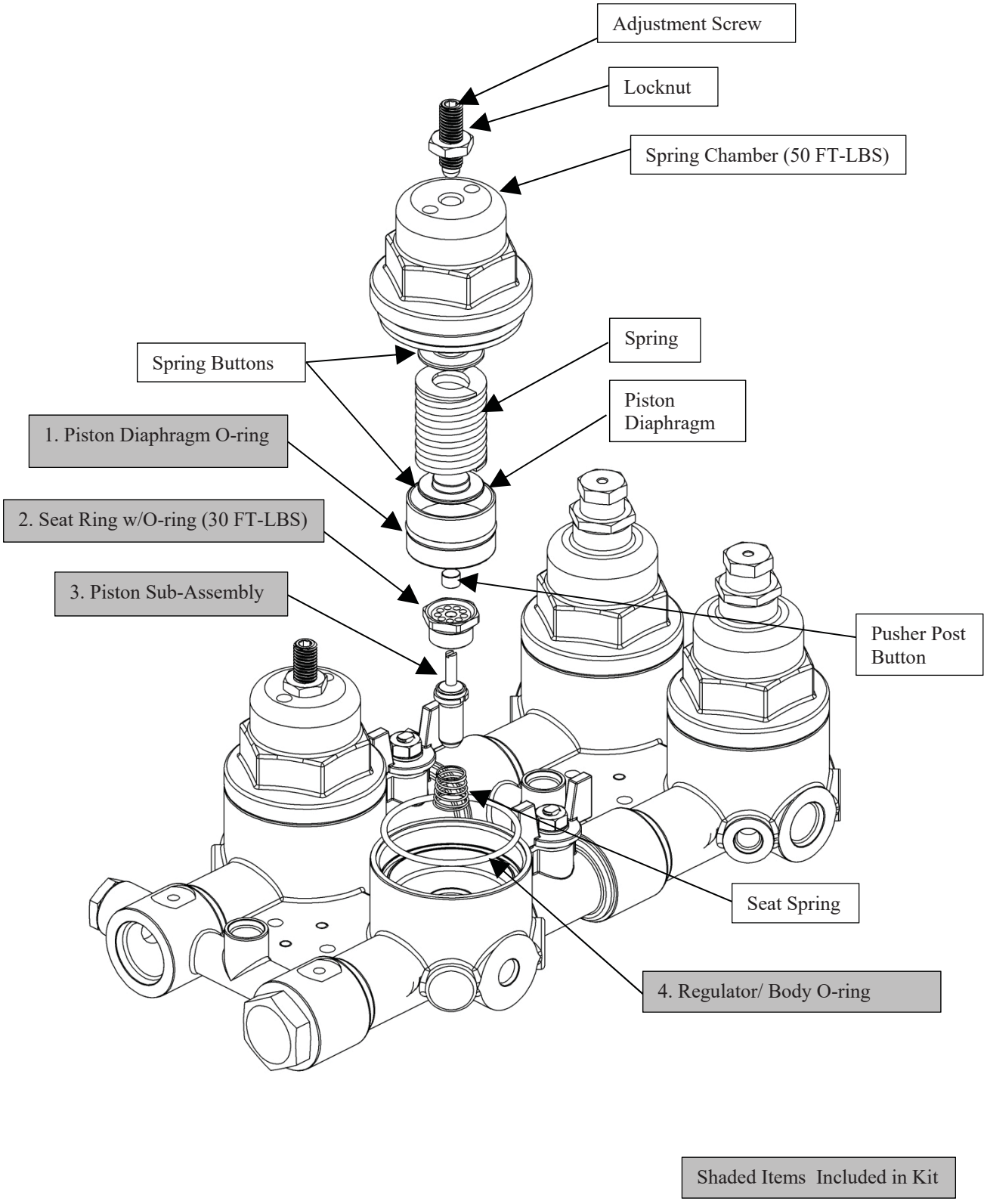


Figure 27: NFPA/ISO version HP x HP Manifold Shown.

5.7 Reserve Header Regulator Maintenance (If Equipped)

IMPORTANT: Vent all inlet pressure and outlet pressure to 0 psig prior to servicing the regulator. Make sure assembly is performed in a clean environment free of any oils and grease (hydrocarbons). Use care as not to damage the regulator's sealing surfaces. Scratches or other damage to certain surfaces may render regulator non-repairable

Following procedure describes process of reserve header regulator. If necessary, reserve header regulator maintenance 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 28 for component identification.

1. Close all high-pressure cylinders connected to reserve header.
2. Vent pressure from reserve header by manual bleed valve on output side of reserve header regulator (See Figure 17).
3. Using a 16mm Wrench, loosen Reserve Regulator Locknut.
4. Using a 5mm Hex Key Wrench, turn the Reserve Regulator Adjustment Screw counter-clockwise to release all spring tension. Remove Adjustment Screw/Locknut and set aside in clean area.
5. Using a 2" Socket, remove the Spring Chamber.
6. Using a Screwdriver, insert into top of Spring Chamber past Adjustment Screw threads and push on the Spring Button to push out Piston Diaphragm, Spring and Spring Button. Set components aside in a clean area.
7. Remove Pusher Post Button and set aside.
8. Using a Plastic Pick, remove the Regulator/Body O-ring. Discard O-ring.
9. Using a ⅞" Socket, remove the Seat Ring by turning counter-clockwise.
10. Discard Seat Ring w/O-ring.
11. Remove Piston Sub-Assembly and discard.
12. Verify the Piston Spring remains in place within regulator body.
13. Insert new Piston Sub-Assembly.
14. Insert new Seat Ring, remove spring pressure from seat ring during installation by pressing on piston sub-assembly while screwing in the seat ring, and torque to 30 ft-lbs.
15. Assemble Pusher Post Button.
16. Insert new Regulator/Body O-ring. Use care to place uniformly in groove.
17. Using Plastic pick, remove old O-ring from Piston Diaphragm and install new one included in kit.
18. Stack Piston Diaphragm, Spring and then the Spring Button together.
19. Place Spring Chamber on top of these components to capture them. The O-ring on the Piston Diaphragm should hold all the components in the Spring Chamber.
20. Assemble Spring Chamber to the Regulator Body. Tighten to 50 ft-lbs.
21 Put Locknut on Adjustment Screw and assemble to Spring Chamber.
22. Slowly open all high pressure cylinders.
23. Turn Adjustment Screw until desired set pressure is reached.
24. Tighten Locknut
25. Verify manifold operation.

> ⚠ **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.

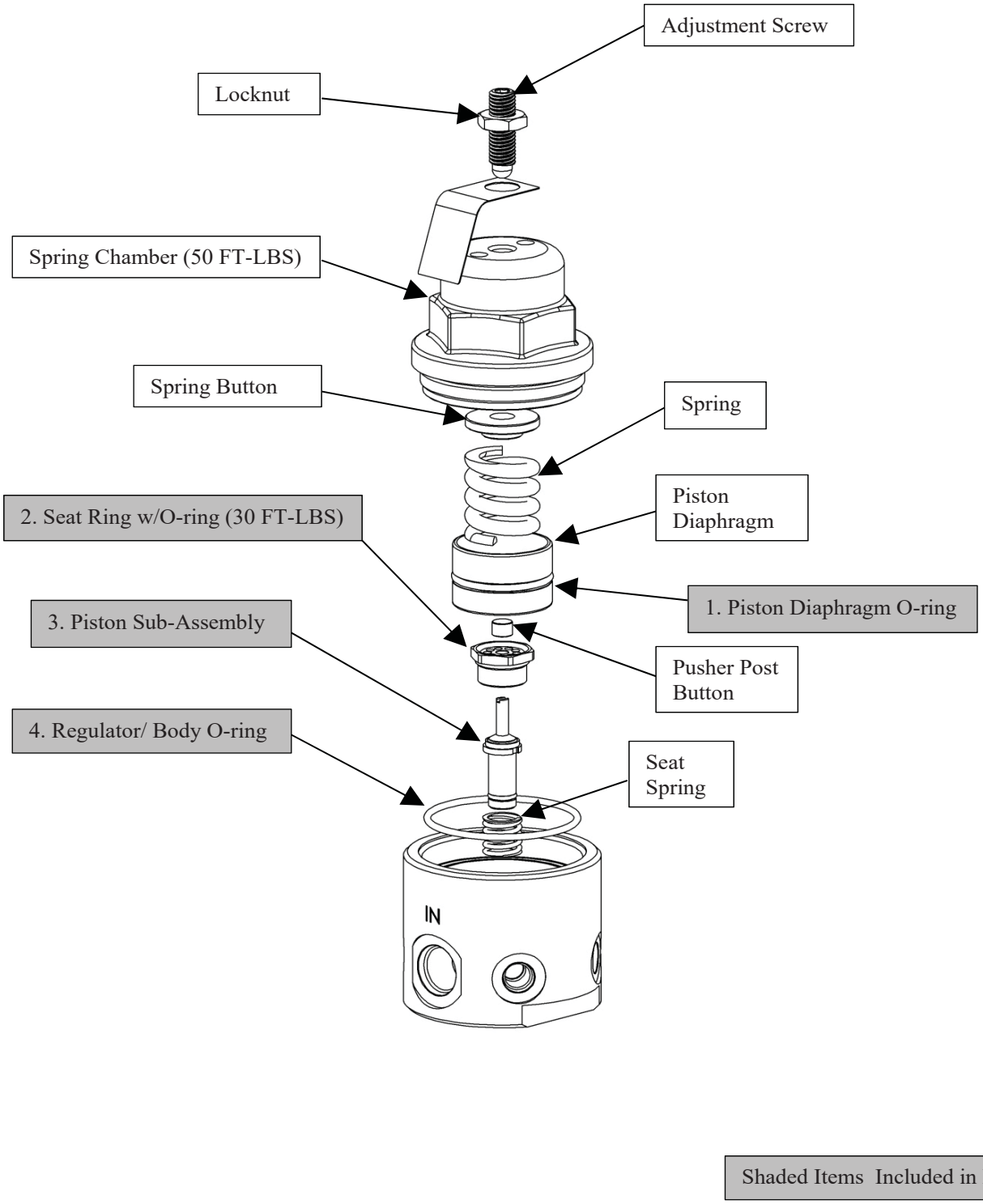


Figure 28: Reserve Regulator Exploded View.

5.8 Reserve Low Pressure Switch/ Transducer Replacement

The following procedure describes process of replacing high-pressure reserve header, reserve low switch/transducer. If necessary, reserve low switch/transducer 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 21 for component identification.

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

2. Disconnect reserve low switch wires at white connector.

3. Vent pressure from reserve header by manual bleed valve on output side of reserve header regulator.

4. After all pressure has been vented, remove reserve low pressure switch from elbow regulator body.

5. Reinstall reserve low pressure switch. Tighten switch. Do not over tighten.

6. Reconnect reserve low switch electrical connector and conduit.

7. Slowly open reserve header master valve and high-pressure cylinders connected to reserve header.

8. Check switch threads for leaks using an oxygen compatible leak detector solution.

9. Adjust pressure switch per reserve low switch adjustment procedure in this manual.

5.9 Check Valve/Ball Valve Replacement

See Figures 29 and 30.

IMPORTANT: Check Valve/ball valve replacement will require a COMPLETE MANIFOLD SHUTDOWN.

IMPORTANT: Vent all inlet pressure and outlet pressure to 0 psig prior to servicing. Make sure assembly is performed in a clean environment free of any oils and grease (hydrocarbons).

Bank Regulator Check Valve/Ball Valve Replacement

1. Remove regulator assembly from system.
2. Remove (2) Socket Head Cap Screws connecting Bracing Bar to Line Regulator section.
3. Carefully pull out (2) Ball Valves with Line Regulator section as shown in Figure 29.
4. Using Retaining Ring pliers, remove Retaining Ring holding in Check Valve. See Figure 30.
5. Using Needle Nose pliers grasp the Guide of Check Valve and pull Check Valve out of the manifold Body. See Figure 30.
6. Insert new Check Valve supplied.
7. Using Needle Nose pliers, push on Check Valve Body. You will feel the O-ring on Check Valve engage the Body. See Figure 30.
8. Insert Retaining Ring into Body to secure the Check Valve. A new Retaining Ring is included in the kit should you lose one. Make sure Re taining Ring is fully engaged in the groove.
9. Re-assemble Line Regulator, Ball Valves and Bank Regulator. Use care to engage the pin on small end of ball valve into slot on line regulator body. Firmly press together Bank and Line sections together and tighten the (2) Socket Head Cap Screws hand tight.
10. Tighten Socket Head Cap screws to 150 in-lbs.
11. Re-assemble regulator assembly into manifold.
12. Verify manifold operation.

Line Regulator Check Valve Replacement

1. If replacing left side check valve, remove SAE-12 Plug to gain access to the Check Valve. If replacing the right side checkvalve, remove Outlet Adapter.
2. Using Retaining Ring pliers, remove Retaining Ring holding in Check Valve.
3. Using Needle Nose pliers grasp the Guide of Check Valve and pull Check Valve out of the manifold Body. See Figure 29 and 30.
4. Insert new Check Valve supplied.
5. Using Needle Nose pliers, push on Check Valve Body. You will feel the O-ring on Check Valve engage the Body.
6. Insert Retaining Ring into Body to secure the Check Valve. A new Retaining Ring is included in the kit should you lose one.
7. Reassemble item(s) from step 1 above.
8. Verify manifold operation.

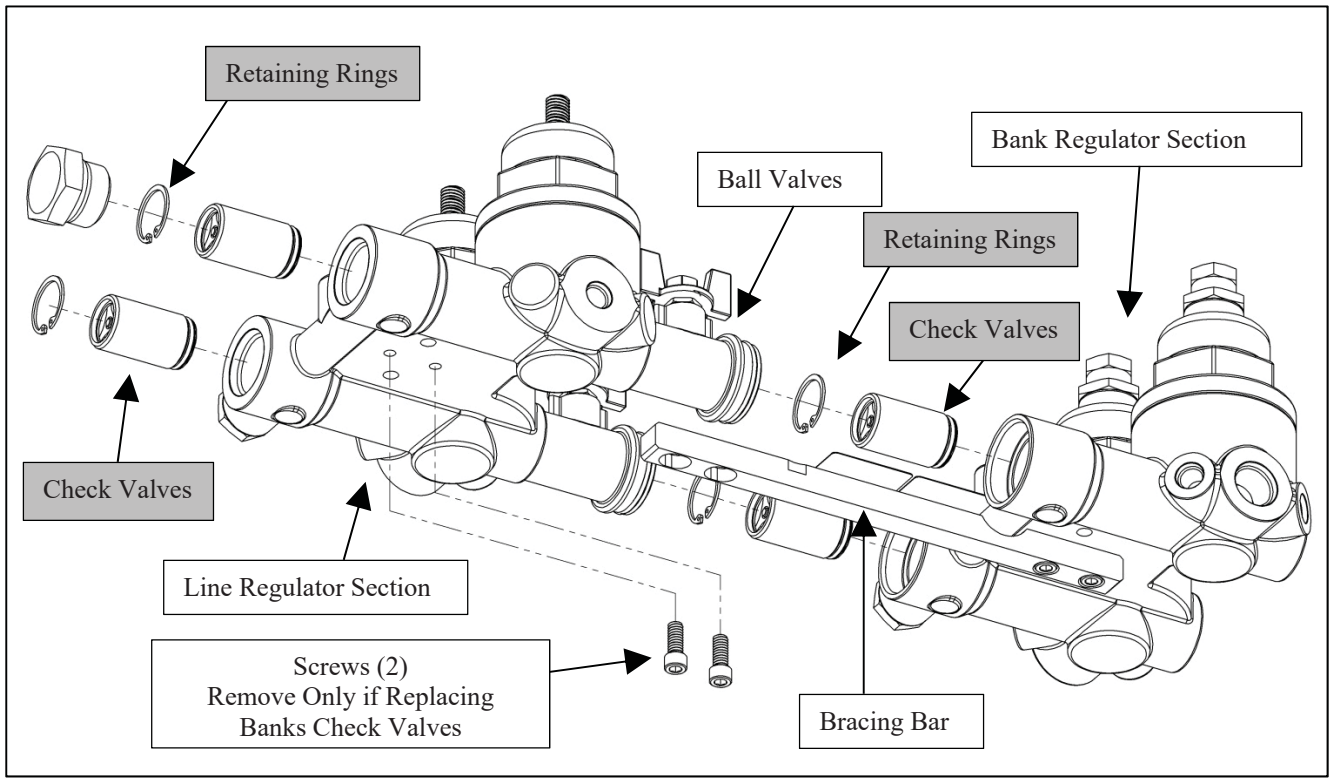


Figure 29: NFPA version HP x HP Manifold Shown.

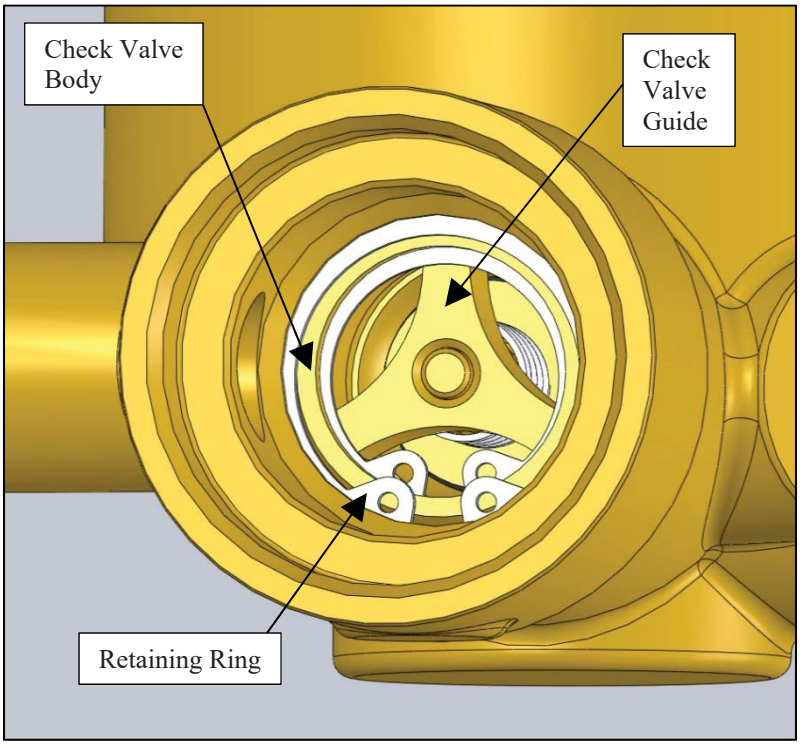


Figure 30: Check Valve Installation Close-up.

5.10 Control Board Replacement

See Figure 31

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 the control board is not recommended.

1. Disconnect power from the manifold.
2. Remove 4 screws from plastic plate covering boards.
3. Disconnect plugable terminal blocks, control connections and power supply cable on the control board, disconnect the Ethernet cable if equipped (TAE models only).
4. Remove control board by pulling the circuit board off the mounting stand-offs.
5. Check removeable jumpers JP1-6 on new circuit board to match orientation of old circuit board.
6. Install new control board on to mounting stand offs.
7. Connect each wire to appropriate terminal.
8. Replace plastic plate to cover boards with 4 screws.
9. Restore power. Verify correct operation of new control board by performing Performance Verification.

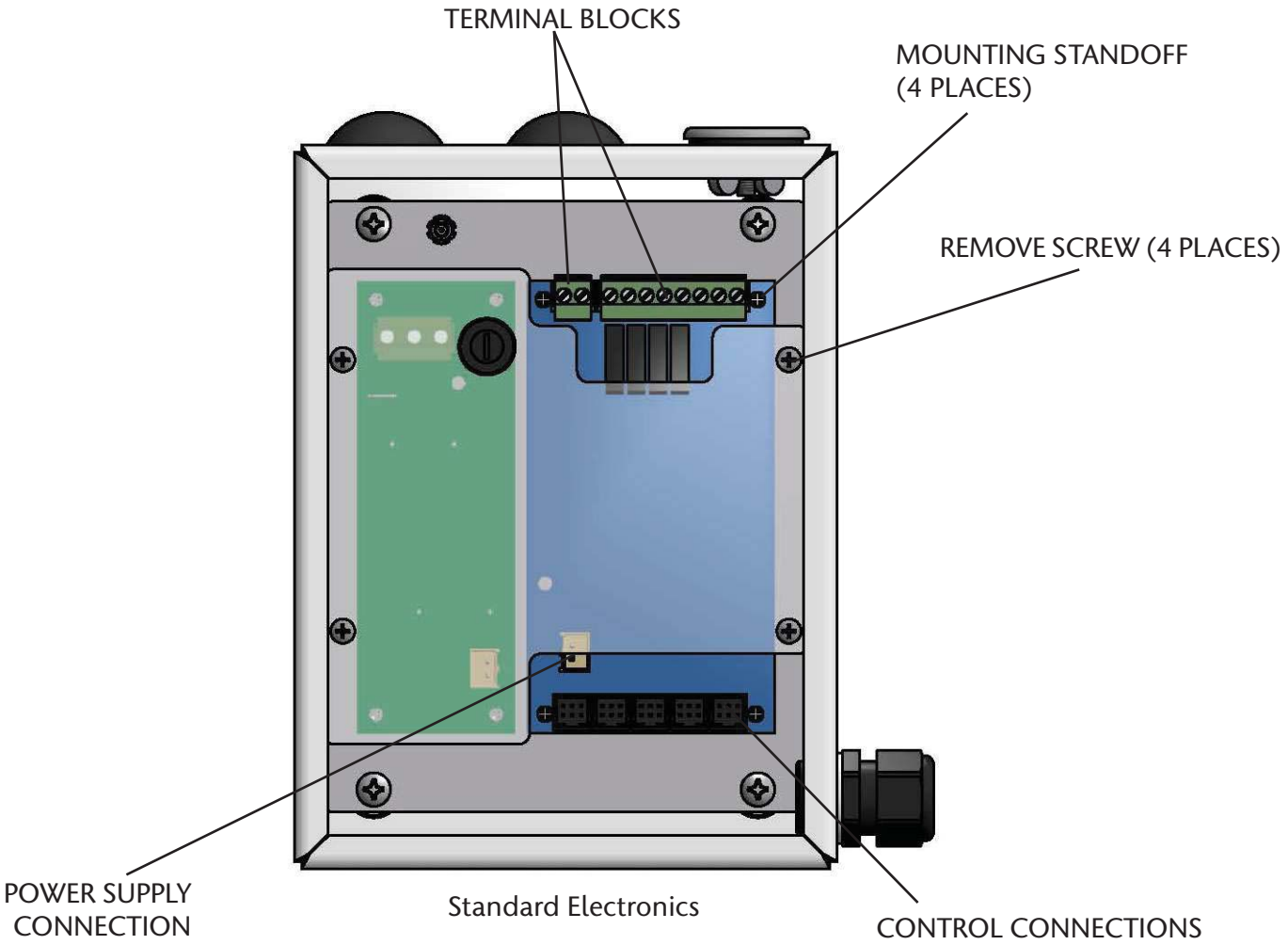


Figure 31: Control Board Replacement.

5.11 Wiring Diagram

NFPA 99, ISO 7396-1 (Standard Electronics)

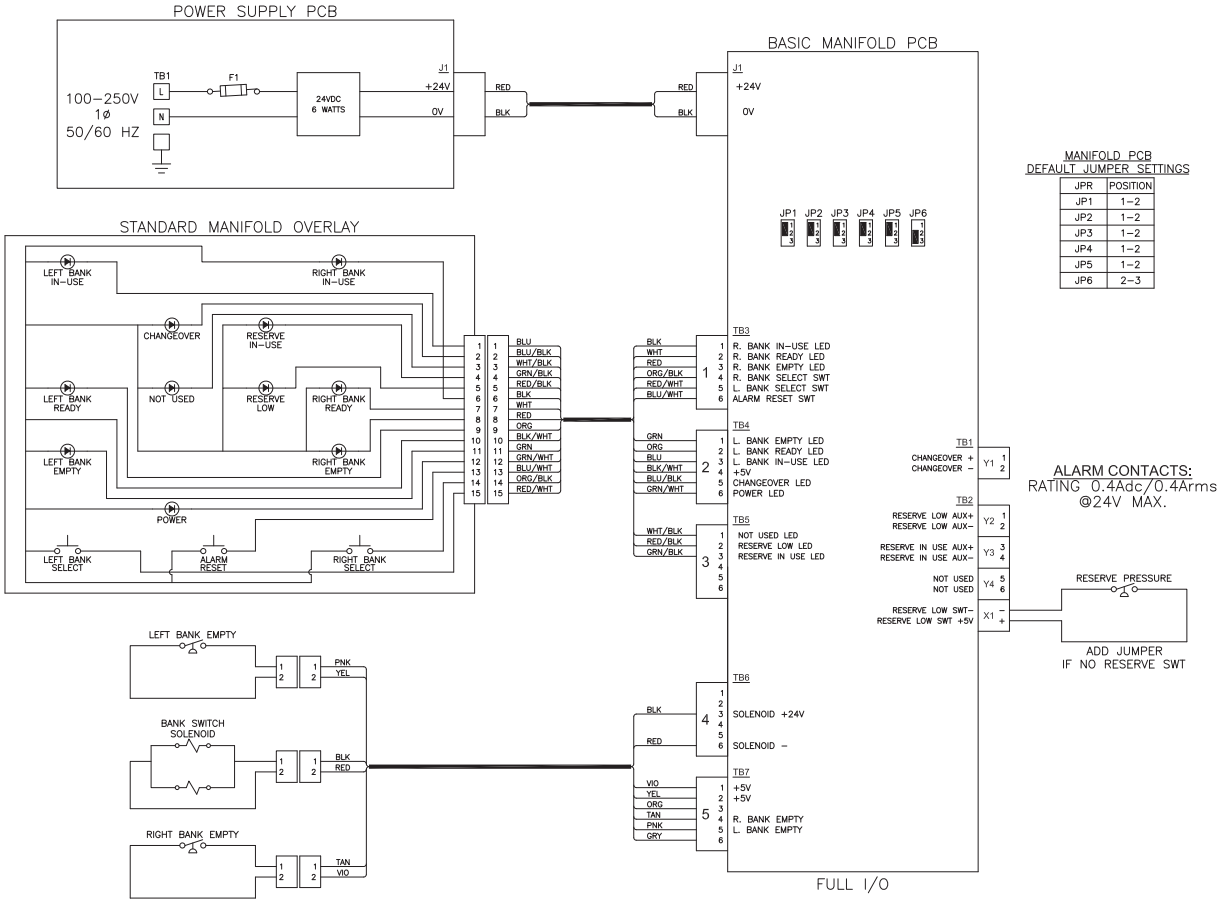


Figure 32

5.11 Wiring Diagram

NFPA 99, ISO 7396-1 (TAE Electronics)

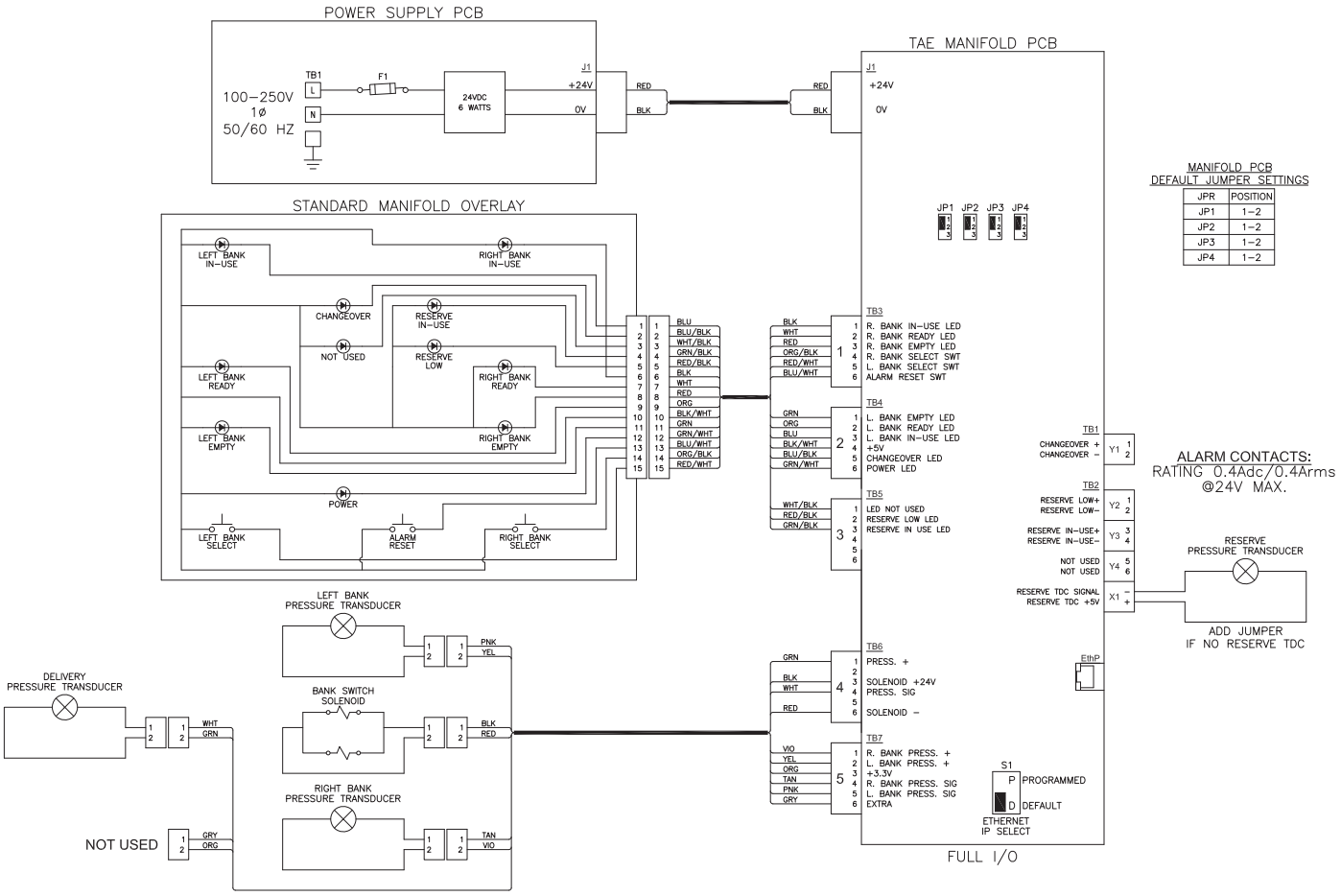


Figure 33

6.0 TotalAlert Embedded (TAE)

6.1 Remote Monitoring

CAUTION: The information systems personnel should be notified before changing any of the network settings. Changing the settings could keep the equipment from working properly.

Set Up: Equipment Required

- PC with an Ethernet connection
- PC with a web browser, such as Microsoft Internet Explorer
- Cat5 or better Ethernet cable

6.2 Set Up: Physical Connection

WARNING:

ONLY CONNECT THE CUSTOMER NETWORK TO THE CUSTOMER ETHERNET CONNECTION AS SHOWN IN FIGURE 34.

NOTE:

Factory Default IP Address:

169.254.100.100

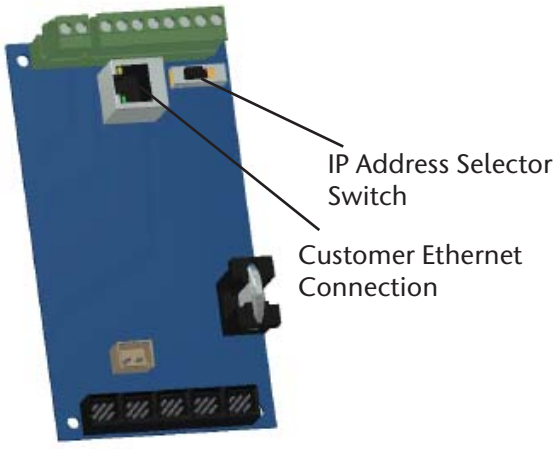


Figure 34: Connecting the cable

1. Place the IP Address Selector Switch in the Left-hand position.
2. Using a Cat5 Ethernet cable, connect the manifold to an Ethernet switch or hub. Connect the cable to the Customer's Ethernet Connection on the control board.
3. Verify the green LINK LED on the control board illuminates.

6.3 Set Up: Network Configuration

1. IP Address can only be configured using the Static Method: Upon power up of the system, the device will immediately begin using the fixed IP configuration.
2. The IP Address Selector Switch allows the user to choose between Factory Default IP address and a User Defined IP Address.
3. The IP Address Selector Switch left-hand position is for the factory default IP Address, which is 169.254.100.100. This cannot be changed.
4. The Selector Switch right-hand position is for the user defined IP Address. User defined IP Address must be set up using the TAE webpage.
5. The middle position of the switch is not used.

6.4 Set Up: Connecting to the Embedded Website of the manifold.

1. Ensure that the IP Address Selector Switch is in the left hand position.
2. Start a web browser, such as Microsoft Internet Explorer.
3. Enter the default IP address into the browser's address bar: **http://169.254.100.100**

6.5 Log in to Setup Pages

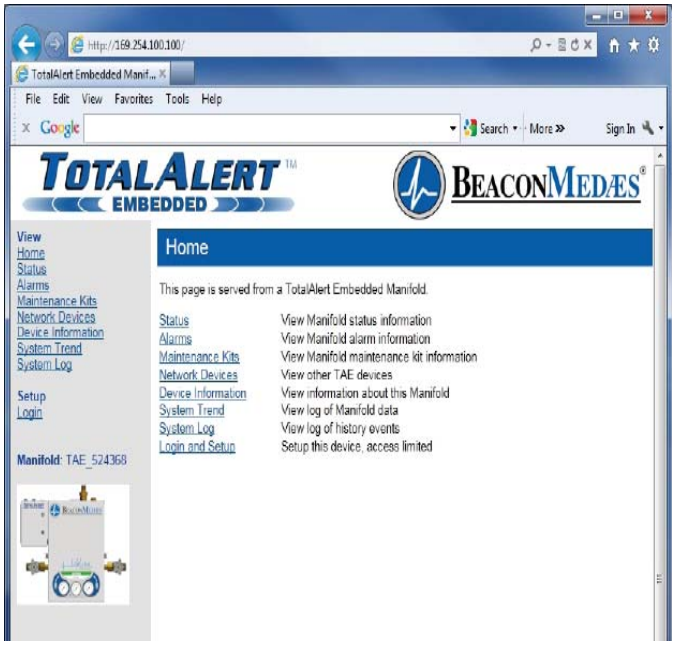


Figure 35: Manifold Home Page

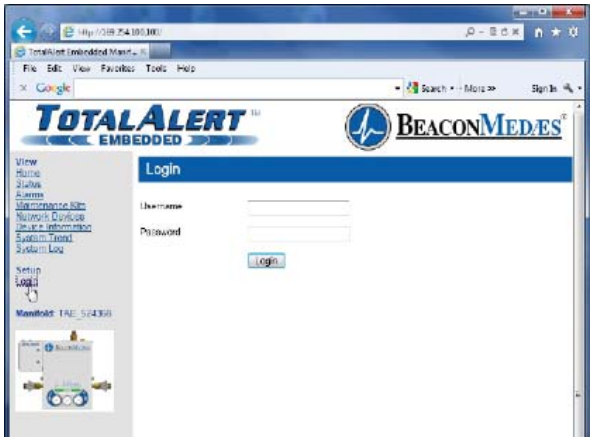


Figure 36: Login for Setup Pages

1. Once connected to the TotalAlert Embedded control system, your browser will display the typical home page (Figure 35).
2. Click “Login” on the menu bar in the left pane. The web browser will request a username and password (Figure 36).
3. The factory defaults are:
   Username: new
   Password: new
4. The left sidebar will now contain the setup links (Figure 37).

6.6 Device Setup

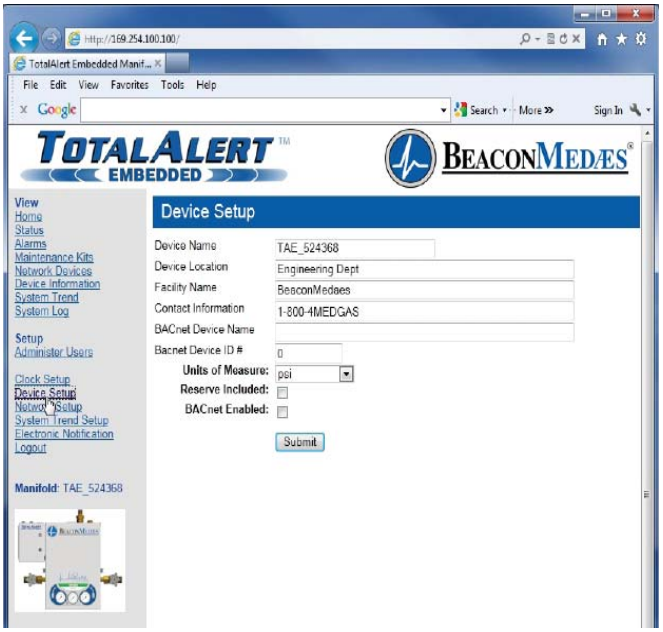


Figure 37: Device Setup

This Device Setup page (Figure 37) is used to configure the manifold name, location, facility name, and contact information.

1. Click Device Setup to access the Device Setup page.
2. Enter the new device name.
3. Enter the location
4. Enter the facility description.
5. Enter the contact information.
6. Click the Submit button.

6.7 Network Setup

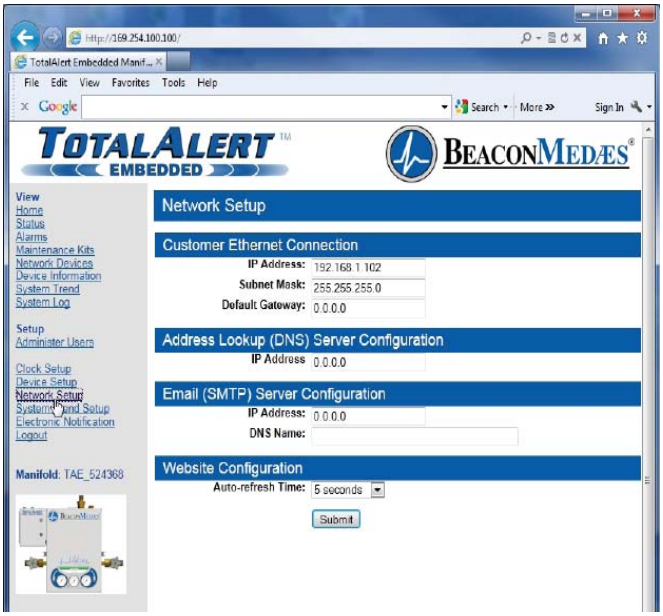


Figure 38: Network Setup

This Network Setup page (Figure 38) is used to configure the facility network information, e-mail server configuration, and wepage auto refresh rate.

NOTE: Obtain the IP Address and DNS Name from the facility's Information Systems department.

To Configure the Customer Ethernet Connection:

1. Click Network Setup to access the Network Setup page.
2. Enter the desired IP Address and Subnet Mask.
3. Click Submit.
4. This User Defined IP Address will only work if the IP selector switch is in the Right Hand Position.

To Configure Email Server:

1. Click Network Setup to access the Network Setup page.
2. If DNS name (Address Lookup) is to be used, enter the IP Address for the DNS Server configuration.
3. Enter the IP Address for the email SMTP server or the Server Name (if Address Lookup is used).
4. Click Submit.

To set the desired Website refresh rate:

1. Select the desired refresh rate.
2. Click Submit.

6.8 System Trend Setup

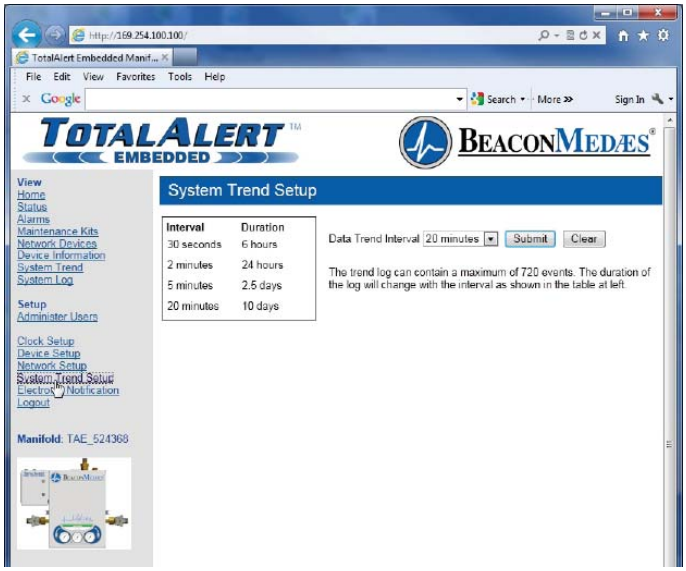


Figure 39: System Trend Setup

This System Trend Setup page (Figure 39) is used to configure the trend log for the website and to allow the data to be cleared. The System Trend screen contains a maximum of 720 events for each of the items recorded, so the actual duration of the trend log changes with the time interval selected. The durations available to select are 6 hours, 24 hours, 2.5 days, and 10 days.

1. Click System Trend Setup to access the System Trend Setup page.
2. Select a time interval from the pull-down list of options.
3. Click the Submit button.
4. To clear the System Trend Data, click the CLEAR button.

CAUTION:
Pressing the CLEAR button will permanently delete all Trend Data!

6.9 Electronic Notification Setup

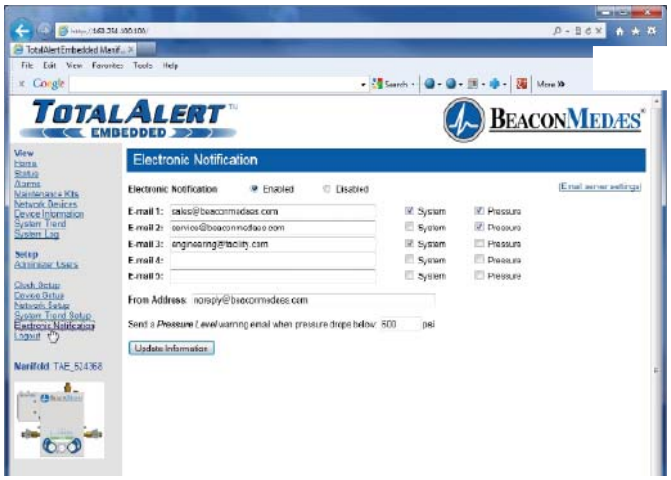


Figure 40: Electronic Notification Setup

This Electronic Notification Setup page (Figure 40) is used to configure the Electronic Notification feature of the TotalAlert Embedded control system. By setting up the Electronic Notification, key personnel can receive notifications of all alarm/shutdown alerts and pressure level alerts. The device acts as an SMTP client. An SMTP server is required for electronic notification to function.

1. Click Electronic Notification Setup to access the Electronic Notification Setup page.
2. Select Enable to enable the e-mail notification tool.
3. Enter up to five email addresses.
4. For each address, select "System" for that person to receive all alarm/shutdown alerts. Select "Pressure" for that person to receive all pressure low alerts. An individual may receive both types of alerts.
5. Enter an email address in the "From" box as this will be the sender of the notifications.
6. Enter the bank pressure level that will used for sending low bank pressure alerts.
7. Click the Submit button.

6.10 Navigating the Website

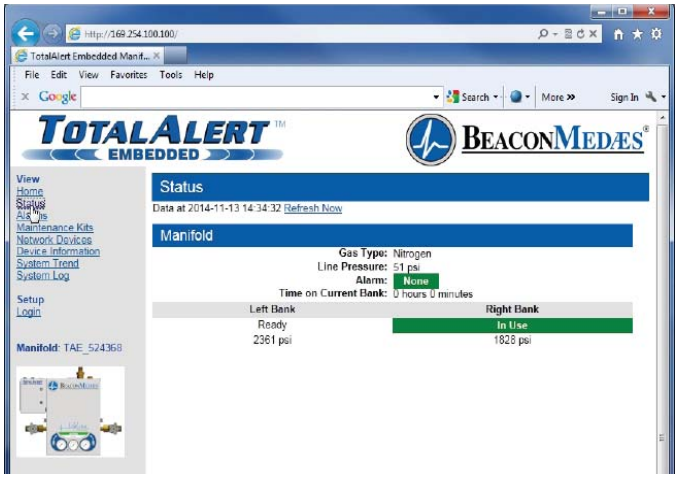


Figure 41: Status Page

The TotalAlert Embedded website allows the user to easily view the status of all activity pertaining to the manifold air system. By clicking the menu items to the left of the screen, a user can view pages displaying accurate and timely information about the system.

These pages include:

Status: The Status page (Figure 41) displays al current pressure conditions including the left and right bank pressure of the manifold as well as any alarm conditions.

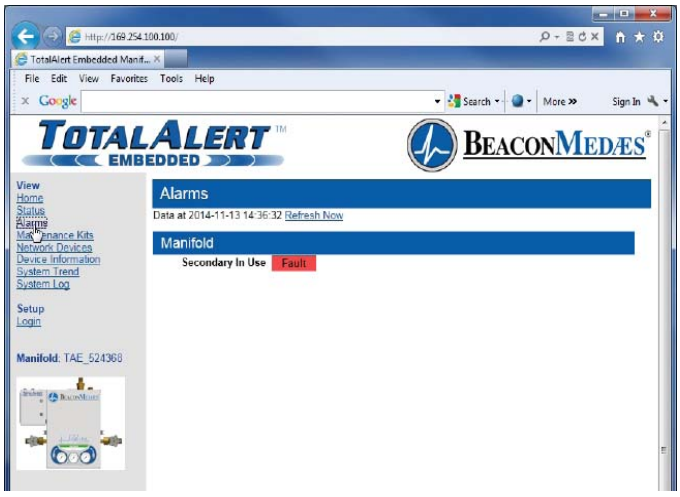


Figure 42: Alarms Page

Alarms: The Alarms page (Figure 42) displays all alarm conditions such as Changeover, Reserve Low, Reserve in Use, and Secondary Low (as provided).

6.10 Navigating the Website Cont.

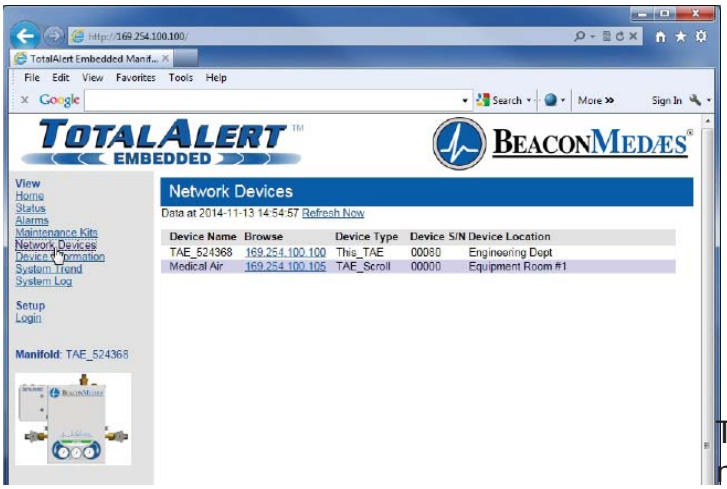


Figure 43: Network Devices

Network Devices: The Network Devices page (Figure 43) displays all TotalAlert and TotalAlert Embedded devices on the facility's network. The page displays the device name, IP address, device type, device serial number, and device location. By clicking the IP address of a device, the user moves to the website of that device.

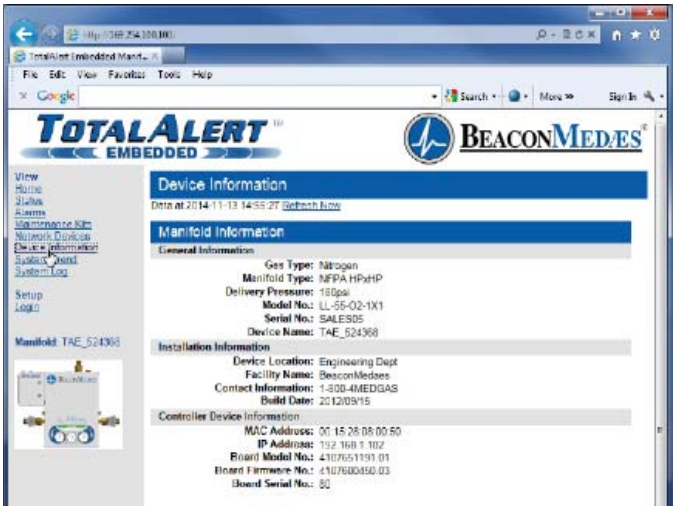


Figure 44: Device Information

Device Information: The Device Information Page (Figure 44) displays information specific to the TotalAlert Embedded device. The information shows all manifold general information, installation information, and controller device information. This information includes model number, serial number and much more.

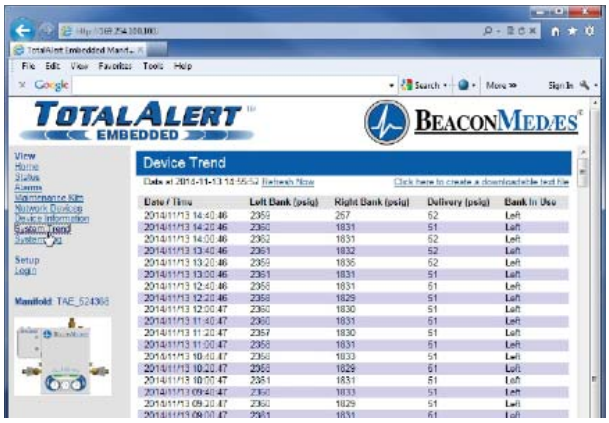


Figure 45: System Trend Page

The System Trend Page (Figure 45 displays mulitple items on the system, measured at specified time intervals. These items may include Left Bank Pressure, Right Bank Pressure, Delivery Pressure and Bank in Use. The time intervals may be every 30 seconds, 2 minutes, 5 minutes, or 20 minutes (see section 6.8 - System Trend Setup). The System Trend page includes the option to create a downloadable spreadsheet file of the events. To clear the System Trend data, go to the System Trend Setup page on the website.

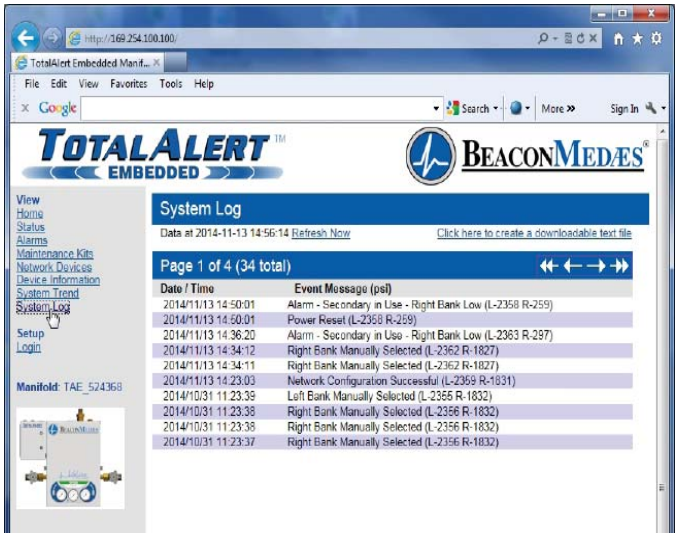


Figure 46: System Log

System Log: The System Log page (Figure 46) displays all manifold events including automatic and manual changeovers, as well as alarm resets. This screen also records bank pressure readings at the time of the events. The System Log page includes the option to create a downloadable text file of the log.

7.0 Optional Reserve Header (ISO Versions)

7.1 Reserve Header Installation

For ISO units requiring a reserve header, the following steps must be followed to ensure proper operation of the manifold.

1. Open the control box cover and remove the electrical jumper located on terminal block X1. See Figure 47.
2. Install the reserve header check valve kit into the right port of the manifold regulator assembly by removing the plug shown in Figure 48.
3. Install the supplied adapter fitting, check valve and zero clearance union into the open port.

NOTE:

Verify the arrow on the check valve is pointing in the direction of gas flow from the reserve header to the regulator assembly.

4. Once the check valve assembly is installed onto the manifold, the reserve header can be mounted and wired into the manifold.

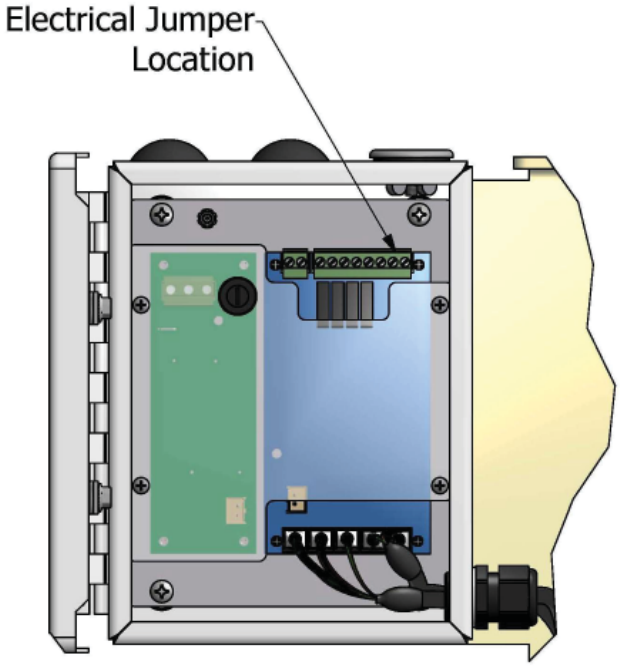


Figure 47: Jumper on Electrical Box

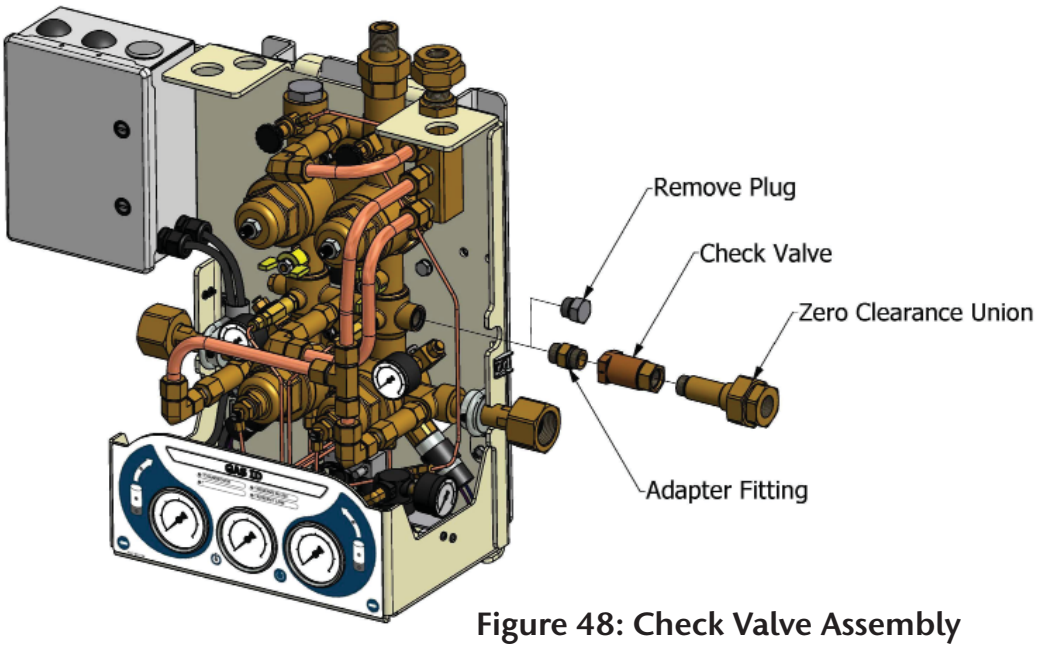


Figure 48: Check Valve Assembly

7.2 Wall Mounting HP Reserve Header

High pressure reserve header components may be shipped in several cartons. One carton will contain the control section assembly consisting of regulator assembly, and reserve low pressure switch as shown in Figure 49. Additional shipping cartons contain header extensions, cylinder pigtails, header wall brackets, master valve, and plug and nut. Depending on the 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. Attach master valve to the regulator assembly. Attach appropriate header extension to regulator assembly. 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 on end of last header extension (Figure 51).
2. Mark wall 65-¾" 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.
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 50.
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). ⅜" 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 51.
7. Tighten all header extension unions and plugs. Ensure all cylinder connections point away from wall.
8. The reserve pressure switch (Transducer for TAE models) should be routed in condit back to the manifold control box and wired into terminal block X1.

Wall Mounting HP Reserve Header (cont.)

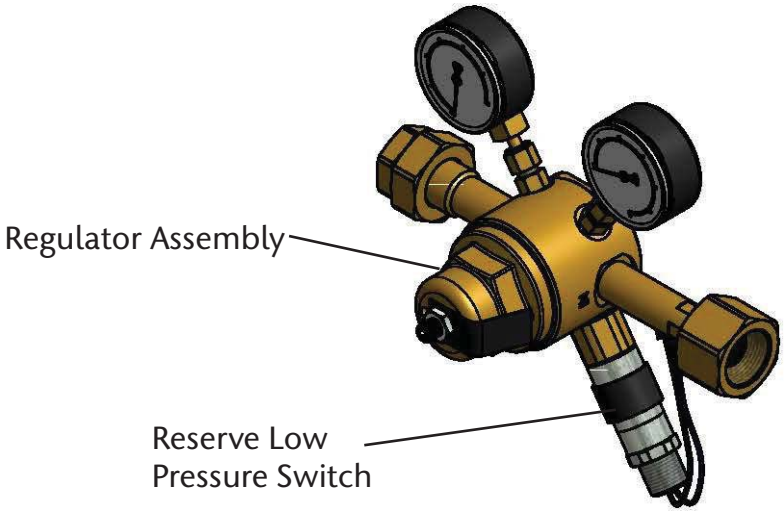


Figure 49

NOTE:

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

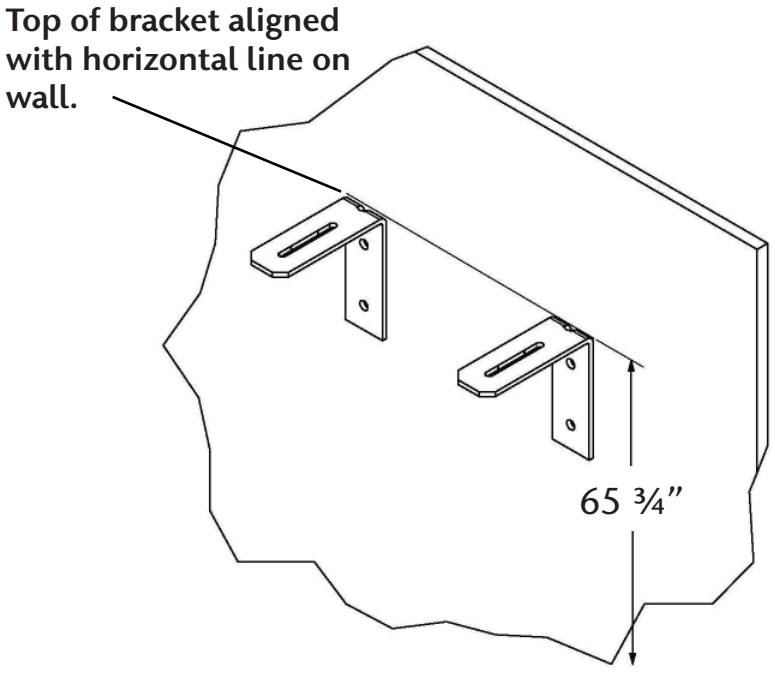


Figure 50

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 49.

Wall Mounting HP Reserve Header (cont.)

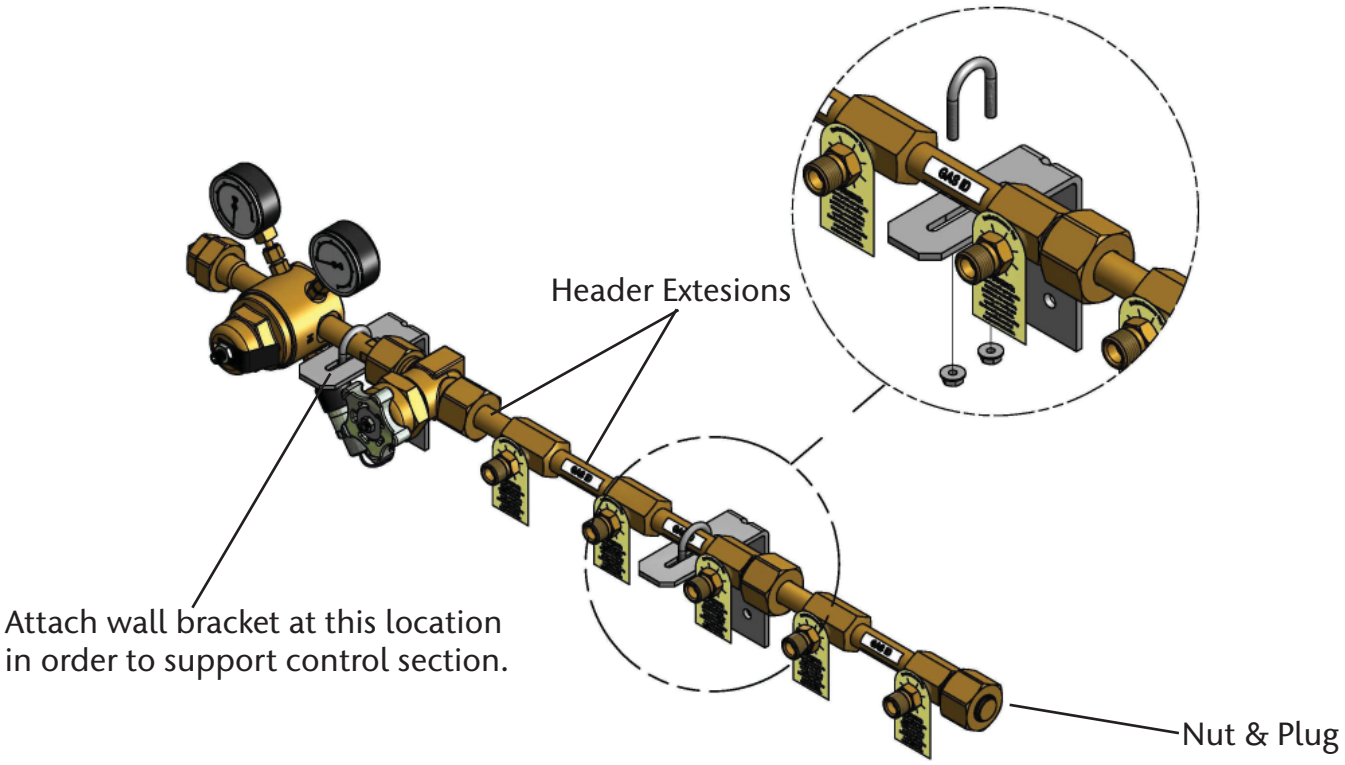


Figure 51

7.3 Initial Power Up and Operational Testing

See Figures 12, 13, 14, and 15.

1. Release two latches on sides of manifold control module cover (one on each side). Remove cover.
2. Verify the following: (Refer to Figure 12 for component location and Figure 13 for Light location).
   - Both manifold master valves are turned fully counterclockwise (open).
   - All isolation valves to be open. (handles vertical)
   - Reserve header master valve is turned fully counterclockwise (open).
   - Both red "EMPTY" lights on front of manifold and yellow "RESERVE IN USE" and red "RESERVE LOW" are illuminated (See Figure 14).
   - If connected to a master alarm panel, "CHANGEOVER", "RESERVE IN USE", and "RESERVE LOW" alarms are activated.
3. Close ¾" source shut-off valve.
4. Slowly open one cylinder on high-pressure reserve header assembly.
5. Verify the following:
   - "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_2, N_2, and AR. / approx. 1000 PSI for N_2O and CO_2).
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 "READY" and "IN USE" light illuminates.
   - Manifold right bank contents gauge reads liquid container pressure.
   - Manifold yellow "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 green "READY" light illuminates.
   - Manifold left bank contents gauge reads liquid container pressure.
   - If connected to a master alarm panel, "CHANGEOVER" alarm cancels.
10. Close manifold right liquid container. Slightly open vent valve (Figure 15). Verify following:
    - Right bank contents gauge drops slowly.
    - As right contents gauge is nearly depleted, manifold changes over to left bank.
    - After changeover, right bank green "READY" and "IN USE" light turns off and red "EMPTY" light illuminates.
    - After changeover, left bank green "IN USE" light illuminates, yellow "CHANGEOVER" light illuminates and changeover alarm sounds.
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 green "READY" light illuminates and"Yellow "CHANGEOVER" light turns off.
    - 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 changeover, left bank green "IN USE" light turns off and red "EMPTY" light illuminates.

- After changeover, right bank green "IN USE" light illuminates and yellow "CHANGEOVER" light illuminates.

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, "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_2O and CO_2 systems), 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 container and high pressure reserve header cylinder.
26. Wait 15 minutes.
27. Compare curent reading of left and right bank cylinder contents gauges to those recorded in step 23. If there is a noticeable pressure change on either gauge, perform leak testing described in section 2.13.
28. Reinstall manifold control panel cover.
29. Slowly open all cylinders on both banks of manifold and reserve header.
30. Open ¾" source shut-off valve.

1059 Paragon Way Rock Hill, SC 29730
(888) 4-MEDGAS (888) 463-3427
Fax (803) 817-5750
www.beaconmedaes.com