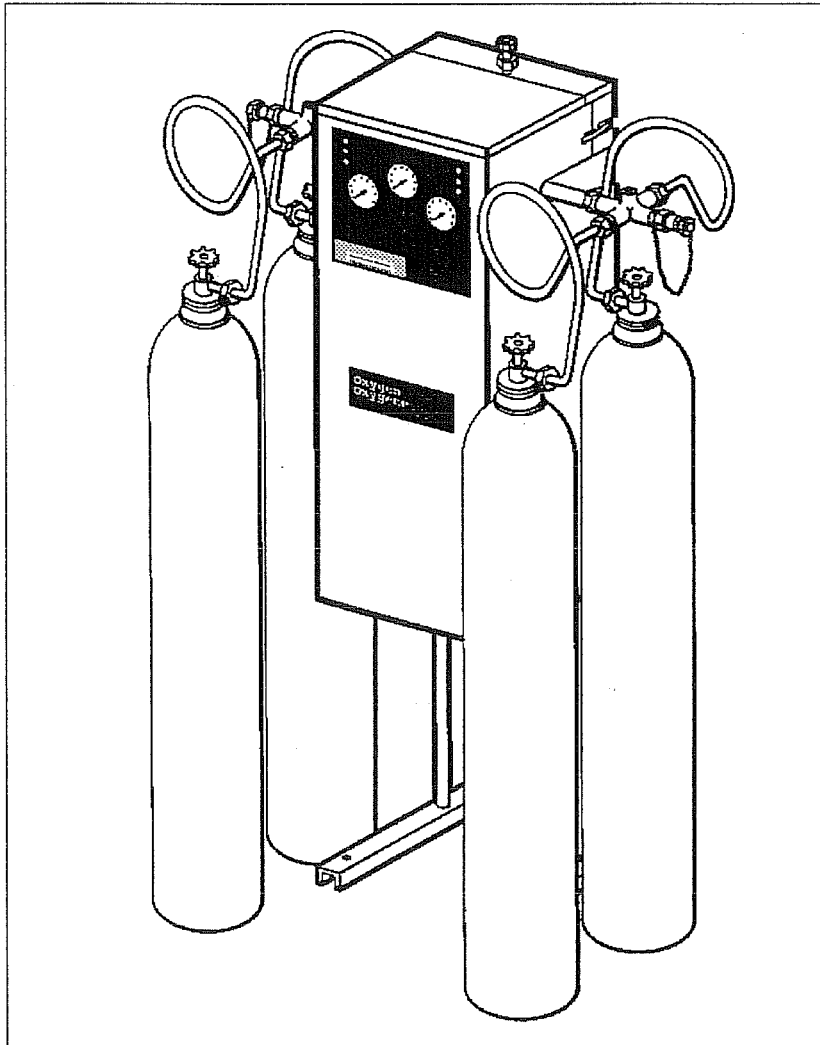


MEDÆS

MedPlus® Manifold

MANUAL



Hill-Rom®
A HILLENBRAND INDUSTRY

MAN01-041

TABLE OF CONTENTS

1/	Introduction	1-1
1.1	Technical Competence	1-1
1.2	User Responsibility	1-1
1.3	Precautions	1-2
1.4	Repair Policy	1-2
2/	Installation	2-1
2.1	Description	2-1
2.2	Precautions	2-1
2.3	Shipping Box Contents	2-1
2.4	Manifold Wall Mounting Instructions	2-4
2.5	Manifold Floor Mounting Instructions	2-4
2.6	Cylinder Bank Installation Information	2-6
2.7	Cylinder Bank Wall Mounting Instructions	2-9
2.8	Cylinder Bank Floor Mounting Instructions	2-10
2.9	Installing the Electrical Transformer	2-11
2.10	Connecting to the Medical Gas Alarm System	2-12
2.11	Connecting to the Medical Gas Delivery Line	2-12
2.12	Connecting to Relief Valves	2-13
2.13	Pressure Testing the Manifold	2-14
2.14	Leak Testing Connections	2-15
2.15	Testing Bank Switch-Over and Status LED Operation	2-15
2.16	System Start-Up	2-16
3/	Operation	3-1
3.1	General Information	3-1
3.2	Specifications	3-1
3.3	Piping Schematic, Piping Layout, and Component Description	3-3
3.4	Theory of Operation	
3.4.1	Primary Supply to Secondary Supply Switch-Over	3-6
3.4.2 Regulators and Pressure Gauges	
3-7		
3.4.3 Relief Valves	
3-7		
3.4.4 Bank Shutoff Valves and Line Regulator Valves	
3-7		
3.4.5 Service Valve	
3-8		
3.4.6 Medical Gas Source Shutoff Valve	
3-8		
3.4.7 Pressure Switches, Status LEDs, and Remote Alarms	
3-8		
3.5	Cylinder Replacement	3-10
3.5.1	Cylinder Removal	3-10
3.5.2 Cylinder Installation	
3-11		
4/	Maintenance	4-1
4.1	Repair Policy	4-1
4.2	Bank Regulator Adjustment	4-2
4.3	Delivery Line Regulator Adjustment	4-4
4.4	Dome Regulator Adjustment	4-5
4.5	Component Replacement	4-6
4.5.1	Bank Shutoff Valves, Bank Regulators, Check Valves, Intermediate Pressure Gauges, Bank Pressure Gauges, and Bank Pressure Switches	4-6
4.5.2 Intermediate Relief Valve	
4-8		
4.5.3 Delivery Line Regulators	
4-9		

1.1 Technical Competence

The information in this Installation, Operation, and Maintenance Manual pertains only to those models of Products which are marketed by Hill-Rom MEDÆS as of the effective date of this manual or the latest revision thereof.

The installation information in Chapter 2 of this manual is prepared for use by competent individuals who have a general knowledge of and experience with the installation of devices of this nature. The operation information in Chapter 3 of this manual is prepared for use by the medical facility staff. The maintenance information in Chapters 4 and 5 of this manual is prepared for use by Hill-Rom MEDÆS Service Representatives.

The information contained in this manual, including performance specifications, is subject to change without notice. Hill-Rom MEDÆS shall not be liable for errors contained in this manual, or for incidental or consequential damages in connection with providing this manual or the use of the material in this manual.

This manual is subject to periodic review, update and revision. Customers are cautioned to obtain and consult the latest version thereof before undertaking any service of the equipment. Call Hill-Rom MEDÆS at 800-556-5596 to request a copy.

This manual is not to be reproduced in any manner, nor are the contents herein to be disclosed to anyone, without the express authorization of Hill-Rom MEDÆS.

1.2 User Responsibility

This Product will perform in conformity with the descriptions contained in this manual and accompanying labels and/or inserts, when assembled, operated, maintained and serviced in accordance with the instructions provided.

This Product must be checked periodically. A defective Product should not be used. Parts that are broken, missing, plainly worn, distorted or contaminated, should be replaced immediately. Should such repair or replacement become necessary, Hill-Rom MEDÆS recommends that a telephonic or written request for service advice be made to the Hill-Rom MEDÆS Service Center. Refer to the list on the back of this manual for locations and telephone numbers.

This Product or any of its parts should not be repaired other than in accordance with written instructions provided by Hill-Rom MEDÆS, or altered without the prior written approval of Hill-Rom MEDÆS. The medical facility staff shall have the sole responsibility for any malfunction of this product which results from improper use, faulty maintenance, improper repair, damage or alteration by anyone other than an Hill-Rom MEDÆS Service Representative.

1.3 Precautions

Statements in this manual preceded by the words **WARNING**, **CAUTION**, and **Note** are of special significance;

WARNING: denotes steps which can prevent injury

CAUTION: denotes steps which can prevent damage to equipment

Note: denotes helpful information

1.4 Repair Policy

Do not use an improperly functioning unit until all necessary repairs are made and the unit has been tested to be sure that it is functioning according to the manufacturer's published specifications. To ensure full reliability, Hill-Rom MEDÆS recommends that all repairs are made by a Hill-Rom MEDÆS Service Representative.

WARNING: Electrical shock hazard. No repair should ever be attempted by anyone not having experience in the repair of devices of this nature. Failure to follow proper repair procedures can result in serious injury.

CAUTION: Genuine replacement parts manufactured by or sold by Hill-Rom MEDÆS must be used for all repairs. Failure to do so can result in serious damage to the unit.

2/INSTALLATION

2.1 Description

The MedPlus[®] Manifold is an automatic changeover manifold designed to deliver an uninterrupted supply of low pressure medical gas from high pressure cylinders to a medical facility gas pipeline system. The bank of cylinders on one side of the manifold serves as the Primary Supply while the bank of cylinders on other side serves as the Secondary Supply. The manifold automatically switches to the Secondary Supply when the Primary Supply is depleted. The MedPlus[®] Manifold is designed in accordance with National Fire Protection Association (NFPA) 99.

2.2 Precautions

WARNING: One person should never attempt to install the manifold alone. At least two people are required to lift and fasten the manifold, whether it is wall or floor mounted.

Note: Refer to the current edition of the NFPA Standard 99 as well as state and local regulations before installing the manifold.

2.3 Shipping Box Contents

Included in the shipping box with each MedPlus[®] Manifold is an electrical transformer and a union (NPT to tube) for connection to the medical gas delivery line. Also included are wall-mounting or floor-mounting legs as specified in your order, the correct number of blind glands and union nuts, header extensions, pigtails, and mounting brackets required for the installation. If the manifold is larger than a 2 x 2 configuration and will be floor mounted, floor-mounting legs for the header extensions are also included as specified in your order (in a separate package). Contact Hill-Rom MEDÆS at 800-556-5596 if parts are damaged or missing.

2/INSTALLATION

2.4 Manifold Wall Mounting Instructions

Note: Refer to Chapter 5 for an illustrated parts break-out, part descriptions, quantities, and stock numbers.

1. The MedPlus® Control Cabinet is bolted to a plywood base in the shipping carton. Use at least 2 persons to lift the manifold from the carton by placing their hands through the rectangular cutouts on the sides of the plywood base.
2. Place the manifold on a clean, flat surface.
3. Release the latches at the top of the manifold cover (1 latch each side). (Figure 2-1)
4. Remove the manifold cover by raising the top of the manifold cover about one foot and then sliding the cover up and away. (Figure 2-2)
5. Remove the four bolts securing the manifold to the plywood base.

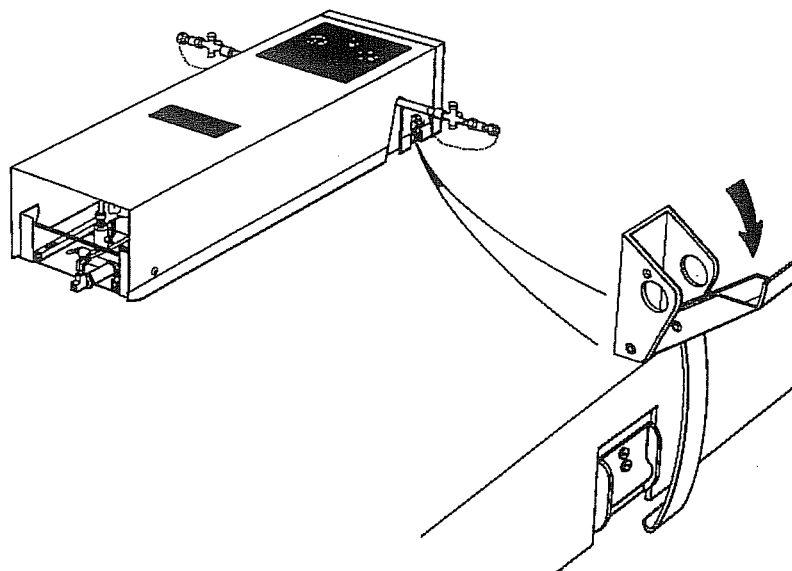


Figure 2-1
Releasing a Latch

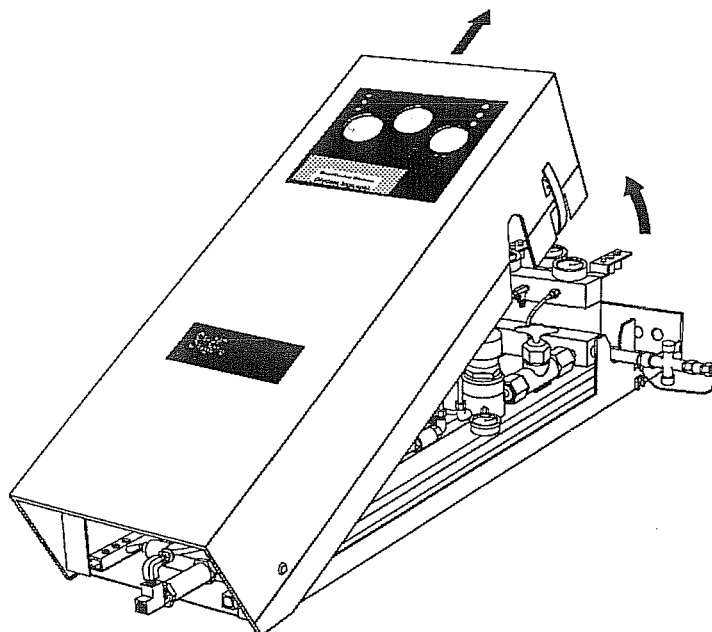


Figure 2-2
Removing the Manifold Cover

2/INSTALLATION

- Slide one wall-mounting leg into each frame end at the bottom of the manifold. (Figure 2-3)
- Thread one bolt into each wall-mounting leg and then tighten the bolts. (Figure 2-3)

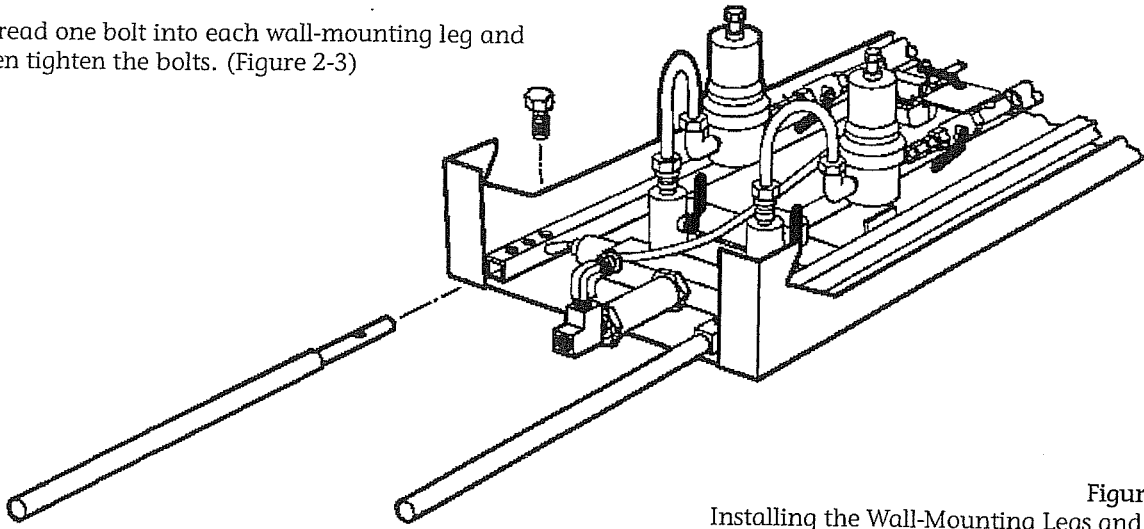


Figure 2-3
Installing the Wall-Mounting Legs and Bolts

- Lift the manifold up onto the wall-mounting legs, move it into position against the wall, and mark the wall through the four holes in the frame brackets. (Figure 2-4)
- Remove the manifold from the wall and lay it on its back, on the floor.
- Make the appropriate size holes in the wall. Insert and fasten the anchors (not included) at the marked locations (3/8" anchors are recommended).

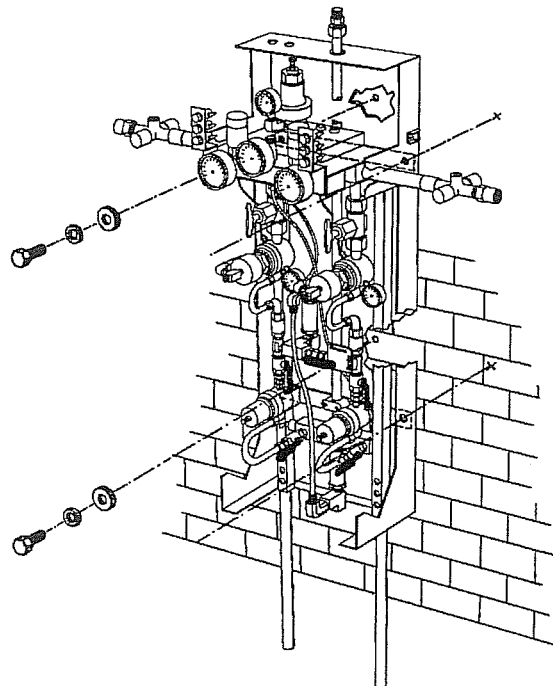


Figure 2-4
Marking Anchor Locations and Installing the Bolts

2/INSTALLATION

2.5 Manifold Floor Mounting Instructions

Note: Refer to Chapter 5 for an illustrated parts break-out, part descriptions, quantities, and stock numbers.

1. The MedPlus® control Cabinet is bolted to a plywood base in the shipping carton. Use at least 2 persons to lift the manifold from the carton by placing their hands through the rectangular cutouts on the sides of the plywood base.

2. Place the manifold on a clean, flat surface.
3. Release the latches at the top of the manifold cover (1 latch each side). (Figure 2-5)
4. Remove the manifold cover by raising the top of the manifold cover about one foot and then sliding the cover up and away. (Figure 2-6)
5. Remove the four bolts securing the manifold to the plywood base.

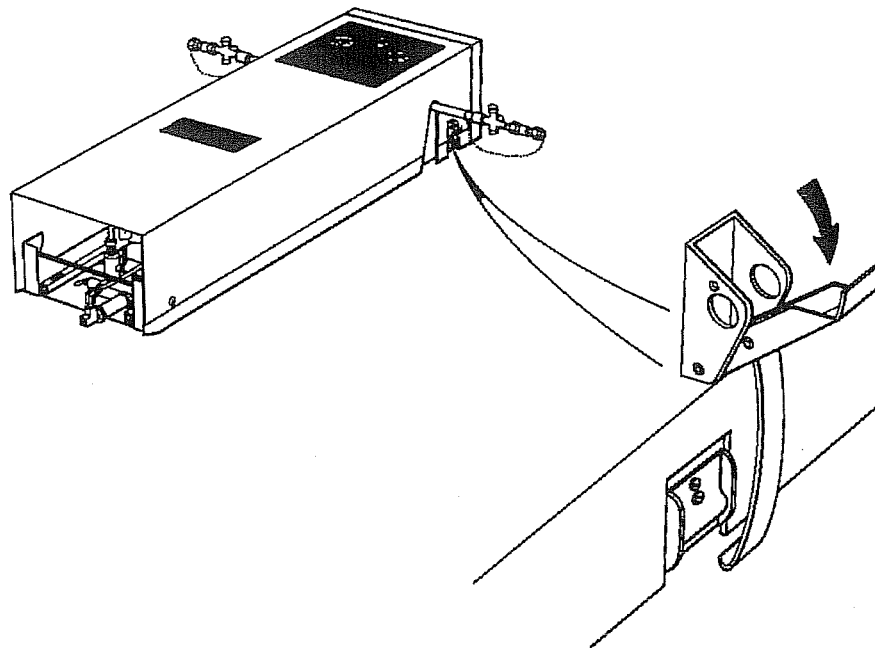


Figure 2-5
Releasing a Latch

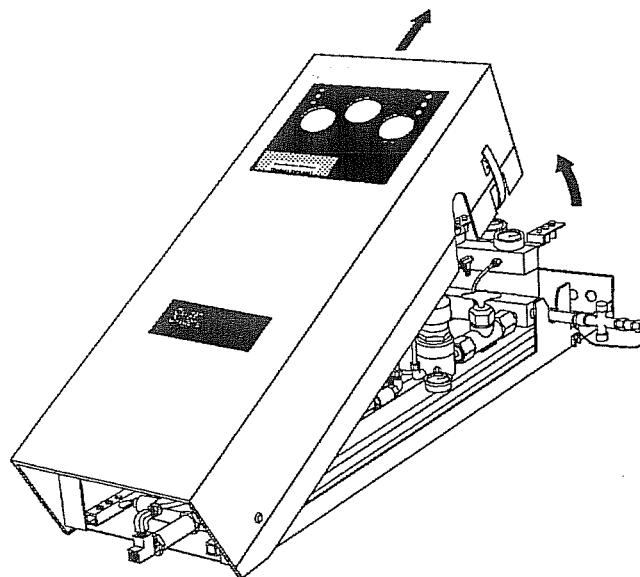


Figure 2-6
Removing the Manifold Cover

2/INSTALLATION

- Slide one floor-mounting leg into each frame end at the bottom of the manifold. (Figure 2-7)
- Thread one bolt into each floor-mounting leg and then tighten the bolts. (Figure 2-7)

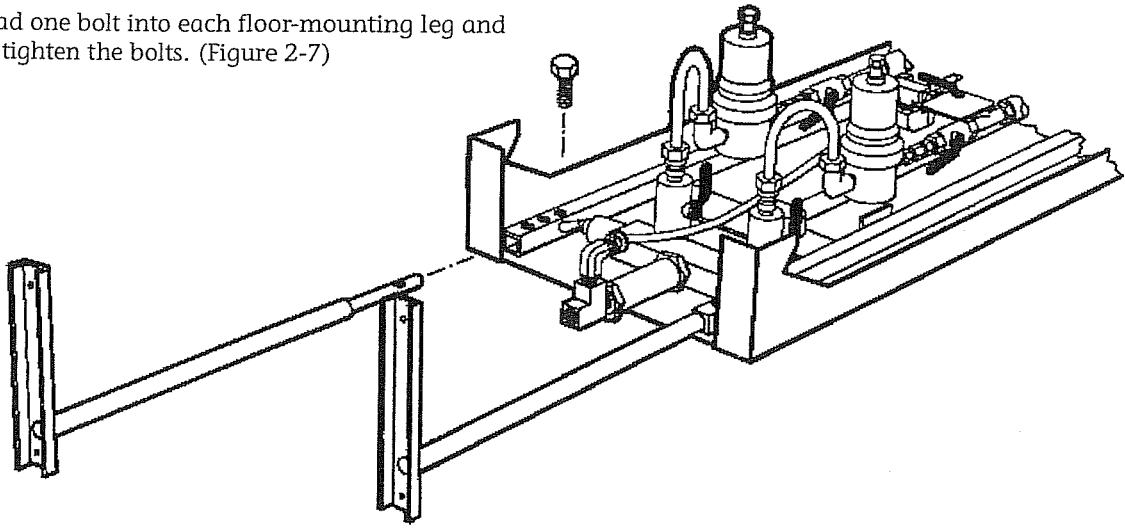


Figure 2-7
Installing the Wall-Mounting Legs and Bolts

- Lift the manifold up onto the floor-mounting legs and move it into position.
- Mark the floor through the four holes in the floor-mounting legs. (Figure 2-8)
- Remove the manifold and lay it on its back, on the floor.
- Make the appropriate size holes in the floor. Insert and fasten the anchors (not included) at the marked locations (3/8" anchors are recommended).
- Lift the manifold up onto the floor-mounting legs and move it into position.
- Using lock washers and washers on each bolt, insert the bolts through the floor-mounting legs and into the anchors. (Figure 2-8)
- Tighten the bolts into the anchors.

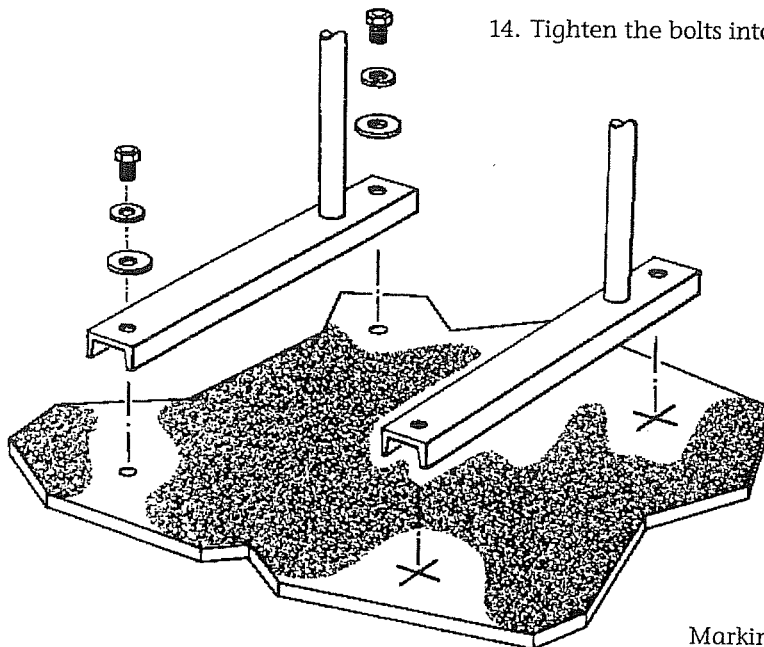


Figure 2-8
Marking Floor Anchor Locations and
Installing the Bolts

2/INSTALLATION

2.6 Cylinder Bank Installation Information

CAUTION: This Section contains important information necessary for proper installation of the cylinder banks. Read it carefully before installing wall-mounted cylinder banks as described in Section 2.7 or floor-mounted cylinder banks as described in Section 2.8.

Note: Manifolds, blind glands and union nuts, header extensions, and pigtails are gas-specific.

Note: Refer to Chapter 5 for an illustrated parts breakout, part descriptions, quantities, and stock numbers.

Each manifold has two manifold headers, one on each side of the manifold (Figure 2-9). A blind gland and union nut is installed on the outboard connection of each manifold header.

Note: Wall guards and cylinder restraints (not included) should be installed as required by code.

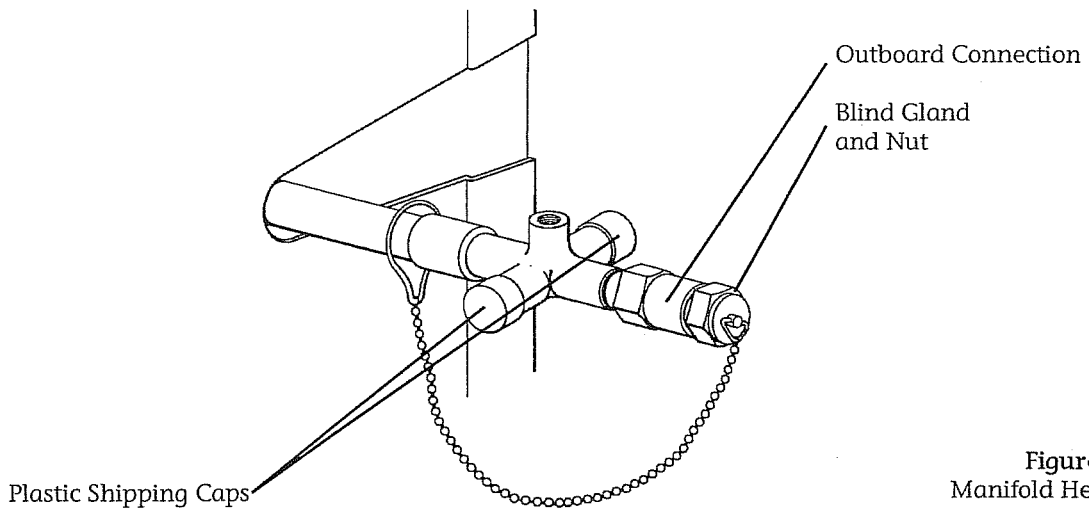


Figure 2-9
Manifold Header

Each manifold header (and header extension) accepts two pigtails for connection to two gas cylinders. (Figure 2-10)

WARNING: Never connect a pigtail to the outboard connection of a manifold header or a header extension. Doing so may result in the release of large quantities of harmful gas.

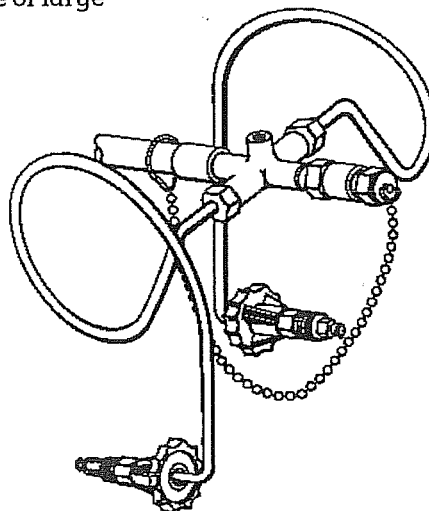


Figure 2-10
Pigtails Connected to a Manifold Header

2/INSTALLATION

If additional cylinders are required, remove the blind gland and union nut from the manifold header. Add a header extension to the outboard connection of the manifold header (Figure 2-11). Then, install the blind gland and union nut to the outboard connection of the header extension.

CAUTION: Do not use thread sealant on header or

pigtail connections.

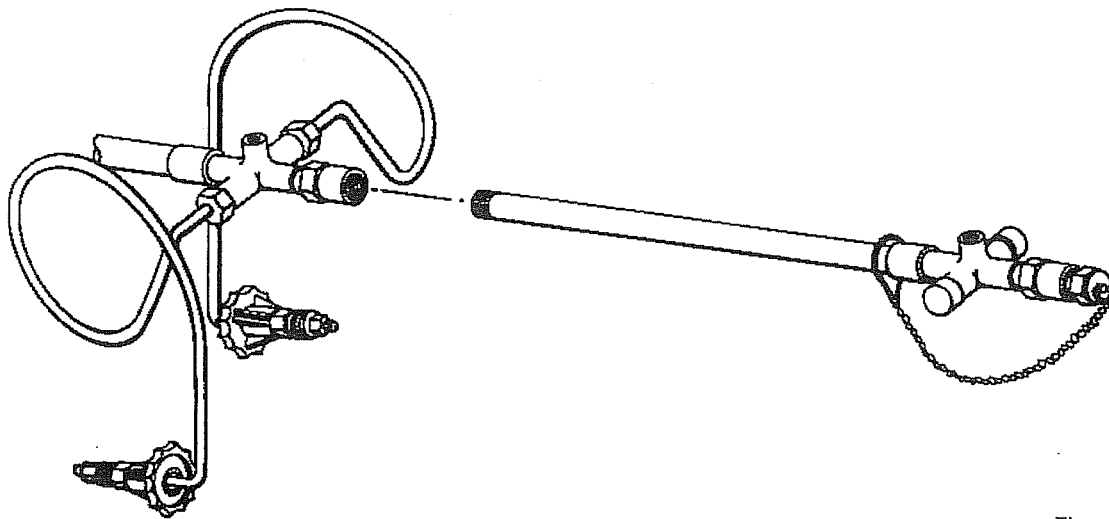


Figure 2-11
Header Extension

For wall-mounted manifolds, screw a mounting bracket to each header extension and then secure the mounting bracket to the wall. (Figure 2-12)

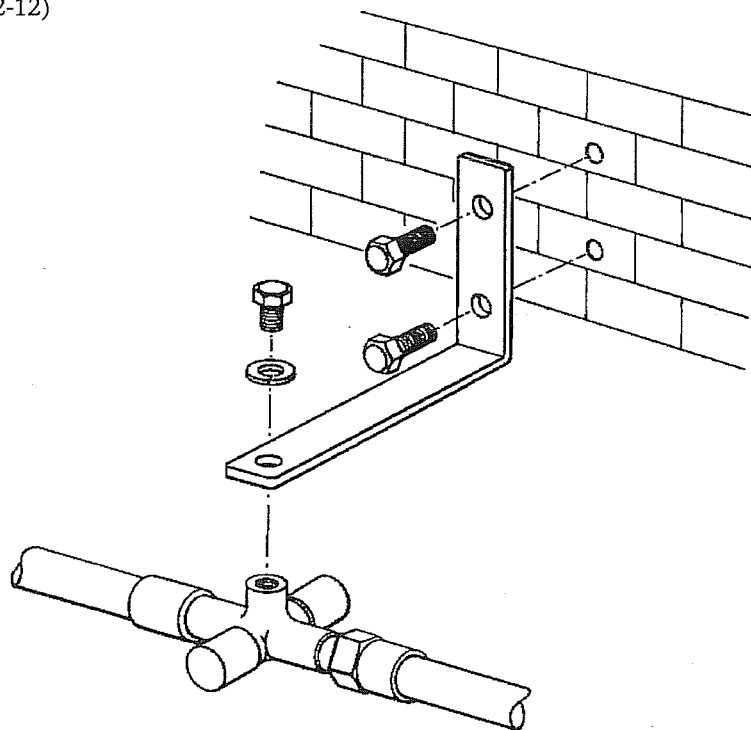


Figure 2-12
Mounting Bracket

2/INSTALLATION

For floor-mounted manifolds, screw a mounting bracket to each header extension and then screw the mounting bracket to a header support leg. The header support leg is then secured to the floor. (Figure 2-13)

Note: All unused header extension connections must be sealed with a blind gland and union nut. Additional gas-specific blind glands and union nuts can be ordered using the stock numbers in Chapter 5.

CAUTION: Cap all unused header connections with a blind gland and union nut to prevent leakage and consequent reduction of pressure. Two blind glands and two union nuts are provided.

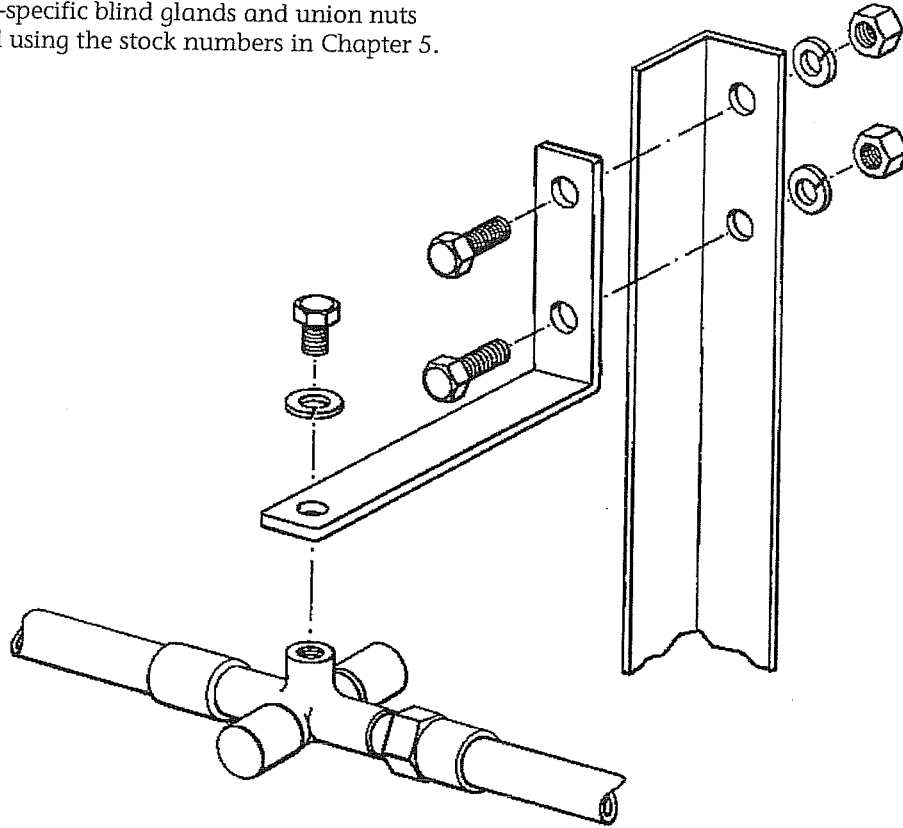


Figure 2-13
Mounting Bracket with Header Support Leg

2/INSTALLATION

2.7 Cylinder Bank Wall Mounting Instructions

CAUTION: Read and understand the information in Section 2.6 before performing this installation.

Note: Refer to Chapter 5 for an illustrated parts breakout, part descriptions, quantities, and stock numbers.

1. If only four cylinders are to be installed, go to Step 9. If more than four cylinders are to be installed, go to Step 2.

Note: Install an equal number of cylinders on each side of the manifold.

2. Screw a header extension into the outboard connection of each manifold header. (Figure 2-11)

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

3. Temporarily fasten the mounting bracket to the header extension using a 3/8" X 1/2" long cap-screw and a 3/8" lock washer. (Figure 2-12)
4. Mark the wall for the mounting anchors (not included).
5. Remove the mounting bracket from the header extension, drill the holes for the mounting anchors, and set the anchors.
6. Permanently fasten the mounting bracket to the header extension using a 3/8" X 1/2" long cap-screw and a 3/8" lock washer. (Figure 2-12)
7. Fasten the mounting bracket to wall with suitable bolts (not included). (Figure 2-12)
8. As needed, attach additional header extensions to the outboard connection of the previous header extension and repeat Steps 3 - 7.
9. Remove the plastic shipping caps from the manifold headers and header extensions (if installed).
10. Connect the ends of the pigtails without the handles to the manifold headers and header extensions (if installed). (Figure 2-10)

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

11. Cap all unused header connections with a blind gland and union nut. (Figure 2-10)
12. Position the cylinders so that the valve openings are near the pigtail handles.
13. Prior to connecting the pigtails to the valve openings, open each cylinder valve slightly to blow out any dirt that may be present and then close the valve securely.
14. With the pigtail handle, pull the union nut to the cylinder and hand tighten the union nut onto the valve.

CAUTION: Do not repeatedly bend, sharply bend, or twist the pigtail as damage to the tubing may result.

15. Tighten all connections firmly. Do not overtighten.

2/INSTALLATION

2.8 Cylinder Bank Floor Mounting Instructions

CAUTION: Read and understand the information in Section 2.6 before performing this installation.

Note: Refer to Chapter 5 for an illustrated parts break-out, part descriptions, quantities, and stock numbers.

1. If only four cylinders are to be installed, go to Step 10. If more than four cylinders are to be installed, go to Step 2.

Note: Install an equal number of cylinders on each side of the manifold.

2. Screw a header extension into the outboard connection of each manifold header. (Figure 2-11)

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

3. Screw a mounting bracket to a header support leg using 3/8" X 7/8" bolts, 3/8" lock washers, and nuts. (Figure 2-13)
4. Temporarily fasten the mounting bracket to the header extension using a 3/8" X 1/2" long cap-screw and a 3/8" lock washer. (Figure 2-13)
5. Plumb header support leg and mark the floor for the mounting anchors (not included).
6. Remove the mounting bracket from the header extension, drill the holes for the mounting anchors, and set the anchors.
7. Permanently fasten the mounting bracket to the header extension using a 3/8" X 1/2" long cap-screw and a 3/8" lock washer.
8. Fasten the mounting bracket to floor with suitable bolts (not included).
9. As needed, attach additional header extensions to the outboard connection of the previous header extension and repeat Steps 3 - 8.
10. Remove the plastic shipping caps from the manifold headers and header extensions (if installed).
11. Connect the ends of the pigtails without the handles to the manifold headers and header extensions (if installed). (Figure 2-10)

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

12. Cap all unused header connections with a blind gland and union nut. (Figure 2-10)
13. Position the cylinders so that the valve openings are near the pigtail handles.
14. Prior to connecting the pigtails to the valve openings, open each cylinder valve slightly to blow out any dirt that may be present and then close the valve securely.
15. With the pigtail handle, pull the union nut to the cylinder and hand tighten the union nut onto the valve.

CAUTION: Do not repeatedly bend, sharply bend, or twist the pigtail as damage to the tubing may result.

16. Tighten all connections firmly. Do not overtighten.

2/INSTALLATION

2.9 Installing the Electrical Transformer

The electrical transformer can be installed in a remote location and the low voltage (24 Vac) output wires run to the manifold. It can also be installed in the manifold cabinet. When installing the transformer in the manifold cabinet, install it in the upper right hand corner (Figure 2-14) and run the wires through the conduit knockouts provided on the top left hand corner of the cabinet.

After the transformer is installed, remove the circuit board cover. Using the lever provided (Figure 2-15), connect the leads from the transformer to the circuit board at TB1, Terminals 9 and 10. (Figure 2-16)

Note: Refer to local codes when installing the transformer.

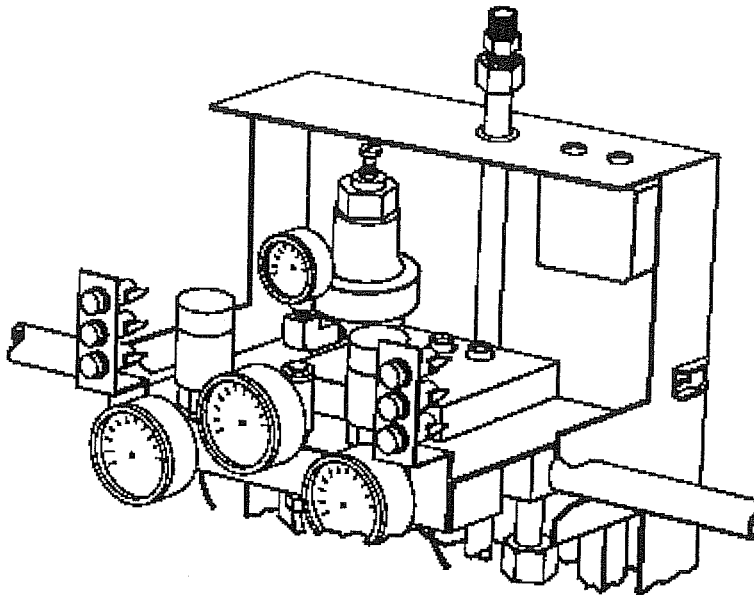


Figure 2-14
Electrical Transformer Installed in the Manifold Cabinet

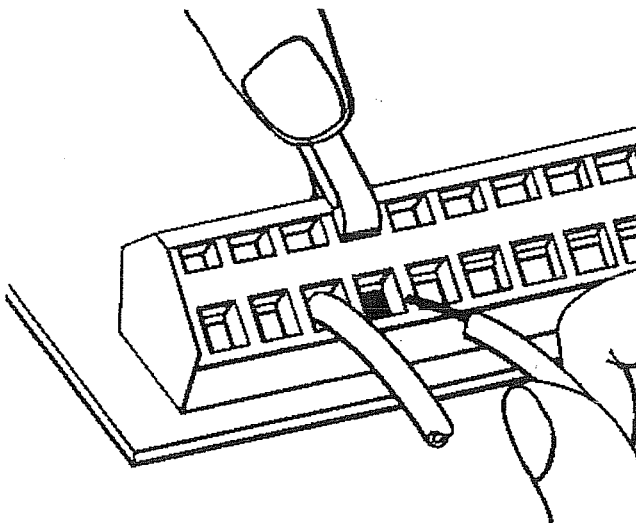


Figure 2-15
Connecting a Wire to a Circuit Board Terminal

2/INSTALLATION

2.10 Connecting to the Medical Gas Alarm System

Determine whether the facility's medical gas alarm system requires a normally-open or normally-closed signal.

If the alarm requires a normally-open signal, use the lever provided (Figure 2-15) to connect the wires to the circuit board at TB2, Terminals 9 and 10. (Figure 2-16) If the alarm requires a normally-closed signal, use the lever provided (Figure 2-15) to connect the wires to the circuit board at TB2, Terminals 10 and 11 (Figure 2-16).

Replace the circuit board cover when these connections are complete.

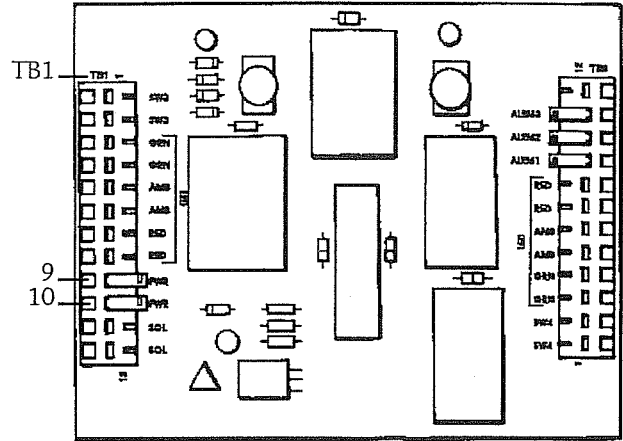
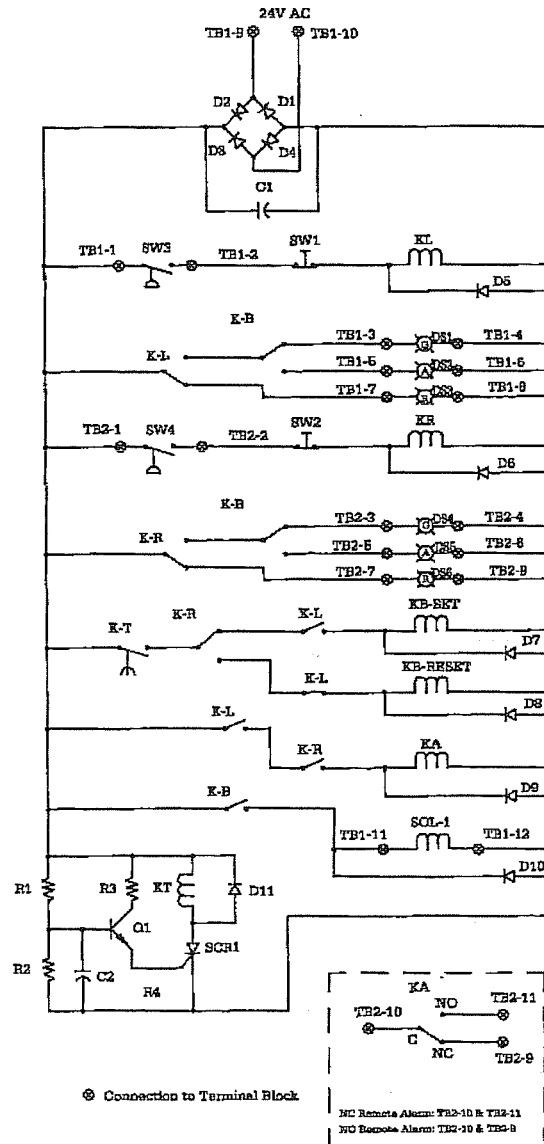


Figure 2-16
Terminals for Connecting the Transformer and Alarm



For Reference
Electrical Schematic

2/INSTALLATION

2.11 Connecting to the Medical Gas Delivery Line

A union (NPT to tube) for connection to the medical gas delivery line is provided. A source shutoff valve of mainline size (not included) must be installed in the gas delivery line immediately downstream of the manifold. (Figure 2-17)

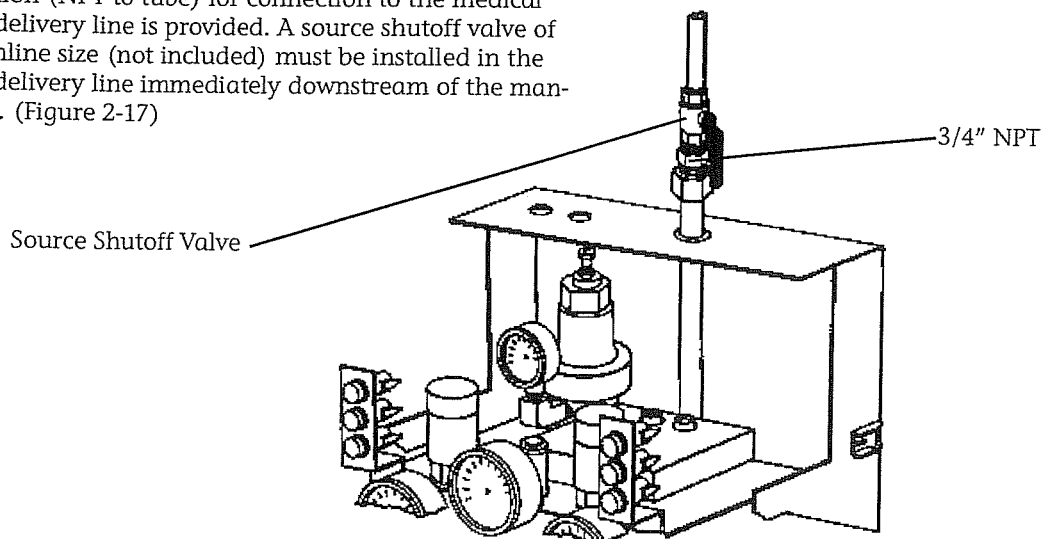


Figure 2-17
Connecting to the Medical Gas Delivery Line

2.12 Connecting to Relief Valves

NFPA 99 requires that all high pressure cylinder manifolds with a combined supply capacity of 2,000 cubic feet (57 m³) or more have a delivery line relief valve vented to the outside atmosphere. Refer to Table 3-2 to determine cylinder capacity of the installation.

If a delivery line relief valve vented to the outside atmosphere is required, connect a 3/8" I.D., or larger, vent line to the outlet end of the fitting beneath the relief valve (Figure 2-18). A 1/2" NPT female type connection is provided for this purpose. The vent line must be piped to the outside of the building, where it must be turned down and screened to prevent contamination.

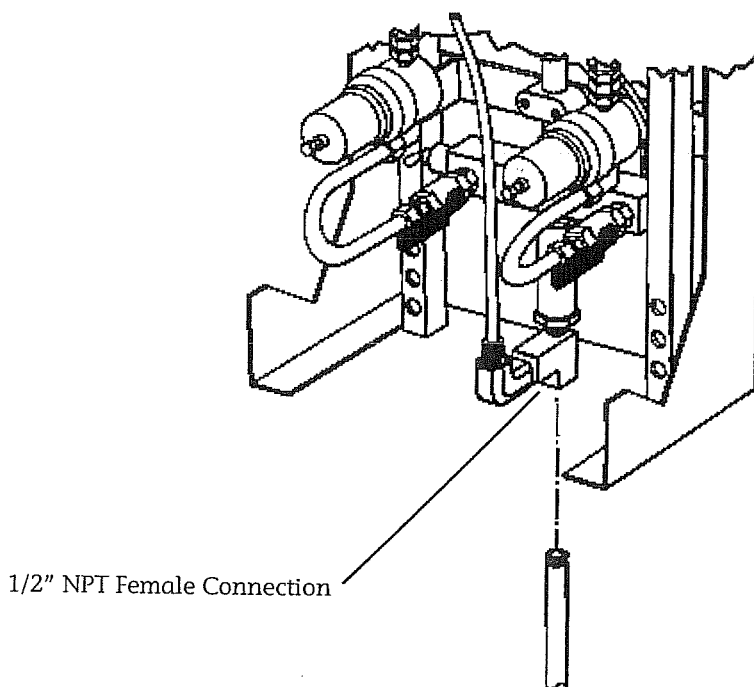


Figure 2-18
Connecting a Vent Line

2/INSTALLATION

2.13 Pressure Testing the Manifold

1. Close the shutoff valve in the medical gas delivery line immediately downstream of the manifold. (Figure 2-19)
2. Open one gas cylinder valve on each bank.
3. Record the pressure displayed in each of the three gauges at the top of the manifold and the two intermediate gauges in the middle of the manifold. (Figure 2-19)
4. Close the left bank and right bank shutoff valves. (Figure 2-19)
5. Close the left side and right side upstream line regulator valves. (Figure 2-19)
6. Close both gas cylinder valves.
7. Wait 15 minutes.
8. Compare the pressure on each gauge to the pressure recorded earlier. If there is a noticeable pressure change on any of the gauges perform the leak test described in the next Section.

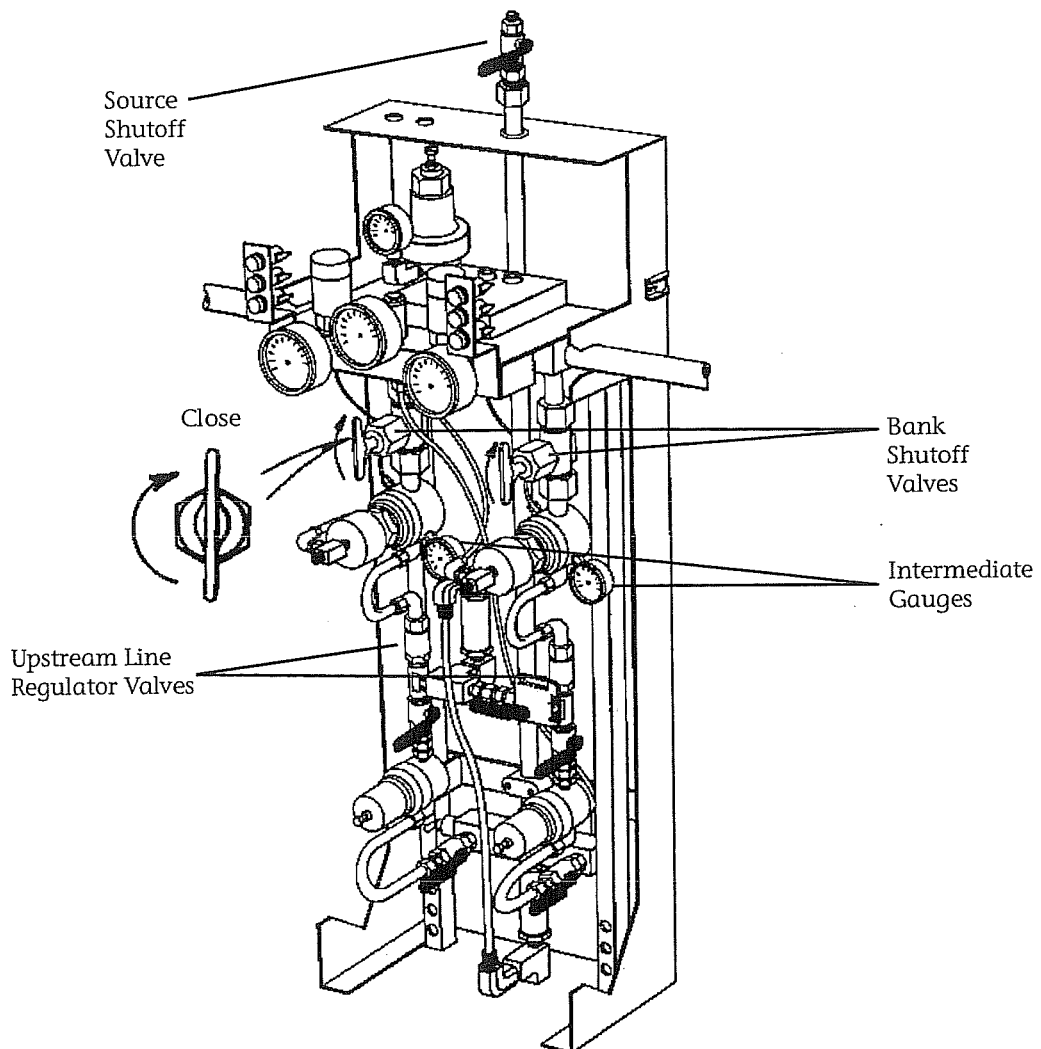


Figure 2-19
Manifold in Pressure Test Condition

2/INSTALLATION

2.14 Leak Testing Connections

Note: Leak test piping connections after any repair or replacement procedure. Perform the leak test with *Snoop, a commercial leak test solution approved by Hill-Rom MEDÆS.

Apply leak test solution to the piping connection under test. Avoid getting the leak test solution on electrical components. Formation of bubbles indicates a leak. Eliminate leaks by tightening or replacing connections and tubing. Retest connections and verify that all leaks have been eliminated.

CAUTION: Clean surface of connection and components after testing.

*Snoop is a trade name of Nupro Company.

2.15 Testing Bank Switch-Over and Status LED Operation

Pressurize the system and test bank switch-over and status LED operation by performing the following steps:

1. Press and release the push button on the side of the printed circuit board which has the green LED (in use) lit. The green LED should go out and the amber LED (ready) should light. The green LED on the opposite bank should light. (Figure 2-20)
2. Press and hold down the same push button. The amber LED should go out and the red LED (empty) should light.
3. The intermediate pressure gauge on the in use bank should be approximately 30 psi higher than the intermediate pressure gauge on the opposite bank. (Figure 2-20)

Note: These pressures may equalize over time because the check valves are designed to prevent gross leaks only.

4. Release the push button.
5. Repeat Steps 1 - 4 for the opposite bank.

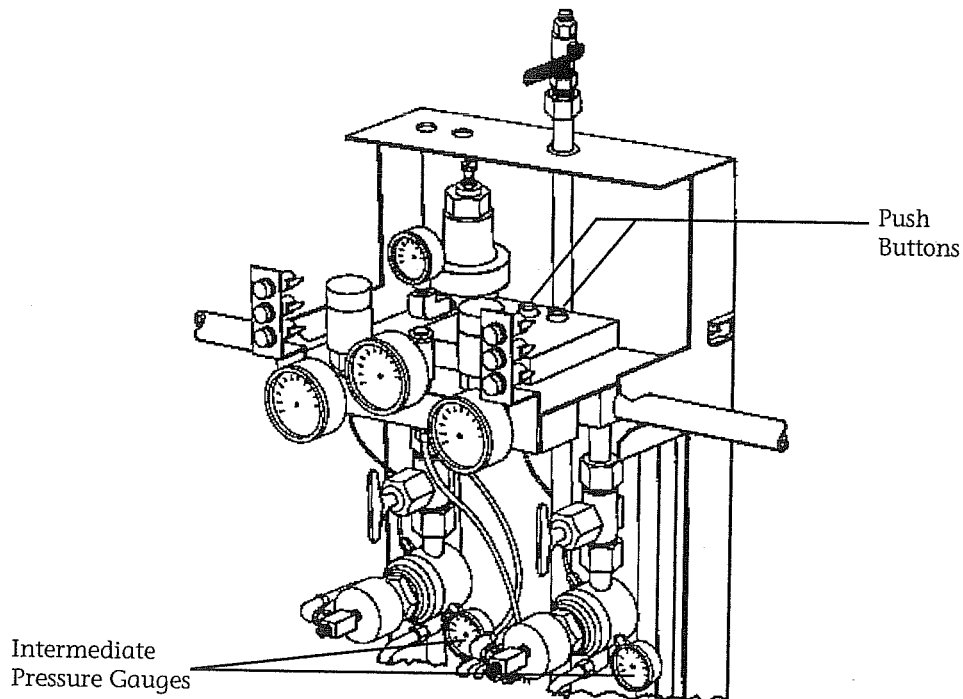


Figure 2-20
Testing Bank Switch-Over and Status LED Operation

2/INSTALLATION

2.16 System Start-Up

1. Open completely all cylinder valves.
2. Make sure the service valve is in the open position. (Figure 2-21)
3. Open completely the left bank shutoff valve and then the right bank shutoff valve. (Figure 2-21)
4. Open completely the left side upstream and downstream line regulator valves and then the right side upstream and downstream line regulator valves. (Figure 2-21)
5. Open completely the medical facility source shutoff valve (not included).
6. The system is now pressurized and operational.
7. Install manifold cover.

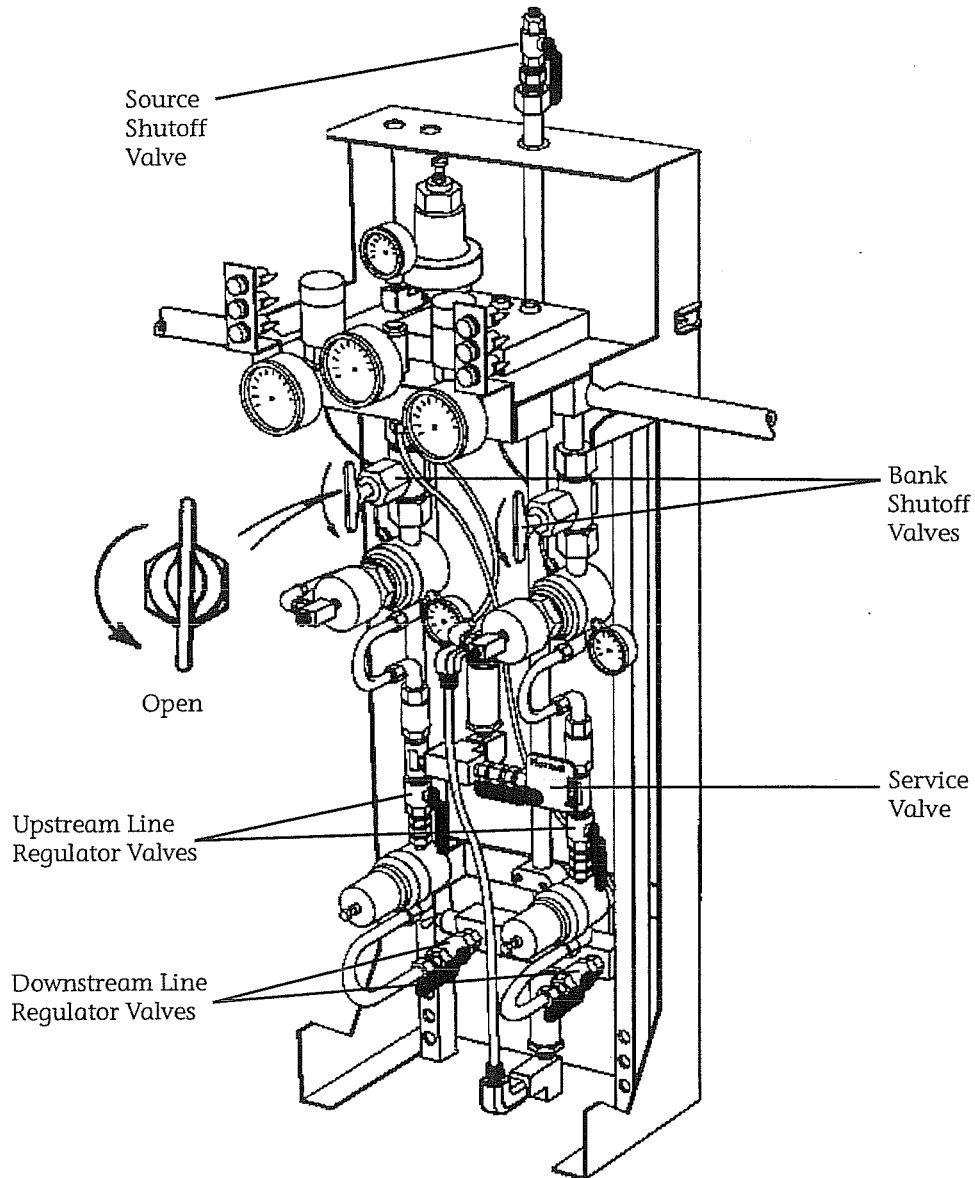


Figure 2-21
Valve Positions at System Start-Up

3/OPERATION

3.1 General Information

The MedPlus[®] Manifold is an automatic changeover manifold designed to deliver an uninterrupted supply of low pressure medical gas from high pressure cylinders to a medical facility gas pipeline system. The bank of cylinders on one side of the manifold serves as the Primary Supply while the bank of cylinders on other side serves as the Secondary Supply. The manifold automatically switches to the Secondary Supply when the Primary Supply is depleted.

The pressure switches control the remote alarms if installed, and the six Light Emitting Diodes (LEDs) on the front panel. These status LEDs provide a visual indication of the system status. The Primary Supply is indicated by a green "In Use" LED. The Secondary Supply is indicated by an amber "Ready" LED. An empty cylinder bank is indicated by a red "Empty" LED. Gauges on the front panel continuously indicate left bank, right bank, and delivery line pressures.

MedPlus[®] Manifolds are available in different models to match specific gasses. They deliver gasses at low pressure from high pressure cylinders (3,000 psig maximum). Delivery pressure is 180 psi for nitrogen, 55 psi for oxygen, nitrous oxide, air, carbon dioxide, helium, argon, xenon, and gas mixtures. Refer to Table 3-1 for additional information.

3.2 Specifications

All MedPlus[®] Manifolds are designed in accordance with NFPA 99.

Power Requirement -120 VAC to transformer

The following table provides gas type and pressure specifications for the MedPlus[®] Manifolds.

Item	Oxygen, Nitrous Oxide, Air, Carbon Dioxide, Helium, Argon, Xenon; Mixtures of Oxygen and Second Gas: Carbon Dioxide < 7.5%, Helium < 80.5%, Nitrogen < 76.5%, Nitrous Oxide 47.5% to 52.5%, Carbon Dioxide > 7.5%, Helium > 80.5%		Nitrogen	
	PSIG	kPa	PSIG	kPa
Delivery Pressure ¹	55	379	180	1,241
Primary Intermediate Pressure ² (In use bank)	100 ± 10	690 ± 69	250 ± 10	1,724 ± 69
Secondary Intermediate Pressure (Ready bank)	70	483	220	1,517
Supply Pressure (Maximum)	3,000	20,685	3,000	20,685
Pressure Switch Setting (On Pressure Drop)	150 ± 5	1,034 ± 35	300 ± 10	2,069 ± 69
Intermediate Relief Valve Pressure	125 ± 12.5	862 ± 86	340 ± 24	2,344 ± 165
Delivery Line Relief Valve Pressure	75 ± 5	517 ± 35	225 ± 12	1,551 ± 83
Dome Bias Pressure ³	30	207	30	207
	CFM	L/M	CFM	L/M
Output capacity at a cylinder pressure of 250 psi or greater	40	1,133	70	1,982

PSIG = pounds per square inch gauge
kPa = Kilopascal

CFM = cubic feet per minute
L/M = liters per minute

¹ Adjust the delivery line regulator pressure settings while gas is flowing through regulator with inlet (intermediate) pressure of 100 ± 10 psig (690 ± 69 kPa) except nitrogen which must be 250 ± 10 psig (1,724 ± 69 kPa).

² Adjust the intermediate (bank regulator) pressure settings with gas flowing through the regulator with an inlet (cylinder) pressure of 1,800 psig (12,411 kPa) or greater except nitrous oxide, carbon dioxide and gas mixtures which must be 600 psig (4,137 kPa) or greater.

³ Applied to the dome of the bank regulator in use.

Table 3-1
Gas Type and Pressure Specifications

3/OPERATION

The following chart shows the flow capacity in scfm (lpm) for various switchover pressures when there is a 5, 10, or 15 psi delivery pressure drop from 55 psig static pressure (for oxygen, nitrous oxide, air, carbon dioxide, helium, argon, xenon and gas mixture manifolds), or a 15 psi delivery pressure drop from 180 psig static pressure (for nitrogen manifolds). [Nitrogen manifolds with line pressures up to 250 psig (1,724 kPa) are also available. Call Hill-Rom MEDÆS Customer Service at 800-556-5596 for information.]

As the chart below illustrates, flow capacity of the manifold increases as switch over pressure increases (and as delivery pressure drop increases). The 55 psig manifold is factory set for a switch hover pressure of 150 psig (1,034 kPa), yielding a flow capacity of 30 scfm (850 lpm) with a 10 psi (69 kPa) pressure drop. However, a 55 psig manifold set at 250 psig (1,724 kPa) switchover would give a flow of 70 scfm (1,982 lpm) @ 10 psi (69 kPa) drop. The 180 psig nitrogen manifold is factory set for a switchover pressure of 300 psig (2,068 kPa), with a flow of 70 scfm (1,982 lpm) with a 15 psi (103 kPa) drop.

Manifold Static Pressure

Switchover Pressure	All Gases Except Nitrogen 55 psig (379 kPa)			Nitrogen 180 psig (1,241 kPa)	Nitrogen > 200 psig (1,379 kPa)
	Delivery Pressure Drop 5 psi (35 kPa)	10 psi (69 kPa)	15 psi (103 kPa)	Delivery Pressure Drop 15 psi (103 kPa)	
psig (kPa)	Flow in scfm (lpm)				
100 (690)	7 (198)	20 (566)	30 (850)	NA	Contact
150 (1,034)	10 (283)	30 (850)	50 (1,416)	NA	Hill-Rom MEDÆS
200 (1,379)	30 (850)	55 (1,557)	75 (2,114)	NA	Customer Service
250 (1,724)	40 (1,133)	70 (1,982)	90 (2,549)	NA	at 800-556-5596
300 (2,068)	NA	NA	NA	70 (1,982)	

Full cylinders of compressed gas, other than Nitrous Oxide and Carbon Dioxide, normally contain approximately 2,200 psig (15,169 kPa). Nitrous Oxide and Carbon Dioxide are liquified in standard full cylinders and cylinder pressures vary with temperature as shown in the following graphs:

Table 3-2
Flow (Output) Capacity

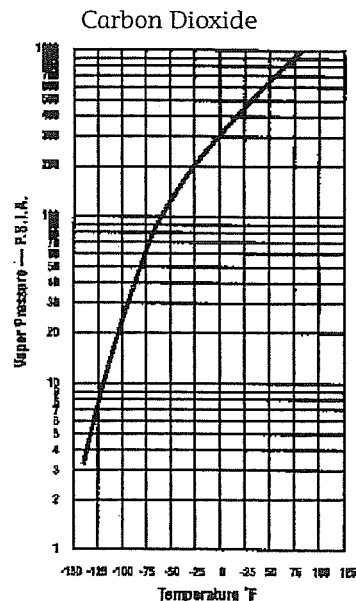
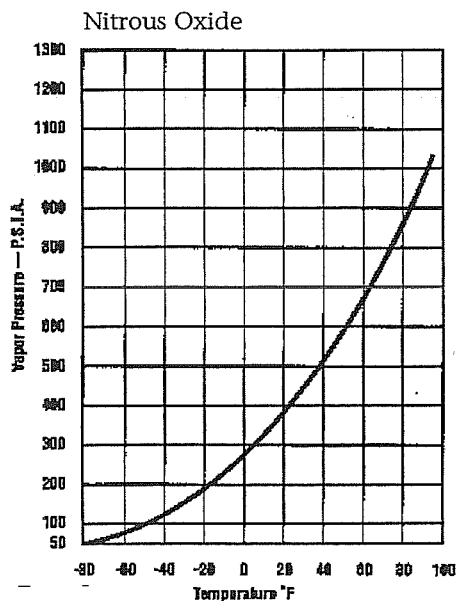


Figure 3-1
Vapor Pressure vs. Temperature

3/OPERATION

The following table provides gas type, CGA designation, and cylinder capacity specifications for the MedPlus[®] Manifolds.

Type of Gas	Cylinder Capacity			
	H - Size		G - Size	
	ft ³	m ³	ft ³	m ³
Oxygen (CGA 540)	244	6.91	187	5.3
Nitrous Oxide (CGA 326)	558	15.8	488	13.82
Air (CGA 346)	232	6.57	178	5.04
Carbon Dioxide (CGA 320)	558	15.8	436	12.35
Helium (CGA 580 - Indicate Gas on Order)	213	6.03	141	3.99
Argon (CGA 580 - Indicate Gas on Order)	244	6.91	187	5.3
Xenon (CGA 580 - Indicate Gas on Order)	88.8	2.52	----	----
Nitrogen (CGA 580)	226	6.34	----	----
Gas Mixture: Oxygen and a Second Gas	<p>Volumes depend on percentages. Ask your gas supplier for additional information.</p>			
Carbon Dioxide <7.5% (CGA 280 - Indicate Gas on Order)				
Helium <80.5% (CGA 280 - Indicate Gas on Order)				
Nitrogen <76.5% (CGA 280 - Indicate Gas on Order)				
Nitrous Oxide 47.5% to 52.5% (CGA 280 - Indicate Gas on Order)				
Carbon Dioxide >7.5% (CGA 500 - Indicate Gas on Order)				
Helium >80.5% (CGA 500 - Indicate Gas on Order)				

Table 3-3
Type of Gas, CGA Designation, and Cylinder Capacity

3.3 Piping Schematic, Piping Layout, and Component Description

This Section contains two illustrations: a piping schematic and a piping layout. Each component in the piping schematic has an item number associated with it. The same item number is used to identify the same component in the piping layout. Table 3-4 provides a description of each item.

3/OPERATION

Item	Component Description
1	Left bank LED indicators
2	Right bank LED indicators
3	Remote switch-over alarm*
4	Printed circuit board*
5	Electrical transformer*
6	Left bank pressure switch
7	Right bank pressure switch
8	Left bank header connection
9	Right bank header connection
10	Left bank pressure gauge
11	Right bank pressure gauge
12	Left bank shutoff valve
13	Right bank shutoff valve
14	Left bank regulator
15	Right bank regulator
16	Four-way solenoid*
17	Left bank intermediate pressure gauge
18	Right bank intermediate pressure gauge
19	Medical facility delivery line pressure gauge
20	Dome regulator pressure gauge
21	Left bank check valve
22	Right bank check valve
23	Dome regulator
24	Service valve
25	Left side upstream line regulator valve
26	Right side upstream line regulator valve
27	Intermediate Pressure Relief Valve
28	Left side delivery line regulator
29	Right side delivery line regulator
30	Left side downstream line regulator valve
31	Right side downstream line regulator valve
32	Bleed valve
33	Delivery line relief valve

* Not visible in Figure 3-3.

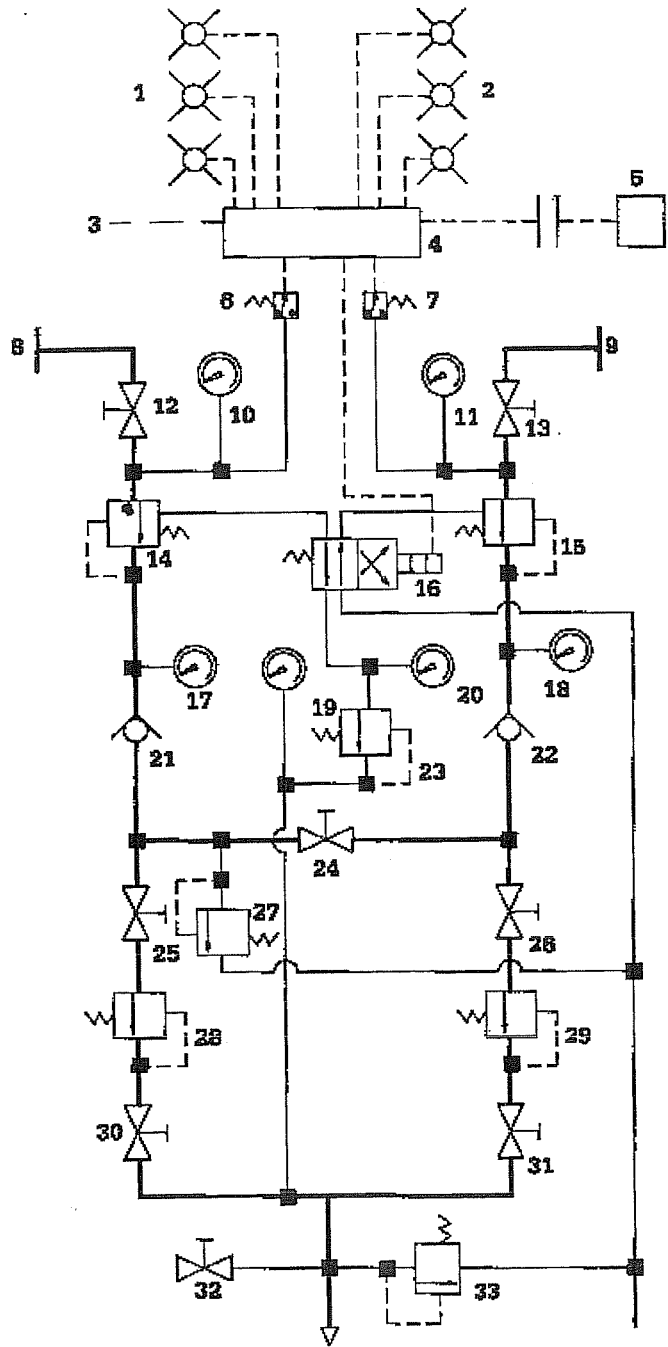


Table 3-4
Item Numbers and Component Descriptions

Figure 3-2
Piping Schematic with Item Numbers

	DEL PSI	DEL Relief Valve	INT PSI	INT Relief Valve	Dome PSI
50 PSI	50	75	100	125	30
N ₂	180	225	220	340	30

3/OPERATION

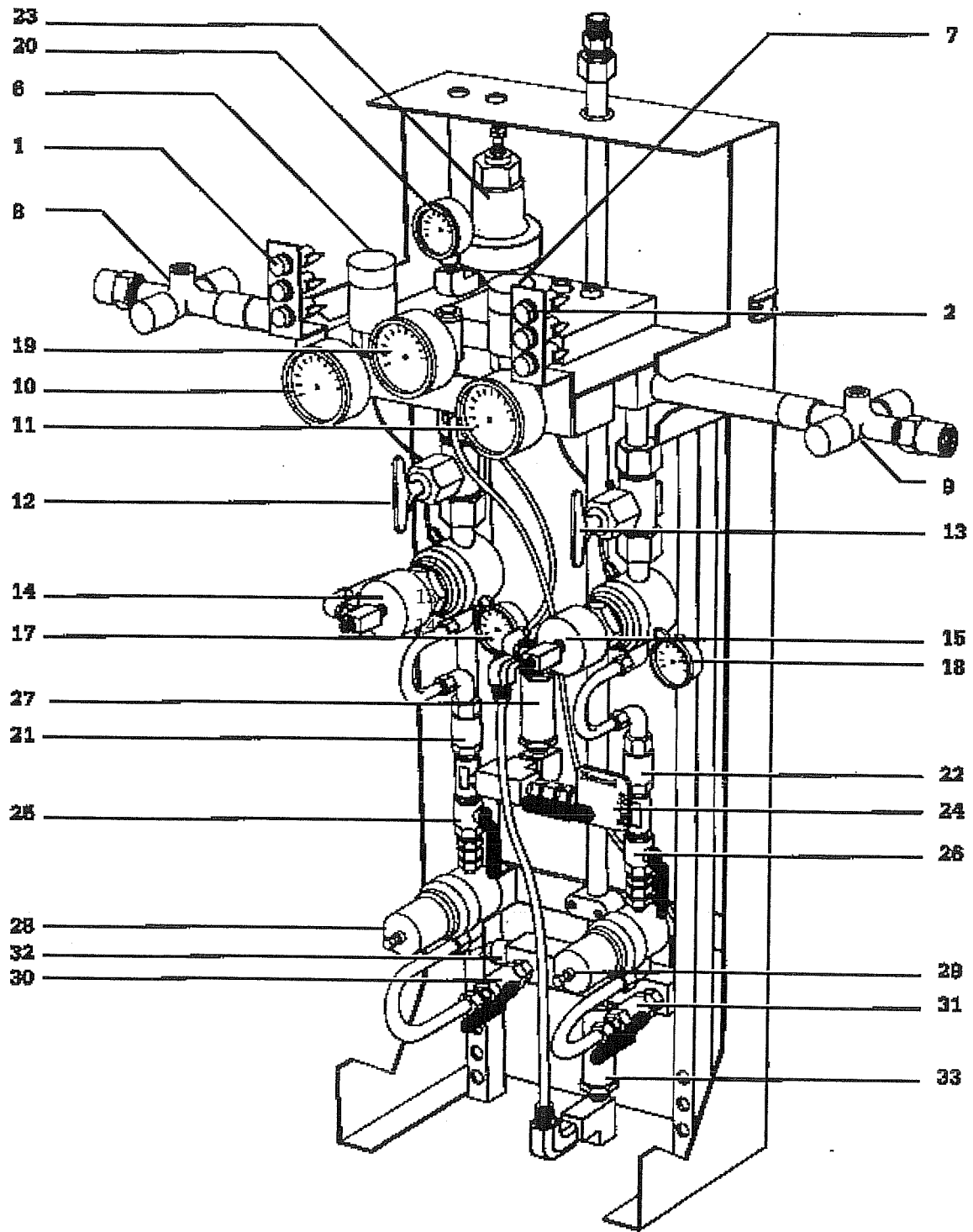


Figure 3-3
Piping Layout with Item Numbers

3.4 Theory of Operation

The MedPlus' theory of operation is discussed in the following Sections:

- 3.4.1 Primary Supply to Secondary Supply Switch-Over 3-6
- 3.4.2 Regulators and Pressure Gauges 3-7
- 3.4.3 Relief Valves 3-7
- 3.4.4 Bank Shutoff Valves and Line Regulator Valves 3-7
- 3.4.5 Service Valve 3-8
- 3.4.6 Medical Gas Source Shutoff Valve 3-8
- 3.4.7 Pressure Switches, Status LEDs, and Remote Alarms 3-8

3.4.1 Primary Supply to Secondary Supply Switch-Over

With all gas cylinders connected and open, the left and right cylinder banks supply their respective bank regulators with gas. A high pressure tapping from each bank regulator supplies a pressure switch and a pressure gauge. The pressure gauges display the gas cylinder pressure of their respective banks. The pressure switches do not activate until the pressure falls below 150 psig (300 psig on N₂ manifolds). Each bank regulator is manually set to provide an output of 70 psi (220 psi for N₂ manifolds) without additional dome bias. Both bank regulators supply gas to the intermediate section of the manifold through their respective check valves.

A tapping from the delivery line is fed to the dome regulator. The dome regulator is manually set to provide an output (bias pressure) of 30 psig (30 psig on N₂ manifolds also). The bias pressure is applied to the dome of one bank regulator in order to increase that regulators output pressure, thereby making it the primary supply. When correctly adjusted, the dome regulator is locked at that pressure.

The following example demonstrates Primary Supply to Secondary Supply switch-over for an N₂ manifold:

With the right bank main pressure regulator set to provide 250 psi pressure (220 psi base plus 30 psi bias), the right bank is designated the Primary Supply and supplies gas to the system. The left bank, designated the Secondary Supply, remains on standby and does not supply gas at this time.

As the contents of the right bank are used, and the pressure falls below 300 psig, the right bank pressure switch opens. This activates the solenoid control circuit which directs signal pressure to the left bank pressure regulator and vents the right bank regulator dome loading line to atmosphere.

Simultaneously, the right bank green LED goes out and the red LED lights, the left bank amber LED goes out and the green LED lights, indicating the Primary to Secondary Supply switch-over has been made.

When full cylinders are installed on the right bank and the bank shutoff valve is opened, the right bank pressure switch closes and activates a relay, causing the red LED go out and the amber LED to light.

3/OPERATION

3.4.2 Regulators and Pressure Gauges

Left and right bank pressure gauges on the front panel indicate the pressure of each corresponding cylinder bank. Each bank regulator reduces the gas pressure of its respective bank to an intermediate line pressure of 70 psig (220 psig on N₂ manifolds). Intermediate pressures are indicated on the pressure gauges mounted to each bank regulator.

At any given time, gas flows through only one bank regulator to the delivery line regulator(s). The delivery pressure 55 psig (180 psig on N₂ manifolds), is indicated by the center gauge on the front panel and is determined by the setting of the delivery line regulators.

In order to maintain proper gas flow and pressure, the bank and delivery line regulators must be set under dynamic (flow) conditions. This is accomplished by allowing gas to flow through the bleed valve while the regulators are being adjusted. Note that under static conditions (when gas is not flowing through the bleed valve or from the medical facility outlets) the pressure gauges indicate slightly higher pressures than under dynamic conditions.

3.4.3 Relief Valves

Pressure relief valves are provided downstream of the bank and delivery line regulators. These relief valves prevent excessive pressures which could damage regulators, pressure gauges, or elevate the pressure in the medical facility delivery line. Such excessive pressure could develop if an upstream regulator were damaged or developed an internal leak. The intermediate pressure relief valve is set to open to atmosphere at a pressure of 125 psig (340 psig on N₂).

Note that NFPA requires all relief valves be piped outside on all supplies with a total capacity of 2000 cu. ft. (57 m³) or more (including unconnected reserves). The outlet of the delivery line relief valve has a 1/2" NPT female connection for the installer to attach the vent line. Use a 3/8" I.D., or larger, vent line. The relief valves must be vented outside the building, where the outlet must be turned down and screened to prevent contamination.

3.4.4 Bank Shutoff Valves and Line Regulator Valves

The bank shutoff valves, upstream of the bank regulators, allow the gas flow from the cylinder banks to be shut off. The line regulator valves allow either line regulator to be isolated for service.

CAUTION: The bank shutoff valves should always be in either the fully open or fully closed position.

3.4.5 Service Valve

The service valve permits the two sides of the manifold to be isolated from each other. This allows all components upstream of the down stream line regulator valve on either side to be serviced without interrupting the flow of gas from the opposite side.

WARNING: The service valve should always be open during operation to prevent dangers caused by the build-up of high pressures.

3.4.6 Medical Gas Source Shutoff Valve

A medical gas source shutoff valve must be installed immediately down stream of the MedPlus® Manifold and inside the manifold room.

3.4.7 Pressure Switches, Status LEDs, and Remote Alarms

Single pole double throw type switches are used to monitor the pressure in each cylinder bank. As the Primary Supply bank is depleted and its pressure decreases to 150 psig (300 psig on N₂ manifolds) the pressure switch activates a relay, causing bank switch-over.

The pressure switches also control the remote alarms if installed, and the six status LEDs on the front panel. The LEDs provide a visual indication of the system status. The Primary Supply is indicated by a green "In Use" LED. The Secondary Supply is indicated by an amber "Ready" LED. An empty cylinder bank is indicated by a red "Empty" LED.

The green LED remains lit as long as the bank is serving as the Primary Supply. When the Primary Supply is interrupted or exhausted, automatic switch-over occurs, causing the green LED to go out and the red LED to light. On what was the Secondary Supply (now the Primary Supply) the amber LED goes off, and the green LED lights. If a remote alarm system is installed, a signal (reserve in use) is sent indicating that switch-over has occurred.

When the cylinders on the empty bank are replaced and the bank shutoff valve is opened, the pressure switch deactivates the relay, causing the red LED to go out and the amber LED to light.

3/OPERATION

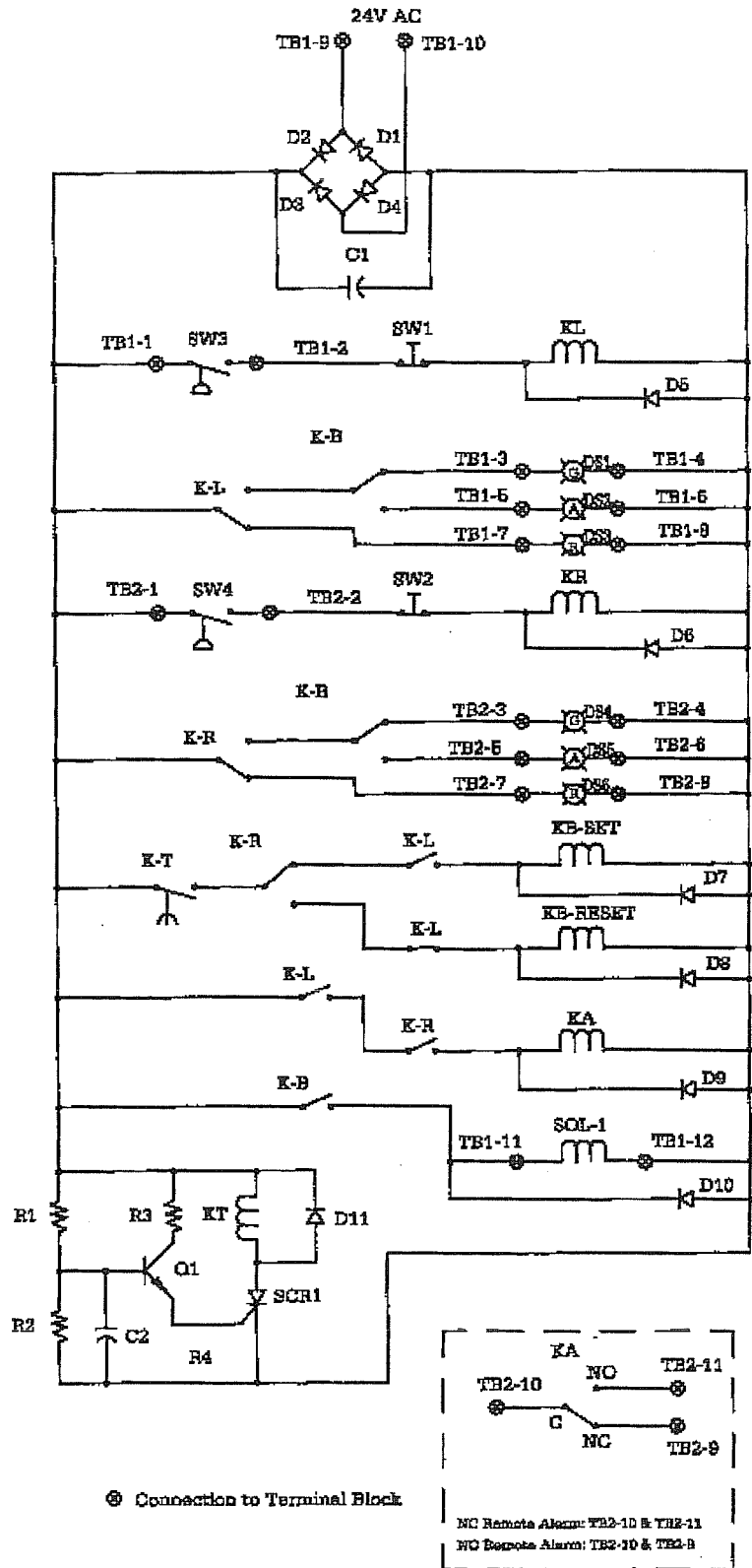


Figure 3-4
 Electrical Schematic

3/OPERATION

3.5 Cylinder Replacement

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

3.5.1 Cylinder Removal

1. Close all cylinder valves on the bank which indicate a pressure of 150 psig (approximately 300 psig on N₂ manifolds).
2. Slightly loosen the pigtails from the cylinders to bleed off any residual pressure.
3. Remove the pigtails from the cylinders and remove the empty cylinders.

3.5.2 Cylinder Installation

1. Position the cylinder so that the valve opening is near the pigtail.
2. Prior to connecting the pigtail to the valve opening, open the cylinder valve slightly to blow out any dirt that may be present and then close the valve securely.
3. With the pigtail handle, pull the union nut to the cylinder valve and hand tighten the union nut onto the valve.

CAUTION: Bend the pigtail as little as possible and avoid kinking it.

CAUTION: Each pigtail must be connected to a cylinder to prevent leaks. The header connection to the pigtail is equipped with a check valve, but this valve is not leak free. If a header inlet is not used, be certain that the pigtail is removed and the header inlet is securely sealed with a blind gland and nut.

4. *SLOWLY* open the valve on the cylinder nearest the manifold, and allow at least 60 seconds for the heat of compression to dissipate. The red LED goes out and the amber LED lights.
5. Then *SLOWLY* open the valves on the other cylinders.

When the cylinder, bank, line regulator, and the medical gas source shutoff valves are open, gas is supplied to the medical facility.

4/MAINTENANCE

4.1 Repair Policy

Do not use malfunctioning equipment. Make all necessary repairs, or have the equipment serviced by a Hill-Rom MEDÆS Service Representative. After repair, test the equipment to ensure that it is functioning properly, in accordance with the manufacturer's published specifications.

To ensure full reliability, have all repairs and service done by a Hill-Rom MEDÆS Service Representative. If this cannot be done, replacement and maintenance of those parts listed in this manual may be undertaken by a competent, trained individual having experience in the repair of devices of this nature.

CAUTION: Repairs should not be attempted by unqualified individuals.

Replace damaged parts with components manufactured or sold by Hill-Rom MEDÆS. Then test the unit to ascertain that it complies with the manufacturer's published specifications.

Contact the Hill-Rom MEDÆS Service Center for service assistance.

In all cases, other than where the Hill-Rom MEDÆS warranty is applicable, repairs will be made at the Hill-Rom MEDÆS current list price for the replacement part(s) plus the current hourly labor charge.

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

4.2 Bank Regulator Adjustment

WARNING: To ensure a continuous supply of gas to the medical facility during regulator adjustment, be certain an ample supply of gas is available in both cylinder banks and never close a bank shutoff valve unless the opposite bank shutoff valve is open.

WARNING: To ensure proper functioning and gas delivery, adjust each regulator while gas is flowing through it. Bank regulator pressure settings must be made with a supply pressure of 1800 psig or greater (600 psig or greater for nitrous oxide, carbon dioxide and gas mixtures).

Note: If necessary, refer to piping schematic, piping layout, and component description in Section 3.3.

Note: This procedure activates switch-over indicators and alarms.

Note: Figure 4-1 shows the direction of gas flow with the valves in their normal operating position.

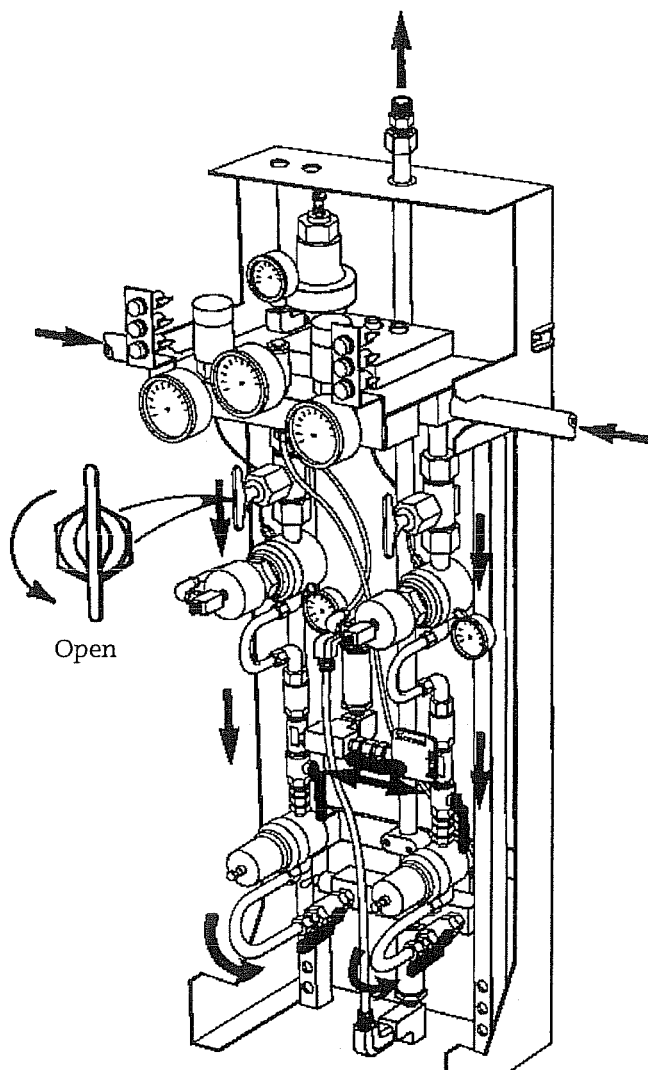


Figure 4-1
Valves in Normal Operating Position

4/MAINTENANCE

1. Verify that both bank pressure gauges indicate 1800 psig or greater (600 psig or greater for nitrous oxide, carbon dioxide and gas mixtures). (Figure 4-1)

Note: The regulator to be adjusted must be for the reserve "Ready" side.

2. If necessary, use the switch on the top of the printed circuit board to place the opposite side "In Use".
3. Close the upstream line regulator valve on the opposite side and the service valve so that gas will flow only through the regulator to be adjusted ("Ready" side).
4. Remove the plug from the end of the regulator to gain access to the 1/4" allen head adjustment screw. (Figure 4-2)
5. Open the bleed valve.
6. Turn the regulator adjustment screw until the intermediate pressure gauge indicates $70 \text{ psig} \pm 10$ psig ($220 \text{ psig} \pm 10$ psig on N_2 manifolds).
7. Replace the plug in the end of the regulator.

8. Close the bleed valve and open the valves closed in step 3.

Note: The intermediate pressure gauge may indicate a slightly greater pressure, up to 85 psig (235 psig on N_2 manifolds), when gas is not flowing through the regulator. Such an increase is normal.

9. Choose the bank with the lowest gas pressure as the Primary Supply.

Note: Except for nitrous oxide and carbon dioxide manifolds, the bank pressure gauge with the lowest reading indicates the bank having the least gas. Nitrous oxide and carbon dioxide, however, are in liquid form in the cylinders at room temperature. Therefore both bank pressure gauges may indicate the same pressure although the liquid level in one bank may be lower. Under such conditions it is not practical to determine which bank is fullest. Simply return the manifold to its original state.

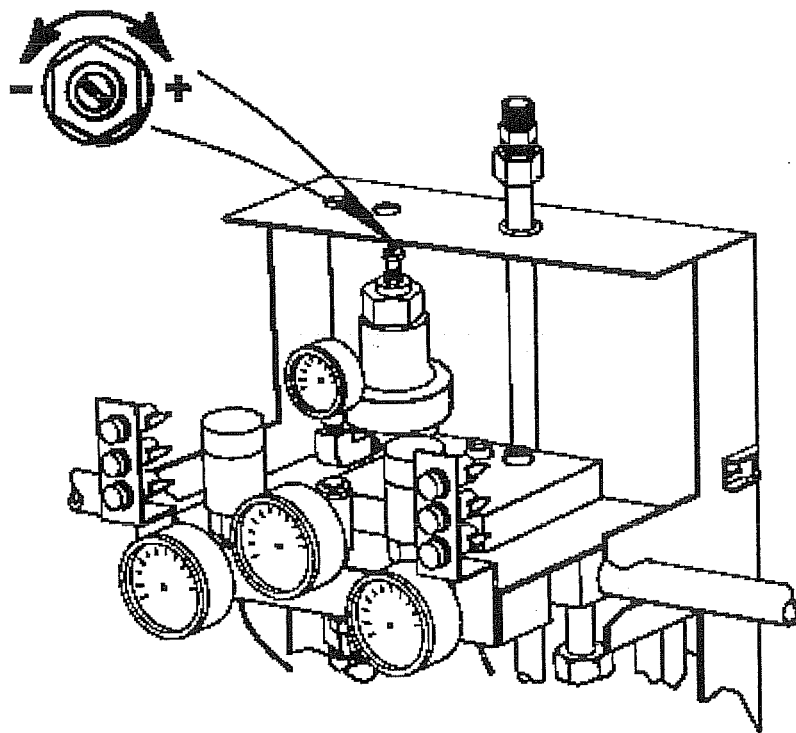


Figure 4-2
Bank Regulator Adjustment

4.3 Delivery Line Regulator Adjustment

WARNING: To ensure a continuous supply of gas to the medical facility during regulator adjustment, be certain an ample supply of gas is available in both cylinder banks and never close a bank shutoff valve unless the opposite bank shutoff valve is open.

WARNING: To ensure proper functioning and gas delivery, adjust each regulator while gas is flowing through it. Delivery line regulators must be set with an inlet pressure (intermediate line pressure) of 100 psig \pm 10 psig (250 psig \pm 10 psig on N₂ manifolds).

Note: If necessary, refer to piping schematic, piping layout, and component description in Section 3.3.

1. Verify that the delivery line regulator inlet pressure is 100 psig \pm 10 psig (250 psig \pm 10 psig on N₂ manifolds). If this is not the pressure, adjust the bank regulator and/or dome regulator as described in Sections 4.2 and 4.4, then go to Step 2.
2. Close the upstream and downstream valves to isolate the regulator that is not being adjusted. (Figure 4-3)

3. Open the bleed valve to obtain flow through the regulator.
4. Turn the delivery line regulator adjustment screw on the regulator in use until the delivery pressure gauge indicates 50 psig \pm 10 psig (180 psig \pm 10 psig on N₂ manifolds).

5. Close the bleed valve.

Note: The delivery pressure gauge may indicate a slightly greater pressure, up to 58 psig (192 psig on N₂ manifolds), when gas is not flowing through the regulator. Such an increase is normal.

6. Open the upstream and downstream valves for the opposite regulator.
7. Repeat Steps 2 - 6 to check and adjust the pressure of the other line regulator.
8. When adjustments to both line regulators are complete, ensure that the upstream and downstream valves are open for both regulators.

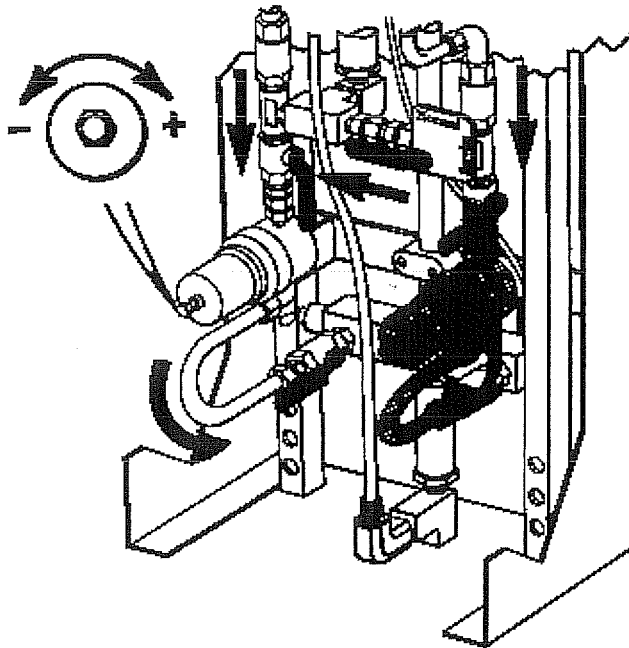


Figure 4-3
Valve Positions for Line Regulator Adjustment
(Left Side)

4/MAINTENANCE

4.4 Dome Regulator Adjustment

WARNING: To ensure a continuous supply of gas to the medical facility during regulator adjustment, be certain an ample supply of gas is available in both cylinder banks and never close a bank shutoff valve unless the opposite bank shutoff valve is open.

If necessary, refer to piping schematic, piping layout, and component description in Section 3.3.

1. Set the dome regulator pressure to 30 psi. (Figure 4-4)
2. Lock regulator adjustment knob in place.
3. If you adjust the pressure to exceed 30 psi:
 - a. Back off the regulator adjustment screw (counterclockwise).
 - b. Bleed the dome pressure by switching banks (use buttons on circuit board).
 - c. Re-adjust the regulator as necessary.

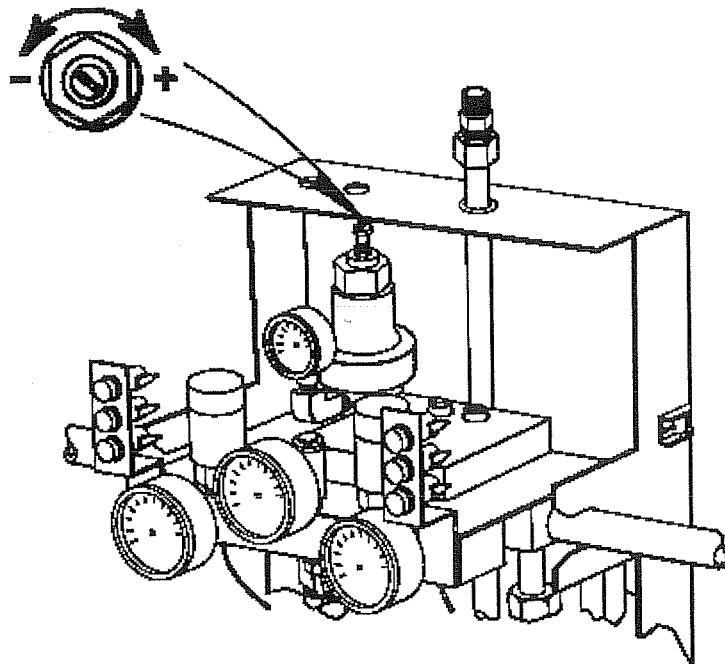


Figure 4-4
Dome Regulator Adjustment

4.5 Component Replacement

Each component of the MedPlus[®] Manifold can be replaced if necessary. Instructions for replacing the components are provided in the following Sections:

- 4.5.1 Bank Shutoff Valves, Bank Regulators, Check Valves, Intermediate Pressure Gauges, Bank Pressure Gauges, and Bank Pressure Switches . 4-6
- 4.5.2 Intermediate Relief Valve 4-8
- 4.5.3 Delivery Line Regulators 4-9
- 4.5.4 Downstream Line Regulator Valves, Delivery Line Relief Valve, Service Valve, and Bleed Valve 4-10
- 4.5.5 Delivery Gauge, Dome Regulator, and Solenoid Valve 4-11

4.5.1 Bank Shutoff Valves, Bank Regulators, Check Valves, Intermediate Pressure Gauges, Bank Pressure Gauges, and Bank Pressure Switches

Note: If necessary, refer to piping schematic, piping layout, and component description in Section 3.3.

Note: The service valve is used for changing components (left or right) between the cylinders and the line regulator without interrupting the flow of gas to the facility. (Figure 4-5)

1. Determine which bank will be used to provide gas service to the medical facility.

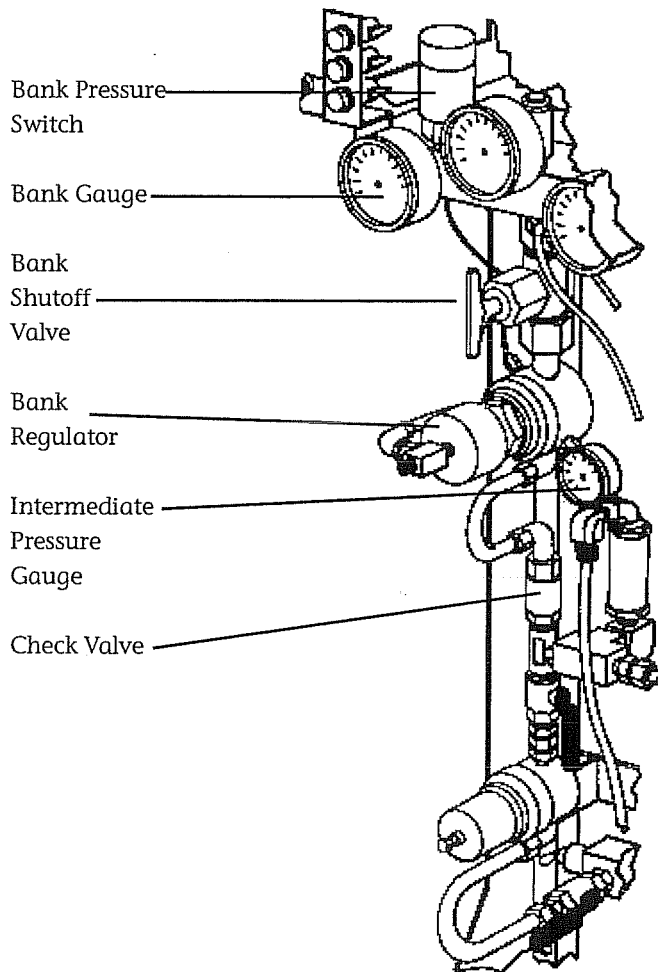


Figure 4-5
Component Location
(Left Side Shown)

4/MAINTENANCE

2. Confirm that the bank which will provide gas service to the medical facility has adequate pressure.
3. Close the bank shutoff valve or cylinder valves on the side of the manifold that is to be serviced.
4. Close the service valve.
5. Close the upstream line regulator valve on the side of the manifold that is to be serviced.
6. Check the line pressure to the medical facility and adjust if necessary.
7. Service the component in need of maintenance.
(Figure 4-6)
8. Open the bank shutoff valve and/or cylinder valves on the side of the manifold that was serviced and check for leaks.
9. Open the service valve and the upstream line regulator valve.
10. Return the manifold to service. Be sure to use the bank with the lowest pressure as the Primary Supply.

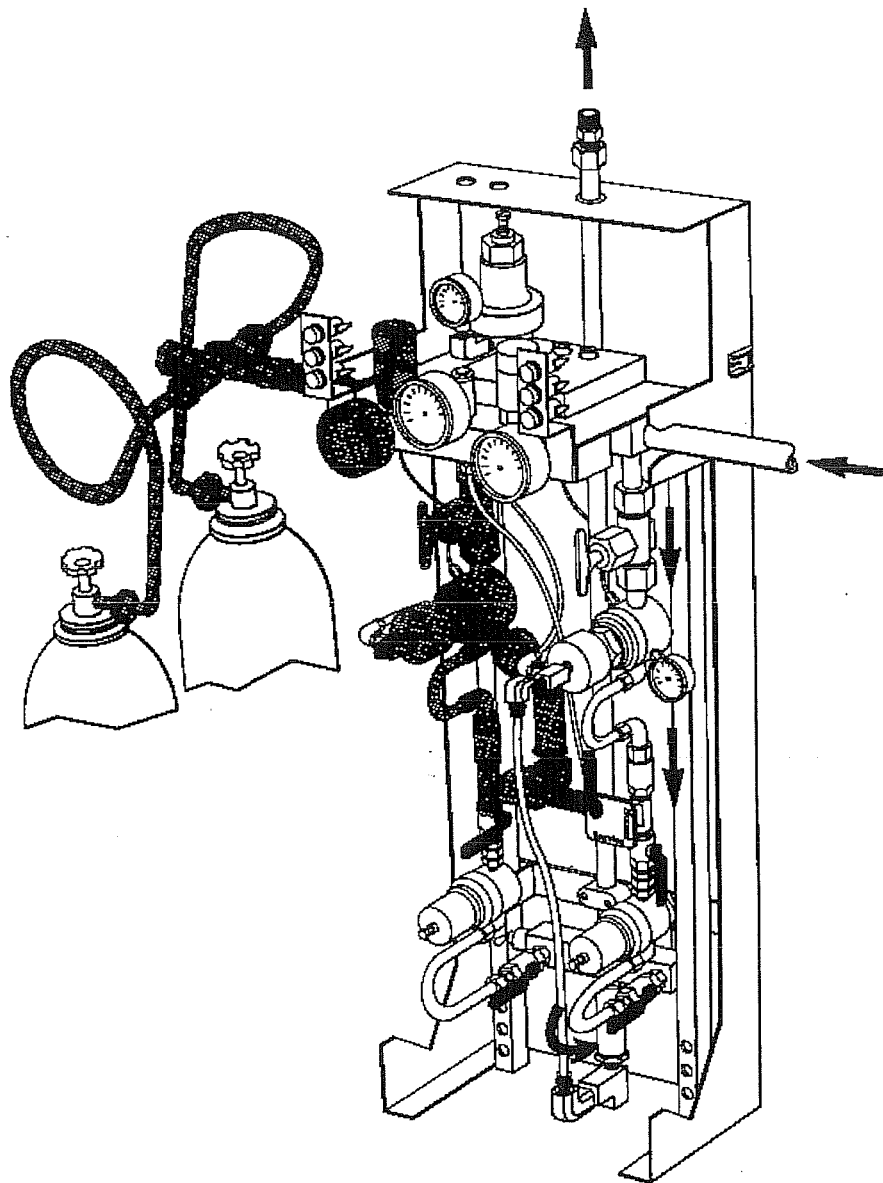


Figure 4-6
Valve Position and Gas Flow During Replacement

4.5.2 Intermediate Relief Valve

Note: If necessary, refer to piping schematic, piping layout, and component description in Section 3.3.

1. Switch to right bank.
2. Close the left upstream line regulator valve, service valve, and left bank shutoff valve. (Figure 4-7)
3. Open the intermediate relief valve to remove residual pressure.
4. Pressurize manifold and check for leaks when service is complete.

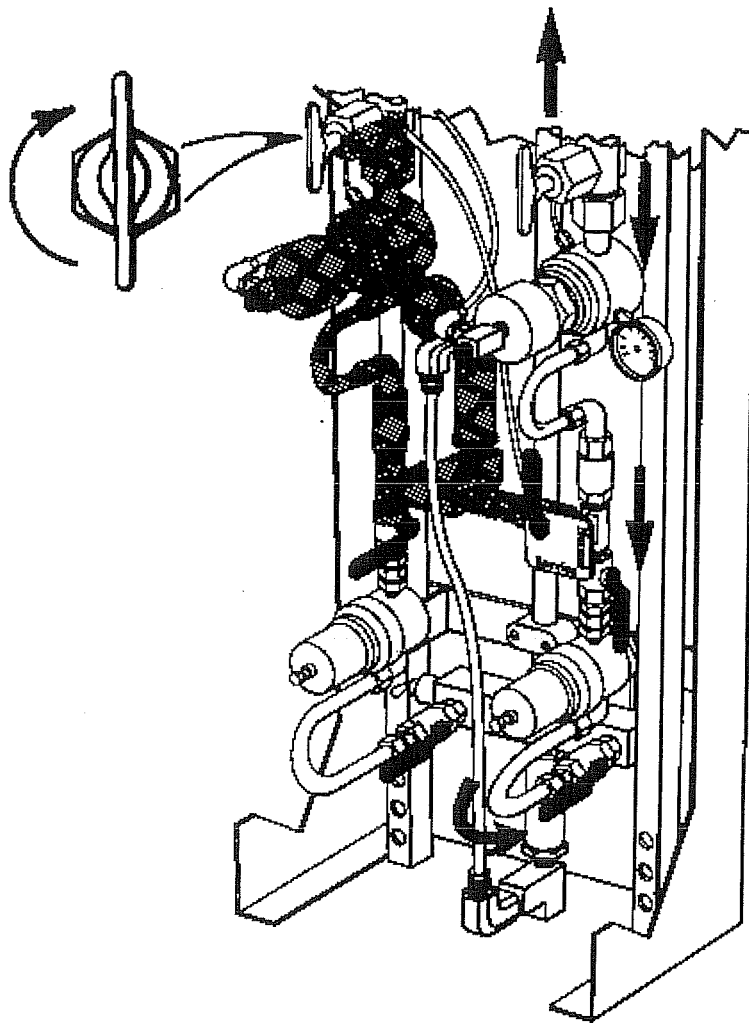


Figure 4-7
Valve Position and Gas Flow During Replacement

4/MAINTENANCE

4.5.3 Delivery Line Regulators

WARNING: When servicing a delivery line regulator, prevent interruption of the gas supply to the medical facility by making sure that the upstream and downstream valves for the other delivery line regulator are open.

Note: If necessary, refer to piping schematic, piping layout, and component description in Section 3.3.

1. Close the upstream and downstream line regulator valves of the regulator to be serviced. (Figure 4-8)

2. Service the delivery line regulator.
3. Open the upstream valve first and check for leaks. Then open the downstream valve.
4. Adjust the delivery line regulator as described in Section 4.3.
5. Ensure that all line regulator valves are open on both sides of the manifold. (Figure 4-9)

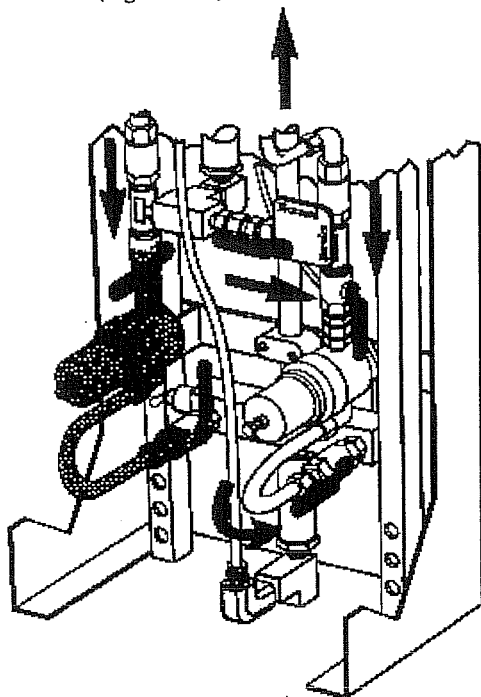


Figure 4-8
Valve Position and Gas Flow
During Replacement (Left Side Shown)

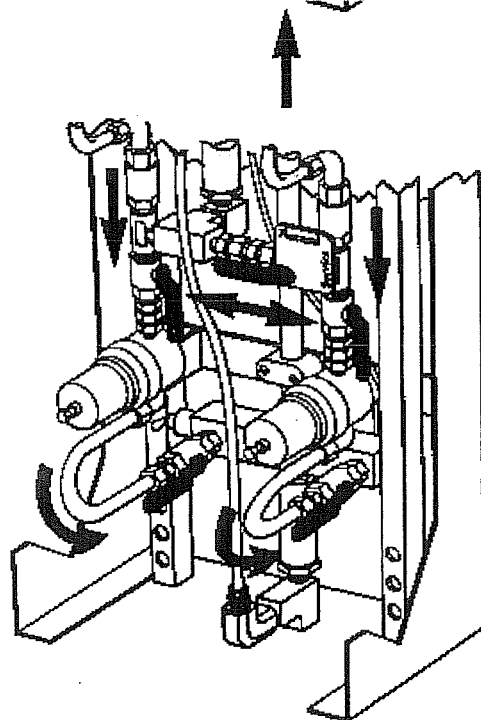


Figure 4-9
Valves in Normal Operating Position

4/MAINTENANCE

4.5.4 Downstream Line Regulator Valves, Delivery Line Relief Valve, Service Valve, and Bleed Valve

WARNING: To service the downstream line regulator valves, delivery line relief valves and service valve, the manifold gas supply to the medical facility must be interrupted. Notify appropriate personnel before servicing these components.

Note: If necessary, refer to piping schematic, piping layout, and component description in Section 3.3.

1. Close the medical gas source shutoff valve. (Figure 4-10)
2. Close both bank shutoff valves and depressurize the manifold. (Figure 4-10)
3. Service the component in need of maintenance.
4. Open the bank shutoff valves and check for leaks.
5. Open the medical gas source shutoff valve. (Figure 4-10)

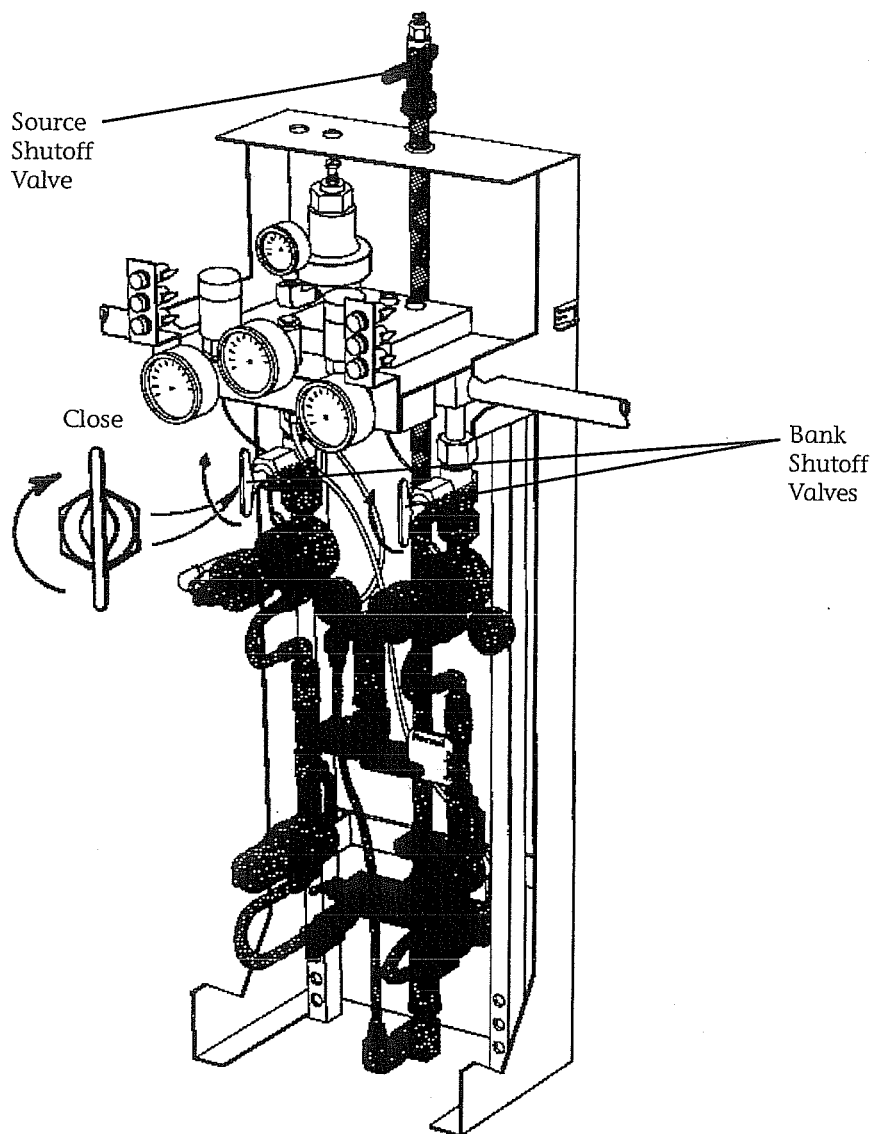


Figure 4-10
Valve Positions During Component Replacement

4/MAINTENANCE

4.5.5 Delivery Gauge, Dome Regulator, and Solenoid Valve

Note: If necessary, refer to piping schematic, piping layout, and component description in Section 3.3.

1. Remove the tube fitting in the line between lower manifold block and the delivery pressure gauge at the lower manifold block connector.

Note: The block is equipped with a check valve designed to prevent gross leakage during service. Some gas will escape while fitting is disconnected.

2. Insert a service gauge (Stock Number 6804-9040-032) into the fitting on the lower manifold block connector so that the delivery pressure can be monitored. (Figure 4-11)
3. Service the component in need of maintenance.
4. Remove the service gauge and reconnect the line between lower manifold block and the delivery pressure gauge at the lower manifold block connector.
5. Check for leaks.

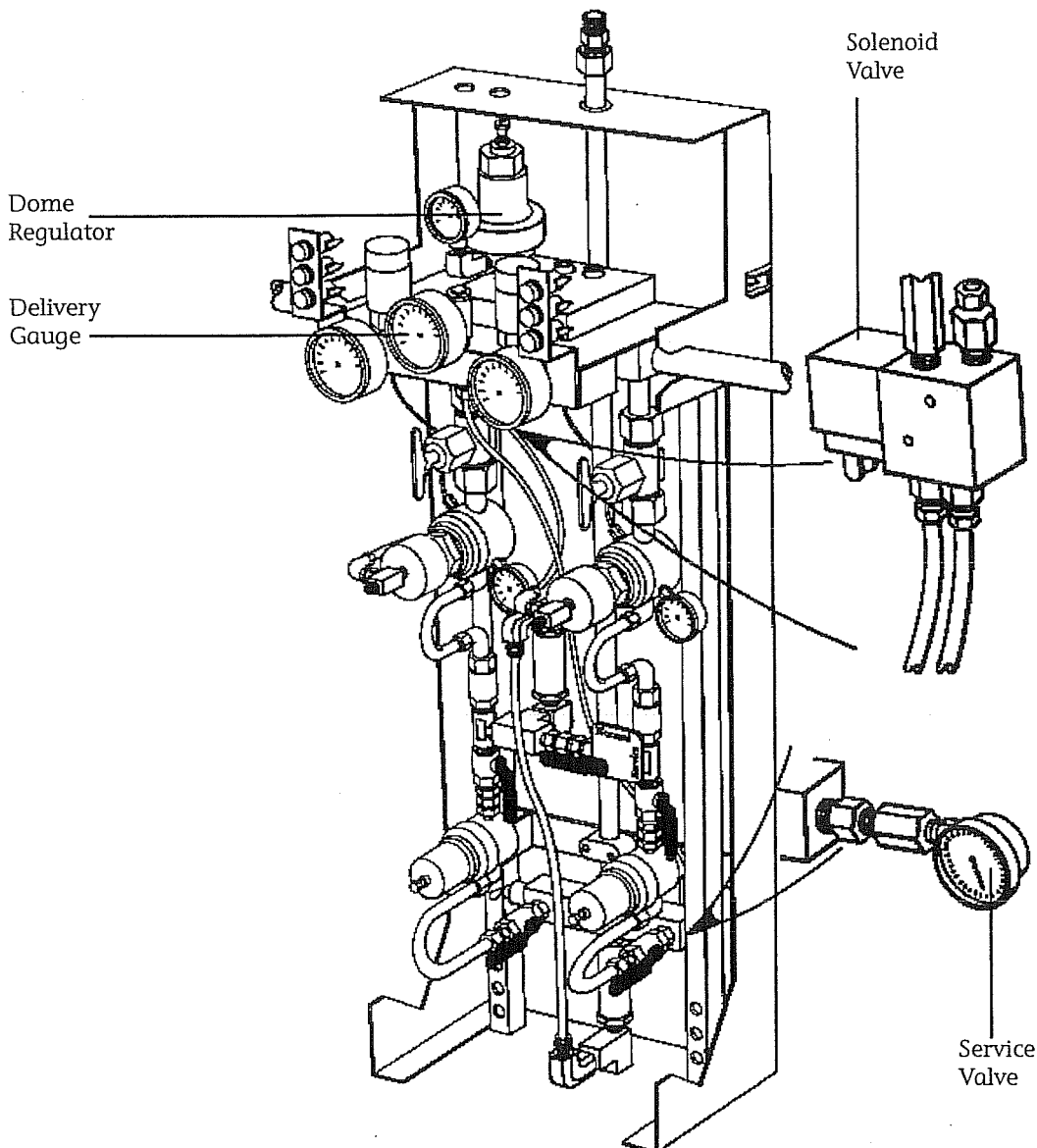


Figure 4-11
Service Gauge Location During
Component Replacement

4.6 Pressure Switch Test

Note: This procedure activates switch-over indicators and alarms.

WARNING: To maintain gas flow to the delivery line during this procedure, be certain a sufficient supply of gas is available in both cylinder banks.

WARNING: During this procedure, bank regulator pressure settings must be changed and readjusted as necessary. To ensure proper flow to the delivery line, the bank regulator adjustment must be made with a bank pressure of 1800 psig or greater (600 psig or greater for nitrous oxide, carbon dioxide, and gas mixtures).

Note: If necessary, refer to piping schematic, piping layout, and component description in Section 3.3.

1. Be certain the bank shutoff valve and cylinder valves on each bank are open and the intermediate pressure is 100 psig \pm 10 psig (250 \pm 10 psig on N₂ manifolds) as indicated on the intermediate pressure gauges. If necessary, adjust bank regulator as described in Section 4.2.
2. The switch being tested must be for the bank which is supplying gas (Figure 4-12). If the opposite bank is supplying gas, actuate the switch on top of the printed circuit board. This will cause the manifold to switch over and the bank for the switch being tested will supply the gas.
3. Slowly close the bank shutoff valve on the side being tested and slowly open the bleed valve.

CAUTION: The pressure at which the pressure switch is set to indicate switch-over must be checked as the bank pressure drops.

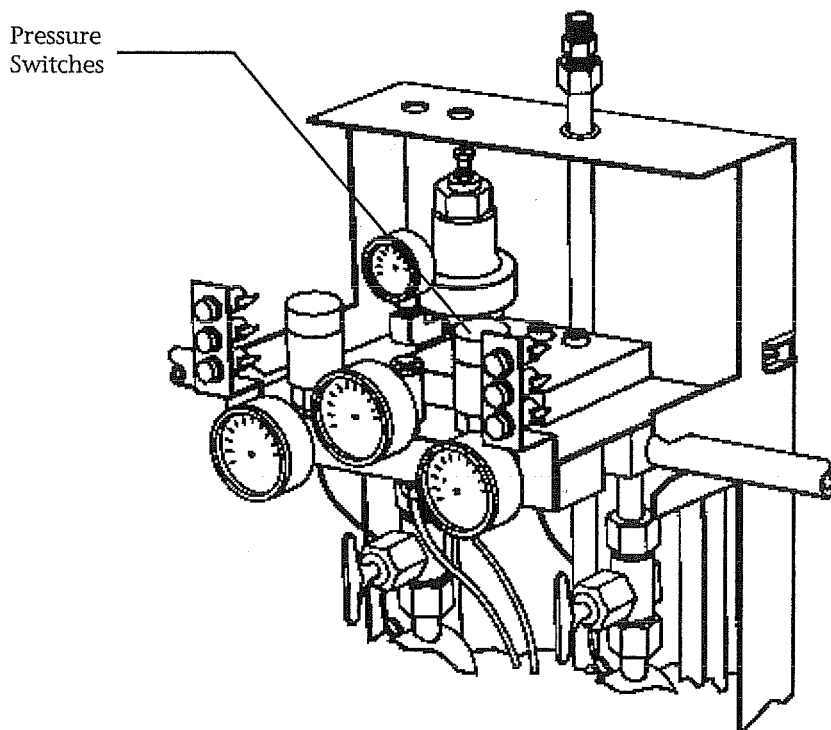


Figure 4-12
Pressure Switch Location

4. Observe the bank pressure gauge and the switch-over indicator LEDs as the pressure drops. The pressure switch must activate when the bank pressure gauge drops below 150 psig (300 psig on N₂ manifolds). The green LED (in use) will turn off and the red LED (empty) will light when the switch activates.

If the pressure switch activates within specifications, it is in adjustment.

If the pressure switch does not activate within specifications, it is out of adjustment. Adjust the pressure switch as described in Section 4.7.

5. Open the bank shutoff valve.
6. Repeat this pressure switch test for the switch on the opposite bank if necessary.

4.7 Pressure Switch Adjustment

Note: This procedure activates switch-over indicators and alarms.

WARNING: To maintain gas flow to the delivery line during this procedure, be certain a sufficient supply of gas is available in both cylinder banks.

WARNING: During this procedure, bank regulator pressure settings must be changed and readjusted as necessary. To ensure proper flow to the delivery line, the bank regulator adjustment must be made with a bank pressure of 1800 psig or greater (600 psig or greater for nitrous oxide, carbon dioxide, and gas mixtures).

Note: If necessary, refer to piping schematic, piping layout, and component description in Section 3.3.

1. Be certain the bank shutoff valve and cylinder valves on each bank are open and the intermediate pressure is 100 psig \pm 10 psig (250 \pm 10 psig on N₂ manifolds). If necessary, adjust bank or dome regulators as described in Sections 4.2 and 4.4.
2. The switch being tested must be for the bank which is supplying gas. If the opposite bank is supplying gas, actuate the switch on top of the printed circuit board. This will cause the manifold to switch-over and the bank for the switch being tested will supply the gas.
3. Slowly close the bank shutoff valve on the side being tested and open the bleed valve.

CAUTION: The pressure at which the switch is set to indicate switch-over must be checked as the bank pressure drops.

4. Observe the bank pressure gauge and the switch-over indicator LEDs as the pressure drops. The pressure switch must activate when the bank pressure gauge drops below 150 psig (300 psig on N₂ manifolds). The green LED (in use) will turn off and the red LED (empty) will light when the switch activates.

4/MAINTENANCE

5. Use a flat-blade screwdriver to adjust the switch. (Figure 4-13)
6. Repeat Steps 2-5 until the pressure switch activates at the correct pressure.
7. Open the bank shutoff valve.
8. Repeat this procedure for the pressure switch on the opposite bank if necessary.

CAUTION: The pressure at which the switch is set to indicate switch-over must be checked as the bank pressure drops.

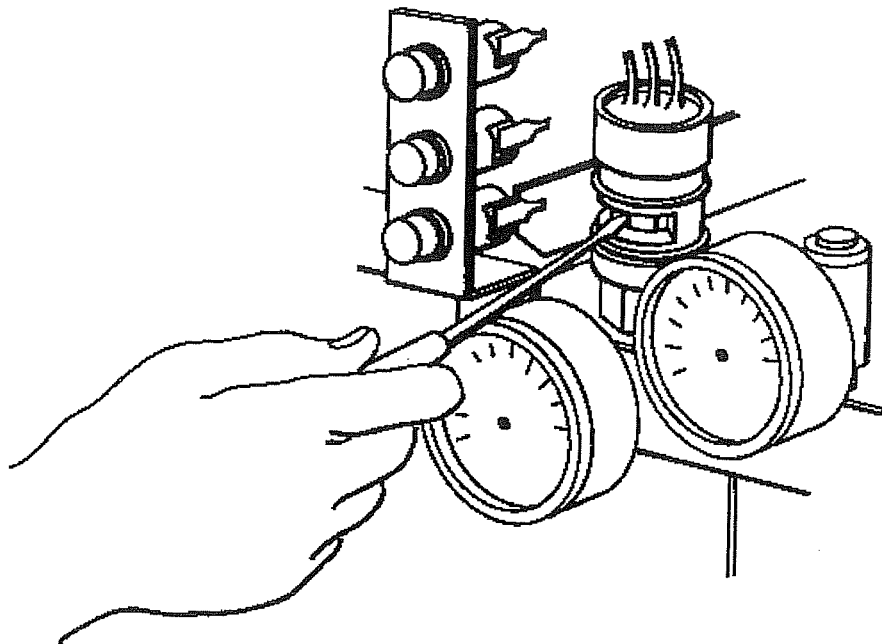


Figure 4-13
Adjusting a Pressure Switch

4.8 Switch-Over Test

WARNING: The left and right banks must have sufficient gas volume to perform any test and still supply medical facility demand.

WARNING: Only one bank shutoff valve may be turned off while the manifold is supplying gas to the medical facility. After performing tests, return bank shutoff valves to the open position. Make sure that the bank with the least gas remaining is chosen as the Primary Supply.

Note: If necessary, refer to piping schematic, piping layout, and component description in Section 3.3.

The switch-over circuit may be tested by simulating left and right bank pressure depletion. If the test results indicate that repairs are necessary, contact the Hill-Rom MEDÆS Regional Service Center for assistance.

4/MAINTENANCE

Item	All Manifolds Except Nitrogen	Nitrogen Manifold
Bank Regulators	70 psig (483 kPa)	220 psig (1,517 kPa)
Delivery Line Regulators	55 psig (379 kPa)	180 psig (1,241 kPa)
Bank Pressure Switches	150 psig (1,034 kPa)	300 psig (2,069 kPa)
Dome Regulator	30 psig (207 kPa)	30 psig (207 kPa)

Note: Refer to Sections 4.2, 4.3, and 4.4 for regulator adjustment information.

1. Make sure both bank shutoff valves are in the open position.
2. The manifold is in a normal operating condition when (Figure 4-14):
 - The pressure in the intermediate line for the primary bank is 100 psig (250 psig on N₂ manifolds).

- The pressure in the intermediate line for the secondary bank is 70 psig (220 psig on N₂ manifolds).

Note: These pressures may have equalized as the check valves which isolate the sides are only in place to prevent gross leaks.

- The green status LED is lit for the primary bank.
- The amber (if full) or red (if empty) status LED is lit for the secondary bank.

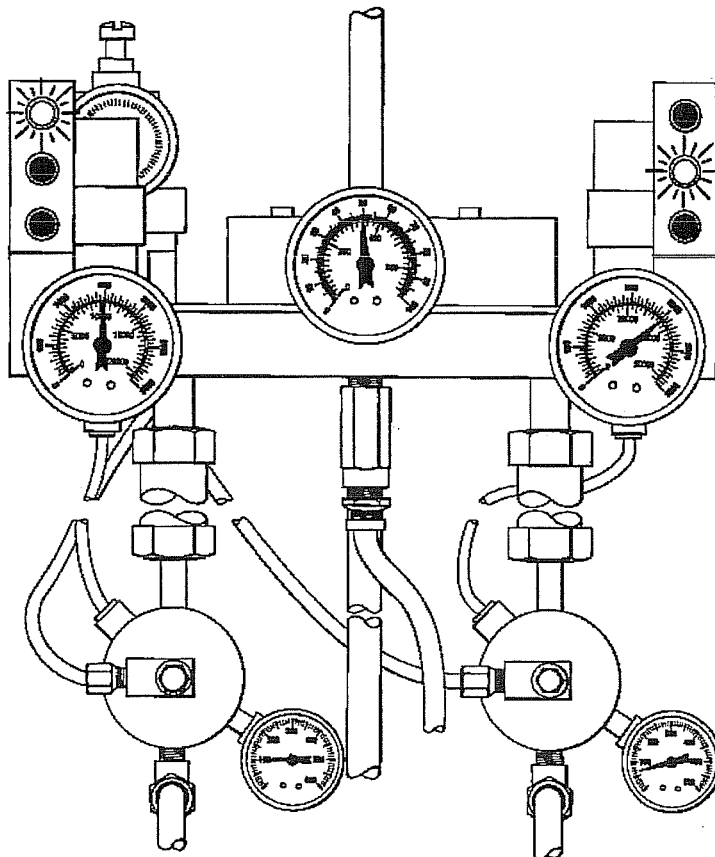


Figure 4-14
LEDs and Gauges – Normal Operation

4/MAINTENANCE

3. Check to see which green LED (in use) indicator is lit to determine which bank is supplying gas to the medical facility delivery line.
 4. Open the bleed valve and *SLOWLY* close the bank shutoff valve on the bank supplying gas to the delivery line. This action simulates the depletion of the Primary Supply. The following activities should take place (Figure 4-15):
 - a. Bank pressure decreases.
 - b. Intermediate line pressure is 30 psi higher on the primary side.
 - c. The pressure switch activates and operates the relay.
 - d. Primary Supply - green LED goes out and the red LED lights.
 - e. Secondary Supply - amber LED goes out and the green LED lights, indicating it is now the Primary Supply.
 - f. Intermediate line pressure drops to 70 psig (220 psig on N₂ manifolds). Intermediate line pressure on the opposite side increases to 100 psig (250 psig on N₂ manifolds).
- Note: These pressures may have equalized as the check valves which isolate the sides are only in place to prevent gross leaks.
- g. If present, remote alarms are activated.
 - h. The manifold is now indicating that the bank is empty.
5. Close the bleed valve and *SLOWLY* reopen the banks shutoff valve closed previously. The following activities should take place (Figure 4-16):

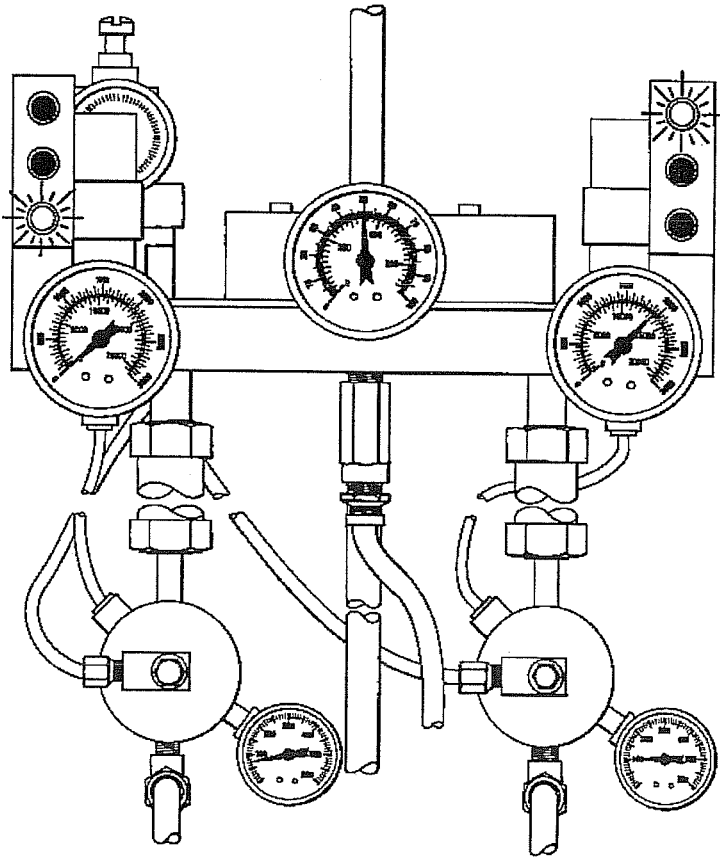


Figure 4-15
LEDs and Gauges After Switch-Over

4/MAINTENANCE

- a. Bank pressure is reestablished.
- b. The pressure switch actuates and operates the relay.
- c. Secondary (formerly Primary) Supply - red LED goes out and the amber LED lights.
- d. Primary (formerly Secondary) Supply - the green LED remains lit.
- e. If present, remote alarms are deactivated.
- f. The manifold is now operating from the opposite bank.

6. Use the push buttons on the circuit board to return the manifold to its original state. (Refer to Section 2.15)

The bank with the least gas should be chosen as the Primary Supply. Except for nitrous oxide and carbon dioxide manifolds, the bank pressure gauge with the lowest reading indicates the bank having the least gas. Nitrous oxide and carbon dioxide, however, are in liquid form in the cylinders at room temperature. Therefore both bank pressure gauges may indicate the same pressure although the liquid level in one bank may be lower. Under such conditions it is not practical to determine which bank is fullest. Simply return the manifold to its original state.

7. If switch-over is not correct, adjust the pressure switch(s) as described in Section 4.7.

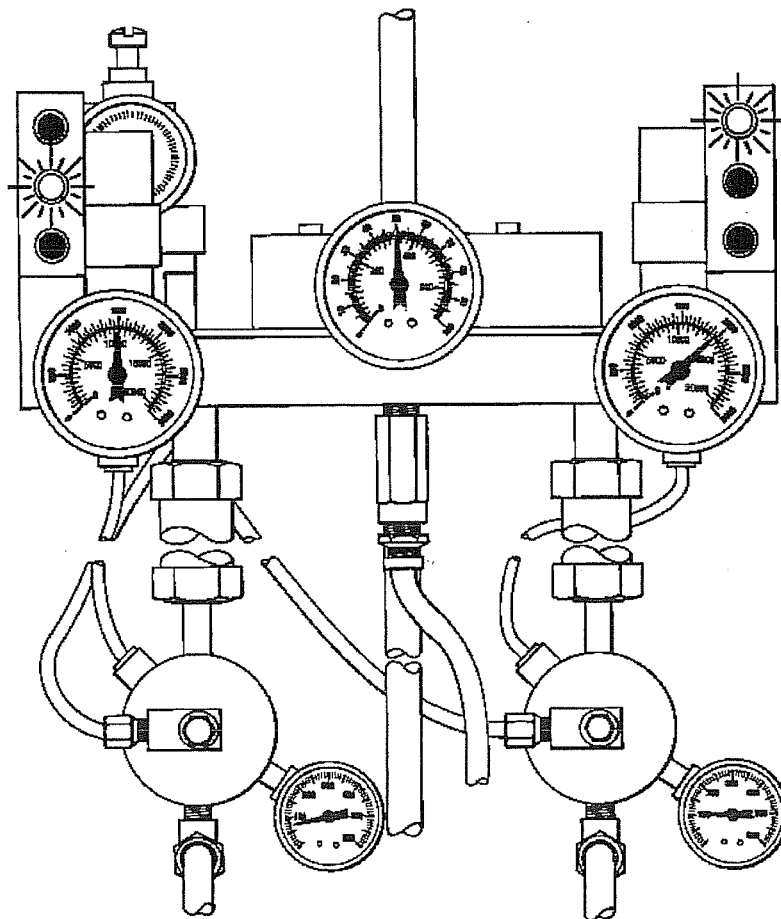


Figure 4-16
LEDs and Gauges with Pressure Restored

5/ILLUSTRATED PARTS LISTS

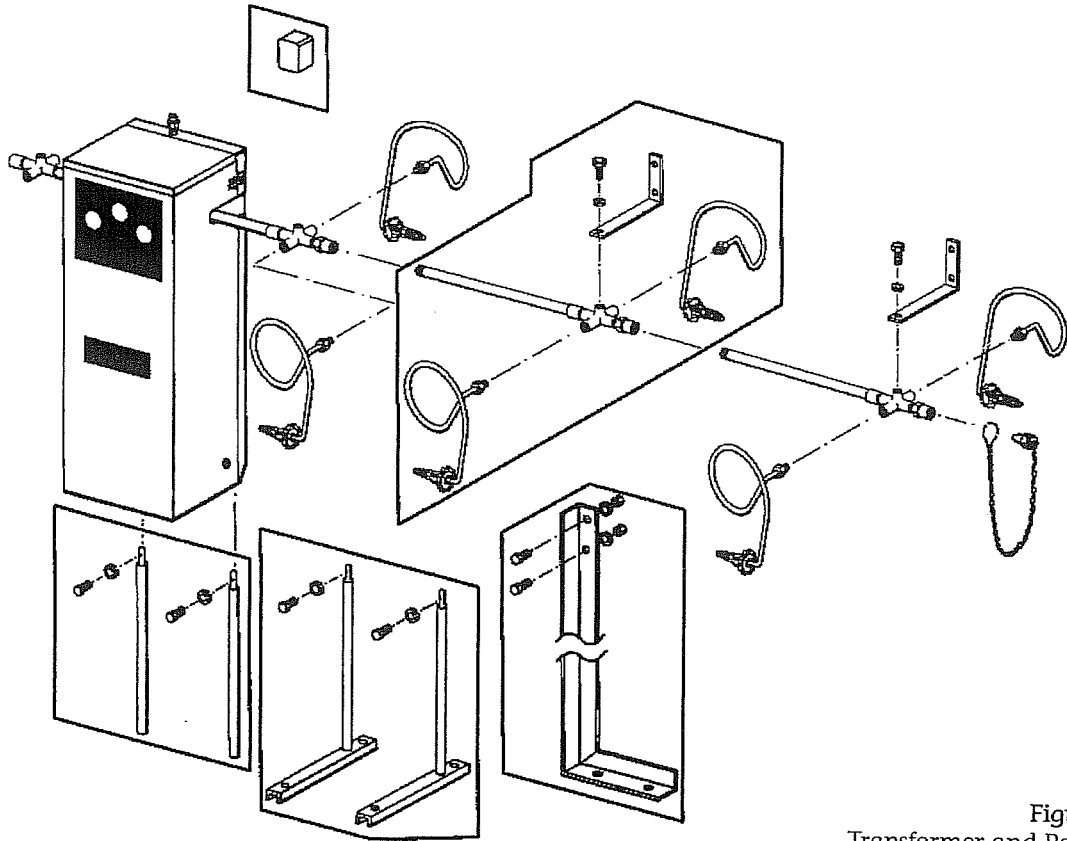


Figure 5-1
Transformer and Parts Kits

Item	Description	Stock Number	Contents
1	Floor Mounting Kit	6804-9040-030	2 Floor-Mount Legs 2 Lock Washers, 3/8" 2 Bolts, 3/8" X 7/8"
2	Wall Mounting Kit	6804-9040-022	2 Wall-Mount Legs 2 Lock Washers, 3/8" 2 Bolts, 3/8" X 7/8"
3	Header Extension Kit	Gas specific - refer to Table 5-2 for Stock Number	2 Header Extensions 4 Pigtails 2 Mounting Brackets 2 Capscrews, 3/8" X 1/2" 2 Lock Washers, 3/8"
4	Header Support Leg Kit	6804-9040-031	2 Header Support Legs 4 Bolts, 3/8" X 7/8" 4 Hex Nuts, 3/8" 4 Lock Washers, 3/8"
5	Electrical Transformer	208-7530-800	

Table 5-1
Transformer and Parts Kits

5/ILLUSTRATED PARTS LISTS

Type of Gas	Header Extension Kit	Pigtail
Oxygen (CGA 540)	6804-9040-023	6804-2580-001
Nitrous Oxide (CGA 326)	6804-9040-024	6804-2580-002
Air (CGA 346)	6804-9040-026	6804-2580-004
Carbon Dioxide (CGA 320)	6804-9040-027	6804-2580-005
Helium (CGA 580)	6804-9040-025	6804-2580-003
Argon (CGA 580)	6804-9040-025	6804-2580-003
Xenon (CGA 580)	6804-9040-025	6804-2580-003
Nitrogen (CGA 580)	6804-9040-025	6804-2580-003
Oxygen and Second Gas Mixture (CGA 280)		
Carbon Dioxide	6804-9040-028	221-5563-700
Helium	6804-9040-028	221-5563-700
Nitrogen	6804-9040-028	221-5563-700
Nitrous Oxide	6804-9040-028	221-5563-700
Oxygen and Second Gas Mixture (CGA 500)		
Carbon Dioxide	6804-9040-029	6804-2580-006
Helium	6804-9040-029	6804-2580-006

Table 5-2
Header Extension Kits and Pigtails

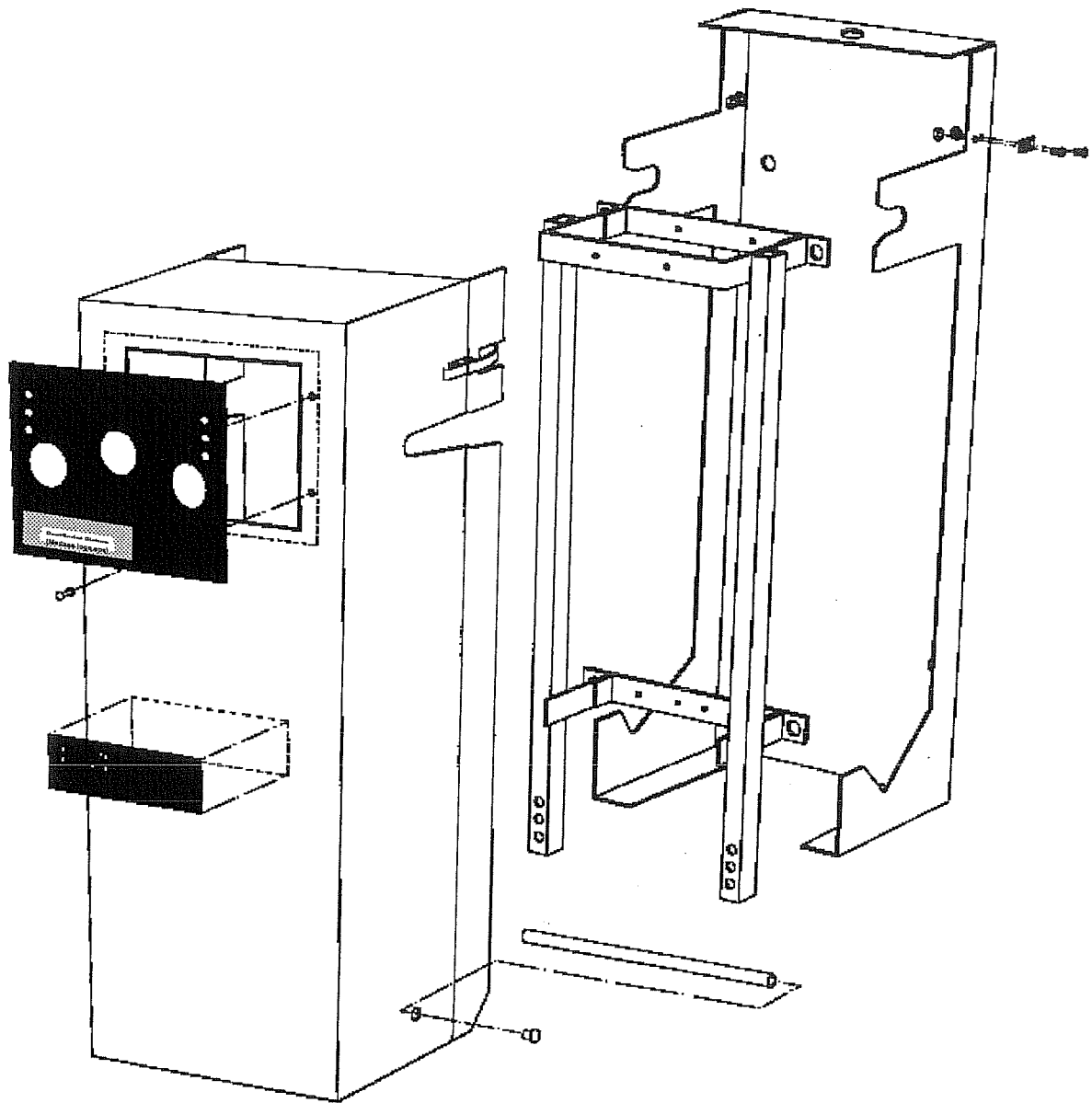


Figure 5-2
Cabinet and Frame

5/ILLUSTRATED PARTS LISTS

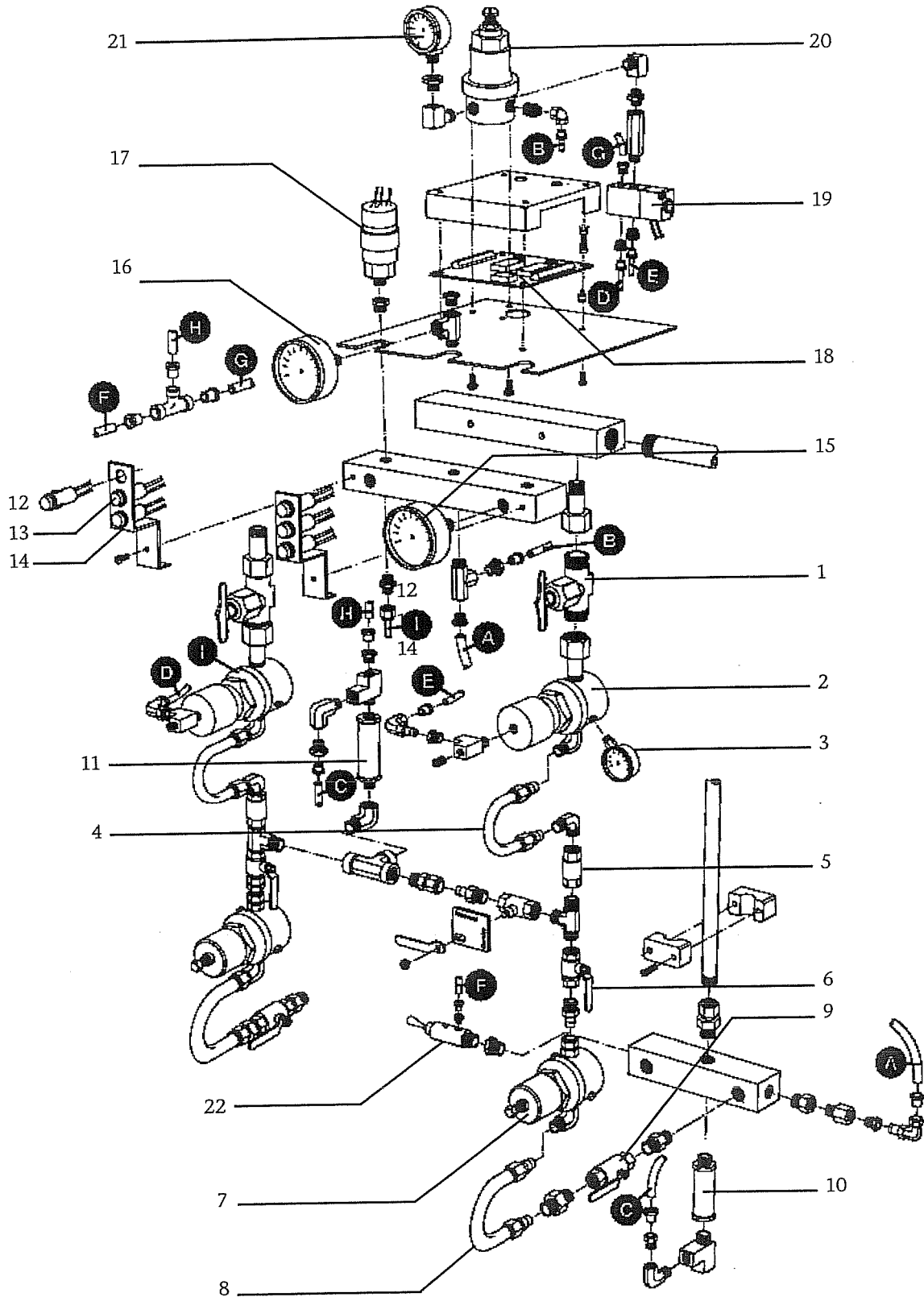


Figure 5-3
Internal Components

5/ILLUSTRATED PARTS LISTS

Item	Description	Stock Number
1	Bank Shutoff Valve	6804-2080-016
2	Bank Regulator	6804-8040-032
3	Intermediate Pressure Gauge	6804-2070-004
4	1/2" U	6804-8040-030
5	Check Valve	6804-2080-009
6	1/2" Ball Valve	6804-2080-010
7	Delivery Line Regulator	6804-8040-033
8	3/4" U	6804-8040-031
9	3/4" Ball Valve	6804-2080-011
10	Delivery Line Relief Valve - 50 psi	0207-8234-300
	Delivery Line Relief Valve - N ₂	0207-8235-300
11	Intermediate Pressure Relief Valve - 50 psi	6804-2080-014
	Intermediate Pressure Relief Valve - N ₂	6804-2080-015
12	Green LED	6804-8040-034
13	Amber LED	6804-8040-035
14	Red LED	6804-8040-036
15	Bank Pressure Gauge	6804-2070-001
16	Delivery Line Pressure Gauge - 50 psi	6804-2070-002
	Delivery Line Pressure Gauge - N ₂	6804-2070-003
17	Pressure Switch	6804-3070-001
18	Printed Circuit Board	6804-7320-000
19	Four-Way Solenoid Valve	6804-2080-012
20	Dome Regulator	6804-2090-009
21	Dome Regulator Pressure Gauge	6804-2070-005
22	Bleed Valve	0207-6054-300

Table 5-3
Stock Numbers for Internal Components

Tube	From	To
A	Delivery Block	Delivery Gauge
B	Delivery Gauge	Dome Regulator
C	Output Intermediate Relief Valve	Output Delivery Relief Valve
D	Left Bank Regulator	4-Way Solenoid
E	Right Bank Regulator	4-Way Solenoid
F	Bleed Valve	Tee
G	4-Way Solenoid	Tee
H	Tee	Output Intermediate Relief Valve
I	Left Bank Regulator	Left Bank Gauge/Switch

Table 5-4
Tubing on Manifold