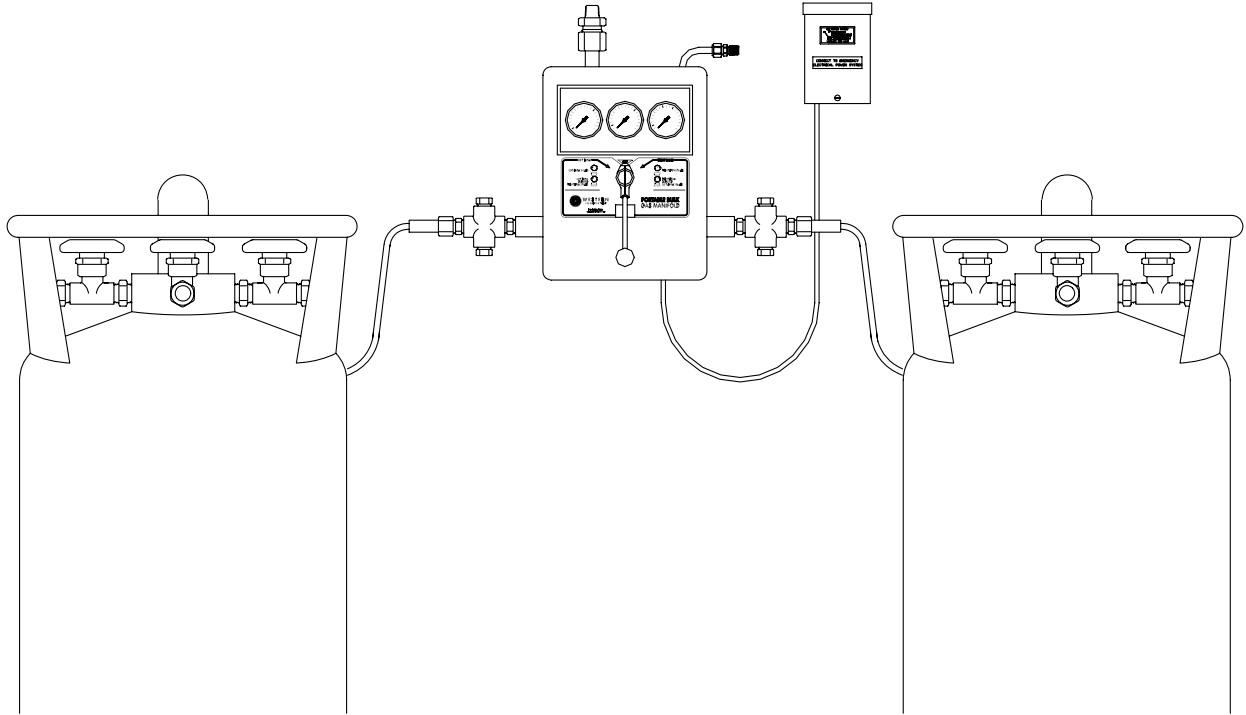


SERVICE MANUAL



SAFETY

Statements in this manual preceded by the following safety signal words are of special significance. Definitions on the SAFETY signal words follow.

DANGER

Means a hazard that will cause death or serious injury if the warning is ignored.

WARNING

Means a hazard that could cause death or serious injury if the warning is ignored.

CAUTION

Means a hazard that may cause minor or moderate injury if the warning is ignored. It also means a hazard that will only cause damage to property.

NOTE

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

INTRODUCTION

This manual provides the information needed to service the Western Enterprises LC and LCHP series manifolds. This information is intended for use by technicians or personnel qualified to repair and service manifold equipment.

The information contained in this document, including performance specifications, is subject to change without notice.

WARRANTY

Western Enterprises makes no warranty of any kind with regard to the material in this manual. Including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

Refer to the **Installation and Operation Instructions** manual for warranty information.

WARNING: This product contains chemicals, including lead, known to the state of California to cause cancer and birth defects or other reproductive harm.
Wash hands after handling.

CAUTION

- Failure to follow the following instructions can result in person injury or property damage:
- Never permit oil, grease, or other combustible materials to come in contact with cylinders, manifold, and connections. Oil and grease may react with explosive force when ignited while in contact with some gases—particularly oxygen and nitrous oxide.
- Cylinder, header, and master valves should always be opened very s-l-o-w-l-y. Heat of recompression may ignite combustible materials.
- Pigtails should never be kinked, twisted, or bent into a radius smaller than 5 inches. Mistreatment may cause the pigtail to burst.
- Do not apply heat. Oil and grease may react with explosive force when in contact with some gases particularly oxygen and nitrous oxide.
- Cylinders should always be secured with racks, chains, or straps. Unrestrained cylinders may fall over and damage or break off the cylinder valve which may propel the cylinder with great force.
- Oxygen manifolds and cylinders should be grounded. Static discharges and lightning may ignite materials in an oxygen atmosphere, creating a fire or explosive force.
- Welding should never be performed near nitrous oxide piping. Excessive heat may cause the gas to dissociate, creating an explosive force.
- Carefully read and follow instructions! Manifolds are designed for gas withdrawal from cryogenic liquids. Contact of a cryogenic liquid or cold gas with skin or eyes may cause a freezing injury.

ABBREVIATIONS

| | | | |
|--------|----------------------------|------|---|
| C | Common | OSHA | Occupational Safety & Health Administration |
| CGA | Compressed Gas Association | PSIG | Pounds per Square Inch Gauge |
| FT-LBS | Foot-Pounds | SCFH | Standard Cubic Feet per Hour |
| IN-LBS | Inch-Pounds | VAC | Voltage, Alternating Current |
| N/C | Normally Closed | VDC | Voltage, Direct Current |
| N/O | Normally Open | PCB | Printed Circuit Board |
| NPT | National Pipe Tape | | |

Western Enterprises shall not be liable for errors contained herein or incidental or consequential damages in connection with providing this manual or the use of material in this manual.

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MAINTENANCE AND REPAIR PARTS**

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MAINTENANCE AND REPAIR PARTS (Repair Drawings)**

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INTRODUCTION & GENERAL INFORMATION**PRODUCT DESCRIPTION**

The automatic changeover manifold is designed to provide a reliable uninterrupted supply of gas to a gas pipeline system.

The manifold has an equal number of cylinders in its "Service" supply and "Secondary" supply banks, automatically switching to the "Secondary" supply when the "Service" supply becomes depleted. When the manifold changes to "Secondary" supply, it sends a signal to the gas alarm system alerting the personnel of the need for the exhausted containers to be replaced with full containers. After new cylinders are in place and turned on, no manual resetting of the manifold is necessary except for turning the control knob.

INSTALLATION INFORMATION

Manifolds should be installed in accordance with guidelines stated by the National Fire Protection Association, the Compressed Gas Association, OSHA, and all applicable local codes. The manifolds should not be placed in a location where the temperature will exceed 120°F (49°C) or fall below 0°F (-18°C). A manifold placed in an open location should be protected against weather conditions including direct rain, snow and heavy moisture. During winter, protect the manifold from ice and snow. In summer, shade the manifold and cylinders from continuous exposure to direct rays of the sun.

Leave all protective covers in place until their removal is required for installation. This precaution will keep moisture and debris from the piping interior, avoiding operational problems

CAUTION:

- Remove all protective caps prior to assembly. The protective cap may ignite due to heat of recompression in oxygen systems.

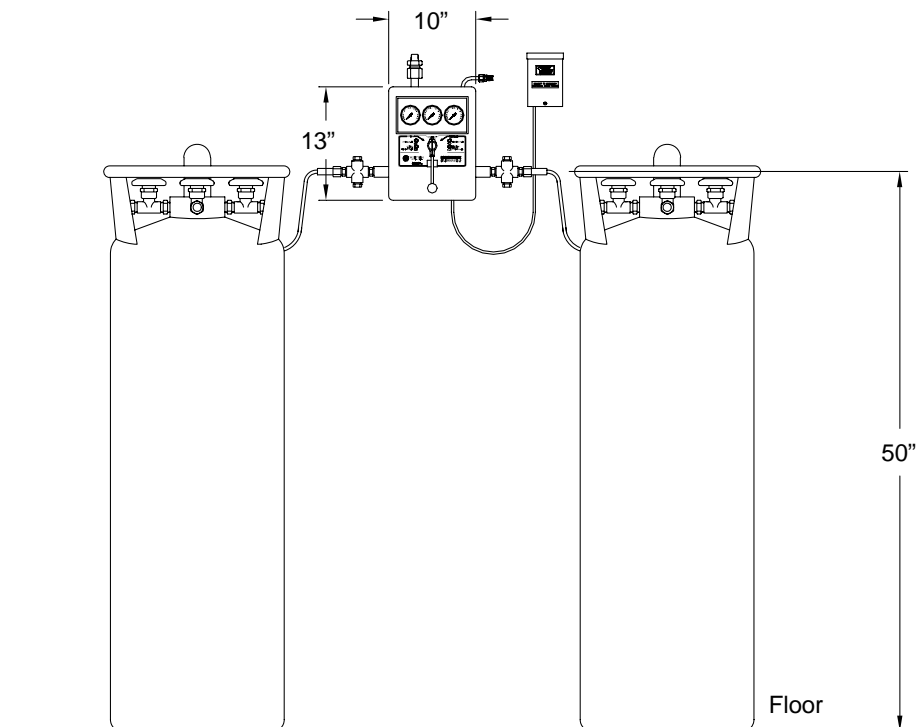


Figure 1-1 Installation Dimensions

MANIFOLD SPECIFICATIONS

Flow Capability

The flow capability of the manifold will depend upon conditions at the installation site, demands of the delivery system and the number of containers in supply service. Maximum capability is 750 SCFH at 50 psig delivery and 125 psig inlet pressure. Maximum capability is 800 SCFH at 160 psig delivery and 250 psig inlet pressure. Installing the manifold in a location which exposes it to ambient temperatures below those specified on page 1-1 is not recommended.

| | |
|----------------|---|
| Argon: | 750 SCFH maximum at 50 psig delivery with a 15 psi pressure drop and 125 psig inlet pressure. 500 SCHF maximum at 50 psig delivery with a 5 psi pressure drop and 125 psig inlet pressure. |
| Oxygen: | 750 SCFH maximum at 50 psig delivery with a 15 psi pressure drop and 125 psig inlet pressure. 500 SCHF maximum at 50 psig delivery with a 5 psi pressure drop and 125 psig inlet pressure. |
| Nitrogen: | 800 SCFH maximum at 160 psig delivery and 15 psi inlet pressure and 250 psig inlet pressure. |
| Nitrous Oxide: | 750 SCFH maximum at 50 psig delivery with a 15 psi pressure drop and 125 psig inlet pressure. 500 SCHF maximum at 50 psig delivery with a 5 psi pressure drop and 125 psig inlet pressure. |
| Carbon Dioxide | 750 SCFH maximum at 50 psig delivery with a 15 psi pressure drop and 125 psig inlet pressure. 500 SCHF maximum at 50 psig delivery with a 5 psi pressure drop and 125 psig inlet pressure. |

Practical Continuous Gas Withdrawal Rates from Liquid Containers at 70° F:

| | |
|----------------|--|
| Argon | 375 SCFH max. from the first container, 185 SCFH from each additional container. |
| Carbon Dioxide | 110 SCFH max. per container. |
| Nitrogen | 375 SCFH max. from the first container, 185 SCFH from each additional container. |
| Nitrous Oxide | 80 SCFH max. per container. |
| Oxygen | 375 SCFH max. from the first container, 185 SCFH from each additional container. |

Power Source Requirements

A 115 VAC to 24 VAC power supply is provided with the manifold to operate the alarm lights on the manifold. Under normal operation the manifold will draw a maximum of 40 milliamperes (.040 amperes)

Piping Connections

| | | |
|------------------|---|---------|
| Header Inlets: | Carbon Dioxide | CGA 320 |
| | Nitrous Oxide | CGA 326 |
| | Oxygen | CGA 540 |
| | Argon | CGA 580 |
| | Nitrogen | CGA 580 |
| Manifold Outlet: | 1/2 NPT male pipe thread (located on the left side on top of the cabinet) | |
| Relief Valve: | 1/2 NPT or 3/4 NPT male pipe thread (located on the left and right bank headers) | |

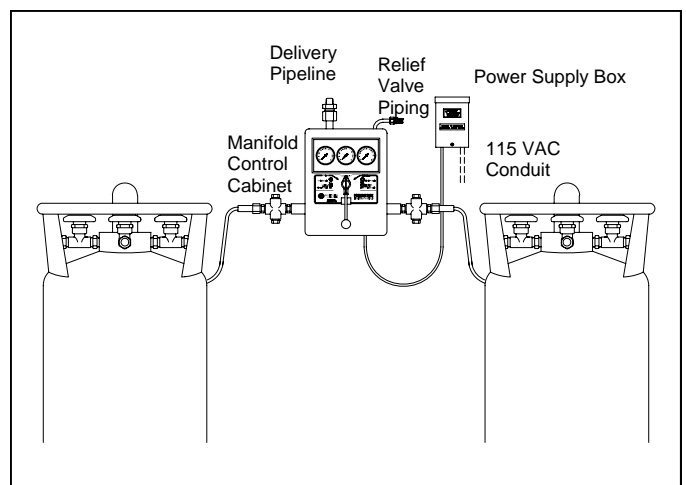


FIGURE 1-2 Connection Locations

ADJUSTMENT SPECIFICATIONS

| Gas | Minimum Cylinder Pressure | Inlet Pressure Relief Valve | Low Pressure Switch | Intermediate Regulator | Intermediate Pressure Relief Valve | Line Regulator |
|---------------------------|---------------------------|-----------------------------|---------------------|------------------------|------------------------------------|----------------|
| LC Series | 125 | 400-450 | 105-110 | 90-95 | 50-60* | 75-80 |
| LCMP | 160 | 400-450 | 140-145 | 130-135 | 50-60* | 120-125 |
| LCMP (except Nitrogen) | 250 | 400-450 | 205-210 | 190-195 | 50-60* | 150-155 |
| LCMP (Nitrogen) | 250 | 400-450 | 235-240 | 220-230 | 50-60* | 205-210 |

Unit of measure: all units are in psig

* Differential pressure

RECOMMENDED TOOLS AND TEST EQUIPMENT

| | |
|---|--|
| Volt/Ohm meter | Available from local source |
| Isopropyl alcohol | Available from local source |
| Phillips screwdriver | Available from local source |
| Flat blade screwdriver | Available from local source |
| Needle nose pliers | Available from local source |
| Wire cutters | Available from local source |
| 1/8" hex key wrench | Available from local source |
| 3/4" hex socket wrench | Available from local source |
| 3/16" hex socket wrench | Available from local source |
| Set of combination wrenches 1/4" thru 1", 1 1/8", 1 1/2" | Available from local source |
| Liquid leak detector | Available from Western Enterprises Part number LT-100 |
| Teflon® tape | Available from Western Enterprises Part number MTT-1 or MTT-2 |

Teflon® is a registered trademark of E. I. du Pont de Nemours & Co. (Inc.).

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THEORY OF OPERATION

GENERAL INFORMATION

This section concentrates on the basic theory of operation of the components of the automatic changeover manifold.

The first part of this section is an operating summary and traces the flow of gas through the various components of the manifold. The second part of this section explains in detail the operation of the individual components contained in the manifold control section.

MANIFOLD OPERATION

The automatic changeover manifold consists of a manifold control and two supply bank crosses, one service and one reserve supply, to provide an uninterrupted supply of gas for the specific gas application. The manifold control includes the following components and features: inlet safety relief valves, green "system normal" and red "replace depleted cylinders" indicator lights, inlet pressure gauges, an economizer bypass check valve, and line pressure gauge. Supply banks consist of 72" flexible pigtails with CGA cylinder connections for hookup to container's gas use port and 1/4 NPT connections for attachments to the control unit cross. The main components of the manifold are shown in Figures 2-1 and 2-2. Figures 2-3 shows the piping schematic and Figure 2-4 is the schematic diagram of the electrical system of the manifold.

The bank that supplies the piping system is known as the "Service" supply while the bank on stand-by is referred to as the "Secondary" supply. Gas flows from the containers through the pigtails and into the left and right inlets of the control sections.

A safety relief valve is connected to each inlet to protect the manifold from over-pressurization. The relief valve setting is noted in the adjustment specification chart in Section 1. Tubing is routed from each inlet to the pressure gauge for that bank. The inlets are connected via tubing to the four-way valve. A check valve is connected in-line between each inlet and the four-way valve. This check valve prevents the gas from flowing backwards toward the inlets.

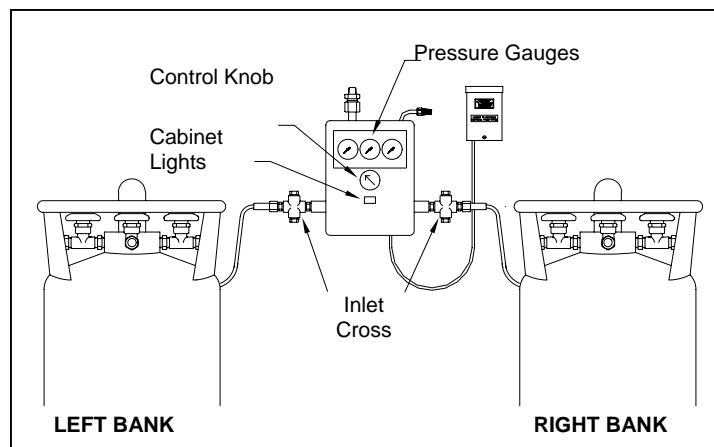


FIGURE 2-1 External Components

The four way valve assembly has three positions. The center position is **OFF**. The **OFF** position is only used during shipment of the manifold. When the valve knob is rotated counterclockwise to the left position, the valve connects the tubing to the left manifold inlet to the outlet tubing on the right and connects the tubing from the right manifold inlet to the tubing leading to the intermediate regulator. When the valve knob is rotated clockwise to the right position, the valve connects the tubing from the right manifold inlet to the outlet tubing on the right and connects the tubing from the left manifold inlet to the tubing leading to the intermediate regulator. Thus by turning the four-way valve knob, the operator may determine which bank of containers is the "Service" supply and which bank is the "Secondary" supply.

The gas from the "Service" supply is routed through the four-way valve outlet on the right of the four-way valve to the intermediate pressure piping. The low pressure switch is connected to this four-way valve port. A check valve located immediately downstream of the pressure switch prevents reactivation of the pressure switch after changeover to the "Secondary" supply.

The intermediate pressure piping has five ports all connected to the same chamber. The gas pressure at all ports is the same as the pressure at the inlet to the piping. Gas enters the intermediate pressure piping from the "Service" supply through the tubing connected at the top right. The lower right port is connected via tubing to the intermediate regulator. The bypass check valve is connected to the lower left port and is connected via tubing to the "secondary" side on the four-way valve. The left port has an adaptor for a test gauge used during manifold testing. The left top port connects to the inlet of the line pressure regulator.

LEGEND

- | | | |
|--------------------------------|-------------------------------|-----------------------------------|
| 1 - Outlet Adaptor | 9 - Bypass Inlet Relief Valve | 19 - Right Inlet Check Valve |
| 2 - Outlet Nut | 10 - Reserve Side Tubing | 20 - Four-Way Valve |
| 3 - Outlet Nipple | 11 - Left Inlet | 19 - Intermediate Pressure Piping |
| 4 - Line Regulator | 12 - Left Inlet Check Valve | 20 - Service Side Check Valve |
| 5 - Line Pressure Gauge Tubing | 13 - Low Pressure Switch | 21 Right Inlet |
| 6 - Bypass Check Valve | 14 - Inlet Gauges Tubing | 22 Relief Valve Vent Tubing |
| 7 - Left Inlet Relief Valve | 15 - Intermediate Regulator | 23 Test Port |
| 8 - Bypass Check Valve Tubing | 16 - Reserve Side Check Valve | |

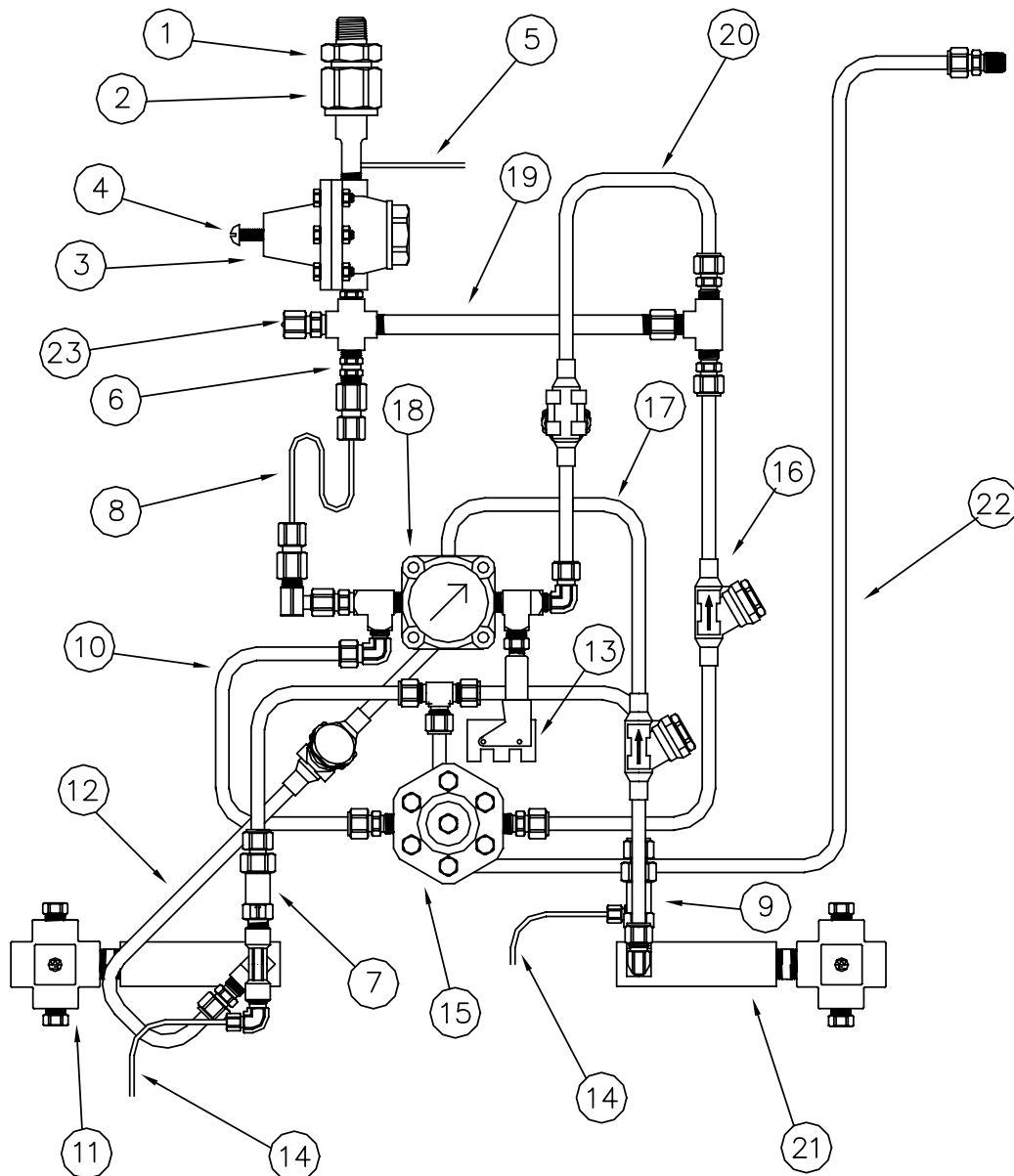


FIGURE 2-2 *Internal Components*

The tubing connected between the intermediate pressure piping and intermediate regulator allows gas from the “Service” supply to flow back towards the intermediate regulator. A check valve is connected in-line between the intermediate regulator outlet and the intermediate pressure piping. This check valve allows servicing the intermediate regulator without having to shutdown the manifold. The intermediate regulator setting determines at which pressure the manifold will switch from “Service” to “Secondary”. Gas from the “Secondary” supply flows from the four-way valve through the intermediate regulator towards the bottom of the check valve. When the gas pressure on the top side of the valve falls to a predetermined pressure, the valve opens and routes the gas from the “Secondary” supply into the intermediate pressure piping and then to the line pressure regulator.

The bypass check valve is connected between the intermediate pressure piping and the four-way valve on the “Secondary” side, thereby passing the intermediate regulator. The bypass check valve is factory set at a 50 psi differential pressure and opens to allow the “Secondary” side to feed the line regulator whenever the “Secondary” pressure exceeds the “Service” pressure by more than 50 psi. This feature permits the system to use “Secondary” gas in low flow or minimum use systems rather than allowing the gas to vent to atmosphere from the containers.

The line pressure regulator further reduces the pressure to the final pressure delivered to the gas piping system. The regulator has one inlet port and one outlet port. Tubing is connected from the outlet piping to the line pressure gauge to sense the pressure of the gas on the downstream side of the regulator. The outlet port is located 180° from the inlet.

The gas flows from the line regulator outlet to the pipeline distribution system. A line pressure relief valve is not provided, but should be tapped into the line routed along with the inlet pressure relief valve to the outside of the building for manifolds located indoors.

When both banks are full, the pressure switch completes the electrical circuit to the green light. Pressures for each bank are indicated on the gauges on the manifold front cover. The “Service” supply is indicated by the position of the control knob. The line pressure is indicated by the center gauge on the manifold front cover.

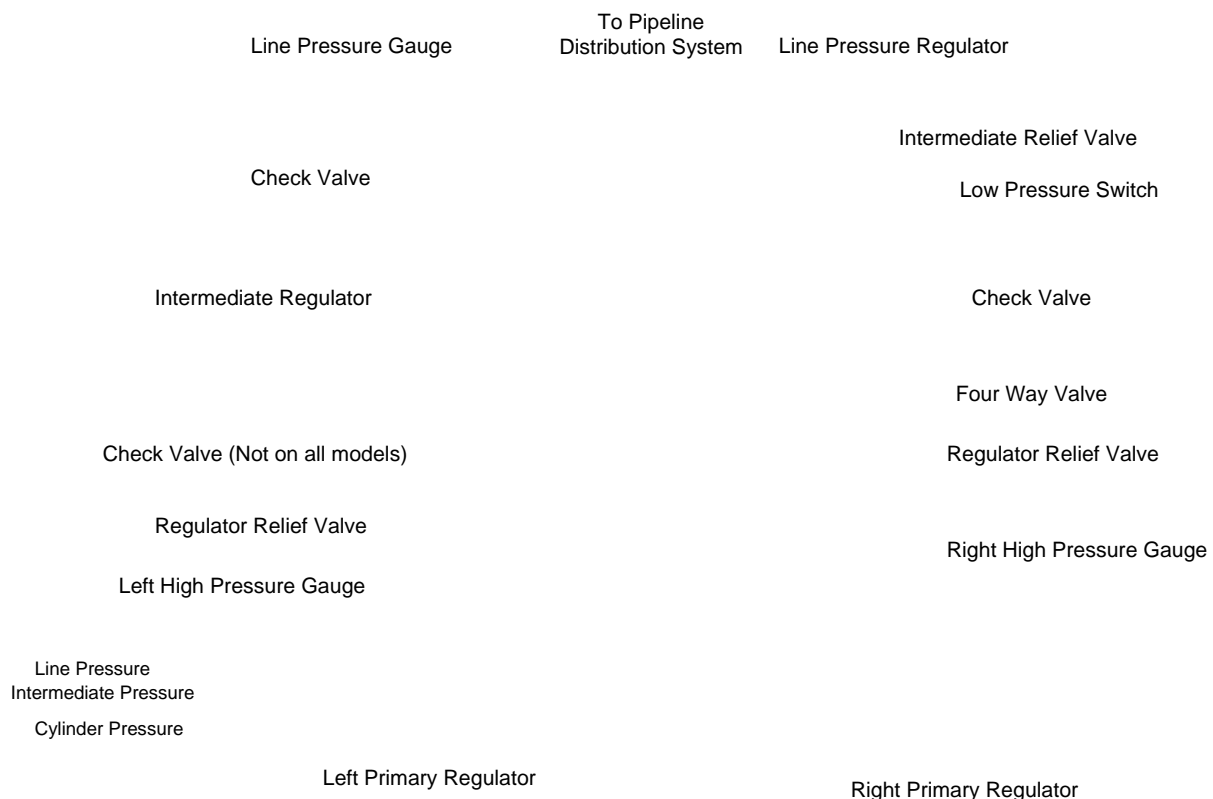
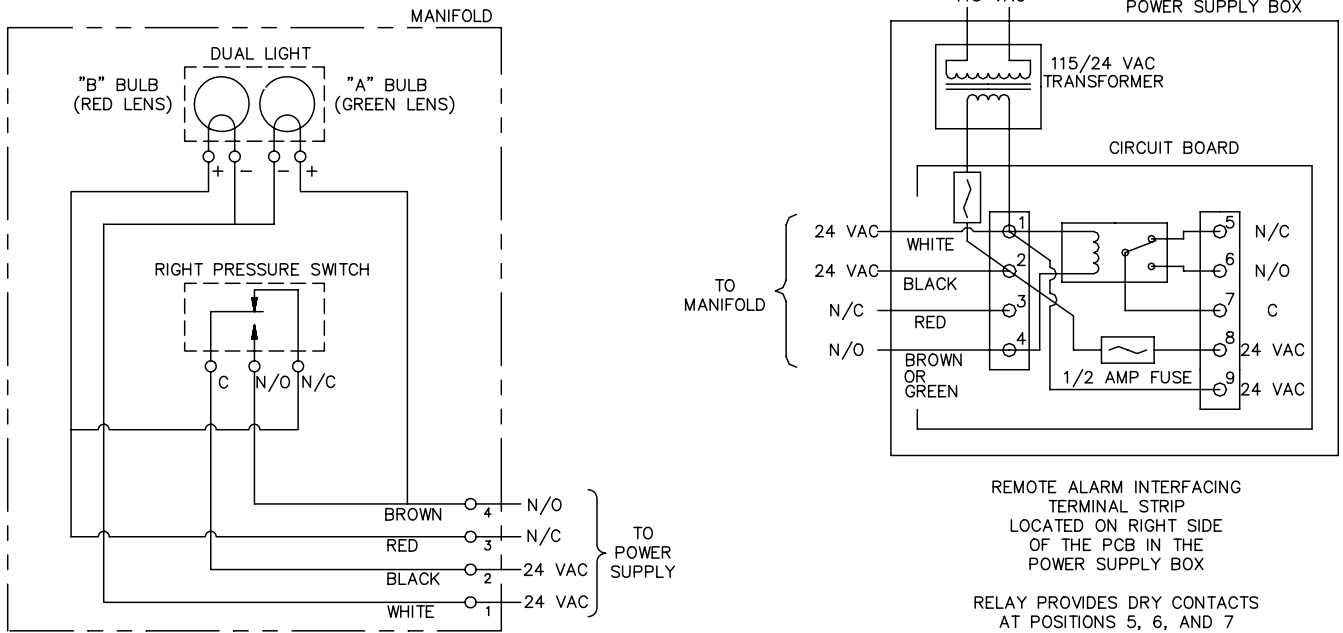


FIGURE 2-3 Piping Schematic



NOTE: PRESSURE SWITCH REFLECTS UNPRESSURIZED MANIFOLD

FIGURE 2-4 Electrical Schematic

The gas from the "Service" supply is depleted, the gas pressure on the "Service" side will begin to fall. Simultaneously, the pressure to the pressure switch, the downstream side of the check valve below the intermediate regulator, and the line regulator also falls. When the "Service" side pressure falls below the set point of the low pressure switch, the red "replace depleted cylinders" light comes on and the green "systems normal" light is extinguished. Any remote alarms are activated at this time. When the "Service" pressure falls to the set point of the intermediate regulator, the check valve is pushed open by the pressure applied from the intermediate regulator. The "Secondary" supply begins to feed the system.

After replacing empty containers and opening the gas use valves, the pressure will actuate the pressure switch, the red "replace depleted cylinders" light will be extinguished and the green "system normal" light will come on. The operator should then turn the control knob to the opposite bank. This will make the partially used "Secondary" bank the "Service" supply and the newly installed containers will become the "Secondary" supply.

CHECK VALVES

The check valves prevent gas from flowing backward from the four-way valve to the inlets. See Figure 2-5.

Gas enters the check valve from the inlet and pushes the check valve seat assembly away from the sealing surface of the valve body. This allows the gas to flow to the outlet port of the valve. When the gas flow stops, the spring of the check valve pushes the valve seat down on the sealing surface preventing any gas flow backward through the valve.

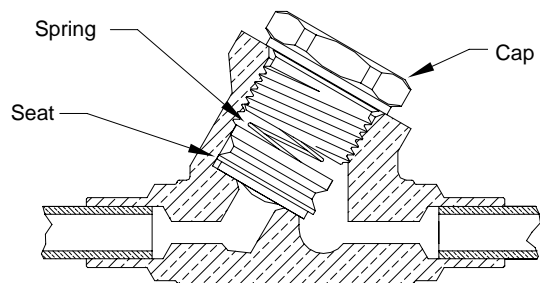


FIGURE 2-5 Check Valve

FOUR-WAY VALVE

The four-way valve assembly is used to route the gas to either the intermediate pressure piping or the intermediate regulator. The four-way valve has two inlet ports on the back side of the valve and two outlet ports located 180° apart on the sides of the valve Figure 2-6.

Figure 2-7a shows the position of the valve ports when the right bank is the “Service” bank and the left bank is the “Reserve”. Gas is directed from inlet port 1 to outlet port **CYL1** and from inlet port 2 to outlet port **CYL2** only. The seals in the valve prevent gas from traveling to the other ports. With the valve in this position, the gas from the right inlet is routed to the intermediate pressure piping and the gas from the left inlet is routed to the intermediate regulator.

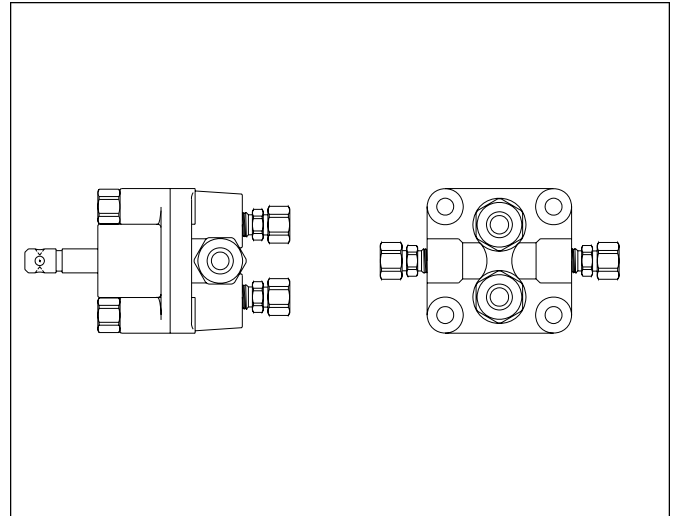


FIGURE 2-6 Four-Way Valve

Figure 2-7b shows the valve in the **OFF** position. The **OFF** position is only used during shipment of the manifold. Notice that the internal porting of the valve shown as dashed lines does not connect any of the inlet ports of the valve with the outlet ports.

Figure 2-7c shows the position of the valve ports when the left bank is the “Service” bank and the right bank is the “Reserve”.

The only function the four-way valve serves is to route the gas to the other components of the manifold.

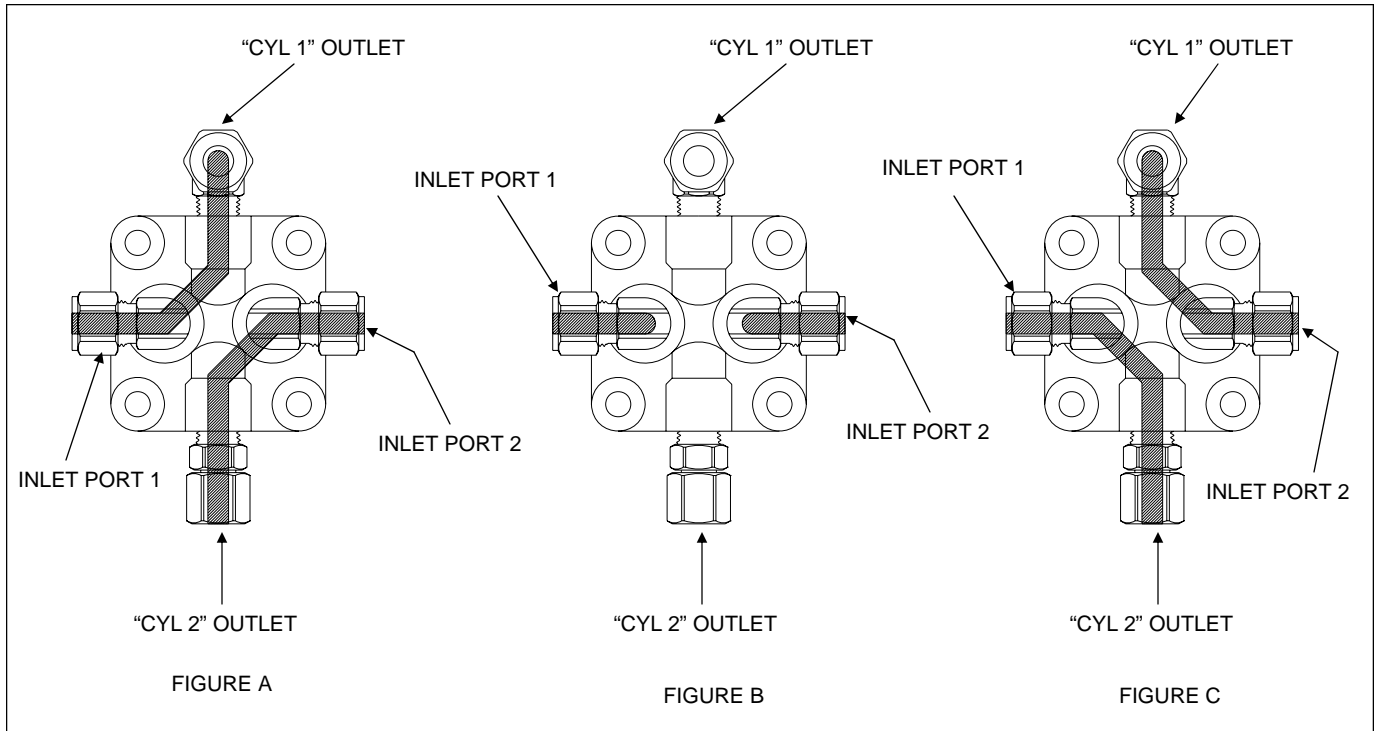


FIGURE 2-7 Four-Way Valve

Figure 2-7 Heater Electrical Schematic

LOW PRESSURE SWITCH

The low pressure switch is used to signal “Reserve in Use” is a piston type with one common contact, one normally closed contact, and one normally open contact. See Figures 2-8 and 2-9.

When the manifold is pressurized to the normal pressures, the piston in the switch is pushed up. The piston pushes the activator of the switch up. This action closes the normally open contact and opens the normally closed contacts. As gas from the cylinder banks is depleted, the piston moves down, releasing the force against the switch activator. The contacts of the switch then return to the normally open and normally closed positions.

The switch completes the electrical circuit to the indicators on the front of the control section and to the remote alarm interface terminal strip in the power supply box.

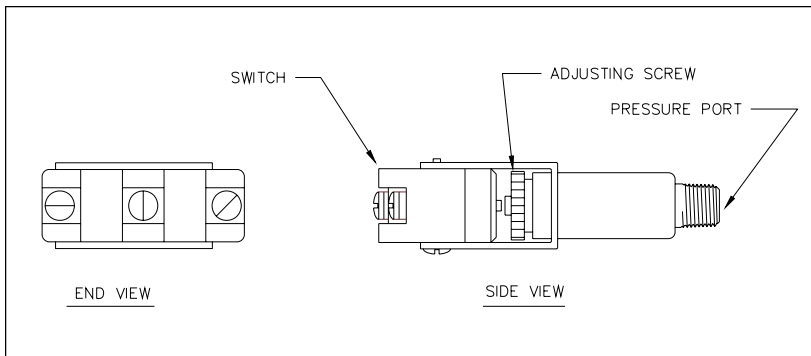


FIGURE 2-8 Low Pressure Switch

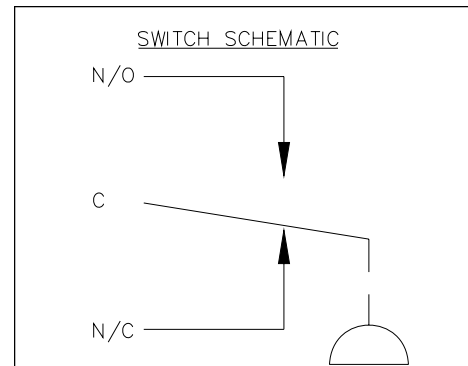


FIGURE 2-9 Switch Schematic

INTERMEDIATE REGULATOR

The intermediate regulator controls the gas flow from the reserve bank to the intermediate pressure piping. The intermediate regulator pressure setting is the pressure at which the manifold will switch over from “Service” to “Reserve” supply. The intermediate regulator has an inlet port connected via tubing to the four-way valve. The outlet port of the intermediate regulator is connected via tubing to the intermediate pressure piping. A Check valve is located immediately downstream of the regulator.

The regulator is comparable to the line regulator illustrated in Figure 2-11. The regulator seat is held shut by the gas pressure from the “Service” bank not allowing the check valve immediately downstream of the intermediate regulator to open. The gas pressure from the intermediate regulator is pushing against the bottom of the check valve seat. When both cylinder banks are full and the regulators properly adjusted, the pressure on the downstream side of the valve is greater than the intermediate regulator pressure. This pressure *differential* holds the valve closed. Turning the adjusting screw of the intermediate regulator in (clockwise) will increase the intermediate regulator pressure thereby increasing the pressure at which the valve will open. Turning the adjusting screw out (counterclockwise) will decrease the intermediate regulator pressure thereby decreasing the pressure at which the valve will open.

When the “Service” pressure falls below the pressure of the intermediate regulator setting as noted in Section 1, the check valve will be pushed open and the “Reserve” bank will begin to supply the system.

BYPASS CHECK VALVE (ECONOMIZER)

The bypass check valve is simply a check valve with a sufficient amount of spring force to create the substantial differential pressure required to open the valve. Refer to Figure 2-10. The bypass valve is connected between the "Reserve" side of the four-way valve and the intermediate pressure piping.

The bypass valve is factory set to open at a 50 psi pressure differential. The spring force combined with the force exerted on the downstream side of the valve seat from the "Service" side pressure create the differential pressure required on the "Reserve" side to open the valve. For example, if the "Service" bank is set for an inlet of 125 psig to the system, the differential pressure required to open the valve would be $125 + 50 = 175$ psig. The "Reserve" side would have to build up to a pressure exceeding 175 psig before the bypass side. As soon as the "Reserve" pressure drops below 175 psig, the bypass valve closes. If the "Service" side pressure was increased to 150 psig, the pressure required on the "Reserve" side to open the valve would be $150 + 50 = 200$ psig.

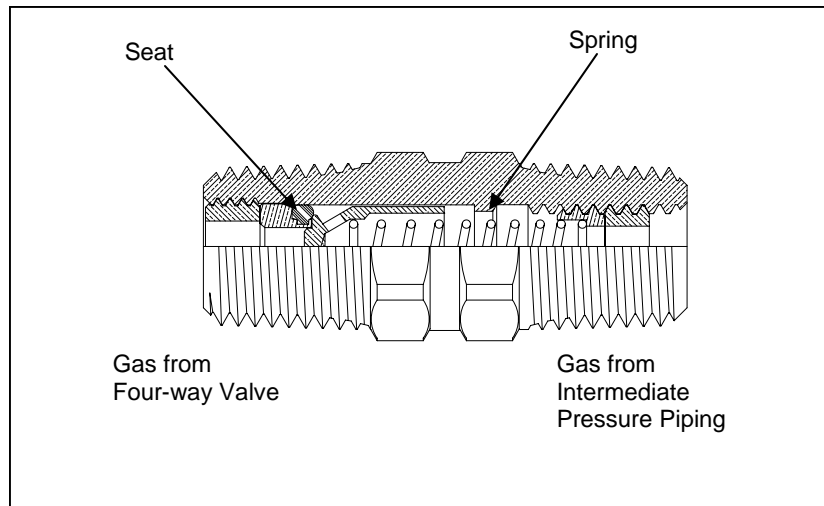


FIGURE 2-10 *Bypass Check Valve*

LINE PRESSURE REGULATOR

The line pressure regulator used in the manifold is a single stage, two port adjustable regulator. Refer to Figure 2-11. It has one inlet port and one outlet port. The inlet port is piped to a port in the intermediate pressure piping. One outlet port is piped to the outlet of the manifold for connection to the main pipeline. Tubing connected to the outlet piping is routed to the delivery line pressure gauge.

Gas enters the regulator through the inlet port and with the adjusting screw backed away from the spring, is sealed in the high pressure chamber of the regulator by the seat and nozzle.

As the adjusting screw is turned in, it compresses the spring and puts a downward force on the diaphragm. When the diaphragm is forced down by the spring, it pushes on the stem of the seat assembly. The seat is pushed away from the nozzle and gas can then flow from the high pressure chamber to the low pressure chamber.

When the low pressure chamber fills with gas, the gas will push upward against the diaphragm. As the pressure continues to build in the low pressure chamber, more upward force will be exerted against the diaphragm and the diaphragm will push up against the bonnet spring compressing the bonnet spring. As the diaphragm is gradually raised by the gas pressure, the seat and nozzle gradually come closer together filling the low pressure chamber slowly and eventually the upward pressure exerted by the gas will be slightly greater than the downward pressure of the bonnet spring and the seat nozzle will close. As gas is released from the low pressure chamber, a proportional amount of gas will be let into the low pressure area from the high pressure chamber. As the adjusting screw is turned in farther and the bonnet spring compressed, the gas pressure required to lift the diaphragm increases, resulting in a higher delivery pressure from the outlet port of the regulator.

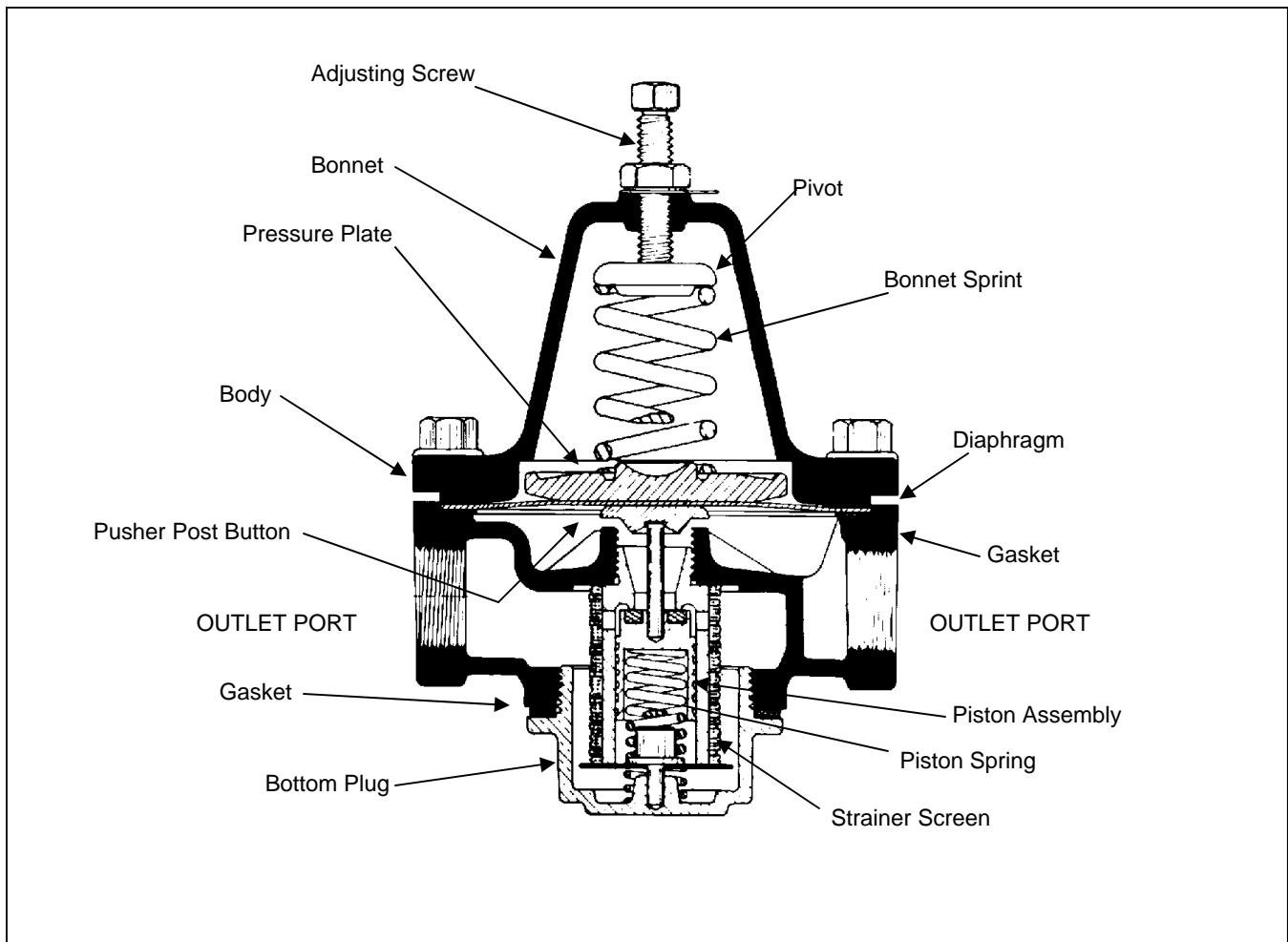


FIGURE 2-11 *Line Pressure Regulator*

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FIELD TESTING & TROUBLE SHOOTING

The manifold performance tests are used to verify the manifold functional performance. When used in conjunction with the trouble-shooting charts, the technician can verify proper performance or rapidly identify the probable source of the problem.

PERFORMANCE VERIFICATION PROCEDURE

1. Shut down the manifold and remove the control section cover as explained in Section 4.
2. Remove the cap from the pressure test fitting on the left side of the intermediate pressure piping.
3. Attach a 400 psi test gauge to the test fitting.
4. Reinstall the control knob on the shaft of the four-way valve.
5. Rotate the control knob counterclockwise to make the left cylinder the "Service" supply and the right bank the "Reserve" supply.
6. **S-l-o-w-l-y** open the gas use valve on one left bank container.
7. **S-l-o-w-l-y** open the gas use valve on one right bank container.
8. Using a leak detect solution, verify that there are no leaks present at the connections.
9. Close the gas use valves on the left and right bank containers.
10. Loosen the union connection to the main supply line to create a slight gas flow through the manifold. Vent the system until all gas has been removed from the manifold.
11. Tighten the main supply line union.
12. **S-l-o-w-l-y** open the gas valve on one left bank container.
13. Verify that the left side contents gauge indicates a minimum inlet pressure as specified in the chart in Section 1. Adjust the pressure building regulator on the container as necessary to obtain the required pressure.
14. Verify that the line pressure gauge is indicating a minimum of 50 psig on all systems except Nitrogen. Nitrogen should indicate a minimum of 160 psig. Adjust to the proper line pressure if necessary.
15. Loosen the union connection to the main supply line to create a slight flow of gas through the manifold.
16. Observe the test gauge and verify the pressure building regulator setting under a flow condition. Adjust the pressure building regulator as necessary to obtain the required pressure.
17. Turn off the gas use valve and allow all gas to vent from the manifold.
18. Tighten the union connection to the main supply line.
19. Repeat steps 12-18 for the other containers on the left bank.
20. Rotate the control knob to its fully clockwise position.
21. **S-l-o-w-l-y** open the gas valve on one right bank container.
22. Complete steps 13-18 for the pressure building regulator on the container.
23. Repeat steps 21 and 22 for the other containers on the right bank.
24. Tighten the main supply union if not already done.
25. Verify that the line pressure regulator is functioning properly by observing the line pressure gauge for two minutes. The gauge should indicate the same pressure at the end of the two minute period.
26. Loosening the union connection to the main supply line to create a slight flow of gas through the manifold.

27. Verify that the line pressure regulator maintains a constant pressure by observing the line pressure gauge.
28. **S-I-o-w-l-y** open the gas use valve on one left bank container.
29. Observe the contents pressure gauges to verify inlet pressures.
30. Close the gas use valve on the right bank container.
31. Observe the contents gauges: the right bank gauge should begin to drop; the left bank gauge should remain constant.
32. Observe the test gauge as the right side pressure continues to drop. As the inlet pressure drops on the right side, the intermediate area also loses pressure. Verify that the pressure falls to the set point of the intermediate regulator (see specification chart in Section 1). Adjust the intermediate regulator as necessary to obtain the required pressure.
33. **S-I-o-w-l-y** open the gas use valve on one right bank container.
34. Verify that the test gauge has returned to the set pressure of the pressure building regulator on the container.
35. Rotate the control knob counterclockwise to make the left bank the service supply.
36. Close the gas use valve on the left bank container.
37. Observe the contents gauges; the left bank gauge should begin to drop; the right bank gauge should remain constant.
38. Observe the test gauge as the right side pressure continues to drop. As the cylinder pressure drops on the left side, the intermediate area also loses pressure. Verify that the pressure falls to the set point of the intermediate regulator (see specification chart in Section 1).
39. Tighten the main supply line union.
40. Verify that the intermediate regulator is functioning properly by observing the test gauge for two minutes. The gauge should indicate the same pressure at the end of the two minute period.
41. **S-I-o-w-l-y** open the gas use valve on one left bank container.
42. Verify that the test gauge has returned to the set pressure of the pressure building regulator on the container.
43. Connect an ohmmeter across the black and brown wires of the wiring harness. The ohmmeter should indicate approximately zero (0) ohms resistance. If the ohmmeter does not indicate approximately zero (0) ohms, connect the meter across the normally open (N/O) and common (C) terminals on the pressure switch. The ohmmeter should register approximately zero (0) ohms resistance when connected to the switch. Adjust or replace the faulty switch. See Section 4 for servicing the pressure switch. Reconnect the ohmmeter to the black and brown wires.
44. Close the gas use valve on one left bank container.
45. Loosen the union connection to the main supply line to create a slight flow of gas through the manifold.
46. Verify an ohmmeter reading of infinite resistance as soon as the test gauge pressure drops to the value for the pressure switch setting indicated in the Specification chart Section 1.
47. **S-I-o-w-l-y** open the gas use valve on one left bank container.
48. Verify that the ohmmeter returns to approximately zero (0) ohms resistance.
49. Rotate the control knob clockwise to make the right bank the service supply.
50. Close the gas use valve on the right bank container.
51. Verify an ohmmeter reading of infinite resistance as soon as the test gauge pressure drops to the value for the pressure switch setting indicated in the Specification chart in Section 1.

52. **S-l-o-w-l-y** open the gas use valve on one right bank container.
53. Verify that the ohmmeter returns to approximately zero (0) ohms resistance.
54. Close all cylinder valves and vent all remaining gas from the manifold.
55. Remove the ohmmeter leads from the black and brown wires.
56. Remove the test gauge from the test fitting and reinstall the test cap.
57. Tighten the main supply line union.
58. **S-l-o-w-l-y** open gas use valve on one right bank container.
59. Using a leak test solution, verify that there are no leaks present at the test cap fitting.
60. Close the gas use valve on the right bank container.
61. Loosen the union connection to the main supply line to create a slight gas flow through the manifold and allow all gas to vent from the manifold.
62. Remove the control knob from the four-way valve.
63. Reinstall the manifold section cover as explained in Section 4.
64. Connect the electrical power source and supply electric power to the manifold.
65. Observe the cabinet system status indicators. Verify that the green indicator is shut off and the red indicator is lit.
66. **S-l-o-w-l-y** open the gas use valve on one left bank container and one right bank container.
67. Observe the cabinet system status indicators. Verify that the green indicator is lit and the red indicator is off.
68. Readjust the line regulator setting if it was modified during cover installation.
69. Close the gas use valve on the right bank container.
70. Loosen the main supply union to create a slight flow of gas through the manifold.
71. Verify that the red light illuminates and the green light is extinguished when the manifold changes over from service to reserve supply.
72. **S-l-o-w-l-y** open the gas use valve on one right bank container.
73. Rotate the control knob counterclockwise to make the left bank the service supply.
74. Observe the cabinet system status indicators. Verify that the green indicator is lit and the red indicator is off.
75. Close the cylinder valve on the left bank of cylinders.
76. Verify that the red light illuminates and the green light is extinguished when the manifold changes over from service to reserve supply.
77. Tighten the main supply line union and test for leaks using a leak detect solution
78. **S-l-o-w-l-y** open all gas use valves on the left and right bank containers.
79. Rotate the control knob to select the bank supplying the system before service was performed.
80. System is now ready for use.

TROUBLESHOOTING (only qualified personnel should make repairs)

| SYMPTOM | PROBABLE CAUSE | REMEDY OR CHECK |
|--|--|---|
| CABINET INDICATOR LIGHTS | | |
| No indicator lights on front panel come on when power is hooked up. | Power input. | Check electrical power supply. |
| | Bulb burned out. | Replace bulb or lamp assembly. |
| | Internal wiring disconnected. | Check all wiring connections. |
| Red indicator light is on but both banks are full. | Gas use valves on bank are Closed. | Slowly open valves. |
| | Pressure switch set at too high a pressures. | Adjust pressure switch or return faulty unit for factory setting. |
| | Pressure building regulator(s) set too low. | Set pressure building regulator(s) Delivery pressure to specifications. |
| Red indicator light does not come on when one bank is empty and changeover occurs. | Control knob was rotated to select new "Service" side without changing empty containers. | Replace depleted containers. |
| | Bulb burned out. | Replace bulb or lamp assembly. |
| | Pressure switch wiring disconnected. | Check connections. |
| | Pressure switch set at too low a pressure. | Adjust pressure switch or return faulty unit for factory setting. |
| | Intermediate regulator setting too high. | Set intermediate regulator delivery pressure to specifications. |
| Green indicator light does not come on but both banks are full. | Bulb burned out. | Replace bulb or lamp assembly. |
| | Pressure switch wiring disconnected. | Check connections. |
| | Pressure switch set at too high a pressure. | Adjust pressure switch or return faulty unit for factory setting. |
| Green indicator light comes on even though one bank of cylinders is empty. | Control knob was rotated to select new "Service" side without changing empty cylinders. | Replace depleted containers. |
| | Pressure switch wiring disconnected. | Check wiring connections. |
| | Pressure switch set at too low a pressure. | Adjust pressure switch or return faulty unit for factory setting. |

| SYMPTOM | PROBABLE CAUSE | REMEDY OR CHECK |
|--|--|--|
| “RESERVE IN USE” SIGNAL | | |
| Remote alarm signal stays in one mode constantly regardless of change over status. | Power supply wiring is incorrect. | Check wiring connections on both power supply terminal strips. |
| | Flow demand too high. | Reduce flow demand. |
| Remote alarm signals are opposite of manifold status. | Faulty connection to remote alarm unit. | Check input from alarm unit to terminal strip. |
| “ABNORMAL” LINE PRESSURE SIGNAL | | |
| Low pressure alarm activated. | Line pressure regulator improperly adjusted. | Readjust line pressure regulator. |
| | Closed gas use valves on containers. | Slowly open valves. |
| | Empty containers. | Replace with full containers. |
| | Pressure building regulator(s) set too low. | Set delivery pressure to specifications. |
| | Faulty line pressure gauge. | Replace line pressure gauge. |
| | Faulty alarm pressure switch. | Readjust or replace pressure switch as necessary. |
| High pressure alarm activated. | Line regulator setting too high. | Readjust line pressure regulator. |
| | Regulator freeze-up. | Reduce the flow demand or increase the number of supply cylinders. |
| | Faulty line pressure gauge. | Replace line pressure gauge. |
| | Faulty alarm pressure switch. | Readjust or replace pressure switch as necessary. |

| SYMPTOM | PROBABLE CAUSE | REMEDY OR CHECK |
|--|---|--|
| LOSS OF CYLINDER CONTENTS | | |
| Audible or inaudible gas leakage (unknown origin). | Leakage at manifold piping connections. | Tighten, reseal or replace. |
| | Leakage at manifold tubing connections. | Tighten, reseal or replace. |
| | Leakage in downstream piping system. | Repair as necessary. |
| | Leakage at cylinder valve. | Replace cylinder. |
| | Gauge leaks. | Reseal or replace. |
| | Regulator leaks. | Repair or replace. |
| Venting at relief valve. | Line regulator setting too high. | Set delivery pressure to specifications. |
| | Overpressure due to creeping or faulty regulation by pressure building regulator. | Replace containers. |
| | Overpressure due to creeping or faulty regulation by line regulator. | Replace regulator seat and nozzle components. |
| | Regulator freeze-up. | Reduce the flow demand or increase the number of supply containers. Add external heaters if necessary. |
| Gas leakage around regulator body or bonnet. | Loose bonnet. | Tighten bonnet. |
| LOSS OF RESERVE BANK CONTENTS | | |
| Both banks feeding. | Intermediate regulator seat leak. | Repair or replace regulator. |
| | Intermediate regulator set to open at too high a pressure. | Adjust intermediate regulator per specifications. |
| | Faulty four-way valve. | Replace four-way valve. |
| | Flow demand too high. | Reduce flow demand. |
| | Faulty economizer check valve. | Replace economizer check valve. |

| SYMPTOM | PROBABLE CAUSE | REMEDY OR CHECK |
|--|--|--|
| LOSS OF RESERVE BANK CONTENTS (continued) | | |
| Opposite bank feeding | Faulty primary regulator and/or intermediate regulator. | Replace intermediate regulator seat and nozzle components. |
| | Faulty economizer check valve | Replace economizer check valve. |
| Premature changeover to reserve bank. | Flow demand too high. | Reduce flow demand. |
| | Leaks in the manifold system. | Leak test, tighten, reseal or replace fittings as necessary. |
| | Intermediate regulator set to open at too high a pressure. | Adjust intermediate regulator per specifications. |
| | Closed gas use valves. | Open valves. |
| No changeover. | Intermediate regulator defective. | Replace or repair regulator. |
| | Empty reserve bank cylinders. | Replace cylinders. |
| PIPELINE DISTRIBUTION | | |
| Pipeline not at desired pressure. | Line regulator not set correctly. | Readjust line pressure regulator. |
| Required gas flow not available. | Line regulator not set correctly. | Readjust line pressure regulator. |
| | Flow demand too high. | Consult factory. |

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SERVICE PROCEDURES

GENERAL MAINTENANCE

1. Daily - record line pressure.
2. Monthly
 - a) Check regulators and valves for external leakage.
 - b) Check valves for closure ability.
 - c) Check pigtails for cleanliness, flexibility, wear, leakage, and thread damage. Replace damaged pigtails immediately.
3. Annually - check relief valve pressures.
4. Every 4 years.
 - a) Replace pigtails.

WARNING

- Repairs to manifold high pressure regulators, valve connections, and piping should be made only by qualified personnel, improperly repaired or assembled parts could fly apart when pressurizing causing **death** or serious **injury**.

SAFETY PRECAUTIONS

1. Examine all parts before repair. **Note: Because manifold parts may be exposed to Oxygen and Nitrous Oxide and the condition of the unrepaired parts is unknown, a repair-inspection should be performed.**
2. Keep 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.
3. Use only proper repair tools and parts. Parts for Western manifolds are shown in this instruction. Special tools are called out as needed.
4. Before connecting the container to the manifold, momentarily open and close the cylinder valve to blow out any dirt or debris.
5. After connecting the cylinder to the manifold, open the cylinder valve **s-l-o-w-l-y** to allow the heat of compression to dissipate.
6. Use only cleaning agents, sealants, and lubricants as specified in this instruction.

CLEANING, LUBRICATION, AND SEALING

Clean metal parts of the manifold with isopropyl alcohol or 1,1,1 trichloroethylene solvent prior to assembly. Dry thoroughly. Do not clean o-rings with this solvent (Freon TF is acceptable).

Teflon® Tape Application

Threaded pipe connections should be sealed with Teflon® tape.

Remove the old sealant from both male and female threads. Apply Teflon® tape to the male pipe thread. Approximately 1 1/2 turns of tape should be sufficient. Do not cover the first thread with tape. Assemble the fittings wrench tight to effect a gastight seal.

Assembly and Disassembly of Compression Fittings

Mark the fitting and nut prior to disassembly. Before re-tightening, make sure the assembly has been inserted into the fitting until the ferrule seats in the fitting. Retighten the nut by hand. Torque the nut with the wrench until the marks line up, which indicates that the fitting has been tightened to its original position. Then snug the nut 1/12 of a turn (1/2 of a wrench flat) past the original position.

NOTE:

- Incorrect assembly of fittings may initially seal, however, leakage may occur over time.

Leak Testing

There are four types of manifold piping connections: sealed (soldered), threaded (unions and elbows), compression (tubing connections), and gasket (diaphragms and o-rings).

When a leak is suspected and cannot be easily located, a leak detector solution should be applied to all connections (in the event of leaks at more than one connection). Be certain to wipe fittings dry after testing to prevent corrosion (Western's LT-100 leak detector dries clean and will not harm apparatus).

If a leak is detected at:

sealed connections, replace the assembly which is joined by the leaking connection.

threaded connections, union sealing surfaces may have burrs or nicks which may be polished out. Be certain to clean parts before reassembly. If the surface will not seal, replace the union. Elbows and tees may be cleaned of old sealant and resealed with Teflon® tape. Refer to cleaning, sealing, and lubricating instructions.

compression fittings, sealing surfaces of fittings or brass ferrules may be damaged and must be replaced. Refer to the parts list for appropriate tubing.

gasket seals, leaks may occur at seals made by gaskets such as diaphragms or o-rings. Gas may leak to atmosphere or across the seal into the opposite pressure circuit. External leaks are evidenced by application of leak detector while leaks across the seal are detected by faulty manifold function. When replacing seals, use care not to damage sealing surfaces.

GENERAL REPAIR PROCEDURES

Be sure all pressure and electrical power is removed from the system prior to initiating any repair procedures.

WARNING

- Do not shutdown the manifold until personnel have been advised of the intended service and all systems requiring industrial gas are being supplied from portable or alternate supplies. Patients still on the pipeline will not receive gas.

Replace parts with **all** components in the repair kit.

HOW TO SHUT DOWN THE MANIFOLD

1. Turn **off** the piping system isolation valve, if present. If an isolation valve is not present, the entire gas system will be reduced to atmospheric pressure. **WARNING: Do not shutdown the manifold until all personnel have been advised of the intended service and all systems requiring industrial gas are being supplied from portable or alternate supplies.**
2. Turn **off** right and left supply bank cylinder valves.
3. Loosen the manifold outlet connection to the supply main to vent residual gas from the system.
4. Tighten the manifold outlet connection.
5. Disconnect electrical power from the manifold at the main power source.

MANIFOLD CABINET COVER REMOVAL

Disassembly

1. Cut lead seal wire with wire cutters and remove.
2. Remove the control knob on the front of the cabinet using a 1/8" hex key wrench.
3. Using a flat blade screwdriver or 5/16" hex wrench, unscrew the four screws holding the gauge plate to the cabinet. Remove the cover plate.
4. Unscrew the electrical connector at the bottom of the unit and unplug the cord.
5. Unscrew the three screws attaching the cover to the backplate using a phillips screwdriver.
6. Carefully pull the cover straight out to clear internal components.

NOTE:

- It may be necessary to turn the adjusting screw on the line regulator all the way in so as to allow the cover to slide past the adjusting screw.

7. Locate and disconnect the three male/female wire terminals to detach the cover electrical wiring from the pressure switch wiring.
8. Lift the cover completely off the backplate.
9. Back out the adjusting screw on the line regulator if it was readjusted to remove the cover.

Reassembly

Reverse order of disassembly. Connect internal wiring by matching up color-coded wires.

GAUGE REPLACEMENT

CAUTION:

- Be careful not to kink or damage the tubing connected to the gauges. Damaged tubing may burst when pressurized.

Removal

1. Shut down the manifold and remove cover as explained earlier in this section.
2. Pull the mounting plate up so that it provides easy access to the gauge screws on the underside of the gauge plate.
3. Mark the compression fittings per the instructions on page 4-2. Using a 7/16" open end wrench, disconnect the tubing from the defective gauge.
4. Using a 3/8" hex wrench, remove the two screws holding the gauge brackets. Slide the gauge brackets off of the screw post.
5. Slide the gauge out through the front of the gauge plate.
6. Using a 3/4" hex wrench, remove the compression fitting from the gauge. Using a 9/16" open end wrench to stabilize the gauge.
7. Remove old sealant from the 1/4 NPT female pipe thread on the compression fitting.

Replacement

1. Apply Teflon® tape to the 1/4 NPT male pipe thread on the new gauge and reassemble in the reverse order of the removal procedure.
2. Make sure gauge face is properly oriented through the front of the gauge plate.
3. If the gauge needle is not on zero, unscrew the gauge bezel and adjust the needle using a flat blade screwdriver.

LOW PRESSURE SWITCH REPLACEMENT

Removal

1. Shutdown the manifold and remove cover as explained earlier in the section.
2. Label the three wires attached to the switch. Loosen the slot head screws on the pressure switch using a flat blade screwdriver and remove the wires.
3. Use a 5/8" open end wrench to stabilize the adaptor and use a 7/8" open end wrench to remove the pressure switch.

Replacement

CAUTION:

- Do not stand directly in front of the body or ports when performing the next step. Eye protection should be worn to protect the service technician. Chips and debris may be propelled into unprotected eyes.

1. Remove old sealant from the street tee adaptor. Blow out the street tee adaptor with oil free Air or Nitrogen to remove all foreign material and dry all surfaces.
2. Apply Teflon® tape to the 1/8 NPT male pipe threads on the pressure switch. Start the threads of the pressure switch into the street tee adaptor. Use a 5/8" open end wrench to stabilize the adaptor while using a 7/8" open end wrench to tighten to effect a gastight seal.
3. Complete the adjustment instructions below prior to installing the signal wires to the pressure switch.

Pressure Switch Adjustment

1. Connect an ohmmeter to the normally closed and common electrical contacts on the switch. The ohmmeter should register zero resistance.
2. Begin pressurizing the manifold by opening the gas use valve on one container side of the manifold the switch is on:
At the actuation pressure, the ohmmeter reading will jump from zero resistance to infinite resistance.
3. Close the cylinder valve.
4. Loosen the main supply union slightly to relieve pressure from the manifold while observing the test gauge and ohmmeter to determine switch setting:
At the actuation pressure, the ohmmeter reading will jump from infinite resistance to zero resistance.
5. Tighten the union connection to the main supply line.
6. Using a flat blade screwdriver, turn the knurl adjustment screw on the pressure switch clockwise to raise the set point or counterclockwise to lower the set point. The pressure switch should be set per the Adjustment Specifications chart in Section 1.
7. Cycle between actuation and reactivation signals and make adjustments as required to achieve the signal setting. The setting should be made on descending pressure. Make adjustments in response to the reading obtained in step 4.

WARNING:

- Be sure power is off when electrical connections are made. Current flowing through the wire may shock the service technician.

8. After setting has been made, connect the signal wires to the appropriate contacts on the pressure switch.

CHECK VALVE REPAIR

Removal

1. Shutdown the manifold and remove cover as explained earlier this section.
2. Mark the compression fittings per the instructions on page 4-2. Disconnect the tubing at the compression fittings using and 11/16" open end wrench.
3. Remove the check valve and tubing assembly from the control section.

Disassembly

1. Secure the check valve in a vise or similar holding fixture. Using a 1 1/8" hex wrench, rotate the valve cap counterclockwise and remove.
2. Remove the seal washer from the valve cap.
3. Pull the spring from the valve body.
4. Using a small needle nose pliers or tweezers, grasp the valve poppet and remove it from the valve body.
5. Clean the interior of the valve body with isopropyl alcohol or 1,1,1 trichloroethylene solvent.

CAUTION:

- Do not stand directly in front of the ports when performing the next step. Eye protection should be worn to protect the service technician. Chips and debris may be propelled into unprotected eyes.

6. Blow out the check valve body with oil free nitrogen to remove all foreign material and dry all surfaces.

Reassembly

1. Insert a new valve poppet into the valve body.
2. Insert the spring into the valve body.
3. Position a new seal washer in the groove of the valve body.
4. Place the valve cap over the spring and push the cap towards the body until the threads engage. Rotate cap clockwise and tighten securely.

Replacement

1. Position the check valve and tube assembly in the control section with the check valve flow arrow pointing towards the outlet.
2. When retightening the fitting the procedure outlined on page 4-2 shall be followed. Connect the compression fittings using an 11/16" open end wrench and tighten to effect a gastight seal.

ECONOMIZER CHECK VALVE REPLACEMENT

Removal

1. Shutdown the manifold and remove cover as explained earlier in this section.
2. Mark the compression fittings per the instructions on page 4-2. Disconnect the tubing from the bypass check valve using a 7/16" open end wrench.
3. Using a 9/16" open end wrench, remove the economizer check valve from the intermediate pressure piping.
4. Remove old sealant from the threads in the intermediate pressure piping.

CAUTION:

- Do not stand directly in front of the ports when performing the next step. Eye protection should be worn to protect the service technician. Chips and/or debris may be propelled into unprotected eyes.

5. Blow out the internal pipe threads with oil free Air or Nitrogen to remove all foreign material.
6. Place the bypass check valve in a vice or similar holding fixture and use a 3/4" hex wrench to remove the compression fitting.
7. Remove the old sealant from the 1/4 NPT female pipe thread on the compression fitting.

Replacement

1. Apply Teflon® tape to both 1/4 NPT male pipe thread on the new bypass check valve and assemble to the intermediate pressure piping. Normal flow is from the four-way valve to the intermediate pressure piping. The flow arrow should point towards intermediate pressure piping.

CAUTION:

- Pay careful attention to the economizer check valve flow direction. Improper connection would cause malfunction of the system during normal operation.

CAUTION:

- Use care when performing steps 2-4. Eye protection should be worn to protect the service technician. Chips and/or debris may be propelled into unprotected eyes.

2. **S-l-o-w-l-y** open the gas use valve on one container on the side the economizer check valve is on.
3. Assemble the compression fitting to the bypass check valve with a 3/4" hex wrench and tighten.
4. When retightening the fitting the procedure outline on page 4-2 shall be followed. Using a 7/16" open end wrench, reconnect the tubing to the compression fitting.

FOUR-WAY VALVE REPLACEMENT

Removal

1. Shutdown the manifold and remove cover as explained earlier in this section.
2. Mark the compression fittings per the instructions on page 4-2. Disconnect the four tubing assemblies at the compression fittings to the four-way valve and at the compression fittings at the other end of the tubing assemblies using an 11/16" open end wrench. Remove the tubing assemblies from the control section (the two inlet check valve tubing assemblies and the two four-way valve outlet tubing sections).
3. Use a phillips screwdriver to remove the two screws that secure the four-way valve to the support bracket and remove the four-way valve assembly.
4. Secure the valve assembly in a vise or similar holding fixture and use a 5/8" open end wrench to remove the two inlet and an 11/16" open end to remove the two outlet adaptors from the valve for use on the replacement valve.
5. Remove the old sealant from the 1/4 NPT male pipe threads on the compression fittings and adaptors

Replacement

1. Apply Teflon® tape to the 1/4 NPT male pipe threads on the compression fittings and adaptors.
2. Secure the new four-way valve in a vise.
3. When retightening the fitting the procedure outlined on page 4-2 shall be followed. Install the compression fitting in the inlet ports on the four-way valve using 5/8" open end wrench.
4. Install the adaptor fittings in the outlet ports on the four-way valve using an 11/16" open end wrench. The bypass check valve tubing must be connected to the **CYL 2** port and the pressure switch must be connected to the **CYL 1**.
5. Remove the valve from the vise and position it behind the support bracket with the **CYL 2** port on the left and the **CYL 1** port on the right.
6. Reinstall the two screws through the bracket and into the two upper threaded holes of the valve. Tighten with a phillips screwdriver.
7. Reconnect the check valve tubing assemblies to the new valve.
Note: the flow direction arrow on the check valves must point towards the four-way valve.
8. Reconnect the two outlet tubing sections to the new valve.
9. When retightening the fitting the procedure outline on page 4-2 shall be followed. Using an 11/16" open end wrench, tighten the compression fittings at the ends of the tubing assemblies to effect a gastight seal.

INTERMEDIATE PRESSURE REGULATOR REPAIR

Removal

1. Shutdown the manifold and remove cover as explained earlier in this section.
2. Mark the compression fittings per the instructions on page 4-2. Disconnect the tubing at the compression fitting to the four-way valve and the intermediate pressure piping using an 11/16" open end wrench.
3. Remove the intermediate regulator from the control section.

Disassembly

1. Secure the intermediate regulator in a vise or similar holding fixture. The vise should grip the regulator on the body hex.
2. Loosening the lock nut and rotate the adjusting screw of the regulator counterclockwise until free of the spring tension.
3. Remove six assembly screws and nuts using 7/16" wrenches and remove the bonnet, spring button, spring, and pressure plate.
4. Remove the metal diaphragm and the gasket.
5. Lift the pusher post button off of the piston post.
6. Using a 1 1/2" hex wrench, loosen the hexagon bottom plug and carefully unscrew by hand.

NOTE:

- The bottom plug is under slight tension because of the piston spring.

7. Remove the plug, piston spring, and strainer screen.
8. Unscrew and remove the hexagon cylinder using a 3/4" hex **socket** wrench to prevent distortion.
9. Clean all interior surfaces of the regulator body with isopropyl alcohol or 1,1,1 trichloroethane solvent.

CAUTION:

- Do not stand directly in front of the ports when performing the next step. Eye protection should be worn to protect the service technician. Chips and/or debris may be propelled into unprotected eyes.

10. Blow out the regulator body and parts with oil free Air or Nitrogen to remove all foreign materials and dry all surfaces.

Reassembly

1. Install the cylinder using a 3/4" hex **socket** wrench to prevent distortion.
2. Position the piston spring, piston, and spring retainer on the plug and assemblies in the body of the regulator. Use a 1 1/2" hex wrench to tighten the plug.

3. Place the pusher post button on the piston post.
4. Set the gasket and the metal diaphragms in the body cavity and place the pressure plate, spring and spring button on top of them.
5. Place the bonnet on top of the body matching up the mounting screw holes. Inset the screws and attach the nuts to them. Tighten opposite screws alternately using a 7/16" hex wrench.
6. Remove the regulator from the vise.

Replacement

1. Position the intermediate regulator in the control section with the inlet connecting to the tubing coming from the four-way valve. The inlet of the regulator is stamped **INLET**.
2. When retightening the fitting the procedure outlined on page 4-2 shall be followed. Connect the compression fittings using an 11/16" open end wrench and tighten to effect a gastight seal.

Intermediate Regulator Adjustment

1. If not already done, open the manifold as explained earlier in this section, remove the manifold cover, and attach a test gauge to the left side of the intermediate pressure piping. Reinstall the four-way valve knob and rotate to select one bank of cylinders as the supply bank.
2. **S-l-o-w-l-y** open one cylinder on the supply bank selected.
3. Verify the contents pressure gauge indicates the minimum inlet pressure per the Adjustment Specification chart in Section 1. Adjust the pressure building regulator pressure as necessary to obtain the required pressure setting.
4. Rotate the control knob so that the arrow of the four-way valve is pointing to the opposite bank.
5. Loosen the main supply union slightly to relieve pressure from the manifold while observing the test gauge.
6. Allow the gas to vent until the test gauge stabilizes or indicates less than the setting for the intermediate regulator listed in the adjustment Specification chart in Section 1.
 - If the gauge stabilizes at a pressure higher than the chart specification, turn the adjusting screw on the intermediate regulator clockwise to increase the gauge reading.
 - If the gauge stabilizes at a pressure lower than the chart specifications, turn the adjusting screw on the intermediate regulator counterclockwise to decrease the gauge reading.
7. Tighten the union connection to the main supply line.
8. Simulate the changeover sequence from both sides and observe the intermediate gauge to verify proper setting.
9. Tighten the lock nut after proper setting is achieved.

LINE REGULATOR REPAIR

NOTE:

- Removal and Replacement procedures are to be followed only if the line regulator assembly is to be scrapped. All service may be performed to the line regulator without removing it from the manifold.

Shutdown the manifold and remove cover as explained earlier in this section.

Removal

1. Mark the compression fittings per the instructions on page 4-2. Using an 11/16" open end wrench, disconnect and remove the intermediate regulator to intermediate pressure piping check valve tubing assembly.
2. Mark the compression fittings per the instructions on page 4-2. Using an 11/16 open end wrench, disconnect and remove the four way valve to the intermediate pressure piping tubing.
3. Mark the compression fittings per the instructions on page 4-2. Using a 7/16" open end wrench, disconnect the line pressure gauge tubing from the line pressure gauge.
4. Mark the compression fittings per the instructions on page 4-2. Using a 7/16" open end wrench, disconnect the four-way valve to bypass check valve tubing from the bypass check valve.
5. Using two 1 1/2" open end wrenches, disconnect the main supply line from the manifold at the union.
6. Using a small pipe wrench, remove the union nipple from the outlet of the line regulator.
7. Using a 7/16" hex wrench, remove the U-bolt from the bracket.
8. Remove the intermediate pressure piping and line regulator assembly from the control section.
9. Secure the intermediate pressure piping in a vise or similar holding fixture.
10. To remove the regulator from the intermediate block, grasp the bonnet of the regulator and rotate the regulator counterclockwise.

Disassembly

1. Secure the intermediate regulator in a vise or similar holding fixture. The vise should grip the regulator on the body hex.
2. Loosen the lock nut and rotate the adjusting screw of the regulator counterclockwise until free of the spring tension.
3. Remove six assembly screws and nuts using 7/16" wrenches and remove the bonnet, spring button, spring, and pressure plate.
4. Remove the metal diaphragms and the gasket.
5. Lift the pusher post button off of the piston post.
6. Using a 1 1/2" hex wrench, loosen the hexagon bottom plug and carefully unscrew by hand.

NOTE:

- The bottom plug is under slight tension because of the piston spring.

7. Remove the plug, piston, piston spring, and strainer screen.

8. Unscrew and remove the hexagon cylinder using a 3/4" hex socket wrench to prevent distortion.
9. Clean all interior surfaces of the regulator body with isopropyl alcohol or 1,1,1 trichloroethane.

CAUTION:

- Do not stand directly in front of the body or ports when performing the next step. Eye protection should be worn to protect the service technician. Chips and/or debris may be propelled into unprotected eyes.

10. Blow out the regulator body ports with oil free Air or Nitrogen to remove all foreign materials and dry all surfaces.

Reassembly

1. Install the cylinder using a 3/4" hex socket wrench to prevent distortion.
2. Position the piston spring, piston, and spring retainer on the plug and assemble in the body of the regulator.
3. Place the pusher post button on the piston post.
4. Set the gasket and the metal diaphragms in the body cavity and place the pressure plate, spring and spring button on top of them.
5. Place the bonnet on top of the body matching up the mounting screw holes. Insert the screws and attach the nuts to them. Tighten opposite screws alternately using a 7/16" hex wrench.
6. Remove the regulator from the vise.

Replacement

1. Secure the intermediate pressure piping in a vise or similar holding fixture.
2. Remove all old sealant from the regulator inlet nipple. Clean all interior surfaces with isopropyl alcohol or 1,1,1 trichloroethane solvent.

CAUTION:

- Do not stand directly in front of the body or ports when performing the next step. Eye protection should be worn to protect the service technician. Chips and/or debris may be propelled into unprotected eyes.

3. Remove all old sealant from the intermediate pressure piping. Blow out the intermediate pressure piping with oil free Air or Nitrogen to remove all foreign materials and dry all surfaces.
4. Apply Teflon® tape to the 1/4 NPT male pipe thread on the regulator inlet nipple. Start the threads of the nipple into the intermediate pressure piping.
5. Position the inlet of the regulator over the nipple and rotate the regulator clockwise to tighten the threads. The inlet of the regulator is stamped **INLET**.
6. Grasp the bonnet of the regulator and rotate the regulator clockwise until tight. The bonnet of the regulator must be parallel to the test fitting on the left side of the intermediate pressure piping.
7. Remove the intermediate block from the vise and using the carriage bolt, reinstall the intermediate pressure piping to the bracket on the backplate. Assemble the nuts and strap to the U-bolt. Tighten loosely.
8. Remove all old sealant from the union nipple. Clean all interior surfaces with isopropyl alcohol or 1,1,1 trichloroethylene solvent.
9. Apply Teflon® tape to the 1/4 NPT male pipe thread on the union nipple. Start the threads of the nipple into the outlet of the line regulator.

10. Using a small pipe wrench, install the union nipple to the outlet of the line regulator.
11. Using a 7/16" hex wrench, reassemble the U-bolt to the bracket.
12. When retightening the fitting the procedure outlined on page 4-2 shall be followed. Using and 11/16" open end wrench, reconnect the four-way valve to intermediate block tubing.
13. When retightening the fitting the procedure outlined on page 4-2 shall be followed. Using and 11/16" open end wrench, reinstall the intermediate regulator to intermediate pressure piping check valve tubing assembly.
14. When retightening the fitting the procedure outlined on page 4-2 shall be followed. Reconnect the four-way valve to bypass check valve tubing to the bypass check valve with a 7/16" open end wrench.
15. Using two 1 1/2" open end wrenches, reconnect the main supply line to the manifold at the union.
16. When retightening the fitting the procedure outlined on page 4-2 shall be followed. Using a 7/16" open end wrench, reconnect the line pressure gauge tubing to the line pressure gauge.

Line Regulator Adjustment

1. Reinstall the manifold cover as explained at the beginning of this section.

CAUTION:

- Be sure to backout the adjusting screw on the line regulator prior to pressurizing the system. If the adjusting screw position was changed it may over pressurize the piping which may cause damage to a downstream item.

2. **S-l-o-w-l-y** open the gas use valve on one container on the system.
3. Verify the cylinder pressure gauge indicates the minimum inlet pressure per the Adjustment Specification Chart in Section 1. Adjust the pressure building regulator pressure as necessary to obtain the required pressure setting.
4. Using a flat blade screwdriver, turn the adjusting screw of the regulator in while observing the line pressure gauge. Set the regulator to the desired pressure.
5. Loosen the main supply union to create a slight flow of gas through the manifold.
6. Readjust the regulator to the proper specifications if necessary.
7. Tighten the union connection to the main supply line. The line pressure gauge will go up slightly higher than the flowing adjusted pressure.
8. Verify that the regulator does not creep by observing the line pressure gauge for two minutes. The gauge must indicate the same pressure at the end of the two minute period.
9. Close the gas use valve on the container.
10. Loosen the main supply line union and vent all remaining gas from the manifold.
11. Tighten the union connection to the main supply line after the gas pressure has been exhausted from the manifold.

LIGHT SOCKET REPLACEMENT

Removal

1. Shutdown the manifold and remove cover as explained earlier in this section.
2. Label and disconnect the four connectors attached to the back of the light socket.
3. Using a small flat blade screwdriver, pry off the two metal clips securing the light socket to the manifold cover.
4. Slide the defective socket out through the front of the manifold cover.

Replacement

1. The new light socket will have two sets of terminals labeled "A" and "B". Insert the back of the new light socket through the rectangular opening in the front of the manifold cover approximately 3/4" with the "+" terminal of the "A" set on the top.
2. Grasp the back of the light socket on the sides and pull the socket in until the front of the socket is flush with the front of the manifold cover.
3. Reattach the connectors to the terminal on the socket.
4. Reinstall the manifold cover and connect electrical power to the manifold. Test for proper function by following the Performance Verification Procedure in Section 3.

INDICATOR LAMP REPLACEMENT

Removal

1. Remove indicator lens cover by pulling lens cover forward. A small depression is molded into the top and bottom of the lens cover to facilitate removal. A flat blade screwdriver can be wedged in the depression and twisted to pry the lens cover off.
2. Remove the faulty lamp by pulling the built-in extractor. The clear plastic tab marked **lamp pull** is the extractor.

Replacement

1. Insert the replacement lamp and push on the lamp until it snaps into place.

NOTE:

- Too much force used to install the lamp could break the socket bezel and allow the socket to be pushed completely through the front of the manifold cover.

2. Reinstall the indicator lens cover with the green lens above the red lens.

NOTE:

- Too much force used to install the lamp could break the socket bezel and allow the socket to be pushed completely through the front of the manifold cover.

MANIFOLD MAINTENANCE & REPAIR PARTS**NOTE:**

- Western manifold systems are designed and tested for optimal performance and adherence to safety specifications. We recommend the use of Western replacement components to maintain the standards of performance and the safety of the product.

REPLACEMENT PIGTAILS**72” Cryogenic Flexible Pigtails**

| | |
|--------------|--|
| WMH-2-5..... | CGA 320 for Carbon Dioxide (CO ₂) Service |
| WMH-2-6..... | CGA 326 for Nitrous Oxide (N ₂ O) Service |
| WMH-2-7..... | CGA 540 for Breathing Oxygen (O ₂) Service |
| WMH-2-8..... | CGA 580 for Inert Gas Service |

INDICATOR LAMP REPLACEMENT PARTS**Round Style**

| | |
|---------------|--------------------------------|
| WME-8-72..... | Bulb Receptacle and Amber Lens |
| WME-8-10..... | 115 V Light Bulb |

Square Style

| | |
|---------------|--------------------------------|
| WME-8-42..... | Light Bulb |
| WME-8-41..... | Bulb Receptacle |
| WME-8-40..... | Red/Green Lens |
| MK-1010..... | Dual Light Assembly Repair Kit |

PANEL MOUNT GAUGES— 2” Diameter, 1/4” NPT Back Port

| | |
|---------------|---------|
| WMG-3-2..... | 200 psi |
| WMG-3-14..... | 300 psi |
| WMG-3-4..... | 400 psi |
| WMG-3-5..... | 600 psi |

REGULATOR & REGULATOR REPAIR KITS

| | |
|---------------|--|
| WMS-3-3..... | Intermediate Regulators for LC and LCMP series manifolds |
| WMR-6-4..... | Line Regulator for LC and LCMP series manifolds |
| WMS-3-20..... | Intermediate Regulator for LCHP series |
| WMR-6-6..... | Line Regulator for LCHP series |
| RK-1070..... | Repair Kit for WMS-3-3, WMR-6-4, WMR-6-6, and WMS-3-20 |

VALVES AND VALVE REPAIR KITS

| | |
|------------------|---|
| WMV-5-25-50..... | Bypass Check Valve (Economizer) Oxygen |
| WMV-5-7..... | Bypass Check Valve (Economizer) Argon, Helium, Nitrogen, CO ₂ , Nitrogen |
| RK-1041..... | Repair Kit for Low Pressure Check Valve |
| WMS-3-2..... | Four-Way Valve Assembly |
| WMV-6-4..... | Pigtail Check Valve |

PRESSURE SWITCHES

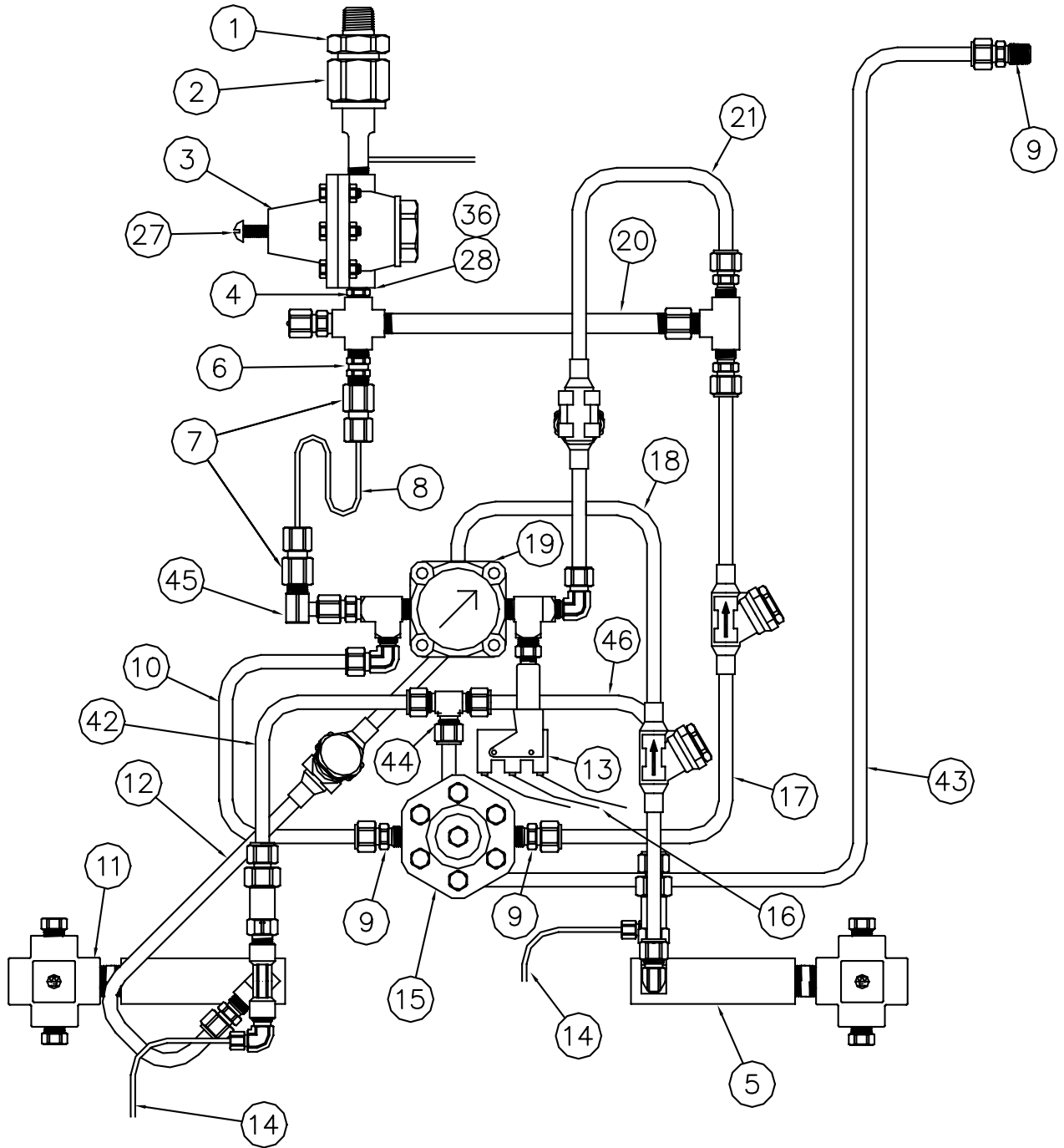
- WME-4-4 Pressure Switch (adjustable 0-300 psi) Argon, Helium, Nitrogen, CO2 and N2O
- WME-4-4C..... Pressure Switch (adjustable 0-300 psi) Oxygen
- WME-4-9 General Purpose Pressure Switch (adjustable 100 -1000 psi)
- WME-4-10 General Purpose Pressure Switch (adjustable 200 - 3000 psi)
- WME-4-13 High/Low Pressure Switch (adjustable 0 - 300 psi)
- WME-4-14 General Purpose Pressure Switch (adjustable 20 - 200 psi)
- WME-4-15 High/Low Pressure Switch (adjustable 0 - 100 psi)

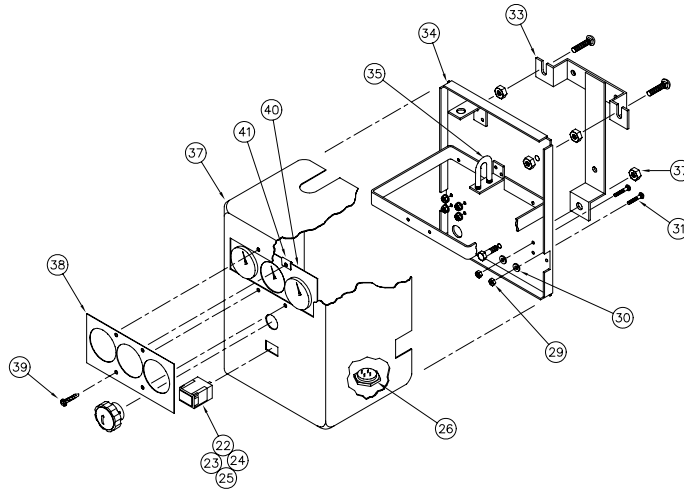
POWER SUPPLY REPLACEMENT PARTS

- 8570D..... Power Supply Assembly
(transformer, PCB with dry contacts, case, and cables)
- WME-8-1 Power Supply PCB for 8570D
(includes dry contacts for remote alarms)

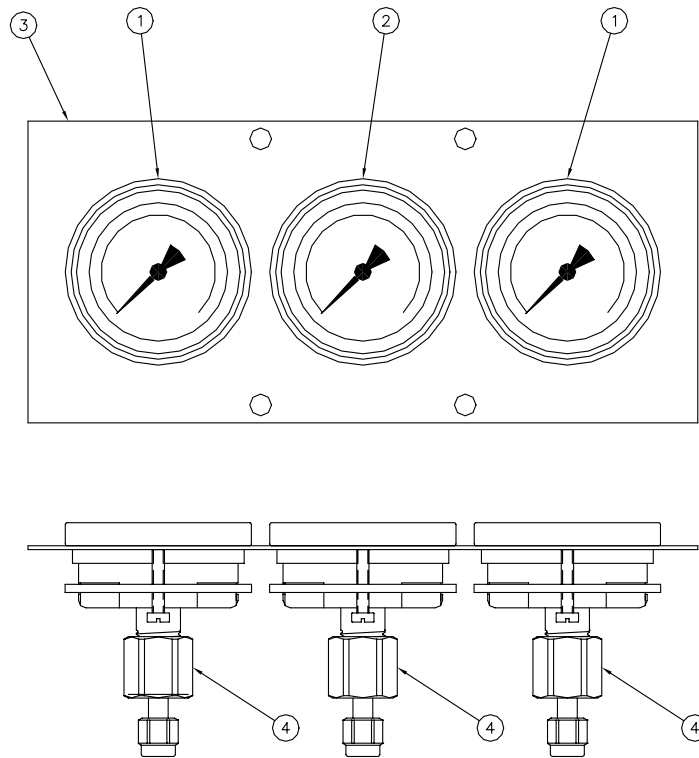
REMOTE ALARMS—24 VAC Service

- BIA-1 Visual - 1 Gas
- BIA-2 Audio/Visual - 2 Gases
- BIA-3 Audio/Visual - 1 Gas
- WMS-9-25C Optional 115 to 24 VAC Power Supply for above Remote Alarms

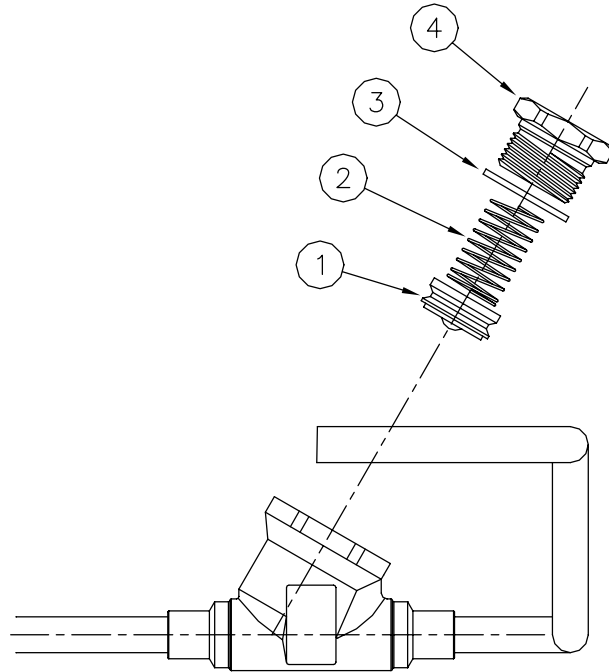




| KEY # | DESCRIPTION | PART # | KEY # | DESCRIPTION | PART # |
|-------|--|------------|-------|--------------------------------|----------|
| 1 | Outlet Adaptor | D-34 | 23 | Dual Light Base | WME-8-41 |
| 2 | Outlet Nut & Nipple | WMS-3-12 | 24 | 24 V Bulb (#85) | WME-8-42 |
| 3 | Line Regulator LC & LCMP series | WMR-6-4 | 25 | Dual Light Label | WME-8-54 |
| | LCHP series | WMR-6-6 | 26 | Case Wiring Harness | WMS-1-14 |
| 4 | 1/4 NPT Pipe Nipple | WLF-1-17 | 27 | Regulator Adjusting Screw | WMC-6-38 |
| 5 | Inlet Block, Right Side | WMS-3-14 | 28 | Concave Screen | 1134 |
| 6 | Bypass Check Valve | See page 5 | 29 | 3/16" Hex Nut | WMC-6-11 |
| 7 | 1/8" Tube x 1/4 NPT Female | WLF-3-4 | 30 | 3.16" Lock Washer | WMC-6-2 |
| 8 | 1/8" x 6" Tubing | WLF-6-17A | 31 | 3/16-24 x 1 3/4" Carriage Bolt | WMC-6-10 |
| 9 | 3/8" Tube x 1/4 NPT | WLF-3-5 | 32 | 3/8-16 Hex Nut | WMC-6-6 |
| 10 | 3/8" Tubing, 4 way to Regulator | WMS-3-10 | 33 | Tee Mounting Bracket | WMC-6-7 |
| 11 | Inlet Block, Left Side | WMS-3-1 | 34 | Backplate Assembly | WMS-3-13 |
| 12 | 3/8" CV Tubing - Left Inlet | WMS-3-8 | 35 | 1/2" Nominal U-bolt | WMC-6-13 |
| 13 | Pressure Switch All except Oxygen | WME-4-4 | 36 | Flat Screen | 1134-1 |
| | Oxygen | WMS-4-4C | 37 | Case | WMC-8-9 |
| 14 | 1/8" x 11" Tubing | WLF-6-17 | 38 | Outer Gauge Plate | WMC-8-2 |
| 15 | Intermediate Regulator LC & LCMP series | WMS-3-3 | 39 | #10-1" Self tapping Screw | WMC-6-39 |
| | LCHP series | WMS-3-20 | 40 | Inner Gauge Plate | WMC-3-5 |
| 16 | Switch Wire Harness | WMS-1-13 | 41 | Screw Receptacle | WMC-6-35 |
| 17 | Reserve CV Tubing | WMS-3-11 | 42 | 3/8" Tubing, Safety Coupling | WMC-3-17 |
| 18 | 3/8" CV Tubing, Right Inlet | WMS-3-7 | 43 | 3/8" Tubing, Safety Nut | WMS-3-18 |
| 19 | Four-Way Valve | WMS-3-2 | 44 | 3/8" Tube Tee | WLF-3-14 |
| 20 | Intermediate Piping | WMS-3-4 | 45 | 90° Adaptor | 223 |
| 21 | Service CV Tubing | WMS-3-16 | 46 | 3/8" Tubing, Safety Vent | WMS-3-28 |
| 22 | Dual Light Lens | WME-8-40 | * | Case Lead Seal | WEM-1-27 |
| | | | * | #8 Sheet Metal Case Screw | WMC-6-23 |
| | | | * | Power Supply Box | 8570D |
| | | | * | Item Not Pictured. | |



| KEY # | DESCRIPTION | PART # |
|-------|--|----------|
| 1 | Cylinder Contents Gauge (400 psi) | WMG-3-4 |
| 2 | Line Pressure Gauge | |
| | LC Series (200 psi) | WMG-3-2 |
| | LCMP Series (200 pis) | WMG-3-2 |
| | LCHP Series (Except Nitrogen, 200 psi) | WMG-3-2 |
| | LCHP Series (Nitrogen, 400 psi) | WMG-3-4 |
| 3 | Gauge Plate | WMC-8-11 |
| 4 | 1/8" Tube x 1/4 NPT Female | WLF-3-4 |



| KEY # | DESCRIPTION | PART # |
|--------------|--|---------------|
| 1* | Poppet | WMV-1-5 |
| 2* | Spring | WMV-1-6 |
| 3* | Washer | WMV-1-7 |
| 4* | Cap | WMV-1-8 |
| * | Item included in repair kit Repair Kit for LC & LCHP Series | RK-1041 |