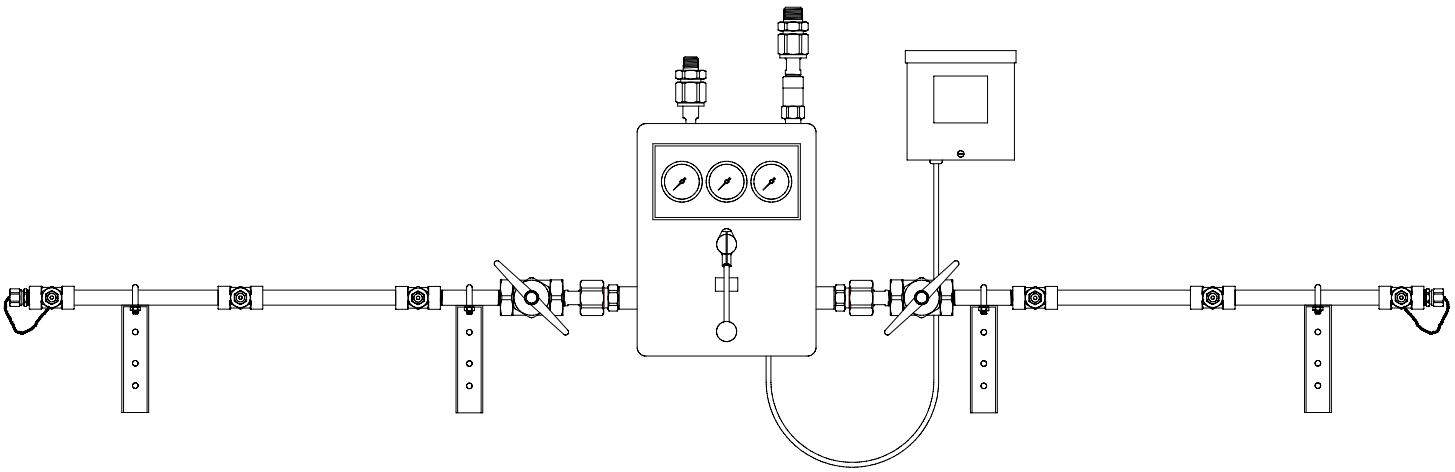
AUTOMATIC CHANGEOVER MANIFOLD

BI, BIHL, & BIHP Series

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 BI, BIHL, and BIHP 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 adhere to the following instructions may 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 and ignite when ignited when 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 3 inches. Mistreatment may cause the pigtail to burst.
- Do not apply heat. Some materials may react and ignite while 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.
- Do not leak test solution that contains ammonia. Solutions containing ammonia may cause the tubing to crack

ABBREVIATIONS

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

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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 in an industrial installation.

The manifold has an equal number of cylinders in its “Service” supply and “Reserve” supply banks, automatically switching to the “Reserve” supply when the “Service” supply becomes depleted. When the manifold changes to “Reserve” supply, it sends a signal to the gas alarm system (if installed) alerting the personnel of the need for the exhausted bank of cylinders to be replaced with full cylinders. 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

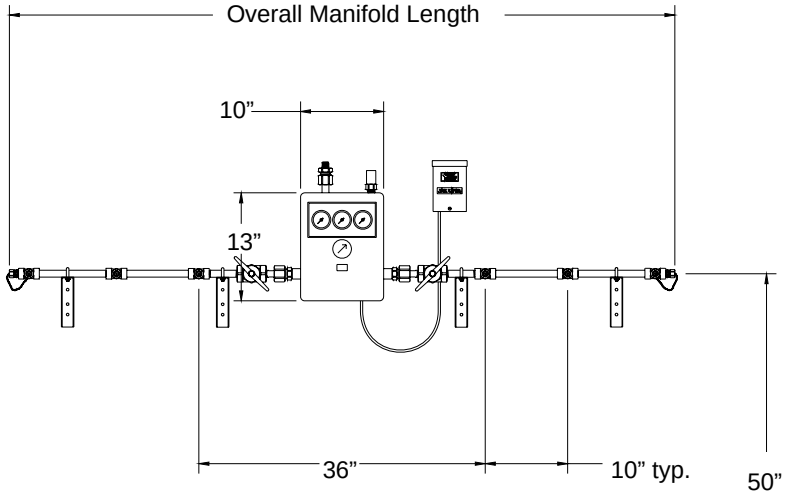
Manifolds should be installed in accordance with guidelines stated by the National Fire Protection Association, the Compressed Gas Association, OSHA, and all applicable local codes. The Carbon Dioxide and Nitrous Oxide manifolds should not be placed in a location where the temperature will exceed 120°F (49°C) or fall below 20°F (-7°C). The manifold for all other gases should not be placed in a location where the temperature will exceed 120° F (49° C) or fall below -20° F (-29° C). A manifold placed in an open location should be protected against adverse weather conditions including rain 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. The manifold should be located in a clean, well ventilated area which is free of oil and combustible materials.

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.

All safety relief valves including those on flash arrestor (BI acetylene systems) shall be piped outside.

CAUTION:

- Remove all protector caps prior to assembly. The protective cap may ignite due to heat of compression in an oxygen system.



Total number of cylinders	4	6	8	10	12
Overall manifold Length	5’-5”	7’-1”	8’-9”	10’-5”	11’-9”
Acetylene manifold length	5’-9”	8’-0”	10’-4”	12’-4”	14’-5”

Note: All dimensions are approximate.

Figure 1-1 *Installation Dimensions*

MANIFOLD SPECIFICATIONS

Flow Capability

Oxygen: 1200 SCFH maximum at 50 psig delivery with a 15 psi pressure drop and 2000 psig inlet pressure.
500 SCHF maximum at 50 psig delivery with a 5 psi pressure drop and 2000 psig inlet pressure.

Nitrogen: 1200 SCFH maximum at 160 psig delivery with a 15 psi pressure drop and 2000 psig inlet pressure.

Nitrous Oxide: Carbon Dioxide: The flow capability of Nitrous Oxide cylinder manifold will depend upon conditions at the installation site, demands of the delivery system, and the number of cylinders in supply service. Maximum capability is 500 SCFH at 50 psig delivery and 750 psig inlet pressure without adding additional heaters. Installing a Nitrous Oxide manifold in a location which exposes it to ambient temperatures below 20°F (-7°C) is not recommended.

Air Argon: 1200 SCFH maximum at 50 psig delivery and 15 psi inlet pressure and 2000 psig inlet pressure

Helium: Hydrogen 1200 SCFH maximum at 50 psig delivery and 15 psi inlet pressure and 2000 psig inlet pressure

Acetylene: 300 SCFH maximum at 15 psig delivery and 5 psi inlet pressure and 200 psig inlet pressure

Liquid Fuel: 400 SCFH maximum at 30 psig delivery and 7 psi inlet pressure and 100 psig inlet pressure

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)

Nitrous Oxide and Carbon Dioxide systems include a 500 SCFH capacity heater. The thermostatically controlled heater warms the gas before entering the regulator, preventing “freeze-up”. An amber light on the control indicates when the heater circuit is on. This heater light is not included on all BIHL units. The heater operates at 115 VAC and draws approximately four amperes

Piping Connections

Header Inlets:	Acetylene	CGA 300 or 510
	Carbon Dioxide	CGA 320
	Nitrous Oxide	CGA 326
	Air	CGA 346
	Hydrogen	CGA 350
	Liquid Fuel Gas	CGA 510
	Oxygen	CGA 540
	Argon	CGA 580
	Helium	CGA 580
	Nitrogen	CGA 580
	Argon/Methane	CGA 350

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)

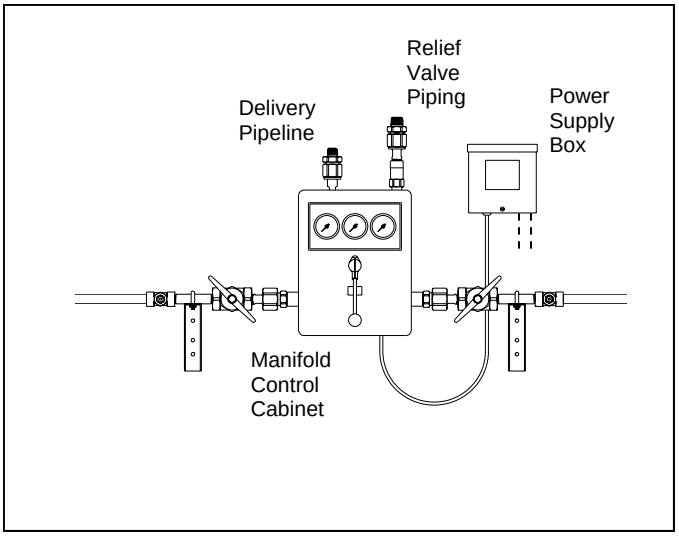


FIGURE 1-2 *Connection Locations*

ADJUSTMENT SPECIFICATIONS

Model	Primary Regulator	Primary Regulator Relief Valve	Low Pressure Switch	Intermediate Regulator	Intermediate Pressure Relief Valve	Line Regulator
BI (S/N < 14349)	*195-205	400	145-150	130-135	250	95-100
BI (S/N > 14349)	*195-205	400	145-150	130-135	375	95-100
BI-4 or BI-8 (S/N < 14349)	*195-205	400	145-150	130-135	250	95-100
BI-4 or BI-8 (S/N > 14349)	*245-255	400	145-150	130-135	375	95-100
BIHP (S/N < 14349)	*295-305	680	235-240	220-225	375	170-175
BIHP S/N > 14349)	*295-305	680	235-240	220-225	450	170-175
BIHL (S/N < 14349)	*195-205	400	145-150	130-135	250	95-100
BIHL (S/N > 14349)	*245-255	400	145-150	130-135	375	95-100
BI-1 & BI-1A	*55-65	N/A	35-40	25-30	N/A	10-15
BI-10	*60-70	N/A	50-55	40-45	N/A	30-35

Unit of measures: all units are in psig N/A = Not Applicable

***All regulator setting should be made with full cylinders. Regulator set pressures may vary from the listed values if partially filled cylinders are used for testing.**

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
5/8" 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 3/8”, 1 1/2", and 1 3/4”	Available from local source
Flourolube® S-30 lubricant	Manufactured by Occidental Chemical Corporation Niagara Falls, New York
Liquid leak detector	Available from Western Enterprises Part number LT-100 (Do not use leak test containing ammonia)
Teflon® tape	Available from Western Enterprises Part number MTT-1 or MTT-2

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

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 headers, 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: green “system normal” and red “replace depleted bank” indicator lights, cylinder pressure gauges, line pressure gauge, and intermediate relief valve. Supply banks consist of 24" stainless steel flexible pigtails with check valves, individual header valves*, master shut-off valves, and union connections for attachment to the control unit. The main components of the manifold are shown in Figures 2-1 through 2-3. Figures 2-4 and 2-5 show the piping schematic Figure 2-6 is the schematic diagram of the electrical system of the manifold. Figure 2-7 is the heater schematic.

The cylinder bank that supplies the piping system is known as the “Service” supply while the cylinder bank on stand-by is referred to as the “Reserve” supply. Gas flows from the cylinder through the pigtails, check valves, headers, and shut-off valves into the left and right inlets of the control section.

Gas flows through the manifold control to the primary regulators on all manifolds except those for Nitrous Oxide and Carbon Dioxide service (Nitrous Oxide and Carbon Dioxide systems include a 500 SCFH capacity heater. The thermostatically controlled heater warms the gas before entering the regulator, preventing “freeze-up” and loss of pressure due to the extreme low temperatures generated when these gases rapidly expand. Some systems include an amber light which indicates there is power to the heater). Tubing is connected from the high pressure port on the primary regulators to the cylinder pressure gauges to sense the pressure of the gas in the cylinders.

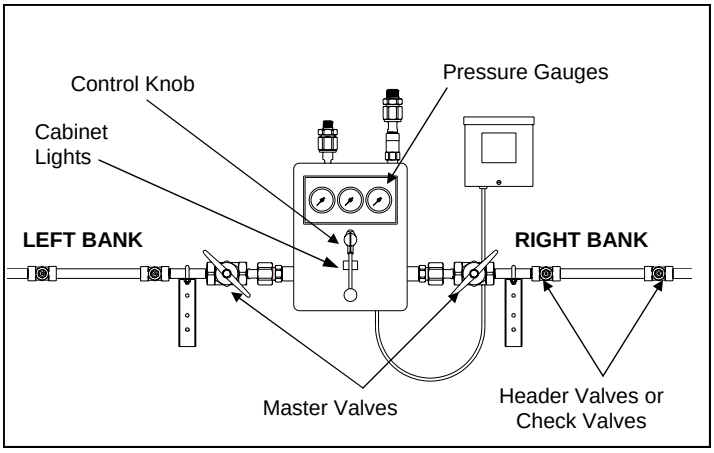


FIGURE 2-1 *External Components*

Pressure is regulated in the primary regulators to the pressure noted in the adjustment specification chart in Section 1. Both primary regulators are factory preset to deliver the same pressure. The primary regulators have two ports on the low pressure side. A safety relief valve is connected to one port. The other port is the outlet port and is connected via tubing to the four-way valve.

The gas flows from the primary regulators to the four-way valve. 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, the valve connects the tubing from the left primary regulator to the outlet tubing on the right and connects the tubing from the right primary regulator 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 primary regulator to the outlet tubing on the right and connects the tubing from the left primary regulator to the tubing leading to the intermediate regulator. Thus by turning the four-way valve knob, the operator may determine which bank of cylinders is the “Service” supply and which bank is the “Reserve” supply.

*Note Oxygen manifolds do not incorporate header valves. Manifolds without header valves are constructed utilizing a check valve outlet bushing.

LEGEND

1 - Outlet Adaptor	8 - Manifold Inlet
2 - Line Regulator	9 - High Pressure Gauge Tubing
3 - Intermediate Block	10 - Line Pressure Gauge Tubing
4 - Check Valve	11 - Low Pressure Switch
5 –Intermediate Regulator	12 - Intermediate Relief Valve
6 - Four Way Valve	13 - Primary Regulator Relief Valve
7 - Primary Regulator	14 - Test Port

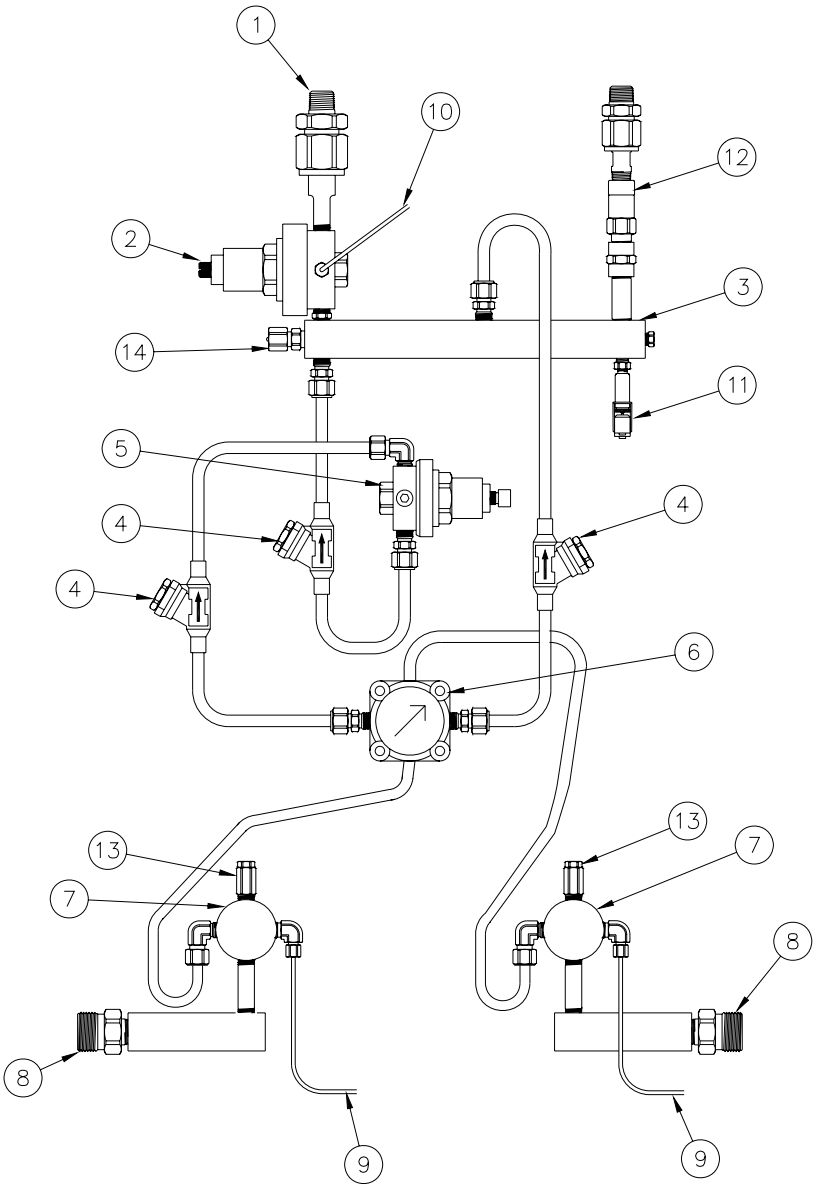


FIGURE 2-2 *Internal Components - BI & BIHP*

LEGEND

1 - Outlet Adaptor
2 - Line Regulator
3 - Intermediate Block
4 - Check Valve
5 –Intermediate Regulator
6 - Four Way Valve
7 - Primary Regulator
8 - Manifold Inlet
9 - High Pressure Gauge Tubing
10 - Line Pressure Gauge Tubing
11 - Low Pressure Switch
12 - Intermediate Relief Valve
13 - Primary Regulator Relief Valve
14 - Test Port
15 - Heater

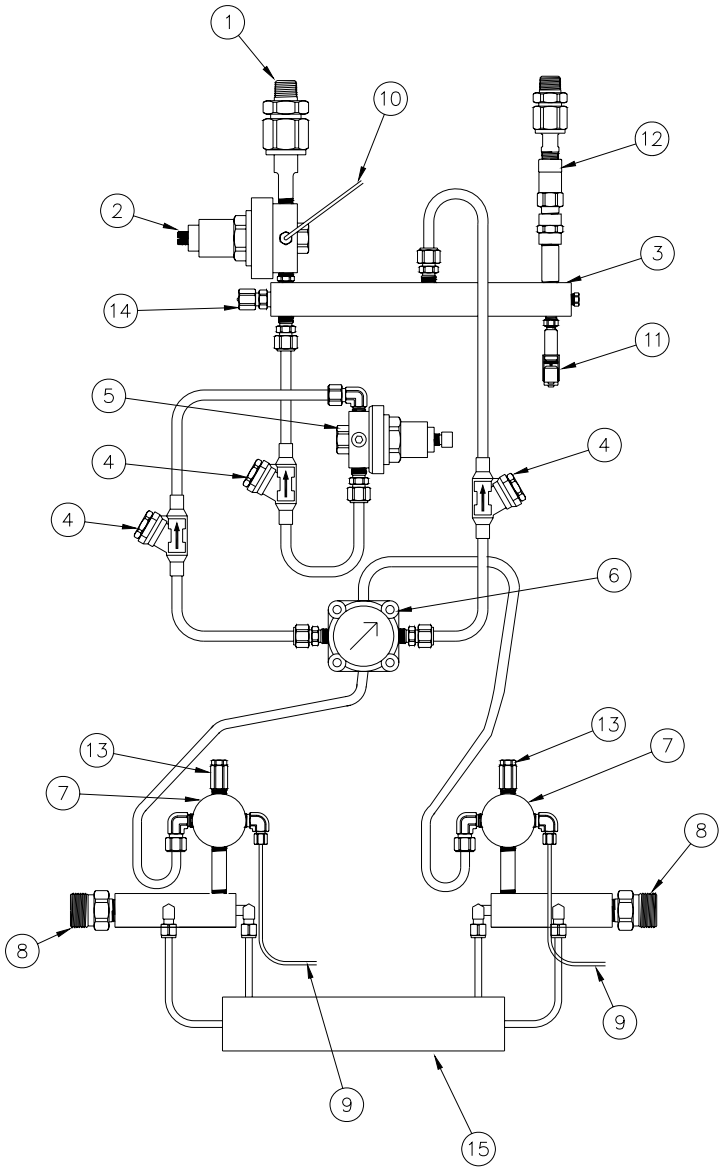


FIGURE 2-3 *Internal Components - BIHL*

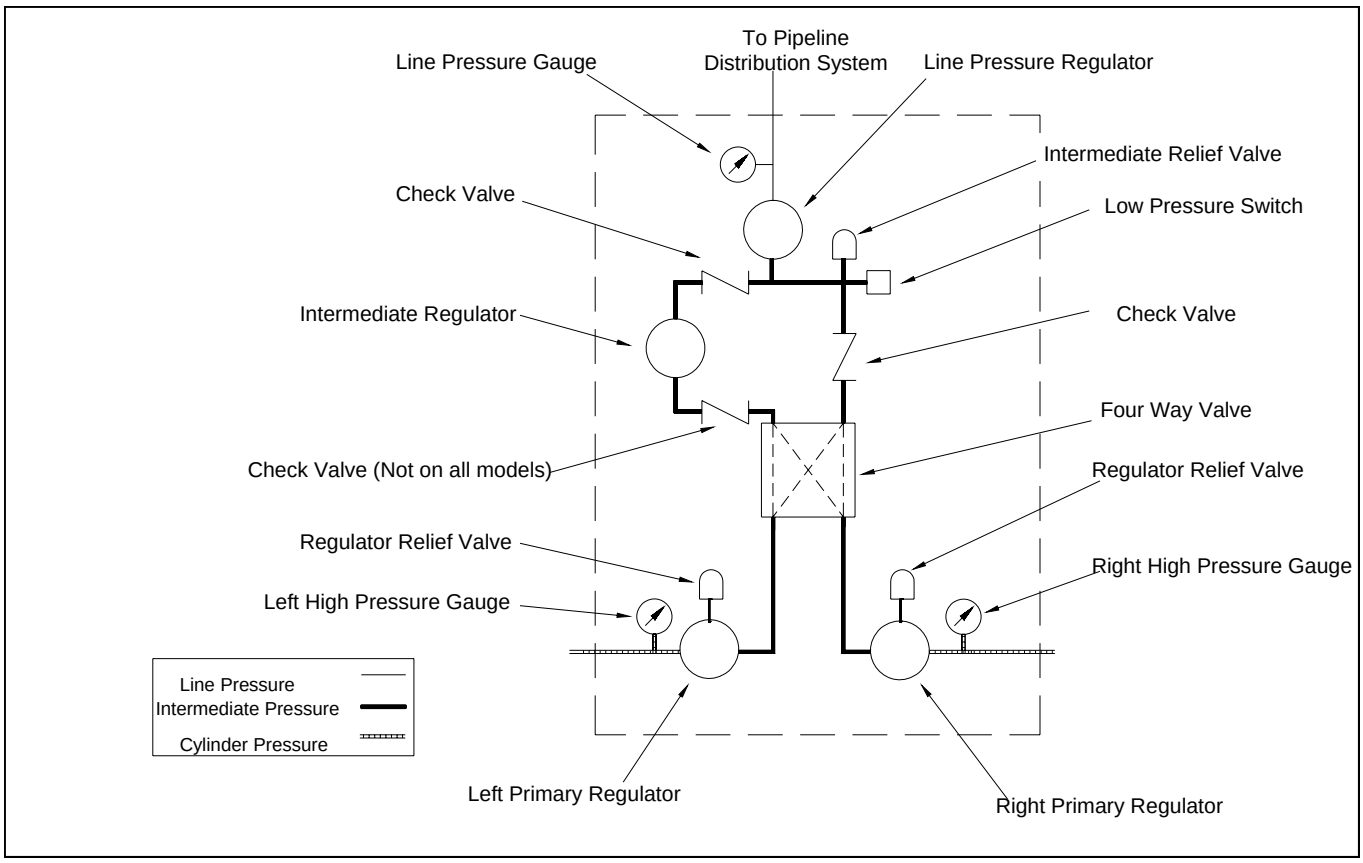


Figure 2-4 *Piping Schematic – BI & BIHP*

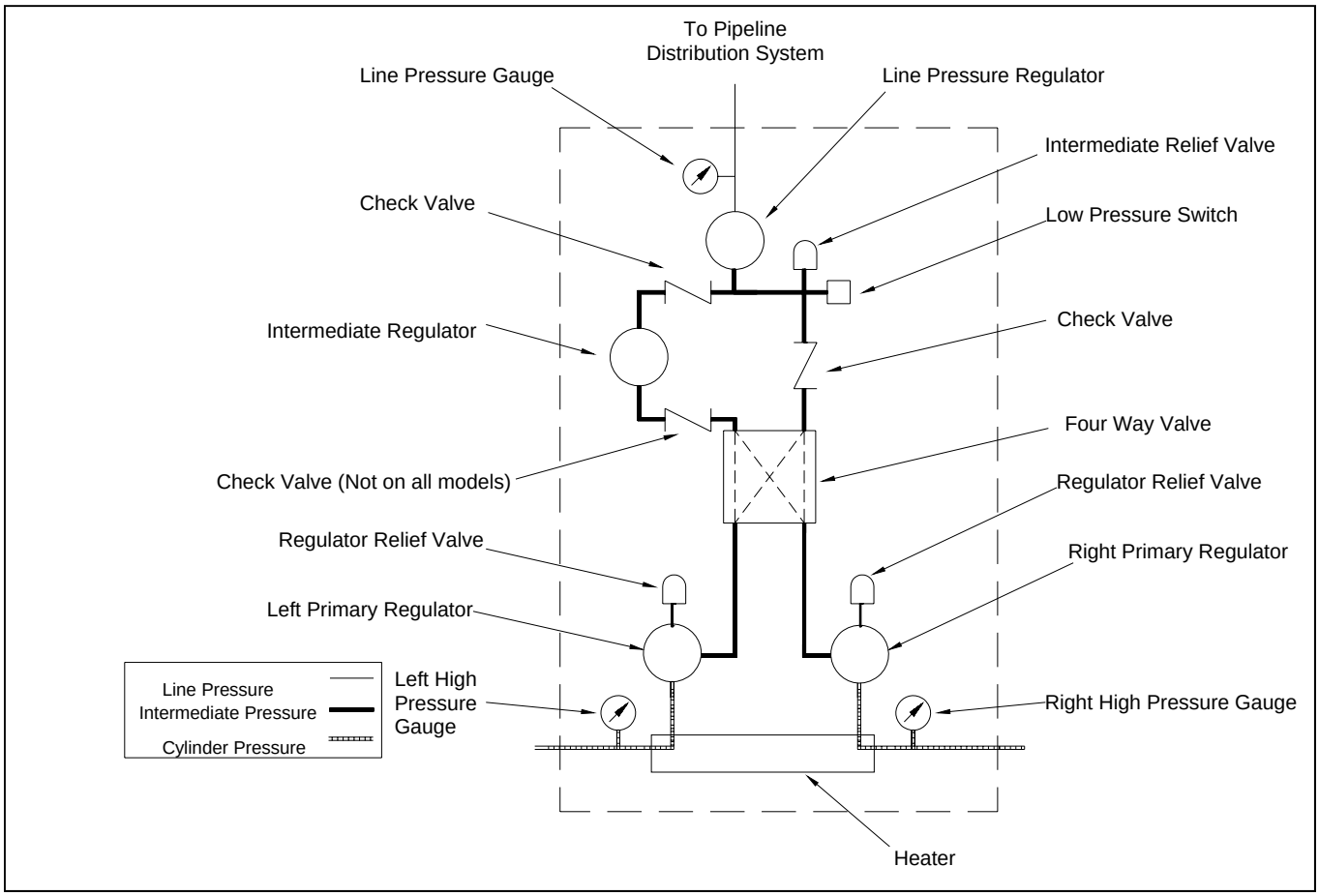


Figure 2-5 *Piping Schematic - BIHL*

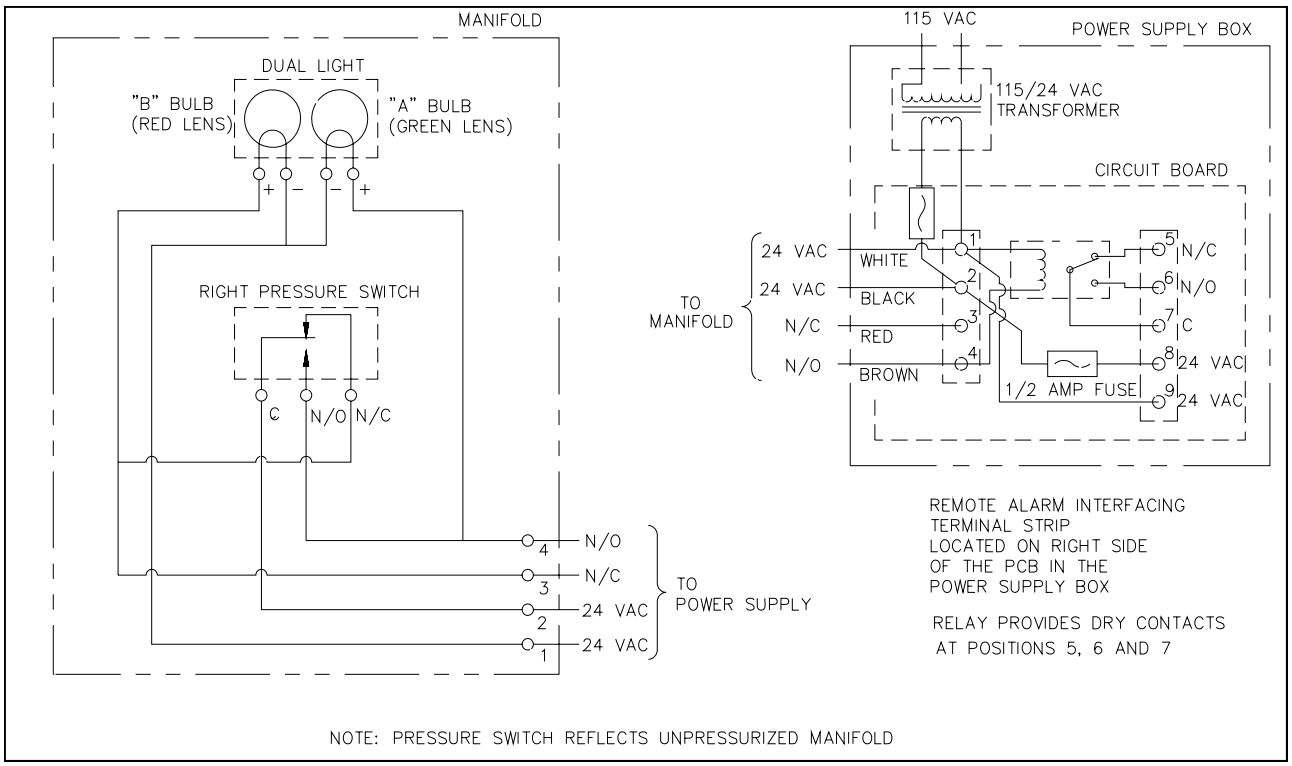


FIGURE 2-6 *Electrical Schematic (less heater)*

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 block assembly. A check valve is connected in-line between the four-way valve outlet and the intermediate block. This check valve prevents the gas from flowing backwards toward the four-way valve.

The intermediate block has seven ports all connected to the same chamber. The gas pressure at all ports is the same as the pressure at the inlet to the block. Gas enters the intermediate block from the “Service” supply through the tubing connected at the top center right. The upper right port of the block is connected to the intermediate pressure relief valve. The port on the right end of the intermediate block is plugged. The low pressure switch is connected to the lower right port. The lower left port is connected via tubing to the intermediate regulator. The left port has an adaptor for a test gauge used during manifold testing. The left top port connects the inlet of the line pressure regulator.

The intermediate pressure relief valve prevents over-pressurization of the intermediate controls of the manifold should the “Service” primary regulator fail. The relief valve setting is noted in the adjustment specification chart in Section 1.

The tubing connected between the intermediate block and intermediate regulator allows gas from the “Service” supply to flow back toward in intermediate regulator. A check valve is connected in-line between the intermediate regulator outlet and the intermediate block. 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 “Reserve”. A check valve is connected in-line between the four-way valve outlet and the intermediate regulator. This check valve prevents the gas from flowing backwards towards the four-way valve.

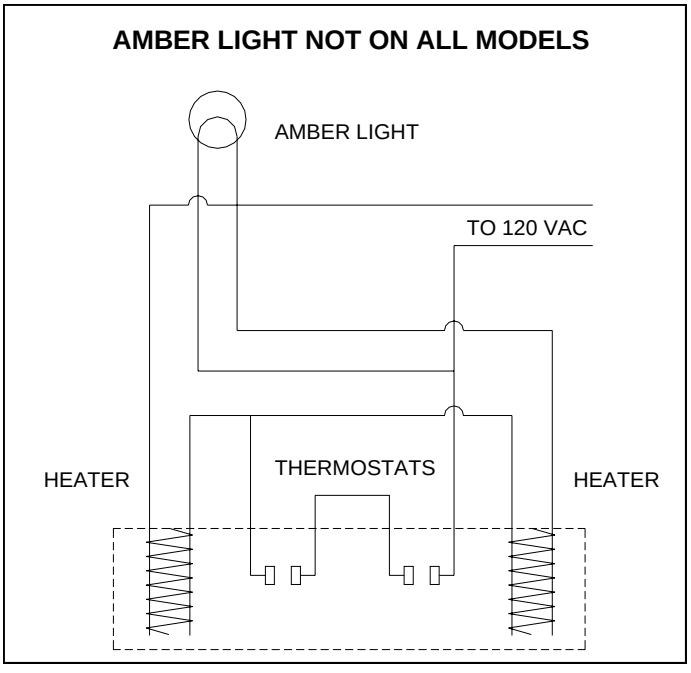


Figure 2-7 *Heater Electrical Schematic*

Gas from the “Reserve” supply flows from the four-way valve through the check valve and the intermediate regulator towards the bottom of the second check valve. When the gas pressure on the top side of the valve falls to predetermined pressure, the valve opens and routes the gas from the “Reserve” supply into the intermediate block and then to the line pressure regulator.

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 three outlet ports. One outlet port is plugged. Tubing is connected from the second port to the line pressure gauge to sense the pressure of the gas on the downstream side of the regulator. The other port is the outlet and is located 180° from the inlet.

The gas flows from the line regulator outlet to the pipeline distribution system.

When both cylinder banks are full, the switch completes the electrical circuit to the green “system normal” light. Cylinder 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.

As the gas from the “Service” supply is depleted, the gas pressure to the “Service” primary regulator 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 “system 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 intermediate regulator. The “Reserve” supply begins to supply the system.

After replacing the empty cylinders and opening the master valve and cylinder valves, the cylinder 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 cylinder bank. This will make the partially used “Reserve” bank the “Service” supply and the newly installed cylinders will become the “Reserve” supply.

PRIMARY REGULATOR

The primary regulator's function is to reduce the cylinder pressure of the supply banks to a more useable pressure.

Gas enters the regulator through the inlet port and fills the high pressure chamber and the port to the cylinder contents gauge with gas (Figure 2-8). Gas in these areas is at the same pressure as the gas in the cylinders. The gas is sealed in this camber by the seat holder and stem being pushed against the nozzle seal by gas pressure and the body spring. An o-ring seals between the nozzle and the regulator body.

The next area of the regulator is the low (regulated) pressure area of the regulator. This chamber is sealed from the high pressure area by the seat/nozzle assembly and the o-ring around the nozzle and is isolated from the atmospheric pressure by the diaphragm sub-assembly forming a seal around the body of the regulator. The diaphragm is squeezed between the body of the regulator, a slip ring, washer, and the regulator bonnet as the bonnet is tightened down on the body.

The third chamber of the regulator is open to atmospheric pressure. This chamber contains the regulator bonnet, adjusting screw, pivot, bonnet spring, washer, and the top side of the diaphragm sub-assembly.

As the adjusting screw is turned in against the pivot the bonnet spring is compressed an puts a downward force on the diaphragm sub-assembly. The bottom of the diaphragm sub-assembly is in direct contact with the seat holder and stem. When the diaphragm is forced down by the spring, the stem 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 sub-assembly. 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.

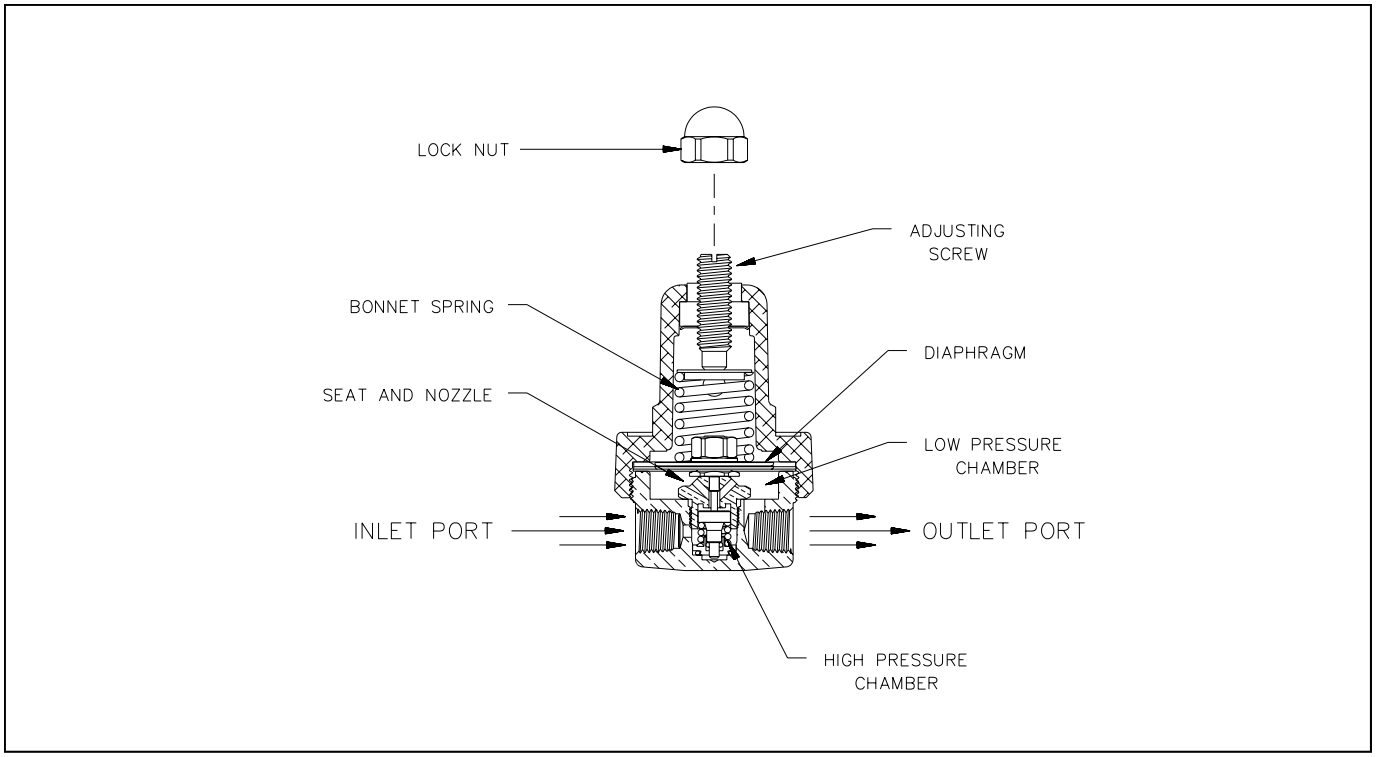


Figure 2-8 *Primary Regulator*

FOUR-WAY VALVE

The four-way valve assembly is used to route the gas from the primary regulators to either the intermediate block 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 2-9.

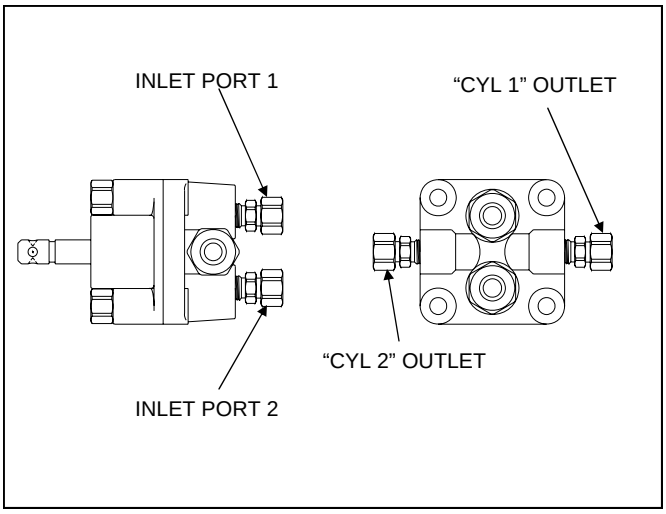


FIGURE 2-9 Four-Way Valve

Figure 2-10a shows the position of the valve ports when the right bank of cylinders 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 primary regulator routed to the intermediate block and the gas from the left primary regulator is routed to the intermediate regulator.

Figure 2-10b 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 2-10c shows the position of the valve ports when the left bank is the "Service" bank and the right bank is the "Reserve".

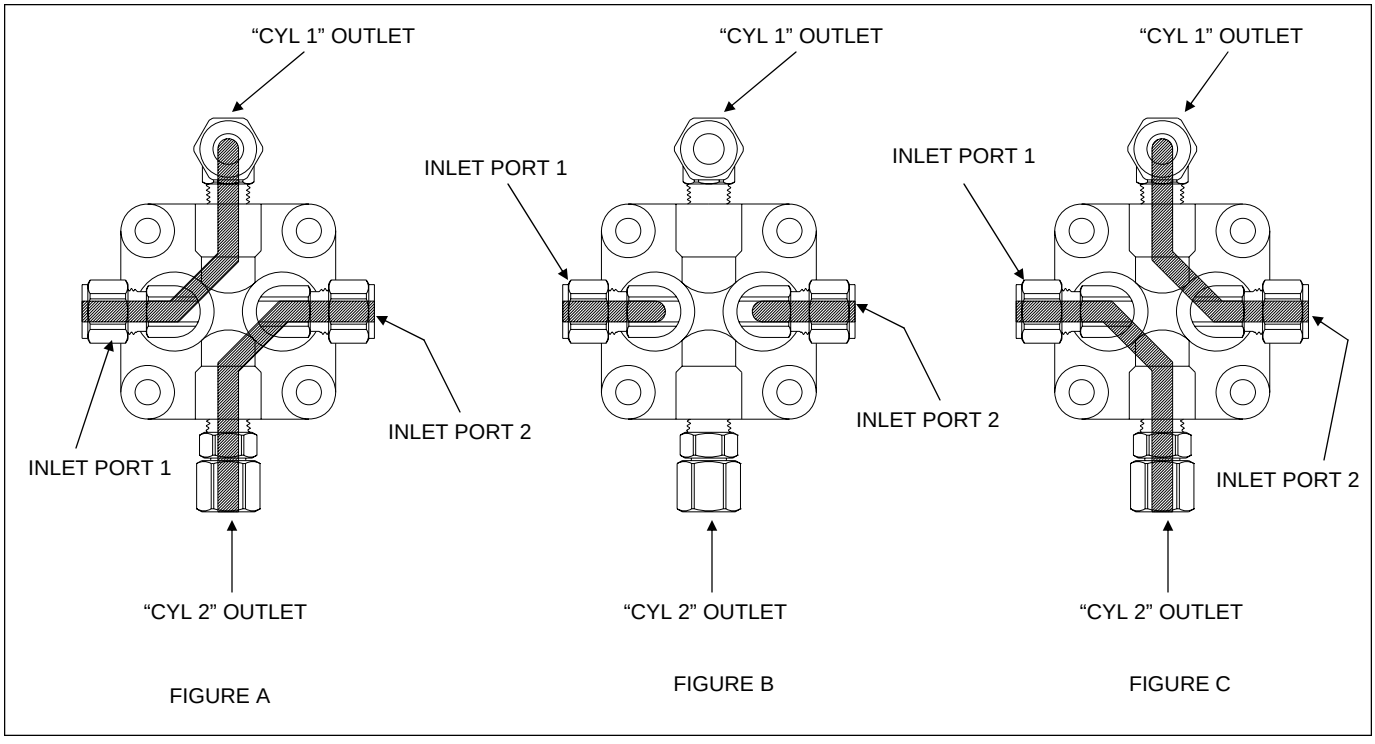


FIGURE 2-10 Four-Way Valve

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

CHECK VALVES

The check valves prevent gas from flowing backward, from the four way valve to the inlets. See Figure 2-11.

Gas enters the check valve from the four-way valve 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.

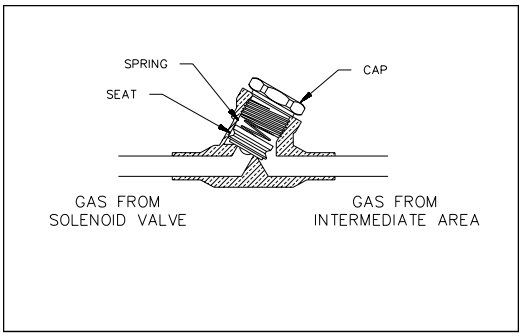


FIGURE 2-11 *Check Valve*

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 2-12 and 2-13.

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

INTERMEDIATE REGULATOR

The intermediate regulator controls the gas flow from the reserve bank of cylinders to the intermediate block. The intermediate regulator pressure setting is the pressure at which the manifold will switchover 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 block. Check valves are located immediately upstream and immediately downstream of the regulator.

The regulator is comparable to the line regulator illustrated in Figure 2-14 and 2-15. 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 banks are full and the regulators properly adjusted, the pressure on the downstream side of the valve is greater than the intermediate regulator pressure.

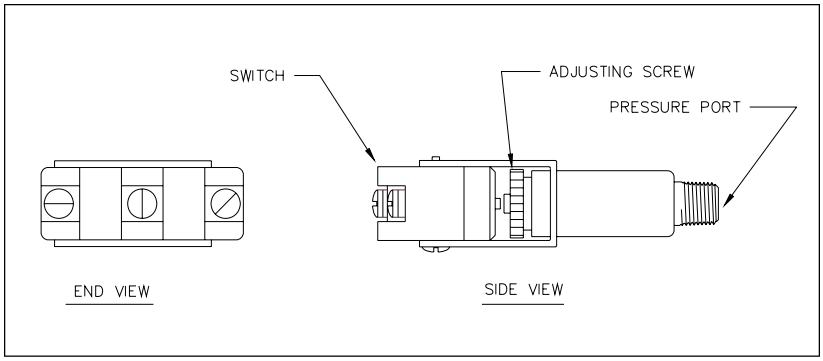


FIGURE 2-12 *Low Pressure Switch*

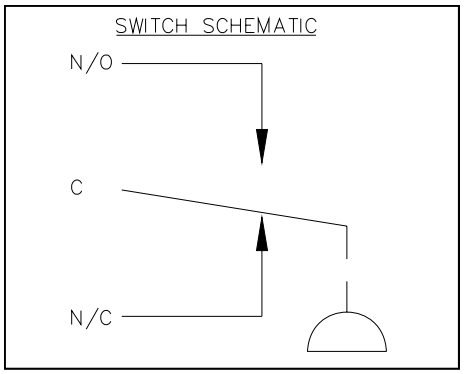


FIGURE 2-13 *Switch Schematic*

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.

As the gas pressure in the “Service” bank of cylinders drops below the setting of the primary regulator, the gas pressure from the “Service” bank primary regulator will begin to fall. 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 cylinders will begin to supply the system.

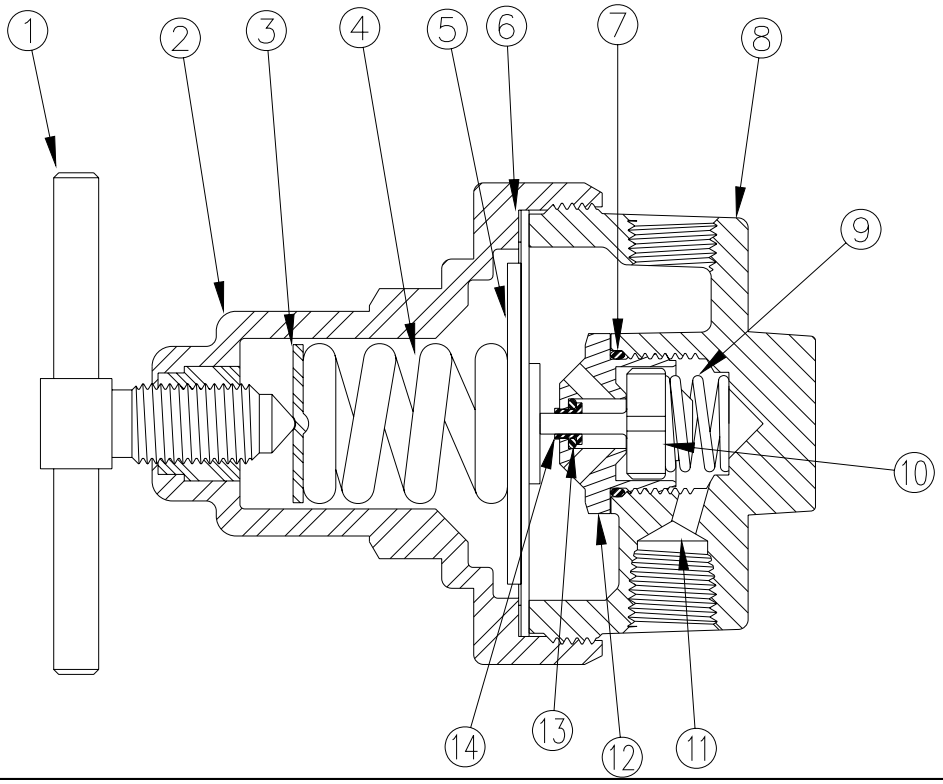
LINE PRESSURE REGULATOR

The line pressure regulator used in the manifold is a single stage, four port adjustable regulator. Refer to Figure 2-14 and Figure 2-15. It has one inlet port and three outlet port. The inlet port is piped to an intermediate pressure port in the manifold block. One outlet port is piped to the outlet of the manifold for connection to the main pipeline. One port is connected to the delivery line pressure gauge and the other port is plugged.

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 subassembly. 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.

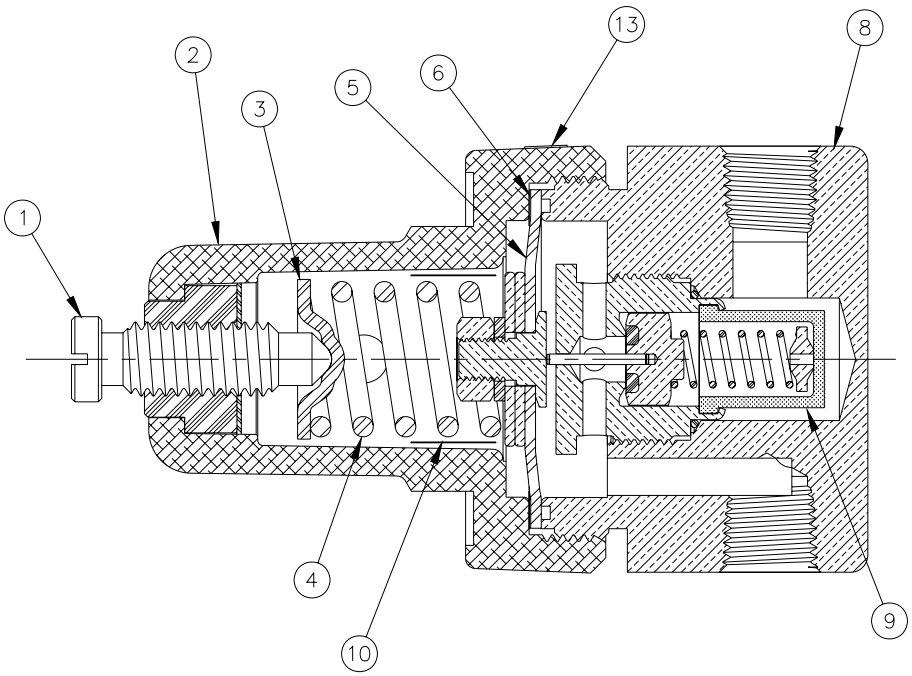
When the low pressure chamber fills with gas, the gas will push upward against the diaphragm subassembly. As the pressure continues to build in the low pressure chamber, more upward force will be exerted against the diaphragm and the diaphragm will push up against the bonnet spring compressing the bonnet 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.



LEGEND

1. Adjusting Screw
2. Bonnet Assembly
3. Pivot
4. Adjusting Screw
5. Diaphragm Assembly
6. Slip Ring
7. O-ring
8. Body
9. Valve Spring
10. Seat Assembly
11. Filter Screen
12. Nozzle
13. O-ring
14. Friction Damper

Figure 2-14 Line Pressure Regulator (Victor)



LEGEND

1. Adjusting Screw
2. Bonnet Assembly
3. Pivot
4. Adjusting Screw
5. Diaphragm Assembly
6. Slip Ring
7. O-ring
8. Body
9. Seat Capsule
10. Friction Damper

Figure 2-15 Line Pressure Regulator (Western)

FIELD TESTING & TROUBLE SHOOTING

The manifold performance tests are use 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 block.
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. Open the master valves located on the cylinder headers prior to pressurizing the manifold.
7. **S-l-o-w-l-y** open one cylinder valve on the left bank of cylinders.
8. **S-l-o-w-l-y** open one cylinder valve on the right bank of cylinders.
9. Using a leak detect solution, verify that there are no leaks present at the connections.
10. Close the cylinder valves on the left and right banks.
11. 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.
12. Tighten the union connection to the main supply line.
13. **S-l-o-w-l-y** open one cylinder valve on the left bank cylinders. (cylinder should be full).
14. Create a slight flow of gas through the manifold outlet or test port. The test gauge should settle and remain constant.
15. Turn off the flow of gas through the manifold.
16. Verify that the test gauge indicates the pressure shown in the specification chart in Section 1 for the primary regulator.
17. Observe the test gauge for two minutes. Very that the primary regulator does not exhibit “creep” or an increase in pressure.
18. Verify that the left side cylinder contents gauge indicates a full cylinder.
19. Verify that the line pressure gauge is indicating a minimum of 30 psig on all systems except Nitrogen. Nitrogen should indicate a minimum of 50 psig. Adjust to the proper line pressure if necessary.
20. Loosen the union connection to the main supply line to create a slight flow of gas through the manifold.
21. Observe the test gauge and verify the primary regulator setting under a flow condition. Adjust the left primary regulator as necessary to obtain the required pressure.
22. Turn off the left cylinder valve and allow all gas to vent from the manifold.
23. Tighten the main supply line union.
24. Rotate the control knob to its fully clockwise position.
25. **S-l-o-w-l-y** open one cylinder valve on the right bank of cylinders. (cylinder should be full).

26. Complete steps 14-22 for the right primary regulator.

27. Tighten main supply union.

28. 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.

29. Loosen the union connection to the main supply line to create a constant pressure by observing the line pressure gauge.

30. Verify that the line pressure regulator maintains a constant pressure by observing the line pressure gauge.

31. **S-l-o-w-l-y** open one cylinder valve on the left bank of cylinders.

32. Observe the cylinder contents pressure gauges to verify cylinder pressure.

33. Close the cylinder valve on the right bank of cylinders.

34. Observe the cylinder contents gauges: the right cylinder bank gauge should begin to drop; the left cylinder bank gauge should remain constant. (Note: test gauge may rise before dropping).

35. Observe the test gauge as the right side pressure continues to drop. As the cylinder 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 n Section 1). Adjust the intermediate regulator as necessary to obtain the required pressure.

36. **S-l-o-w-l-y** open one cylinder valve on the right bank of cylinders.

37. Verify that the test gauge has returned to the set pressure of the primary regulator.

38. Rotate the control knob counterclockwise to make the left bank the service supply.

39. Close the cylinder on the left bank of cylinders.

40. Observe the cylinder contents gauges; the left cylinder bank gauge should begin to drop; the right cylinder bank gauge should remain constant. (Note: test gauge may rise before falling).

41. 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 n Section 1).

42. Tighten the main supply line union.

43. 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.

44. **S-l-o-w-l-y** open one cylinder valve on the left bank of cylinders.

45. Create a slight flow of gas through the manifold outlet or test port. The test gauge should settle and remain constant.

46. Turn off the flow of gas through the manifold.

47. Verify that the test gauge has returned to the set pressure of the primary regulator.

48. 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.

49. Close the cylinder valve on the left bank of cylinders.

50. Loosen the union connection to the main supply line to create a slight flow of gas through the manifold.

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 Section 1.

52. **S-l-o-w-l-y** open one cylinder valve on the left bank of cylinders.

53. Verify that the ohmmeter returns to approximately zero (0) ohms resistance.

54. Rotate the control knob clockwise to make the right bank of cylinders the service supply.

55. Close the cylinder valve on the right bank of cylinders.

56. 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.

57. **S-lo-w-l-y** open one cylinder valve on one right bank of cylinders.

58. Verify that the ohmmeter returns to approximately zero (0) ohms resistance.

59. Close all cylinder valves and vent all remaining gas from the manifold.

60. Remove the ohmmeter leads from the black and brown wires.

61. Remove the test gauge from the test fitting and reinstall the test cap.

62. Tighten the main supply line union.

63. **S-l-o-w-l-y** open one cylinder valve on one right bank of cylinders.

64. Using a leak test solution, verify that there are no leaks present at the test cap fitting.

65. Close the cylinder valve on the right bank of cylinders.

66. 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.

67. Remove the control knob from the four-way valve.

68. Reinstall the manifold section cover as explained in Section 4.

69. Connect the electrical power source and supply electric power to the manifold.

70. Observe the cabinet system status indicators. Verify that the green indicator is shut off and the red indicator is lit.

71. **S-l-o-w-l-y** open one cylinder valve on one left and right bank of cylinders.

72. Observe the cabinet system status indicators. Verify that the green indicator is lit and the red indicator is off.

73. Readjust the line regulator setting if it was modified during cover installation.

74. Close the cylinder valve on the right bank of cylinders.

75. Loosen the main supply union to create a slight flow of gas through the manifold.

76. Verify that the red light illuminates and the green light is extinguished when the manifold changes over from service to reserve supply.

77. **S-l-o-w-l-y** open one cylinder valve on one right bank of cylinders.

78. Rotate the control knob counterclockwise to make the left bank the service supply.

79. Observe the cabinet system status indicators. Verify that the green indicator is lit and the red indicator is off.

80. Close the cylinder valve on the left bank of cylinders.

81. Verify that the red light illuminates and the green light is extinguished when the manifold changes over from service to reserve supply.

82. Tighten the main supply line union and test for leaks using a leak detect solution

83. **S-l-o-w-l-y** open all cylinder valves on the left and right bank of cylinders.

84. Rotate the control knob to select the bank of cylinders supplying the system before service was performed.

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.	Master valve, header valves, or. cylinder 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.
	Service primary regulator setting too low.	Set primary regulator 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 cylinders.
	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 a high 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 master valves, headers valves, or cylinder valves.	Slowly open valves.
	Empty cylinders.	Replace with full cylinders.
	Primary regulator setting 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. (Nitrous Oxide or Carbon Dioxide)	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 regulator seat and nozzle components.
	Overpressure due to creeping or faulty regulation by line regulator.	Replace regulator seat and nozzle components.
	Regulator freeze-up. (Nitrous Oxide or Carbon Dioxide)	Reduce the flow demand or increase the number of supply cylinders.
	Heater Failure. (Nitrous Oxide or Carbon Dioxide)	Reduce the flow demand or increase the number of supply cylinders.
Gas leakage around regulator body or bonnet.	Loose bonnet.	Tighten bonnet.
	Diaphragm leak on regulator.	Replace diaphragm.
Gas leakage around valve stem or packing nut on master valve or header valves.	Valve packing leaks.	Tighten bonnet.
	Faulty valve.	Replace diaphragm.
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.

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.
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.
No changeover.	Close cylinder or shutoff valves.	Open valves.
	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

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 standard of performance and safety of the product.

GENERAL MAINTENANCE

1. Main section.
   a) Daily - record line pressure.

   b) Monthly
      1) Check regulators, compression fittings and valves for external leakage.
      2) Check valves for closure ability.

   c) Annually
      1) Check relief valve pressures.
      2) Check primary regulator seats.

3. Manifold header
   a) Daily - observe Nitrous Oxide and Carbon Dioxide systems for cylinder frosting or surface condensation. Should excessive condensation or frosting occur it may be necessary to increase manifold capacity.

   b) Monthly
      1) Inspect valves for proper closure.
      2) Check cylinder pigtails for cleanliness, flexibility, wear, leakage, and thread damage. Replaced damaged pigtails immediately.
      3) Inspect pigtail check valves for closure ability.

   c) Every 4 years.
      1) 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 before exposing the parts to high pressure gas.**

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 (except for Hydrogen manifolds).

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 re-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). Do NOT use solution containing ammonia on Acetylene manifolds. The ammonia may cause stress cracks in the brass tubing.

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. Systems still running on the manifold gas line 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.

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.

6. Carefully pull the cover straight out to clear internal components.
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 REPLACMENT

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. When retightening the fitting procedures outlined on page 4-2 shall be followed.

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.

PRIMARY REGULATOR REPAIR

NOTE:
- Removal and Replacement Procedures are to be followed only in the primary regulator assembly is to be scrapped. All service may be performed to the primary 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 a 11/16” open end wrench, disconnect the outlet tubing from the regulator at the compression fitting.

2. Mark the compression fittings per the instructions on page 4-2. Using a 7/16” open end wrench, disconnect the gauge tubing from the regulator at the compression fitting.

3. Using a 1 3/8” hex wrench and a 1 3/4” hex wrench disconnect the header from the inlet block to the manifold at the union connection.

4. Using a 3/8” hex wrench, remove the hex nuts and lock washers from the two carriage bolts holding the inlet block to the backplate.

5. Using a soft face hammer, tap gently on the end of the carriage bolts to loosen them. Reach behind the backplate and pull the bolts out with one hand while holding the regulator and inlet block with the other.

6. Remove the inlet block and primary regulator from the control section and clamp the block assembly in a vise.

7. To remove the regulator from the inlet block, grasp the bonnet of the regulator and rotate the regulator counterclockwise.

Disassembly

1. Remove the acorn nut from the regulator by turning it counterclockwise using a 3/4” hex wrench.

2. Using a flat blade screwdriver, turn the adjusting screw counterclockwise until it turns freely and all compression is removed from the bonnet spring.

3. Using a 1 3/8” hex wrench, rotate the bonnet counterclockwise and remove it along with the pivot, bonnet spring, washer, slip ring, and diaphragm sub-assembly.

4. Using a 13/16” hex socket wrench, rotate the nozzle counterclockwise and remove it along with the seat holder and stem, compensating spring, and the spring retainer.

5. Clean all interior surfaces of the regulator body with isopropyl alcohol or 1,1,1 trichloroethylene solvent.

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

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

Reassembly

1. Apply a thin coating of Flourolube® S-30 lubricant to the o-rings.

Note: steps 2-6 are not applicable to Oxygen regulator cartridge valve assemblies.
(manifold S/N 7969 through 11348)

2. Assemble small o-rings with the spring retainer. Push the smaller o-ring to the bottom of the bore it rests in.

3. Assemble the large o-ring with the nozzle.

4. Insert the new seat holder and stem into the nozzle. The silver colored end of the seat holder and stem must enter the nozzle first.

5. Place the compensating spring over the seat holder and stem.

6 Place the compensating spring retainer on the compensating spring. The boss on the retainer will enter the internal diameter of the spring and the larger o-ring will now be on top. (Not all assemblies use an o-ring in this area).

7. Grasp the flats of the nozzle with one hand and carefully guide the seat/nozzle assembly into the body of the regulator until the threads are engaged. Rotate the nozzle clockwise and hand tighten.

8. Using the 13/16” hex socket and torque wrench, tighten the nozzle to approximately 5 ft-lbs. torque.

9. Lubricate the outer (regulator body to diaphragm) sealing surface of the regulator body with a small amount of water. Do not allow water to enter the low pressure chamber of the regulator.

10. Hold the bonnet upside down and place the pivot and bonnet spring in the bore provided. The small diameter of the pivot should enter the internal diameter of the spring.

11. Place the washer in the large bonnet cavity, beveled side up.

12. Lay the slip ring on top of the washer.

13. Insert the diaphragm sub-assembly in the bonnet cavity. The side marked “UP” should be against the slip ring.

14. Carefully place the bonnet on the regulator body. Rotate the bonnet clockwise and tighten to 85-95 ft-lbs. torque.

Replacement

1. Secure the inlet block 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 trichloroethylene 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 inlet block. Blow out the inlet block 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 threads on the regulator inlet nipple. Start the threads of the nipple into the inlet block.

5. Position the inlet of the regulator over the nipple and rotate the regulator clockwise to tighten the threads.

6. Grasp the bonnet of the regulator and rotate the regulator clockwise until tight. The bonnet of the regulator must be perpendicular to the inlet block.

7. Remove the inlet block from the vise.

8. Position the inlet block assembly in the control section and install the carriage bolts, lock washers, and nuts. Using a 3/8” hex wrench, tighten securely.

9. Connect the inlet of the block to the union connection of the header using a 1 3/8” hex wrench and a 1 3/4” hex wrench.

10. When retightening the fitting the procedure outlined on page 4-2 shall be followed. Using a 7/16” open end wrench, connect the outlet tubing to the 1/8” tube compression fitting located on the right side of the regulator, 90° from the regulator inlet.

11. When retightening the fitting the procedure outlined on page 4-2 shall be followed. Using and 11/16” open end wrench, connect the outlet tubing to the 3/8” tube compression fitting located on the left side of the regulator, 90° from the regulator inlet.

Primary Regulator Adjustment

1. If not already done, shutdown the manifold as explained earlier in this section, remove the manifold cover, attach a test gauge to the left side of the intermediate pressure block, and remove the acorn nut from the primary regulator.

2. Reinstall the control knob on the four-way valve and rotate the knob to select the side the regulator to be adjusted is on.

3. **S-l-o-w-l-y** open one cylinder on the side of the regulator to be adjusted.

4. Verify the cylinder pressure gauge indicated the minimum pressure of 1500 psig on Oxygen, Air, and Nitrogen systems or a minimum of 600 psig on Nitrous Oxide and Carbon Dioxide systems.

5. Using a flat blade screwdriver, turn the adjusting screw of the regulator in while observing the test gauge. Set the regulator to the pressure indicated on the Adjustment Specification chart in Section1.

6. Loosen the main supply union to create a slight flow of gas through the manifold.

7. Readjust the regulator to the proper specifications if necessary.

8. Tighten the union connection to the main supply line. The line pressure gauge will go up slightly higher than the flowing adjusted pressure.

9. Verify that the regulator does not creep by observing the test gauge for two minutes. The gauge must indicate the same pressure at the end of the two minute period.

10. Close the cylinder valve.

11. Loosen the main supply line union and vent all remaining gas from the manifold.

12. Tighten the union connection to the main supply line after the gas pressure has been exhausted from the manifold.

13. Install the acorn nut on the primary regulator.

LOW PESSURE 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 between the pressure switch and the intermediate block 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 intermediate block adaptor. Blow out the intermediate block 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 one cylinder on the 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 reactuation 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 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.

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 intermediate block.

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.

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 primary regulator to four-way valve tubing sections and the two check valve tubing assemblies.)

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 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.

Replacement

1. Apply Teflon® tape to the 1/4 NPT male pipe threads on the compression fittings.

2. Secure the new four-way valve in a vise.

3. Install the 1/4 NPT x 3/8” tube straight compression fittings in the ports on the four-way valve using a 5/8” open end wrench.

4. Remove the valve port 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.

5. Reinstall the two screws through the bracket and into the two upper threaded holes of the valve. Tighten with a phillips screwdriver.

6. Reconnect the inlet tubing assemblies to the new valve.

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. 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 block 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. Rotate the adjusting screw of the regulator counterclockwise and remove.

3. Remove the bonnet by holding the body hex with a wrench to stabilize the assembly and using another wrench to loosen the bonnet. The adjusting spring and pivot will come off with the bonnet.

4. Remove the diaphragm assembly and slip ring.

5. Using a 5/8” socket wrench, rotate the nozzle counterclockwise and remove the nozzle.

6. Grasp the stem of the seat and pull the seat, compensating spring, gland, and friction washer from the regulator body.

7. Remove the gasket from the regulator body with a pair of tweezers.

8. Clean all interior surfaces of the regulator body with isopropyl alcohol or 1,1,1 trichloroethylene solvent.

CAUTION:

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

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

Reassembly

1. Install the compensating spring, gland, and friction washer on the stem.

2. Position the stem assembly in the body of the regulator.

3. Install the nozzle over the stem and rotate clockwise to engage the threads. Use a 5/8” socket wrench and tighten securely.

4. Hold the bonnet upside down and place the pivot and bonnet spring in the bore provided. The small diameter of the pivot should enter the internal diameter of the spring.

5. Lay the slip ring in the large bonnet cavity.

6. Insert the diaphragm sub-assembly in the bonnet cavity. Make sure backup plate and nut face the spring.

7. Carefully guide the bonnet over the body of the regulator until the threads engage. Rotate the bonnet clockwise and tighten. Using a wrench to stabilize the body, tighten the bonnet using 50-60 ft-lb. of torque.

8. Loosely install the adjusting screw in the bonnet.

9. 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 **IN**.

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 in this section, remove the manifold cover, attach a test gauge to the left side of the intermediate pressure block. 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 cylinder pressure gauge indicates the minimum inlet pressure of 1500 psig on Oxygen, Air, and Nitrogen systems or a minimum of 600 psig on Nitrous Oxide and Carbon Dioxide systems.

4. Verify a test gauge pressure indicating the primary regulator setting per the Adjustment Specification chart in Section 1. Adjust the primary regulator pressure as necessary to obtain the required pressure setting.

5. Rotate the control knob so that the arrow of the four-way valve is pointing to the opposite bank of cylinders.

6. Loosen the main supply union slightly to relieve pressure from the manifold while observing the test gauge.

7. 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.

8. Tighten the union connection to the main supply line.

9. Simulate the changeover sequence from both sides and observe the intermediate gauge to verify proper setting.

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 block 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 block 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 regulator.

4. Disconnect the intermediate pressure relief valve from the building's vent line.

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. Using a 3/8" hex wrench, remove the nut and washer from the carriage bolt holding the intermediate block to the bracket and remove the bolt and the intermediate block.

9. Secure the intermediate block 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. Rotate the adjusting screw of the regulator counterclockwise with a flat blade screwdriver and remove.

2. Remove the bonnet by holding the body hex with a wrench to stabilize the assembly and using another wrench to loosen the bonnet. The adjusting spring and pivot will come off with the bonnet.

3. Remove the diaphragm assembly and slip ring.

4. Using the appropriate socket wrench, rotate the nozzle counterclockwise and remove the nozzle.

5. Grasp the stem of the seat and pull the seat, compensating spring, gland, and friction washer from the regulator body. Some regulators use a seat capsule. This capsule is part of the nozzle assembly that was removed in step 4.

6. Remove the gasket from the regulator body with a pair of tweezers.
   (not required on capsule style regulators)

7. Clean all interior surfaces of the regulator body with isopropyl alcohol or 1,1,1 trichloroethylene 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.

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

Reassembly

1. Install the compensating spring, gland, and friction washer on the stem. (not required on capsule style)

2. Position the stem assembly in the body of the regulator. (not required on capsule style)

3. Install the nozzle over the stem and rotate clockwise to engage the threads. Use the appropriate socket wrench and tighten securely. (Tighten the capsule of capsule style regulators.)

4. Hole the bonnet upside down and place the pivot and bonnet spring in the bore provided. The small diameter of the pivot should enter the internal diameter of the spring.

5. Lay the slip ring in the large bonnet cavity.

6. Insert the diaphragm sub-assembly in the bonnet cavity. Make sure backup plate and nut face the spring.

7. Carefully guide the bonnet over the body of the regulator until the threads engage. Rotate the bonnet clockwise and tighten. Using a wrench to stabilize the body, tighten the bonnet using 50-60 ft-lbs. of torque.

8. Loosely install the adjusting screw in the bonnet.

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 trichloroethylene 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 block. Blow out the intermediate block 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 block.

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 **IN**.

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 block to the bracket on the backplate. Assemble the nuts and washer to the carriage 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 block tubing assembly.

14. Reconnect the intermediate pressure relief valve to the building’s vent line.

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 regulator.

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 system causing something to burst or rupture.

2. **S-l-o-w-l-y** open one cylinder on the system.

3. Verify the cylinder pressure gauge indicated the minimum pressure of 1500 psig on Oxygen, Air, and Nitrogen systems or a minimum of 600 psig on Nitrous Oxide and Carbon Dioxide systems.

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 cylinder valve.

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

24" Stainless Steel Flexible Braid with Check Valves

PF-16CVFA-24R ..... CGA 300 with flash arrestor for Acetylene Service
PF-320CV-24R..... CGA 320 for Carbon Dioxide (CO_2) Service
PF-326CV-24R..... CGA 326 for Nitrous Oxide (N_2O) Service
PF-346CV-24R..... CGA 346 for Breathing (Air) Service
PF-83CV-24R..... CGA 350 (except Hydrogen Service)
PF-15CVFA-24R ..... CGA 510 with flash arrestor for Acetylene Service
PF-15CV-24R..... CGA 510 with Liquid Fuel Gas Service
PF-63CV-24 ..... CGA 540 for Oxygen (O_2) Service
PF-92CV-24R..... CGA 580 for Inert Gas Service (except Helium)
PF-93CV-24R..... CGA 590 for Industrial Air Service
PF-83CVR-24RV..... CGA 350 for Argon/Methane Mixture

24" Synthetic Fiber Braid Hose with Check Valve

PFS-83CV-24R ..... CGA 350 for Hydrogen Service
PFS-92CV-24R ..... CGA 580 for Helium (He) Service

REGULATOR & REGULATOR REPAIR KITS

Primary Regulators

WMS-1-117 ..... Primary Regulator for BI-1, -1A (Acetylene) S/N > 14349
WMS-1-118 ..... Primary Regulator for BI-1 series (Air, Ar, He, H_2 & N_2) S/N > 14349
WMS-1-119 ..... Primary Regulator for BI-9 series (Oxygen) S/N > 14349
WMS-1-120 ..... Primary Regulator for BIHL series (CO_2 & N_2O) S/N > 14349
WMS-1-121 ..... Primary Regulator for BIHP series (Air, Ar, He, H_2 & N_2) S/N > 14349
WMS-1-122 ..... Primary Regulator for BIHP-9 series (Oxygen) S/N > 14349
WMS-1-56 ..... Primary Regulator for BI-9 (Oxygen) S/N > # 11348
WMS-1-3 ..... Primary Regulator for BI & BIHL series (Air, Ar, He, H_2 & N_2, CO_2 & N_2O) S/N < 14349
WMS-1-24 ..... Primary Regulator for BI-series Oxygen Manifolds (S/N < # 7969)
WMS-1-31 ..... Primary Regulator for BI-series Oxygen Manifolds
(Serial numbers between # 7969 and #11348)
WMS-8-1 ..... Primary Regulator for BI series Acetylene and Liquefied Fuel Gas manifolds (S/N < # 14349)
WMS-5-1 ..... Primary Regulator for BIHP series manifolds (S/N < # 14349)
RK-1010 ..... Repair Kit for WMS-8-1 Primary Regulator and
WMS-1-3 for manifolds with ((S/N < # 3999)
RK-1020 ..... Repair Kit for WMS-1-3 Primary Regulator (S/N > # 3999) and
WMS-5-1 for BIHP series manifolds
RK-1010 ..... Repair Kit for WMS-1-24 Primary Regulator for Oxygen manifolds with (S/N < # 3999)
RK-1020 ..... Repair Kit for WMS-1-24 Primary Regulator (S/N < # 3999)
RK-1023 ..... Repair Kit for WMS-1-31 Primary Regulator (S/N < # 3999)
RK-1033 ..... Repair Kit for WMS-1-56 Primary Regulator (S/N < # 11348)
RK-1036 ..... Repair Kit for WMS-1-117
RK-1037 ..... Repair Kit for WMS-1-118, WMS-1-120, & WMS-1-121
RK-1038 ..... Repair Kit for WMS-1-119 & WMS-1-122

POWER SUPPLY REPLACEMENT PARTS

8570D ..... Power Supply Assembly (transformers, PCB with dry contacts, case, and cable)
WME-8-1 ..... Power Supply PCB for WMS-9-3 (includes dry contacts for remote alarms)

Intermediate Regulators

WMS-1-5 ..... Intermediate Regulator for BI, BIHL, & BIHP series (Air, Ar, CO_2, N_2O, He, H_2, O_2 & N_2) S/N < 22220
WMS-8-12 ..... Intermediate Regulator for BI series Acetylene and LPG < 22220
RK-1040 ..... Repair Kit for WMS-1-5 and WMS-8-12 Intermediate Regulators
WLR-2-5 ..... Intermediate Regulator for BI & BIHL series (Air, Ar, CO_2, N_2O, He, H_2, O_2 & N_2) S/N > 22220
WLR-2-7 ..... Intermediate Regulator for BIHP series (Air, Ar, CO_2, N_2O, He, H_2, O_2 & N_2) S/N > 22220
WLR-8-12 ..... Intermediate Regulator for BI series Acetylene and LPG < 22220
RK-1160 ..... Repair Kit for WLR-2-5 & WLR-2-7 Intermediate Regulators
RK-1161 ..... Repair Kit for WLR-8-12 Intermediate Regulators

Line Regulators

WMS-1-6 ..... Line Regulator for BI & BIHL series (Air, Ar, CO_2, N_2O, He, H_2, O_2 & N_2) S/N < 22220
WLR-2-6 ..... Line Regulator for BI & BIHL series (Air, Ar, CO_2, N_2O, He, H_2, O_2 & N_2) S/N > 22220
WMS-8-13 ..... Line Regulator for BI-1 & BI-1A series manifolds S/N < 22220
WLR-8-3 ..... Line Regulator for BI-1 & BI-1A series manifolds S/N > 22220
WMS-5-3 ..... Line Regulator for BIHP series manifolds (Air, Ar, CO_2, N_2O, He, H_2, O_2 & N_2) S/N < 22220
WLR-5-3 ..... Line Regulator for BIHP series manifolds (Air, Ar, CO_2, N_2O, He, H_2, O_2 & N_2) S/N > 22220
WMS-8-13 ..... Line Regulator for BI-10 S/N < 14600
WMS-8-14 ..... Line Regulator for BI-10 S/N between 14600 and 22220
WLR-8-14 ..... Line Regulator for BI-10 S/N > 22220
RK-1050 ..... Repair Kit for WMS-1-6 Line Regulator for manifolds with serial < 4199
RK-1051 ..... Repair Kit for WMS-1-6 and WMS-8-13 Line Regulators (Serial numbers between 4199 and 22220)
RK-1040 ..... Repair Kit for WMS-5-3 Line Regulator
RK-1160 ..... Repair Kit for WLR-2-6 Line Regulator
RK-1161 ..... Repair Kit for WLR-5-3, WLR-8-13, and WLR-8-14 Line Regulators

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

WMG-3-7 ..... 30 psi
WMG-3-5 ..... 600 psi
WMG-3-3 ..... 100 psi
WMG-3-2 ..... 200 psi
WMG-3-4 ..... 400 psi
WMG-3-14 ..... 300 psi
WMG-3-8 ..... 2000 psi
WMG-3-12 ..... 4000 psi

VALVES AND VALVE REPAIR KITS

RK-1041 ..... Repair Kit for Low Pressure Check Valve
WMS-1-4 ..... Four Way Valve
WMV-2-16 ..... Master Valve
RK-1083 ..... Repair Kit for WMV-2-16 (430A)
RK-1085 ..... Repair Kit for WMV-2-16 (430B & C)
WMV-2-31 ..... CGA 300 Header Valve
WMV-2-7 ..... CGA 320 Header Valve
WMV-2-14 ..... CGA 326 Header Valve
WMV-2-4 ..... CGA-346 Header Valve
WMV-2-19 ..... CGA 350 Header Valve
WMV-3-30 ..... CGA 510 Header Valve
WMS-1-53 ..... CGA 540 Spud Check Valve
WMV-2-3 ..... CGA 580 Header Valve
WMV-2-32 ..... CGA 590 Header Valve

INDICATOR LAMP REPLACEMENT PARTS

Round Style (for heater)

WME-8-4 ..... 24 V Light Bulb
WME-8-72 ..... Bulb Receptacle & Lens

Square Style

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

PRESSURE SWITCHES

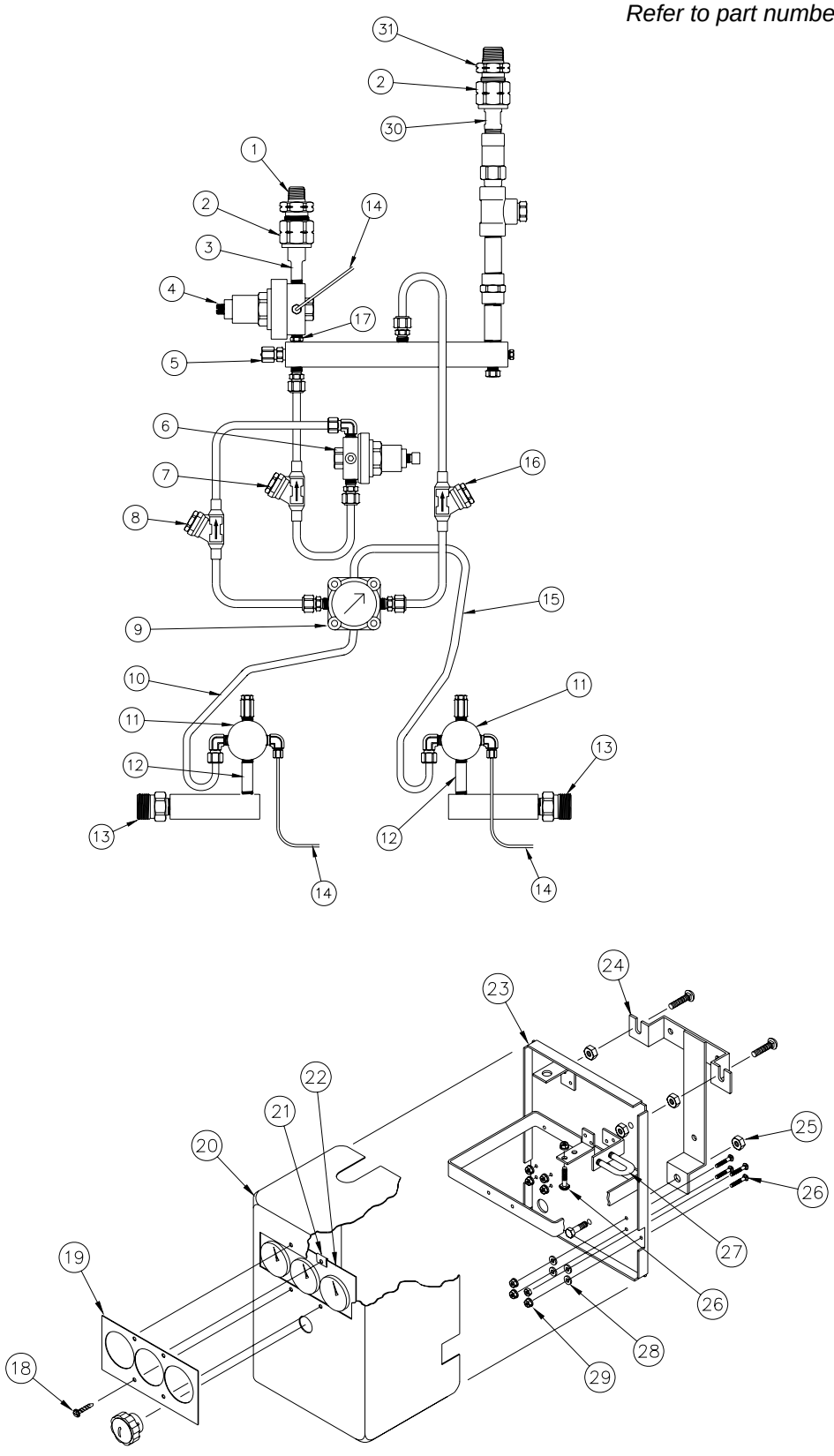
WME-4-4 ..... Open Frame Pressure Switch (Air, Ar, CO_2, H_2, He, N_2 & N_2O)
WME-4-4C..... Open Frame Pressure Switch (Oxygen)
WME-4-5 ..... Explosion Proof Pressure Switch (FGAK-H)
WME-4-6 ..... Explosion Proof Pressure Switch (FGAK-A and FGAK-L)

WMS-3-20 ..... Intermediate Regulator for CLC2HP-series manifold
WMR-6-4 ..... Line Regulator for CLC2-series manifold
WMR-6-6 ..... Line Regulator for CLC2HP-series manifold
RK-1070 ..... Repair Kit for WMS-3-3, WMR-6-4, WMR-6-6, and WMS-3-20

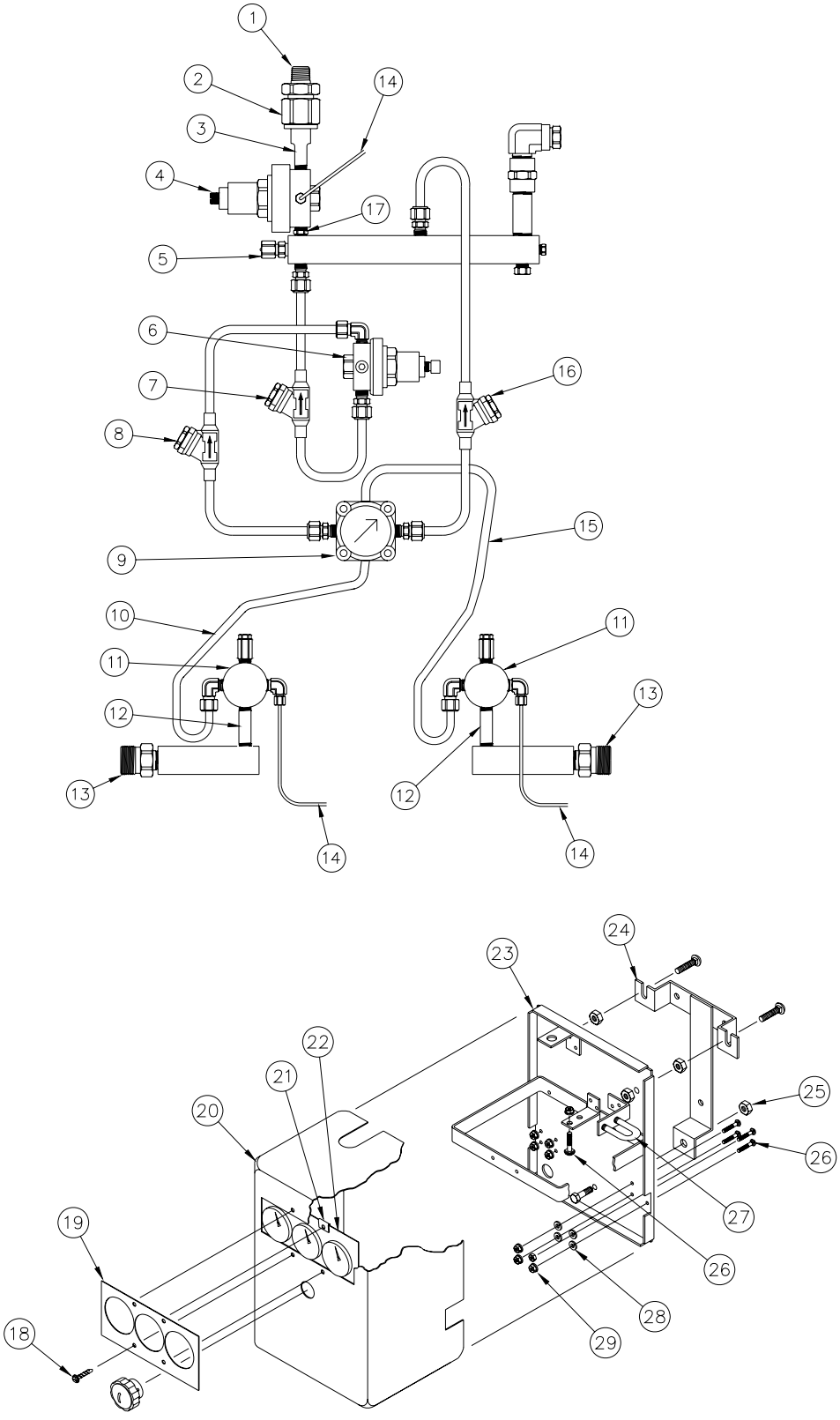
REMOTE ALARMS—24 VAC Service

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

Refer to part numbers on page 5-6



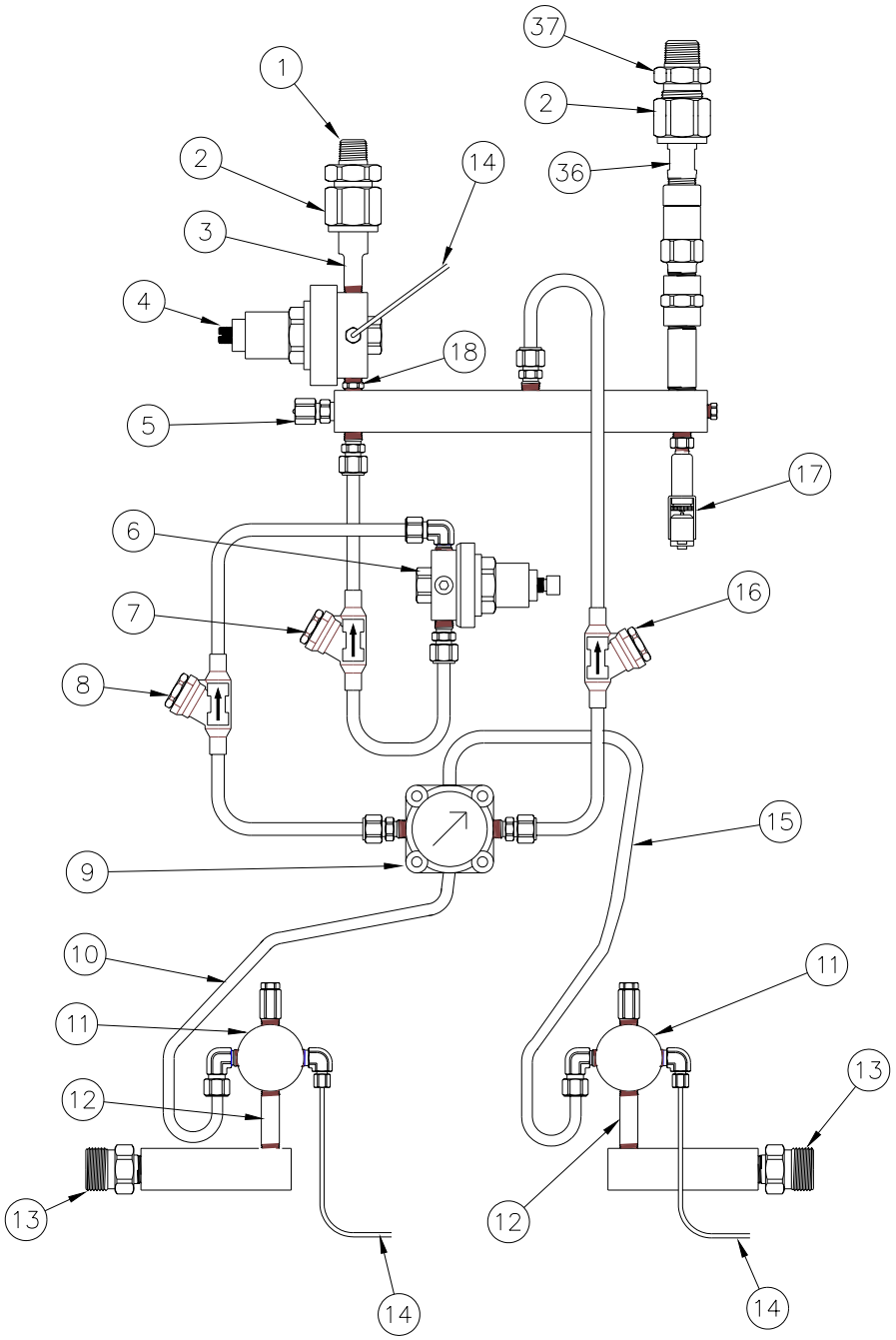
Refer to part numbers on page 5-6



KEY #	DESCRIPTION	PART #
1	Outlet Adaptor	D-35
2	Outlet Nut	D-8
3	Outlet Nipple	WLF-5-4
4	Line Regulator	See Page 5-2
5	Intermediate Block	
	BI-1, -10	WMS-8-6
	BI-6	WMS-1-66
	BIHP-6	WMS-5-5
6	Intermediate Regulator	See page 5-1
7	Intermediate CV Tubing	
	S/N < 2220	
	BI-1	WMS-8-5
	BI-6, -10, BIHP-6	WMS-1-10
	SN > 22220	
	BI-1	WMS-8-5
	BI-6, -10 & BIHP-6	WMS-1-128
8	Reserve CV Tubing	
	SN < 22220	
	BI-1	WMS-1-130
	BI-6, -10 & BIHP-6	WMS-1-8
	S/N > 22220	
	BI-1	WMS-1-129
	BI-6, -10 & BIHP	WMS-1-127
9	Four-Way Valve	WMS-1-4
10	3/8” Tubing—Left Regulator	
	BI-1	WMS-8-9
	BI-6, -10 & BIHP-6	WMS-1-16
11	Primary Regulator	See Page 5-1
12	Inlet Mount Nipple	WMS-1-18
13	Inlet Block	WMS-4-1
14	1/8” x 11” Tubing	
	BI-1	WLF-6-19
	BI-6, -10 & BIHP-6	WLF-6-17
15	3/8” Tubing, Right Regulator	
	BI-1	WMS-8-4
	BI-6, -10 & BIHP-6	WMS-1-9
16	3/8” CV Tubing, 4 way to Int.	
	BI-1	WMS-8-2
	BI-6, -10 & BIHP-6	WMS-1-7
17	1/4 NPT Pipe Nipple	
	BI-1, -6, -10	WLF-1-17
	BIHP-6	WLF-1-10
18	#10-1” Self –tapping screw	WMC-6-39
19	Outer Gauge Plate	WMC-8-2
20	Case	
	BI-1, -10	WMC-8-6
	BI-6 & BIHP-6	WMC-8-6S
21	Screw Receptacle	WMC-6-35
22	Inner Gauge Plate	
	BI-1	WMS-8-7
	BI-6	WMS-1-12
	BI-10	WMS-8-11
	BIHP-6	WMS-5-4
23	Backplate Assembly	WMS-1-2
24	Tee Mounting Bracket	WMC-6-7
25	3/8-16 Hex Nut	WMC-6-6
26	3/16-24 x 1 3/4 Carriage Bolt	WMC-6-10
27	1/2” Nominal U-bolt	WMC-6-13
28	3/16” Lock Washer	WMC-6-12
29	3/16” Hex Nut	WMC-6-11
30	“D” Size Nipple	D-20
31	“D” Size Adaptor x 3/4 NPT	D-33
*	Case Lead Seal	WEM-1-27
*	#8 Sheet Metal Case Screw	WMC-6-23
*	Item not Pictured	

Piping layout for BI-6 and BIHP-6 is shown on page 5-4

Piping layout for BI-1 and BI-10 is shown on page 5-5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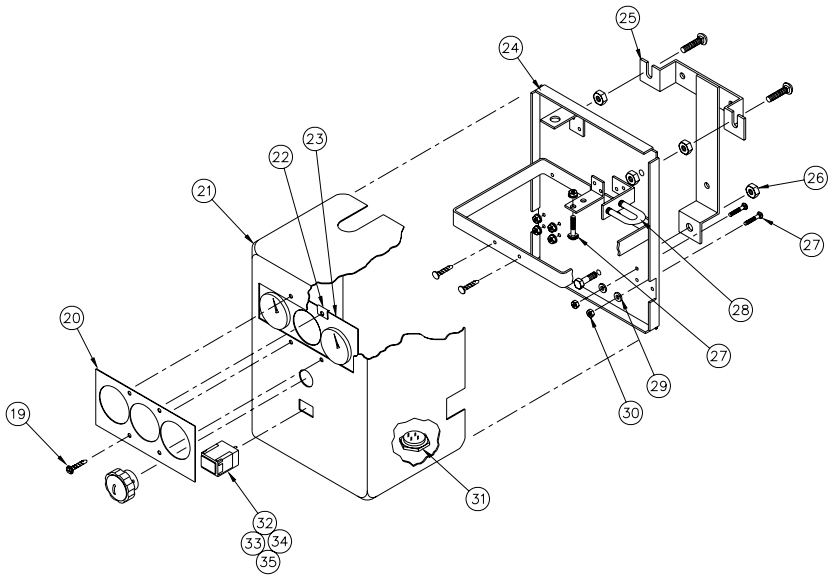
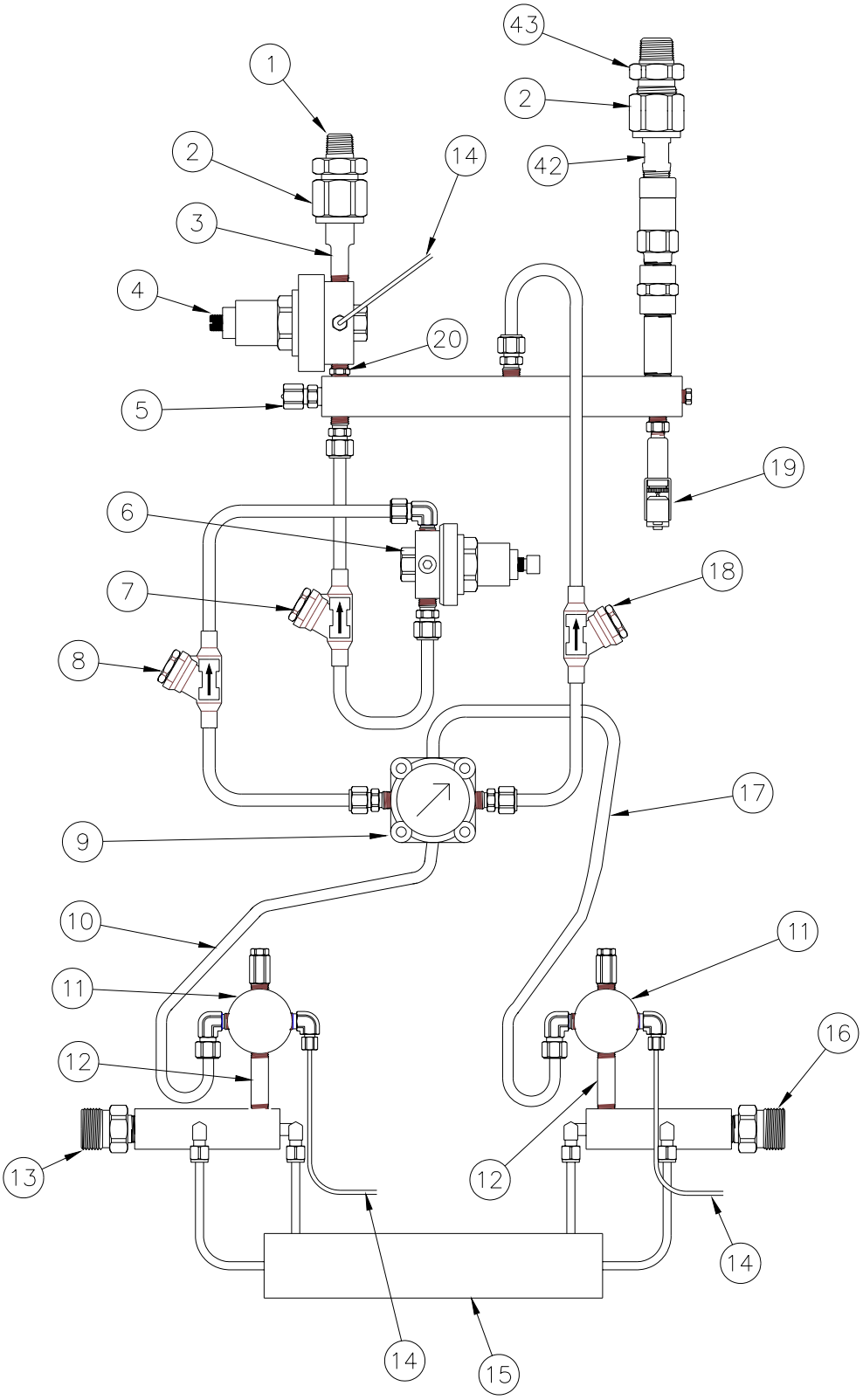


KEY #	DESCRIPTION	PART #	KEY #	DESCRIPTION	PART #
1	Outlet Adaptor	D-34	19	#10-1” Self-tapping screw	WMC-6-39
2	Outlet Nut	D-7	20	Outer Gauge Plate	WMC-8-2
3	Outlet Nipple	WLF-5-4	21	Case	WMC-8-9
4	Line Regulator	See Page 5-2	22	Screw Receptacle	WMC-6-35
5	Intermediate Block		23	Inner Gauge Plate	
	BI Series	WMS-1-11		BI Series	WMS-1-12
	BIHP Series	WMS-5-2		BIHP Series	WMS-5-4
6	Intermediate Regulator	See page 5-1	24	Backplate Assembly	WMS-1-2
7	Intermediate CV Tubing		25	Tee Mounting Bracket	WMC-6-7
	S/N < 22220	WMS-1-10	26	3/8-16 Hex Nut	WMC-6-6
	S/N > 22220	WMS-1-128	27	3/6-24 x 1 3/4 Carriage Bolt	WMC-6-10
8	Reserve CV Tubing		28	1/2” Nominal U-Bolt	WMC-6-13
	S/N < 22220	WMS-1-8	29	3/16” Lock Washer	WMC-6-12
	S/N > 22220	WMS-1-127	30	3/16” Hex Nut	WMC-6-11
9	Four-Way Valve	WMS-1-4	31	Case Wiring Harness	WMS-1-14
10	3/8” Tubing—Left Regulator	WMS-1-16	32	Dual Light Lens	WME-8-40
11	Primary Regulator	See page 5-1	33	Dual Light Base	WME-8-41
12	Inlet Mount Nipple	WMS-1-18	34	24 V Bulb (#85)	WME-8-42
13	Inlet Block	WMS-1-1	35	Dual Light Label	WME-8-54
14	1/8” x 11” Tubing	WLF-6-17	36	“D” Size Nipple	D-20
15	3/8” Tubing, Right Regulator	WMS-1-9	37	“D” Size Adaptor x 3/4 NPT	D-32
16	3/8” CV Tubing, 4-way to Int.	WMS-1-7	*	Switch Wiring Harness	WMS-1-13
17	Pressure Switch		*	Case Lead Seal	WEM-1-27
	Oxygen service	WME-4-4C	*	#8 Sheet Metal Case Screw	WMC-6-23
	All other gases	WME-4-4	*	Power Supply Box	8570D
18	1/4 NPT Pipe Nipple				
	BI Series	WLF-1-17			
	BIHP Series	WLF-1-10	*	Item not pictured.	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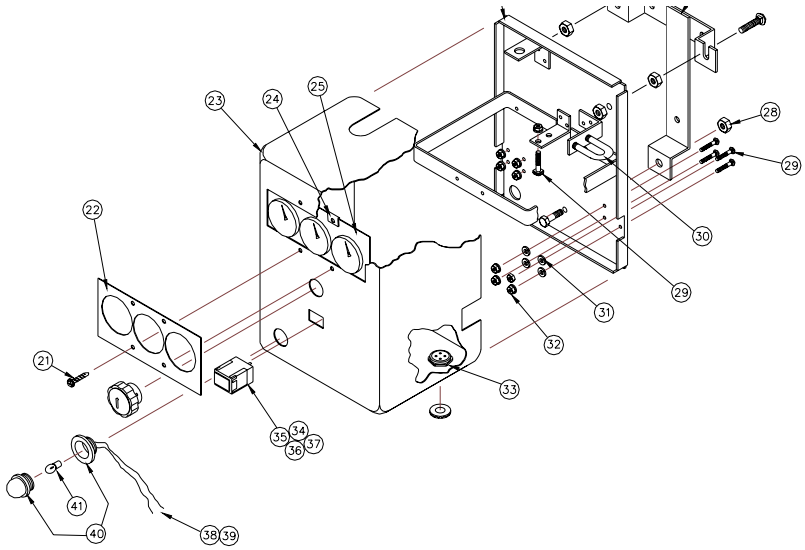
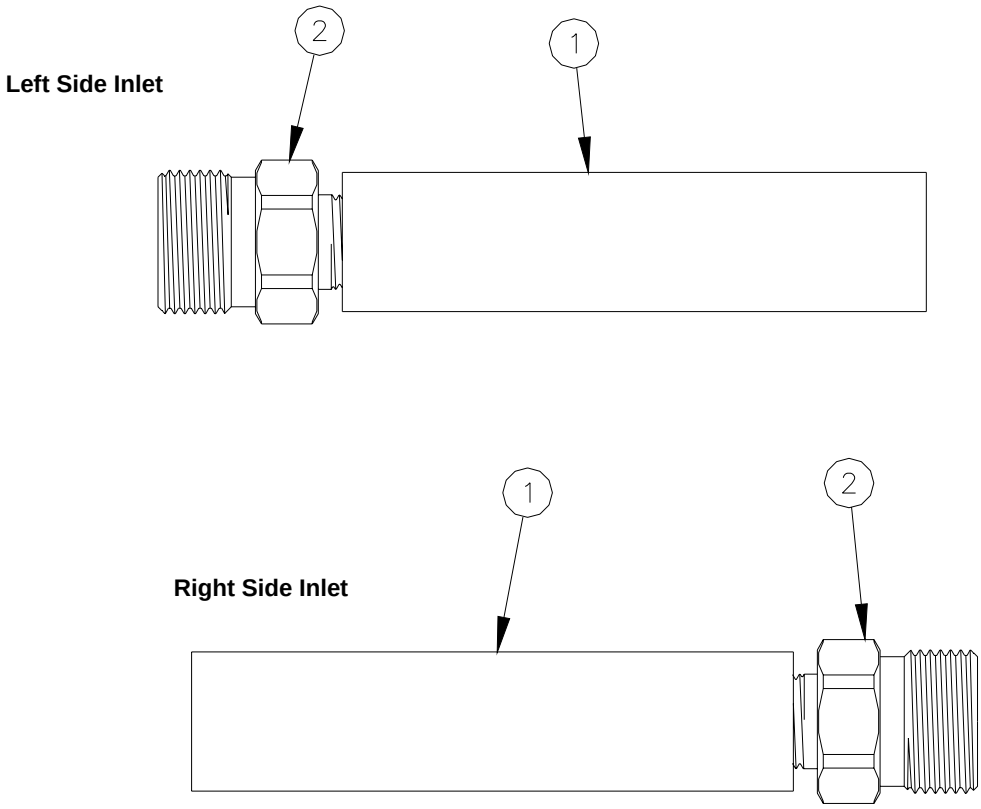
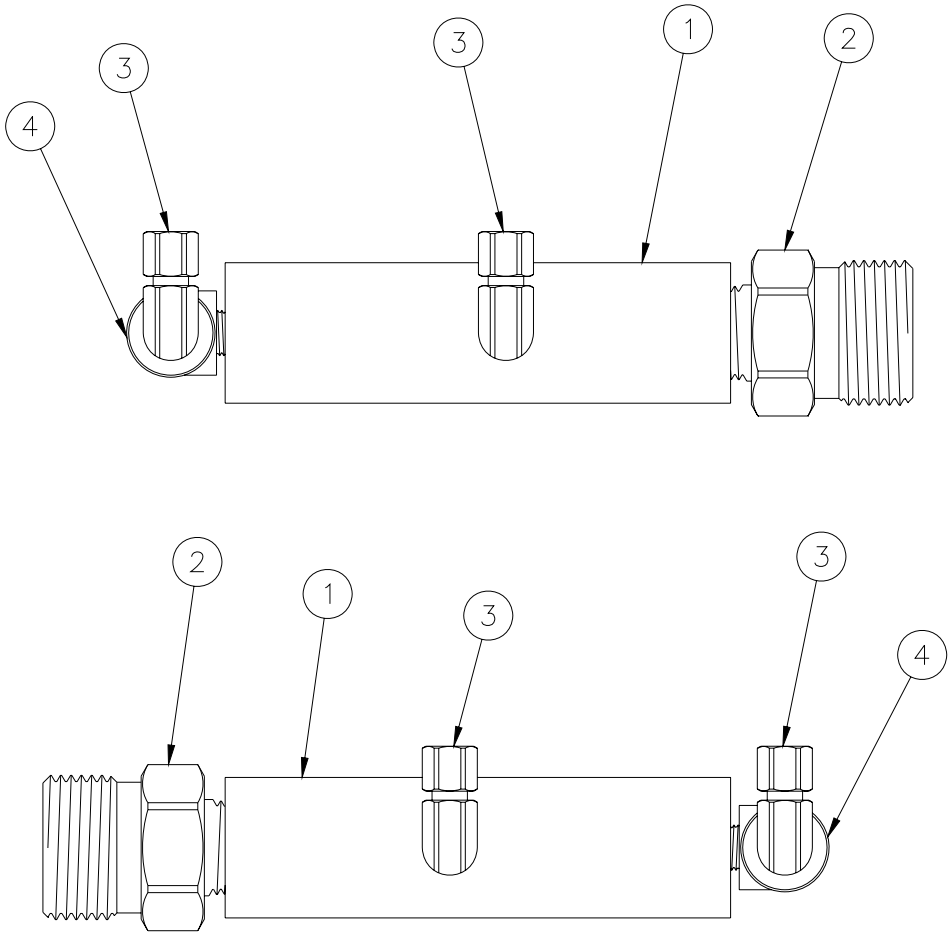


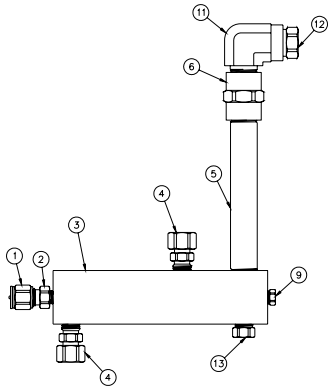
KEY #	DESCRIPTION	PART #	KEY #	DESCRIPTION	PART #
1	Outlet Adaptor	D-34	24	Screw Receptacle	WMC-6-35
2	Outlet Nut	D-7	25	Inner Gauge Plate	WMS-2-3
3	Outlet Nipple	WLF-5-4	26	Backplate Assembly	WMS-1-2
4	Line Regulator	See Page 5-2	27	Tee Mounting Bracket	WMC-6-7
5	Intermediate Block	WMS-1-11	28	3/8-16 Hex Nut	WMC-6-6
6	Intermediate Regulator	See page 5-1	29	3/6-24 x 1 3/4 Carriage Bolt	WMC-6-10
7	Intermediate CV Tubing		30	1/2” Nominal U-Bolt	WMC-6-13
	S/N < 22220	WMS-1-10	31	3/16” Lock Washer	WMC-6-12
	S/N > 22220	WMS-1-128	32	3/16” Hex Nut	WMC-6-11
8	Reserve CV Tubing		33	Case Wiring Harness	WMS-1-14
	S/N < 22220	WMS-1-8	34	24 V Bulb (#85)	WME-8-42
	S/N > 22220	WMS-1-127	35	Dual Light Label	WME-8-54
9	Four-Way Valve	WMS-1-4	36	Dual Light Base	WME-8-41
10	3/8” Tubing—Left Regulator	WMS-1-16	37	Dual Light Lens	WME-8-40
11	Primary Regulator	See page 5-1	38	16 Gage Wire 16”	WME-8-57
12	Inlet Mount Nipple	WMS-1-18	39	Female Wire Terminal	WME-8-27
13	Inlet Block—Left Side	WMS-2-2	40	Light Receptacle & Lens	WME-8-72
14	1/8” x 11” Tubing	WLF-6-17	41	115 V Bulb	WME-8-10
15	115 VAC Heater	WMS-11-42	42	“D” Size Nipple	D-20
16	Inlet Block-Right Side	WMS-2-1	43	“D” Size Adaptor x 3/4 NPT	D-32
17	3/8 “ Tubing, Right Regulator	WMS-1-9	*	Strain Relief Bushing	WME-8-34
18	3/8” CV tubing, 4 way to Tin.	WMS-1-7	*	7’ Header Cord	WME-8-33
19	Pressure Switch	WME-4-4	*	Switch Wiring Harness	WMS-1-13
20	1/4 NPT Pipe Nipple	WLF-1-17	*	Case Lead Seal	WEM-1-27
21	#10-1” Self Tapping Screw	WMC-6-39	*	#8 Sheet Metal Case Screw	WMC-6-23
22	Outer Gauge Plate	WMC-8-2	*	Wire Nut	WME-8-58
23	Case	WMC-8-9	*	Power Supply Box	8570D
			*	Item not pictured.	



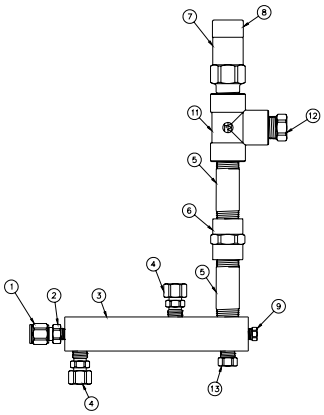
KEY #	DESCRIPTION	PART #
1	High Pressure Mounting Block	WMC-2-20
2	1”-11 1/2 NPSM x 1/2 NPT Adaptor	WMS-1-40



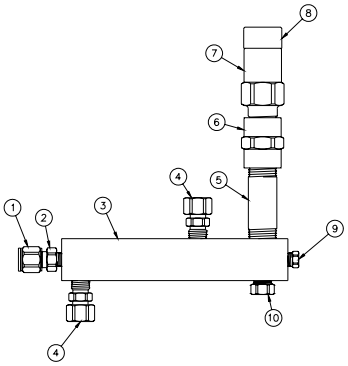
KEY #	DESCRIPTION	PART #
1	High Pressure Mounting Block	
	Left Side Inlet	WMC-2-22
	Right Side Inlet	WMC-2-23
2	1”-11 1/2 NPSM x 1/2 NPT Adaptor	WMS-1-40
3	1/4” Tube x 1/8 NPT Male 90°	WLF-3-3
4	1/8 NPT Street Elbow	BL-2HP



Fuel Gas Manifolds:
BI-1 & BI-10 Series



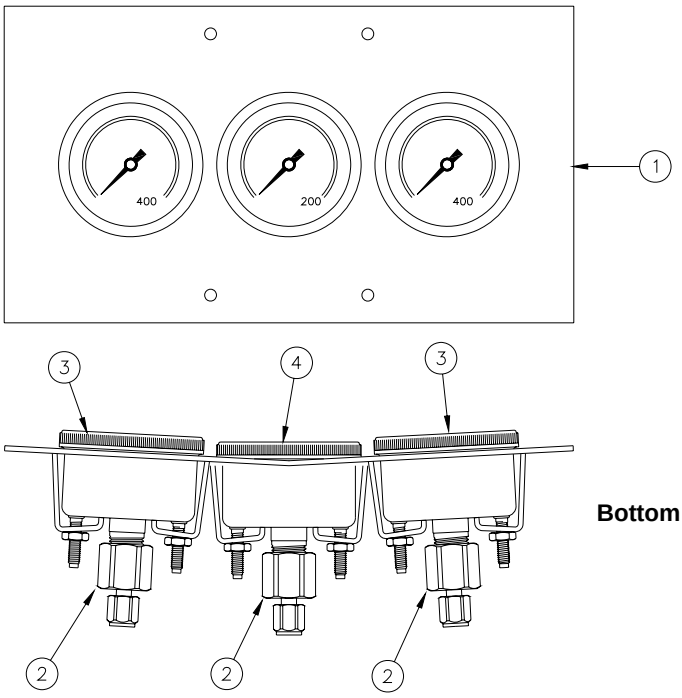
Hydrogen Manifolds:
BI-6 Series



All Others

KEY #	DESCRIPTION	PART #
1	CGA 022 Nut & Plug	WLF-5-8
2	CGA 022 Body x 1/8 NPT	M24-40
3	Intermediate Pressure Block	
	BI, BI-6 & BI-10 series	WMC-2-25
	All others	WMC-2-18
4	3/8” Tube x 1/4 NPT	WLF-3-5
5	1/2 NPT Nipple 3”	WLF-1-15
6	1/2 NPT Coupler	
	BI-1, BI-10 use 1/2 NPT Pipe Cap	PC-8HP
	All other BI, BIHL, & BIHP	BF-8HP
7	Safety Relief Valve	
	NOT APPLICABLE for BI-1, -10 manifolds	
	BI & BIHL series (375 psig)	WMV-8-375
	BIHP and BI-9 series (450 psig)	WMV-8-450
8	Pipe Away Adaptor	WMV-8-7
9	1/8 NPT Plug	P-2HP
10	1/8 NPT x 1/4 NPT Adaptor	
	NOT APPLICABLE for BI-1, BI-6, -10 & BIHP-6	
	All others BI, BIHL, & BIHP Series	BB-2-4HP
11	1/2 NPT Elbow or Tee	
	BI-1 and BI-10 Series use Elbow	BL-8HP
	BI-6 Series use Tee	WHF-4-7
12	1/2 NPT Plug	P-8HP
13	1/4 NPT Plug	P-4HP

Front View



Bottom View

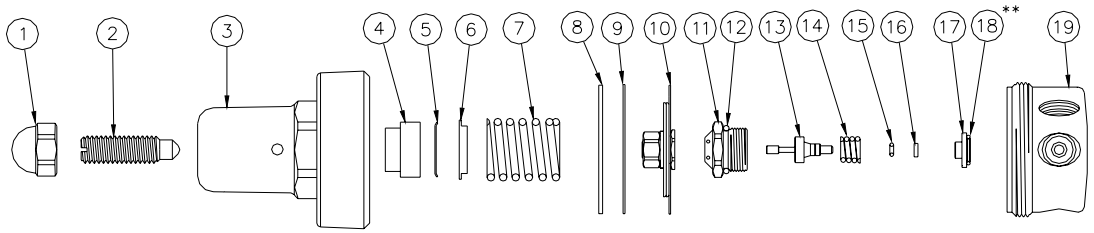
KEY #	DESCRIPTION	PART #
1	Gauge Plate	WMC-8-11
2	1/8” Tube x 1/4 NPT Female	WLF-3-4
3	Cylinder Contents Gauge	
	BI-1, -10 (400 psi)	WMG-3-4
	BI & BIHP series (4000 psi)	WMG-3-12
	BIHL series (2000 psi)	WMG-3-8
4	Line Pressure Gauge	
	BI-1 (30 psi)	WMG-3-7
	BI-10 (100 psi)	WMG-3-3
	BI & BIHL series (200 psi)	WMG-3-2
	BIHP series (400 psi)	WMG-3-4

Western Enterprises

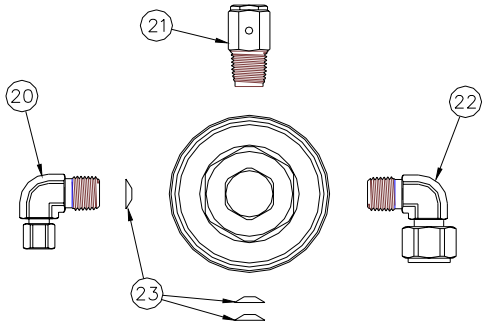
AUTOMATIC CHANGEOVER MANIFOLD
BI, BIHL, & BIHP Series
and BI-9 Serial numbers greater than 11348

Repair Drawing

Primary Regulator Components



**** This item not included with regulators shipped after serial number 14349**



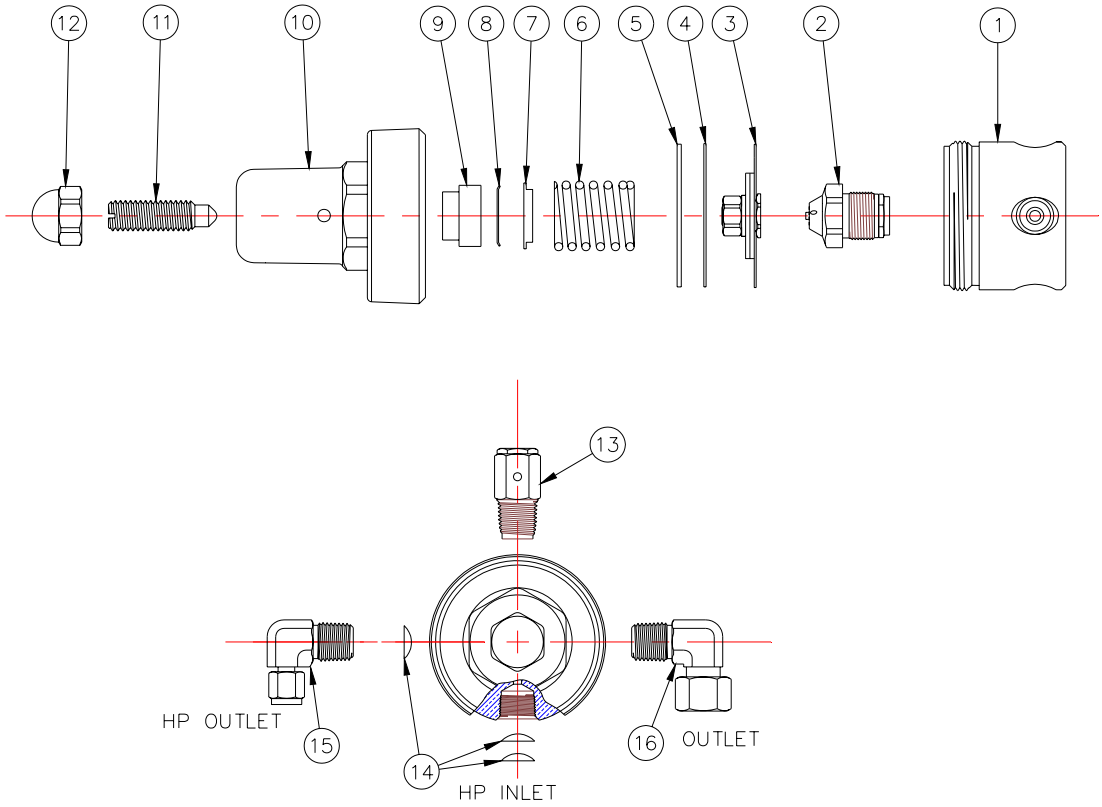
KEY #	DESCRIPTION	PART #60	KEY #	DESCRIPTION	PART #
1	Acorn Nut	RWS-3-1P	13*	Seat Holder & Stem	
2	Preset Adjusting Screw	RWS-3-3		BI, BIHL, BIHP	RWS-6-8
3	Regulator Bonnet			BI-9	RWS-6-3
	BI-1, -10	RWS-2-2P	14*	Body Spring	
	BI, BIHL, BIHP	RWS-2-3P		BI-9 series	RWS-1-17
4	Bonnet Bushing	RWS-3-12		All others	RWS-1-8
5	Bushing Retainer	RWC-3-14	15*	O-ring	
6	Pivot	RWC-2-8P		BI-1, -10	RWS-3-13
7	Bonnet Spring			BI, BIHL, BIHP	RWS-3-47
	BI-1, -10	RWS-1-11	16*	Backup Ring	RWS-5-7
	BI, BIHL, & BIHP	RWS-1-13	17*	Spring Retainer	RWS-3-15
8*	Washer		18*	Small O-ring	
	NOT APPLICABLE for BI-1, -10			BI, -10	RWS-3-11
	For others BI, BIHL, BIHP	RWS-3-26		BI, BIHL, BIHP	RO-012E
9*	Slip Ring	RWS-3-17	19	Regulator Body	RWS-1-3
10*	Diaphragm Assembly		20	1/8” Tube x 1/4 NPT 90°	WLF-3-7
	BI-1, -10	RWS-3-16	21	Safety Relief Valve	
	BI, BIHL, BIHP	RWS-3-28		BI-1, -10 use pipe cap	P-4HP
11*	Nozzle			BI, BHIL Series	RWC-3-5
	BI-9 Series	RWS-5-1		BIHP Series	RWX-X3
	All others	RWS-6-9	22	3/8” Tube x 1/4 NPT 90°	WLF-3-6
12*	Large O-ring		23	Filter	1134
	BI-1, -10	RWS-3-12	*	Item included in repair kits	
	BI, BIHL, BIHP	RO-015E			

Western Enterprises

AUTOMATIC CHANGEOVER MANIFOLD
BI-9 Series S/N between 7969 and 11348

Repair Drawing

Primary Regulator Components

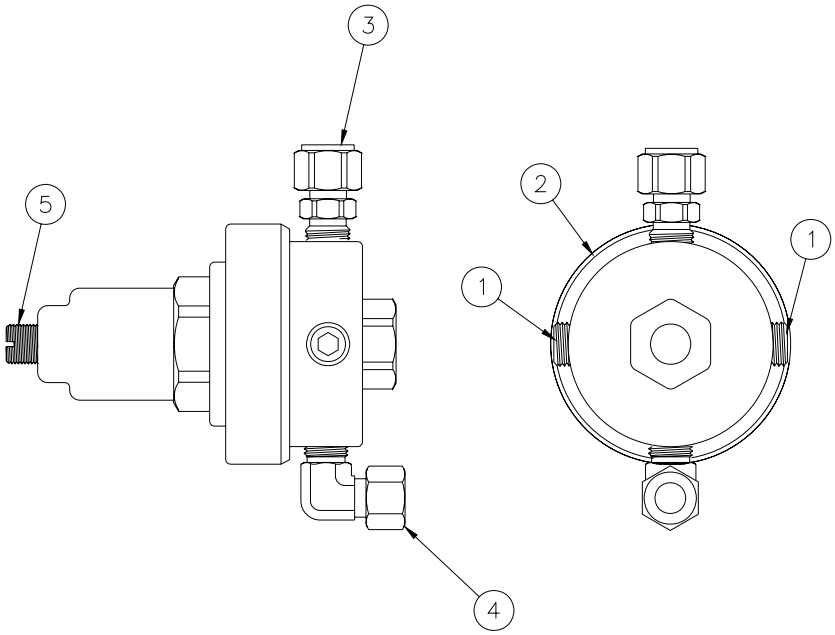


KEY #	DESCRIPTION	PART #60	KEY #	DESCRIPTION	PART #
1	Regulator Bocy, 4 ports	RWS-1-5	13	Relief Valve	RWC-3-5
2*	Cartridge Assembly	RWD-2-19	14	Concave Screen	1134
3*	Diaphragm Assembly	RWS-3-28	15	1/4 NPT x 1/8 CPI Elbow	WLF-3-7
4*	Slip Ring	RWS-3-17	16	1/4 NPT x 3/8 CPI Elbow	WLF-3-6
5*	Washer	RWS-3-26P			
6	Bonnet Bushing	RWS-1-12			
7	Pivot	RWC-2-8P	*	Item Included in repair kits	
8	Bushing Retainer	RWC-4-14			
9	Bushing 7/16-14F	RWC-3-12		Repair kit for BI-9	
10	High Pressure Bonnet	RWS-2-3		(Serial #'s < 4000)	RK-1011
11	Preset Screw 7/16-14M	RWS-3-3		(3999 < Serial #'s < 7969)	RK-1021
12	Acorn Nut	RWS-3-1		7969 < Serial #'s < 11348)	RK-1023

Western Enterprises

AUTOMATIC CHANGEOVER MANIFOLD
BI, BIHL, BIHP Series

Victor Style
Repair Drawing **Intermediate Regulator Components**



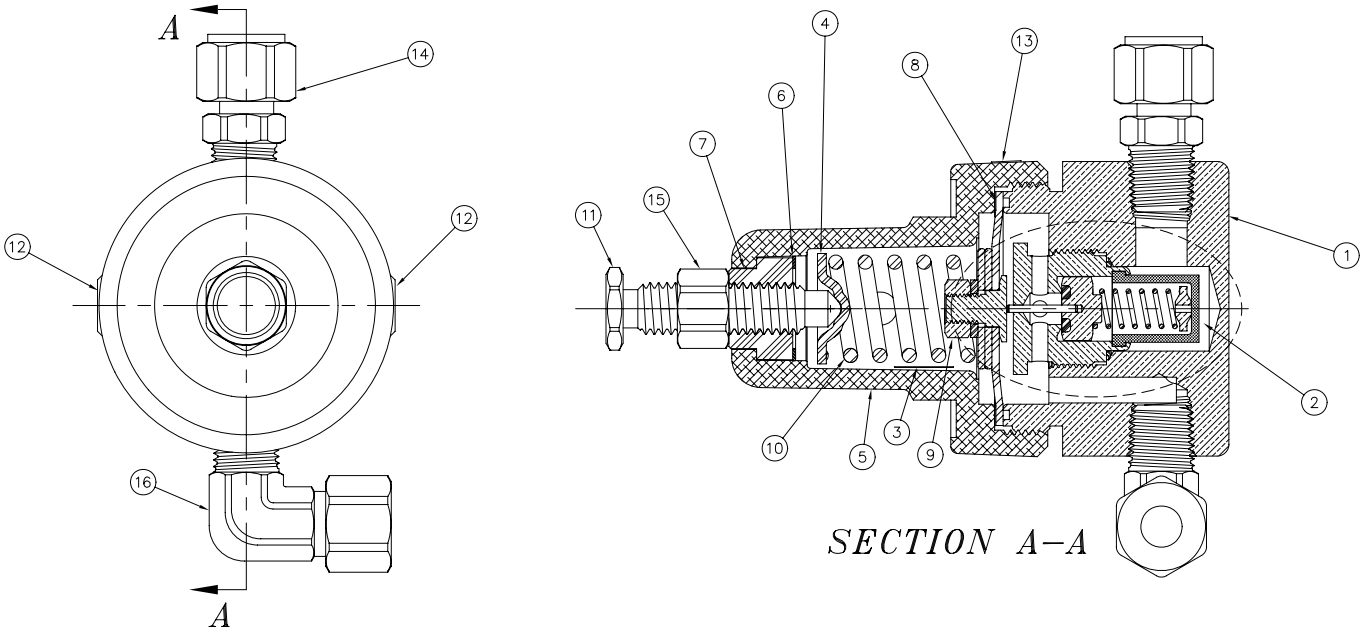
KEY #	DESCRIPTION	PART #
1	1/4 NPT Plug	WLF-1-21
2	Intermediate Regulator (0-200 psi)	WMR-1-20
3	3/8” Tube x 1/4 NPT	WLF-3-5
4	3/8” Tube x 1/4 NPT 90°	WLF-3-6
5	Present Adjusting Screw	WMC-6-37
	Repair Kit for Intermediate Regulator internal parts (components not shown)	RK-1040

Western Enterprises

AUTOMATIC CHANGEOVER MANIFOLD
BI, BIHL, BIHP Series

Repair Drawing

Western Style
Intermediate Regulator Components



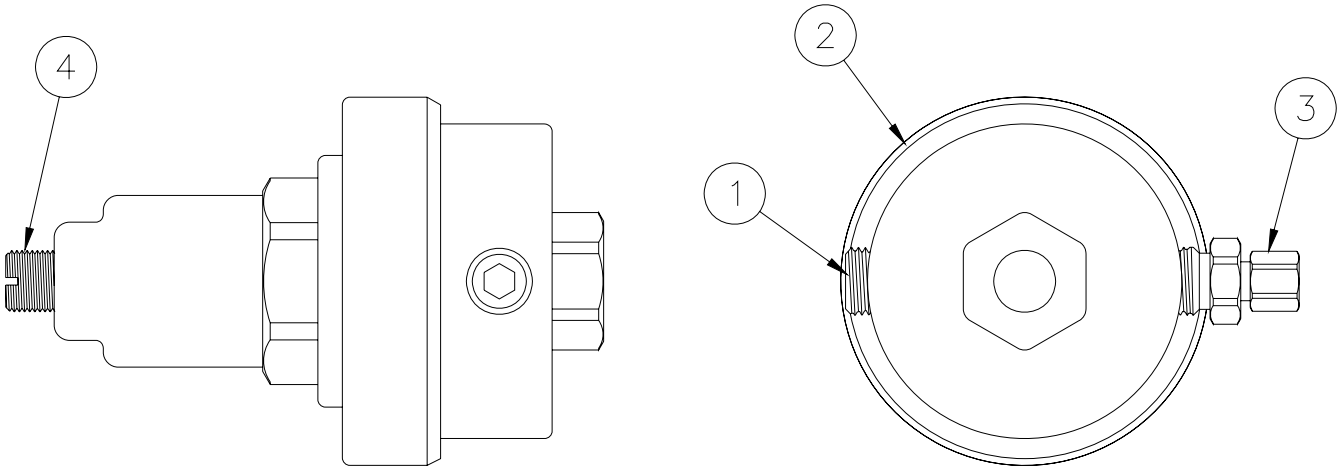
KEY #	DESCRIPTION	PART #
1	Regulator Body, 4 ports	WLR-1-1
2*	Seat Capsule	WLR-1-10
3	Anti-Vibrator	WLR-1-14
4	Pivot	RWC-2-8P
5	Bonnet	RWS-2-2P
6	Bushing Retainer	RWC-3-14
7	Bonnet Bushing	RWC-3-12
8*	Slip Ring	RWS-3-17
9*	Diaphragm Assembly	
	WLR-2-5	RWS-3-28
	WLR-2-7 & WLR-8-12	RWS-3-16
10	Delivery Spring	
	WLR-2-5	RWS-1-11
	WLR-2-7	RWS-1-12
	WLR-8-12	RWC-1-4

KEY #	DESCRIPTION	PART #
11	Adjusting Screw	RWS-3-2
12	1/4 NPT plug	WLF-1-21
13	Label	HPRL
14	1/4 NPT x 3/8 tube	WLF-3-5
15	1/4 NPT x 3/8 tube elbow	WLF-3-6
*	Item Included in repair kits	
	Repair kit for:	
	WLR-2-5	RK-1160
	WLR-2-7 & WLR-8-12	RK-1161

Western Enterprises

AUTOMATIC CHANGEOVER MANIFOLD
BI, BIHL, BIHP Series

Victor Style
Repair Drawing
Line Regulator Components



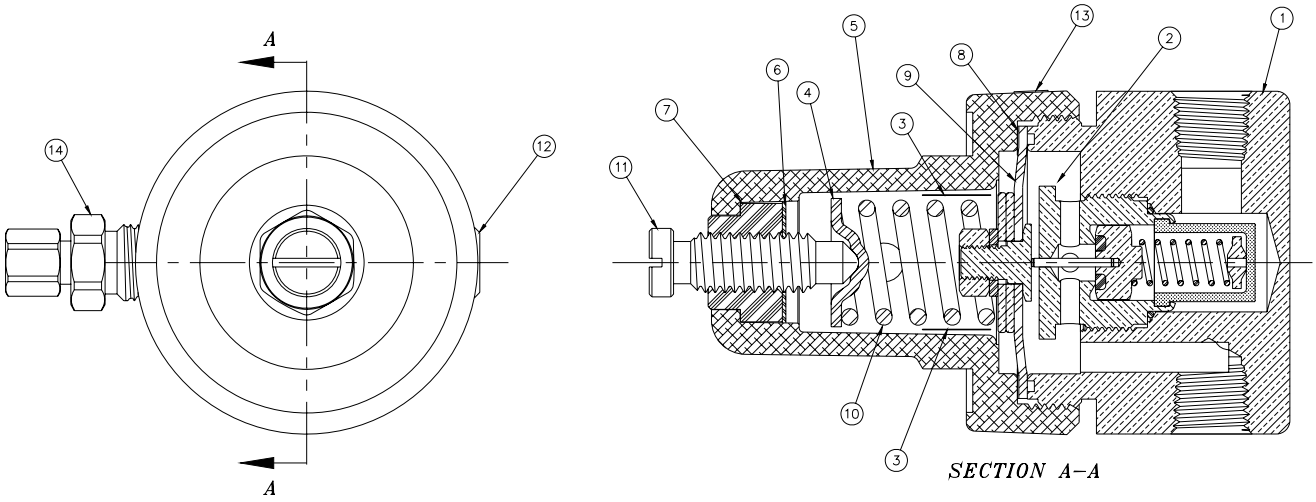
KEY #	DESCRIPTION	PART #
1	1/4 NPT Plug	WLF-1-21
2	Line Regulator	
	BI & BIHL Series (0-125 psi)*	WMR-1-15
	BIHP Series (0-200 psi)	WMR-1-20
3	1/8” Tube x 1/4 NPT	WLF-3-8
4	Preset Adjusting Screw	
	BI & BIHL Series	WMS-6-36
	BIHP Series	WMC-6-37
*	For BI-1, -10-order replacement spring	WMR-1-16
	Repair Kits for Line Regulator internal parts (components not shown)	
	BI & BIHL (Serial #’s up to 4199)	RK-1050
	BI & BIHL Series (Serial #’s > 4199)	RK-1051
	BIHP Series	RK-1040

Western Enterprises

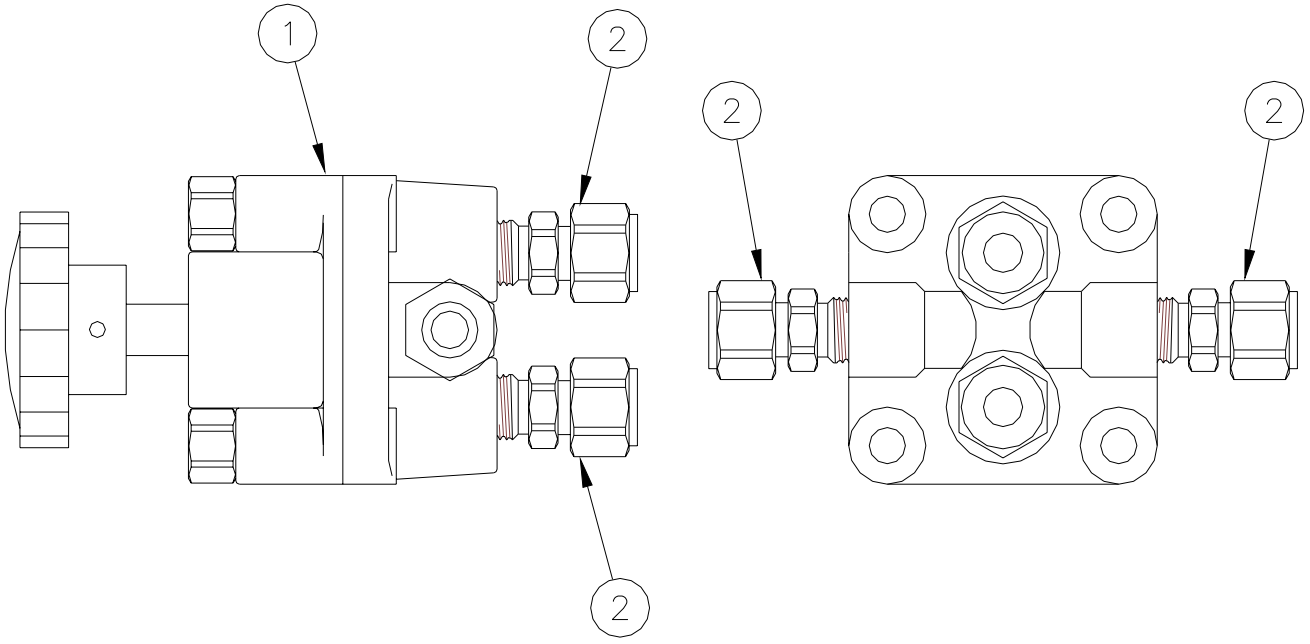
AUTOMATIC CHANGEOVER MANIFOLD
BI, BIHL, BIHP Series

Repair Drawing

Western Style
Line Regulator Components

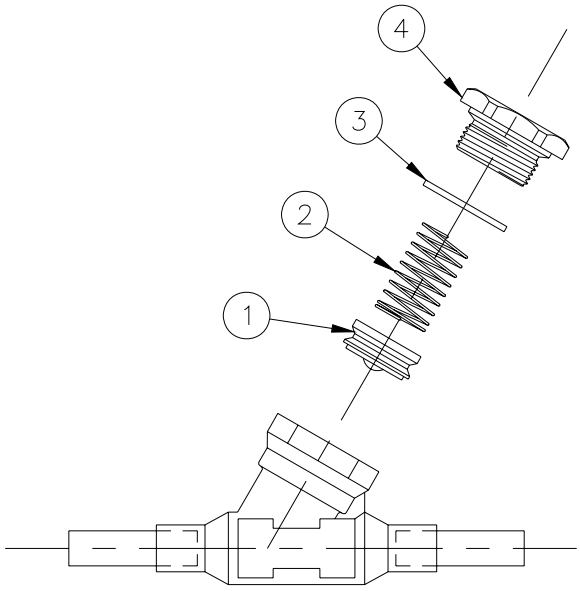


KEY #	DESCRIPTION	PART #	KEY #	DESCRIPTION	PART #
1	Regulator Body, 4 ports	WLR-1-1	11	Adjusting Screw	WLR-1-11
2*	Seat Capsule	WLR-1-10	12	1/4 NPT plug	WLF-1-21
3	Anti-Vibrator	WLR-1-14	13	Label	HPRL
4	Pivot	RWC-2-8P	14	1/4 NPT x 1/8 tube	WLF-3-8
5	Bonnet	RWS-2-2P			
6	Bushing Retainer	RWC-3-14			
7	Bonnet Bushing	RWC-3-12	*	Item Included in repair kits	
8*	Slip Ring	RWS-3-17			
9*	Diaphragm Assembly			Repair kit for:	
	WLR-2-6	RWS-3-28		WLR-2-6	RK-1160
	WLR-5-3 & WLR-8-13	RWS-3-16		WLR-5-3 & WLR-8-13	RK-1161
	WLR-8-14	RWS-3-16		WLR-8-14	RK-1161
10	Delivery Spring				
	WLR-2-6	WLR-1-8			
	WLR-5-3	RWS-1-12			
	WLR-8-13	RWC-1-14			
	WLR-8-14	RWC-1-14			



KEY #	DESCRIPTION	PART #
1	Four-Way Valve	WMV-5-3
2	3/8” Tube x 1/4 NPT	WLF-3-5

Repair Drawing — Check Valve Components



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 BI, BIHL, & BIHP Series	RK-1041